FINAL REPORT OF THE RESEARCH SCHEME

1. **Project title**: "Studies on intestinal obstruction in cross bred cattle of high altitude with special reference to prognostic, diagnostic and therapeutic aspects."
2. **Sanction No.:** F No. 1 (40)/ 2001-ASR-IV dated 2nd/9th Dec. 2002.
3. **Date of start**: 15.09.2003
4. **Date of termination**: 14.09.2006
5. **Institution name**: CSK, Himachal Pradesh Krishi Vishvavidyalaya

Place: Palampur
District: Kangra
State: Himachal Pradesh
Dept./ Div. Name: Dr. G. C. Negi College of Veterinary & Animal Science
Actual Location: Department of Veterinary Surgery & Radiology

6. **Principal investigator**

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8.**Technical personnels employed**:

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Designation	JRF
Date of Joining	29-10-2003
Date of Leaving	14.09.2006

9. **Total cost of the scheme**:	Rs. 9,09,800/- (**Revised)**
(a) Share of ICAR	100%
(b) Share of participating agency	Nil

10. **Total amount spent**	Rs.8,93,602/-
(a) Share of ICAR	100%
(b) Share of participating agency	Nil

11. **Objectives of the Scheme**:

Himachal Pradesh is a state of marginal farmers and more than half of the geographical area of the Himalayan State comes under sweeping high altitude ranges. The major source of their livelihood is Animal Husbandry, where a cattle rearing is considered to be of significant importance. Crossbreeding and upgrading of Zebu cattle had achieved a pace with the development in the cattle. One of the major problems in high altitudes cross bred animals has been recorded as obstruction of the gastrointestinal tract. The spectrum of which varies from simple to strangulated obstruction and is followed by a high rate of mortality in high yielder. The effects of obstruction vary widely in these cross bred cattle, depending on the site and type of obstruction. The pathogenesis of intestinal obstruction has been studied intensively in man and simple stomached animals. Experimental data, even though limited in cattle concerning the intestinal obstruction of posterior located segments of small intestine. Because it is difficult to determine when the obstruction actually occurs in clinical cases, therefore it is necessary to create the intestinal obstruction experimentally to determine the prognostic and diagnostic changes and to formulate therapeutic strategy at different at different postoperative time period, the clinical differentiation between simple and strangulated obstruction is still difficult. The information regarding the status of body fluids dynamics in bowel obstruction in cattle is lacking and the role of dehydration and sepsis is still not clear in strangulated obstruction. This creates a major hurdle in the management of such patients. The project was undertaken with following objectives:-

(A) To study Pathophysiology and survival time following intestinal obstruction in cattle of high altitude.

(B) To evaluate prognosis following intestinal obstruction and subsequent its treatment in cattle of high altitude

(C) To correlate clinical, haematological and biochemical alterations in simple and strangulated intestinal obstruction in cattle.

(D) To evolve suitable therapeutic regimen for intestinal obstruction based on surgical intervention, electrolytes imbalance and fluid replacement in cattle of high altitude.

(E) To apply and recommend the best diagnostic and therapeutic strategies in clinical cases of intestinal obstruction in cattle evolved out of the above results.

DETAILED PROJECT REPORT

A. MODEL OF PROXIMAL AND DISTAL INTESTINAL OBSTRUCTION IN CALVES

(i). Creation of simple and strangulated proximal jejunal obstruction

Total of 24 Healthy male cross bred cow calves, 8 to 15 months of age, with their body weight ranging between 70 to 150 kg were divided in six groups of four animals each. In all the animals, right paralumbar fossa was prepared for aseptic surgery. The animals were restrained in left lateral recumbency for undertaking laparotomy through right flank incision. The abdominal cavity was entered through a linear incision at the centre of the right paralumbar fossa under local infiltration analgesia using two per cent lignocaine hydrochloride. Following the entrance to the abdominal cavity, the layers of omentum were incised to locate the cranial jejunum. To create the simple jejunal obstruction a constricting ligature consisting of flexible silicon tubing braced with umbilical tape suture material in its lumen was loosely placed around the cranial jejunum in a double loop fashion without interfering with the mesenteric vasculature(Plate 1) .The strangulated jejunal obstruction was created with similar technique but in addition the blood vessels supplying to the constricted segment (20cm long) were ligated (Plate 2) with the help of 1-0 catgut (Ethicon) suture.

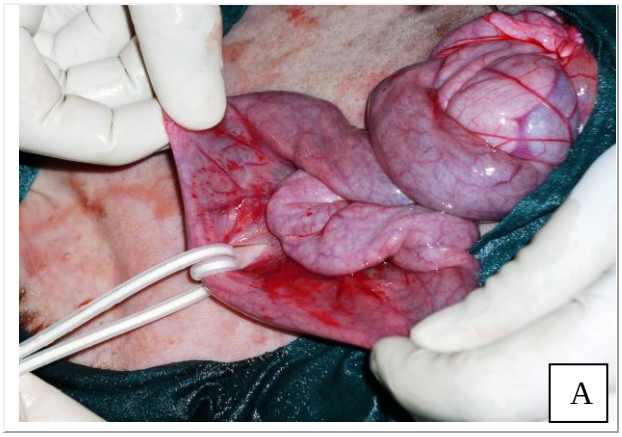
Two separate holes were created through the omentum and from these the silicon tubing was passed outside the omentum (Plate 1, 2). This was done to keep the jejunum within the omental aquarium and to prevent the direct exposure of the jejunum to the abdominal wall. The incised omental layers were then sutured using 1-0 Polyglactin 910 (Vicryl, Ethicon) in simple continuous fashion. Two plastic discs were used on the interior and exterior side of the abdominal wall (Plate 1, 2). These two plastic discs were then fixed tightly to the lateral wall by the Stainless steel wire threads, which were then passed through corresponding small holes, at the periphery and opposite positions of the two plastic discs.

The ligature was tightened in standing position, by pulling the free ends of the plastic tubing protruding from abdominal wall, immediately after closure of wound.

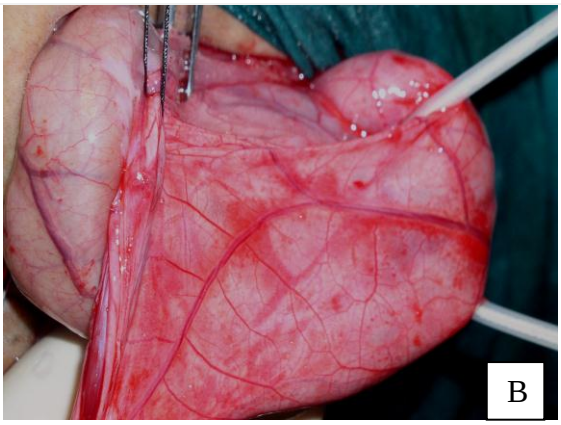
Composition of groups

Simple Proximal Jejunal Obstruction	**Group I**	Four animals served as untreated control
	Group II	Four animals were given conservative treatment
	Group III	Four animals were treated surgically and were maintained on conservative treatment post-operatively
Strangulated Proximal Jejunal Obstruction	**Group I**	Four animals served as untreated control
	Group II	Four animals were given conservative treatment
	Group III	Four animals were treated surgically and were maintained on conservative therapy post operatively

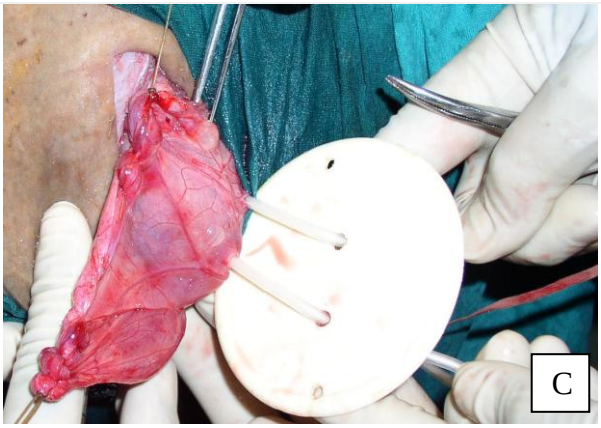
PLATE 1: CREATION OF SIMPLE JEJUNAL OBSTRUCTION IN CALVES



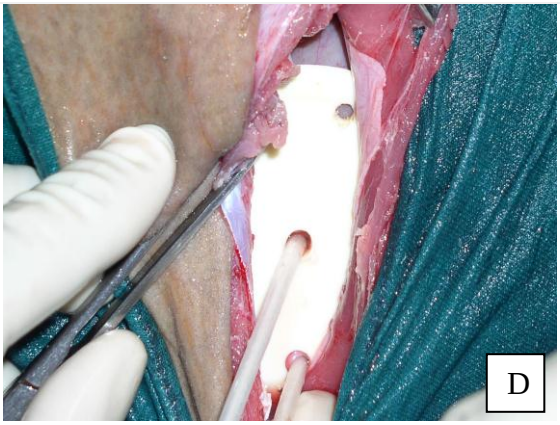
Silicon catheter braced with umbilical tape was looped around the segment of bowel



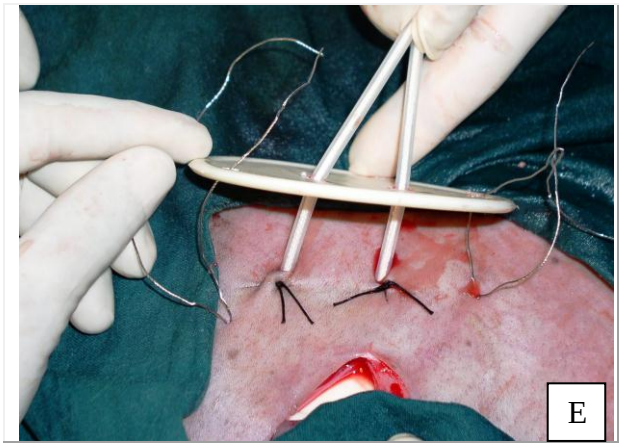
Looped segment of bowel placed in the omentum and the tubing was egressed after creating holes in the omentum



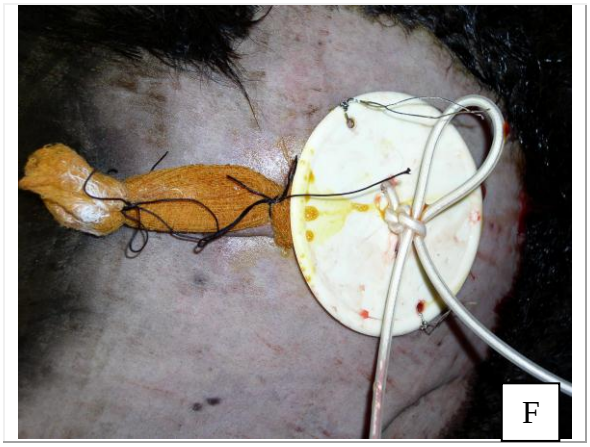
The omental incision was sutured and tubing was transfixed with a plastic disc



The plastic disc transfixed to tubing was placed intra-abdominally

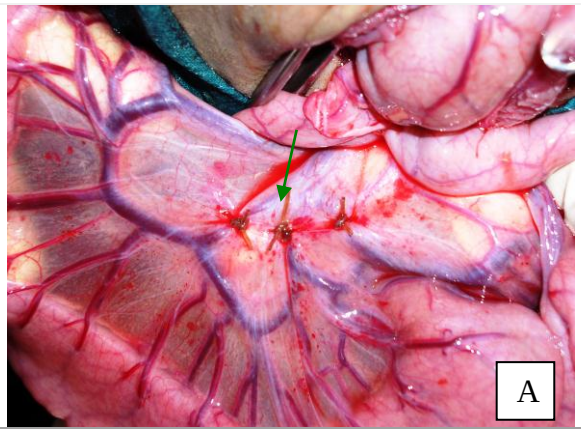


Stainless steel sutures were applied through the abdominal wall to secure internal and external plate in proximity

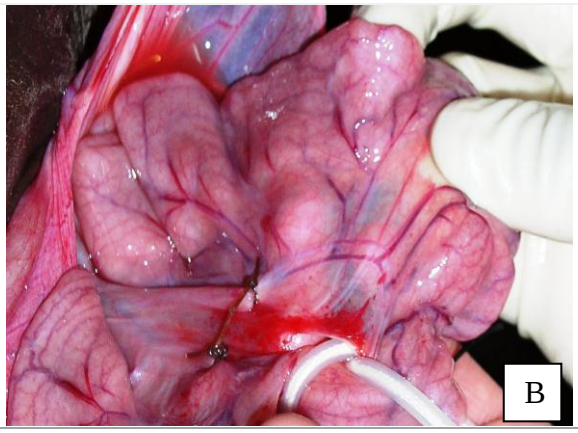


The silicone catheter was tied in a shoe lace fashion to obstruct the intestinal lumen

PLATE 2: CREATION OF STRANGULATED JEJUNAL OBSTRUCTION IN CALVES

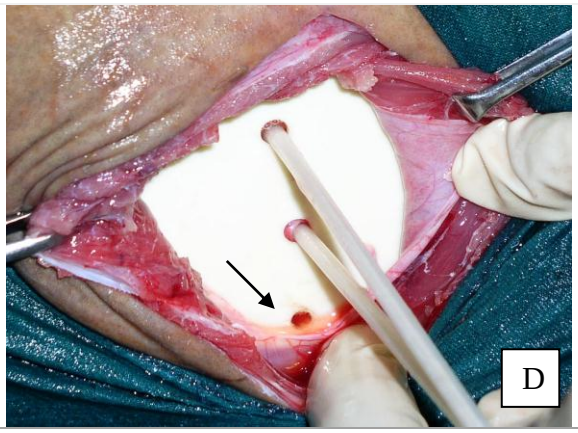


Ligature applied to strangulate the mesenteric vessels

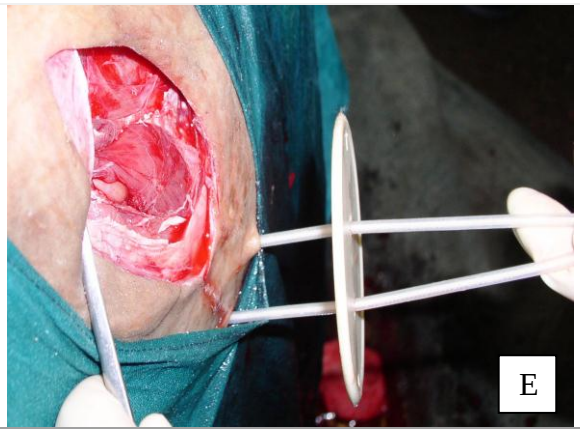


Silicon tubing looped around the bowel segment to constrict the lumen

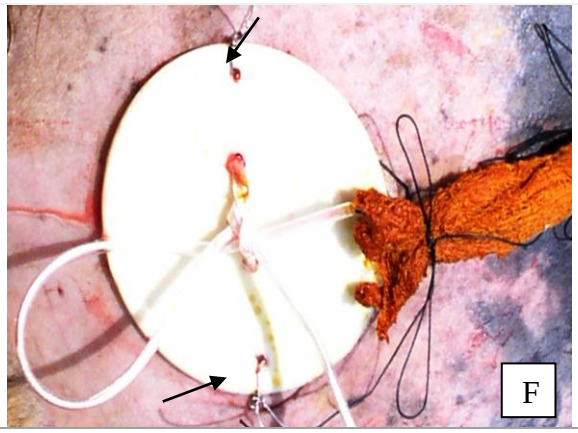
Omentum sutured as such and two additional holes are created to take the tubing out of the omental cavity



Internal disc looped with silicone tubing was placed intra-abdominally (Additional holes [→] were used to transfix the internal and external plate using stainless steel sutures)



External disc looped with the tubing was fixed extra-abdominally



[→] indicates external disc transfixed with the internal disc using stainless steel sutures to immobilize the looped bowel

(ii). Creation of simple and strangulated colonic obstruction

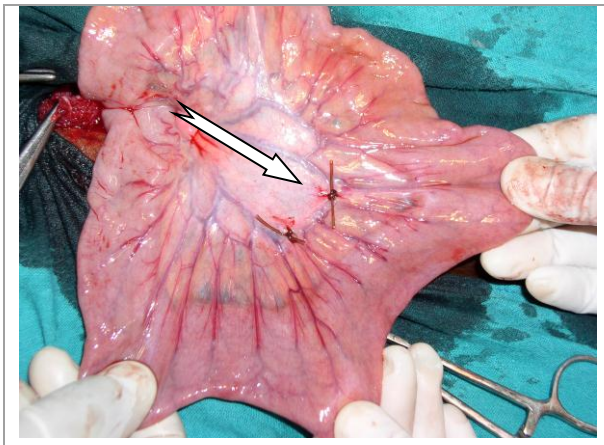
Total of 24 healthy male cross bred cow calves, 8 to 15 months of age, with their body weight ranging between 70 to150 were divided in six groups of four animals each. In all the animals, right paralumbar fossa was prepared for aseptic surgery. The animals were restrained in left lateral recumbency for undertaking laparotomy through right flank incision. The abdominal cavity was entered through a linear incision at the centre of the right paralumbar fossa under local infiltration analgesia using two per cent lignocaine hydrochloride. Following the entrance to the abdominal cavity, the layers of omentum were incised to locate the colon. To create the simple colonic obstruction a constricting ligature consisting of flexible silicon tubing braced with umbilical tape suture material in its lumen was loosely placed around the colonic segment in a double loop fashion without interfering with the mesenteric vasculature .The strangulated colonic obstruction was created with similar technique but in addition the blood vessels supplying to the constricted segment (20cm long) were ligated (Plate 3) with the help of 1-0 catgut (Ethicon) suture .

Two separate holes were created through the omentum and from these the silicon tubing was passed outside the omentum (Plate 3). This was done to keep the colon within the omental aquarium and to prevent the direct exposure of the colon to the abdominal wall. The incised omental layers were then sutured using 1-0 Polyglactin 910 (Vicryl, Ethicon) in simple continuous fashion. Two plastic discs were used on the interior and exterior side of the abdominal wall. These two plastic discs were then fixed tightly to the lateral wall by the Stainless steel wire threads, which were then passed through corresponding small holes, at the periphery and opposite positions of the two plastic discs. In a standing position, the ligature was tightened by pulling the free ends of the plastic tubing protruding from abdominal wall, immediately after closure of wound.

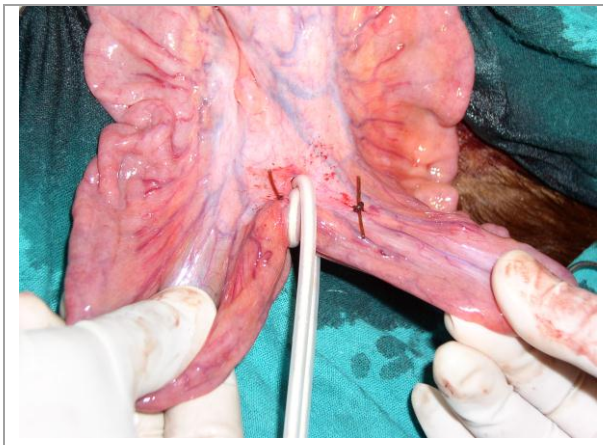
Composition of groups

Simple colonic obstruction	***Group I***	Four animals served as untreated control
	Group II	Four animals were given conservative treatment
	Group III	Four animals were treated surgically and were maintained on conservative treatment post-operatively
Strangulated colonic obstruction	***Group I***	Four animals served as untreated control
	Group II	Four animals were given conservative treatment
	Group III	Four animals were treated surgically and were maintained on conservative therapy post operatively

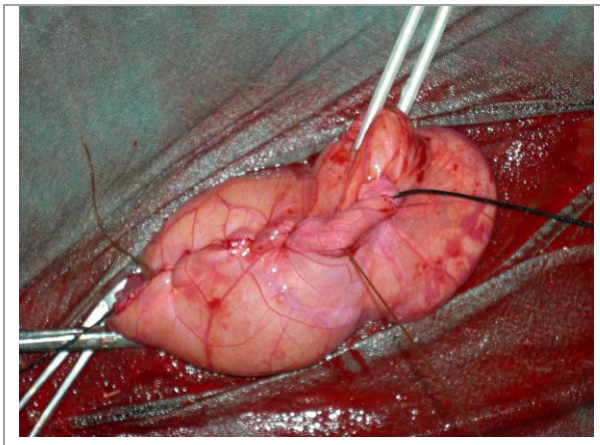
PLATE 3 :CREATION OF STRANGULATED COLONIC OBSTRUCTION IN CALVES



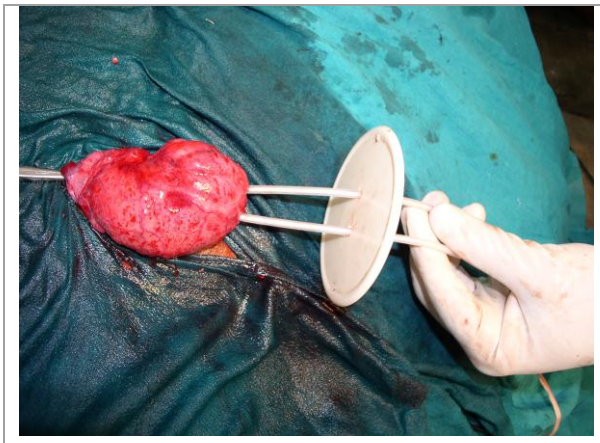
Ligature applied to strangulate the mesenteric vessels



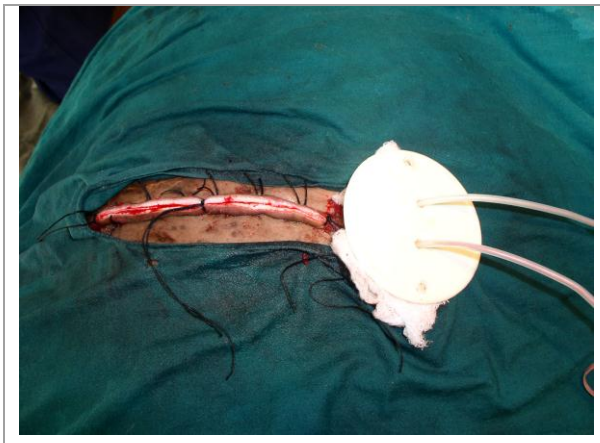
Silicon tubing looped around the colonic segment



Omentum sutured as such and two additional holes are created to take the ting out of the omental cavity



Internal disc looped with silicon tubing



External disc looped with silicon tubing

Silicon tube tied after the animal is in standing position

B. THERAPEUTIC REGIMENS

(i)Surgical treatment

Following the creation of strangulated jejunal obstruction the corrective surgery was performed at 24 hours interval and following the creation of simple jejunal obstruction surgery was performed at 3rd day interval The four animals each of group III, belonging to both simple and strangulated obstructions were reopened from the same site of laparotomy incision to relieve the obstruction by resecting the non viable segment of the jejunum. Similarly following the creation of strangulated and simple colonic obstruction the corrective surgery was performed at 3rd and 6th post obstruction day respectively. The four animals each of group III, belonging to both simple and strangulated colonic obstructions were reopened from the same site of laparotomy incision to relieve the obstruction by resecting the non viable segment of the jejunum.

Following resection of the mesentery and affected segment of the jejunum, end to end anastomosis was achieved using a two layer anastomosis with a simple continuous pattern for the submucosal/mucosal layer, followed by a continuous lambert in the seromuscular layer (Eggleston, 2001) using 2-0 Polyglactin 910 (Vicryl, Ethicon)) suture. Similar technique was used for the end to end anatomosis of the affected colonic segment in the distal obstruction. The defect in the mesentery was closed in simple continuous suture pattern, using 2-0 Synthetic Polyglactin 910 suture (Plate 4). The absence of any leakage and luminal patency at the anastomotic site was checked by gentle milking of the intestinal contents (Plate 4). After rinsing the anastomosed segment with a lukewarm saline solution, it was replaced back into the abdomen. The abdominal incision was closed in a routine manner.

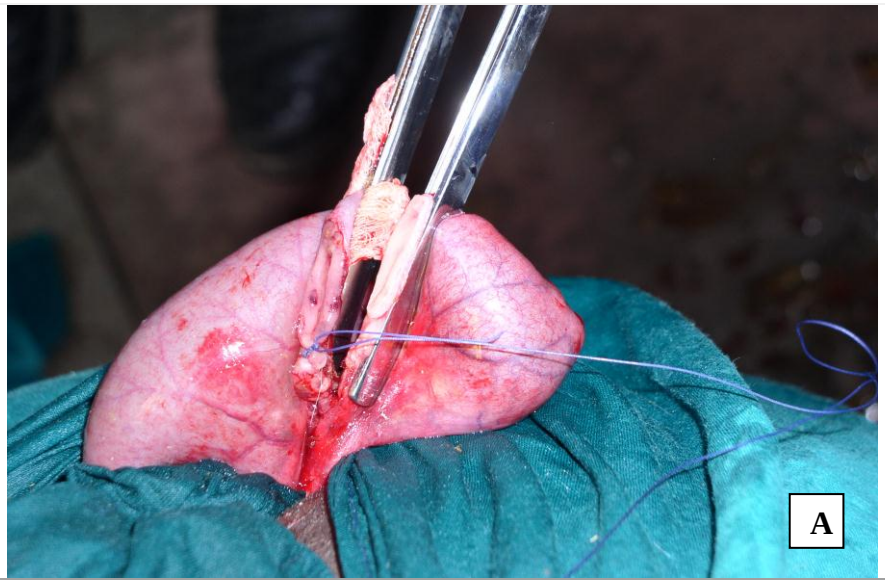
(ii)Conservative treatment

Following the creation of strangulated jejunal obstruction the medical treatment was instituted at 24 hours interval in the animals of group II and III and continued upto 96 hours and following the creation of simple jejunal obstruction, the treatment was instituted at 3rd day interval in the animals of group II and III and continued till 8th day interval. Likewise following the creation of strangulated colonic obstruction the medical treatment was instituted at 3rd post obstruction day in the animals of group II and III and continued upto 7th day and following the creation of simple colonic obstruction, the treatment was instituted at 3rd day interval in the animals of group II and III and continued till 8th day interval.

The formulation of conservative treatment was based on the pathophysiological alterations observed in the animals of group I after creation of proximal and distal obstruction. In all of the animals, metabolic alkalosis accompanied by hypochloraemia and hypokalemia was observed. For this reason, the following treatment schedule was instituted in the animals of group II and III.

1. 5 per cent Dextrose Normal Saline, IV
2. Ringer Solution, IV

PLATE 4 : ENTEROANASTOMOSIS IN SIMPLE AND STRANGULATED JEJUNAL OBSTRUCTION IN CALVES



The viable part of intestine held together with intestinal clamps for enteroanastomosis

The luminal integrity was monitored by milking the contents from proximal to distal segments to rule out anastomotic leakage

3. Normal Saline solution, IV
4. Amoxicillin & Cloxacillin (Inimox, Indian Immunologicals) -8 mg/Kg b.wt., 8 hourly
5. Potassium Chloride – 1gm/ litre of Nacl, IV
6. Liver Extract/ B complex vitamins(Belamyl, Sarabhai Zydus)- 5 ml alternate days, IM
7. Vitamin C (Revici, Kee Pharma)- 5 ml, IV
8. Dexamethasone (Dexona Vet, Cadilla Health Care) - 16 mg, (8 mg, IM and 8mg, IV)
9. Neostigmine (Myostgmin, Neon labs) 2 mg, IM at 6 hour interval , p.r.n. (Group III only)
10. *Sacchromyces cerevisiae, Lactobacillus sporogenes*, multiminerals and UGF's (Biobloom, Sarabhai Zydus) – 5 gm/day, orally
11. Antimony Potassium tartrate and ferrous sulphate (Bovirum bolus, Sarabhai Zydus) – I bolus orally, b.d.
12. Ruminal cud - Oral transfaunation post operatively

Composition of Ringer's solution

Sodium Chloride	-	0.84 per cent
Potassium chloride	-	0.03 per cent
Calcium chloride	-	0.033 per cent

The Ringer's solution, 5 per cent Dextrose normal saline and potassium chloride solution were prepared using pyrogen free water from Millipore filter, taking all the necessary precautions.

Formula for calculation of fluid therapy

The amount of intra-venous administered in the animals of group II and III was assessed as per the following formula

Fluid required overcoming dehydration (ml)

= Patient PCV x 0.66 x body weight (in Kg) x 4 (Kumar, 1995)

COLLECTION OF SAMPLES

The blood, peritoneal and ruminal fluid samples were collected for analysis of various physio-chemical and Haemato-biochemical alterations.

1. At 0, 2, 3, 4, 6 and 8 days time intervals for simple obstruction
2. At 0, 24, 48, 72 and 96 hours time interval for strangulated obstruction
3. At 0, 3, 6, 9, 12 and 15 days time interval for simple colonic obstruction
4. At 0, 1, 2, 3, 4, 5 and 6 days time interval for the strangulated colonic obstruction

STATISTICAL ANALYSIS

The statistical analysis of data was carried out to evaluate the pathogenesis and effect of treatment in each group and within the group. The pre treatment values were compared with respective base values and the post treatment values were compared with the respective values on the day of treatment intervention in respective groups (24 hours in strangulated jejunal obstruction, 3rd day in simple jejunal and strangulated colonic , 6th day in simple colonic obstruction).The data was subjected to repeated measures ANOVA,

Student's 't' test and Dunnett's test as per the requirement using Instat software (Graph Pad). The results were evaluated at 5 per cent and 1 per cent level of significance.

C.PROXIMAL INTESTINAL OBSTRUCTION

C(1). CLINICO-HAEMATO-BIOCHEMICAL ALTERATIONS AND THERAPEUTIC (CONSERVATIVE AND SURGICAL) ASPECTS IN SIMPLE PROXIMAL JEJUNAL OBSTRUCTION

I. CLINICAL OBSERVATIONS

PRE TREATMENT

All the animals showed mild signs of discomfort such as reflex guarding of abdomen while standing, grinding of teeth and mild pain during movement immediately after creation of simple jejunal obstruction. These symptoms abolished within 6-8 hours and thereafter the animals resumed their normal activity. The signs of mild abdominal pain reappeared after two days in two animals of group I and one animal of group II. These animals exhibited groaning, kicking at the abdomen and restlessness on 3rd day. The animals showed a tendency to lie down for a longer period of time and tried to seek the shady areas. These signs disappeared at 4th day onward and thereafter the symptoms of weakness were observed.

Defecation was normal on the day of creation of simple jejunal obstruction but as the time passed stools became insufficient and desiccated. On 3rd day the calves of all the three groups strained to defecate and passed very little amount of faeces with slightly off colour. On 4th day hard dehydrated dung balls were voided, which later at 5th day were laced with foul smelling mucoid discharge. At 6th day the faeces consisted more of the mucous discharge and very less dung. As the duration of obstruction continued from 7th day onward the mucous clogged the anus and mucoid plugs with fetid odour were voided. The frequency of defecation for initial four days was 2-3 times a day, which later decreased to once a day. Urination was normal in the animals of group II and III but oligouria was noticed in group I as the duration of obstruction progressed.

The feed and water intake was normal in all the animals of three groups upto 3rd day of creation of obstruction, thereafter appetite reduced considerably but browsing on small amount of fodder was continued throughout the period of study till 7th day. Subsequently on 8th day all the animals of group I and II showed the tendency of prolonged recumbency and were totally reluctant to eat even when the fodder was offered.

Generalized frailty in terms of muscular debility was appreciated constantly in all the animals. These animals showed a weak footing on 2nd day of creation of jejunal obstruction which increased after 3rd day and eventually the animals showed a perceptible reluctance to move and a tendency to keep head down for an extended period of time. In the terminal part of study the animals were avert to stand and assumed sternal and often a lateral recumbency.

Rumen motility decreased to almost half at 2nd post obstruction day and later from 3rd day onward the rumen became totally atonic. In one animal, regurgitation of ruminal contents was noticed at 3rd day. Intestinal borborygmi were audible on auscultation upto 4th post obstruction day. However, these sounds diminished progressively from 6th day onward.

A persisting absence of gut sounds was evident in the terminal part of study. Abdominal distention was seen on 2nd day onward which gradually increased with time and in later part of the study markedly distended abdomen posed much difficulty in carrying the weight of the animal by itself. This distention was bilateral and doughy on palpation.

There was a significant ($P<0.01$) decrease in the rectal temperature at 3rd post obstruction day when compared to the base values in the animals of all three groups. The decrease in the rectal temperature also remained highly significant ($P<0.01$) throughout the period of study in the animals of group I (Table 1). A significant increase in the respiratory rate was recorded in the animals of group II ($P<0.05$) and this increase was highly significant in group III ($P<0.01$) at 3rd post obstruction day when compared to their respective base values. However, a significantly higher ($P<0.01$) increase in respiration rate was observed in the animals of the group I at 4th day onward when compared to its base value (Table 1). An increase in heart rate was seen in all the animals of three groups from 2nd post obstruction day which was significant ($P<0.01$) on 3rd post obstruction day when compared to base values. The highly significant tachycardia persisted throughout the period of obstruction in the animals of group I (Table 1). The pulse rate in the animals of all the three groups also showed the similar trend.

A comprehensive lassitude was evident in all the animals after 2-3 days following the creation of the obstruction. The hair coat appeared muffled, dry and the elasticity of skin gradually diminished. The eyes began to retract inside the orbital cavity and at 7th day the recession of eye balls was very much conspicuous. These symptoms were exaggerated in the animals of group I as compared to group II. The ongoing deterioration in the condition of animals of group I was grievous, late at 8th day. The elasticity of skin was moderately decreased at 3rd post obstruction day and skin became almost inelastic at 6th day onward. Capillary refill time (CRT) was increased significantly at 3rd post obstruction day and was highly significant at 4th and 6th post obstruction day in the animals of group I (Table 2).

There was significant decrease in ruminal fluid pH in the animals of group I ($P<0.05$) and II ($P<0.01$) at 3rd post obstruction day when compared to base values (Table 2). The significant ($P<0.01$) decreasing trend in the ruminal fluid pH continued throughout the period of study upto 6th day in the animals of group I. There was a moderate loss (++) of ruminal microflora at 3rd post obstruction day but as the duration of obstruction progressed, the loss became sluggish (+) at 4th and 5th day and afterwards complete loss (-) was evident.

TABLE 1: EFFECT OF SIMPLE JEJUNAL OBSTRUCTION ON RECTAL TEMPERATURE, RESPIRATION RATE, HEART RATE AND PULSE RATE IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF JEJUNAL OBSTRUCTION					
	0	2	3#	4	6	8
RECTAL TEMPERATURE (ºF)						
Group I	101.95 ±0.263 (n=4)	101.65 ±0.276 (n=4)	99.95** ±0.263 (n=4)	99.40** ±0.455 (n=4)	98.10** ±0.742 (n=4)	98.20 N.I. ±1.2 (n=2)
Group II	102.15 ±0.263 (n=4)	101.95 ±0.189 (n=4)	100.65** ±0.35 (n=4)	99.70 ±0.656 (n=4)	98.55[a] ±0.922 (n=4)	97.33[b] ±0.067 (n=3)
Group III	101.65 ±0.238 (n=4)	101.50 ±0.265 (n=4)	100.60** ±0.183 (n=4)	101.05 ±0.499 (n=4)	101.65[de] ±0.427 (n=4)	101.80[de] ±0.559 (n=4)
RESPIRATION RATE (/min)						
Group I	12.5 ±0.28 (n=4)	13.0 ±0.58 (n=4)	14.3 ±0.629 (n=4)	15.5** ±1.04 (n=4)	15.5** ±0.29 (n=4)	17.5 N.I. ±0.50 (n=2)
Group II	13.0 ±0.58 (n=4)	15.5 ±0.96 (n=4)	16.0* ±1.155 (n=4)	17.5 ±0.5 (n=4)	19.5[d] ±0.96 (n=4)	21.3 N.I. ±1.33 (n=3)
Group III	12.5 ±0.5 (n=4)	13.5 ±1.5 (n=4)	16.5** ±0.957 (n=4)	14.5[f] ±0.5 (n=4)	15.5[e] ±0.5 (n=4)	14.0[f] ±0.82 (n=4)
HEART RATE (/min)						
Group I	71.5 ±3.30 (n=4)	75.5 ±3.304 (n=4)	81.0** ±1.915 (n=4)	84.5** ±2.22 (n=4)	89.0** ±2.08 (n=4)	91.0 N.I. ±3.0 (n=2)
Group II	67.0 ±2.65 (n=4)	71.0 ±2.38 (n=4)	79.3** ±2.926 (n=4)	81.5 ±3.12 (n=4)	88.3[b] ±4.37 (n=4)	96.0[a] ±7.57 (n=3)
Group III	69.5 ±0.957 (n=4)	73.5 ±0.5 (n=4)	82.0** ±2.449 (n=4)	71.0[ac] ±4.359 (n=4)	68.0[bdf] ±2.16 (n=4)	66.5[bce] ±3.76 (n=4)
PULSE RATE (/min)						
Group I	70.0 ±3.464 (n=4)	74.5 ±3.403 (n=4)	77.5* ±0.957 (n=4)	80.0** ±1.633 (n=4)	85.5** ±1.50 (n=4)	87.0 N.I. ±1.0 (n=2)
Group II	66.0 ±2.16 (n=4)	69.5 ±1.5 (n=4)	78.0** ±2.449 (n=4)	81.0 ±2.887 (n=4)	86.5[b] ±3.862 (n=4)	93.3[b] ±5.696 (n=3)
Group III	68.0 ±1.633 (n=4)	72.5 ±0.958 (n=4)	80.5** ±1.5 (n=4)	69.0[bce] ±3.697 (n=4)	67.5[bdf] ±2.062 (n=4)	65.5[bcf] ±3.202 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

TABLE 2: EFFECT OF SIMPLE JEJUNAL OBSTRUCTION ON CAPILLARY REFILL TIME AND RUMINAL FLUID pH IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF JEJUNAL OBSTRUCTION					
	0	2	3#	4	6	8
CAPILLARY REFILL TIME (sec)						
Group I	0.62 ±0.125 (n=4)	1.25 ±0.144 (n=4)	1.38* ±0.125 (n=4)	1.75** ±0.323 (n=4)	2.38** ±0.239 (n=4)	2.50N.I. ±0.50 (n=2)
Group II	0.75 ±0.145 (n=4)	1.00 ±0.204 (n=4)	1.13 ±0.125 (n=4)	1.50 ±0.204 (n=4)	1.25d ±0.144 (n=4)	1.67 N.I. ±0.167 (n=3)
Group III	0.63 ±0.125 (n=4)	1.00 ±0.204 (n=4)	1.13 ±0.239 (n=4)	1.00 ±0.204 (n=4)	0.88d ±0.239 (n=4)	0.63df ±0.125 (n=4)
RUMINAL FLUID Ph						
Group I	7.25 ±0.144 (n=4)	7.05 ±0.166 (n=4)	6.85* ±0.087 (n=4)	6.63** ±0.075 (n=4)	6.55** ±0.086 (n=4)	6.20 N.I. ±0.200 (n=2)
Group II	7.13 ±0.125 (n=4)	6.93 ±0.075 (n=4)	6.65** ±0.050 (n=4)	6.55 ±0.15 (n=4)	6.43 ±0.075 (n=4)	6.23 ±0.145 (n=3)
Group III	6.85 ±0.086 (n=4)	6.65 ±0.05 (n=4)	6.60 ±0.058 (n=4)	6.73 ±0.075 (n=4)	6.85 ±0.866 (n=4)	6.77e ±0.075 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

POST TREATMENT

The animals of group II voided faeces upto 7th post obstruction day. The amount of faeces decreased and the mucoid content persistently increased even after institution of medical therapy at 3rd post obstruction day. Complete cessation of defecation was observed at 8th post obstruction day onward. The animals of group III passed scanty faeces in the form of dung balls with a little amount of mucous after 4-5 hours of the surgical treatment. The consistency of faeces was watery on 4th day and later from 5th day onward the consistency was almost normal. The frequency of defecation was 3-4 times on 4th and 5th day and 2-3 times from 6th day onward. The stools passed immediately after the operation had a foul odour, which vanished in due course of time.

The frequency of urination was 4-5 times a day in the animals of group II and III after the institution of treatment. Feed and water intake was reduced progressively in the animals of group II. All the animals showed the tendency of occasional grasps at the fodder but after 8th post obstruction day the feed and water intake was absolutely absent, whereas the animals of group III resumed normal feed and water intake from 5th day onward. Signs of muscular weakness persisted in all the animals of group II but the severity was less in comparison to the animals of group I. Signs of debility manifested by prolonged recumbency during night hours, inability to stand during early morning hours and adoption of frequent

sternal recumbency with staggering gait were seen after 6th day and remained so till the completion of the study. The animals of group III did not show any such signs after the institution of surgical treatment except the animals were reluctant to walk on 4th post obstruction day. These signs attenuated as the animals recovered. Complete cessation of ruminal movements was recorded in all the animals of group II even after the institution of medical treatment at 3rd day, whereas, in the animals of group III a feeble contraction of rumen was observed at 4th day when compared with 3rd post obstruction day interval. From 6th day onward appreciable ruminal motility (1/3min) was present but the rumen was hypotonic. Intestinal borborygmi in the animals of group II was audible on auscultation up to 5th post obstruction day and was clinically unappreciable from 6th day onward, whereas in the animals of group III the bowel sounds were very much appreciable at 3rd day onward. There was a progressive enlargement of the abdomen in the animals of group II and at the end of the study marked bilateral abdominal distention was observed.

A significant fall in the rectal temperature was recorded at 6th ($P<0.05$) and 8th day ($P<0.01$) in the animals of group II when compared to 3rd post obstruction day, whereas no significant alteration was noticed in the animals of group III when compared to day three. A significant increase in rectal temperature was recorded at 6th and 8th day in the animals of group III when compared with the animals of group I ($P<0.01$) and II ($P<0.05$). Respiratory rate did not register any significant change in the animals of group II and III but increasing trend was seen in the animals of group II during post treatment period. The comparison within groups showed a significant increase in respiration rate in animals of group II at 6th day when compared to group I. Whereas, a significant decrease ($P<0.05$: 6th day and $P<0.01$: 8th day) in respiration rate was noticed in the animals of group III when compared with the animals of group II in the post treatment period (Table 1). The increase in heart rate in the animals of group II was significant at day 6th ($P<0.01$) and 8th ($P<0.05$) day when compared to 3rd post obstruction day. Contrariwise, heart rate decreased significantly ($P<0.01$) during post treatment intervals in the animals of group III when compared to 3rd post obstruction day. The inter group comparison revealed a statistically significant decrease ($P<0.01$) in heart rate attaining normalcy following treatment in group III when compared to group I and II. Similar changes were observed in pulse rate (Table 1).

The skin turgor was affected mildly during the entire post treatment period in the animals of group II. There was no sign of enophthalmia during the entire period of observation but muffling of hair coat and dryness of muzzle were constant findings in all the animals of group II. The animals of group III did not show such sign except the muzzle was dry at 4th and 5th day which became wet in later stages. Submandibular oedema was a constant finding in all the animals of group II and in one animal of group III. Conjunctival mucous membrane was pale in the terminal part of study in the animals of group II. Statistically non-significant increase in CRT was seen in group II whereas it was normal in post treatment period in the animals of group III. The increase in CRT in the animals of

group I in comparison to group II and III was significant (P<0.01) at 6th day and 8th day (Table 2).

Non-significant alteration in the pH of ruminal fluid was recorded in the animals of group II and III following the treatment. On comparative basis a significant shift in ruminal pH at 8th day interval was recorded in the animals of group III (Table 2). The loss of ruminal microflora in the animals of group II was almost comparable to group I with a difference of slow pace in former, whereas in group III sluggish (+) to moderate (++) loss of micro flora was present upto 6th day and afterwards complete rejuvenation (+++) of microflora was observed.

