

**STUDIES ON
CLINICO-BIOCHEMICAL CHANGES
IN EXPERIMENTAL ABOMASAL
DISPLACEMENT AND TORSION
IN BUFFALO CALVES.**

Thesis

Submitted to the Faculty of Veterinary Science
RAJENDRA AGRICULTURAL UNIVERSITY, BIHAR
in partial fulfilment of the requirements
for the degree of
MASTER OF SCIENCE (VETERINARY)

By

Laliteshwar Lall Dass

B. V. Sc. & A. H. (Pat.)

JUNIOR RESEARCH FELLOW, R. A. U., (BIHAR)
Post-Graduate Department of Surgery

**BIHAR VETERINARY COLLEGE
P A T N A.**

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P A T N A,

Dated, the 28th January, 1977.

This is to certify that the work embodied
in this Thesis entitled "STUDIES ON CLINICO-
BIOCHEMICAL CHANGES IN EXPERIMENTAL ABOMASAL
DISPLACEMENT AND TORSION IN BUFFALO CALVES" is
the bonafide work of Dr. Laliteshwar Lall Dass
and was carried out under my guidance and
supervision.


(A.A. KHAN)

C E R T I F I C A T E

Certified that the research work
incorporated in this Thesis has not
been published in part or in full in
any other journal.



(LALITESHWAR LALL DASS)

DEDICATED TO
MY LATE GRAND MOTHER
FOR HER BENEDICTION.

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INTRODUCTION

I N T R O D U C T I O N

In an agricultural country like India cattle play a vital role in national economy in terms of motive power, milk and milk products which can be increased by all-round improvement in the animal husbandry and proper treatment of animals in diseases.

Abomasal displacement and torsion are relatively a newly recognised ailment of bovines. These reduce milk yield, weight gain, reproductive ability, motive power and frequently cause death when associated with toxæmia, dehydration and shock. These conditions are of great importance as it may confuse the diagnosis of several digestive and metabolic disorders in cattle. However, in past many workers viz. Begg (1950), Richardson (1956), Espersen (1964), Fox (1965), Gibbons (1966), Boucher and Abt (1968), Gabel and Heath (1969) have attempted to correlate the clinical manifestations associated with these diseases.

Displacement and torsion of abomasum have generally been recorded in the animals of exotic breeds. In India, it has also been reported but not too frequently. Sporadic reports may suggest that many of the cases might not have been detected due to the lack of adequate clinical and biochemical analysis. According to our present policy for the development of livestock, a considerable number of exotic breeds have already been introduced in our country

for cross breeding programme. The prevalence of these diseases in exotic breeds might become a burning problem in our country as well on account of inherent and predisposing factors. Keeping this aspect in view, the present project has been undertaken with an idea to solve the impending problems.

In health, various biochemical constituents are maintained within normal limits. In diseased conditions the integrated reactions going on inside the cell are altered resulting in far reaching effects.

Many attempts have been made to correlate the shift in normal pattern of specific biochemical parameters with diseased conditions in veterinary surgery since biochemical constituents of blood provide valuable informations regarding diagnosis of the various diseases.

In the recent past some workers viz. Espersen (1964), Robertson (1965, 1966), Poulsen (1967), Boucher and Abt (1968), Svendsen (1969) and Gabel and Heath (1969) have discussed various parameters to correlate the biochemical and haematological changes associated with displacement and torsion of the abomasum. No comprehensive account on these aspects could be evidenced in this country on the basis of available literature. Hence, it was deemed necessary to ascertain the various changes which are associated with the aforesaid conditions.

In the present study efforts have been made to produce displacement and torsion of the abomasum in experimental animals to

simulate the clinico-biochemical changes associated with these conditions. This would pave the way for early diagnosis and proper treatment of the diseased animals in time. Once the case is diagnosed properly the treatment becomes easier and thus the economic loss caused by these diseases in cattle may be reduced to a great extent.

The findings of this study, in addition to providing adequate and efficient diagnosis of the maladies, would help compare the results hitherto obtained by previous workers and at the same time provide impetus for further research in this direction.