II. HAEMATOLOGICAL ALTERATIONS

PRE TREATMENT

A significant (P<0.05) increase in the haemoglobin concentration was recorded 3rd post obstruction day and it was highly significant (P<0.01) at 4th and 6th post obstruction day in the animals of group I. This increase in haemoglobin was highly significant (P<0.01) at 3rd post obstruction day in the animals of group II and III when compared to base values. Inconsistent variations were found during inter group comparisons (Table 3). An increase in PCV was seen from 2nd post obstruction day onward and this rise in PCV became significant (P<0.01) at 3rd post obstruction day in the animals of all the three groups when compared with base values. In the animals of group I, a significant (P<0.01) increase in the PCV was observed throughout the period of study (Table 3).

A highly significant increase in total erythrocytic count (TEC) was found on 3rd post obstruction day in all the three groups when compared to their base values. A significant (P<0.01) rise in TEC persisted throughout the period of study in the animals of group I (Table 4). Similar observations were recorded in total leukocytic count (TLC) in all the animals of three groups but leukocytosis was significant (P<0.01) from 2nd post obstruction day when compared to base value (Table 4). A significant (P<0.01) neutrophilia was evident on 3rd day after the creation of simple jejunal obstruction. An unrelenting neutrophilia compared to base value persisted in the entire post obstruction period in the animals of Group I (Table 4). Contrariwise, a highly significant post obstruction decrease in lymphocytic count was noticed on 3rd day following creation of simple jejunal obstruction in the animals of all the three groups when compared to base values. A highly significant decrease in lymphocytes was observed throughout the period of obstruction in the animals of group I (Table 4).

POST TREATMENT

The animals of group II during post treatment period showed a mild increase in haemoglobin (Hb) concentration which was statistically non-significant when compared with 3rd post obstruction day, whereas, in the animals of group III, a significant (P<0.01) decrease in Hb concentration was noticed when compared with its 3rd day values (Table 3). There was non-significant alteration in PCV values at 4th and 6th day in the animals of group II when

TABLE 3: EFFECT OF SIMPLE JEJUNAL OBSTRUCTION ON HAEMOGLOBIN, PACKED CELL VOLUME AND TOTAL ERYTHROCYTE COUNT IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF JEJUNAL OBSTRUCTION					
	0	2	3#	4	6	8
HAEMOGLOBIN (g%)						
Group I	7.05 ±0.443 (n=4)	7.70 ±0.404 (n=4)	8.15* ±0.403 (n=4)	8.50** ±0.387 (n=4)	9.20** ±0.274 (n=4)	9.20 N.I. ±0.40 (n=2)
Group II	8.85 ±0.25 (n=4)	9.65 ±0.222 (n=4)	10.25** ±0.126 (n=4)	10.25c ±0.419 (n=4)	10.30 ±0.519 (n=4)	10.87c ±0.176 (n=3)
Group III	9.90 ±0.723 (n=4)	10.15 ±0.619 (n=4)	10.80** ±0.559 (n=4)	10.00b ±0.668 (n=4)	9.90b ±0.655 (n=4)	9.80b ±0.627 (n=4)
PACKED CELL VOLUME (%)						
Group I	29.5 ±2.86 (n=4)	33.0 ±2.915 (n=4)	38.0** ±1.826 (n=4)	39.5** ±1.71 (n=4)	48.0** ±2.71 (n=4)	50.0 N.I. ±2.0 (n=2)
Group II	36.0 ±0.82 (n=4)	38.0 ±0.82 (n=4)	39.5** ±0.957 (n=4)	39.0 ±0.58 (n=4)	40.5 ±1.5 (n=4)	43.3a ±1.764 (n=3)
Group III	31.8 ±2.72 (n=4)	34.8 ±1.109 (n=4)	37.5** ±1.893 (n=4)	33.0bce ±1.732 (n=4)	31.5bdf ±1.893 (n=4)	31.0bdf ±1.732 (n=4)
TOTAL ERYTHROCYTIC COUNT (millions/cu mm)						
Group I	5.26 ±0.736 (n=4)	5.53 ±0.69 (n=4)	6.12** ±0.804 (n=4)	6.31** ±0.797 (n=4)	6.74** ±7.387 (n=4)	5.95 N.I. ±0.530 (n=2)
Group II	6.32 ±0.073 (n=4)	6.43 ±0.025 (n=4)	6.51** ±0.061 (n=4)	6.56 ±0.062 (n=4)	6.65b ±0.081 (n=4)	6.82a ±0.075 (n=3)
Group III	6.02 ±0.438 (n=4)	6.24 ±0.324 (n=4)	6.49** ±0.359 (n=4)	5.94b ±0.444 (n=4)	5.88b ±0.490 (n=4)	5.89b ±0.465 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

compared to it 3rd post obstruction day but significant (P<0.05) increase in PCV was recorded at 8th day in the animals of group II. The animals of group III showed a highly significant decrease in PCV during the entire post treatment period when compared to 3rd post obstruction day. The inter group comparison of group I and II with group III revealed statistically significant (P<0.01) decrease at corresponding intervals (Table 3). The inter group comparison showed a statistically significant (P<0.01) tendency of normalization in the values of neutrophils at 6th and 8th days in the animals of group III (Table 4). Following conservative therapy a gradual decline in the lymphocytic count was noticed which was significantly (P<0.05) low at 8th day when compared to 3rd post obstruction day in the animals of group II. The inter group comparison illustrated a statistically significant (P<0.01) tendency

of normalization in the values of lymphocytes at 6th and 8th in the animals of group III (Table 4).

A significant increase in TEC at 6th (P<0.01) and significant increase at 8th (P<0.05) day was recorded in the animals of group II when compared to 3rd post obstruction day, whereas the TEC decreased significantly (P<0.01) following surgical treatment when compared to 3rd post obstruction day in the animals of group III (Table 4). Similar trends were found in TLC but on comparative basis the animals of group III showed significant (P<0.01) decrease in leukocytic count at 8th day (Table 4). No significant change in neutrophils was appreciated both in group II and III upto 6th day following treatment but, significant reduction in neutrophils was seen at 8th day in the animals of group III as compared to its 3rd post obstruction day value.

III. BIOCHEMICAL CHANGES IN PLASMA

PRE TREATMENT

Blood glucose concentration did not show any significant alteration throughout the period of study in the animals of group I, whereas significant (P<0.05) increase in blood glucose concentration was noticed at 2nd post obstruction day in the animals of group II and significant (P<0.01) increase at 2nd and 3rd post obstruction day in the animals of group III when compared to base values (Table 5).

There was an increase in total plasma protein from on 2nd day onward following creation of simple jejunal obstruction and it was found significantly high (P<0.01) at 3rd post obstruction day in all the animals of three groups in comparison to base values. A highly significant increase in the total plasma protein concentration continued throughout the period of study in the animals of group I (Table 5).

The blood urea nitrogen concentration increased significantly (P<0.05) at 3rd post obstruction day in the animals of all the three groups. This concentration remained constantly higher (P<0.01) in the entire post obstruction period in the animals of group I (Table 5). The plasma creatinine concentration increased significantly in animals of group I (P<0.01), group II (P<0.05) and III (P<0.05) at 3rd day following creation of simple jejunal obstruction. In the animals of group I significant (P<0.01) rise in the concentration of plasma creatinine was observed throughout the period of study (Table 5). The increase in plasma total bilirubin concentration was significant (P<0.05) at 4th post obstruction day and subsequently it was significantly (P<0.01) higher on 6th and 8th post obstruction day in the animals of group I when compared with base value. There was no alteration in plasma total bilirubin in the animals of group II and III at 3rd post obstruction day when compared with base values (Table 6).

A significant (P<0.01) decrease in plasma sodium concentration was recorded in the animals of group I at 3rd, 4th and 6th day following the creation of simple jejunal obstruction(Table 7). As compared to base value a significant decline (P<0.01) in plasma

TABLE 4: EFFECT OF SIMPLE JEJUNAL OBSTRUCTION ON TOTAL LEUKOCYTE COUNT, NEUTROPHILS AND LYMPHOCYTES IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF JEJUNAL OBSTRUCTION					
	0	2	3#	4	6	8
TOTAL LEUKOCYTIC COUNT (x 10^3/cu mm)						
Group I	8.03 ±0.304 (n=4)	11.54** ±0.665 (n=4)	11.39** ±0.562 (n=4)	11.14** ±0.620 (n=4)	10.74** ±0.617 (n=4)	11.38 N.I. ±0.425 (n=2)
Group II	8.05 ±0.439 (n=4)	11.43** ±0.506 (n=4)	11.54** ±0.467 (n=4)	11.36 ±0.498 (n=4)	10.65b ±0.478 (n=4)	10.22 N.I. ±0.261 (n=3)
Group III	7.10 ±0.417 (n=4)	10.14** ±0.626 (n=4)	10.26** ±0.515 (n=4)	9.68 ±0.542 (n=4)	9.05b ±0.517 (n=4)	8.48bdf ±0.287 (n=4)
NEUTROPHILS (% of TLC)						
Group I	32.8 ±1.11 (n=4)	36.0 ±0.707 (n=4)	40.3** ±0.75 (n=4)	41.8** ±2.56 (n=4)	44.5** ±0.87 (n=4)	48.5a ±0.5 (n=2)
Group II	30.5 ±1.04 (n=4)	33.5 ±0.866 (n=4)	39.3** ±1.315 (n=4)	38.8 ±1.70 (n=4)	43.0 ±0.41 (n=4)	44.0 ±1.155 (n=3)
Group III	30.0 ±1.83 (n=4)	35.0 ±1.472 (n=4)	37.8** ±0.250 (n=4)	38.0 ±1.35 (n=4)	36.0df ±1.47 (n=4)	34.0adf ±1.83 (n=4)
LYMPHOCYTES (% of TLC)						
Group I	65.8 ±1.44 (n=4)	62.7 ±1.031 (n=4)	57.8** ±1.031 (n=4)	56.8** ±2.56 (n=4)	54.0** ±1.00 (n=4)	50.5 N.I. ±1.5 (n=2)
Group II	68.8 ±0.85 (n=4)	65.8 ±0.75 (n=4)	58.8** ±1.031 (n=4)	59.0 ±0.58 (n=4)	55.5 ±0.65 (n=4)	55.7a ±1.453 (n=3)
Group III	68.5 ±2.06 (n=4)	63.5 ±1.258 (n=4)	60.3** ±0.629 (n=4)	60.3 ±1.79 (n=4)	62.8df ±1.31 (n=4)	65.5ade ±1.94 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

potassium concentration was recorded at 2nd and 3rd day following induction of simple jejunal obstruction and this decreasing trend continued (P<0.01) throughout the period of study in the animals of group I (Table 7).

Likewise a significant hypochloraemia was noticed on 2nd post obstruction day (P<0.05: group I and P<0.01: group II and III) and it was highly significant (P<0.01) at 3rd day in the animals of all the three groups in comparison to their base values. A significant (P<0.01) hypochloraemia was observed in the animals of group I throughout the period of study (Table 7). Inconsistent changes were recorded in plasma calcium and phosphorus concentration in all the animals of three groups when compared to base values (Table 7, 42).

TABLE 5: EFFECT OF SIMPLE JEJUNAL OBSTRUCTION ON GLUCOSE, TOTAL PLASMA PROTEINS, BLOOD UREA NITROGEN AND CREATININE IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF JEJUNAL OBSTRUCTION					
	0	2	3#	4	6	8
GLUCOSE (mg/dL)						
Group I	65.5 ±3.50 (n=4)	69.5 ±2.50 (n=4)	67.8 ±2.25 (n=4)	63.5 ±4.113 (n=4)	70.75 ±8.097 (n=4)	67.0 ±9.00 (n=2)
Group II	70.5 ±3.43 (n=4)	84.3* ±4.33 (n=4)	80.5 ±2.217 (n=4)	73.0 ±7.69 (n=4)	72.5 ±13.45 (n=4)	70.0 ±16.17 (n=3)
Group III	68.3 ±5.14 (n=4)	83.8** ±3.119 (n=4)	85.0** ±2.082 (n=4)	88.5^{d} ±2.754 (n=4)	79.8 ±2.84 (n=4)	83.0 ±2.38 (n=4)
TOTAL PLASMA PROTEIN (mg/dL)						
Group I	6.60 ±0.408 (n=4)	7.22 ±0.098 (n=4)	8.65** ±0.515 (n=4)	8.96** ±0.520 (n=4)	10.77** ±0.4250 (n=4)	13.00* ±0.200 (n=2)
Group II	6.88 ±0.179 (n=4)	7.25 ±0.065 (n=4)	7.63** ±0.103 (n=4)	7.75 ±0.155 (n=4)	8.15^{bd} ±0.125 (n=4)	8.87^{ad} ±0.233 (n=3)
Group III	6.63 ±0.132 (n=4)	7.03 ±0.165 (n=4)	7.85** ±0.156 (n=4)	7.35^{ac} ±0.096 (n=4)	6.95^{bdf} ±0.132 (n=4)	6.63^{bdf} ±0.179 (n=4)
BLOOD UREA NITROGEN (mg/dL)						
Group I	11.37 ±0.67 (n=4)	19.98 ±3.916 (n=4)	26.10* ±5.5 (n=4)	44.80** ±2.042 (n=4)	72.45** ±3.638 (n=4)	92.35* ±4.05 (n=2)
Group II	8.18 ±0.698 (n=4)	14.35 ±4.2 (n=4)	14.35* ±4.2 (n=4)	35.83^{bc} ±1.485 (n=4)	51.78^{bd} ±1.44 (n=4)	63.83^{a} ±1.88 (n=3)
Group III	10.33 ±0.206 (n=4)	19.38 ±4.651 (n=4)	24.53* ±4.386 (n=4)	24.23^{df} ±0.994 (n=4)	14.95^{df} ±1.135 (n=4)	12.33^{adf} ±0.541 (n=4)
CREATININE (mg/dL)						
Group I	0.96 ±0.165 (n=4)	2.10 ±0.434 (n=4)	3.08** ±0.325 (n=4)	3.30** ±0.353 (n=4)	4.45** ±0.206 (n=4)	6.25* ±0.150 (n=2)
Group II	1.26 ±0.083 (n=4)	1.46 ±0.039 (n=4)	1.69* ±0.081 (n=4)	2.33^{bc} ±0.084 (n=4)	2.58^{bd} ±0.1025 (n=4)	3.03^{bc} ±0.57 (n=3)
Group III	0.98 ±0.283 (n=4)	1.54 ±0.333 (n=4)	1.74* ±0.209 (n=4)	2.02^{ce} ±0.075 (n=4)	1.19^{df} ±0.017 (n=4)	1.06^{af} ±0.171 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

Plasma Alkaline phosphatase, aspartate amino transferase and alanine amino transferase concentrations were elevated ($P<0.05$) at 3rd day following creation of simple

TABLE 6: EFFECT OF SIMPLE JEJUNAL OBSTRUCTION ON PLASMA TOTAL BILIRUBIN (mg/dL) IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF JEJUNAL OBSTRUCTION					
	0	2	3#	4	6	8
Group I	0.08 ±0.1633 (n=4)	0.13 ±0.236 (n=4)	0.15 ±0.015 (n=4)	0.23* ±0.170 (n=4)	0.33** ±0.017 (n=4)	0.43** ±0.015 (n=2)
Group II	0.10 ±0.103 (n=4)	0.14 ±0.014 (n=4)	0.15 ±0.011 (n=4)	0.21[a] ±0.108 (n=4)	0.24[b] ±0.119 (n=4)	0.30[a] ±0.12 (n=3)
Group III	0.11 ±0.015 (n=4)	0.15 ±0.019 (n=4)	0.16 ±0.014 (n=4)	0.16 ±0.005 (n=4)	0.13[d] ±0.009 (n=4)	0.11[ad] ±0.010 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

jejunal obstruction in the animals of all three groups when compared to their base values (Table 9). The concentration of these enzymes remained significantly (P<0.01) elevated during the entire course of obstruction in the animals of group I. Serum amylase concentration in comparison to base value was high in the animals of group I (P<0.05), II and III (P<0.01) at 3rd day following creation of jejunal obstruction. A constant rise (P<0.01) in serum amylase concentration persisted throughout the period of obstruction in the animals of group I (Table 9).

POST TREATMENT

Variable changes in plasma glucose concentration during post treatment period were found inconclusive. Overall, an increase in the glucose concentration was recorded both in the animals of group II and III. The inter group comparison revealed significant (P<0.01) increase in glucose concentration in animals of group III as compared to group I at 4th day (Table 5).

A constant increase in total plasma protein concentration was recorded in the entire post treatment period at 6th (P<0.01) and 8th (P<0.05) days in the animals of group II when compared to 3rd post obstruction day value. There was a significant decrease (P<0.05) in plasma protein concentration in the animals of group III at 4th day and this decrease was significantly higher (P<0.01) at 6th and 8th day. The animals of group III revealed a statistically significant (P<0.05: 4th day and P<0.01: 6th and 8th day) decrease of plasma protein during post treatment period when compared to the corresponding intervals of animals of group I. Similarly, this decrease was significant (P<0.01) in group III in comparison to group II at 6th and 8th day of recording after treatment (Table 5). Blood urea nitrogen in comparison to 3rd day's value remained significantly elevated (4th and 6th day: P<0.01 and 8th day: P<0.05) even after institution of conservative therapy in the animals of

TABLE 7: EFFECT OF SIMPLE JEJUNAL OBSTRUCTION ON PLASMA SODIUM, POTASSIUM, CHLORIDE AND CALCIUM IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF JEJUNAL OBSTRUCTION					
	0	2	3#	4	6	8
SODIUM (mEq/L)						
Group I	144.0 ±0.81 (n=4)	140.5 ±1.5 (n=4)	133.5** ±0.957 (n=4)	131.0** ±0.57 (n=4)	128.0** ±0.81 (n=4)	119.0 N.I. ±2.00 (n=2)
Group II	145.0 ±0.577 (n=4)	142.5 ±0.957 (n=4)	142.0 ±0.817 (n=4)	142.0d ±1.63 (n=4)	144.0d ±1.41 (n=4)	142.0d ±1.155 (n=3)
Group III	144.0 ±0.817 (n=4)	143.5 ±0.5 (n=4)	143.5 ±0.5 (n=4)	145.0d ±0.577 (n=4)	142.0d ±0.82 (n=4)	143.0d ±0.58 (n=4)
POTASSIUM (mEq/L)						
Group I	4.95 ±0.493 (n=4)	3.93** ±0.144 (n=4)	3.33** ±0.170 (n=4)	3.13** ±0.170 (n=4)	2.93** ±0.201 (n=4)	2.65 N.I. ±0.150 (n=2)
Group II	4.98 ±0.296 (n=4)	4.35** ±0.222 (n=4)	4.00** ±0.216 (n=4)	3.80c ±0.163 (n=4)	3.53c ±0.103 (n=4)	3.25c ±0.065 (n=3)
Group III	5.05 ±0.171 (n=4)	4.35 ±0.15 (n=4)	4.08 ±0.125 (n=4)	4.13d ±0.180 (n=4)	4.38df ±0.132 (n=4)	4.63df ±0.085 (n=4)
CHLORIDE (mEq/L)						
Group I	99.08 ±0.953 (n=4)	87.00* ±1.861 (n=4)	75.25** ±4.469 (n=4)	71.78** ±2.918 (n=4)	68.38** ±2.363 (n=4)	65.90* ±1.4 (n=2)
Group II	102.70 ±1.914 (n=4)	87.60** ±0.964 (n=4)	75.10** ±3.712 (n=4)	92.48bd ±0.819 (n=4)	91.55bd ±0.839 (n=4)	94.40d ±2.65 (n=3)
Group III	104.40 ±0.406 (n=4)	85.28** ±3.023 (n=4)	75.00** ±3.584 (n=4)	94.13bd ±1.365 (n=4)	98.75bdf ±0.928 (n=4)	100.80bde ±0.408 (n=4)
CALCIUM (mg/dL)						
Group I	6.61 ±0.987 (n=4)	6.78 ±0.545 (n=4)	6.63 ±0.487 (n=4)	6.70 ±0.531 (n=4)	6.58 ±0.448 (n=4)	6.45 ±0.15 (n=2)
Group II	6.65 ±0.863 (n=4)	6.68 ±0.496 (n=4)	6.58 ±0.347 (n=4)	6.50 ±0.492 (n=4)	6.65 ±0.676 (n=4)	6.80 ±0.702 (n=3)
Group III	6.90 ±0.123 (n=4)	6.95 ±0.065 (n=4)	6.78 ±0.075 (n=4)	6.80 ±0.71 (n=4)	6.83 ±0.063 (n=4)	6.88 ±0.048 (n=4)

- Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

group II. However, significant ($P<0.05$) decrease in BUN concentration was noticed at 8th day as compared to 3rd post obstruction day in the animals of group III. The inter-group comparison inferred a constantly significant ($P<0.05$) rise in the concentration of BUN in the animals of group II when compared to group I. Whereas, animals of group III showed highly

TABLE 8: EFFECT OF SIMPLE JEJUNAL OBSTRUCTION ON PLASMA PHOSPHORUS IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF JEJUNAL OBSTRUCTION					
	0	2	3#	4	6	8
Group I	5.42 ±0.259 (n=4)	5.45 ±0.232 (n=4)	5.40 ±0.173 (n=4)	5.45 ±0.171 (n=4)	5.58 ±0.193 (n=4)	5.75 ±0.050 (n=2)
Group II	5.85 ±0.484 (n=4)	5.8 ±0.528 (n=4)	5.83 ±0.492 (n=4)	5.78 ±0.521 (n=4)	5.95 ±0.609 (n=4)	5.90 ±0.764 (n=3)
Group III	5.58 ±0.278 (n=4)	5.73 ±0.319 (n=4)	5.60 ±0.418 (n=4)	5.63 ±0.364 (n=4)	5.55 ±0.353 (n=4)	5.75 ±0.226 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

significant (P<0.01) recovery in BUN values after surgical correction when compared to animals of group I and II (Table 5).

The plasma creatinine concentration remained significantly (P<0.01) higher in the animals of group II throughout the post treatment period when compared to 3rd post obstruction day. On the contrary, after surgical treatment in the animals of group III the plasma creatinine concentration showed decreasing trend and this decrease was significant (P<0.05) at 8th day. The significant (P<0.05) increase in plasma creatinine concentration was gradual in group II in comparison to group I. Whereas, a significant (4th day: P<0.05 and 6th day: P<0.01) decrease in plasma creatinine concentration was recorded in group III when compared to corresponding values of other two groups (Table 5).

The plasma total bilirubin concentration remained significantly high (P<0.05: 4th day and P<0.01: 6th day) during entire treatment period when compared to 3rd post obstruction day. In the animals of group II reduction in plasma bilirubin concentration was significant (P<0.05) at 8th day in the animals of group III when compared to 3rd post obstruction day. The animals of group III showed significant (P<0.01) lowering of bilirubin concentration in comparison to group I at 6th and 8th day (Table 6).

The blood sodium concentration remained in normal range in the animals of group II and III in comparison to respective 3rd post obstruction day. A significant (P<0.01) increase in sodium concentration was recorded in the animals of group II and III when compared to group I in the post treatment period (Table 7). Similarly, a slow pace drop in the plasma potassium concentration was evident in the animals of group II when compared to 3rd post obstruction day. Whereas, in the period after surgery as compared to 3rd post obstruction day a gradual revival of plasma potassium concentration (6th day: P<0.05 and 8th day:

P<0.01) was observed in the animals of group III. A significant (P<0.01) increase in plasma potassium concentration towards normalization was noticed during the post treatment period in the animals of group III when compared to group I and II (Table 7). A significant (P<0.01) increase in plasma chloride concentration at 4th and 6th day persisted in the animals of group II when compared to its 3rd day value. Whereas, a significant (P<0.01) recuperation in plasma chloride concentration (Table 7) in the animals of group III occurred during entire post surgical period when compared to 3rd post obstruction day. The inter-group comparison revealed that decline in plasma chloride concentration was significant (P<0.01) in the untreated animals of group I in comparison to group II and III. Furthermore, the comparison of group II and III depicted that the recovery of chloride concentration was significant (P<0.01) in the animals of group III in comparison to group II at 6th day. Incoherent alterations in the values of plasma calcium and phosphorus following medical and surgical treatment were observed in the animals of group II and III (Table 7,42).

A significant to highly significant rise in plasma Alkaline phosphatase (ALKP) was recorded throughout the entire post treatment period in the animals of group II when compared to 3rd post obstruction day value. The ALKP remained higher (P<0.01) on the day after surgery when compared to 3rd post obstruction day and thereafter it decreased and was almost comparable to its base value in the terminal part of observations in the animals of group III. There was marked (P<0.01) improvement in ALKP concentration at 6th and 8th day in the animals of group III when compared to the corresponding intervals of group I and II (Table 9).

The plasma AST and ALT concentration was higher in the animals of group II at 6th (P<0.01) and 8th (P<0.05) days when compared to 3rd post obstruction day. Whereas a significant drop in AST concentration (8th day: P<0.01) and ALT (6th day: P<0.05 and 8th day: P<0.01) was noticed during post treatment period in the animals of group III when compared to respective 3rd post obstruction day values.

A significant (P<0.01) decline in AST and ALT values was seen at the 6th and 8th post treatment day in the animals of group III when compared to group I and II (Table 9).

An unrelenting increase (P<0.01) in plasma amylase concentration persisted continuously during post treatment period in the animals of group II as compared to 3rd post obstruction day. Following surgery the decrease in plasma amylase concentration started at 6th (P<0.05) day onward and was significant (P<0.01) at 8th day. Comparison within groups showed gradual increase (P<0.05: 6th day) in the amylase concentration of the animals of group II when compared to group I. The improvement in plasma amylase concentration following surgery in group III was significant (P<0.01) in comparison to group I and it was significant (P<0.05) in comparison to group II at 6th and 8th day respectively (Table 9).

TABLE 9: EFFECT OF SIMPLE JEJUNAL OBSTRUCTION ON PLASMA ALKP, AST, ALT AND AMYLASE IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF JEJUNAL OBSTRUCTION					
	0	2	3#	4	6	8
ALKALINE PHOSPHATASE (IU/L)						
Group I	99.75 ±2.955 (n=4)	103.00 ±2.739 (n=4)	110.50* ±2.901 (n=4)	125.75** ±1.750 (n=4)	141.00** ±1.291 (n=4)	150.50* ±1.5 (n=2)
Group II	88.25 ±6.811 (n=4)	100.75 ±3.301 (n=4)	113.00* ±4.203 (n=4)	126.00[a] ±4.243 (n=4)	133.75[b] ±4.049 (n=4)	147.30[a] ±2.667 (n=3)
Group III	98.75 ±4.09 (n=4)	107.50 ±2.958 (n=4)	114.25* ±4.404 (n=4)	130.00[b] ±2.483 (n=4)	116.75[d] ±1.887 (n=4)	106.75[df] ±2.562 (n=4)
AST (IU/L)						
Group I	81.0 ±8.81 (n=4)	92.5 ±5.852 (n=4)	104.3* ±8.33 (n=4)	121.5** ±8.38 (n=4)	151.0** ±4.44 (n=4)	189.0 N.I. ±3.0 (n=2)
Group II	85.0 ±2.517 (n=4)	97.5 ±1.708 (n=4)	104.8* ±3.902 (n=4)	119.5 ±2.754 (n=4)	148.0[b] ±6.48 (n=4)	166.7[a] ±9.615 (n=3)
Group III	80.5 ±1.323 (n=4)	92.3 ±3.705 (n=4)	102.5* ±5.752 (n=4)	117.0 ±3.512 (n=4)	87.0[df] ±3.536 (n=4)	57.5[bdf] ±2.96 (n=4)
ALT (IU/L)						
Group I	29.3 ±4.99 (n=4)	39.8 ±2.097 (n=4)	47.0* ±3.109 (n=4)	60.0** ±5.148 (n=4)	76.3** ±4.131 (n=4)	101.0* ±3.00 (n=2)
Group II	29.63 ±3.092 (n=4)	38.0 ±3.028 (n=4)	44.5* ±3.014 (n=4)	55.5 ±2.630 (n=4)	69.5[b] ±2.217 (n=4)	82.0[a] ±5.292 (n=3)
Group III	28.5 ±0.956 (n=4)	35.8 ±2.78 (n=4)	43.0* ±4.021 (n=4)	31.8[df] ±2.25 (n=4)	27.5[adf] ±1.555 (n=4)	24.5[bdf] ±1.555 (n=4)
AMYLASE (IU/L)						
Group I	19.00 ±2.858 (n=4)	24.50 ±2.986 (n=4)	29.25* ±3.224 (n=4)	31.50** ±3.227 (n=4)	40.25** ±1.75 (n=4)	48.50* ±4.500 (n=2)
Group II	18.25 ±1.887 (n=4)	22.25 ±0.479 (n=4)	26.26** ±2.097 (n=4)	28.50[b] ±2.179 (n=4)	32.25[bc] ±2.097 (n=4)	35.33[a] ±3.712 (n=3)
Group III	18.50 ±1.555 (n=4)	23.75 ±1.436 (n=4)	29.00** ±1.225 (n=4)	30.50 ±1.893 (n=4)	25.75[ade] ±1.315 (n=4)	22.00[bde] ±1.08 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

IV. CHANGES IN PERITONEAL FLUID

PRE TREATMENT

The peritoneal fluid in the animals of group I was straw colour before creation of simple jejunal obstruction. It remained same upto 2nd post obstruction day but later at 3rd and 4th day, slight increase in the yellowish tinge was seen which discoloured to deep yellow from 6th day onward (Plate 5). A slight decrease in the pH was observed on narrow range pH paper in the animals of group III, however, there were no alterations in peritoneal fluid pH in the animals of group I and II (Table 10).

A significant ($P<0.01$) increase in the peritoneal fluid total protein and cell count was recorded throughout the period of study when compared to base values in the animals of group I. The significant ($P<0.01$) rise in proteinaceous (3rd day) and cellular components (2nd and 3rd day) was noticed in all the animals of three groups following creation of simple jejunal obstruction when compared to their base values (Table 10).

A significant decrease in peritoneal fluid sodium concentration was recorded at 3rd day in the animals of group I ($P<0.05$) and III ($P<0.01$) when compared to their '0' hour concentrations respectively. However, this decline in sodium concentration was significant ($P<0.01$) throughout the period of obstruction in the animals of group I (Table 11).

The potassium concentration in peritoneal fluid decreased significantly at 3rd day following creation of jejunal obstruction in the animals of group I, II ($P<0.05$) and III ($P<0.01$) as compared to respective base values (Table 11). This decline in peritoneal fluid potassium concentration was consistently significant ($P<0.01$) during the whole period of observation in the animals of group I.

The changes in peritoneal fluid chloride concentration as compared to base value were significantly low ($P<0.01$) at 3rd post obstruction day and continued till death supervened in the animals of group I. A significant ($P<0.05$) decrease in peritoneal fluid chloride concentration at 3rd post obstruction day was also observed in group III when compared to base value (Table 11). The changes in the concentration of calcium and phosphorus in the peritoneal fluid were inconclusive following creation of jejunal obstruction in all the animals of three groups (Table 11, 46).

POST TREATMENT

The discolouration in peritoneal fluid showed gradual improvement towards normalcy after institution of the surgical treatment and was near normal at 8th day in the animals of group III. No changes were recorded in peritoneal fluid pH in group II animals (Table 10).

The total protein concentration of peritoneal fluid remained elevated ($P<0.01$) in the animals of group II as compared to 3rd post obstruction day. However, decrease in total protein was noticed at 6th ($P<0.05$) and 8th ($P<0.01$) day when compared to 3rd post obstruction day in the animals of group III.

PLATE 5: PERITONEAL FLUID CHANGES AFTER CREATION OF SIMPLE JEJUNAL OBSTRUCTION IN CALVES

		
"0" Day (Base Value)	**2nd day post creation**	**3rd day post creation**
		
4th day post creation	**6th day post creation**	**8th day post creation**

TABLE 10: EFFECT OF SIMPLE JEJUNAL OBSTRUCTION ON PERITONEAL FLUID pH, TOTAL PROTEINS AND NUCLEATED CELL COUNT IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF JEJUNAL OBSTRUCTION					
	0	2	3#	4	6	8
PERITONEAL FLUID pH						
Group I	7.18 ±0.284 (n=4)	7.25 ±0.25 (n=4)	7.00 ±0.123 (n=4)	6.83 ±0.214 (n=4)	6.75 ±0.206 (n=4)	6.75 ±0.206 (n=2)
Group II	7.36 ±0.239 (n=4)	7.30 ±0.286 (n=4)	7.13 ±0.175 (n=4)	7.05 ±0.206 (n=4)	6.98 ±0.188 (n=4)	6.73 ±0.145 (n=3)
Group III	7.10 ±0.308 (n=4)	6.90 ±0.2 (n=4)	6.70 ±0.123 (n=4)	7.03 ±0.347 (n=4)	7.10 ±0.308 (n=4)	7.17 ±0.284 (n=4)
TOTAL PERITONEAL FLUID PROTIENS (mg/dL)						
Group I	2.55 ±0.1258 (n=4)	3.18 ±0.278 (n=4)	4.15** ±0.096 (n=4)	4.53** ±0.125 (n=4)	5.40** ±0.178 (n=4)	6.00 N.I. ±0.30 (n=2)
Group II	2.70 ±0.216 (n=4)	3.15 ±0.287 (n=4)	3.50** ±0.248 (n=4)	3.80c ±0.187 (n=4)	4.23bd ±0.193 (n=4)	4.46ac ±0.203 (n=3)
Group III	2.38 ±0.263 (n=4)	2.75 ±0.185 (n=4)	3.75** ±0.272 (n=4)	3.78d ±0.144 (n=4)	3.38ade ±0.149 (n=4)	2.93bdf ±0.170 (n=4)
NUCLEATED CELL COUNT (x 10^3/cu mm)						
Group I	3.01 ±0.080 (n=4)	4.41** ±0.281 (n=4)	5.44** ±0.116 (n=4)	5.93** ±0.119 (n=4)	6.63** ±0.116 (n=4)	7.35* ±0.10 (n=2)
Group II	3.19 ±0.103 (n=4)	4.84** ±0.229 (n=4)	5.43** ±0.601 (n=4)	6.10b ±0.552 (n=4)	6.46b ±0.481 (n=4)	6.88a ±0.627 (n=3)
Group III	3.24 ±0.186 (n=4)	4.55** ±0.203 (n=4)	5.43** ±0.573 (n=4)	6.18b ±0.318 (n=4)	6.83b ±0.215 (n=4)	7.13b ±0.171 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

The comparison of group I and II revealed a significantly slower (P<0.01) increase of peritoneal fluid total protein in the animals of group II. On the contrary, a significant decrease was observed in group III when compared to group I and II at 6th (P<0.05) and 8th (P<0.01) day (Table 10). A significant increase in peritoneal fluid cell count was recorded (4th, 6th day: P<0.01 and 8th day: P<0.05) in the animals of group II when compared to 3rd post obstruction day. Similarly, a statistically significant (P<0.01) increase in the cell count was present throughout the post treatment period in the animals of group III as compared to 3rd post obstruction day (Table 10).

TABLE 11: EFFECT OF SIMPLE JEJUNAL OBSTRUCTION ON PERITONEAL FLUID SODIUM, POTASSIUM, CHLORIDE AND CALCIUM IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF JEJUNAL OBSTRUCTION					
	0	2	3#	4	6	8
SODIUM (mEq/L)						
Group I	142.5 ±0.96 (n=4)	140.0 ±0.816 (n=4)	137.5* ±0.957 (n=4)	136.0** ±0.82 (n=4)	132.0** ±0.82 (n=4)	131.0 N.I. ±1.0 (n=2)
Group II	143.0 ±0.577 (n=4)	142.0 ±0.817 (n=4)	142.5 ±0.5 (n=4)	142.0c ±1.83 (n=4)	143.5d ±1.71 (n=4)	141.3d ±0.67 (n=3)
Group III	145.5 ±1.5 (n=4)	143.0 ±1.0 (n=4)	141.0** ±1.0 (n=4)	141.5c ±1.71 (n=4)	141.5d ±1.26 (n=4)	143.0d ±1.29 (n=4)
POTASSIUM (mEq/L)						
Group I	4.80 ±0.294 (n=4)	4.23 ±0.085 (n=4)	3.73* ±0.232 (n=4)	3.45** ±0.175 (n=4)	2.97** ±0.137 (n=4)	2.40* ±0.20 (n=2)
Group II	5.00 ±0.548 (n=4)	4.35 ±0.287 (n=4)	4.05* ±0.388 (n=4)	3.85 ±0.366 (n=4)	3.53b ±0.312 (n=4)	3.26a ±0.409 (n=3)
Group III	4.83 ±0.132 (n=4)	4.25 ±0.155 (n=4)	3.75** ±0.065 (n=4)	4.20ac ±0.187 (n=4)	4.63bde ±0.193 (n=4)	4.65bde ±0.096 (n=4)
CHLORIDE (mEq/L)						
Group I	98.95 ±2.693 (n=4)	91.18 ±2.307 (n=4)	82.70** ±2.53 (n=4)	77.92** ±3.113 (n=4)	71.42** ±1.392 (n=4)	65.65* ±1.850 (n=2)
Group II	98.50 ±3.096 (n=4)	95.03 ±2.29 (n=4)	94.75 ±1.556 (n=4)	96.40d ±0.40 (n=4)	98.18d ±1.312 (n=4)	96.13d ±0.884 (n=3)
Group III	101.95 ±1.012 (n=4)	96.68 ±2.152 (n=4)	94.13* ±0.214 (n=4)	94.38d ±0.853 (n=4)	99.05bd ±1.093 (n=4)	101.53bde ±1.229 (n=4)
CALCIUM (mg/dL)						
Group I	6.05 ±0.444 (n=4)	5.98 ±0.2872 (n=4)	6.03 ±0.193 (n=4)	5.90 ±0.294 (n=4)	6.05 ±0.311 (n=4)	6.05 ±0.071 (n=2)
Group II	5.30 ±0.374 (n=4)	5.33 ±0.386 (n=4)	5.35 ±0.328 (n=4)	5.03 ±0.492 (n=4)	5.05 ±0.448 (n=4)	5.33 ±0.203 (n=3)
Group III	5.45 ±0.499 (n=4)	5.45 ±0.357 (n=4)	5.53 ±0.397 (n=4)	5.43 ±0.371 (n=4)	5.40 ±0.576 (n=4)	5.28 ±0.449 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

TABLE 12: EFFECT OF SIMPLE JEJUNAL OBSTRUCTION ON PERITONEAL FLUID PHOSPHORUS IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF JEJUNAL OBSTRUCTION					
	0	2	3#	4	6	8
Group I	4.52 ±0.356 (n=4)	4.33 ±0.259 (n=4)	4.43 ±0.357 (n=4)	4.37 ±0.419 (n=4)	4.60 ±0.324 (n=4)	4.95 ±0.150 (n=2)
Group II	4.40 ±0.455 (n=4)	4.35 ±0.494 (n=4)	4.50 ±0.532 (n=4)	4.45 ±0.413 (n=4)	4.40 ±0.392 (n=4)	4.60 ±0.231 (n=3)
Group III	4.13 ±0.132 (n=4)	4.10 ±0.204 (n=4)	4.20 ±0.283 (n=4)	4.00 ±0.324 (n=4)	4.15 ±0.321 (n=4)	4.03 ±0.229 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

There was no significant change in the peritoneal fluid sodium concentration in the animals of group II and III respectively. The inter-group comparison revealed that the conservative (group II) and surgical (group III) therapy offsets ($P<0.01$) the sodium deficit which was quite evident in group I (Table 11). There was a continuous fall (6^{th} day: $P<0.01$ and 8^{th} day: $P<0.05$) in the peritoneal fluid potassium concentration in the animals of group II. The potassium concentration increased significantly ($P<0.05$) immediately a day after the operation and significant ($P<0.01$) increase was recorded in its concentration at 6^{th} and 8^{th} days in the animals of group III when compared to 3^{rd} post obstruction day. The animals of group III showed significant ($P<0.05$) recovery of potassium at 4^{th} day and it was significantly higher ($P<0.01$) at 6^{th} and 8^{th} day in comparison to group I. The potassium concentration remained significantly ($P<0.05$) low at 6^{th} and 8^{th} day in the animals of group II when compared to group III (Table 11). The chloride concentration in peritoneal fluid remained statistically unaffected in the animals of group II when compared to 3^{rd} post obstruction day. The chloride concentration in peritoneal fluid was elevated significantly ($P<0.01$) at 6^{th} and 8^{th} day in the animals of group III as compared to 3^{rd} post obstruction day.

There was a significant ($P<0.01$) loss of peritoneal fluid chloride in group I as compared to group II and III. Furthermore, a significant recuperation of chloride in peritoneal fluid occurred on 8^{th} day in the animals of group III when compared to group II (Table 11). No alterations in peritoneal fluid calcium and phosphorus were seen at different time intervals in the animals of group II and III (Table 11, 46).

V. ALTERATIONS IN RUMINAL FLUID BIOCHEMISTRY

PRE TREATMENT

A decreasing trend in the ruminal fluid sodium and potassium concentration was seen from 2^{nd} day onward following creation of simple jejunal obstruction. In comparison to

their respective base values its drop was highly significant at 3rd post obstruction day in the animals of all the three groups. A significant (P<0.01) decrease in ruminal fluid sodium and potassium concentration was observed throughout the period of obstruction in the animals of group I as compared to their base values (Table 13). Contrarily, the ruminal fluid chloride concentration rose significantly (P<0.01) in all the groups on 3rd day following simple jejunal obstruction when compared to base value. A significant (P<0.01) progressive rise in ruminal fluid chloride concentration persisted throughout period of study in the animals of animals of group I (Table 13).

Inconsistent changes were encountered in ruminal fluid calcium concentration following creation of jejunal obstruction in all the animals of three groups (Table 13). The rumen fluid phosphorus concentration increased significantly (P<0.05) in the animals of group II and III and it was significantly higher (P<0.01) in group I at 2nd post obstruction day which later on increased significantly (P<0.01) in all the groups at 3rd day. A progressive and significant (P<0.01) increase in ruminal fluid phosphorus continued throughout the entire period of study in all the animals of group I when compared to base value (Table 14).

POST TREATMENT

A progressively significant (P<0.01) decline in ruminal fluid sodium concentration persisted at 6th and 8th day in group II in comparison to 3rd post obstruction day. However, the animals of group III did not show such change but maintained constancy in ruminal fluid sodium concentration during the entire post operative period. The inter-group comparison revealed a significant recovery of sodium on 8th day in the animals of group III in comparison to group I (Table 13). Whereas, at 6th (P<0.05) and 8th (P<0.01) day sodium concentration increased significantly in the animals of group III as compared to group II.

The deficit in ruminal fluid potassium concentration as compared to 3rd post obstruction day was significantly (P<0.01, 6th day and P<0.05, 8th day) apparent in the animals of group II. However, the potassium concentration in ruminal fluid of group III significantly (P<0.01) recuperated to near normal at 8th post treatment day. The comparison of group III with group I and II revealed a significant (P<0.01) recovery in ruminal potassium concentration after surgical treatment (Table 13).

The ruminal fluid chloride concentration remained significantly high (P<0.01: 6th day and P<0.05: 8th day) in post treatment period when compared to 3rd post obstruction day in the animals of group II. Whereas, a highly significant decrease as compared to 3rd post obstruction day's value was noticed during post surgery period in the animals of group III. The inter-group comparison revealed significant (P<0.01) normalization of ruminal fluid chloride concentration in the animals of group III as compared to group I and II (Table 13).

No changes in ruminal fluid calcium were noticed during post treatment period in the animals of group II and III (Table 13). A significant (P<0.05: 4th day and P<0.01: 6th day) rise in ruminal fluid phosphorus concentration was recorded in the animals of group II but a

TABLE 13: EFFECT OF SIMPLE JEJUNAL OBSTRUCTION ON RUMINAL FLUID SODIUM, POTASSIUM, CHLORIDE AND CALCIUM IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF JEJUNAL OBSTRUCTION					
	0	2	3#	4	6	8
SODIUM (mEq/L)						
Group I	112.0 ±5.66 (n=4)	104.5 ±5.058 (n=4)	94.0** ±2.160 (n=4)	91.5** ±2.22 (n=4)	82.0** ±0.82 (n=4)	76.0 N.I. ±2.00 (n=2)
Group II	98.5 ±4.03 (n=4)	92.0 ±1.155 (n=4)	86.0** ±2.582 (n=4)	85.0c ±1.29 (n=4)	76.0bd ±0.83 (n=4)	64.0ac ±1.155 (n=3)
Group III	102.5 ±1.708 (n=4)	96.5 ±1.5 (n=4)	85.5** ±4.717 (n=4)	86.5 ±6.70 (n=4)	88.0e ±4.76 (n=4)	94.0cf ±4.08 (n=4)
POTASSIUM (mEq/L)						
Group I	27.97 ±2.042 (n=4)	23.90 ±0.545 (n=4)	20.50** ±1.443 (n=4)	19.57** ±1.722 (n=4)	15.75** ±1.109 (n=4)	14.5 N.I. ±0.500 (n=2)
Group II	29.55 ±1.926 (n=4)	25.38 ±1.346 (n=4)	21.38** ±1.609 (n=4)	21.38 ±1.61 (n=4)	18.10b ±1.56 (n=4)	14.77a ±1.748 (n=3)
Group III	27.75 ±1.548 (n=4)	23.43 ±1.105 (n=4)	17.75** ±1.031 (n=4)	20.75a ±1.493 (n=4)	24.00bde ±1.472 (n=4)	26.25bdf ±1.493 (n=4)
CHLORIDE (mEq/L)						
Group I	37.17 ±1.756 (n=4)	45.05 ±3.025 (n=4)	55.08** ±2.116 (n=4)	64.27** ±2.823 (n=4)	86.23** ±5.062 (n=4)	99.15* ±0.350 (n=2)
Group II	31.30 ±1.714 (n=4)	40.35 ±2.739 (n=4)	52.10** ±1.663 (n=4)	60.53 ±2.555 (n=4)	72.98b ±5.68 (n=4)	82.90a ±5.351 (n=3)
Group III	27.88 ±2.631 (n=4)	37.40 ±3.219 (n=4)	53.30** ±2.627 (n=4)	34.15bdf ±3.973 (n=4)	30.70bdf ±2.980 (n=4)	28.95bdf ±3.013 (n=4)
CALCIUM (mg/dL)						
Group I	8.80 ±0.572 (n=4)	8.70 ±0.420 (n=4)	8.93 ±0.263 (n=4)	8.38 ±0.175 (n=4)	8.63 ±0.328 (n=4)	9.15 ±0.45 (n=2)
Group II	8.30 ±0.168 (n=4)	8.28 ±0.214 (n=4)	8.35 ±0.524 (n=4)	8.25 ±0.296 (n=4)	8.33 ±0.319 (n=4)	8.03 ±0.219 (n=3)
Group III	8.95 ±0.263 (n=4)	8.95 ±0.226 (n=4)	8.90 ±0.204 (n=4)	9.10 ±0.379 (n=4)	9.03 ±0.218 (n=4)	9.05 ±0.296 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

significant (P<0.01) fall in ruminal fluid phosphorus concentration was observed in group III when compared to their respective 3rd post obstruction day values.

TABLE 14: EFFECT OF SIMPLE JEJUNAL OBSTRUCTION ON RUMINAL FLUID PHOSPHORUS IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF JEJUNAL OBSTRUCTION					
	0	2	3#	4	6	8
	PHOSPHORUS (mg/dL)					
Group I	12.80 ±0.628 (n=4)	27.2** ±1.655 (n=4)	36.70** ±2.286 (n=4)	44.15** ±1.825 (n=4)	58.10** ±2.964 (n=4)	73.00* ±0.60 (n=2)
Group II	9.80 ±1.582 (n=4)	26.85* ±4.918 (n=4)	33.75** ±5.555 (n=4)	39.80[a] ±5.283 (n=4)	53.48[b] ±4.794 (n=4)	68.73[a] ±3.083 (n=3)
Group III	9.83 ±1.59 (n=4)	23.96* ±5.042 (n=4)	32.58** ±4.693 (n=4)	22.30[bde] ±4.049 (n=4)	16.28[bdf] ±2.744 (n=4)	12.30[bdf] ±0.892 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

In comparison to group I and II, the normalization in ruminal fluid phosphorus concentration was significant (P<0.01) in the animals of group III (Table 14).

VI. OPERATIVE FINDINGS

The site of obstructed loop was discolored and appeared grayish in colour with irreversible stricture. The segment of intestine proximal to the site of obstruction was greatly distended and showed bluish discolouration with no peristalsis upto considerable length. The distal segment was collapsed and the mesentery was hemorrhagic with adhesive reaction.

VII. TOTAL SURVIVAL TIME

The animals of group I served as diseased control succumbed at different time interval following creation of simple jejunal obstruction. Three animals of group I survived upto 8 days. The average survival time in the animals of group I was 7.99±0.793 days. The average survival time in the animals of group II with conservative treatment was 9.29±0.49 days. All the animals of group III survived following surgical treatment.

C(2). CLINICO-HAEMATO-BIOCHEMICAL ALTERATIONS AND THERAPEUTIC (CONSERVATIVE AND SURGICAL) ASPECTS IN STRANGULATED PROXIMAL JEJUNAL OBSTRUCTION

I. CLINICAL OBSERVATIONS

PRE TREATMENT

All the animals exhibited clinical signs of acute pain within half to two hours of creation of strangulated jejunal obstruction which were manifested by kicking at the abdomen, restlessness, lying down and getting up frequently, vocalization, bruxism, straining to urinate and defecate, lying their head and neck flat against the ground or down across their back. These signs persisted upto 4-5 hours and the intensity of pain was severe during initial 2-3 hours of obstruction.

The majority of animals in all the three groups defecated immediately after creation of strangulated obstruction but as the time passed, defecation became scanty. After 24 hours, the water content of faeces decreased and assumed the shape of balls in all the animals of three groups. Initially, the animals of group I made unsuccessful attempts to defecate and there was complete cessation of defecation after 24 hours and only the mucous with foul odour was voided (Plate 6). The frequency of passing the mucous was 2-3 times a day till 48 hours in group I. Later on the nature of faeces became crupous with diphtheritic shreds (Plate 5) and remained so till the death of animals. Urination was normal in all the animals of group I, II and III but was reduced at terminal stages in group I.

Calves of group I and II resumed almost normal feed and water intake at 12 post obstruction hours but appetite was reduced after 24 – 36 hours in the animals of group I. Water intake was normal in the animals of group I, II and III upto 24 hours and thereafter in the animals of group I the water intake reduced progressively.

Signs of muscular weakness were constantly observed in all the animals of three groups which were manifested initially by reluctance to move at 12 hours, instability of hind limbs whenever animals tried to shift the position at 24 hours. Eventually the animals exhibited difficulty while assuming the sternal recumbency and even greater difficulty when tried to rise at 72 hours. As the time period of obstruction progressed the animals of group I and II became recumbent and were unable to rise even with assistance at 96 hours.

The rumen was usually hypotonic in the animals of group I and II on 24 hours and virtually no contraction could be detected on and after 48 hours. In all the animals rumination ceased completely at 24 hours following the jejunal obstruction. On auscultation intestinal borborygmi revealed tinkling and clicking sounds from the abdomen which were evident upto 48 hours in the animals of group I and later on quiescence in abdomen was appreciated. Abdominal distention was not very much appreciable during initial period of obstruction in all the groups however, in group I progressive bilateral distention was observed after 48 hours and it became prominent at 72 and 96 post obstruction hours.

Rectal temperature showed a significant ($P<0.05$) decrease at 24 hours and this decline was significantly ($P<0.01$) higher at 48 hours when compared to base values in the animals of group I (Table 15). The respiration rate (Table 15) in the animals of group I increased significantly ($P<0.05$) at 24 hours and then this increase was significantly ($P<0.01$) higher at 48 hours in comparison to base values. There was a significant ($P<0.01$) increase in heart and pulse rate at 24 post obstruction hours in animals of group I, II and III when compared to base values. The heart and pulse rate remained significantly ($P<0.01$: 48 hours and $P<0.05$: 72 hours) elevated upto 72 post obstruction hours in the animals of group I (Table 15).

The generalized listlessness and depression following creation of obstruction was seen in all the animals of group I and II accompanied by cold extremities and sunken eye balls.

These symptoms were more pronounced in group I and their severity increased with the passage of time. The gradual worsening in attentiveness was observed in animals of group I as the time of death approached. All the animals in three groups manifested the signs of dehydration i.e. the moderate recession of eye ball by 48 hours which was marked at the end of the period of obstruction especially in the animals of group I. The elasticity of skin decreased from 24 hours (3-4 seconds) and became inelastic after 48 (10-12 seconds) hours onward. Usually after 24 hours the muzzle was mildly wet and became dry from 48 hours onward. A significant increase in capillary refill time (CRT) was observed at 24 ($P<0.05$) and 48 ($P<0.01$) post obstruction hours in the animals of group I. Its value was highest (3 seconds) at the end of the period of obstruction. In the animals of group III, the CRT was significant ($P<0.05$) at 24 post obstruction hours (Table 16).

Ruminal fluid pH decreased significantly ($P<0.05$) in the animals of group I and II and this decline in the ruminal fluid pH remained significant ($P<0.05$) in the entire post obstruction period in the animals of group I (Table 16). The large ruminal protozoa suffered moderate (++) loss at 24 hours in the animals of all the three groups. The protozoal motility in animals of group I was sluggish (+) comprising of only the smaller protozoa at 48 hours with complete (-) loss at 96 hours.

POST TREATMENT

The animals of group II made attempts to defecate at almost all the intervals. Animals passed dehydrated dung balls with small amount of mucous at 24 hours and the faeces were malodourous, majorly mixed with the mucous at 48 hours, later at 72 and 96 hours only thick mucous was voided which often clogged the anus. The animals of group III passed dung balls after 5-6 hours of treatment. The consistency of the faeces was semisolid with fair amount of moisture and was almost well formed at 72 and 96 hours of treatment, but slight mucous was persistently present. Normal consistency of faeces without foul odour was regained at 96 hours post treatment in the animals of group III. The frequency and quantity of urination was normal in the animals of group II and III during the entire post treatment period.

The animals of group II had normal appetite upto 24 hours and thereafter it reduced, but intermittent intake of fodder was observed even upto the end of post treatment period. All the animals of group III resumed normal feed intake at 72 post obstruction hours. Water intake was normal in the animals of group II upto 24 hours but later it reduced to almost nil as the duration of obstruction increased, whereas in the animals of group III, water intake was almost normal after 24 hours of treatment.

Signs of muscular weakness were observed during the post treatment period in the animals of group II which were evident by frequent assumption of recumbency after 48 hours of creation of strangulated jejunal obstruction. The animals assumed prolonged sternal recumbency with inability to stand at 72 hours, eventually lead to digging of head into the flank. Whereas, the animals of group III were able to get up and walk without assistance.

TABLE 15: EFFECT OF STRANGULATED JEJUNAL OBSTRUCTION ON RECTAL TEMPERATURE, RESPIRATION RATE, HEART RATE AND PULSE RATE IN CALVES (MEAN±S.E).

GROUPS	HOURS AFTER CREATION OF JEJUNAL OBSTRUCTION				
	0	24#	48	72	96
RECTAL TEMPERATURE (ºF)					
Group I	102.15 ±0.25 (n=4)	101.60* ±0.316 (n=4)	100.60** ±0.337 (n=4)	100.20 ±0.8 (n=2)	98.60$^{N.I.}$ ±0.0 (n=1)
Group II	102.10 ±0.129 (n=4)	101.50 ±0.369 (n=4)	100.50 ±0.387 (n=4)	99.40^{a} ±0.116 (n=3)	99.00$^{N.I.}$ ±0.2 (n=2)
Group III	101.75 ±0.479 (n=4)	102.25 ±0.096 (n=4)	102.15^{df} ±0.126 (n=4)	102.05^{df} ±0.263 (n=4)	102.00^{f} ±0.245 (n=4)
RESPIRATION RATE (/min)					
Group I	12.25 ±0.75 (n=4)	14.00* ±0.71 (n=4)	16.25** ±0.629 (n=4)	17.50 ±1.5 (n=2)	18.00$^{N.I.}$ ±0.0 (n=1)
Group II	13.00 ±0.58 (n=4)	14.50 ±0.96 (n=4)	15.50 ±0.96 (n=4)	16.67 ±1.764 (n=3)	18.00$^{N.I.}$ ±2.00 (n=2)
Group III	14.50 ±0.96 (n=4)	15.00 ±1.29 (n=4)	14.50 ±0.5 (n=4)	15.00 ±1.0 (n=4)	15.00 ±0.58 (n=4)
HEART RATE (/min)					
Group I	69.5 ±0.957 (n=4)	89.5** ±2.5 (n=4)	85.5** ±0.957 (n=4)	90.0* ±3.0 (n=2)	80.0$^{N.I.}$ ±0.0 (n=1)
Group II	65.5 ±0.957 (n=4)	87.5** ±1.708 (n=4)	86.0 ±1.414 (n=4)	80.6 ±6.566 (n=3)	86.0 ±6.0 (n=2)
Group III	69.5 ±2.5 (n=4)	84.5** ±2.363 (n=4)	71.5^{bdf} ±3.304 (n=4)	71.0^{bd} ±2.38 (n=4)	71.5^{be} ±2.217 (n=4)
PULSE RATE (/min)					
Group I	68.5 ±0.5 (n=4)	87.5** ±4.193 (n=4)	83.5** ±2.63 (n=4)	86.5* ±6.50 (n=2)	78.0$^{N.I.}$ ±0.0 (n=1)
Group II	62.5 ±0.957 (n=4)	85.5** ±0.957 (n=4)	85.5 ±1.5 (n=4)	80.0 ±6.11 (n=3)	84.0 ±4.0 (n=2)
Group III	69.0 ±2.517 (n=4)	83.0** ±2.082 (n=4)	70.5^{bcf} ±2.986 (n=4)	70.5^{bc} ±2.5 (n=4)	70.5^{be} ±1.258 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 hour value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 24 hour value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding hour.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding hour.
N.I. - Value not included for statistical analysis within group.

TABLE 16: EFFECT OF STRANGULATED JEJUNAL OBSTRUCTION ON CAPILLARY REFILL TIME AND RUMINAL FLUID pH IN CALVES (MEAN±S.E).

GROUPS	HOURS AFTER CREATION OF JEJUNAL OBSTRUCTION				
	0	24#	48	72	96
CAPILLARY REFILL TIME (sec)					
Group I	0.63 ±0.125 (n=4)	1.25* ±0.144 (n=4)	1.63** ±0.125 (n=4)	2.25 ±0.25 (n=2)	3.00 N.I. ±0.0 (n=1)
Group II	0.63 ±0.125 (n=4)	0.75 ±0.144 (n=4)	0.75d ±0.144 (n=4)	0.67d ±0.167 (n=3)	0.50 ±0.0 (n=2)
Group III	0.50 ±0.0 (n=4)	0.88* ±0.125 (n=4)	0.75d ±0.144 (n=4)	0.50 ±0.0 (n=4)	0.50 ±0.0 (n=4)
RUMINAL FLUID pH					
Group I	7.20 ±0.123 (n=4)	6.93 ±0.075 (n=4)	6.78* ±0.075 (n=4)	6.55** ±0.15 (n=2)	6.40N.I. ±0.0 (n=1)
Group II	7.20 ±0.123 (n=4)	7.00* ±0.123 (n=4)	6.93 ±0.144 (n=4)	6.80 ±0.10 (n=3)	6.55 ±0.15 (n=2)
Group III	6.70 ±0.123 (n=4)	6.48 ±0.075 (n=4)	6.70 ±0.123 (n=4)	6.78 ±0.75 (n=4)	6.85 ±0.15 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 hour value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 24 hour value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding hour.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding hour.
N.I. - Value not included for statistical analysis within group.

Rumen motility decreased at 24 hours (½ per 3 min) onward in group II and rumen became atonic at 72 hours onward till the end of the study whereas in group III the tonicity of rumen increased slightly after 48 hours (1 per 3 min) but the rumen remained hypotonic till 96 hours (1 per 3 min). On auscultation intestinal borborygmi comprising of rumbling noise of fluids were present in the animals of group II upto 72 hours, whereas in the animals of group III unique sounds of peristaltic rushes were heard at 24 hours onward. Marked bilateral distention of the abdomen was observed after 48 hours in the animals of group II, whereas the abdominal distention observed prior to treatment in the animals of group III subsided within 24 hours after the treatment.

There was significant ($P<0.05$: 72 hours) decrease in the rectal temperature in the animals of group II when compared to 24 hours, whereas the rectal temperature remained almost normal throughout the post treatment period in the animals of group III. On inter-group comparison the decline in rectal temperature in the animals of group I was significant ($P<0.01$) at 48 and 72 hours when compared to group III. Likewise, a significant ($P<0.01$) decrease in rectal temperature was evident during entire post treatment period in the animals of group II in comparison to group III (Table 15). An increasing trend in the respiration rate was observed in group II but respiratory movements became progressively

shallow with occasional groaning as the period of illness increased, whereas in the animals of group III after the surgical treatment the respiratory rate remained unchanged (Table 16). An increasing trend in heart rate was seen in the animals of group II upto 96 hours whereas a significant ($P<0.01$) decrease with a tendency of restitution towards normalcy was seen in the entire post treatment period. The inter-group comparison between group I and group III indicated significant ($P<0.01$) decrease, which almost came to normal at 96 hours in group III (Table 16). Similar trend in pulse rate was observed in the animal of group II and III. A stronger pulse was appreciated in group III after the treatment was ensued (Table 16).

The animals of group II were active upto 48 hours and thereafter they became dull and depressed. The animals of group III remained active and attentive throughout the post treatment period. Hydration status in all the animals of group II and III was normal as evident by normal skin tenting time and condition of eye ball but dryness of muzzle was seen at 48 hours of obstruction which remained as such till the terminal part of study in the animals of group II. Only one animal of group II showed some signs of dehydration with increased skin tenting time and retraction of globe in the orbital cavity at 72 post obstruction hours. Conjunctival mucous membrane remained pink throughout the period of study. Capillary refill time (CRT) remained unchanged both in the animals of group II and III in comparison to base values. The inter-group comparison between group I, II and III indicated that there was significant ($P<0.01$) decrease in the CRT during post treatment period in the animals of group II and III when compared with group I at 48 and 72 hours (Table 16).

The pH of ruminal fluid in the animals of group II and III did not show any significant changes (Table 16). Ruminal microflora showed moderate (++) motility at 24 hours interval and there was sluggish (+) motility upto 72 hours with complete loss at 96 hours in group II, whereas in group III there was mild loss of ruminal microflora at 48 hours but its livability increased at 72 hours onward.

II. HAEMATOLOGICAL OBSERVATIONS

PRE-TREATMENT

A significant ($P<0.01$) increase in the hemoglobin concentration was recorded at 24 post obstruction hours when compared to base values in the animals of all the three groups. Whereas, in the animals of group I a statistically significant ($P<0.01$: 48 hours and $P<0.05$: 72 hours) increase was observed in haemoglobin concentration when compared to its base value (Table 17). There was significant ($P<0.01$) increase in packed cell volume at 24 post obstruction hours in the animals of all the three groups when compared to respective base values. The significant elevation (48 hours: $P<0.01$ and 72 hours: $P<0.05$) in the PCV continued through out the period of study in the animals of group I (Table 17). The total erythrocytic count showed significant ($P<0.01$) increase at 24 post obstruction hours in comparison to base values, in the animals of group I and II. A progressive increase in total erythrocytic count was noticed in the animals of group I throughout the period of observation (Table 17).

A significant (P<0.01) increase in total leukocyte count (TLC) was recorded at 24 hours in all the animals of group I, II and III in comparison to base values. A statistically significant (P<0.05) increase in TLC continued through out the period of study in the animals of group I (Table 18). A significant (P<0.01) increase in neutrophils was observed in the animals of group I and II at 24 post obstruction hours when compared to base values, whereas this increase in neutrophils continued through out the period of study in group I (Table 18). There was significant (P<0.01) decrease in lymphocytes at 24 hours period both in the animals of group I and II when compared to base values. The pace of decrease in lymphocytes of group I was significant through out the period of observation (Table 18).

POST TREATMENT

There was statistically significant (P<0.01) increase in haemoglobin in the animals of group II at 72 hours when compared to 24 hours value, where as in group III, significant (P<0.01: 72 hours onward) reduction was observed following surgery which at 96 hours approached near normal base value. The inter-group comparison revealed a significant (P<0.05) decrease in haemoglobin at 72 hours in the animals of group III when compared to the corresponding value of group I (Table 17).The packed cell volume increased significantly (P<0.05) at 72 hours onward in comparison to 24 hours value in the animals of group II, whereas in group III animals at 24 hours onward the decrease in packed cell volume was significant (P<0.01) and it persisted upto 96 hours. The inter-group comparison revealed significant (P<0.01) decrease in PCV in the animals of group III from 48 to 72 hours as compared to group I, similarly the comparison between group II and III revealed significant (P<0.01) decrease in packed cell volume in the animals of group III after the treatment (Table 17). An increasing trend in total erythrocytic count (TEC) was observed in the animals of group II in comparison to 24 hours value, whereas in group III a decrease in TEC was noticed following surgery in comparison to 24 post obstruction hours. The inter-group comparison revealed a significant (P<0.05) decrease in TEC at 72 hours in the animals of group III when compared to group I.

There was an increase in TLC in the entire post treatment period in the animals of group II, whereas, in the animals of group III a significant decrease (P<0.05: 48, 72 hours and P<0.01: 96 hours) was recorded when compared to 24 hours value. The inter-group comparison revealed a significant (P<0.05) decrease in TLC at 72 hours in the animals of group III when compared to group I and significant (P<0.05) decrease in TLC when compared to group II at 96 hours (Table 18). A significant (P<0.01: 48 hours and P<0.05: 72 hours) neutrophilia was observed in the animals of group II when compared with 24 hours value. The decrease in the neutrophils was statistically significant (P<0.01: 72 hours and P<0.05: 96 hours) in the animals of group III when compared to its 24 hours value (Table 18). A statistically significant (P<0.01) decrease in the lymphocytes was seen in the animals of group II when compared to its 24 hours value.

TABLE 17: EFFECT OF STRANGULATED JEJUNAL OBSTRUCTION ON HAEMOGLOBIN, PACKED CELL VOLUME AND TOTAL ERYTHROCYTE COUNT IN CALVES (MEAN±S.E).

GROUPS	HOURS AFTER CREATION OF JEJUNAL OBSTRUCTION				
	0	24#	48	72	96
HAEMOGLOBIN (g%)					
Group I	9.75 ±0.310 (n=4)	11.60** ±0.216 (n=4)	11.95** ±0.25 (n=4)	12.00* ±0.2 (n=2)	12.60 N.I. ±0.0 (n=1)
Group II	8.85 ±0.331 (n=4)	11.50** ±0.238 (n=4)	11.65 ±0.331 (n=4)	11.67a ±0.291 (n=3)	11.80 N.I. ±0.20 (n=2)
Group III	10.20 ±0.408 (n=4)	12.10** ±0.238 (n=4)	11.70 ±0.173 (n=4)	10.90bc ±0.192 (n=4)	10.45b ±0.359 (n=4)
PACKED CELL VOLUME (%)					
Group I	30.50 ±0.957 (n=4)	39.25** ±1.797 (n=4)	44.50** ±1.708 (n=4)	49.00* ±1.0 (n=2)	50.00 N.I. ±0.0 (n=1)
Group II	30.25 ±1.931 (n=4)	39.75** ±1.436 (n=4)	41.00 ±0.577 (n=4)	43.67a ±1.856 (n=3)	47.50a ±0.5 (n=2)
Group III	32.00 ±1.472 (n=4)	42.75** ±1.25 (n=4)	36.50bdf ±0.957 (n=4)	33.00bdf ±1.291 (n=4)	32.50bf ±0.50 (n=4)
TOTAL ERYTHROCYTE COUNT (millions/cu mm)					
Group I	5.86 ±0.294 (n=4)	7.57** ±0.777 (n=4)	7.66** ±0.751 (n=4)	7.72 ±0.40 (n=2)	8.04 N.I. ±0.0 (n=1)
Group II	5.06 ±0.215 (n=4)	6.08** ±0.332 (n=4)	6.22 ±0.278 (n=4)	6.37 ±0.393 (n=3)	6.17 ±0.29 (n=2)
Group III	6.25 ±0.281 (n=4)	6.81 ±0181 (n=4)	6.65 ±0.119 (n=4)	6.53c ±0.084 (n=4)	6.35 ±0.098 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 hour value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 24 hour value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding hour.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding hour.
N.I. - Value not included for statistical analysis within group.

The inter-group comparison between group I, II and III revealed significant decrease in lymphocytes in animals of group I as compared to group II ($P<0.05$) and III ($P<0.01$) at 72 hours. Whereas, a significant ($P<0.05$) decrease in lymphocytes was seen in the animals of group II when compared with group III at 96 hours (Table 18).

TABLE 18: EFFECT OF STRANGULATED JEJUNAL OBSTRUCTION ON TOTAL LEUKOCYTE COUNT, NEUTROPHILS AND LYMPHOCYTES IN CALVES (MEAN±S.E).

GROUPS	HOURS AFTER CREATION OF JEJUNAL OBSTRUCTION				
	0	24#	48	72	96
TOTAL LEUKOCYTE COUNT (x10^3/cu mm)					
Group I	6.00 ±0.333 (n=4)	13.11** ±0.279 (n=4)	13.31** ±0.386 (n=4)	13.73* ±0.275 (n=2)	14.10 N.I. ±0.0 (n=1)
Group II	6.19 ±0.519 (n=4)	12.81** ±0.621 (n=4)	12.89 ±0.535 (n=4)	13.07 ±0.577 (n=3)	13.28 ±0.491 (n=2)
Group III	6.95 ±0.801 (n=4)	12.85** ±0.644 (n=4)	12.36^a ±0.503 (n=4)	11.67^{ac} ±0.368 (n=4)	10.83^{be} ±0.367 (n=4)
NEUTROPHILS (% of TLC)					
Group I	32.8 ±1.25 (n=4)	41.5** ±1.5 (n=4)	46.8** ±1.89 (n=4)	53.5* ±2.5 (n=2)	62.0 N.I. ±0.0 (n=1)
Group II	31.3 ±1.25 (n=4)	39.8** ±1.32 (n=4)	44.3^b ±1.8 (n=4)	45.7^a ±1.764 (n=3)	46.0 N.I. ±0.5 (n=2)
Group III	32.5 ±1.44 (n=4)	40.8 ±1.65 (n=4)	41.5 ±1.94 (n=4)	39.3^{ac} ±1.89 (n=4)	37.3^{be} ±1.89 (n=4)
LYMPHOCYTES (% of TLC)					
Group I	65.5 ±1.26 (n=4)	57.5** ±1.5 (n=4)	53.0** ±1.87 (n=4)	45.0* ±2.0 (n=2)	38.0 N.I. ±0.0 (n=1)
Group II	68.3 ±1.11 (n=4)	59.8** ±1.49 (n=4)	54.5^b ±1.19 (n=4)	54.0^{bc} ±1.732 (n=3)	53.0 N.I. ±1.0 (n=2)
Group III	66.3 ±1.70 (n=4)	59.8 ±2.78 (n=4)	57.5 ±1.44 (n=4)	58.5^d ±1.32 (n=4)	62.3^e ±2.02 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 hour value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 24 hour value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding hour.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding hour.
N.I. - Value not included for statistical analysis within group.

III. BIOCHEMICAL CHANGES IN PLASMA

PRE TREATMENT

There was significant (P<0.01) increase in blood glucose concentration at 24 post obstruction hours when compared to base values in the animals of group I and III. A steady elevation (P<0.01) in the blood glucose concentration was recorded at 48 post obstruction hours in the animals of group I when compared to 24 hours (Table 19).

The increase in total plasma protein (TPR) concentration was significant (P< 0.01) at 24 post obstruction hours in the animals of group I, II and III when compared to base values and this significant (P<0.01: 48 hours and P<0.05: 72 hours) increase in total plasma protein continued throughout the period of study in the animals of group I (Table 19).

Increase in blood urea nitrogen was significant (P<0.01) at 24 post obstruction hours in comparison to base values of the animals of group I, II and III. A progressive elevation in the values of BUN was noticed at 48 hours (P<0.01) onward in all the animals of group I as the time period of obstruction increased (Table 19). A significant (P<0.01) increase in the values of plasma creatinine was found in the animals of group II and III at 24 post obstruction hours, whereas significant (P<0.01: 48 hours and P<0.05: 72 hours) increase in plasma creatinine was recorded in the animals of group I when compared to base values(Table 19).

Plasma total bilirubin concentration increased significantly (P<0.05) in the animals of group II and III after 24 hours following creation of strangulated obstruction when compared to base values, whereas a significant (P<0.01) increase was observed in total bilirubin at 48 hours interval in the animals of group I (Table 20).

There was significant (P<0.01) decrease in plasma sodium concentration in all the animals of three groups at 24 hours interval when compared to base values. A significant (P<0.01) decrease in plasma sodium concentration was recorded at 48 post obstruction hours in the animals of group I (Table 21). A significant (P<0.01) hypokalemia was observed in the animals of all the three groups at 24 post obstruction hours in comparison to their base values. A consistently decreasing trend (P<0.01: 48 hours and P<0.05: 72 hours) in potassium concentration was noticed in all the animals of group I as the duration of obstruction increased (Table 21).

A significant (P<0.01) hypochloraemia was observed in the animals of all the three groups at 24 hours in comparison to base value. A significant perpetual (P<0.01: 48 hours and P<0.05: 72 hours) decline in plasma chloride concentration was recorded in the animals of group I till the terminal part of study when compared to base value (Table 21). Incoherent changes in relation to base values were recorded in plasma calcium and phosphorus concentration in the animals of all the groups (Table 21, 56).

The elevation in plasma alkaline phosphatase (ALKP) concentration was significant (P<0.01) in the animals of all three groups at 24 hours of creation of strangulated obstruction and this significant (P<0.01: 48 hours and P<0.05: 72 hours) rise in the values of ALKP was consistent throughout the period of obstruction in comparison to base value in the animals of group I (Table 23). A significant (P<0.01) increase in comparison to base value was observed in plasma Aspartate amino transferase (AST) concentration in the animals of all three groups at 24 hours period and this rise was continual (P<0.01: 48 hours and P<0.05: 72 hours) in group I throughout the period of study (Table 23).

The plasma alanine amino transferase (ALT) recorded a significant (P<0.01) increase at 24 post obstruction hours in the animals of group I as compared to base value and this rise continued till the end of study (Table 23).

TABLE 19: EFFECT OF STRANGULATED JEJUNAL OBSTRUCTION ON GLUCOSE, TOTAL PLASMA PROTEIN, BLOOD UREA NITROGEN AND CREATININE IN CALVES (MEAN±S.E).

GROUPS	HOURS AFTER CREATION OF JEJUNAL OBSTRUCTION				
	0	24#	48	72	96
GLUCOSE (mg/dL)					
Group I	57.5 ±2.22 (n=4)	69.0** ±1.29 (n=4)	73.5** ±2.22 (n=4)	81.0 ±7.0 (n=2)	82.0N.I. ±0.0 (n=1)
Group II	59.3 ±2.29 (n=4)	75.5 ±7.47 (n=4)	94.8 ±13.36 (n=4)	99.7 ±9.35 (n=3)	113.0 ±4.0 (n=2)
Group III	62.5 ±4.63 (n=4)	78.0** ±4.163 (n=4)	80.8 ±4.715 (n=4)	83.0a ±3.697 (n=4)	84.5be ±4.992 (n=4)
TOTAL PLASMA PROTEIN (g/dL)					
Group I	5.63 ±0.301 (n=4)	9.13** ±0.256 (n=4)	10.73** ±0.170 (n=4)	11.85* ±0.25 (n=2)	12.60N.I. ±0.0 (n=1)
Group II	6.40 ±0.238 (n=4)	8.83** ±0.246 (n=4)	8.93d ±0.218 (n=4)	9.30d ±0.231 (n=3)	9.55 ±0.150 (n=2)
Group III	5.90 ±0.216 (n=4)	9.25** ±0.233 (n=4)	7.80bdf ±0.147 (n=4)	6.55bdf ±0.456 (n=4)	6.30bf ±0.303 (n=4)
BLOOD UREA NITROGEN (mg/dL)					
Group I	14.25 ±1.548 (n=4)	26.25** ±1.702 (n=4)	36.00** ±1.472 (n=4)	45.00 ±1.0 (n=2)	52.00N.I. ±0.0 (n=1)
Group II	6.90 ±1.168 (n=4)	12.60** ±1.374 (n=4)	21.83bd ±1.969 (n=4)	30.93ad ±1.026 (n=3)	35.30N.I. ±1.1 (n=2)
Group III	6.15 ±0.776 (n=4)	19.48** ±0.890 (n=4)	17.38d ±2.027 (n=4)	14.00adf ±1.268 (n=4)	9.25bf ±0.457 (n=4)
CREATININE (mg/dL)					
Group I	1.03 ±0.34 (n=4)	1.22 ±0.025 (n=4)	1.50** ±0.071 (n=4)	2.12* ±0.065 (n=2)	2.64N.I. ±0.0 (n=1)
Group II	0.96 ±0.639 (n=4)	1.28** ±0.051 (n=4)	1.48b ±0.030 (n=4)	1.78ad ±0.012 (n=3)	2.27a ±0.065 (n=2)
Group III	0.90 ±0.029 (n=4)	1.19** ±0.069 (n=4)	1.19df ±0.026 (n=4)	1.05df ±0.037 (n=4)	0.94af ±0.062 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 hour value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 24 hour value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding hour.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding hour.
N.I. - Value not included for statistical analysis within group.

A significant (P<0.01) rise in plasma amylase concentration was noticed at 24 hours post obstruction in the animals of all the three groups and this increase persisted (P<0.01: 48 hours and P<0.05: 72 hours) throughout the period of obstruction in group I (Table 23).

POST TREATMENT

A non-significant increase in plasma glucose concentration was observed in the animals of group II, whereas there was significant increase in the blood glucose concentration at 72 hours ($P<0.05$) and 96 hours ($P<0.01$) when compared to the 24 post obstruction hours value in the animals of group III (Table 19). A significant ($P<0.01$) decrease in blood glucose concentration was noticed at 96 hours in the animals of group III when compared to the corresponding value of group II.

A non-significant increase in total plasma protein concentration was recorded in the animals of group II when compared to its 24 hour value. Whereas, a significant ($P<0.01$) decline in the TPR concentration was observed in the animals of group III when compared to 24 post obstruction hour. The inter group comparison revealed a significant ($P<0.01$). increase in total protein concentration in the animals of group II when compared to group I. Similarly, the animals of group III showed a significant ($P<0.01$) decrease in plasma protein concentration when compared to group I and II (Table 19).

The increased blood urea nitrogen concentration was significant ($P<0.01$: 48 hours and $P<0.05$: 72 hours) in the animals of group II, whereas there was a significant ($P<0.05$: 72 hours and $P<0.01$: 96 hours) decrease in BUN in the animals of group III when compared to 24 hours value. The inter-group comparison revealed a significant ($P<0.01$) decrease in BUN values in the animals of group II and III when compared to group I at 48 and 72 hours and a significant ($P<0.01$) fall in BUN concentration was noticed at 72 and 96 hours in the animals of group III when compared with group II (Table 19). The plasma creatinine concentration remained significantly ($P<0.01$: 48 hours and $P<0.05$: 72, 96 hours) high when compared to its 24 hours value in the animals of group II, whereas there was a significant ($P<0.05$) decrease in plasma creatinine at 96 hours when compared to 24 post obstruction hours in the animals of group III. The value recorded at 96 hours was almost comparable to its base value. On inter-group comparison there was a significant ($P<0.01$) decline in plasma creatinine concentration in the animals of group II at 72 hours as compared to corresponding interval of group I. Likewise, the animals of group III showed statistically significant ($P<0.01$) fall in the values of plasma creatinine from 48 hours onward when compared to animals of group II and I (Table 19).

A gradual and non-significant increase in plasma total bilirubin concentration recorded during the entire post treatment period in the animals of group II when compared to 24 post obstruction hour value. The animals of group III recorded a significant ($P<0.01$) increase in total bilirubin at 48 hours when compared to 24 hours value, thereafter, the concentration decreased and the drop was significant ($P<0.05$) at 96 hours in comparison to 24 post obstruction hour value.

TABLE 20: EFFECT OF STRANGULATED JEJUNAL OBSTRUCTION ON PLASMA TOTAL BILIRUBIN IN CALVES (MEAN±S.E).

GROUPS	HOURS AFTER CREATION OF JEJUNAL OBSTRUCTION				
	0	24#	48	72	96
Group I	0.16 ±0.020 (n=4)	0.18 ±0.013 (n=4)	0.26** ±0.015 (n=4)	0.42 ±0.025 (n=2)	0.52N.I. ±0.0 (n=1
Group II	0.11 ±0.125 (n=4)	0.18* ±0.012 (n=4)	0.22 ±0.019 (n=4)	0.29 ±0.035 (n=3	0.41 ±0.05 (n=2)
Group III	0.12 ±0.013 (n=4)	0.18* ±0.014 (n=4)	0.25b ±0.026 (n=4)	0.19 ±0.206 (n=4)	0.17af ±0.028 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 hour value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 24 hour value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding hour.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding hour.
N.I. - Value not included for statistical analysis within group.

On comparative basis a significant (P<0.01) decrease in plasma bilirubin concentration was observed at 96 hours in the animals of group III as compared to group II (Table 20).

There was a gradual decrease in plasma sodium concentration in the animals of group II throughout the period of study when compared with 24 post obstruction hours value, this decrease at 72 hours was significant (P<0.01) and it continued upto 96 hours. A significant (P<0.05: 72 hours and P<0.01: 96 hours) rise in sodium concentration was recorded when compared to its 24 post obstruction hours value in the animals of group III. At the end of study it reached almost to normal in comparison to base value. A significant hyponatraemia was present in group I at 48 (P<0.01) and 72 (P<0.05) hours as compared to group II. Comparison between group I and III revealed that there was a significant (P<0.01) increase in the sodium concentration in the animals of group III at 48 and 72 hours onward till the end of study. A significant (P<0.01) increase in plasma sodium concentration was recorded in the animals of group III when compared to animals of group II at 72 and 96 hours (Table 21).

The plasma potassium concentration dropped significantly (P<0.05) at 48 and 72 hours (P<0.01) in the animals of group II when compared with 24 post obstruction hours. In the animals of group III the potassium concentration was significantly high in the post treatment period (P<0.05: 72 hours and P<0.01: 96 hours) when compared to 24 hour value. The inter-group comparison revealed significant (P<0.01) increase in the potassium concentration in the animals of group III as compared to group II (Table 21). A significant (P<0.05) increase in chloride concentration was noticed in the animals of group II when compared to 24 post obstruction hour.

TABLE 21: EFFECT OF STRANGULATED JEJUNAL OBSTRUCTION ON PLASMA SODIUM, POTASSIUM, CHLORIDE AND CALCIUM IN CALVES (MEAN±S.E).

GROUPS	HOURS AFTER CREATION OF JEJUNAL OBSTRUCTION				
	0	24#	48	72	96
SODIUM (mEq/L)					
Group I	144.0 ±1.63 (n=4)	122.5** ±3.30 (n=4)	116.5** ±1.71 (n=4)	108.0 ±4.0 (n=2)	104.0N.I. ±0.0 (n=1
Group II	142.5 ±0.957 (n=4)	136.0** ±0.816 (n=4)	134.5d ±1.708 (n=4)	124.6bc ±1.764 (n=3	119.0N.I. ±1.0 (n=2)
Group III	145.0 ±1.00 (n=4)	136.0** ±0.817 (n=4)	137.5d ±1.258 (n=4)	141.0adf ±1.291 (n=4)	142.0bf ±1.155 (n=4)
POTASSIUM (mEq/L)					
Group I	5.18 ±0.409 (n=4)	3.40** ±0.071 (n=4)	3.18** ±0.095 (n=4)	2.90* ±0.30 (n=2)	2.80N.I. ±0.0 (n=1
Group II	5.05 ±0.222 (n=4)	3.40** ±0.071 (n=4)	3.25a ±0.065 (n=4)	3.03b ±0.088 (n=3	2.95N.I. ±0.15 (n=2)
Group III	5.15 ±0.171 (n=4)	3.55** ±0.096 (n=4)	3.80df ±0.071 (n=4)	4.08adf ±0.085 (n=4)	4.90bf ±0.129 (n=4)
CHLORIDE (mEq/L)					
Group I	103.45 ±0.913 (n=4)	68.63** ±3.035 (n=4)	66.75** ±3.064 (n=4)	64.75* ±4.95 (n=2)	63.50 N.I. ±0.0 (n=1
Group II	104.28 ±0.485 (n=4)	67.58** ±2.677 (n=4)	72.08a ±1.687 (n=4)	75.83a ±2.061 (n=3	76.55N.I. ±3.85 (n=2)
Group III	105.25 ±0.184 (n=4)	68.30** ±3.684 (n=4)	77.35bcf ±1.169 (n=4)	97.70bdf ±1.092 (n=4)	102.38bf ±0.826 (n=4)
CALCIUM (mg/dL)					
Group I	7.53 ±0.359 (n=4)	7.48 ±0.435 (n=4)	7.30 ±0.314 (n=4)	7.10 ±0.7 (n=2)	7.33 N.I. ±0.0 (n=1
Group II	7.83 ±0.266 (n=4)	7.43 ±0.366 (n=4)	7.45 ±0.429 (n=4)	7.63 ±0.536 (n=3	7.55 ±0.75 (n=2)
Group III	6.90 ±0.367 (n=4)	6.73 ±0.165 (n=4)	6.63 ±0.333 (n=4)	7.07 ±0.272 (n=4)	7.05 ±0.218 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 hour value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 24 hour value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding hour.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding hour.
N.I. - Value not included for statistical analysis within group.

TABLE 22: EFFECT OF STRANGULATED JEJUNAL OBSTRUCTION ON PLASMA PHOSPHORUS IN CALVES (MEAN±S.E).

GROUPS	HOURS AFTER CREATION OF JEJUNAL OBSTRUCTION				
	0	24#	48	72	96
Group I	5.28 ±0.349 (n=4)	5.15 ±0.312 (n=4)	5.25 ±0.296 (n=4)	5.10 ±0.6 (n=2)	5.20 N.I. ±0.0 (n=1
Group II	5.03 ±0.304 (n=4)	5.25 ±0.384 (n=4)	5.18 ±0.401 (n=4)	5.20 ±0.493 (n=3	5.55 ±0.25 (n=2)
Group III	5.40 ±0.092 (n=4)	5.43 ±0.188 (n=4)	5.13 ±0.103 (n=4)	5.23 ±0.111 (n=4)	5.40 ±0.108 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 hour value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 24 hour value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding hour.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding hour.
N.I. - Value not included for statistical analysis within group.