*

REVIEW OF LITERATURE

REVIEW OF LITERATURE

(A) CLINICAL ASPECT.

Fincher (1927) observed the clinical symptoms of torsion of the abomasum in one month Guernsey heifer; the main symptoms being anorexia, marked depression, slightly subnormal temperature, recumbent position and dilated rectum with only mucous and serum. Ultimately the heifer died three days later.

Loje (1948) observed the clinical cases of torsio abomasi in cows with abomasum deviating to right or left, more frequently to the left. He reported melaena in those cases which were of over 36 hours duration and in some cases its diviation could be palpated on rectal examination. He recommended paracentesis abdominis for diagnostic purpose.

Begg (1950) studied three clinical cases of abomasal displacement in adult ruminants and found the abomasum present between rumen and the left abdominal wall. In two cases he observed in appetite and decrease in the passage of faeces with the appearance of a tympanitic viscus at the border of the last rib on the left side and a large area with a pronounced tympanitic resonance in the region of the lower half of the posterior ribs.

Ford (1950) observed a case of left displacement of abomasum in a six year old short-horn cow, which was confirmed on

exploratory laparotomy. He found the animal in deteriorating condition, accompanied with inappetence, diarrhoea, atonic rumen with intermittent tremoring of the shoulder muscles and grunting while depressing the back.

Moore et al. (1954) observed clinical symptoms of displaced abomasum in bovine and reported sudden diminution or cessation of appetite, which remains intermittent but always poor. Other constant symptoms observed were scanty faeces of a soft, pasty nature, a dull listless attitude and a tucked up appearance, rapid loss of weight. In all cases, except one, the temperature remained normal or slightly subnormal.

Marr and Jarrett (1955) reported a case of displaced abomasum associated with peptic ulcer, the animal being in rundown state. Auscultation of the rumen over the left sublumbar region revealed sluggish ruminal movements occurring approximately once per minute. Auscultation over the left lower segment of the abdomen revealed the presence of abomasal sounds in an area just behind the costal arch. These sounds were of higher pitch, of a more fluid nature and more reminiscent of true intestinal borborygmi than the slow "churning" type of sound normally heard in this area and associated with ruminal movement. Rectal examination revealed that the posterior part of the abdomen was abnormally empty and one had the impression that the arm was being sucked up to the right upper part of the abdomen giving a sensation of a negative pressure in the rectum. The appetite was of an intermittent nature.

Begg and Whiteford (1956) studied the clinical manifestations of abomasal displacement in cow and reported ruminal tympany which might be associated with colicky pain, normal pulse, temperature and respiration. The appetite remains very poor, but there is no tendency, as in acetonaemia, to selective feeding. In very marked contrast to acetonaemia, rumination is greatly depressed.

They indicated that one of the most notable features of the condition is a "patchiness" or even a marked periodicity of the appetite.

According to their observation, faecal elimination is understandably erratic. Consistency of the faeces is variable but usually normal or slightly soft. No case showed those faecal abnormalities associated invariably with abomasal torsion and occasionally with traumatic reticulitis.

Richardson (1956) studied abomasal torsion in case of bovine and observed intermittent colic, thirst, complete anorexia, scanty faeces, dillness, complete toneless rumen, a peculiar "tinkling" sound over the lower two-thirds of right flank extending forward to the middle of the last two or three ribs.

Normal borborygmi were absent when forceful ballottement was done on the right flank but a sound of splashing water was detected. The rectum was completely devoid of faeces and the rumen could only be palpated with difficulty. On rectal examination, a large, tense viscus was encountered to the right of the midline,

approximately just beyond and on the level with the brim of the pelvis.

Steere (1959) discussed about the right sided dilatation and suggested that when enough dilatation has occurred, torsion is the mechanical sequel. He found that this condition is associated with foetid diarrhoea, indigestion, ketosis, accelerated pulse and respiration. The temperature is usually normal or even subnormal, unless peritonitis is present.

The animal often groans and may grunt on percussion of the tender abomasum. There is abrupt kicking of abdomen, if symptoms of colic are present.