Similarly, increase in plasma chloride concentration was significantly (P<0.01) higher in the animals of group III when compared to 24 hour value. The inter-group comparison revealed a significant recovery in plasma chloride concentration in the animals of group III as compared to group II (P<0.01) and I (P<0.05: 48 hours and P<0.01: 72 hours) (Table 21).

No statistically significant alterations were seen in plasma calcium and phosphorus concentration during post treatment period in the animals of group II and III (Table 21, 56).

A significant increase in plasma alkaline phosphatase (ALKP) was recorded in the animals of group II at 48 (P<0.01) and 72 hours (P<0.05), whereas, the decrease in ALKP was significant (P<0.05: 48 hours and P<0.01: 72, 96 hours) in the animals of group III when compared to 24 post obstruction hours. On comparative basis a significant (P<0.05) increase was noticed in alkaline phosphatase concentration in the animals of group II when compared to group I at 48 hours. A significant (P<0.01) decrease in alkaline phosphatase was seen in the animals of group III at 72 hours when compared to group I and II. Likewise, a significant (P<0.01) decrease in ALKP in the animals of group III was observed at 96 hours when compared with group II (Table 23).

A statistically significant (P<0.01: 48 hours and P<0.05: 72 hours) rise in plasma AST concentration was maintained in the animals of group II, whereas, a significant (P<0.01) decrease in AST concentration was noticed in the animals of group III as compared to 24 hour values. The inter-group comparison revealed a statistically significant decrease in AST concentration in the animals of group III as compared to group I (P<0.05: 48 hours and P<0.01: 72 hours) and II (P<0.05: 48 hours and P<0.01: 72, 96 hours) (Table 23).

A rise in plasma ALT concentration in the animals of group II was statistically significant (P<0.01: 48 hours and P<0.05: 72, 96 hours) in the entire post treatment period as compared to its 24 hours value.

TABLE 23: EFFECT OF STRANGULATED JEJUNAL OBSTRUCTION ON PLASMA ALKP, AST, ALT AND AMYLASE IN CALVES (MEAN±S.E).

GROUPS	HOURS AFTER CREATION OF JEJUNAL OBSTRUCTION				
	0	24#	48	72	96
ALKALINE PHOSPHATASE (IU/L)					
Group I	92.25 ±1.652 (n=4)	131.25** ±2.428 (n=4)	145.25** ±1.436 (n=4)	154.00* ±4.00 (n=2)	156.00 N.I. ±0.0 (n=1
Group II	93.00 ±2.646 (n=4)	130.75** ±2.78 (n=4)	138.25bc ±1.887 (n=4)	142.67a ±2.333 (n=3	147.50 N.I. ±1.50 (n=2)
Group III	90.25 ±6.033 (n=4)	131.50** ±4.481 (n=4)	137.50ac ±2.102 (n=4)	121.50bdf ±1.443 (n=4)	107.50bf ±1.708 (n=4)
AST (IU/L)					
Group I	82.3 ±2.955 (n=4)	149.5** ±4.924 (n=4)	161.0** ±3.582 (n=4)	172.5* ±1.50 (n=2)	178.0 N.I. ±0.0 (n=1)
Group II	80.0 ±5.164 (n=4)	154.8** ±3.351 (n=4)	161.8b ±3.172 (n=4)	170.0a ±3.215 (n=3	174.5 N.I. ±1.5 (n=2)
Group III	82.5 ±7.932 (n=4)	156.5** ±8.49 (n=4)	139.5bce ±5.172 (n=4)	121.0bdf ±2.858 (n=4)	106.3bf ±2.394 (n=4)
ALT (IU/L)					
Group I	21.8 ±1.377 (n=4)	30.0** ±1.225 (n=4)	39.8** ±1.601 (n=4)	50.5* ±4.95 (n=2)	60.0 N.I. ±0.0 (n=1
Group II	24.0 ±1.225 (n=4)	26.8 ±0.75 (n=4)	30.3b ±2.109 (n=4)	35.0a ±1.0 (n=3	50.5a ±0.5 (n=2)
Group III	23.5 ±1.190 (n=4)	33.0 ±0.189 (n=4)	31.5 ±1.19 (n=4)	29.0 ±0.707 (n=4)	24.8b ±1.493 (n=4)
AMYLASE IU/L					
Group I	11.25 ±0.854 (n=4)	25.75** ±1.25 (n=4)	31.75** ±2.25 (n=4)	38.50* ±1.5 (n=2)	44.00 N.I. ±0.0 (n=1
Group II	14.25 ±0.854 (n=4)	24.00** ±1.472 (n=4)	29.25a ±2.175 (n=4)	32.00a ±3.215 (n=3	36.50a ±3.5 (n=2)
Group III	16.25 ±0.75 (n=4)	33.25** ±0.125 (n=4)	33.50 ±0.194 (n=4)	24.50bc ±2.394 (n=4)	20.00bf ±1.414 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 hour value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 24 hour value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding hour.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding hour.
N.I. - Value not included for statistical analysis within group.

A gradual decline approaching to normalcy was observed in the animals of group III as evidenced by a significantly (P<0.01) lower concentration of ALT at 96 hour when compared to 24 hour value (Table 23).

A significant (P<0.05) rise in plasma amylase concentration was recorded during the entire period of study in the animals of group II as compared to 24 post obstruction hours. In comparison to 24 hours value a significant (P<0.01) decline in plasma amylase was observed at 72 and 96 hours in the animals of group III. The inter-group comparison revealed a significant drop in amylase concentration in the animals of group III as compared to group I (P<0.05) at 72 hours and group II (P<0.01) at 96 hours (Table 23).

IV. CHANGES IN PERITONEAL FLUID

PRE TREATMENT

The normal straw colour of peritoneal fluid showed a yellowish tinge following creation of jejunal obstruction in all the animals of three groups at 24 post obstruction hours. As the duration of obstruction progressed in the animals of group I the peritoneal fluid appeared deep yellow in colour. A decreasing trend in the peritoneal fluid pH was observed immediately after creation of strangulated jejunal obstruction in all the animals of three groups and this decrease was significant (P<0.01) at 72 hours in the animals of group I (Table 24).

A significant (P<0.01) increase in the total protein of peritoneal fluid (Table 24) was observed at 24 hours in comparison to base value in all the animals of three groups. The increase in total protein of peritoneal fluid remained significantly (P<0.01: 48 hours and P<0.05: 72 hours) high throughout the period of study in the animals of group I (Table 24). A significant (P<0.01) increase in peritoneal fluid nucleated cell count was observed in all the animals of three groups at 24 hours when compared to base values.

A continual increase in the nucleated cell count was recorded during entire period of observation in the animals of group I which was significant (P<0.01) at 48 hours (Table 24).

A significant decrease in peritoneal fluid sodium concentration was recorded at 24 post obstruction hours in the animals of group II (P<0.05) and III (P<0.01), when compared with base values. However, in the animals of group I a significant (P<0.01) decrease was noticed at 48 hours was consistent in the animals of group I till the end of the period of observation but the decrease was significant (P<0.01) only at 48 hours (Table 25).

The chloride concentration in peritoneal fluid decreased significantly (P< 0.01) at 24 hours when compared with base values in the animals of group I and II. The drop (P<0.01: 48 hours) in chloride concentration of peritoneal fluid was constant throughout the period of study in the animals of group I (Table 25). The peritoneal fluid calcium and phosphorus concentration did not reveal any significant alteration following strangulated jejunal obstruction in all the animals of three groups (Table 25, 60).

TABLE 24: EFFECT OF STRANGULATED JEJUNAL OBSTRUCTION ON PERITONEAL FLUID pH, TOTAL PROTEIN AND NUCLEATED CELL COUNT IN CALVES (MEAN±S.E).

GROUPS	HOURS AFTER CREATION OF JEJUNAL OBSTRUCTION				
	0	24#	48	72	96
PERITONEAL FLUID Ph					
Group I	6.93 ±0.075 (n=4)	6.85 ±0.087 (n=4)	6.78 ±0.075 (n=4)	6.55[b] ±0.15 (n=2)	6.40 N.I. ±0.0 (n=1
Group II	6.85 ±0.087 (n=4)	6.78 ±0.075 (n=4)	6.60 ±0.058 (n=4)	6.60 ±0.1 (n=3	6.85 ±0.15 (n=2)
Group III	6.70 ±0.123 (n=4)	6.55 ±0.194 (n=4)	6.63 ±0.075 (n=4)	6.55 ±0.027 (n=4)	6.63 ±0.075 (n=4)
TOTAL PERITONEAL FLUID PROTEIN (g/dL)					
Group I	2.93 ±0.155 (n=4)	4.80** ±0178 (n=4)	5.35** ±0.144 (n=4)	6.65* ±0.150 (n=2)	7.30 N.I. ±0.0 (n=1
Group II	2.73 ±0.125 (n=4)	4.10** ±0.265 (n=4)	4.73[b] ±0.218 (n=4)	5.37[bc] ±0.296 (n=3)	6.10[a] ±0.2 (n=2)
Group III	2.40 ±0.147 (n=4)	4.48** ±0.16 (n=4)	4.10[d] ±0.204 (n=4)	3.38[bdf] ±0.085 (n=4)	2.98[bf] ±0.165 (n=4)
NUCLEATED CELL COUNT (x 10^3/cu mm)					
Group I	2.94 ±0.083 (n=4)	6.38** ±0.188 (n=4)	6.68** ±0.222 (n=4)	7.15 ±0.300 (n=2)	6.90 N.I. ±0.0 (n=1)
Group II	3.04 ±0.116 (n=4)	7.33** ±0.364 (n=4)	7.48[a] ±0.350 (n=4)	7.68 ±0.460 (n=3	8.35 ±0.200 (n=2)
Group III	2.95 ±0.184 (n=4)	7.43** ±0.259 (n=4)	7.73[bc] ±0.249 (n=4)	7.88[b] ±0.247 (n=4)	8.11[b] ±0.263 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 hour value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 24 hour value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding hour.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding hour.
N.I. - Value not included for statistical analysis within group.

POST TREATMENT

The peritoneal fluid retained its deep yellow colour in the animals of group II during the entire post treatment period, whereas, the colour of peritoneal fluid in the animals of group III was dark yellow at 48 hours following treatment but gradually it returned to normal straw colour from 72 hours onward. The concentration of peritoneal fluid total protein increased significantly ($P<0.01$: 48, 72 hours and $P<0.05$: 96 hours) in the animals of group II when compared to 24 hour value, whereas, it decreased significantly ($P<0.01$) from 72 hours onward in the animals of group III as compared to 24 post obstruction hours. The comparison within groups revealed significant ($P<0.05$) rise in the peritoneal fluid protein concentration in the animals of group I as compared to group II at 72 hours.

TABLE 25: EFFECT OF STRANGULATED JEJUNAL OBSTRUCTION ON PERITONEAL FLUID SODIUM, POTASSIUM, CHLORIDE AND CALCIUM IN CALVES (MEAN±S.E).

GROUPS	HOURS AFTER CREATION OF JEJUNAL OBSTRUCTION				
	0	24#	48	72	96
SODIUM (mEq/L)					
Group I	138.5 ±0.96 (n=4)	135.5 ±1.26 (n=4)	128.0** ±2.16 (n=4)	121.0 ±3.0 (n=2)	112.0 N.I. ±0.0 (n=1)
Group II	144.5 ±2.06 (n=4)	140.0* ±1.83 (n=4)	135.0ac ±1.29 (n=4)	128.6a ±1.764 (n=3)	126.0 ±2.0 (n=2)
Group III	142.5 ±0.957 (n=4)	139.0** ±0.577 (n=4)	140.5df ±0.50 (n=4)	141.0df ±0.58 (n=4)	141.5f ±0.50 (n=4)
POTASSIUM (mEq/L)					
Group I	4.68 ±0.193 (n=4)	3.98** ±0.86 (n=4)	3.60** ±0.141 (n=4)	3.60 ±0.2 (n=2)	3.10 N.I. ±0.0 (n=1)
Group II	4.58 ±0.132 (n=4)	4.08** ±0.111 (n=4)	3.73a ±0.049 (n=4)	3.40a ±0.115 (n=3)	3.10 N.I. ±0.30 (n=2)
Group III	4.68 ±0.138 (n=4)	4.05** ±0.096 (n=4)	4.30df ±0.041 (n=4)	4.38cf ±0.085 (n=4)	4.43e ±0.155 (n=4)
CHLORIDE (mEq/L)					
Group I	96.33 ±2.401 (n=4)	83.55** ±2.021 (n=4)	81.78** ±1.624 (n=4)	75.80 ±1.4 (n=2)	69.30 N.I. ±0.0 (n=1)
Group II	92.15 ±2.408 (n=4)	86.20** ±2.043 (n=4)	81.30a ±1.369 (n=4)	75.87b ±1.374 (n=3)	74.45 N.I. ±0.85 (n=2)
Group III	93.97 ±3.772 (n=4)	94.28 ±1.512 (n=4)	96.18df ±2.116 (n=4)	93.15cf ±3.365 (n=4)	93.18f ±1.894 (n=4)
CALCIUM (mg/dL)					
Group I	6.53 ±0.272 (n=4)	6.30 ±0.279 (n=4)	6.57 ±0.243 (n=4)	6.70 ±0.50 (n=2)	6.60 N.I. ±0.0 (n=1)
Group II	6.23 ±0.111 (n=4)	5.97 ±0.063 (n=4)	6.20 ±0.108 (n=4)	6.16 ±0.145 (n=3)	6.15 ±0.05 (n=2)
Group III	6.48 ±0.293 (n=4)	6.38 ±0.236 (n=4)	6.85 ±2.72 (n=4)	6.43 ±0.309 (n=4)	6.43 ±0.206 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 hour value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 24 hour value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding hour.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding hour.
N.I. - Value not included for statistical analysis within group.

Similarly, a significant (P<0.01) decrease in peritoneal fluid protein concentration was observed in the animals of group III when compared to group I (48 and 72 hours) and II (72 and 96 hours) (Table 24). In all the animals of group II the nucleated cell count of peritoneal fluid remained high (P<0.01: 48 hours) throughout the post treatment period when compared to 24 post obstruction hours. In the animals of group III a significant (P<0.01) increase in the cell count was recorded throughout the post operative period when compared to 24 hours. The inter-group comparison revealed a significant rise in the cell count in the animals of group III when compared to group I at 48 hours interval (Table 24).

There was a significant (P<0.05: 48, 72 hours) decrease in peritoneal fluid sodium concentration in the animals of group II, whereas, no significant change in peritoneal fluid sodium concentration was observed in the animals of group III when compared to 24 post obstruction hours. The animals of group III when compared to group II showed significantly (P<0.01) increasing trend in peritoneal fluid sodium concentration during post treatment period and this increase was significant (P<0.01) in comparison to group I at 48 and 72 hours (Table 25).

A significant (P<0.05) decrease in peritoneal fluid potassium concentration was observed in the animals of group II when compared to 24 hours value but it continued to rise from 48 hours onward in the animals of group III. The inter-group comparison revealed a significant recovery in potassium concentration in the animals of group III at 48 (P<0.01) and 72 (P<0.05) hours when compared with group I. Similarly, a significant increase in peritoneal fluid potassium was observed in the animals of group III (P<0.01: 48, 72 hours and P<0.05: 96 hours) when compared with group II (Table 25).

In all the animals of group II a significant decrease in the peritoneal fluid chloride concentration was noticed at 48 (P<0.05) and 72 (P<0.01) hours, when compared to 24 post obstruction hours. The peritoneal fluid chloride level in the animals of group III almost remained unaltered. On comparative basis (Table 25) the animals of group III showed significant recovery in peritoneal fluid chloride concentration when compared to group I (P<0.01: 48 hours and P<0.05: 72 hours) and II (P<0.01: 48, 72, 96 hours). No significant changes in peritoneal fluid calcium and phosphorus concentration were seen in the animals of group II and III (Table 25, 60).

V. RUMINAL FLUID BIOCHEMISTRY

PRE TREATMENT

There was significant (P<0.01) decrease in ruminal fluid sodium concentration at 24 post obstruction hours when compared to base values in the animals of group I and II. This decrease was gradual during rest of the post obstruction period in the animals of group I but it was significant (P<0.01) at 48 hours (Table 27). The ruminal fluid potassium (Table 27) concentration dropped significantly (P<0.01) at 24 hours when compared to base value in the animals of group I and II.

TABLE 26: EFFECT OF STRANGULATED JEJUNAL OBSTRUCTION ON PERITONEAL FLUID PHOSPHORUS IN CALVES (MEAN±S.E).

GROUPS	HOURS AFTER CREATION OF JEJUNAL OBSTRUCTION				
	0	24#	48	72	96
Group I	5.08 ±0.375 (n=4)	5.03 ±0.349 (n=4)	5.03 ±0.446 (n=4)	4.95 ±0.15 (n=2)	5.10 N.I. ±0.0 (n=1)
Group II	4.80 ±0.358 (n=4)	4.77 ±0.240 (n=4)	4.88 ±0.368 (n=4)	4.73 ±0.41 (n=3)	4.65 ±0.55 (n=2)
Group III	3.93 ±0.602 (n=4)	3.90 ±0.652 (n=4)	4.05 ±0.792 (n=4)	3.80 ±0.803 (n=4)	3.63 ±0.662 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 hour value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 24 hour value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding hour.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding hour.
N.I. - Value not included for statistical analysis within group.

This decline in ruminal fluid potassium concentration was significant (P<0.01: 48 hours and P<0.05: 72 hours) throughout the period of obstruction in the animals of group I.

The increase in ruminal fluid chloride concentration was significant (P<0.01) at 24 hours in all the animals of three groups when compared to respective base values. The concentration of chloride remained significantly (P<0.01) high throughout the period of study in the animals of group I (Table 27).

Ruminal fluid calcium concentration did not show any significant changes at 24 post obstruction hour in the animals of group I, II and III (Table 28). A significant (P<0.01) increase in ruminal fluid phosphorus was recorded at 24 post obstruction hours in all the animals of three groups when compared with respective base values. A consistently high (P<0.01: 48 hours and P<0.05: 72 hours) concentration of phosphorus was conspicuous in the ruminal fluid throughout the entire period of study in the animals of group I (Table 28).

POST TREATMENT

A significant (P<0.05) decrease in the ruminal fluid sodium was recorded at 48 hours in the animals of group II but there was no significant change in the ruminal fluid sodium concentration in the animals of group III. The inter-group comparison revealed significant (P<0.05) loss of sodium in group I as compared to group III at 48 and 72 hours. Whereas, a significant (P<0.05) increase was noticed in the animals of group III at 72 and 96 hours when compared to group II (Table 27).

A significant (P<0.01) decrease in ruminal fluid potassium concentration was observed from 48 hours onward in the animals of group II when compared to 24 hours value, whereas, non-significant alteration was evident in potassium concentration in the animals of group III. On comparative basis a significant (P<0.01: 48 hours and P<0.05: 72 hours) loss of potassium was noticed in the animals of group I as compared to group III.

TABLE 27: EFFECT OF STRANGULATED JEJUNAL OBSTRUCTION ON RUMINAL FLUID SODIUM, POTASSIUM AND CHLORIDE IN CALVES (MEAN±S.E).

GROUPS	HOURS AFTER CREATION OF JEJUNAL OBSTRUCTION				
	0	24#	48	72	96
SODIUM (mEq/L)					
Group I	134.5 ±1.5 (n=4)	126.5** ±2.06 (n=4)	124.5** ±2.217 (n=4)	125.0 ±1.0 (n=2)	122.0 N.I. ±0.0 (n=1)
Group II	134.0 ±0.41 (n=4)	130.0** ±0.41 (n=4)	127.5[a] ±0.96 (n=4)	126.7 ±0.67 (n=3)	124.5 ±0.50 (n=2)
Group III	131.5 ±1.71 (n=4)	133.5 ±2.5 (n=4)	131.5[c] ±1.5 (n=4)	130.0[ce] ±0.817 (n=4)	133.5[e] ±1.71 (n=4)
POTASSIUM (mEq/L)					
Group I	27.5 ±0.958 (n=4)	24.25** ±0.63 (n=4)	17.75** ±0.75 (n=4)	15.5* ±1.5 (n=2)	12.0 N.I. ±0.0 (n=1)
Group II	26.5 ±0.87 (n=4)	22.0** ±1.08 (n=4)	18.8[b] ±1.25 (n=4)	15.67[b] ±1.202 (n=3)	12.5 N.I. ±0.50 (n=2)
Group III	26.5 ±2.63 (n=4)	23.5 ±2.53 (n=4)	27.4[df] ±3.81 (n=4)	26.25[cf] ±3.64 (n=4)	28.0[f] ±3.37 (n=4)
CHLORIDE (mEq/L)					
Group I	29.50 ±1.19 (n=4)	40.75** ±0.854 (n=4)	53.00** ±1.291 (n=4)	72.50** ±1.5 (n=2)	88.00 N.I. ±0.0 (n=2)
Group II	27.80 ±1.89 (n=4)	43.45** ±2.374 (n=4)	56.70[a] ±3.34 (n=4)	79.20[a] ±3.564 (n=2)	92.60 N.I. ±2.0 (n=2)
Group III	29.30 ±0.78 (n=4)	42.15** ±0.788 (n=4)	41.18[de] ±2.87 (n=4)	37.95[df] ±1.168 (n=4)	31.60[bf] ±1.786 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 hour value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 24 hour value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding hour.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding hour.
N.I. - Value not included for statistical analysis within group.

TABLE 28: EFFECT OF STRANGULATED JEJUNAL OBSTRUCTION ON RUMINAL FLUID CALCIUM AND PHOSPHORUS IN CALVES (MEAN±S.E).

GROUPS	HOURS AFTER CREATION OF JEJUNAL OBSTRUCTION				
	0	24#	48	72	96
CALCIUM (mg/dL)					
Group I	8.00 ±0.365 (n=4)	7.98 ±0.103 (n=4)	7.88 ±0.253 (n=4)	8.05 ±0.15 (n=2)	8.10 N.I. ±0.0 (n=1)
Group II	8.23 ±0.511 (n=4)	8.03 ±0.433 (n=4)	8.10 ±0.473 (n=4)	8.26 ±0.441 (n=3)	8.30 ±0.9 (n=2)
Group III	8.08 ±0.249 (n=4)	7.90 ±0.354 (n=4)	8.15 ±0.353 (n=4)	8.05 ±0.296 (n=4)	7.90 ±0.204 (n=4)
PHOSPHORUS (mg/dL)					
Group I	7.68 ±0.673 (n=4)	14.75** ±0.644 (n=4)	27.25** ±1.448 (n=4)	38.10* ±2.4 (n=2)	51.20 N.I. ±0.0 (n=1)
Group II	10.00 ±1.255 (n=4)	18.25** ±1.438 (n=4)	30.45[b] ±1.962 (n=4)	43.23[b] ±2.795 (n=3)	49.75[b] ±3.05 (n=2)
Group III	13.68 ±1.180 (n=4)	22.53** ±3.644 (n=4)	24.08 ±4.613 (n=4)	29.90 ±4.353 (n=4)	23.05[e] ±4.565 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 hour value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 24 hour value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding hour.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding hour.
N.I. - Value not included for statistical analysis within group.

Whereas, a significant (P<0.01) recovery during post treatment period was observed in the animals of group III when compared to group II (Table 27). The increase in ruminal fluid chloride concentration in the animals of group II was significant (P<0.05) at 48 and 72 hours of treatment when compared with 24 hours in the animals of group II. However, a significant (P<0.01) decline in ruminal fluid chloride was observed at 96 post obstruction hours in the animals of group III when compared to 24 hours. The comparison within groups (Table 27) revealed a significantly low ruminal fluid chloride concentration in the animals of group III as compared to group I (P<0.01: 48, 72 hours) and II (P<0.05: 48 hours and P<0.01: 72, 96 hours).

The ruminal fluid calcium did not show any significant alterations in the animals of group II and III in post treatment period (Table 28). The ruminal fluid phosphorus concentration continued to increase significantly (P<0.01) throughout the post treatment period in the animals of group II, whereas, no significant alteration was observed in the animals of group III when compared to 24 post obstruction hours. At 96 hours in group III, the ruminal fluid phosphorus concentration was significantly (P<0.05) low as compared to its corresponding value in the animals of group II (Table 28).

VI. OPERATIVE FINDINGS

The site of obstructed loop was discolored and appeared grayish in colour with irreversible stricture. The segment of intestine proximal to the site of obstruction was distended and was heavily congested with stagnated venous channels. The peristalsis was not seen in the immediate proximal. The distal segment was collapsed. The mesentery was extensively hemorrhagic and arterial pulsation was not present in the vicinity of affected intestine.

VII. TOTAL SURVIVAL TIME

The animals of group I served as disease control succumbed at different time following creation of strangulated jejunal obstruction. Two animals survived upto 72 hours and only one animal survived upto 96 hours. The average survival time in the animals of group I was 78.0± 9.49 hours. The survival time in the animals of group II with conservative treatment was 92.25 ± 8.67 hours. All the animals of group III survived following surgical treatment.

VIII. MICROBIOLOGICAL STUDIES

The peritoneal fluid was collected periodically before (0hour), during pretreatment and post treatment period for isolation and culture sensitivity tests. No microbial growth was observed in '0' hour samples of peritoneal fluid. Gram +ve bacilli, Gram –ve rods and Gram –ve cocobacilli were found during post treatment especially at 24 and 48 hours of strangulated and 4th day onwards in simple jejunal obstruction. The drug sensitivity profile revealed the sensitivity of the isolates to Amoxycillin, Gentamicin, Tetracycline, Ciprofloxacin, Cloxacillin, Erythromycin and Penicillin.

IX. ELECTROCARDIOGRAPHIC STUDIES

The electrocardiograms of group I and II revealed shallow T wave and ST segment depression at 48 hours of creation of strangulated jejunal obstruction. These changes on electrocardiogram were more pronounced in strangulated obstruction and appeared very late (6th day) in simple jejunal obstruction. One animal with simple obstruction exhibited atrial flutter and was found regurgitating the ruminal contents on the same day.

D. COMPARISON OF PATHOPHYSIOLOGICAL CHANGES BETWEEN SIMPLE AND STRANGULATED JEJUNAL OBSTRUCTION

The pathophysiological alterations which occurred in blood following creation of strangulated and simple jejunal obstruction were compared at 24 and 72 hours post obstruction respectively. All the haematological parameters were almost comparable at this stage but there was a slight increase in packed cell volume and TLC in the strangulated obstruction when compared to simple obstruction (Table 29). The plasma electrolyte concentration showed early and severe hypochloraemia, hypokalemia in the strangulated obstruction at 24 hours post obstruction as compared to 72 hours of simple obstruction.

TABLE 29: COMPARISON OF CLINICAL AND HAEMATOLOGICAL PARAMETERS BETWEEN SIMPLE AND STRANGULATED JEJUNAL OBSTRUCTION (MEAN ± S.E.)(n=12).

S. No.	Parameter	Strangulated (24 hours)	Simple (3rd day)
1	Rectal temperature (^{o}F)	101.78±0.18	100.4±0.172
2	Respiration rate (/min)	14.5±0.544	15.58±0.570
3	Heart rate (/min)	87.17±1.313	80.75±1.332
4	CRT (sec)	0.96±0.096	1.21±0.096
5	Ruminal fluid pH	6.8±0.085	6.7±0.047
6	Haemoglobin (g%)	10.7±0.153	9.73±0.404
7	PCV (%)	36±0.749	38.33±0.882
8	TEC (x 10^{6}/cu mm)	6.28±0.142	6.37±0.271
9	TLC (x 10^{3}/cu mm)	7879.17±281.73	11062.5±319.69
10	Neutrophils	40.67±0.81	39.08±0.556
11	Lymphocytes	59±1.101	58.92±0.57
12	Ruminal Motility (/2min)	0.495±0.118	0.248±0.109

The increase in plasma total proteins concentration was marked in strangulated obstruction than in the simple one. The plasma enzymes though remained in normal range but there was considerable elevation in the concentration of ALKP, AST and ALT in all the animals of three groups subjected to strangulated jejunal obstruction when compared to simple jejunal obstruction (Table 30). The total proteins concentration and total nucleated cell count of peritoneal fluid were higher in strangulated obstruction as compared to simple obstruction. All other parameters *viz.* clinical parameters, blood biochemical profile, peritoneal fluid biochemical profile and ruminal fluid biochemical profile indicated comparable pathological alterations after 24 hours of creation of strangulated obstruction and following 72 hours of simple obstruction (Table 29, 30).

TABLE 30: COMPARISON OF PATHOPHYSIOLOGICAL CHANGES IN BODY FLUIDS BETWEEN SIMPLE AND STRANGULATED JEJUNAL OBSTRUCTION (MEAN ± S.E.) (n=12).

S. No.	Parameter	Strangulated (24 hours)	Simple (3rd day)
1	Plasma glucose (mg/dL)	74.167±2.847	77.75±2.481
2	Plasma total Protein (g/dL)	7.07±0.139	8.04±0.211
3	Plasma BUN (mg/dL)	19.44±1.825	22.83±2.786
4	Plasma creatinine (mg/dL)	1.23±0.029	2.17±0.227
5	Plasma total bilirubin (mg/dL)	0.18±0.007	0.15±0.007
6	Plasma sodium (mEq/L)	131.5±2.19	139.67±1.389
7	Plasma potassium (mEq/L)	4.13±0.041	4.0±0.136
8	Plasma chloride (mEq/L)	98.17±1.645	89.12±2.058
9	Plasma calcium (mg/dL)	7.14±0.180	6.66±0.182
10	Plasma phosphorus (mg/dL)	5.28±0.164	5.61±0.208
11	Plasma ALKP (IU/L)	109.17±2.088	112.58±2.087
12	Plasma AST (IU/L)	111.08±2.569	103.83±3.284
13	Plasma ALT (IU/L)	29.92±0.965	44.83±1.850
14	Plasma amylase (IU/L)	27.67±1.394	28.17±1.284
15	Peritoneal fluid pH	6.73±0.077	6.94±0.091
16	Peritoneal fluid total protein (g/dL)	3.98±0.134	3.8±0.14
17	Peritoneal fluid cell count (x 10^3/cu mm)	3.67±0.127	3.41±0.92
18	Peritoneal fluid sodium (mEq/L)	138.17±0.903	140.33±0.772
19	Peritoneal fluid potassium (mEq/L)	4.075±0.052	3.84±0.145
20	Peritoneal fluid chloride (mEq/L)	88.01±1.688	90.53±1.895
21	Peritoneal fluid calcium (mg/dL)	6.22±0.124	5.63±0.187
22	Peritoneal fluid phosphorus (mg/dL)	4.57±0.276	4.475±0.251
23	Ruminal fluid sodium (mEq/L)	130±1.371	88.5±2.105
24	Ruminal fluid potassium (mEq/L)	23.25±0.897	20.53±0.981
25	Ruminal fluid chloride (mEq/L)	42.12±0.864	53.49±1.192
26	Ruminal fluid calcium (mg/dL)	7.97±0.172	8.73±0.203
27	Ruminal fluid phosphorus (mg/dL)	18.51±1.534	34.34±2.357

E. AUTOPSY CHANGES

Simple obstruction

Gross changes

The affected segment of intestine was dark purple to bluish in colour. The segment orad to obstruction was extremely distended with fluidy and foul smelling ingesta while the distal part appeared pallor and collapsed and the mucosa was peeling off easily. The omasum contained dehydrated ingesta. Petechial hemorrhages were observed in the mesentery and peritoneum. The quantity of peritoneal fluid was more with its colour appearing high yellow. The rumen epithelium was found sloughed at certain areas.

Histopathological changes

The mucosa of the affected part of intestine showed severe necrosis and infiltration with predominantly the neutrophils. The submucosa was heavily thickened due to oedema and infiltration with lymphocytes and macrophages (Plate 8). Serosa was also congested and oedematous.

Strangulated obstruction

Gross changes

The affected segment of the bowel appeared dark red, with marked wall thickening due to oedema and infiltration of blood. Mucosa was severely congested, oedematous and exhibited ulcerated surface. The Serosal surface of the distal bowel segment also appeared severely congested and haemorrhagic. Coprostatic obstruction within the distended loop of intestine was evident. The mesentery was thick and rubbery with ecchymotic areas. The peritoneal fluid in the abdominal cavity was serosanguinous. The lymph nodes within the involved mesentery were swollen. The mucosal wall of abomasum was denuded and it contained more of the fluidy ingesta. Omasum contained dehydrated feed particles. Adhesions were present between omentum and peritoneum also involving loops of intestine.

Histopathological changes

The affected part of intestine showed complete mucosal damage and sloughing of the epithelial lining to the extent that even muscular layers were exposed at some places. The submucosa was heavily congested and oedematous (Plate 6). Atrophic and necrotic changes in muscularis layer were conspicuous. The serosa appeared thick due to edema and severely congested blood vessels.

Plate 6 : Photomicrograph of intestine affected with intestinal obstruction

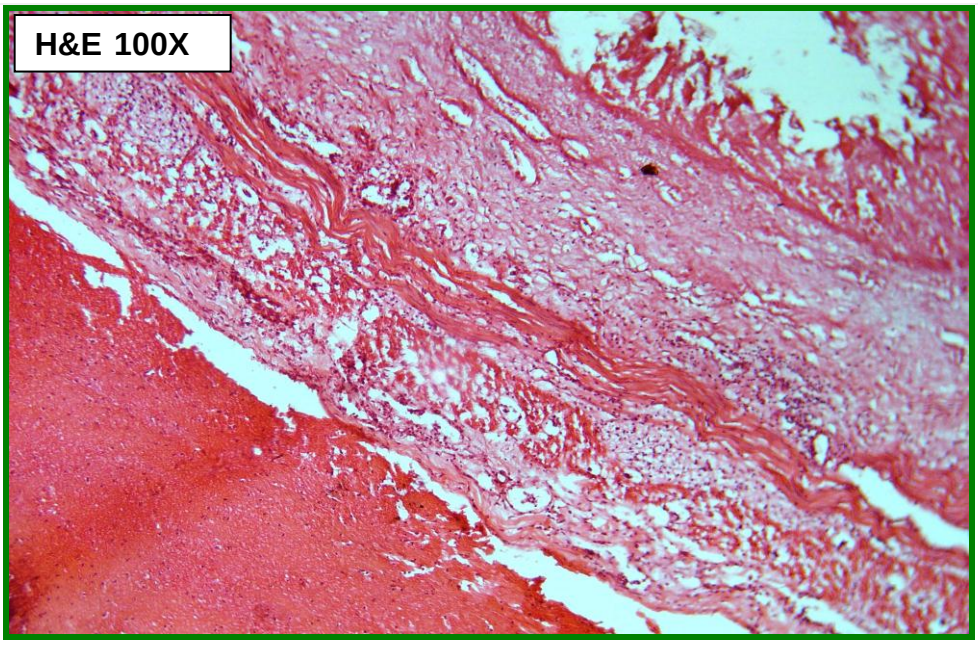
SIMPLE JEJUNAL OBSTRUCTION

A

1. Sloughing of villi from mucosal surface
2. Increase in eosinophilic matrix in the submucosa

STRANGULATED JEJUNAL OBSTRUCTION

B



1. Denudation of epithelial lining
2. Severe oedema in submucosa
3. Atrophic and necrotic changes in muscularis layer
4. Serosa heavily congested and oedematous

F. DISTAL INTESTINAL OBSTRUCTION

F (1). SIMPLE COLONIC OBSTRUCTION

I. CLINICAL OBSERVATIONS

PRE TREATMENT

All the animals showed mild signs of discomfort and pain after creation of simple colonic obstruction. These symptoms abolished within 4-6 hours and thereafter the animals resumed their normal activity. Animals exhibited groaning, kicking at the abdomen and restlessness on 5th day. The animals showed a repeated tendency to lie down 11th and 12 the day. The signs disappeared and from 13th day onwards the symptoms of weakness were observed.

Defecation was normal on the day of creation of simple intestinal obstruction. Urination was normal in the animals of group II and III but oligouria was noticed in group I as the duration of obstruction progressed.

The feed and water intake was normal in all the animals of three groups upto 7th day of creation of obstruction, thereafter appetite reduced considerably but browsing on small amount of fodder was continued throughout the period of study till 11th day. Subsequently on 13th day all the animals of group I and II showed the tendency of prolonged recumbency and were totally reluctant to eat even when the fodder was offered.

Rumen motility decreased to almost half at 2nd post obstruction day and later from 3rd day onward the rumen became totally atonic. The gut sounds were absent in the terminal part of study. Abdominal distention was seen on 4th day onward which gradually increased with time and in later part of the study.

There was a significant ($P<0.01$) decrease in the rectal temperature at 3rd and 6th post obstruction days when compared to the base values in the animals of all three groups. The decrease in the rectal temperature also remained highly significant ($P<0.01$) throughout the period of study in the animals of group I (Table 31). A highly significant ($P<0.01$) rise in the respiratory rate was recorded in the animals of group II and III at 6th post obstruction day when compared to their respective base values. However, a significantly higher ($P<0.01$) rise in respiration rate was observed in the animals of the group I at 6th day onward when compared to its base value (Table 31). There was a significant ($P<0.01$) decrease in the heart rate at 3rd and 6th post obstruction days when compared to the base values in the animals of all three groups. The highly significant tachycardia persisted throughout the period of obstruction in the animals of group I (Table 31). The pulse rate in the animals of all the three groups also showed the similar trend (Table 31).

A comprehensive lassitude was evident in all the animals after 4-5 days following the creation of the obstruction. The hair coat appeared muffledand the elasticity of skin gradually diminished. The muzzle was completely dry (Plate 7). The eyes began to retract inside the

orbital cavity and at 9th day the recession of eye balls was very much conspicuous (Plate 7). These symptoms were exaggerated in the animals of group I as compared to group II. The ongoing deterioration in the condition of animals of group I was grievous, late at 10th day.

Rise in capillary refill time (CRT) was significant (P<0.05) in group I and highly significant (P<0.01) in group II and III at 6th post obstruction day. However, this rise was highly significant 9th post obstruction day onwards in the animals of group I (Table 32). T

There was significant decrease in ruminal fluid pH in the animals of group I and III (P<0.05) at 6th post obstruction day when compared to base values (Table 32). The significant (P<0.01) decreasing trend in the ruminal fluid pH continued throughout the period of study upto 12th day in the animals of group I. There was a moderate loss (++) of ruminal microflora at 5th post obstruction day but as the duration of obstruction progressed, the loss became sluggish (+) at 7th and 9th day and afterwards complete loss (-) was evident.

POST TREATMENT

The animals of group II voided faeces upto 9th post obstruction day. The amount of faeces decreased and the mucoid content persistently increased even after institution of medical therapy at 3rd post obstruction day. Animals passed watery faeces on 2nd day and later from 5th day onward the consistency was almost normal. The stools passed immediately after the operation had a foul odour, which vanished in due course of time. The frequency of urination was 4-5 times a day in the animals of group II and III after the institution of treatment.

Feed and water intake was reduced progressively in the animals of group II. All the animals showed the tendency of occasional grasps at the fodder but after 10th post obstruction day the feed and water intake was absolutely absent, whereas the animals of group III resumed normal feed and water intake from 5th day onward.

Complete cessation of ruminal movements was recorded in all the animals of group II even after the institution of medical treatment at 6th day, whereas, in the animals of group III a feeble contraction of rumen was observed at 5th day when compared with 3rd post obstruction day interval. From 7th day onward appreciable ruminal motility (1/3min) was present but the rumen was hypotonic. There was a progressive enlargement of the abdomen in the animals of group II and at the end of the study marked bilateral abdominal distention was observed.

A significant (P<0.01) decrease in the rectal temperature was recorded at 9th, 12th and 15th days in the animals of group II when compared to 6th post obstruction day, whereas, a significant (P<0.01) increase was noticed in the animals of group III on corresponding days when compared to the 6th day values. A significant (P<0.01) rise in rectal temperature was recorded at 9th, 12th and 15th days and in the animals of group III when compared with the animals of group I and II.

PLATE 7: CLINICAL SIGNS DURING SIMPLE COLON OBSTRUCTION IN CALVES

DRYNESS OF MUZZLE

Eye ball recession during terminal stage of obstruction

TABLE 31: FFECT OF SIMPLE COLONIC OBSTRUCTION ON RECTAL TEMPERATURE, RESPIRATION RATE, HEART RATE AND PULSE RATE IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION					
	0	3	6#	9	12	15
RECTAL TEMPERATURE (ºF)						
Group I	101.85 ±0.320 (n=4)	101.15** ±0.222 (n=4)	100.3** ±0.263 (n=4)	99.35** ±0.320 (n=4)	98.10** ±0.420 (n=4)	97.33** ±0.176 (n=3)
Group II	102.1 ±0.238 (n=4)	101.2** ±0.294 (n=4)	100.4** ±0.316 (n=4)	99.6[b] ±0.258 (n=4)	98.63[b] ±0.309 (n=4)	97.6[b] ±0.271 (n=4)
Group III	101.8 ±0.216 (n=4)	100.8** ±0.294 (n=4)	99.95** ±0.379 (n=4)	101.65 [bdf] ±0.330 (n=4)	101.75 [bdf] ±0.340 (n=4)	101.7 [bdf] ±0.351 (n=4)
RESPIRATION RATE (/min)						
Group I	14.0 ±0.816 (n=4)	15.5 ±0.50 (n=4)	17.0** ±0.577 (n=4)	18.5** ±0.5 (n=4)	21.5** ±1.5 (n=4)	26.0* ±2.0 (n=3)
Group II	14.75 ±0.478 (n=4)	15.5 ±0.5 (n=4)	18.5** ±0.5 (n=4)	20.0 ±1.414 (n=4)	22.0[a] ±1.414 (n=4)	24.5[b] ±1.258 (n=4)
Group III	13.5 ±0.957 (n=4)	15.5 ±0.5 (n=4)	17.0** ±1.291 (n=4)	14.5[bde] ±0.5 (n=4)	14.0[bdf] ±0.817 (n=4)	14.75[bdf] ±0.854 (n=4)
HEART RATE (/min)						
Group I	73.0 ±1.291 (n=4)	81.0** ±2.646 (n=4)	95.0** ±3.109 (n=4)	106.75** ±3.038 (n=4)	114.5** ±2.754 (n=4)	122.0 [N.I.] ±3.0 (n=3)
Group II	74.0 ±2.449 (n=4)	83.5** ±3.5 (n=4)	97.0** ±3.697 (n=4)	103.5[b] ±3.403 (n=4)	110.0[b] ±4.397 (n=4)	115.5[b] ±4.272 (n=4)
Group III	71.5 ±1.708 (n=4)	81.0** ±2.646 (n=4)	94.0** ±3.162 (n=4)	74.0[bdf] ±2.582 (n=4)	73.5[bdf] ±2.217 (n=4)	72.5[bdf] ±2.062 (n=4)
PULSE RATE (/min)						
Group I	73.0 ±1.291 (n=4)	80.5** ±2.217 (n=4)	94.0** ±2.582 (n=4)	105.5** ±2.50 (n=4)	114.0** ±2.582 (n=4)	122.0 [N.I.] ±3.464 (n=3)
Group II	73.5 ±2.754 (n=4)	83.5** ±3.5 (n=4)	96.5** ±3.304 (n=4)	102.5[b] ±2.872 (n=4)	109.0[b] ±3.873 (n=4)	114.5[b] ±3.775 (n=4)
Group III	71.0 ±1.732 (n=4)	80.5** ±2.630 (n=4)	94.0** ±3.162 (n=4)	73.5[bdf] ±2.217 (n=4)	73.0[bdf] ±1.732 (n=4)	71.5[bdf] ±1.708 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 6 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

TABLE 32: EFFECT OF SIMPLE COLONIC OBSTRUCTION ON CAPILLARY REFILL TIME AND RUMINAL FLUID pH IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION					
	0	3	6#	9	12	15
CAPILLARY REFILL TIME (sec)						
Group I	0.675 ±0.118 (n=4)	0.875 ±0.125 (n=4)	1.125* ±0.239 (n=4)	1.5** ±0.288 (n=4)	2.125** ±0.239 (n=4)	2.667** ±0.167 (n=3)
Group II	0.55 ±0.05 (n=4)	0.8 ±0.123 (n=4)	1.25** ±0.144 (n=4)	1.50 ±0.204 (n=4)	1.75[b] ±0.144 (n=4)	1.875[b] ±0.239 (n=4)
Group III	0.6 ±0.058 (n=4)	0.725 ±0.103 (n=4)	1.375** ±0.125 (n=4)	0.875[a] ±0.239 (n=4)	0.6[bdf] ±0.057 (n=4)	0.55[bdf] ±0.05 (n=4)
RUMINAL FLUID Ph						
Group I	6.925 ±0.075 (n=4)	6.85 ±0.087 (n=4)	6.7* ±0.123 (n=4)	6.55** ±0.087 (n=4)	6.425** ±0.103 (n=4)	6.433 ±0.145 (n=3)
Group II	7.0 ±0.123 (n=4)	6.85 ±0.087 (n=4)	6.775 ±0.144 (n=4)	6.625 ±0.075 (n=4)	6.475[a] ±0.075 (n=4)	6.425[b] ±0.103 (n=4)
Group III	6.95 ±0.086 (n=4)	6.875 ±0.075 (n=4)	6.675* ±0.118 (n=4)	6.85[c] ±0.087 (n=4)	7.025[bdf] ±0.025 (n=4)	6.95[acf] ±0.087 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 6 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

Respiratory rate increased significantly on 12th (P<0.05) and 15th (P<0.01) days in the animals of group II when compared to 6th day values, on the contrary, in animals of group III significant (P<0.01) decrease in respiration rate was observed on 9th, 12th and 15th days in post treatment period when compared to 6th day values. The comparison within groups showed a significant decrease in respiration rate in animals of group III at 9th, 12th and 15th day when compared to group I and II in the post treatment period (Table 1). The increase in heart rate in the animals of group II was significant (P<0.01) at day 9th, 12th and 15th when compared to 6th post obstruction day. Contrariwise, heart rate decreased significantly (P<0.01) during post treatment intervals in the animals of group III when compared to 6th post obstruction day. The inter group comparison revealed a statistically significant (P<0.01) decrease in heart rate attaining normalcy following treatment in group III when compared to group I and II. Similar changes were observed in pulse rate (Table 31).

The skin turgor was affected mildly during the entire post treatment period in the animals of group II. Conjunctival mucous membrane was pale in the terminal part of study in the animals of group II. Statistically significant (P<0.01) rise in CRT was seen on 12th and 15th days in the animals of group II. CRT values were near normal in post treatment period in the animals of group III which were significantly (P<0.01) lower in comparison to group I and II on 12th and 15th day (Table 32).

A significant decrease in the pH of ruminal fluid was recorded in the animals of group II (12th day: P<0.05, 15th day: P<0.01) and III (12th day: P<0.01, 15th day: P<0.05) when compared to 6th day in post treatment period. On comparison to group I, a significant increase in ruminal pH at 9th (P<0.05), 12th (P<0.01) and 15th (P<0.05) day interval was observed in the animals of group III. Similarly, significant (P<0.01) increase was recorded in ruminal pH at 12th and 15th days in the animals of group III on comparison to group II (Table 66). The loss of ruminal microflora in the animals of group II was almost comparable to group I with a difference of slow pace in former, whereas in group III sluggish (+) to moderate (++) loss of micro flora was present upto 8th day and afterwards complete rejuvenation (+++) of microflora was observed.

II. HAEMATOLOGICAL ALTERATIONS

PRE TREATMENT

A highly significant (P<0.01) rise in the haemoglobin concentration was recorded 3rd and 6th post obstruction days in the animals of all the three groups when compared with base values. A highly significant (P<0.01) rise was observed in haemoglobin values in the animals of group I. A significant rise in the PCV was observed on 3rd (P<0.05) and 6th (P<0.01) post obstruction days in the animals of group II and III when compared to base values. Whereas, a highly significant (P<0.01) rise was observed in the PCV in the animals of group I throughout the period of study.

A highly significant (P<0.01) rise in total erythrocytic count (TEC) was found on 3rd and 6th post obstruction days in all the three groups when compared to their base values. A significant (P<0.01) rise in TEC persisted throughout the period of study in the animals of group I (Table 33). Similar observations were recorded in total leukocytic count (TLC) in all the animals of three groups when compared to respective base values (Table 34). A significant (P<0.01) neutrophilia was evident on 3rd and 6th days after the creation of simple intestinal obstruction. An unrelenting neutrophilia compared to base value persisted in the entire post obstruction period in the animals of Group I (Table 34). Contrariwise, a highly significant post obstruction decrease in lymphocytic count was noticed on 6th day following creation of simple intestinal obstruction in the animals of all the three groups when compared to base values. A highly significant decrease in lymphocytes was observed throughout the period of obstruction in the animals of group I (Table 34).

POST TREATMENT

The animals of group II during post treatment period showed a significant rise in haemoglobin (Hb) concentration on 9th (P<0.05), 12th (P<0.01) and 15th (P<0.01) days when compared with 6th post obstruction day, whereas, in the animals of group III, a significant (P<0.01) decrease in Hb concentration was noticed when compared with its 6th day values. The increase in Hb concentration in group I was significant on 12th (P<0.05) and 15th (P<0.01) days when compared to corresponding days in group II. Similarly, Hb concentration

TABLE 33: EFFECT OF SIMPLE COLONIC OBSTRUCTION ON HAEMOGLOBIN, PACKED CELL VOLUME AND TOTAL ERYTHROCYTE COUNT IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION					
	0	3	6#	9	12	15
HAEMOGLOBIN (g%)						
Group I	9.45 ±0.299 (n=4)	10.6** ±0.374 (n=4)	12.15** ±0.411 (n=4)	13.75** ±0.457 (n=4)	15.45** ±0.350 (n=4)	16.73** ±0.291 (n=3)
Group II	9.85 ±0.222 (n=4)	11.05** ±0.299 (n=4)	12.65** ±0.301 (n=4)	13.1[a] ±0.265 (n=4)	13.8[bc] ±0.294 (n=4)	14.4[bd] ±0.216 (n=4)
Group III	10.2 ±0.337 (n=4)	11.8** ±0.432 (n=4)	13.3** ±0.387 (n=4)	10.45[bdf] ±0.556 (n=4)	10.2[bdf] ±0.283 (n=4)	10.25[bdf] ±0.222 (n=4)
PACKED CELL VOLUME (%)						
Group I	31.25 ±1.109 (n=4)	36.5** ±1.258 (n=4)	42.0** ±1.826 (n=4)	47.5** ±2.217 (n=4)	52.25** ±2.715 (n=4)	56.67** ±0.667 (n=3)
Group II	34.0 ±2.121 (n=4)	39.0* ±1.78 (n=4)	43.0** ±2.483 (n=4)	46.0[a] ±1.581 (n=4)	48.5[b] ±1.555 (n=4)	50.75[bc] ±1.652 (n=4)
Group III	37.75 ±2.016 (n=4)	42.25* ±2.955 (n=4)	46.25** ±4.11 (n=4)	39.75[a] ±2.626 (n=4)	38.5[bdf] ±1.443 (n=4)	37.25[bdf] ±1.548 (n=4)
TOTAL ERYTHROCYTIC COUNT (millions/cu mm)						
Group I	6.07 ±0.107 (n=4)	6.695** ±0.255 (n=4)	7.17** ±0.177 (n=4)	7.733** ±0.209 (n=4)	8.213** ±0.191 (n=4)	8.656** ±0.530 (n=3)
Group II	6.445 ±0.229 (n=4)	6.91** ±0.329 (n=4)	7.37** ±0.238 (n=4)	7.493[c] ±0.245 (n=4)	7.59[a] ±0.302 (n=4)	7.738[b] ±0.292 (n=4)
Group III	6.71 ±0.192 (n=4)	7.143** ±0.255 (n=4)	7.608** ±0.313 (n=4)	6.973[b] ±0.101 (n=4)	6.873[bd] ±0.106 (n=4)	6.698[bde] ±0.154 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 6 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

was significantly (P<0.01) lower in the animals of group III in comparison to group I and II in the post treatment period (Table 33).

There was significant increase in PCV values at 9th (P<0.05), 12th (P<0.01) and 15th (P<0.01) day in the animals of group II when compared to its 6th post obstruction day. The animals of group III showed a highly significant decrease in PCV on 9th (P<0.05), 12th (P<0.01) and 15th (P<0.01) when compared to 6th post obstruction day. The animals of group II showed significant (P<0.05) decrease in PCV values on 15th day when compared to group I. Whereas, the inter group comparison of group III with group I and II revealed statistically significant (P<0.01) decrease on 12th and 15th day intervals (Table 33).

TABLE 34: EFFECT OF SIMPLE COLONIC OBSTRUCTION ON TOTAL LEUKOCYTE COUNT, NEUTROPHILS AND LYMPHOCYTES IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION					
	0	3	6#	9	12	15
TOTAL LEUKOCYTIC COUNT (x 10^3/cu mm)						
Group I	8.71 ±0.574 (n=4)	10.56** ±0.648 (n=4)	12.65** ±0.790 (n=4)	13.46** ±0.725 (n=4)	14.55** ±0.667 (n=4)	15.37** ±0.567 (n=3)
Group II	8.46 ±0.441 (n=4)	10.95** ±0.419 (n=4)	13.08** ±0.495 (n=4)	13.65^{b} ±0.508 (n=4)	13.78^{b} ±0.573 (n=4)	14.04^{b} ±0.587 (n=4)
Group III	8.31 ±0.729 (n=4)	10.88** ±0.737 (n=4)	13.24** ±0.867 (n=4)	11.35^{b} ±0.124 (n=4)	10.36^{bce} ±0.106 (n=4)	9.95^{bde} ±0.991 (n=4)
NEUTROPHILS (% of TLC)						
Group I	28.75 ±0.629 (n=4)	32.25** ±1.109 (n=4)	36.5** ±1.323 (n=4)	41.25** ±1.109 (n=4)	45.25** ±1.377 (n=4)	48.67* ±0.882 (n=3)
Group II	27.75 ±0.478 (n=4)	31.5** ±0.866 (n=4)	35.5** ±1.323 (n=4)	38.75^{b} ±0.854 (n=4)	41.5^{b} ±0.866 (n=4)	44.75^{b} ±1.436 (n=4)
Group III	29.5 ±1.041 (n=4)	33.75** ±1.548 (n=4)	37.0** ±1.472 (n=4)	35.25^{ac} ±1.493 (n=4)	32.75^{bdf} ±1.75 (n=4)	30.75^{bdf} ±2.056 (n=4)
LYMPHOCYTES (% of TLC)						
Group I	70.0 ±0.707 (n=4)	66.5** ±1.258 (n=4)	62.5** ±0.958 (n=4)	58.0** ±0.707 (n=4)	53.0** ±1.291 (n=4)	50.0** ±1.732 (n=3)
Group II	70.75 ±0.250 (n=4)	67.0* ±1.080 (n=4)	63.0** ±0.816 (n=4)	60.25^{a} ±1.181 (n=4)	57.25^{bc} ±0.75 (n=4)	54.5^{b} ±1.555 (n=4)
Group III	69.25 ±1.436 (n=4)	64.75** ±1.109 (n=4)	61.5** ±1.555 (n=4)	63.5^{ac} ±1.323 (n=4)	66.25^{bdf} ±1.377 (n=4)	67.75^{bdf} ±1.797 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 6 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

A significant rise in TEC at 12th (P<0.05) and 15th (P<0.01) day was recorded in the animals of group II when compared to 6th post obstruction day, whereas the TEC decreased significantly (P<0.01) following surgical treatment when compared to 6th post obstruction day in the animals of group III (Table 33). The animals of group I showed significant rise in TEC values when comparison to group II (9th day: P<0.05) and III (12th and 15th day: P<0.01) in post treatment period, whereas, in group III a significant (P<0.05) decrease was recorded on 15th day when compared to group II. The animals of group II exhibited a significant (P<0.01) increase in TLC following treatment when compared to 6th post obstruction day. However, a significant (P<0.01) decrease in TLC was observed in animals of group III when compared to 6th day value following the surgical treatment. The animals of group III showed significant decrease in TLC when compared to group I (12th day: P<0.05, 15th day: P<0.01) and II (12th

and 15th day: P<0.05) following surgical treatment.A significant (P<0.01) increase in neutrophils was recorded in group II at all post treatment intervals but, significant reduction in neutrophils was seen at 9th (P<0.05), 12th (P<0.01) and 15th (P<0.01) days in the animals of group III when compared to its 6th post obstruction day value. The inter group comparison showed a statistically significant tendency of normalization in the values of neutrophils in the animals of group III when compared to group I (9th day: P<0.05, 12th and 15th day: P<0.01) and II (12th and 15th day: P<0.01) (Table 34).

Following conservative therapy a gradual decline in the lymphocytic count was noticed which was statistically significant at 9th (P<0.05), 12th (P<0.01) and 15th (P<0.01) day when compared to 6th post obstruction day in the animals of group II, whereas, a significant increase was observed in the animals of group III on 9th (P<0.05), 12th (P<0.01) and 15th (P<0.01) day when compared to 6th post obstruction day. On inter group comparison with group II, a significant (P<0.05) decrease was noticed in lymphocytic count at 12th day in animals of group I. Whereas, a statistically significant tendency of normalization in the values of lymphocytes was observed in the animals of group III when compared to group I (9th day: P<0.05, 12th and 15th day: P<0.01) and group II (12th and 15th day: P<0.01) (Table 34).

III. BIOCHEMICAL CHANGES IN PLASMA

PRE TREATMENT

Blood glucose concentration did not show any significant alteration throughout the period of study in the animals of group II, whereas a slight non-significant rise in blood glucose concentration was noticed at 3rd and 6th post obstruction days in the animals of group I and III when compared to base value (Table 35).

There was significant (P<0.01) increase in total plasma proteins on 3rd and 6th post obstruction days following creation of simple intestinal in all the animals of three groups in comparison to base values. A highly significant rise in the total plasma protein concentration continued throughout the period of study in the animals of group I (Table 35).

The blood urea nitrogen concentration increased significantly (P<0.01) at 3rd and 6th post obstruction days in the animals of group II and III. This concentration was significantly (P<0.05) elevated on 3rd day and remained constantly higher (P<0.01) in the entire post obstruction period in the animals of group I (Table 35). The plasma creatinine concentration increased significantly (P<0.01) in all the animals of all groups at 3rd and 6th days following creation of simple intestinal obstruction. In the animals of group I significant (P<0.01) rise in the concentration of plasma creatinine was observed throughout the period of study (Table 35).

TABLE 35: EFFECT OF SIMPLE COLONIC OBSTRUCTION ON GLUCOSE, TOTAL PLASMA PROTEINS, BLOOD UREA NITROGEN AND CREATININE IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION					
	0	3	6#	9	12	15
GLUCOSE (mg/dL)						
Group I	56.25 ±4.328 (n=4)	60.78 ±3.594 (n=4)	63.5 ±1.848 (n=4)	65.5 ±2.661 (n=4)	64.75 ±1.797 (n=4)	65.67 ±2.186 (n=3)
Group II	65.25 ±1.493 (n=4)	67.25 ±2.810 (n=4)	66.75 ±1.931 (n=4)	81.5^{bd} ±3.069 (n=4)	79.75^{bd} ±3.425 (n=4)	76.25^{ac} ±2.869 (n=4)
Group III	53.5 ±1.708 (n=4)	64.0** ±1.080 (n=4)	66.25** ±1.652 (n=4)	88.25^{bd} ±4.09 (n=4)	92.5^{bd} ±5.331 (n=4)	90.0^{bde} ±4.637 (n=4)
TOTAL PLASMA PROTEIN (mg/dL)						
Group I	6.23 ±0.269 (n=4)	7.3** ±0.319 (n=4)	8.7** ±0.286 (n=4)	10.25** ±0.233 (n=4)	11.2** ±0.208 (n=4)	12.43* ±0.145 (n=3)
Group II	6.425 ±0.132 (n=4)	7.5** ±0.183 (n=4)	8.575** ±0.10 (n=4)	7.925^{d} ±0.202 (n=4)	8.3^{d} ±0.158 (n=4)	9.075^{bd} ±0.202 (n=4)
Group III	6.575 ±0.193 (n=4)	7.875** ±0.281 (n=4)	8.775** ±0.333 (n=4)	7.0^{bde} ±0.258 (n=4)	6.675^{bdf} ±0.239 (n=4)	6.6^{bdf} ±0.147 (n=4)
BLOOD UREA NITROGEN (mg/dL)						
Group I	11.65 ±1.318 (n=4)	23.5* ±1.323 (n=4)	42.75** ±2.136 (n=4)	67.0** ±3.697 (n=4)	85.0** ±5.447 (n=4)	104.0** ±3.055 (n=2)
Group II	9.35 ±0.685 (n=4)	25.45** ±1.735 (n=4)	46.425** ±2.722 (n=4)	61.9^{b} ±1.567 (n=4)	77.2^{b} ±2.584 (n=4)	99.025^{b} ±2.322 (n=3)
Group III	11.75 ±1.118 (n=4)	28.5** ±1.8 (n=4)	48.25** ±1.813 (n=4)	34.5^{bdf} ±1.369 (n=4)	17.9^{bdf} ±1.298 (n=4)	10.85^{bdf} ±1.019 (n=4)
CREATININE (mg/dL)						
Group I	1.123 ±0.066 (n=4)	1.833** ±0.073 (n=4)	2.708** ±0.119 (n=4)	3.663** ±0.082 (n=4)	4.77** ±0.117 (n=4)	5.51* ±0.091 (n=3)
Group II	1.14 ±0.065 (n=4)	1.938** ±0.080 (n=4)	2.948** ±0.117 (n=4)	3.183^{bc} ±0.104 (n=4)	3.58^{bd} ±0.135 (n=4)	3.945^{bd} ±0.099 (n=4)
Group III	1.253 ±0.109 (n=4)	2.158** ±0.157 (n=4)	3.128** ±0.184 (n=4)	1.965^{bdf} ±0.102 (n=4)	1.332^{bdf} ±0.077 (n=4)	1.215^{bdf} ±0.051 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 6 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

TABLE 36: EFFECT OF SIMPLE COLONIC OBSTRUCTION ON PLASMA TOTAL BILIRUBIN (mg/dL) IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION					
	0	3	6#	9	12	15
Group I	0.106 ±0.011 (n=4)	0.21* ±0.03 (n=4)	0.33** ±0.029 (n=4)	0.45** ±0.037 (n=4)	0.618** ±0.068 (n=4)	0.73** ±0.015 (n=3)
Group II	0.113 ±0.103 (n=4)	0.218** ±0.015 (n=4)	0.358** ±0.023 (n=4)	0.46^{b} ±0.027 (n=4)	0.563^{b} ±0.035 (n=4)	0.64^{b} ±0.032 (n=4)
Group III	0.115 ±0.021 (n=4)	0.26** ±0.044 (n=4)	0.38** ±0.045 (n=4)	0.248^{bdf} ±0.038 (n=4)	0.185^{bdf} ±0.025 (n=4)	0.13^{bdf} ±0.022 (n=4)

\# - Day of institution of treatment

*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.

a, b - 5% and 1% level of significance respectively when compared to 6 day value of the same group.

c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.

e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

The rise in plasma total bilirubin concentration was significant (P<0.05) at 3rd post obstruction day and subsequently it was significantly (P<0.01) higher throughout the period of observation in the animals of group I when compared with base value. There was highly significant (P<0.01) increase in plasma total bilirubin in the animals of group II and III at 3rd and 6th post obstruction days when compared with base values (Table 36).

A significant (P<0.01) decrease in plasma sodium concentration was recorded in all the animals of all the groups at 3rd and 6th days and this decrease was persistent throughout the period of observation in the animals of group I (Table 71). Similarly, as compared to base value a significant decline (P<0.01) in plasma potassium concentration was recorded at 3rd and 6th days following induction of simple intestinal obstruction in all the animals of all the groups and this decreasing trend continued (P<0.01) throughout the period of study in the animals of group I (Table 37). Likewise a significant (P<0.01) hypochloraemia was noticed on 3rd and 6th post obstruction days obstruction in all the animals of all the groups. A significant (P<0.01) hypochloraemia was observed in the animals of group I throughout the period of study (Table 37). Inconsistent changes were recorded in plasma calcium and phosphorus concentration in all the animals of three groups when compared to base values (Table 37, 38).

Plasma Alkaline phosphatase and aspartate amino transferase concentrations were elevated (P<0.01) at 3rd and 6th days following creation of simple intestinal obstruction in the animals of all the three groups when compared to their base values (Table 39). The concentration of these enzymes remained significantly (P<0.01) elevated during the entire course of obstruction in the animals of group I. Plasma alanine amino transferase concentration was elevated significantly (P<0.01) on 3rd post obstruction day in animals of group III and on 6th

TABLE 37: EFFECT OF SIMPLE COLONIC OBSTRUCTION ON PLASMA SODIUM, POTASSIUM, CHLORIDE AND CALCIUM IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION					
	0	3	6#	9	12	15
SODIUM (mEq/L)						
Group I	145.5 ±1.258 (n=4)	140.5** ±0.957 (n=4)	134.0** ±0.817 (n=4)	127.5** ±0.957 (n=4)	119.5** ±1.708 (n=4)	114.67** ±1.764 (n=3)
Group II	146.0 ±1.414 (n=4)	139.5** ±1.708 (n=4)	133.0** ±2.082 (n=4)	144.5bd ±1.258 (n=4)	145.0bd ±1.291 (n=4)	143.5bd ±1.5 (n=4)
Group III	146.0 ±1.155 (n=4)	139.0** ±1.291 (n=4)	130.5** ±1.5 (n=4)	144.5bd ±1.5 (n=4)	144.0bd ±0.817 (n=4)	146.0bd ±1.155 (n=4)
POTASSIUM (mEq/L)						
Group I	4.7 ±0.058 (n=4)	4.2** ±0.082 (n=4)	3.55** ±0.096 (n=4)	3.2** ±0.163 (n=4)	2.85** ±0.15 (n=4)	2.4** ±0.116 (n=3)
Group II	4.65 ±0.129 (n=4)	4.35** ±0.129 (n=4)	3.75** ±0.171 (n=4)	3.6 ±0.141 (n=4)	3.45bc ±0.129 (n=4)	3.45bd ±0.15 (n=4)
Group III	4.8 ±0.082 (n=4)	4.15** ±0.096 (n=4)	3.55** ±0.096 (n=4)	4.85bdf ±0.05 (n=4)	4.9bdf ±0.058 (n=4)	4.85bdf ±0.096 (n=4)
CHLORIDE (mEq/L)						
Group I	103.25 ±1.336 (n=4)	88.9** ±1.795 (n=4)	79.63** ±2.241 (n=4)	70.23** ±1.199 (n=4)	61.75** ±1.279 (n=4)	54.53** ±1.299 (n=3)
Group II	103.53 ±1.031 (n=4)	91.35** ±1.318 (n=4)	82.75** ±2.933 (n=4)	81.28c ±2.891 (n=4)	79.78d ±2.734 (n=4)	78.175bd ±1.829 (n=4)
Group III	102.05 ±1.084 (n=4)	91.25** ±2.070 (n=4)	80.95** ±1.143 (n=4)	100.2bdf ±0.636 (n=4)	102.13bdf ±0.695 (n=4)	101.63bdf ±0.811 (n=4)
CALCIUM (mg/dL)						
Group I	7.1 ±0.178 (n=4)	6.88 ±0.086 (n=4)	6.83 ±0.202 (n=4)	6.98 ±0.382 (n=4)	6.93 ±0.085 (n=4)	7.17 ±0.088 (n=3)
Group II	7.03 ±0.063 (n=4)	6.83 ±0.202 (n=4)	6.95 ±0.104 (n=4)	7.0 ±0.178 (n=4)	6.9 ±0.135 (n=4)	6.93 ±0.103 (n=4)
Group III	6.98 ±0.086 (n=4)	6.85 ±0.029 (n=4)	7.03 ±0.132 (n=4)	6.85 ±0.185 (n=4)	7.1 ±0.147 (n=4)	7.03 ±0.111 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 6 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

TABLE 38: EFFECT OF SIMPLE COLONIC OBSTRUCTION ON PLASMA PHOSPHORUS IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION					
	0	3	6#	9	12	15
Group I	5.6 ±0.071 (n=4)	5.63 ±0.232 (n=4)	5.67 ±0.025 (n=4)	5.63 ±0.048 (n=4)	5.68 ±0.048 (n=4)	5.67 ±0.088 (n=3)
Group II	5.83 ±0.063 (n=4)	5.56 ±0.189 (n=4)	5.9 ±0.082 (n=4)	5.95 ±0.119 (n=4)	5.88 ±0.149 (n=4)	5.95 ±0.233 (n=4)
Group III	5.9 ±0.268 (n=4)	5.75 ±0.238 (n=4)	5.95 ±0.318 (n=4)	5.85 ±0.260 (n=4)	5.68 ±0.179 (n=4)	5.73 ±0.180 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 6 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

post obstruction day in animals of all the three groups. Serum ALT concentration of these remained significantly (P<0.01) elevated 6th day onward in the animals of group I.

POST TREATMENT

Variable changes in plasma glucose concentration during post treatment period were found inconclusive. Overall, significant rise in the glucose concentration was recorded both in the animals of group II (9th and 12th day: P<0.01, 15th day: P<0.05) and III (P<0.01). On comparison basis animals of group II exhibited significant increase in glucose concentration when compared to group I. The inter group comparison revealed significant rise in glucose concentration in animals of group III as compared to group I (P<0.01) and group II (15th day: P<0.05) (Table 35).

A significant rise in total plasma protein concentration was recorded on 15th day (P<0.01) in the animals of group II, whereas, a significant (P<0.01) decrease was noticed on all post treatment intervals in group III when compared to 6th post obstruction day value of respective groups. There was significant (P<0.01) decline in the concentration of total plasma proteins on all post treatment intervals in the animals of group II and III when compared to group I. Similarly, the animals of group III revealed a statistically significant (P<0.05: 9th day and P<0.01: 12th and 15th day) decrease of plasma proteins during post treatment period when compared to the corresponding intervals of animals of group II. (Table 35).

The blood urea nitrogen concentration remained significantly (P<0.01) elevated even after institution of conservative therapy when compared to 6th post obstruction day in the animals of group II. However, significant (P<0.01) decrease in BUN concentration was noticed

TABLE 39: EFFECT OF SIMPLE COLONIC OBSTRUCTION ON PLASMA ALKP, AST AND ALT IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION					
	0	3	6#	9	12	15
ALKALINE PHOSPHATASE (IU/L)						
Group I	98.0 ±1.871 (n=4)	114.75** ±2.689 (n=4)	131.5** ±3.5 (n=4)	146.0** ±5.339 (n=4)	156.0** ±4.262 (n=4)	168.67** ±6.692 (n=3)
Group II	96.25 ±2.562 (n=4)	117.25** ±2.562 (n=4)	134.75** ±3.172 (n=4)	142.5[b] ±3.227 (n=4)	150.5[b] ±3.926 (n=4)	162.25[b] ±3.568 (n=4)
Group III	101.75 ±2.056 (n=4)	120.25** ±3.172 (n=4)	137.5** ±4.052 (n=4)	132.75 ±2.839 (n=4)	123.75[bdf] ±4.715 (n=4)	110.75[bdf] ±4.871 (n=4)
AST (IU/L)						
Group I	85.75 ±8.81 (n=4)	123.75** ±3.473 (n=4)	147.5** ±5.485 (n=4)	163.5** ±3.069 (n=4)	195.0** ±4.44 (n=4)	218.67** ±9.838 (n=3)
Group II	79.5 ±2.363 (n=4)	125.25** ±6.588 (n=4)	148.5** ±4.787 (n=4)	160.75[b] ±5.706 (n=4)	173.5[b] ±6.602 (n=4)	198.0[b] ±4.301 (n=4)
Group III	88.75 ±4.211 (n=4)	126.0** ±3.367 (n=4)	154.25** ±4.785 (n=4)	138.25[bde] ±3.301 (n=4)	128.5[bdf] ±3.884 (n=4)	104.75[bdf] ±5.677 (n=4)
ALT (IU/L)						
Group I	24.0 ±3.559 (n=4)	31.0 ±2.323 (n=4)	38.5** ±3.014 (n=4)	46.25** ±5.105 (n=4)	54.25** ±6.290 (n=4)	64.67** ±4.702 (n=3)
Group II	28.5 ±1.041 (n=4)	34.75 ±2.136 (n=4)	41.25** ±4.442 (n=4)	44.75 ±5.039 (n=4)	48.5[a] ±4.252 (n=4)	54.75[b] ±5.893 (n=4)
Group III	27.25 ±2.898 (n=4)	35.75** ±2.136 (n=4)	44.25** ±3.119 (n=4)	38.25[b] ±2.926 (n=4)	34.75[bce] ±3.326 (n=4)	29.75[bde] ±3.705 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 6 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

in comparison to 6th day in the animals of group III from 9th day onward. The animals of group III showed very significant (P<0.01) recovery in BUN values after surgical correction when compared to animals of group I and II (Table 35). The plasma creatinine concentration remained significantly (P<0.01) higher in the animals of group II throughout the post treatment period when compared to 6th post obstruction day. On the contrary, after surgical treatment in the animals of group III the plasma creatinine concentration decreased significant (P<0.01) from 9th day onward. The animals of group II showed a gradual but significant increase in plasma creatinine concentration on 9th (P<0.05), 12th (P<0.01) and 15th (P<0.01) day in comparison to group I. Whereas, a highly significant (P<0.01) decrease in plasma creatinine concentration was recorded in group III when compared to corresponding values of other two groups (Table 35).

The plasma total bilirubin concentration remained significantly high (P<0.01) during entire treatment period when compared to 6th post obstruction day in the animals of group II. Whereas, in the animals of group III, the plasma bilirubin concentration reduced significantly (P<0.01) following surgical treatment when compared to 6th post obstruction day. The animals of group III showed significant (P<0.01) lowering of bilirubin concentration following treatment in comparison to group I and II (Table 36).

The blood sodium concentration returned to normal range in the animals of group II and III in comparison to respective 6th post obstruction day. A significant (P<0.01) rise in sodium concentration was recorded in the animals of group II and III when compared to group I in the post treatment period (Table 37). Similarly, a slow pace but significant (p<0.01) drop in the plasma potassium concentration was evident 12th and 15th day in the animals of group II when compared to 6th post obstruction day. Whereas, following surgical treatment a significant (P<0.01) revival of plasma potassium concentration in comparison to 6th post obstruction day was observed in the animals of group III. The animals of group II exhibited slow pace decrease (12 day: P<0.05, 15 day: P<0.01) in potassium concentration as compared to group I. A significant (P<0.01) rise in plasma potassium concentration towards normalization was noticed during the post treatment period in the animals of group III when compared to group I and II (Table 37). A significant (P<0.01) decrease in plasma chloride concentration at 15th day was observed in the animals of group II when compared to 6th day value. Whereas, a significant (P<0.01) recuperation in plasma chloride concentration occurred in the animals of group III during entire post surgical period when compared to 6th post obstruction day (Table 37).

The inter-group comparison revealed a significant higher levels of plasma chloride concentration in the animals of group II when compared to group I (9th day: P<0.05, 12th and 15th day: P<0.01). Furthermore, the comparison of group III with group I and II exhibited a significant (P<0.01) recovery in the plasma chloride concentration in surgically treated animals during the entire post treatment period. Incoherent alterations in the values of plasma calcium and phosphorus following medical and surgical treatment were observed in the animals of group II and III (Table 37, 38).

A highly significant (P<0.01) rise in plasma Alkaline phosphatase (ALKP) was recorded throughout the entire post treatment period in the animals of group II when compared to 6th post obstruction day value. In the animals of group III plasma ALKP decreased towards normal level and its post treatment values were significantly (P<0.01) lower when compared to 6th post obstruction day. There was marked (P<0.01) improvement in ALKP concentration at 12th and 15th day in the animals of group III when compared to the corresponding intervals of group I and II (Table 39). The plasma AST concentration was significantly (P<0.01) higher in the animals of group II when compared to 6th post obstruction day. The animals of group III revealed a significant (P<0.01) decrease in plasma AST in comparison to 6th day value during the entire post treatment period. The decrease in plasma

AST was highly significant in the animals of group III when compared to group I ($P<0.01$) and II (9^{th} day: $P<0.05$, 12^{th} and 15^{th} day: $P<0.01$) on corresponding days (Table 39). A statistically significant rise in plasma ALT concentration was recorded on 12^{th} ($P<0.05$) and 15^{th} ($P<0.01$) day when compared to 6^{th} day in animals of group II. Whereas, a significant ($P<0.01$) decrease in plasma ALT was observed in the animals of group III during the entire post surgery period, when compared to 6^{th} post obstruction day. Plasma ALT values decreased towards normalcy in the group III animals when compared to group I (12^{th} day: $P<0.05$, 15^{th} day: $P<0.01$) and II (12^{th} and 15^{th} day: $P<0.05$).

IV. CHANGES IN PERITONEAL FLUID

PRE TREATMENT

The peritoneal fluid in the animals of group I was straw colour before creation of simple colonic but the colour showed yellowish tinge as the duration of obstruction increased intestinal obstruction. The animals of group I showed highly significant ($P<0.01$) decrease in peritoneal pH from 6^{th} day post obstruction onward. A significant decrease in the pH was observed on narrow range pH paper in the animals of group II (3^{rd} and 6^{th} day: $P<0.05$) and III (3^{rd} day: $P<0.05$, 6^{th} day: $P<0.01$) in the pre treatment period (Table 40).

A significant ($P<0.01$) rise in the peritoneal fluid total protein and cell count was recorded throughout the period of study when compared to base values in the animals of group I. The significant ($P<0.01$) rise in protein content was noticed on 3^{rd} and 6^{th} day in all the animals of three groups following creation of simple intestinal obstruction when compared to their base values (Table 40). A significant increase in cell count was noticed on 3^{rd} (Group I and II: $P<0.01$, Group III: $P<0.05$) and 6^{th} day ($P<0.01$: Group I, II and III) post obstruction when compared to base values.

A significant decrease in peritoneal fluid sodium concentration was recorded at 3^{rd} day in the animals of group I and III ($P<0.05$) and II ($P<0.01$) when compared to their '0' hour concentrations respectively. On 6^{th} day this decline in sodium concentration was highly significant ($P<0.01$) in animals of all the three groups. However, this decline in sodium concentration was significant ($P<0.01$: 9^{th} and 12^{th} day, $P<0.05$: 15^{th} day) throughout the period of obstruction in the animals of group I (Table 11). The potassium concentration in peritoneal fluid decreased significantly at 3^{rd} (Group I: $P<0.01$) and 6^{th} day following creation of intestinal obstruction in the animals of group I, II ($P<0.01$) and III ($P<0.05$) as compared to respective base values (Table 41). This decline in peritoneal fluid potassium concentration was consistently significant ($P<0.01$) during the whole period of observation in the animals of group I.

The peritoneal fluid chloride concentration decreased significantly ($P<0.01$) when compared to base value at 3^{rd} post obstruction day and this decreasing trend continued till death supervened in the animals of group I. Similarly, a significant ($P<0.01$) decrease in peritoneal fluid chloride concentration at 3^{rd} and 6^{th} post obstruction days was observed in group II and III when compared to respective base values (Table 41).

TABLE 40: EFFECT OF SIMPLE COLONIC OBSTRUCTION ON PERITONEAL FLUID pH, TOTAL PROTEINS AND NUCLEATED CELL COUNT IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION					
	0	3	6#	9	12	15
PERITONEAL FLUID pH						
Group I	7.23 ±0.103 (n=4)	7.18 ±0.854 (n=4)	6.98** ±0.025 (n=4)	6.9** ±0.071 (n=4)	6.85** ±0.065 (n=4)	6.77* ±0.033 (n=3)
Group II	7.3 ±0.071 (n=4)	7.18* ±0.048 (n=4)	7.13* ±0.075 (n=4)	6.95^{a} ±0.104 (n=4)	6.83^{b} ±0.075 (n=4)	6.73^{b} ±0.025 (n=4)
Group III	7.28 ±0.048 (n=4)	7.13* ±0.085 (n=4)	6.9** ±0.082 (n=4)	7.05^{b} ±0.065 (n=4)	7.15^{bce} ±0.065 (n=4)	7.23^{bdf} ±0.048 (n=4)
TOTAL PERITONEAL FLUID PROTIENS (mg/dL)						
Group I	2.23 ±0.209 (n=4)	3.25** ±0.259 (n=4)	4.3** ±0.424 (n=4)	4.93** ±0.391 (n=4)	5.95** ±0.459 (n=4)	6.5** ±0.351 (n=3)
Group II	2.48 ±0.170 (n=4)	3.28** ±0.269 (n=4)	3.75** ±0.301 (n=4)	4.93^{b} ±0.179 (n=4)	5.5^{b} ±0.204 (n=4)	5.9^{b} ±0.363 (n=4)
Group III	2.55 ±0.155 (n=4)	3.68** ±0.259 (n=4)	4.85** ±0.218 (n=4)	2.95^{bdf} ±0.202 (n=4)	2.65^{bdf} ±0.353 (n=4)	2.53^{bdf} ±0.263 (n=4)
NUCLEATED CELL COUNT (x 10^3/cu mm)						
Group I	2.14 ±0.151 (n=4)	3.29** ±0.223 (n=4)	4.44** ±0.466 (n=4)	5.59** ±0.223 (n=4)	6.78** ±0.371 (n=4)	7.77** ±0.551 (n=3)
Group II	1.89 ±0.191 (n=4)	3.33** ±0.285 (n=4)	4.31** ±0.314 (n=4)	4.84^{b} ±0.386 (n=4)	5.23^{bc} ±0.326 (n=4)	5.46^{bc} ±0.436 (n=4)
Group III	1.98 ±0.217 (n=4)	3.15* ±0.636 (n=4)	4.38** ±0.482 (n=4)	3.78^{ac} ±0.461 (n=4)	3.21^{bdf} ±0.279 (n=4)	2.66^{bdf} ±0.30 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 6 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.
N.I. - Value not included for statistical analysis within group.

The changes in the concentration of calcium and phosphorus in the peritoneal fluid were inconclusive following creation of intestinal obstruction in all the animals of three groups (Table 41, 42).

POST TREATMENT

The animals of group II showed significant decrease in peritoneal fluid pH at 9th day (P<0.05), 12th (P<0.01) and 15th (P<0.01) day when compared to 6th day. Whereas, a significant (P<0.01) increase was evident in the peritoneal fluid pH in the animals of group III (Table 10) when compared to the 6th day. The animals of group III showed significant (12th day: P<0.05, 15th day: P<0.01) improvement towards normalcy when compared to animals of group I and II.

TABLE 41: EFFECT OF SIMPLE COLONIC OBSTRUCTION ON PERITONEAL FLUID SODIUM, POTASSIUM, CHLORIDE AND CALCIUM IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION					
	0	3	6#	9	12	15
SODIUM (mEq/L)						
Group I	140.0 ±2.449 (n=4)	137.0* ±2.380 (n=4)	135.0** ±2.082 (n=4)	132.0** ±1.633 (n=4)	127.5** ±2.217 (n=4)	125.33* ±2.404 (n=3)
Group II	141.5 ±1.50 (n=4)	137.5** ±2.217 (n=4)	134.5** ±1.708 (n=4)	142.0^{bd} ±1.826 (n=4)	140.5^{bd} ±1.50 (n=4)	141.5^{bd} ±1.893 (n=4)
Group III	139.0 ±1.291 (n=4)	1.35* ±2.082 (n=4)	131.5** ±2.363 (n=4)	141.0^{bd} ±1.732 (n=4)	141.5^{bd} ±1.50 (n=4)	141.0^{bd} ±1.291 (n=4)
POTASSIUM (mEq/L)						
Group I	4.45 ±0.15 (n=4)	4.1** ±0.129 (n=4)	3.85** ±0.126 (n=4)	3.6** ±0.141 (n=4)	3.35** ±0.222 (n=4)	2.93** ±0.241 (n=3)
Group II	4.25 ±0.206 (n=4)	4.05 ±0.15 (n=4)	3.6** ±0.163 (n=4)	4.1^{bc} ±0.129 (n=4)	3.95^{bc} ±0.096 (n=4)	3.75^{c} ±0.126 (n=4)
Group III	4.3 ±0.173 (n=4)	4.1 ±0.129 (n=4)	3.95* ±0.096 (n=4)	4.35^{bc} ±0.15 (n=4)	4.4^{bc} ±0.183 (n=4)	4.35^{bdf} ±0.096 (n=4)
CHLORIDE (mEq/L)						
Group I	98.55 ±2.079 (n=4)	87.18** ±4.041 (n=4)	75.58** ±3.283 (n=4)	66.85** ±1.836 (n=4)	56.18** ±3.769 (n=4)	52.4** ±2.479 (n=3)
Group II	97.75 ±2.164 (n=4)	84.55** ±3.694 (n=4)	72.58** ±4.827 (n=4)	78.83^{bc} ±3.901 (n=4)	75.8^{d} ±2.948 (n=4)	73.75^{d} ±3.531 (n=4)
Group III	97.03 ±1.473 (n=4)	84.83** ±3.611 (n=4)	74.48** ±4.394 (n=4)	90.1^{bd} ±3.022 (n=4)	95.78^{bdf} ±2.109 (n=4)	96.63^{bdf} ±2.115 (n=4)
CALCIUM (mg/dL)						
Group I	5.85 ±0.185 (n=4)	5.9 ±0.108 (n=4)	5.68 ±0.225 (n=4)	5.95 ±0.194 (n=4)	6.05 ±0.156 (n=4)	6.13 ±0.233 (n=3)
Group II	6.15 ±0.210 (n=4)	6.2 ±0.091 (n=4)	6.05 ±0.087 (n=4)	5.93 ±0.165 (n=4)	6.03 ±0.165 (n=4)	5.88 ±0.111 (n=4)
Group III	5.8 ±0.070 (n=4)	5.85 ±0.065 (n=4)	5.73** ±0.132 (n=4)	5.68 ±0.048 (n=4)	5.88 ±0.138 (n=4)	5.68 ±0.103 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 6 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

The discolouration in peritoneal fluid showed gradual improvement towards normalcy after institution of the surgical treatment in the animals of group III. The total protein concentration of peritoneal fluid remained elevated ($P<0.01$) in the animals of group II as compared to 6th post obstruction day.