Tutt et al. (1959) reported a case of displaced abomasum associated with peptic ulceration in a cow which showed capricious appetite, dull appearance, normal temperature and characteristic high-pitched tinkling sounds on auscultation of the left flank anterior to costal arch.

Sippel (1959) reported about clinical symptoms of displaced abomasum such as anorexia, emaciation, decreased milk flow, slight puffiness in the left paralumbar fossa, normal temperature and a "roached back" stance.

Macleod (1960) reported a case of abomasal displacement in a 2½ years old bullock which manifested the symptoms of anorexia, marked distention over and behind the left costal arch which

produced a marked resonant sound on percussion.

Neal and Pinsent (1960) reported four cases of dilatation and five of torsion with dilatation of the abomasum.

He stated that once torsion is established, the condition progresses rapidly to death. There is shock with rapid pulse (120-160/minute) and subnormal temperature with cold extremities, extreme dullness and weakness. There is extreme abdominal pain, distention of the right flank, and empty rectum on exploration except for a small quantity of tarry mucous. Food is refused, but water may be taken. Dilatation can be detected by examination of the right flank, which is distended, and simultaneously reveals typical high-pitched fluid sounds on auscultation. Rectal examination may reveal the distended abomasum forward in the right side of the abdominal cavity.

Hortig (1961) studied about the dilatation of abomasum and mentioned that the animal is depressed, anorexic, and refuses to drink, regurgitation stops, milk production decreases, and colic is present temporarily, followed by constipation. The abomasum is palpable in the ventral aspect of the hypochondrium.

Steere (1961) advocated that the symptoms of abomasal distention (displacement to the right) usually appear rapidly, are unremitting, and gradually become more severe. The only really significant symptom is the distention itself, which is detectable

by appearance, palpation, percussion and auscultation or ballottement and auscultation. Rectal examination may be helpful in differential diagnosis, which must exclude such conditions as peritonitis, foetal hydrops, atony and distention of the rumen, and distention of the caecum.

He further stated that the symptoms of abomasal displacement (displacement to the left) are similar to those of ketosis and are usually mild and intermittent. Diagnosis can usually be made by auscultation of the area between the 11th and 12th ribs approximately 6-10 inch below the costochondra junction, where the abomasal tinkle can be heard about every 5 minutes. When displacement is complete, rumen sounds are muffled, ballottement of the left flank produces a splashing sound, and a swelling can sometimes be seen in the paralumbar fossa just behind and parallel to, the costal arch.

Pinsent et al. (1961) clinically examined 80 cases of displaced bovine abomasum and observed loss of appetite in varying degree, loss of condition and reduction in milk yield. The temperature and pulse remained normal and faeces passed were either normal or fluid in consistency.

Rumen movements were invariably reduced in frequency and amplitude and rumination was either completely in abeyance or intermittent and irregular. Rumen sounds were either inaudible or extremely faint.

They further observed that in some cases the abomasum was displaced to such a degree that it caused swelling of the left paralumbar fossa just posterior to the last rib. This swelling varied in degree not only from case to case but also in the same case from day to day. There was no constant relationship between the presence of this swelling and the severity of the clinical signs.

Orfeur (1961) described a case of dilatation of the abomasum in a cow, but clinical symptoms observed differed from those described by Richardson (1956) and Neal and Pinsent (1960).

He found mild degree of bloat, poor appetite, rise in temperature and pulse associated with strong ruminal movements which might have probably been exaggerated by previous medicinal treatment. There was a mild diarrhoea which was foul smelling but appeared normal in quantity.

On rectal examination, the wall of the abomasum was found to be thickened. On ballottement of the right ventral abdominal wall fluid sounds were not as loud as those heard in displacement of the abomasum and there was no distention of the right flank, as described by Neal and Pinsent (1960) in their cases.

Halhead (1961) observed a case of dilatation and torsion in a 7 years old Ayrshire cow. Although she appeared in good general condition yet the cow manifested the symptoms of acute abdominal pain with depressed back and ^{stood} with hind legs stretched back. The respiratory rate was increased although the pulse and

temperature were within the normal limit. There was slight distention of the right flank which gave a resonant sound on percussion. Rectal examination revealed the presence of a small amount of dark, foulsmelling diarrhoeic material.