TABLE 42: EFFECT OF SIMPLE COLONIC OBSTRUCTION ON PERITONEAL FLUID PHOSPHORUS IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION					
	0	3	6#	9	12	15
Group I	4.58 ±0.144 (n=4)	4.6 ±0.100 (n=4)	4.38 ±0.132 (n=4)	4.48 ±0.103 (n=4)	4.53 ±0.165 (n=4)	4.5 ±0.058 (n=3)
Group II	4.73 ±2.256 (n=4)	4.83 ±0.075 (n=4)	4.8 ±0.108 (n=4)	4.75 ±0.065 (n=4)	4.7 ±0.071 (n=4)	4.85 ±0.133 (n=4)
Group III	4.9 ±0.123 (n=4)	4.98 ±0.179 (n=4)	4.77 ±0.064 (n=4)	4.86 ±0.127 (n=4)	4.83 ±0.048 (n=4)	4.88 ±0.138 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 6 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

Whereas, a significant (P<0.01) decrease in total protein was noticed during entire post surgery intervals when compared to 6th post obstruction day in the animals of group III. The animals of group III exhibited a significant (P<0.01) decrease when compared to group I and II at all post treatment intervals (Table 40). A significant (P<0.01) rise in peritoneal fluid cell count was recorded in the animals of group II when compared to 6th post obstruction day. Whereas, a statistically significant (P<0.01) decrease in the cell count was observed on 9th (P<0.05), 12th (P<0.01) and 15th (P<0.01) in the animals of group III as compared to 6th post obstruction day. On comparative basis, a significant (P<0.05) slow pace increase in peritoneal fluid cell count was observed on 12th and 15th day in the animals of group II when compared to group I. Similarly, a significant decrease in peritoneal cell count was recorded in animals of group III when compared to group I (9th day: P<0.05, 12th and 15th day: P<0.01) and II (12 and 15th day: P<0.01) (Table 40).

The animals of both the groups II and III showed a significant (P<0.01) increase in the peritoneal fluid sodium concentration on all post treatment intervals when compared to 6th post obstruction day.

The inter-group comparison revealed that the conservative (group II) and surgical (group III) therapy offsets (P<0.01) the sodium deficit which was quite evident in the animals of group I (Table 41). There was a significant (9th and 12th day: P<0.01) increase in the peritoneal fluid potassium concentration in the animals of group II when compared to 6th post obstruction day. Similarly, after surgical treatment, a significant (P<0.01) rise in potassium concentration was recorded at all post treatment intervals in the animals of group III when compared to 6th post obstruction day. The animals of group II showed significant (P<0.05) recovery of potassium at 9th, 12th and 15th day in comparison to group I. The animals of group III exhibited a significant increase in peritoneal fluid potassium concentration when

compared to group I (9th and 12th day: P<0.05, 15th day: P<0.01) and II (15th day: P<0.01) (Table 41). The chloride concentration in peritoneal fluid improved significantly (P<0.01) on 9th day in the animals of group II when compared to 6th post obstruction day. The chloride concentration in peritoneal fluid was elevated significantly (P<0.01) at all post treatment days in the animals of group III as compared to 6th post obstruction day.

The animals of group II showed significant higher peritoneal chloride concentration on 9th (P<0.05), 12th and 15th (P<0.01) day when compared to group I value of the corresponding interval. Similarly, a significant recuperation of chloride in peritoneal fluid occurred in the animals of group III when compared to group I (all days: P<0.01) and II (12th and 15th days: P<0.01) (Table 41). No alterations in peritoneal fluid calcium and phosphorus were seen at different time intervals in the animals of group II and III (Table 41, 42).

V. ALTERATIONS IN RUMINAL FLUID BIOCHEMISTRY

PRE TREATMENT

A decreasing trend in the ruminal fluid sodium concentration was seen from 3rd day onward following creation of simple intestinal obstruction. In comparison to their respective base values its drop was highly significant (P<0.01) at 3rd and 6th post obstruction day in the animals of all the three groups. A significant (P<0.01) decrease in ruminal fluid sodium concentration was observed throughout the period of obstruction in the animals of group I as compared to base values (Table 43).

In comparison to their respective base values the drop in ruminal fluid potassium concentration was significant at 3rd (P<0.01: Group II, P<0.05: group III) and 6th (P<0.01 : All groups) post obstruction days. A significant (P<0.01) decrease in ruminal fluid sodium concentration was observed throughout the period of obstruction following 9th day in the animals of group I as compared to base value (Table 43).

Contrarily, the ruminal fluid chloride and phosphorus concentration rose significantly (P<0.01) in all the groups on 3rd and 6th day following simple intestinal obstruction when compared to respective base values. A significant (P<0.01) progressive rise in ruminal fluid chloride and phosphorus concentration persisted throughout period of study in the animals of animals of group I (Table 43).Inconsistent changes were encountered in ruminal fluid calcium concentration following creation of intestinal obstruction in all the animals of three groups (Table 43).

POST TREATMENT

A significant (P<0.01) decline in ruminal fluid sodium concentration persisted throughout the post treatment period in group II in comparison to 6th post obstruction day. However, the animals of group III depicted a significant (P<0.01) increase in ruminal sodium concentration when compared to 6th post obstruction day. The inter-group comparison revealed a significant recovery of sodium in the animals of group III in comparison to group I (9th and 12th day: P<0.05, 15th day: P<0.01) and II (all days: P<0.01) (Table 43).

TABLE 43: EFFECT OF SIMPLE COLONIC OBSTRUCTION ON RUMINAL FLUID SODIUM, POTASSIUM, CHLORIDE AND CALCIUM IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION					
	0	3	6#	9	12	15
SODIUM (mEq/L)						
Group I	125.0 ±6.608 (n=4)	112.5** ±6.131 (n=4)	102.5** ±4.573 (n=4)	96.5** ±6.185 (n=4)	90.5** ±6.602 (n=4)	83.33** ±5.457 (n=3)
Group II	118.5 ±2.630 (n=4)	107.0** ±4.435 (n=4)	99.5** ±5.252 (n=4)	94.0^{b} ±4.243 (n=4)	88.5^{b} ±4.349 (n=4)	84.0^{b} ±4.690 (n=4)
Group III	121.5 ±2.217 (n=4)	110.0** ±4.163 (n=4)	101.5** ±3.775 (n=4)	117.5^{bcf} ±3.096 (n=4)	116.5^{bcf} ±2.872 (n=4)	119.5^{bdf} ±3.862 (n=4)
POTASSIUM (mEq/L)						
Group I	30.0 ±2.944 (n=4)	26.5 ±3.304 (n=4)	24.0** ±3.162 (n=4)	21.25** ±2.810 (n=4)	17.75** ±1.931 (n=4)	15.33** ±2.906 (n=3)
Group II	27.0 ±3.512 (n=4)	24.5* ±3.304 (n=4)	20.5** ±4.031 (n=4)	18.0 ±3.651 (n=4)	17.0^{a} ±3.00 (n=4)	15.0^{b} ±3.317 (n=4)
Group III	27.5 ±4.031 (n=4)	24.0** ±3.916 (n=4)	21.0** ±4.435 (n=4)	25.0^{a} ±4.041 (n=4)	27.0^{b} ±4.796 (n=4)	28.5^{be} ±3.862 (n=4)
CHLORIDE (mEq/L)						
Group I	22.5 ±1.80 (n=4)	37.25** ±2.411 (n=4)	57.43** ±4.03 (n=4)	73.45** ±4.692 (n=4)	89.93** ±5.183 (n=4)	106.03** ±3.991 (n=3)
Group II	21.13 ±1.945 (n=4)	38.03** ±3.027 (n=4)	57.75** ±4.113 (n=4)	72.9^{b} ±4.636 (n=4)	91.18^{b} ±5.419 (n=4)	102.85^{b} ±5.53 (n=4)
Group III	24.28 ±3.05 (n=4)	41.38** ±4.351 (n=4)	61.5** ±5.002 (n=4)	39.15^{bdf} ±2.873 (n=4)	25.48^{bdf} ±3.97 (n=4)	26.2^{bdf} ±2.526 (n=4)
CALCIUM (mg/dL)						
Group I	8.5 ±0.263 (n=4)	8.3 ±0.214 (n=4)	8.55 ±0.425 (n=4)	8.63 ±0.529 (n=4)	8.78 ±0.427 (n=4)	8.33 ±0.219 (n=3)
Group II	8.55 ±0.202 (n=4)	8.45 ±0.148 (n=4)	8.63 ±0.193 (n=4)	8.53 ±0.249 (n=4)	8.7 ±0.109 (n=4)	8.65 ±0.144 (n=4)
Group III	8.7 ±0.246 (n=4)	8.65 ±0.187 (n=4)	8.6 ±0.119 (n=4)	8.63 ±0.222 (n=4)	8.53 ±0.159 (n=4)	8.63 ±0.164 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 6 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

The deficit in ruminal fluid potassium concentration as compared to 6th post obstruction day was significantly (12th day: P<0.05, 15th day: P<0.01) evident in the animals of group II. However, the potassium concentration in ruminal fluid of group III significantly (P<0.01) recuperated at 12th post treatment day onward.

TABLE 44: EFFECT OF SIMPLE COLONIC OBSTRUCTION ON RUMINAL FLUID PHOSPHORUS IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION					
	0	3	6#	9	12	15
PHOSPHORUS (mg/dL)						
Group I	9.4 ±1.007 (n=4)	21.43** ±1.864 (n=4)	36.6** ±3.388 (n=4)	49.38** ±4.236 (n=4)	67.93** ±2.798 (n=4)	81.5** ±4.382 (n=3)
Group II	8.88 ±1.095 (n=4)	21.18** ±2.092 (n=4)	35.03** ±3.202 (n=4)	47.75^{b} ±2.938 (n=4)	62.65^{b} ±3.642 (n=4)	77.88^{b} ±4.570 (n=4)
Group III	9.2 ±1.16 (n=4)	21.23** ±2.44 (n=4)	36.275** ±3.022 (n=4)	19.95^{bdf} ±2.44 (n=4)	13.85^{bdf} ±2.274 (n=4)	10.03^{bdf} ±1.068 (n=4)

\# - Day of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 'hour' value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 6 day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

The comparison of group III with group II at 15th day revealed a significant (P<0.01) recovery in ruminal potassium concentration following surgical treatment (Table 43). The ruminal fluid chloride concentration remained significantly (P<0.01) high in post treatment period when compared to 6th post obstruction day in the animals of group II. Whereas, a highly significant (P<0.01) decrease as compared to 6th post obstruction day's value was noticed during post surgery period in the animals of group III. The inter-group comparison revealed significant (P<0.01) normalization of ruminal fluid chloride concentration in the animals of group III as compared to group I and II (Table 43).No changes in ruminal fluid calcium were noticed during post treatment period in the animals of group II and III (Table 43). A significant (P<0.01) rise in ruminal fluid phosphorus concentration was observed in the animals of group II but a significant (P<0.01) decrease in ruminal fluid phosphorus concentration was recorded in group III when compared to their respective 6th post obstruction day values. In comparison to group I and II, the normalization in ruminal fluid phosphorus concentration was significant (P<0.01) in the animals of group III (Table 44).

OPERATIVE FINDINGS

The site of obstructed loop was discolored and showed irreversible stricture. The segment of intestine proximal to the site of obstruction was greatly distended and showed bluish discolouration with no peristalsis upto considerable length. The distal segment was collapsed and the mesentery was hemorrhagic with adhesive reaction. The mesenteric vessels showed stasis and were engorged.

TOTAL SURVIVAL TIME

The animals of group I served as diseased control succumbed at different time interval following creation of simple colonic obstruction. The average survival time in the animals of group I was 15.75±0.629 days. The average survival time in the animals of group II with conservative treatment was 18.25±0.75 days. All the animals of group III survived following surgical treatment.

F(2). STRANGULATED COLONIC OBSTRUCTION

CLINICO-HAEMATO-BIOCHEMICAL ALTERATIONS AND THERAPEUTIC (CONSERVATIVE AND SURGICAL) ASPECTS IN STRANGULATED COLONIC OBSTRUCTION

I. CLINICAL OBSERVATIONS

Pre treatment

All the animals were showing clinical signs of acute pain within two hours of creation of strangulated colon obstruction which were exhibited by kicking at the abdomen, restlessness, lying down and getting up frequently, vocalization, stretching, straining to urinate and defecate. These signs remain visible up to 24 hours and the severity of pain was severe during initial 4-6 hours of obstruction. Absence of defecation in majority of animals was found after creation of strangulated colonic obstruction in all groups with exception of few in which scant faeces was seen. As the duration of obstruction increased the animals showed intense straining to eliminate a mucoid shreds (Plate 8) without a trace of stools.

The general frequency of passing the mucous was once a day till 3rd day in group I. The croupous and diptheric shreds from the rectum were visible after 4th day post obstruction up till the death of animals. Urination reduced gradually in animals of all the groups. The progressive debilitation continued in the animals of group I which was evident by dry lusterless hair coat and general appearance.

The animals of group I and II resumed almost normal feed and water intake after 36 ± 4.89 hours post obstruction hours but on 3rd day post obstruction marked loss of appetite was appreciated in animals of all the groups. Water intake was normal in the animals of all the group up to 3rd day and thereafter the animals of group I started to show the reduction in water intake till the completion of studies. The animals of all three groups exhibited the signs of muscular weakness which were manifested initially by reluctance to move at, instability of both fore and hind limbs at 24 hours. There was recession of eye ball at 4th day (Plate 8).

The animals exhibited difficulty while assuming the sternal recumbency. And even felt greater difficulty when attempted tried to rise at 3rd day post obstruction. Animals staggered to walk after 4th day. With the progression of time period of obstruction the animals of group I became recumbent in the terminal stage of sickness. In all the animals rumination ceased completely at 24 hours following the creation of obstruction.

Rectal temperature showed non significant increase initially up to 2nd day of creation of obstruction in all the groups and after that there was decline in the rectal temperature in group I and group II. This decline was highly significant ($P<0.01$) at 5th and 6th day post creation of the obstruction as compared to base values in the animal of group I (Table 79). There was slight increase in the rectal temperature in animals of group III on day 1 and 2nd day which became significant only at 3rd day ($P<0.05$).

PLATE 8: PATTERN OF FAECES AFTER CREATIOIN OF STRAGULATED COLONIC OBSTRUCTION AND SIGNS OF DEHYDRATION

	**24 hours post creation**
	**Animal defecating mucoid shreds after 48 hours post creation**
	**Eye ball Recession during the terminal stages of strangulated colonic obstruction**

There was increase in the respiration rate but was not significant untill 4th day but increase was highly significant (P<0.01) at 4th to 6th day when compared to base value of group I. Similarly there was non significant increase in the respiration rate in group II and animals of group III showed significant (P<0.01) increase on 2nd day post obstruction. There was significant increase in the heart rate (P<0.01) at 2nd day post obstruction in animals of group I, II, and III when compared to the base values. The heart remained significantly higher (P<0.01) throughout the period of obstruction in the animals of group I(Table 79).The pulse rate showed similar character it remained significantly higher (P<0.01) on and after day1 of obstruction till the end in animals of group I. The elevated pulse rate was seen after 24 hours which remained significantly (P<0.05) higher in animals of group II and the level of significance was (P<0.01) in animals of group III before the institution of the treatment.

There was general debility and animals were depressed after creation of obstruction in all the animals of group-I and group-II accompanied by the signs of dehydration. There was moderate recession of eye ball by 3rd day post obstruction in all the animals of group I, II. There was decrease in elasticity of skin after 4th day post obstruction in animals of group I. The muzzle became dry on 2nd day after creation of obstruction in animals of all the groups. A significant increase in capillary refill time (CRT) was observed at 5th day (P<0.01) and 6th day (P<0.05) post obstruction in the animals of group-I. The CRT values were showing non significant increase in the animals of group II. However, group III animals revealed significant (P<0.01) increase on 3rd post obstruction day.

Ruminal fluid pH showed decrease and it had decreased very significantly (P<0.01) from the 2nd post obstruction day through entire period of obstruction in the animals of group I and significant (P<0.05) from 3rd day in animals of group II. The ruminal fluid pH revealed significant (P<0.01) decline in animals of group III after 1st post obstruction day. The ruminal micro flora suffered sufficient loss at 48 hours and protozoan motility was almost negligible. There was no ruminal motility after 2nd days post obstruction in animals of all the groups.

POST TREATMET

The animals of group II and III passed scant faeces upto 2nd day post obstruction and from 3rd day onwards thick mucoid shreds were voided on intense straining. There was no defecation at all after 4th day post obstruction in animals of group II. The urination was normal in all the animals of group II but oligurea was seen towards in terminal part of the observation whereas, the animals group III the frequency and volume of urination remained unaffected. The animal showed reduced appetite after 1st day post obstruction and thereafter persistent reluctance for fodder was appreciated up to end of post treatment period. The animals of group III consumed rice gruel, soft hay and treacle after 6 hours of surgery and was able to consume full ration within three four day of surgical correction. Water intake was normal in the animal of group II up to 3rd day then it reduced considerably as the duration of obstruction progressed.

TABLE 45: EFFECT OF STRANGULATED COLONIC OBSTRUCTION ON RECTAL TEMPERATURE, RESPIRATION RATE, HEART RATE AND PULSE RATE IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF DISTAL STANGULATED OBSTRUCTION						
	0 D	1D	2D	3D#	4D	5D	6D
RECTAL TEMPERATURE (°F)							
GROUPI	101.05 ±0.52 (n=4)	101.95 ±0.68 (n=4)	102.15 ±0.66 (n=4)	101.75 ±0.52 (n=4)	100.75 ±0.377 (n=4)	99.35** ±0.59 (n=4)	98.86** ±0.61 (n=3)
GROUPII	100.9 ±0.129 (n=4)	102.10 ±0.46 (n=4)	102.20 ±0.35 (n=4)	102.10 ±0.17 (n=4)	101.7 ±0.26 (n=4)	100.9ad ±0.36 (n=4)	100.00b ±0.42 (n=4)
GROUPIII	100.23 ±0.233 (n=4)	100.73 ±0.133 (n=4)	100.66 ±0.768 (n=4)	101.63* ±0.296 (n=4)	100.53e ±0.267 (n=4)	100.53c ±0.176 (n=4)	100.43c ±0.176 (n=4)
RESPIRATION RATE (/MIN)							
GROUP I	14.00 ±0.40 (n=4)	16.25 ±0.47 (n=4)	16.50 ±0.86 (n=4)	17.75 ±1.31 (n=4)	19.00** ±1.29 (n=4)	20.00** ±1.38 (n=4)	22.00** ±1.08 (n=3)
GROUP II	13.00 ±0.40 (n=4)	15.00 ±0.40 (n=4)	15.00 ±0.40 (n=4)	16.00** ±0.40 (n=4)	17.25 ±0.47 (n=4)	18.50a ±0.65 (n=4)	19.25b ±0.75 (n=4)
GROUP III	14.25 ±0.62 (n=4)	16.00 ±0.40 (n=4)	17.50** ±0.86 (n=4)	19.00** ±0.81 (n=4)	18.50 ±0.65 (n=4)	17.00 ±0.40 (n=4)	16.50ad ±0.64 (n=4)
HEART RATE (/MIN)							
GROUP I	71.25 ±1.493 (n=4)	78.00 ±1.080 (n=4)	83.75** ±1.75 (n=4)	92.50** ±2.562 (n=4)	99.00** ±1.472 (n=4)	108.5** ±2.056 (n=4)	110.75** ±1.652 (n=3)
GROUP II	69.25 ±1.377 (n=4)	75.00 ±1.08 (n=4)	77.75** ±1.109 (n=4)	82.50**c ±1.041 (n=4)	88.75d ±1.315 (n=4)	93.00bd ±1.683 (n=4)	95.00bd ±2.483 (n=4)
GROUP III	61.75 ±1.652 (n=4)	68.25df ±1.548 (n=4)	72.00**d ±2.483 (n=4)	76.00**d ±2.198 (n=4)	70.00adf ±1.414 (n=4)	69.00adf ±0.408 (n=4)	66.25bdf ±0.75 (n=4)
PULSE RATE (/MIN)							
GROUP I	69.00 ±0.91 (n=4)	75.25** ±2.016 (n=4)	81.25** ±1.315 (n=4)	87.00** ±2.041 (n=4)	92.50** ±2.327 (n=4)	99.00** ±2.041 (n=4)	106.50** ±1.756 (n=3)
GROUP II	68.250 ±1.190 (n=4)	73.75* ±1.377 (n=4)	77.00** ±1.581 (n=4)	80.75** ±1.181 (n=4)	85.75c ±0.478 (n=4)	89.50d ±0.645 (n=4)	92.00d ±0.707 (n=4)
GROUP III	59.25 ±0.853 (n=4)	64.75** ±0.853 (n=4)	68.00** ±0.912 (n=4)	72.50** ±0.957 (n=4)	67.25df ±0.853 (n=4)	64.50df ±0.645 (n=4)	63.25df ±0.853 (n=4)

\# - Time of institution of treatment

*, ** - 5% and 1% level of significance respectively when compared to 0 day value of the same group.

a, b - 5% and 1% level of significance respectively when compared to 3rd day value of the same group.

c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day

e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

TABLE 46: EFFECT OF STRANGULATED COLONIC OBSTRUCTION ON CAPILLARY REFILL TIME AND RUMINAL FLUID pH IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION						
	0	1	2	3#	4	5	6
CAPILLARY REFILL TIME(SEC)							
GROUP I	0.52 ±0.047 (n=4)	0.56 ±0.055 (n=4)	0.60 ±0.040 (n=4)	0.67 ±0.062 (n=4)	0.71 ±0.042 (n=4)	0.78** ±0.042 (n=4)	0.90* ±0.040 (n=3)
GROUP II	0.55 ±0.05 (n=4)	0.63 ±0.02 (n=4)	0.71 ±0.01 (n=4)	0.85 ±0.05 (n=4)	0.87 ±0.06 (n=4)	0.96 ±0.14 (n=4)	1.03 ±0.19 (n=4)
GROUP III	0.5 ±0.0 (n=4)	0.56 ±0.03 (n=4)	0.73 ±0.14 (n=4)	0.86** ±0.17 (n=4)	0.86 ±0.06 (n=4)	0.66 ±0.03 (n=4)	0.56^{ae} ±0.03 (n=4)
RUMINAL FLUID pH							
GROUP I	7.075 ±0.047 (n=4)	6.95 ±0.028 (n=4)	6.73** ±0.023 (n=4)	6.62** ±0.047 (n=4)	6.40** ±0.108 (n=4)	6.27** ±0.094 (n=4)	6.17** ±0.062 (n=3)
GROUP II	7.12 ±0.047 (n=4)	6.97 ±0.062 (n=4)	6.88 ±0.065 (n=4)	6.52* ±0.118 (n=4)	6.42 ±0.131 (n=4)	6.35 ±0.119 (n=4)	6.27 ±0.179 (n=4)
GROUP III	7.10 ±0.040 (n=4)	6.90** ±0.040 (n=4)	6.80** ±0.040 (n=4)	6.65** ±0.028 (n=4)	6.75 ±0.028 (n=4)	6.82^{adf} ±0.025 (n=4)	6.97^{bdf} ±0.062 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 day value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3rd day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

Where as, in animals of group III water intake remained normal throughout the period of observation.

There were sign of muscular weakness during the post treatment period in animals of group II which was visible by frequent assumption of recumbency with difficulty to stand at 4th day and inability to stand at 7th day post obstruction. Whereas, animals of group III showed staggering gait in the morning hours upto 3rd post surgery day but were able to walk briskly by 6th post correction day.

The ruminal motility ceased at 24 hours post obstruction and remained so till the end in the animals of group II. Whereas, the animals of group III, rumen remained atonic till 48 hours after the surgical treatment but the rumen regained motility after 48 hours after surgical correction but remained hypotonic (1 per 5min).

The animals of group II suffered significant decrease ($P<0.05$; 5th day and $P<0.01$; 6th day) in the rectal temperature when compared to 3rd post obstruction day. However, rectal temperature showed decrease as compared to 3rd day towards the base value in the animals of group III. On inter group comparison the decline in the temperature in group I was significant ($P<0.05$; 5th and 6th day) when compared to group III (Table 45) and in comparison to group II the temperature was significantly ($P<0.01$) lower on 5th day in animals

of group I. On comparison with group II there was significant (P<0.01) decline on 4th day in animals of group III. The respiration rate kept on increasing after the institution of conservative treatment in animal of group II and was significantly high (P<0.05; 5th day, P<0.01; 6th) when compared to 3rd post obstruction day. Where as in surgically treated group the respiration rate decreased significantly (P<0.05) and showed a restitution at 6th day. On comparative basis the animals of group III showed significant improvement in respiration rate as compared to group I.

The increase in heart rate in animals of group II was significant at day 5th (P<0.05) and 6th (P<0.01) day when compared to 3rd post obstruction day. Contrary wise heart rate decreased significantly (P<0.05; 4th and 5th day, P<0.01; 6th day) day when compared to 3rd post obstruction day in group III animals. The inter group comparison revealed a statistically significant decrease (P<0.01) in heart rate following treatment in group II and III when compared to group I. Similarly in the animals of group III heart rate recorded was significantly (P<0.01) lower attaining normalcy following treatment when compared to group II. In the animals of group II and III non significant increase in the pulse rate was recorded in the entire post treatment period when compared to as compared to 3rd day post obstruction. On inter group comparison between animals of group I with group II and III, there was significant (P<0.05; 4th, P<0.01; 5th and 6th day) increase in pulse rate in group II, whereas in animals of group III there was significantly (P<0.01) lower pulse rate from 4th day onwards. In the animals of group III a significantly lower pulse rate from 4th day on wards was recorded as compared to group II.

There were signs of dehydration from 4th post obstruction day in the animals of group II marked by moderate increase in skin turgor and eye ball recession. the animals of group III did not show such signs except dryness of muzzle in few animals. Statistically non significant increase in CRT was seen in group II whereas, the CRT was significant (P<0.05) on 6th day when compared to the 3rd day value within the group III. On comparison with the group II with III, there was significantly (P<0.05) lower CRT in animals of surgically treated group III on 6th day.

Statistically non significant changes were recorded during post treatment period in the animals of group II, whereas, in the animals of group III the pH was significantly lower (P<0.05; 5th day, P<0.01; 6th day) when compared to 3rd post obstruction day. The ruminal fluid pH was significantly (P<0.01) higher in group III as compared to group I and group II on 5th and 6th day during the post treatment period. No motility in ruminal microflora was observed 3rd day post obstruction and remained so till the end in group II, Whereas, in animals of group III after surgical treatment the micro flora some moderate activity was recorded on 4th, 5th day and good motility on 6th day. Complete atonicity of the rumen was there in the animals of group II whereas mild tonicity of the rumen got initiated by 4th day and by 6th day the ruminal tonicity was satisfactory.

II. HAEMATOLOGICAL OBSREVATION

PRE-TREATRMENT

A significant (P<0.01) increase in the haemoglobin concentration and packed cell volume was recorded from 2nd day post obstruction in all the three groups when compared to their respective base values. In the animals of group I haemoglobin concentration and PCV increased significantly as the duration of obstruction increased (Table 47).

A progressive significant (P<0.05) increase from 2nd day in the total erythrocytic count (TEC) was observed in the animals of group I to the end of study in comparison to base value. A statistically significant (: P<0.05; 2nd day and P<0.01; 3rdday) increase in total leuckocyte count was observed in the animals of group I when compared to the base value. This progressive increase continued in the animals of group I till death ensued. Whereas, in animals of group III, there was significantly (P<0.05) high TLC on 3rd day prior to institution of treatment. A highly significant (P<0.01) increase in the neutrophilic count was observed in all the three groups on second and third day after the creation of the obstruction. The increase in neutrophil continued throughout the period of obstruction in animals of control group. Contrarily decrease in lymphocyte was observed during pretreatment intervals in all the three groups. The pace of decrease in lymphocyte of group I was significant (P<0.01) throughout the period of obstruction.

POST TREATMENT

The Haemoglobin concentration increased significantly (P<0.05) on 6th day in the animals of group II when compared with the 3rd post obstruction day. Where as in group III, there was significant decrease in the haemoglobin values from 5th day on wards when compared to 3rd post obstruction day. The inter group comparison revealed a significant decline in the value of haemoglobin from 4th day onwards after the surgical correction of the obstruction when compared to the value of corresponding day of the group I and II (Table 47).

A significant increase in the packed cell volume (PCV) was recorded from 5th post treatment day when compared to 3rd post obstruction day in the animals of group II. Whereas, a significant (P<0.01) normalization of PCV was found in the surgically treated animals (Table 47). On comparative basis a significant decrease during post surgical period was evident in the animals of group III as compared to group I and II. An increasing trend in total erythrocytic (TEC) count was observed in animals of group II in comparison to 3rd post obstruction day, whereas in animals of group III a decreasing trend in TEC following surgery was noted in entire post surgical period.

A statically non significant increase in total leukocyte count (TLC) in the entire post treatment period in animals of group II, whereas, in the animals of group III there was decrease in the TLC though it was non significant when compared to 3rd day value. The inter group comparison revealed a significant (P<0.05; 5th day and P<0.01; 6th day) decrease

in animals of group III when compared to group I recordings of the corresponding day (Table 48).

A significant (P<0.01) increase in the neutrophils was observed in the animals of group II during entire post treatment period when compared to 3rd post obstruction day. Contrarily the neutrophils decreased significantly (P<0.01) n post surgical duration in the animals of group III as compared to 3rd post obstruction day. On inter group comparison the neutrophils were found to be markedly elevated in the animals of groupI and II when compared to animals of group III where the decrease was highly significant (P<0.01). A statistically significant (P<0.01) decrease in the lymphocytes was seen in the animals of group II from 4th day onwards when compared to 3rd day whereas On inter group comparison the animals of group III showed a significant recovery in lymphocytic count from 4th day onwards as compared to group I and II.

III. BIOCHEMICAL CHANGES IN PLASMA

PRE TREATMENT

A significant (P<0.01) increase in the plasma glucose concentration was observed from 2nd day onwards till the end when compared to the base value in animals of group I (Table 49). In animals of group III a significant (P<0.05 1st day, P<0.01 2nd and 3rd day) increase in the plasma glucose was observed when compared to 3rd post obstruction day.

The increase in total plasma protein concentration was significant (P<0.05) at 2nd post obstruction day in animals of group I when compared to base value and this significant (P<0.01) elevation continued throughout the period of study in animals of group I.

A significant (P<0.05) elevation in BUN was initially observed on 4th day after creation of obstruction which was marked (P<0.01) in the rest of the period of observation in the animals of group I as compared to the base values. Whereas, the animals of group II revealed significant (P<0.01) increase from 2nd day onwards and in group III the increase was significant (P<0.01) on 3rd post obstruction day. A significant (P<0.01) increase in the plasma creatinine was observed on 3rd post obstruction day until the end of study in the animals of group I, when compared to the base value. Similarly, in group III a significant (P<0.01) increase as compared to the base value was also encountered in plasma creatinine concentration (Table 49) on 2nd and 3rd day.

Plasma total Bilirubin concentration increased significantly (P<0.05) on 3rd post obstruction day and the value remained elevated (P<0.01) beyond 4th post obstruction day in animals of group I when compared to the base value. The animals of group III showed significant (P<0.01) increase in the plasma total bilirubin from 2nd day onwards till the institution of treatment as compared to the base value (Table 50). In animals of group II there was significant increase only on 3rd day prior to treatment in comparison to base value.

TABLE 47: EFFECT OF STRANGULATED COLONIC OBSTRUCTION ON HAEMOGLOBIN, PACKED CELL VOLUME AND TOAL ERYTHROCYTE COUNT IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION						
	0	1	2	3#	4	5	6
HAEMOGLOBIN (g%)							
GROUP I	8.82 ±0.292 (n=4)	9.00 ±0.496 (n=4)	10.25** ±0.170 (n=4)	10.75** ±0.15 (n=4)	11.35** ±0.170 (n=4)	11.75** ±0.189 (n=4)	12.5** ±0.129 (n=3)
GROUP II	9.7 ±0.31 (n=4)	10.42 ±0.165 (n=4)	10.95** ±0.273 (n=4)	11.62**c ±0.154 (n=4)	12.02c ±0.085 (n=4)	12.42c ±0.131 (n=4)	12.77b ±0.154 (n=4)
GROUP III	9.27 ±0.228 (n=4)	10.07 ±0.281 (n=4)	10.57** ±0.383 (n=4)	10.90** ±0.264 (n=4)	10.12df ±0.149 (n=4)	9.85adf ±0.189 (n=4)	9.77adf ±0.301 (n=4)
PACKED CELL VOLUME (%)							
GROUP I	33.50 ±0.655 (n=4)	37.00 ±1.041 (n=4)	45.00** ±0.912 (n=4)	47.50** ±0.645 (n=4)	51.75** ±0.853 (n=4)	54.25** ±1.632 (n=4)	57.50** ±1.443 (n=3)
GROUP II	31.50 ±1.19 (n=4)	35.50 ±1.19 (n=4)	42.25** ±1.887 (n=4)	47.25** ±1.797 (n=4)	50.75 ±1.652 (n=4)	53.00a ±1.08 (n=4)	56.00b ±1.291 (n=4)
GROUP III	29.50 ±0.957 (n=4)	34.50 ±0.645 (n=4)	39.00** ±1.291 (n=4)	42.00** ±1.78 (n=4)	43.25df ±1.25 (n=4)	35.75 bdf ±1.75 (n=4)	33.75bdf ±2.916 (n=4)
TOTAL ERYTHROCYTE COUNT(millions/cu mm)							
GROUP I	5.89 ±0.24 (n=4)	6.16 ±0.206 (n=4)	6.83* ±0.087 (n=4)	7.17** ±0.07 (n=4)	7.74** ±0.165 (n=4)	8.06** ±0.284 (n=4)	8.14** ±.202 (n=3)
GROUP II	6.10 ±0.165 (n=4)	6.69 ±0.259 (n=4)	6.93 ±0.248 (n=4)	7.14* ±0.229 (n=4)	7.30 ±0.208 (n=4)	7.47 ±0.19 (n=4)	7.63 ±0.181 (n=4)
GROUP III	7.05 ±0.147 (n=4)	7.40d ±0.188 (n=4)	7.54 ±0.196 (n=4)	7.77 ±0.154 (n=4)	7.79 ±0.134 (n=4)	7.76 ±0.173 (n=4)	7.60 ±0.134 (n=4)

- Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 day value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3rd day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

There was significant (P<0.01) decrease in plasma sodium concentration (hyponatremia) on 3rd post obstruction day in the animals of group I (P<0.01) and II (P<0.05) as compared to their base value (Table 51). A significant (P<0.01) decrease in plasma sodium concentration persisted during entire period of observation in animals of group I.

A significant (P<0.01) hypokalemia was observed in the animals of all the three groups at 3rd post obstruction day in comparison to base values. In animals of group I a consistently decreasing trend (P<0.01) in potassium concentration was noticed from 2nd day onwards and as the duration of obstruction increased.

TABLE 48: EFFECT OF STRANGULATED COLONIC OBSTRUCTION ON TOTAL LEUCOCYTE COUNT, NEUTROPHILS AND LYMPHOCYTES IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION						
	0	1	2	3#	4	5	6
TOTAL LEUKOCYTE COUNT(x 10^3 /cu mm)							
GROUP I	9.25 ±0.325 (n=4)	10.30 ±0.123 (n=4)	11.10* ±0.29 (n=4)	12.88** ±0.582 (n=4)	13.69** ±0.637 (n=4)	14.85** ±0.711 (n=4)	16.05** ±.635 (n=3)
GROUP II	9.37 ±0.759 (n=4)	9.58 ±0.739 (n=4)	10.30 ±1.133 (n=4)	10.65 ±1.217 (n=4)	11.01 ±1.362 (n=4)	11.74 ±1.533 (n=4)	12.27 ±1.725 (n=4)
GROUP III	7.68 ±0.31 (n=4)	8.69 ±0.252 (n=4)	9.43 ±0.397 (n=4)	10.22* ±0.703 (n=4)	10.32 ±0.909 (n=4)	9.75c ±0.68 (n=4)	9.22d ±0.548 (n=4)
NEUTROPHILS (% of TLC)							
GROUP I	27.75 ±1.109 (n=4)	33.25 ±1.548 (n=4)	39.75** ±1.315 (n=4)	44.50** ±1.555 (n=4)	51.25** ±1.652 (n=4)	55.50** ±2.95 (n=4)	58.75** ±2.496 (n=3)
GROUP II	28.5 ±1.19 (n=4)	33.25 ±1.60 (n=4)	37.75** ±0.853 (n=4)	43.50** ±0.957 (n=4)	50.25a ±1.315 (n=4)	56.50b ±1.555 (n=4)	61.25b ±1.493 (n=4)
GROUP III	30.50 ±1.323 (n=4)	34.00* ±1.08 (n=4)	38.00** ±0.408 (n=4)	47.50** ±1.041 (n=4)	42.50bdf ±0.645 (n=4)	39.50bdf ±0.645 (n=4)	35.25bdf ±0.478 (n=4)
LYMPHOCYTES (% of TLC)							
GROUP I	71.00 ±1.08 (n=4)	65.75 ±1.548 (n=4)	58.75** ±1.493 (n=4)	54.50** ±1.535 (n=4)	47.75** ±1.652 (n=4)	44.00** ±2.858 (n=4)	41.00** ±2.415 (n=3)
GROUP II	70.00 ±1.826 (n=4)	66.00 ±2.041 (n=4)	61.5** ±0.645 (n=4)	56.25** ±1.109 (n=4)	48.25a ±1.109 (n=4)	42.75b ±1.652 (n=4)	37.5b ±1.555 (n=4)
GROUP III	68.50 ±1.323 (n=4)	64.50* ±1.258 (n=4)	60.75** ±0.478 (n=4)	51.50 ±1.19 (n=4)	56.00bdf ±0.707 (n=4)	60.00bdf ±0.408 (n=4)	63.50bdf ±0.50 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 day value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3rd day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day

A significant (P< 0.01) hypochloraemia was observed in the animals of all the groups from 2nd day when compared to their base values and decline in plasma chloride concentration continued till the end of study in animals of group I. Incoherent changes were observed in the values of plasma calcium and phosphorous in all the animals of all three groups (Table 51). The elevation in the plasma alkaline phosphatase (ALKP) concentration was significant (P<0.01) in the animals group I from 2nd , in group II from 3rd and group III 1st post obstruction day as compared to their base value (Table 53). The rise in the concentration of the alkaline phosphatase was consistently significant (P<0.01) through out the period of obstruction in the animals of group I.

TABLE 49: EFFECT OF STRANGULATED COLONIC OBSTRUCTION ON GLUCOSE, TOTAL PLASMA PROTEIN, BLOOD UREA NITROGEN AND CREATININE IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION						
	0	1	2	3#	4	5	6
GLUCOSE(mg/dL)							
GROUP I	62.92 ±1.875 (n=4)	68.87 ±2.38 (n=4)	74.52** ±1.525 (n=4)	82.60** ±0.889 (n=4)	88.67** ±1.417 (n=4)	92.70** ±1.439 (n=4)	98.37** ±0.867 (n=3)
GROUP II	62.25 ±2.323 (n=4)	69.05 ±2.244 (n=4)	74.50 ±2.958 (n=4)	80.00* ±3.719 (n=4)	87.50 ±4.735 (n=4)	93.50 ±5.331 (n=4)	98.75[a] ±4.715 (n=4)
GROUP III	66.75 ±2.594 (n=4)	87.00* ±7.382 (n=4)	95.50** ±7.643 (n=4)	107.50** ±8.339 (n=4)	86.00[a] ±3.582 (n=4)	85.00[a] ±1.871 (n=4)	78.75[bdf] ±1.109 (n=4)
TOTAL PLASMA PROTEIN(g/dL)							
GROUP I	6.20 ±0.369 (n=4)	7.32 ±0.423 (n=4)	9.15* ±0.719 (n=4)	10.55** ±0.841 (n=4)	11.95** ±0.793 (n=4)	13.50** ±0.939 (n=4)	14.65** ±0.911 (n=3)
GROUP II	5.77 ±0.125 (n=4)	7.22 ±0.125 (n=4)	7.92 ±0.311 (n=4)	8.90* ±0.46 (n=4)	9.72 ±0.458 (n=4)	10.47 ±0.546 (n=4)	11.60[a] ±0.769 (n=4)
GROUP III	6.92 ±0.319 (n=4)	8.40 ±0.50 (n=4)	10.37** ±0.545 (n=4)	11.55** ±0.619 (n=4)	8.57 [bc] ±0.794 (n=4)	8.15[bd] ±0.523 (n=4)	7.65[bdf] ±0.436 (n=4)
BLOOD UREA NITROGEN(mg/dL)							
GROUP I	9.87 ±1.190 (n=4)	13.85 ±1.973 (n=4)	17.10 ±3.023 (n=4)	21.35 ±3.174 (n=4)	26.17* ±3.477 (n=4)	35.10** ±5.16 (n=4)	38.82** ±4.779 (n=3)
GROUP II	7.95 ±0.446 (n=4)	12.45 ±0.864 (n=4)	15.70** ±1.34 (n=4)	21.22** ±1.112 (n=4)	24.42 ±0.958 (n=4)	27.60[b] ±1.452 (n=4)	30.82[b] ±1.110 (n=4)
GROUP III	9.67 ±0.447 (n=4)	13.95 ±1.344 (n=4)	16.57 ±1.639 (n=4)	20.12** ±1.991 (n=4)	15.85[c] ±2.794 (n=4)	14.25[de] ±2.535 (n=4)	11.92[adf] ±2.229 (n=4)
CREATININE(mg/dL)							
GROUP I	0.94 ±0.059 (n=4)	1.35 ±0.184 (n=4)	1.57 ±0.137 (n=4)	2.22** ±0.205 (n=4)	2.55** ±0.253 (n=4)	2.92** ±0.259 (n=4)	3.25** ±0.217 (n=3)
GROUP II	0.63 ±0.088 (n=4)	0.84 ±0.136 (n=4)	1.05 ±0.138 (n=4)	1.30 ±0.147 (n=4)	1.60[c] ±0.244 (n=4)	1.95[c] ±0.290 (n=4)	2.28[c] ±0.365 (n=4)
GROUP III	0.70 ±0.091 (n=4)	0.85 ±0.104 (n=4)	1.22** ±0.110 (n=4)	1.65** ±0.104 (n=4)	1.35[d] ±0.064 (n=4)	1.20[bd] ±0.040 (n=4)	1.05[bde] ±0.028 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 day value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3rd day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

TABLE 50: EFFECT OF STRANGULATED COLONIC OBSTRUCTION ON PLASMA TOTAL BILIRUBIN IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION						
	0	**1**	**2**	**3#**	**4**	**5**	**6**
GROUP I	0.25 ±0.032 (n=4)	0.30 ±0.034 (n=4)	0.37 ±0.040 (n=4)	0.44* ±0.037 (n=4)	0.51** ±0.043 (n=4)	0.58** ±0.047 (n=4)	0.68** ±0.040 (n=3)
GROUP II	0.20 ±0.016 (n=4)	0.24 ±0.020 (n=4)	0.33 ±0.019 (n=4)	0.43** ±0.184 (n=4)	0.50 ±0.149 (n=4)	0.57^{a} ±0.020 (n=4)	0.64^{b} ±0.021 (n=4)
GROUP III	0.23 ±0.008 (n=4)	0.27 ±0.006 (n=4)	0.36** ±0.012 (n=4)	0.46** ±0.031 (n=4)	0.39^{c} ±0.021 (n=4)	0.34^{bdf} ±0.021 (n=4)	0.30^{bdf} ±0.016 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 day value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3rd day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

A significant (P<0.01) increase in the value of plasma Aspartate amino transferase (AST) concentration was observed when compared to the base value in animals of group I and III on 2nd post obstruction day. A significant (P<0.01) increase from day one onwards in group II in comparison to base value was recorded (Table 53). A persistent elevation (P<0.01) continued in the animals of group I. The plasma alanine amino transferase (ALT) also increased significantly (P<0.01) on 2nd day in comparison to base value in animals of group I and it became significantly (P<0.01) high on 3rd post obstruction day in all the three groups (Table 53). The value remained elevated significantly (P<0.01) throughout the period of study from 3rd day in animals of group I. as compared to the base value.

POST TREATMENT

A significant (P<0.05) increase in plasma glucose concentration was observed on 6th day in group II as compared to 3rd post obstruction day (Table 49). Where as in animals of group III, a significant (P<0.05) decrease in the plasma glucose concentration was observed on 4th day as compared to the 3rd post obstruction day value. On comparative basis a significant decrease in glucose was observed in the animals of group III when compared to the corresponding value of group I and II.

A significant (P<0.05) increase in the total plasma protein concentration was recorded in the animals of group II on 6th post obstruction day when compared to the 3rd post obstruction day. Whereas, it began to decrease significantly (P<0.01) in surgically treated group during the post surgical period. On comparison, in the animals of group III there was significant (P<0.05; 4th day, P<0.01; 5th and 6th day) decrease in the plasma protein concentration when compared to corresponding day values of the animals of group I and the same was also significant (P<0.01) on 6th day when compared to the group II (Table 49).

TABLE 51: EFFECT OF STRANGULATED COLONIC OBSTRUCTION ON PLASMA SODIUM, POTASSIUM, CHLORIDE AND CALCIUM IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRCTION						
	0	1	2	3#	4	5	6
SODUIM (mEq/L)							
GROUP I	143.50 ±2.63 (n=4)	138.28 ±3.591 (n=4)	132.75 ±3.425 (n=4)	122.00** ±1.472 (n=4)	112.50** ±2.784 (n=4)	106.25** ±3.425 (n=4)	100.75** ±3.146 (n=3)
GROUP II	139.25 ±3.924 (n=4)	131.5 ±3.014 (n=4)	128.75 ±3.301 (n=4)	124.00* ±3.162 (n=4)	116.00 ±3.24 (n=4)	109.50[a] ±3.379 (n=4)	104.25[b] ±2.962 (n=4)
GROUP III	149.75 ±3.881 (n=4)	143.00 ±3.24 (n=4)	139.00 ±3.708 (n=4)	136.00[ce] ±3.582 (n=4)	142.25[df] ±4.871 (n=4)	146.40[df] ±4.992 (n=4)	148.25[df] ±4.442 (n=4)
POTASSIUM(mEq/L)							
GROUP I	5.75 ±0.132 (n=4)	5.00 ±0.297 (n=4)	4.32** ±0.249 (n=4)	3.85** ±0.184	3.35** ±0.175 (n=4)	2.975* ±0.137 (n=4)	2.92** ±0.184 (n=3)
GROUP II	5.47 ±0.225 (n=4)	4.82 ±0.342 (n=4)	4.50 ±0.385 (n=4)	4.02* ±0.340 (n=4)	3.82 ±0.306 (n=4)	3.60 ±0.318 (n=4)	3.32 ±0.361 (n=4)
GROUP III	5.32 ±0.39 (n=4)	4.87 ±0.430 (n=4)	4.15 ±0.250 (n=4)	3.67* ±0.311 (n=4)	4.17[c] ±0.103 (n=4)	4.62[d] ±0.342 (n=4)	4.87[df] ±0.314 (n=4)
CHLORIDE(mEq/L)							
GROUP I	97.07 ±2.76 (n=4)	89.10 ±2.511 (n=4)	80.52** ±2.066 (n=4)	75.15** ±2.185 (n=4)	70.12** ±2.068 (n=4)	63.92** ±1.922 (n=4)	66.00** ±6.096 (n=4)
GROUP II	96.07 ±2.945 (n=4)	88.50 ±2.723 (n=4)	76.60** ±5.464 (n=4)	76.10** ±2.551 (n=4)	74.25 ±1.931 (n=4)	69.77 ±1.633 (n=4)	67.25 ±1.652 (n=4)
GROUP III	105.40 ±6.467 (n=4)	86.37 ±3.891 (n=4)	73.80** ±6.694 (n=4)	76.30** ±5.106 (n=4)	84.60[d] ±2.241 (n=4)	93.50[d] ±5.331 (n=4)	98.62[adf] ±1.248 (n=4)
CALCIUIM (mg/dL)							
GROUP I	6.94 ±0.082 (n=4)	6.90 ±0.091 (n=4)	6.87 ±0.094 (n=4)	6.80 ±0.089 (n=4)	6.74 ±0.087 (n=4)	6.70 ±0.095 (n=4)	6.65 ±0.064 (n=3)
GROUP II	7.47 ±0.201 (n=4)	7.37 ±0.239 (n=4)	7.35 ±0.259 (n=4)	7.27 ±0.236 (n=4)	7.30 ±0.204 (n=4)	7.3 ±0.203 (n=4)	7.33 ±0.184 (n=4)
GROUP III	8.65 ±0.551 (n=4)	8.627 ±0.543 (n=4)	8.80 ±0.388 (n=4)	8.07 ±0.638 (n=4)	8.67 ±0.576 (n=4)	8.57[de] ±0.526 (n=4)	8.57[d] 0.548 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 day value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3rd day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

TABLE 52: EFFECT OF STRANGULATED I COLONIC OBSTRUCTION ON PLASMA PHOSPHORUS IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRCTION						
	0	1	2	3#	4	5	6
GROUP I	4.95 ±0.119 (n=4)	4.88 ±0.096 (n=4)	4.78 ±0.082 (n=4)	4.71 ±0.068 (n=4)	4.66 ±0.082 (n=4)	4.63 ±0.08 (n=4)	4.65 ±0.097
GROUP II	4.72 ±0.131 (n=4)	4.70 ±0.088 (n=4)	4.66 ±0.08 (n=4)	4.63 ±0.077 (n=4)	4.60 ±0.108 (n=4)	4.65 ±0.086 (n=4)	4.55 ±0.084 (n=4)
GROUP III	4.87 ±0.085 (n=4)	4.93 ±0.023 (n=4)	4.91 ±0.031 (n=4)	4.88 ±0.031 (n=4)	4.88 ±0.037 (n=4)	4.83 ±0.031 (n=4)	4.86 ±0.037 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 day value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3rd day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

There was significant (P<0.01) increase in the blood urea nitrogen (BUN) in animals of group II from 5th day when compared to the 3rd post obstruction day. However, a significant (P<0.01) decrease in the BUN concentration was observed on 6th day as compared to 3rd post obstruction day in the animals of group III. The inter group comparison revealed a significant (P<0.05:4th day, P<0.01 5th and 6th day) decrease of BUN in the group III as compared to group I on corresponding day after the institution of surgical treatment on 3rd post obstruction day. Similarly, in comparison to the group II there was significant decrease in the BUN in group III (P<0.05: 5th day, P<0.01 6th day (Table 49).

A non significant increase, in the plasma creatinine concentration was noticed in the animals of group II when compared to its 3rd post obstruction day. Contrary wise the blood creatinine levels got lowered significantly (P<0.01) from 5th day onwards in the surgically treated group III (Table 49). On inter group comparison plasma creatinine concentration was significantly (P<0.05) lower in entire post treatment period of group II and III compared to group I. Likewise in surgically treated group III the creatinine levels receded significantly (P<0.05) on 6th day as compared to the corresponding day of the group II.

A Gradual significant (P<0.05: 5th day, P<0.01: 6th day) increase in total plasma bilirubin was recorded in the animals of group II during post treatment period as compared to the 3rd post obstruction day (Table 50). Whereas, in the animals of group III a significant (P<0.01: 5th and 6th day) decrease in total bilirubin concentration was noticed after institution of surgical treatment as compared to the 3rd post obstruction day. Inter group comparison inferred a significant (P<0.01: 5th and 6th day) decrease in the total plasma bilirubin in group III as compared to the corresponding interval of the group I and II.

TABLE 53: EFFECT OF STRANGULATED COLONIC OBSTRUCTION ON PLASMA ALKP, AST AND ALT IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OSTRUCTIUON						
	0	1	2	3#	4	5	6
ALKALINE PHOSHATASE (IU/L)							
GROUP I	93.75 ±2.529 (n=4)	105.35 ±3.365 (n=4)	124.6** ±1.965 (n=4)	151.50** ±3.476 (n=4)	160.75** ±2.288 (n=4)	181.75** ±5.677 (n=4)	191.75** ±4.802 (n=3)
GROUP II	94.25 ±2.78 (n=4)	107.00 ±4.223 (n=4)	118.5 ±5.188 (n=4)	136.25** ±6.537 (n=4)	166.00 ±4.378 (n=4)	181.50^{b} ±4.052 (n=4)	195.75^{b} ±6.824 (n=4)
GROUP III	99.50 ±3.428 (n=4)	130.25** ±5.721 (n=4)	150.00** ±5.37 (n=4)	161.00** ±4.491 (n=4)	127.50^{bdf} ±2.63 (n=4)	123.00^{bdf} ±3.367 (n=4)	115.25^{bdf} ±4.871 (n=4)
AST (IU/L)							
GROUP I	60.75 ±2.955 (n=4)	74.50 ±3.428 (n=4)	94.50** ±3.014 (n=4)	119.5** ±4.252 (n=4)	150.5** ±7.643 (n=4)	164.5** ±4.787 (n=4)	177.0** ±5.431 (n=3)
GROUP II	84.75 ±3.728 (n=4)	109.5** ±4.907 (n=4)	131.0** ±3.082 (n=4)	142.0** ±1.291 (n=4)	156.5^{a} ±2.021 (n=4)	166.25^{b} ±1.25 (n=4)	174.25^{b} ±2.496 (n=4)
GROUP III	66.00 ±2.972 (n=4)	84.0 ±4.041 (n=4)	98.25** ±5.573 (n=4)	104.0** ±6.468 (n=4)	97.5^{d} ±6.144 (n=4)	89.0^{df} ±5.583 (n=4)	82.25^{adf} ±3.966 (n=4)
ALT (IU/L)							
GROUP I	20.02 ±0.894 (n=4)	24.50 ±0.645 (n=4)	28.75* ±0.853 (n=4)	38.75** ±1.315 (n=4)	45.0** ±2.16 (n=4)	51.25** ±2.78 (n=4)	61.75** ±2.462 (n=3)
GROUP II	21.25 ±1.109 (n=4)	25.7 ±1.363 (n=4)	30.5 ±1.041 (n=4)	38.5** ±1.041 (n=4)	44.37 ±1.455 (n=4)	51.50^{b} ±0.645 (n=4)	60.0^{b} ±1.08 (n=4)
GROUP III	20.33 ±0.912 (n=4)	24.0 ±1.472 (n=4)	33.0** ±1.581 (n=4)	44.25** ±4.008 (n=4)	39.00 ±3.391 (n=4)	32.75^{bdf} ±2.496 (n=4)	26.75^{bdf} ±2.562 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 day value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3rd day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

There was a gradual decline in the plasma sodium concentration in animals of group II through out the period of study when compared to the 3rd post obstruction day, this decrease was significant (P<0.05) on 5th day and was highly significant (P<0.01) on the 6th day (Table 51). The animals of group III, showed non significant increasing trend in the plasma sodium concentration during post treatment period. The inter group comparison revealed a significant (P<0.01) decrease in the plasma sodium concentration (Hyponatraemia) in animals of group I and II when compared to the group III plasma sodium concentration from 4th day and remained so till the end of study.

The plasma potassium concentration decreased but the decline was non significant as compared to 3rd day value of plasma potassium in animals of group II. In animals of group III, the concentration of potassium remain elevated non significantly in comparison to the 3rd post obstruction day. Inter group comparison revealed there was significant (P<0.05) decrease in the potassium concentration in animals of group I on 4th day and similar recordings were made on 5th and 6th day showing significant (P<0.01) decrease in the concentration when compared to the group III at same intervals (Table 51). The blood chloride concentration showed a decreasing trend through out the post conservative treatment period as compared to 3rd post obstruction day however in surgically treated group III the chloride concentration in the blood showed a recuperating trend with significant (P<0.05) concentration at 6th day. The inter group comparison revealed a highly significant (P<0.01) recovery in animals of group III as compared to group I (P<0.01; 4th to 6th day) and II (P<0.01; 6th day).A statistically non significant alteration was seen in plasma calcium and phosphorous concentration in post treatment period in animals of group II and III (Table 51, 52).

A significant (P<0.01) increase in the plasma alkaline phosphatase (ALKP) was recorded in the animals of group II from 5th day onwards, when compared to 3rd post obstruction day (Table 53). In case of animals of group III a significant (P<0.01) decrease in plasma alkaline phosphatase was seen as during entire post surgical period as compared to 3rd post obstruction day. On inter group comparison a significant (P<0.01) decrease was noticed in the animals of group III from 4th day onwards as compared to corresponding interval of group I and II.

A significant (P<0.05; 4th day) rise in the plasma Aspartate amino transferase (AST)and in animals of group II was observed as compared to 3rd post obstruction day, which turned highly significant (P<0.01) on 5th and 6th day. Where as, in the animals of group III there was significant decrease in the AST on 6th day as compared to 3rd post obstruction day (Table 53). Inter group comparison revealed a highly significant decrease in AST concentration in post surgical period as compared to corresponding interval of group I. Likewise the decrease was even significant (P<0.05) when compared to group II from 5th day onwards.

A statistically significant (P<0.01) rise in the plasma alanine amino transferase (ALT) was recorded from 5th day onwards as compared to 3rd post obstruction day in animals of group II. A statistically significant (P<0.01) decline in the plasma ALT concentration in group III was recorded from 5th day onwards as compared to 3rd post obstruction day (Table 53). On inter group comparison in the animals of group III there was significant (P<0.01) decrease in the plasma ALT concentration as compared to group I and II on 5th and 6th day.

IV. CHANGES IN PERITONEAL FLUID

PRE TREATMENT

The peritoneal fluid normally is yellowish tinged and nearly transparent fluid. No changes were observed in the peritoneal fluid in the strangulated colonic obstruction.A decreasing trend in the peritoneal fluid pH was observed in all the three groups following creation of obstruction (Table 54). And this decrease was significant ($P<0.01$) from 3rd day till the end of study as compared to base value in animals of group I and significant ($P<0.0.1$) decrease on 2nd day post obstruction in animals of group III.

A significant ($P<0.05$;4th day, $P<0.01$; 5th and 6th day) increase in the total peritoneal fluid protein was recorded in animals of group I from 4th day post obstruction (Table 54). A significant ($P<0.01$) increase in the total peritoneal fluid protein was seen in animals of group II and III prior to institution of conservative and surgical treatment respectively on 1st day onwards as compared to base value of respective groups.

There was always an increasing trend in the nucleated cell count but was not significant until the 6th day when increase was quite significant ($P<0.01$) in group I. Similarly, the animals of group II and III didn't reveal any significant increase in the pre treatment period.

The creation of distal colonic obstruction induced a significant ($P<0.01$) decrease in the peritoneal fluid sodium concentration from 2nd day onwards till the completion of study in group I. Likewise the decrease was significant in group II on 3rd post obstruction day and group III ($P<0.05$; 1st day, $P<0.01$; 2nd and 3rd day) post obstruction day as compared to their respective base values (Table 55).

There was significant ($P<0.05$) decrease in the peritoneal fluid potassium concentration from 2nd day and the decrease remained significant ($P<0.01$) till the end of study in animals of group I when compared to the base values (Table 55). However, there was decrease in the potassium concentration in animals of group II and III during pretreatment period, but was of no significance.

The peritoneal fluid chloride concentration decreased significantly ($P<0.01$) at 2nd post obstruction day in the animals of group I and III as compared to the base value. A persistently significant ($P<0.01$) loss of chloride was evident in the animals of group I as long as the obstruction was present (Table 55). The peritoneal fluid calcium and phosphorous concentration were non significant in all the three groups. Though, minor decreases were recorded in the values.

POST TREATMEMT

In animals of group II there was significant ($P<0.01$) increase in total protein of the peritoneal fluid from 5th day as compared to the 3rd post obstruction day. Where as it revealed a significant ($P<0.01$) decrease in the total protein concentration from 4th day onwards as compared to the 3rd post obstruction day in the surgically treated group III (Table

54). Inter group comparison revealed there was significant (P<0.01) decrease in the value of the total protein in animals of group III as compared to group I on 5th and 6th. There was significant (P<0.01) increase in the value of total protein in animals of group II on 6th day when compared to corresponding day value of the animals of group III.

A statistically non significant increase in the nucleated cell count was recorded in the animals of group II after institution of the treatment whereas this count decreased in group III during post surgical period but was non significant. The noteworthy finding is the significant(P<0.05) decrease in nuclear cell count on 6th day in group IIII as compared to corresponding intervals of group I and II(table 54). Significant (P<0.01) hyponatremia persisted through out the entire post conservative period (group II) of study as compared to 3rd post obstruction day. Where as, the peritoneal fluid sodium concentration recovered significantly (P<0.01) from 5th day onwards during post operative period. Inter group comparison revealed a significant (P<0.01) normalization of peritoneal fluid concentration from 5th day onwards in the animals of group III as compared to the group I and II (Table 55).

A statistically non significant decrease in the animals of group II and non significant increase in group III in the peritoneal fluid potassium concentration was observed as compared to the 3rd post obstruction day. Inter group comparison between animals of group III with group I revealed a significant (P<0.05: 4th and 5th day, P<0.01; 6th day) increase from 4th day in the peritoneal fluid potassium concentration on institution of surgical treatment whereas and in comparison to group II a significant (P<0.01) increase was observed on 6th day (Table 55).

A significant (P<0.05: 5th day; P<0.01: 6th day) decrease in the peritoneal fluid chloride concentration was observed from 5th day onwards in animals of group II as compared to the 3rd post obstruction day. Whereas, a significant (P<0.01) recuperation in the peritoneal fluid chloride concentration was recorded immediately after correction of obstruction till the period of study in the animals of group III as compared to the 3rd post obstruction day. Inter group comparison revealed a significant (P<0.01) increase in the peritoneal fluid potassium concentration during post operative period in group III when compared to the corresponding interval of group I. Similarly there was significant (P<0.01) increase in the peritoneal fluid potassium concentration in animals of group III on 5th and 6th as compared to group II (Table 55).

TABLE 54: EFFECT OF STRANGULATED COLONIC OBSTRUCTION ON PERITONEAL FLUID pH, TOTAL PROTEIN AND NUCLEATED CELL COUNT IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRCTION						
	0	1	2	3#	4	5	6
PERITONEAL FLUID pH							
GROUP I	6.92 ±0.075 (n=4)	6.85 ±0.064 (n=4)	6.67 ±0.075 (n=4)	6.56** ±0.471 (n=4)	6.50** ±0.04 (n=4)	6.43** ±0.074 (n=4)	6.35** ±0.095 (n=3)
GROUP II	6.97 ±0.025 (n=4)	6.95 ±0.05 (n=4)	6.80 ±0.0353 (n=4)	6.62 ±0.062 (n=4)	6.57 ±0.085 (n=4)	6.43 ±0.102 (n=4)	6.37[a] ±0.103 (n=4)
GROUP III	6.97 ±0.062 (n=4)	6.80 ±0.101 (n=4)	6.62** ±0.075 (n=4)	6.56** ±0.055 (n=4)	6.75[c] ±0.048 (n=4)	6.82[ce] ±0.063 (n=4)	6.92[bdf] ±0.047 (n=4)
TOTAL PERITONEAL FLUID PROTEIN (g/dL)							
GROUP I	2.56 ±0.195 (n=4)	3.42 ±0.503 (n=4)	4.05 ±0.545 (n=4)	4.75 ±0.736 (n=4)	5.55* ±0.784 (n=4)	6.85** ±0.839 (n=4)	7.62** ±0.702 (n=3)
GROUP II	2.88 ±0.077 (n=4)	3.77** ±0.110 (n=4)	4.07** ±0.160 (n=4)	4.70** ±0.158 (n=4)	5.10 ±0.195 (n=4)	5.62[b] ±0.215 (n=4)	6.42[b] ±0.165 (n=4)
GROUP III	2.87 ±0.085 (n=4)	4.10** ±0.108 (n=4)	4.87** ±0.085 (n=4)	5.37** ±0.110 (n=4)	4.42[b] ±0.175 (n=4)	3.97[bd] ±0.154 (n=4)	3.33[bdf] ±0.322 (n=4)
NUCLEATED CELL COUNT (x 10^3/Cu mm)							
GROUP I	2.21 ±0.539 (n=4)	2.73 ±0.446 (n=4)	3.37 ±0.630 (n=4)	3.92 ±0.641 (n=4)	4.47 ±0.716 (n=4)	4.86 ±0.620 (n=4)	5.86** ±0.531 (n=3)
GROUP II	2.35 ±0.374 (n=4)	2.74 ±0.409 (n=4)	3.017 ±0.346 (n=4)	3.33 ±0.328 (n=4)	3.53 ±0.267 (n=4)	4.10 ±0.408 (n=4)	4.48 ±0.357 (n=4)
GROUP III	2.15 ±0.297 (n=4)	2.46 ±0.303 (n=4)	3.14 ±0.490 (n=4)	3.82* ±0.756 (n=4)	3.66 ±0.470 (n=4)	3.19 ±0.330 (n=4)	2.87[de] ±0.291 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 day value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3rd day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

TABLE 55: EFFECT OF STRANGULATED COLONIC OBSTRUCTION ON PERITONEAL FLUID SODIUM, POTASSIUM, CHLLORIDE AND CALCIUM IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREAION OF INTESTINAL OBSRUCTION						
	0	1	2	3#	4	5	6
SODIUM (mEq/L)							
GROUP I	141.25 ±1.315 (n=4)	134.05 ±2.721 (n=4)	127.35** ±3.672 (n=4)	116.95** ±1.228 (n=4)	106.38** ±1.143 (n=4)	100.17** 1.055 (n=4)	90.50** ±1.555 (n=3)
GROUP II	139.25 ±2.869 (n=4)	129.75 ±1.25 (n=4)	126.03 ±2.176 (n=4)	121.15* ±2.392 (n=4)	115.13 ±4.293 (n=4)	111.88 ±5.369 (n=4)	108.4 ±5.436 (n=4)
GROUP III	148.25 ±2.72 (n=4)	139.00* ±1.472 (n=4)	135.75** ±1.377 (n=4)	115.67** ±2.936 (n=4)	120.73c ±2.639 (n=4)	142.85bdf ±1.997 (n=4)	143.53bdf ±1.021 (n=4)
POTASIUIM(mEq/L)							
GROUP I	5.05 ±0.132 (n=4)	4.52 ±0.170 (n=4)	4.20* ±0.168 (n=4)	3.85** ±0.125 (n=4)	3.55** ±0.119 (n=4)	3.02** ±0.239 (n=4)	2.80** ±0.255 (n=3)
GROUP II	5.45 ±0.259 (n=4)	5.15 ±0.210 (n=4)	4.85 ±0.155 (n=4)	4.42** ±0.165 (n=4)	4.12 ±0.201 (n=4)	3.92 ±0.131 (n=4)	3.82 ±0.259 (n=4)
GROUP III	5.35 ±0.225 (n=4)	4.52 ±0.442 (n=4)	4.20 ±0.547 (n=4)	4.00 ±0.227 (n=4)	4.40c ±0.752 (n=4)	4.50c ±0.437 (n=4)	4.80df ±0.336 (n=4)
CHLORIDE(mEq/L)							
GROUP I	95.77 ±1.775 (n=4)	91.82 ±1.178 (n=4)	83.45** ±1.426 (n=4)	74.77** ±1.856 (n=4)	68.85** ±0.785 (n=4)	60.80** ±0.769 (n=4)	57.25** ±0.853 (n=3)
GROUP II	96.125 ±1.346 (n=4)	91.95 ±1.280 (n=4)	87.72 ±0.707 (n=4)	86.25 ±2.080 (n=4)	81.25 ±2.706 (n=4)	73.15a ±3.498 (n=4)	67.00b ±3.238 (n=4)
GROUP III	91.35 ±2.745 (n=4)	82.12 ±3.080 (n=4)	69.02** ±4.003 (n=4)	63.90** ±3.902 (n=4)	85.87bd ±4.180 (n=4)	92.30bdf ±2.664 (n=4)	92.27bdf ±3.705 (n=4)
CALCIUM (mg/dL)							
GROUP I	6.88 ±0.136 (n=4)	6.9 ±0.040 (n=4)	6.87 ±0.062 (n=4)	6.81 ±0.057 (n=4)	6.86 ±0.106 (n=4)	6.79 ±0.125 (n=4)	6.77 ±0.110 (n=3)
GROUP II	6.17 ±0.125 (n=4)	6.07 ±0.125 (n=4)	6.03 ±0.116 (n=4)	5.96 ±0.110 (n=4)	6.02d ±0.176 (n=4)	5.96d ±0.190 (n=4)	5.95d ±0.188 (n=4)
GROUP III	6.65 ±0.064 (n=4)	6.56 ±0.044 (n=4)	6.44 ±0.067 (n=4)	6.36 ±0.065 (n=4)	6.34c ±0.042 (n=4)	6.37 ±0.130 (n=4)	6.48 ±0.136 (n=4)

- Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 day value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3rd day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

TABLE 56: EFFECT OF STRANGULATED COLONIC OBSTRUCTION OF ON PERITONEAL FLUID PHOSPHOROUS IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION						
	0	1	2	3#	4	5	6
GROUP I	4.75 ±0.144 (n=4)	4.67 ±0.143 (n=4)	4.67 ±0.143 (n=4)	4.60 ±0.147 (n=4)	4.60 ±0.122 (n=4)	4.57 ±0.085 (n=4)	4.52 ±0.103 (n=3)
GROUP II	4.67 ±0.062 (n=4)	4.65 ±0.064 (n=4)	4.60 ±0.040 (n=4)	4.62 ±0.047 (n=4)	4.65 ±0.028 (n=4)	4.60 ±0.408 (n=4)	4.57 ±0.025 (n=4)
GROUP III	4.72 ±0.075 (n=4)	4.67 ±0.075 (n=4)	4.60 ±0.057 (n=4)	4.57 ±0.047 (n=4)	4.62 ±0.047 (n=4)	4.65 ±0.028 (n=4)	4.67 ±0.047 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 day value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3rd day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

Incoherent changes in the peritoneal fluid calcium were observed. The peritoneal fluid calcium and phosphorous concentration were not showing significant changes (Table 56 and 57). The significant changes which were observed were due to the fact that the base values of the group I was higher.

V. RUMINAL FLUID BIOCHEMISTERY

PRE TREATMENT

There was significant (P<0.01) decrease in the ruminal fluid sodium and potassium concentration from 2nd post obstruction day when compared to the base values in animals of all the groups in comparison to base value (Table 57). The significant (P<0.01) loss of sodium and potassium in the ruminal fluid continued in the animals of group I as long as the obstruction was present.

There was significant increase in the ruminal fluid chloride concentration in the animals of group I from 1st post obstruction day (P<0.01) in the animals of group I (P<0.01) and group III (P<0.05). This increase turned significantly high (P<0.01) in the pretreatment period in of all the groups and it remained significantly (P<0.01) elevated in animals of control group I.

Nothing significant was observed in ruminal fluid calcium concentration in the animals of group I, II and III. The ruminal fluid phosphorous concentration revealed significant (P<0.01) increase as compared to the base value from 1st post obstruction day in group I. Similar significant (P<0.05) increase was recorded in the animals of group III from 1st post obstruction day as compared to the base value. Animals of group II showed significant (P<0.01) increase from 2nd day post obstruction (Table 58).

POST TREATMENT

After institution of conservative and surgical treatment in the animals of group II and III respectively the non significant decrease in ruminal fluid sodium concentration continued during post treatment period with exception of 6th day in group III where it increased (Table

57). Inter group comparison revealed that there was significant (P<0.05; 4th day, P<0.01; 6th day) increase in ruminal fluid sodium concentration in animals of group III post surgical period as compared to the group I animals. A significant (P<0.05; 5th day, P<0.01; 6th day) increase in ruminal fluid sodium was recorded in animal of group III as compared to group I.

Ruminal fluid potassium concentration decreased significantly (P<0.01) from 5th post obstruction day as compared to the 3rd day in animals of group II (Table 91). Whereas, the animals of group III revealed significant (P<0.01) increase in the potassium concentration from 5th day onwards. Inter group comparison revealed a significant (P<0.01) increase in the ruminal fluid potassium concentration from 5th day in the animals of group III as compared to group I and II. A significant (P<0.05) increase in the ruminal fluid chloride concentration from 4th day in animals of group II was observed as compared to 3rd day and this increase remained highly significant (P<0.01) through out the conservative treatment period from 5th post obstruction day (Table 57). However, the animals of group III revealed a significant (P<0.01) decrease in the ruminal fluid concentration from 5th day as compared to 3rd post obstruction day. Inter group comparison revealed a significant (P<0.01) decrease in the value of ruminal fluid chloride concentration in animals of group II as compared to animals of group I from 4th day onwards. Likewise animals of group III a revealed a significant (P<0.01) decrease in the ruminal fluid chloride concentration from 5th day as compared to the animals of group I and II.

The non significant observations were made in ruminal fluid calcium concentration in animals of group II and III during post treatment period. The ruminal fluid phosphorous concentration registered a significant (P<0.01) increase from 4th day in animals of group II as compared to its 3rd post obstruction day. Similarly in animals of group III, it increased significantly (P<0.01 5th day and P<0.05; 4th and 6th day) as compared to 3rd post obstruction day (Table 58).

TABLE 57: EFFECT OF STRANGULATED COLONIC OBSTRUCTION ON SODIUM, POTASSIUM AND CHLOIRIDE RUMINAL FLUID IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION						
	0	1	2	3	4	5	6
SODIUM (mEq/L)							
GROUP I	111.33 ±2.984 (n=4)	104.42 ±2.083 (n=4)	99.12** ±1.916 (n=4)	93.85** ±1.805 (n=4)	87.80** ±1.153 (n=4)	81.47** ±1.526 (n=4)	75.7** ±0.645 (n=3)
GROUP II	104.07 ±2.402 (n=4)	97.47* ±1.055 (n=4)	93.82** ±1.636 (n=4)	91.77** ±2.549 (n=4)	90.10 ±1.059 (n=4)	88.67^{c} ±1.251 (n=4)	85.47^{d} ±0.877 (n=4)
GROUP III	102.6 ±1.878 (n=4)	95.00 ±2.677 (n=4)	88.50** ±2.784 (n=4)	83.50** ±3.403 (n=4)	79.25^{ce} ±3.683 (n=4)	85.50 ±2.598 (n=4)	90.75^{de} ±1.797 (n=4)
POTASIUIM(mEq/L)							
GROUP I	29.77 ±1.628 (n=4)	26.87 ±1.410 (n=4)	24.82** ±1.086 (n=4)	21.27** ±0.458 (n=4)	19.47** ±0.340 (n=4)	16.32** ±0.561 (n=4)	13.95** ±0.512 (n=3)
GROUP II	26.87 ±0.879 (n=4)	24.77 ±0.466 (n=4)	22.15** ±0.278 (n=4)	21.47** ±0.349 (n=4)	19.57 ±0.666 (n=4)	17.02^{b} ±0.782 (n=4)	15.57^{b} ±0.523 (n=4)
GROUP III	25.50 ±0.94 (n=4)	21.97 ±0.97 (n=4)	18.92** ±1.52 (n=4)	17.35** ±1.72 (n=4)	21.32 ±1.36 (n=4)	24.90^{bdf} ±1.08 (n=4)	24.90^{bdf} ±0.75 (n=4)
CHLORIDE(mEq/L)							
GROUP I	26.50 ±1.318 (n=4)	36.27** ±1.543 (n=4)	42.92** ±1.636 (n=4)	53.62** ±1.734 (n=4)	69.77** ±2.040 (n=4)	80.9** ±1.722 (n=4)	86.42** ±1.436 (n=3)
GROUP II	27.75 ±1.315 (n=4)	29.52 ±1.553 (n=4)	35.72 ±1.729 (n=4)	44.92** ±1.502 (n=4)	58.27^{ad} ±2.870 (n=4)	64.40^{bd} ±3.053 (n=4)	70.97^{bd} ±2.482 (n=4)
GROUP III	19.60 ±1.696 (n=4)	27.95* ±3.203 (n=4)	36.60** ±1.792 (n=4)	54.80** ±2.377 (n=4)	49.15 ±0.497 (n=4)	42.62^{bdf} ±1.224 (n=4)	34.67^{bdf} ±1.312 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 day value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3rd day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

TABLE 58: EFFECT OF STRANGULATED COLONIC OBSTRUCTION OF ON RUMINAL FLUID CALCIUM AND PHOSPHOROUS IN CALVES (MEAN±S.E).

GROUPS	DAYS AFTER CREATION OF INTESTINAL OBSTRUCTION						
	0	1	2	3#	4	5	6
CALCIUM (mg/dL)							
GROUP I	7.62 ±0.094 (n=4)	7.62 ±0.094 (n=4)	7.60 ±0.070 (n=4)	7.62 ±0.062 (n=4)	7.65 ±0.086 (n=4)	7.62 ±0.062 (n=4)	7.65 ±0.064 (n=3)
GROUP II	7.2 ±0.393 (n=4)	7.14 ±0.402 (n=4)	7.12 ±0.402 (n=4)	7.03 ±0.391 (n=4)	7.00 ±0.407 (n=4)	7.015 ±0.456 (n=4)	6.95 ±0.438 (n=4)
GROUP III	7.60 ±0.070 (n=4)	7.57 ±0.085 (n=4)	7.55 ±0.064 (n=4)	7.52 ±0.075 (n=4)	7.55 ±0.064 (n=4)	7.52 ±0.062 (n=4)	7.50 ±0.040 (n=4)
PHOSPHOROUS(mg/dL)							
GROUP I	9.00 ±0.601 (n=4)	13.5** ±0.704 (n=4)	17.90** ±1.182 (n=4)	22.65** ±0.987 (n=4)	28.75** ±1.534 (n=4)	32.97** ±2.572 (n=4)	36.75** ±1.887 (n=3)
GROUP II	9.30 ±0.821 (n=4)	12.87 ±0.826 (n=4)	18.00** ±1.472 (n=4)	24.00** ±1.683 (n=4)	30.00^{b} ±1.080 (n=4)	33.00^{b} ±0.816 (n=4)	36.25^{b} ±0.75 (n=4)
GROUP III	8.57 ±0.575 (n=4)	12.62* ±0.850 (n=4)	18.00** ±1.080 (n=4)	23.50** ±0.866 (n=4)	27.25^{a} ±0.853 (n=4)	30.50^{b} ±0.957 (n=4)	27.00^{adf} ±0.707 (n=4)

\# - Time of institution of treatment
*, ** - 5% and 1% level of significance respectively when compared to 0 day value of the same group.
a, b - 5% and 1% level of significance respectively when compared to 3rd day value of the same group.
c, d - 5% and 1% level of significance respectively when compared to group I value of corresponding day.
e, f - 5% and 1% level of significance respectively when compared to group II value of corresponding day.

OPERATIVE FINDINGS

The site of obstructed loop was discolored and showed irreversible stricture. The segment of intestine proximal to the site of obstruction was distended and showed bluish discolouration with no peristalsis upto considerable length (Plate 9). The distal segment was collapsed and the mesentery was hemorrhagic with adhesive reaction. The mesenteric vessels showed stasis and were engorged (Plate 9). The obstructed segment was resected and followed by enteroanastomsis. (Plate 9).

TOTAL SURVIVAL TIME

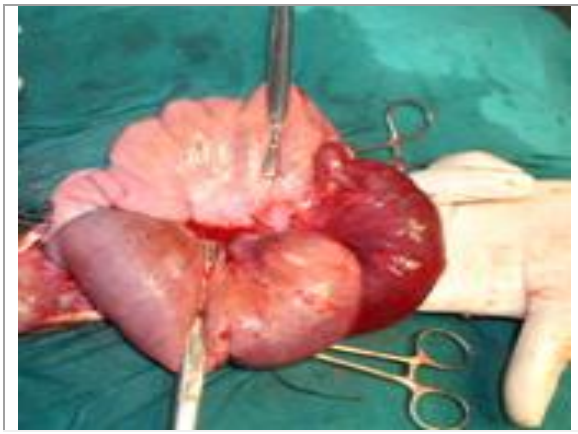
The animals of group I served as diseased control succumbed at different time interval following creation of simple colonic obstruction. The average survival time in the animals of group I was 5.75±0.025 days. The average survival time in the animals of group II with conservative treatment was 9±1.225 days. All the animals of group III survived following surgical treatment.

MICROBIOILOGICAL STUDIES

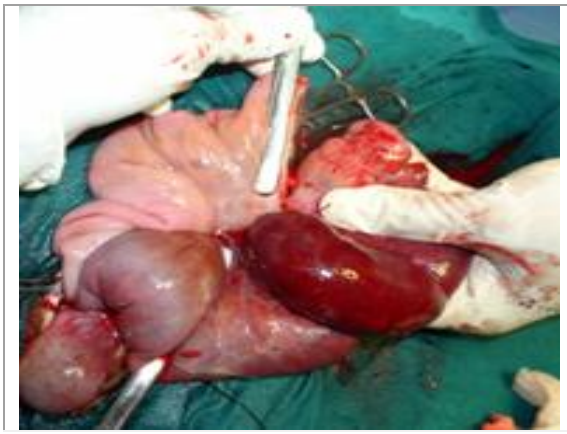
Peritoneal fluid was collected periodically before, during treatment and post treatment period for isolation and culture sensitivity tests. No, microbial growth was observed in zero Day sample. Proteus, Staphylococcus and Corynebacteriuim were isolated in the samples of animals control group.

PLATE 9 : OPERATIVE FINDINGS AND SURGICAL CORRECTION IN STRANGULATED COLONIC OBSTRUCTION IN CALVES

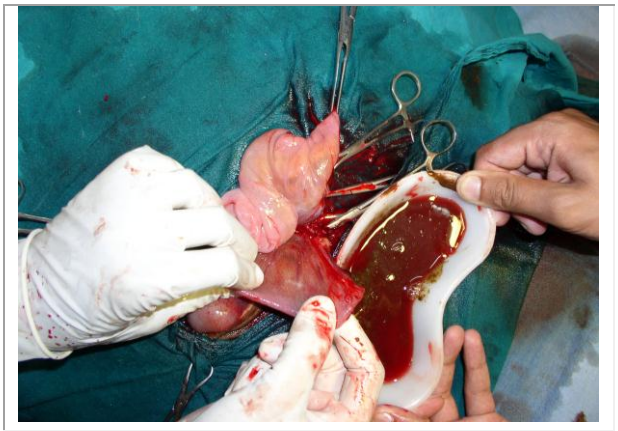
Obstructed colonic segment



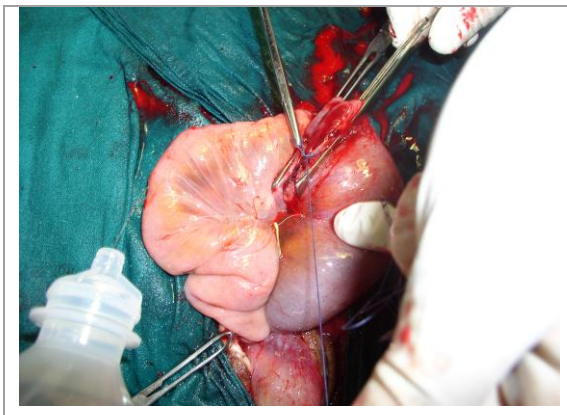
Doyen's clamps applied to segment to be resected

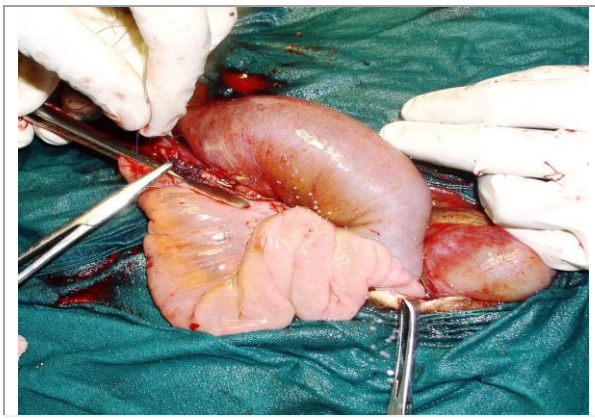


Obstructed colonic segment being resected



Proximal colonic segment being milked





End to end anastomosis of colonic segment

G. CLINICAL CASE STUDIES OF INTESTINAL OBSTRUCTION

A total of 15 cases suffering from intestinal obstruction in bovines, 14 at Veterinary Teaching Clinical Complex and one at Veterinary Polyclinic, Shahpur were treated during the period 2002-2005. All the patients were females except one male and their age ranged from 2-10 years.

I. HISTORY AND CLINICAL SIGNS

The history of failure of defecation ranged from 3 to 8 days. All the cases referred to University Clinics were undiagnosed but suspected for intestinal obstruction. The progression of ailment started initially with symptoms like acute intestinal colic manifested by vigorous kicking at belly, paddling of limbs, semi crouching, shifting lateral and sternal recumbencies, tremors of muscles of hind quarter. These symptoms were abolished after 2-3 days. Repeated attempts to void feces with flatus were seen. The nature of faeces became increasingly scanty with hard dung balls covered with mucous. Melena was seen frequently with mucosal shreds from rectum. All the affected animals were treated with purgatives and rumenotorics before they were referred for treatment. The animals presented after 4 days of above mentioned symptoms had reduced appetite but water intake was sufficient. Partial to complete anorexia developed over a period of hours to days in some cases. Only 3 animals were presented in recumbent posture. Twelve out of 15 animals had a history of being fed with mature bamboo leaves.

II. PHYSICAL EXAMINATION

All the animals presented with intestinal obstruction did not show any sign of acute colic. All the animals had a typical finding of soiling of tail with mucoid tarry colored faecal material. The muzzle was dry with symptoms of dehydration. The animals were not agile in walking and tended to guard their abdomen while in motion. The rectal temperature was subnormal. The respiratory rate was often elevated with shallow respiration. In five animals the abdominal wall palpation and percussion revealed a generalized rigidity of muscles to the extent that it interfered in normal respiration and resulted in difficult thoracic respiration. The heart rate of the affected animals was found to be slightly elevated initially but as the chronicity of the case developed the heart rate increased considerably (Table 59).

Ruminal contractions were totally abolished with tympanitic sound on light palpation and impacted on deep palpation. Bilateral distension of abdomen was found with tightness of abdominal musculature. Affected animals were depressed and reluctant to move. The extent of dehydration in few animals was marked with eyeball recession and increased skin tent. Intestinal borborygmi on auscultation revealed mild tinkling and fluid splashing sounds but in the cases presented after 4-5 days the quiescence of abdominal cavity was conspicuous.

TABLE 59: PREOPERATIVE CLINICAL OBSERVATIONS IN CLINICAL CASES OF COWS SUFFERING FROM INTESTINAL OBSTRUCTION (MEAN ± S.E.).

S. NO.	PARAMETER	SURVIVORS (N=6)	NON SURVIVORS (N=9)
1	Rectal Temperature (^{o}F)	100.7±0.657	100.71±0.478
2	Heart Rate (/min)	83.33±2.459	77.11±3.128
3	Respiration Rate (/min)	25±1.693	27.88±1.399

Per rectal examination revealed dryness and edema of the rectal mucosa with lot of tarry colored mucous and occasionally mucosal shreds. The lumen of rectum was collapsed in some animals whereas it was gas filled in other animals. The rumen had a doughy consistency and had reached almost to the brim of pelvic inlet almost in all the animals. The more cranial palpation towards right side of the abdomen revealed gas filled intestinal loops along with an obstructed loop which appeared as thick, slightly movable and impacted mass of intestinal tract. The manipulation of this segment elicited a severe pain to the animal. In three animals thick bands of mesentery running dorso-ventrally in the abdominal cavity were palpated. Three animals were presented during gestation period of more than 5 months where the obstructed loop within the abdominal cavity could not be located by per rectal examination.

III. LABORATORY DATA

The preoperative laboratory data of the patients was obtained and has been divided into two groups namely the survivors (n=6) and non survivors (n=9). The values presented in the table are before undertaking surgery.The haematological parameters revealed increased haematocrit with elevated total leukocytic count and total erythrocytic count towards higher range (Table 60).

The blood biochemistry analysis revealed hypokalemia, hypochloraemia and azotemia (only in severely dehydrated animals). The plasma phosphorus, calcium, bilirubin and total proteins were towards higher range (Table 61).The plasma creatinine level was high and mild decrease in plasma sodium concentration was also appreciated. The plasma Alkaline phosphatase, Alanine amino transferase and Aspartate amino transferase were elevated to their maximum range with a very high increase in plasma amylase concentration (Table 61).

IV. DIAGNOSIS

The history of the course of illness comprising symptoms of colic and failure to defecate, reflex guarding of abdomen, crouching, rigidity of abdominal muscles with abdominal distention and postural abnormalities were indicative of acute abdomen.

TABLE 60: PREOPERATIVE HAEMATOLOGICAL OBSERVATIONS IN CLINICAL CASES OF COWS SUFFERING FROM INTESTINAL OBSTRUCTION (MEAN ± S.E.).

S. NO.	PARAMETER	SURVIVORS (N=6)	NON SURVIVORS (N=9)
1	Haemoglobin (7.5-12.5 g/dl)*	9.43±0.448	9.53±0.551
2	PCV (23-36%)*	42±1.789	44.78±2.235
3	TEC ($5-8 \times 10^6$/ul)*	6.34±0.338	6.42±0.531
4	WBC count ($4-20 \times 10^3$/ul)*	9.24±0.418	7.31±0.301
5	Neutrophils	41.17±2.088	39.89±1.968
6	Lymphocytes	56.83±1.922	59.11±1.806

*Normal references ranges, University of Florida Veterinary Teaching Hospital.

Auscultation and ballottement of abdominal wall was observed to be important tool for diagnosis of intestinal obstruction. The presence of fluid splashes along with resonant tinkling sounds during early phase of obstruction and relative quietness during later phase of obstruction aided in diagnosis.

Digital rectal examination proved to be the most informative diagnostic procedure in cases of intestinal obstruction. Almost 80 per cent of the cases suffering from intestinal obstruction involving jejunum, ileum, colon and caecum were easily diagnosed per rectally. The intestinal loops could not be palpated per rectally in the pregnant animals with gravid uterus of more than 5 months, thus restricting diagnostic options to only exploratory laparotomy and subsequent surgical correction.

The presence of tympanitic loops of intestine, tight mesenteric bands and discrete pain on palpation of the obstructed loops helped in confirmation of intestinal obstruction. The laboratory data indicating hypochloraemia, hypokalemia and azotemia were characteristic of bowel obstruction. The other findings like elevated plasma enzymes especially amylase, bilirubin and total proteins also followed the intestinal obstruction. Other laboratory tests indicated a very high increase in ruminal fluid chloride concentration with increased protein and cellular content of peritoneal fluid. The discolouration of the peritoneal fluid also pointed towards the intestinal pathology (Table 62).

TABLE 61: PREOPERATIVE BIOCHEMICAL OBSERVATIONS IN CLINICAL CASES OF COWS SUFFERING FROM INTESTINAL OBSTRUCTION (MEAN ± S.E.).

S. NO.	PARAMETER	SURVIVORS (N=6)	NON SURVIVORS (N=9)
1	Glucose	64.3±4.24	63.88±12.534
2	BUN(10-22 mg/dl)*	30.05±1.733	39.04±.899
3	Creatinine(0.5-1.5 mg/dl)*	3.72±0.141	4.76±0.344
4	Total Bilirubin(0.1-0.4 mg/dl)*	0.42±0.064	0.45±0.048
5	Plasma Total Proteins (6.5-8.0 g/dl)*	6.98±0.323	7.63±0.273
6	Sodium	133.33±1.43	134.44±1.937
7	Potassium(4-5.5 mEq/L)*	4.06±0.333	3.54±0.173
8	Chloride(99-110 mEq/L)*	90.32±3.031	78.85±2.62
9	Calcium	5.97±0.385	6.15±0.288
10	Phosphorus(4-7 mg/dl)*	5.92±0.254	7.11±0.285
11	ALKP(19-126 IU/L)*	127.8±7.731	126.67±9.833
12	SGOT (AST)	146±13.653	152.33±13.427
13	SGPT (ALT)	130.33±7.923	133.77±8.188
14	Amylase(4-38 IU/L)*	51.17±4.308	32.67±3.169

* Normal references ranges, University of Florida Veterinary Teaching Hospital.

TABLE 62: PREOPERATIVE RUMINAL AND PERITONEAL FLUID ANALYSIS IN CLINICAL CASES OF COWS SUFFERING FROM INTESTINAL OBSTRUCTION (MEAN ± S.E.).

S. NO.	PARAMETER	SURVIVORS (N=6)	NON SURVIVORS (N=9)
1	Ruminal fluid – Chloride (30mEq/L)*	66.1±8.036	73.68±5.119
2	Ruminal fluid – pH	6.48±0.210	6.05±0.13
3	Peritoneal fluid – Proteins (1-5 mg/dl)*	5.17±0.499	6±0.294
4	Peritoneal fluid - Cell count (1 - 20,000 cells/mm3)*	3591.67±548.55	5266.7±289.88
5	Peritoneal fluid - pH	6.87±0.117	6.87±0.0954

* Normal references ranges, University of Florida Veterinary Teaching Hospital

V. TREATMENT

The existence of pre operative dehydration and hypochloraemia indicated the vital need for rapid parenteral fluid replacement therapy, started preferably before surgery or as soon as possible afterwards. The administration of Ringer's solution and additional potassium chloride by IV route was preferred in these patients to offset the impending and ongoing metabolic alkalosis.

The amount of intra-venous fluid administered in the patients was calculated as per the following formula

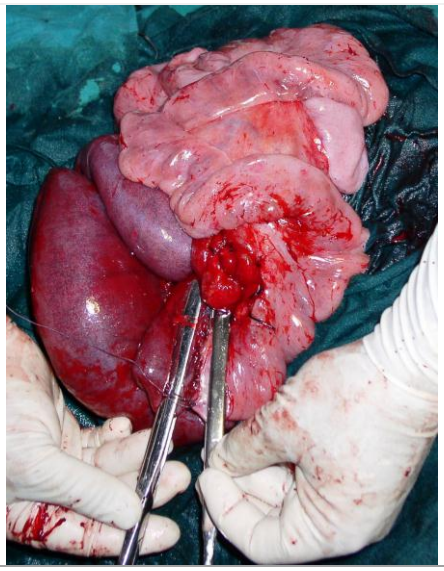
Fluid required to overcome dehydration (ml)

= Patient PCV x 0.66 x body weight (in Kg) x 4 (Kumar, 1995)

The pre operative administration of corticosteroids, NSAIDS and antibiotics helped to reduce the stress induced by surgery. The corticosteroids were not given in pregnant animals because of the possibilities of potential complications.

Right flank laparotomy was performed under linear infiltration analgesia in standing position. The per rectal findings were corroborated to locate the obstructed loop of intestine. Usually the omental covering was reflected forward to locate and exteriorize the affected segment but in certain cases there was considerable tightening of mesentery enforcing difficult or even impossible exposure of the affected loop, in these cases the omental layers were incised for easy exteriorization.

PLATE 10: CORRECTIVE SURGERY FOR INTUSSUSCEPTION COMPRISING OF ENTEROANASTOMOSIS IN CLINICAL CASES OF COWS



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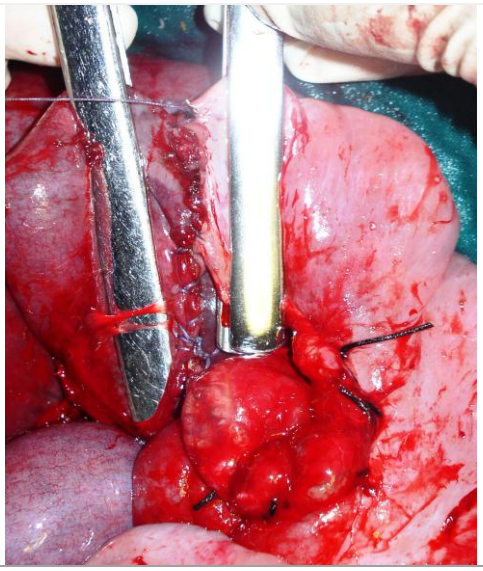

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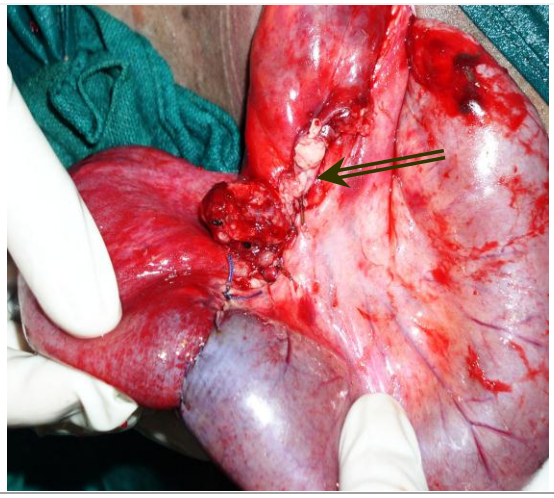

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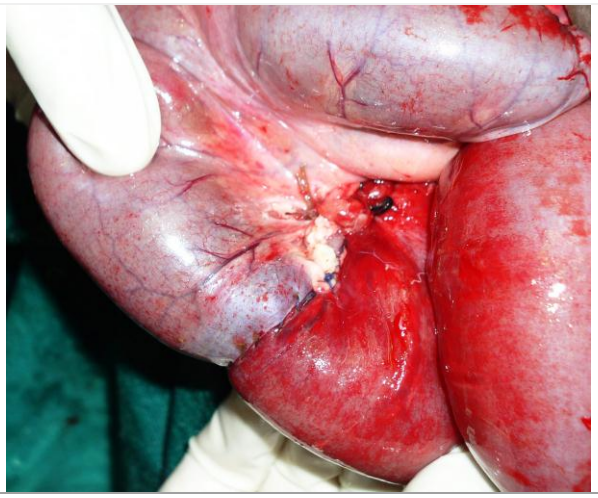

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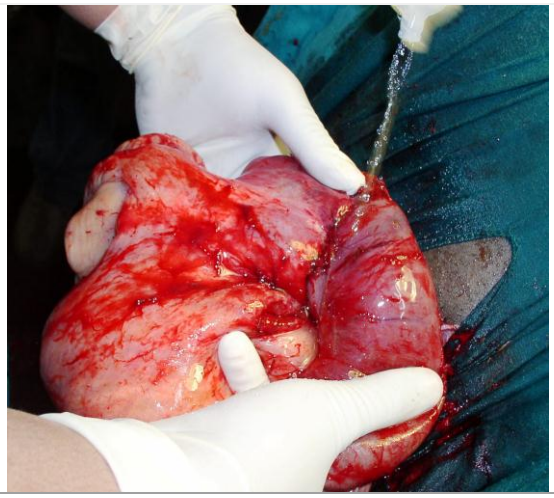


E

A. Placement of doyens intestinal clamp for anastomosis

B. First simple continuous layer to join the lumens

C. Mesenteric rent joined by suturing

D. Complete enteroanastomosis

E. Copious washing of the setting with normal saline before reposing back into intestinal cavity

The viable segments of intestine proximal and distal to the obstruction were identified and the affected/obstructed segment was removed by ligating the mesentery in between the two healthy segments. The mesentery selected for resection of the intestine was infiltrated with 2 per cent xylocaine. Following resection, intra operative decompression of the distended segment was performed and end to end anastomosis (Plate 10) was achieved using two layer anastomotic technique with a simple continuous pattern for the submucosal/mucosal layer, followed by a continuous Lambert pattern in the seromuscular layer using 2-0 Vicryl (Polyglactin 910). The laparotomy wound was closed in a standard routine manner.

The post operative care included administration of Ringer's solution, normal saline solution, 5 per cent dextrose normal saline, calcium borogluconate, antibiotics, Vitamin C, analgesics, corticosteroids, metronidazole (intraperitoneally) and Nuxvomica (PO). The animals were fed, rice gruel, soft hay and treacle after 6 hours of surgery followed by a handful of hay mixed with green supple grass after every 3-4 hour interval in post operative period. The full ration was asked to resume within 3-4 days.. The transfaunation of ruminal cud 12 hours after surgery in the present study was done in all the cases.

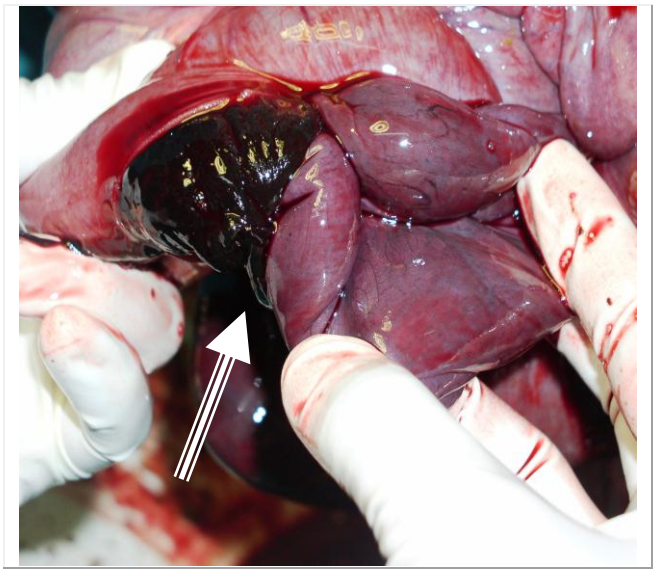
Specific therapy included administration of neostigmine in the patients those were unable to defecate within 12 hours of surgery. Additional potassium chloride was included in the treatment protocol where the animals resumed eating but were unable to defecate and developed ruminal tympany. The patients with feeble or nil ruminal motility combined with sluggish/nil protozoal motility were given ruminotorics, biobloom and ruminal cud.

VI. OPERATIVE FINDINGS AND OUTCOME OF CASES

One of the 15 affected animals was bull and 3 out of 14 cows were pregnant with gestation period of 5 months or more. All the cases suffered from intussusception (Plate 11) at the following locations, Jejunojejunal (n=5), Jejunoileocaecocolic (n=1), Ileiocaecocolic (n=1), Caecocolic (n=7) and Colocolic (n=1). Three animals had intussusception with rupture of the intestine at the affected site. Surgical intervention was attempted in all the cases. Out of 15 cases 6 animals survived and 9 animals died. Non survivors also included 3 pregnant animals and 3 with intestinal rupture and peritonitis (Table 63).

In all the animals, failure to defecate was associated with telescoping of the alimentary tract (Plate 11) with severe oedema of the intestine and particularly of mesentery which was grossly infiltrated and distended with oedematous fluid and noticeably heavy and painful on palpation. In three cases loose adhesions of affected segment were found with the mesentery and peritoneal fluid contained free floating and grossly visible masses of fibrin. The segment of intestine distal to obstruction was collapsed and proximal segment was greatly distended with ischemic changes (Plate 12).

PLATE 11: INTRA-OPERATIVE FINDINGS IN CLINICAL CASES OF COWS



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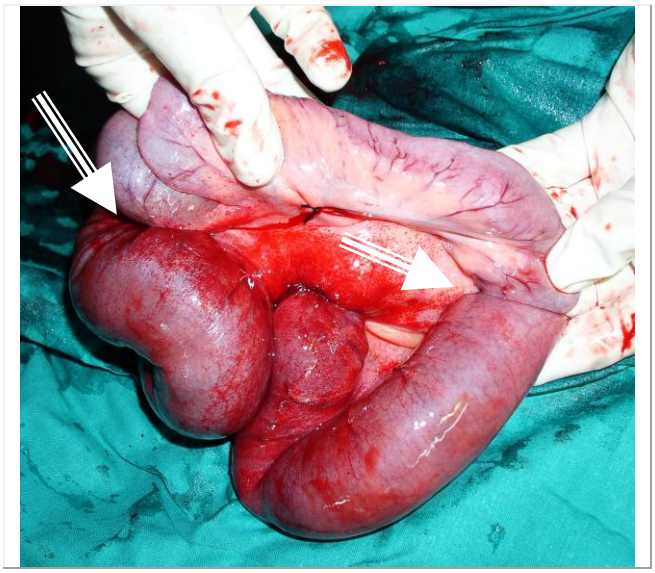

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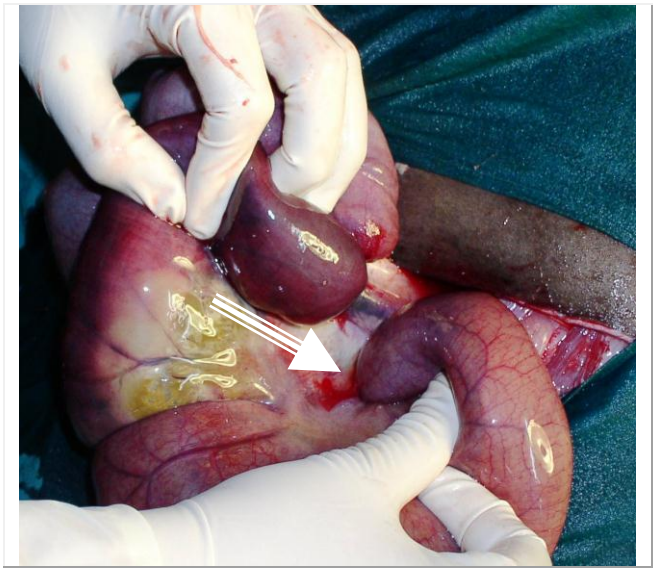


C

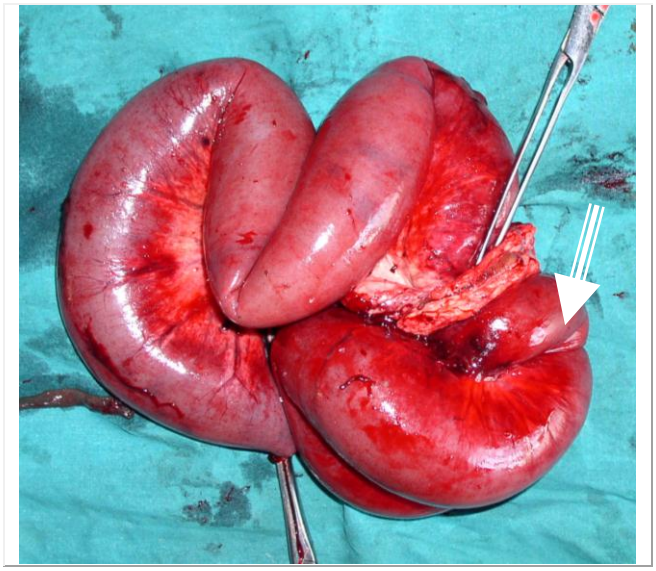
A. Ileiocecocolic Intussusception
(Note the extent of mucosal damage)

B. Colocolic Intusussception
(Telescoping at two points)

C. Colocolic Intusussception
(Bowel wall necrosis upto mucosa)

→ (ARROW INDICATES SITE OF TELESCOPING)

PLATE12:RESECTION OF VARIOUS INTUSSUSCEPTUM DURING CORRECTIVE SURGERY IN CLINICAL CASES OF COWS



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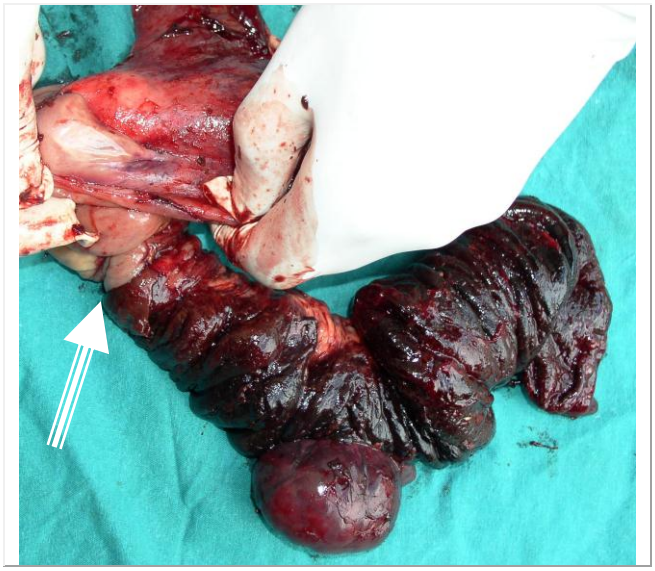

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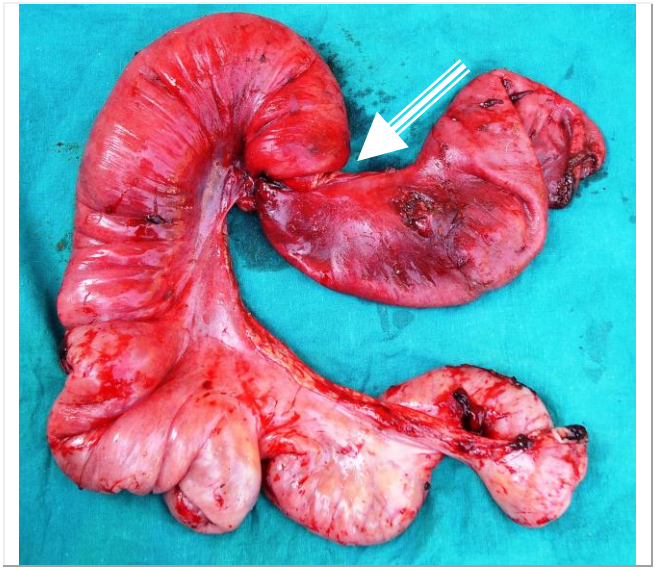

C

A. Colocolic Intussusception
(Resected part of intestine)

B. Jejunojejunal Intussusception
(Intussusceptum dissected with transmural injury)

C. Jejunoileal Intussusception
(Intussuscepien is engorged as compared to collapsed part of intestine)

→ ARROW INDICATES SITE OF TELESCOPING

TABLE 63: SUMMARY OF CLINICAL CASES OF INTESTINAL OBSTRUCTION WITH RESPECT TO SIGNALMENT AND OUTCOME IN COWS.

S. No.	Species	Age (Years)	Sex	Day of Surgery*	Diagnosis	Outcome
1	Cow	4	F	6	Intussception Caeco colic junction	Died
2	Buffalo	7	F	6	Jejunum Intussception	Died
3	Cow	10	M	8	Jejunum Intussception	Died
4	Cow	7	F	2	Intussception Jejuno ileocaecocolic junction	Died
5	Cow	4	F	4	Intussception Caeco colic junction	Died
6	Cow	2	F	3	Intussception Caeco colic junction	Survived
7	Cow	5	F	3	Intussception Caeco colic junction	Survived
8	Cow	3	F	5	Intussception at ileocaecal junction	Survived
9	Cow	3	F	5	Intussception at caeco colic junction	Died
10	Cow	2	F	4	Intussception Jejunum	Died
11	Cow	7	F	6	Torsion and Intussception	Died
12	Cow	5½	F	5	Intussception of caecum into colon	Survived
13	Cow	6	F	5	Intussception Rupture at Caecocolic junction	Died
14	Cow	6	F	7	Intussception Colon	Survived
15	Cow	5	F	3	Intussception Jejunum	Survived

VII. POST MORTEM FINDINGS

On autopsy of the non survivors, adhesions were noticed in the abdominal cavity and the affected segment of the bowel appeared dark red. The mesentery was thick and rubbery with ecchymotic areas. Serosanguinous peritoneal fluid was usually present in the abdominal cavity. Coprostatic obstruction within the distended loop of intestine was evident. The lymph nodes within the involved mesentery were swollen. There was no anastomotic leakage but the serosa of the reconstructed intestinal segment was denuded and focal ulcers were seen on the mucosal surface. The mucosa of abomasum was edematous and it contained more of fluidy ingesta, whereas, omasum contained dehydrated feed particles.

H. SUMMARY:

Simple and strangulated obstruction of cranial jejunum was created in 24 calves which were randomly divided into six groups of four animals each. Similarly simple and strangulated colonic obstruction was created in 24 calves, which were further divided into 6 groups of four animals each. The animals of group I served as untreated control, group II served as conservative and in the animals of group III conservative and surgical treatment was done. In proximal jejunal strangulated obstruction the animals of groups II were treated with conservative therapy alone at 24^{th} post obstruction hours and in simple jejunal obstruction were treated at 3^{rd} post obstruction day. Whereas in strangulated colonic obstruction conservative treatment was started at 3^{rd} post obstruction day and in simple colonic obstruction the treatment was done at 6^{th} post obstruction day. The strangulated and simple cranial jejunum obstruction in the animals of groups III were corrected by surgical intervention at 24^{th} post obstruction hour and 3^{rd} post obstruction day respectively and these animals were also maintained on conservative therapy till the end of study. Likewise in the strangulated and simple colonic obstruction the animals of group III were surgically corrected at 3^{rd} and 6^{th} post obstruction day respectively. The blood, peritoneal fluid and ruminal fluid samples were collected at 0, 24, 48, 72 and 96 post obstruction hours (cranial jejunal strangulated obstruction) and at 0, 2, 3, 4, 6 and 8^{th} post obstruction day (cranial jejunal Simple obstruction). Similarly the samples were collected at 0, 1, 2, 3, 4, 5 and 6^{th} post obstruction day (strangulated colonic obstruction) and at 0, 3, 6, 9, 12 and 15^{th} post obstruction day (Simple colonic obstruction). Clinical, physical, cytological, haematological and biochemical alterations in body fluids were studied before and after induction of simple and strangulated obstruction and following its treatment.

1. SIMPLE AND STRANGULATED JEJUNAL OBSTRUCTION:

All the animals showed mild signs of discomfort like reflex guarding of abdomen while standing, grinding of teeth and mild pain during movement, immediately after creation of simple intestinal obstruction. These symptoms abolished within 6-8 hours. The mild abdominal pain reappeared after two days exhibited by groaning, kicking at the abdomen and restlessness. These signs disappeared at 4^{th} day onwards and there after the symptoms of weakness were observed. Stools became insufficient, desiccated and mucoid with strained

defecation. Total atony of the rumen was seen along with the sluggish protozoal motility. Intestinal borborygmi were audible on auscultation upto 4th post obstruction day.

The abdomen was bilaterally distended and a comprehensive lassitude marked by diminished elasticity of the skin, eyeball recession and increased capillary refill time was recorded. Elevated haemoglobin, packed cell volume (38.33 ±0.88 per cent) and total erythrocytic count was observed in all the animals. At 3rd day, following simples intestinal obstruction the increase in total leucocyte count (11062.5 ±319.69 cells/ µl) with absolute neutrophilia, hypochloraemia (75.12±2.05mEq/L), hypokalemia (3.8 ±0.13 mEq/L), azotemia (BUN: 22.83±2.78 mg/dl and creatinine:2.17±0.27 mg/dl), hyperproteinemia (8.04±0.21mg/dl) and increased level of alkaline phosphatase (112.58±2.08IU/L) and amylase (28.17 ±1.28IU/L) were observed. High yellow colour discolouration of peritoneal fluid with increased levels of total protein concentration (3.08±0.14 g/dl), nucleated cell count (3412.5±91.93 cells/µl), decreased sodium (140.33±0.77mEq/L), potassium (3.84±0.14 mEq/L) and chloride 990.53±1.89 mEq/L) concentration were recorded. The decrease in ruminal fluid sodium and potassium and substantial increase in ruminal fluid chloride (53.49±1.19mEq/L) concentration was a prominent finding.

All the animals following creation of strangulated jejunal obstruction exhibited clinical signs of acute abdominal pain manifested by kicking at the abdomen, restlessness, lying down and getting up frequently, bruxism within half to two hours and these signs persisted upto 4-5 hours. Intensity of these signs was more severe during 2-3 hours following creation of intestinal obstruction. Defecation became scanty after 12 hours of creation and after 24 hours only the mucous with foul odour was voided which later after 48 hours contained the mucosal and diphtheric shreds till the death of animals. Signs of muscular weakness were constantly observed in all the animals of three groups which were manifested initially by reluctance to move after 12 hours and instability of hind limbs at 24 hours, difficulty while assuming the sternal recumbency and getting up on feet at 72 hours. The rumen was usually hypotonic on 24 hours and became atonic on and after 48 hours. There was an appreciable loss in large ruminal protozoa at 24 hours and later after 48 hours onward the protozoal motility comprising of only the smaller species of protozoa was feebly appreciable. Intestinal borborygmi were audible upto 48 hours and progressive bilateral abdominal distention was observed from 48 hours onward. All the animals manifested the signs of dehydration like the recession of eye ball from 48 hours and became markedly so at the end of the period of obstruction. The elasticity of skin decreased from 24 hours (3-4 seconds) and became inelastic after 48 (7-8 seconds) hours onward. Following 24 hours of creation of strangulated intestinal obstruction serious physiological alterations characterized by haemoconcentration (40.58±0.91 per cent), leucocytosis (7879.17±281.73 cells/µl) with neutrophilia were observed. The striking characteristics were hyperproteinenmia (9.07±0.13 mg/dl), azotemia (BUN: 19.44±1.82 mg/dl and Creatinine: 1.23±0.02 mg/dl), hypochloraemia (68.17±1.64 mEq/L), hypokalemia (3.45±0.04 mEq/L) with raised levels of alkaline

phosphatase (131.17±1.75 IU/L) and amylase (27.67±1.394 IU/L). The peritoneal fluid colour exhibited high yellowish colored tinge in the post obstruction period. A highly significant increase in the total proteins (4.45±0.13 mg/dl) and nucleated cell count (3666.67±127.38 cells/µl) of peritoneal fluid was observed at 24 hours. There was a significant decline in sodium, potassium and chloride concentrations of peritoneal fluid. The ruminal fluid chloride concentration which rose to 42.12±0.86 mEq/L can be an important diagnostic test to be included in biochemical profile.

2. SIMPLE AND STRANGULATED COLONIC OBSTRUCTION:

All the animals showed signs of discomfort and pain after creation of simple colonic obstruction. These symptoms abolished within 4-6 hours and thereafter the animals resumed their normal activity. Animals exhibited signs like groaning, kicking at the abdomen and restlessness on 5^{th} day. The signs disappeared and from 13^{th} day onwards the symptoms of weakness were observed. Defecation was normal on the day of creation of simple intestinal obstruction. Urination was normal in the animals of group II and III but oligouria was noticed in group I as the duration of obstruction progressed.

The feed and water intake was normal in all the animals of three groups upto 7^{th} day of creation of obstruction, thereafter appetite reduced considerably but browsing on small amount of fodder was continued throughout the period of study till 11^{th} day. Subsequently on 13^{th} day all the animals of group I and II showed the tendency of prolonged recumbency and were totally reluctant to eat even when the fodder was offered.

Rumen motility decreased to almost half at 2^{nd} post obstruction day and later from 3^{rd} day onward the rumen became totally atonic. Abdominal distention was seen on 4^{th} day onward which gradually increased with time and in later part of the study.

There was a decrease in the rectal temperature at 3^{rd} and 6^{th} post obstruction days. A comprehensive lassitude was evident in all the animals after 4-5 days following the creation of the obstruction. The signs of dehydration like muffled hair coat, reduced elasticity of skin and dryness of muzzle were observed. There was increased heart rate, pulse rate and respiration rate. Decrease in the ruminal fluid pH (6.7±0.123) was observed from 6^{th} day after simple colonic obstruction. A moderate loss of ruminal microflora at 5^{th} post obstruction day but as the duration of obstruction progressed, the loss became sluggish at 7^{th} and 9^{th} day and afterwards complete loss was observed. There was increase in hemoglobin concentration (13.75± 0.457 g%), packed cell volume (47.5%) ,the total erythrocytic count (8.213x 10^6 ± 0.191µl) and total leukocytic count (13460±0.725 cells/µl) on 9^{th} day. There was hyperproteinemia (8.7±0.286g/dl), increased BUN (42.75±2.136 mg/dL), creatinine (2.708±0.119mg/dL) and increased levels of alkaline phosphatase (131.5±3.5 IU/L) on 6^{th} day. Whereas, on 6^{th} day after creation of simple colonic obstruction, there was hypokalemia (3.55±0.096 mEq/L) and hypochloremia (79.63±2.241 mEq/L). There were elevated levels of protein (4.3±0.424 g/dL), nucleated cell count (4444±0.466 cells/ cu mm) in the peritoneal fluid and a decrease was observed in peritoneal fluid potassium (3.85±0.126 mEq/L), sodium

(135±2.082 mEq/L) and chloride (75.58±3.283 mEq/L) after 6th day of creation of simple colonic obstruction. There was decrease in the ruminal fluid potassium (24.0±3.162mEq/L), sodium (102.5±4.573 mEq/L) and increase in the chloride (57.43±4.03 mEq/L) concentration .

All the animals were showed clinical signs of acute pain within two hours of creation of strangulated colon obstruction which were exhibited by kicking at the abdomen, restlessness, lying down and getting up frequently, vocalization, stretching, straining to urinate and defecate. These signs remain visible up to 24 hours and the severity of pain was recorded during initial 4-6 hours of obstruction. Absence of defecation in majority of animals was seen after creation of strangulated colonic obstruction in all groups with exception of few in which scant faeces was observed. As the duration of obstruction increased the animals showed intense straining to eliminate a mucoid shreds without a trace of stools. The general frequency of passing the mucous was once a day till 3rd day in control group. The croupous and diptheric shreds from the rectum were visible after 4th day post obstruction up till the death of animals. The progressive debilitation continued in the animals of group I which was evident by dry lusterless hair coat and general appearance.

The animals resumed almost normal feed and water intake after 36 ± 4.89 hours post obstruction hours but on 3rd day post obstruction marked loss of appetite was appreciated.. There were signs of muscular weakness which were manifested initially by reluctance to move at, instability of both fore and hind limbs at 24 hours. There was recession of eye ball at 4th day.

In all the animals, rumination ceased completely at 24 hours following the creation of obstruction. There was decrease in the ruminal fluid pH (6.62±0.047) on 3rd day and increased capillary refill time (0.67± 0.062). There was marked hyperproteinemia (10.55±0.841mg/dl), azotemia (BUN: 21.35±3.174 mg/dl and creatinine 2.22±0.205 mg/dl), hypochlorimea (75.15±2.185mEq/L), hypokalemia (3.85±0.184mEq/L), increased alkaline phosphatase(151.5±3.476IU/L) and increased AST (119.5±4.252IU/L) after 3rd post obstruction day. A significant increase in peritoneal fluid protein (4.75±0.736 g/dl) concentration and nucleated cell count (3920±0.641cell/cumm) was observed at 3rd post obstruction day. There was marked decrease in sodium (93.85±1.805 mEq/L), potassium(21.27±0.458 mEq/L) and increase in chloride (53.62±1.734mEq/L) concentration in the ruminal fluid at 3rd post obstruction day.

The criteria for surgical and medical intervention were based on above findings which have a significant prognostic importance. In either type of obstructions the treatments were instituted when plasma chloride has not fallen below 75 mEq/L, plasma potassium has not declined below 3.5 mEq/L and haematocrit has not risen above 40 per cent. During treatment, efforts were being made to maintain the concentrations at above mentioned optimal levels. Ringer's solution and potassium chloride were being given to maintain the optimal concentration of chloride and potassium as mentioned *ut supra*. When the electrolyte levels were restored, the normal saline, dextrose normal saline (5 per cent) and calcium

borogluconate were administered to cater the fluid deficit due to dehydration. Post operative supportive therapy comprising of antibiotics, anti-inflammatory drugs, ruminal motility rejuvenators, and transfaunation aided in improving the prognosis in intestinal obstruction.

The effectiveness of conservative treatment in group II and surgical treatment along with conservative treatment in the animals of group III of either type of obstruction was evidenced clinically. The conservative treatment given to the animals of group II decreased the pace of deterioration of the pathophysiology and increased the life span of the animals as compared to the animals of group I. Haemoconcentration and other signs of dehydration were delayed in the animals of group II and subsided in group III following treatment. The concentrations of total protein decreased and blood electrolytes increased in the post treatment period when compared to the day of treatment In proximal obstruction (24 hours in strangulated jejunal obstruction and 3rd day in simple jejunal obstruction) and similarly in colonic obstruction (3rd day in strangulated colonic obstruction and 6th day in simple colonic obstruction). The peritoneal fluid samples collected before obstruction revealed no growth. However, Gram +ve bacilli, Gram –ve rods and Gram –ve cocobacilli were found during post treatment period. The isolates were found sensitive to Amoxycillin, Gentamicin, Tetracycline, Ciprofloxacin, Cloxacillin, Erythromycin and Penicillin. The histopathological changes in the strangulated intestine revealed autolytic changes whereas in simple obstruction necrotic changes were evident.

I. RESULTS WHICH CAN BE EXPLOITED IN PILOT OR FIELD SCALE:

Based on the results of present scheme, the following recommendations are made:

1. The Strangulated and simple cranial jejunal obstruction produced severe pathophysiology within 24 hours and 72 hours of creation respectively manifested by scant feces with mucosal/ diphtheric shreds, hypochloraemia, hypokalemia, haemoconcentration, azotemia with increased plasma alkaline phosphatase and amylase concentration. Similar signs were exhibited in strangulated and simple colonic obstruction from 3rd and 6th post obstruction day, respectively.
2. In proximal intestinal obstruction the prognosis is favourable if plasma chloride is not < 75 mEq/L, plasma potassium is not < 3.5 mEq/L and hematocrit is not > 40 per cent. Whereas in distal intestinal obstruction the prognosis is good if plasma chloride is not < 78.48 mEq/L, plasma potassium is not < 3.73 mEq/L and hematocrit is not > 42.87 per cent.
3. Increased ruminal fluid chloride (> 40 mEq/L) indicated outflow obstruction thus is an important prognostic factor.
4. a) Conservative treatment following simple and strangulated jejunal obstruction in the animals of group II decreased the pace of deterioration of pathology as compared to diseased control group I. It increased the survival time by 14 hours in strangulated and one and half day in simple intestinal obstruction as compared to control group I.

b) Conservative treatment following simple and strangulated colonic obstruction in the animals of group II subsided pathology as compared to diseased control group I. It increased the survival time by 3.25 days in strangulated and 2.5 days in simple colonic obstruction as compared to control group I.

5. Blood chloride concentration can serve as an important index for selection of fluid to be administered in both types of obstruction and should be maintained around 75mEq/L by giving ringer solution combined with potassium chloride.
6. To correct the hypochloraemia, Ringer's solution combined with potassium chloride can be given and when the blood chloride level are restored optimally, normal saline and dextrose normal saline can be given for maintenance.
7. The clinical cases of intussusception in cattle presented with dehydration (PCV > 45 per cent), hypochloraemia (<78 mEq/L), hypokalemia (<3.5 mEq/L) and increased ruminal concentration (74 mEq/L) with severe abdominal distension, recumbency along with pregnancy had poor prognosis.
8. To avoid post surgical mortality and to improve the prognosis of clinical cases of intestinal obstruction during postoperative period, the supportive treatment should comprise of Ringer's solution, potassium chloride, isotonic saline, dextrose normal saline, calcium borogluconate, antibiotics, corticosteroids and transfaunation with rumen microflora rejuvenators (rumen cud, rice gruel with treacle) and to prevent post-operative ileus, neostigmine can be added.
9. In majority of the clinical cases, intussusception of the distal intestine affecting caecocolic junction was observed and recorded primarily in the females and pregnant animals. Feeding of the Bamboo hay was found to be a major etiological factor.
10. Digital per rectal examination proved an important tool for diagnosing 80 % clinical cases of intestinal obstruction and exploratory laparotomy was performed to confirm it.
11. Prompt surgical intervention at following interval is needed for better post surgical prognosis of animals:
    i. 24 hours in cranial strangulated jejunal obstruction.
    ii. 3rd day in cranial simple jejunal and strangulated colonic obstruction.
    iii. 6th day in simple colonic obstruction.
12. Change in the colour of the peritoneal fluid from normal straw to deep yellow served as an important indicator for both proximal and distal intestinal obstruction.

J. PAPERS/ARTICLES PREPARED/ ACCEPTED/PUBLISHED: -Nil-

K. SUGGESTION FOR FUTURE LINE OF WORK:

1. Application of large animal diagnostic Ultrasonography and MRI are important tools used nowadays for delineating the abdominal disorders. The use of such modalities can be investigated.
2. Comprehensive studies are required on blood gas analysis for understanding the correct pathophysiology and to evaluate the response of treatment.
3. Corrective surgery comprising of staple anastomosis technique and some newer methods of anastomosis combined with antioxidant therapy can be evaluated.
4. Reperfusion and ischemic studies following various intestinal obstructions can be carried out.
5. Detailed studies can be undertaken on diagnostic and therapeutic aspects of post operative anastomotic adhesions.
6. Investigations can be carried out on the effect of electromagnetic field stimulation on intestinal anastomotic healing.

L. ACKNOWLEDGEMENTS:

At the outset investigator wishes to express appreciation and sincere thanks to Indian Council of Agriculture Research New Delhi for sanctioning the project and releasing the funds in time. We are further grateful to the Council to acceding our request and increasing the pay of JRF and Animal Attendant of the project. We convey our thanks to the Honourable Vice Chancellor, Director of Research and Controller of CSKHPKV, Dean, Dr. G. C. Negi College of Veterinary and Animal Sciences, CSKHPKV for their cooperation and help without which the smooth running of the project was not possible. Special thanks to Professor and Head department of Surgery and Radiology for timely help and cooperation. We extend our gratitude to our departmental colleagues, laboratory and administrative staff of the department and post graduate students for their whole hearted cooperation during the entire tenure of the project. The cooperation extended by the Animal Husbandry Department for conducting the research in clinical cases of intestinal obstruction is duly acknowledged.

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No.
Dated: 7.6.07

From

The Dean,

To

The Director of Research,
CSK, HPKV Palampur

Subject: Submission of FINAL TECHNICAL REPORT (15.9.03 to 14.9.06) in respect of project entitled “Studies on intestinal obstruction in cross bred cattle of high altitude with special reference to prognostic, diagnostic and therapeutic aspects.”

Sir,

Kindly find enclosed herewith FINAL TECHNICAL REPORT (15.9.03 to 14.9.06) in 11 copies in respect of project entitled “Studies on intestinal obstruction in cross bred cattle of high altitude with special reference to prognostic, diagnostic and therapeutic aspects.” for onward transmission to Asstt. Director General (AH), Indian Council of Agricultural Research, Krishi Bhavan, New Delhi-110 001 for further action.

Yours Faithfully,

(Prof. A.C. Varshney)
Dean

Ecnl: ICAR Project report in 11 copies

Based on the results of ICAR adhoc project, the following New recommendations are made: Annexure-I

1. The Strangulated and simple cranial jejunal obstruction produced severe pathophysiology within 24 hours and 72 hours of creation respectively manifested by scant feces with mucosal/ diphtheric shreds, hypochloraemia, hypokalemia, haemoconcentration, azotemia with increased plasma alkaline phosphatase and amylase concentration. Similar signs were exhibited in strangulated and simple colonic obstruction from 3rd and 6th post obstruction day, respectively.
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6. To correct the hypochloraemia, Ringer's solution combined with potassium chloride can be given and when the blood chloride level are restored optimally, normal saline and dextrose normal saline can be given for maintenance.
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