Pinsent (1962) advocated that auscultation, auscultation with ballottement, and percussion give very satisfactory result in diagnosing the case of abomasal displacement.

He stated that the clinical picture varies considerably with severity of the condition. In mild cases there is slightly reduced appetite, rumination and milk yield, while in occasional acute cases there is complete inappetence, absence of rumination, loss of condition, marked weakness, scanty diarrhoea and grunting, groaning and grinding of teeth. This type may show appreciable left flank distention.

He further stated that once torsion has supervened the animal's condition deteriorates rapidly. Symptoms of acute pain and shock are discernible and death soon occurs. Appetite is non-existent, but there may be thirst. No defaecation occurs, and the rectum is empty except for a little tarry mucous.

Albert and Ramey (1964) observed two types of clinical syndrome in 11 cases of displacement of the abomasum to the right. One group of animals with simple displacement showed a gradual onset of decreased feed consumption and milk production together with non-responsive acetonemia. Another group where displacement was

accompanied by torsion there was sudden onset of anorexia, cessation of milk production, normal bowel activity and severe abdominal pain. Both the forms revealed a large gas filled organ on the right side along with high pitched tinkling sound typical of a displaced abomasum on percussion and auscultation.

Espersen (1964) dealt with dilatation and displacement of the abomasum to the right flank and described that in acute cases the animals at once show ileus symptoms. As a rule the animals are apathetic, colic is rarely present and in a few days of illness, they can become dehydrated with shunken eyes and unelastic skin which is most marked in animals with diarrhoea. The visible mucous membrane are as a rule normal, but moribund cases exude mucosal fluid from the eyes and nostrils. Temperature and respiration remain normal while the pulse remains accelerated.

The author stated four specific symptoms viz. (1) Visually apparent swelling in the right flank (2) Paralumbar fossa with splashing sounds (3) Percussion field in the right side (4) A balloon like dilated abomasum in the right side of the abdominal cavity, found by rectal examination.

Albert and Ramey (1965) observed the clinical symptoms in partial abomasal torsion without displacement and found partial anorexia, normal body temperature and ketonaemia. Normal auscultation and percussion failed to reveal sounds indicating an abomasal displacement to the right or left. Auscultation of the right paralumbar fossa revealed nothing abnormal but percussion over a

finger on the area of the fossa and the last 2 ribs, yielded high-pitched pinging sound. They observed confusing signs of various characteristic sounds and after operation found that the abomasum was in normal position and there was a partial torsion of the abomasum near its junction with the omasum and it was rotated on its longitudinal axis approximately 90° in a counter clockwise direction and it was distended with gas.

Robertson (1965) described the diagnostic considerations of left displacement of abomasum based on a review of the literature as well as first hand observations of some 200 cases.

He mentioned that the onset of anorexia is gradual and intermittent, milk yield is reduced, diarrhoea is usually seen which may alternate with normal bowel movements or constipation. Constipation occurs but rarely lasts longer than 24 hours. Occult blood is seldom observed in the faeces. The faeces are dark green and scant. Majority of patients are normal or slightly depressed and in some there is dehydration as judged by their skin turgor. Asymmetric distention of the left lower abdominal wall in the area of the costal arch is often evident.

The temperature, pulse and respiration remain normal unless there is a concurrent infection, which occurs in a 25% of the cases. Rumen motility is usually depressed, however, complete rumen stasis is rare. On auscultation of the abdominal wall in the area of costo-chondral junctions of the last 3 ribs on the left may reveal characteristic high-pitched tinkling sounds. On

auscultation and percussion on one of ribs, 11, 12, 13 or on the corresponding intercostal spaces at the level of the costo-chondral junction, a gas-filled viscus will give rise to a high-pitched "pinging" sound which varies in pitch.

Abomasal contents and gas have a characteristic sour odour distinct from that of the rumen ingesta. The colour of the abomasal ingesta is khaki brown. The aspirated abomasal fluid on testing with natrazine paper gives a red colour indicating a pH of 1-4.

He further stated that if the abomasum becomes dilated or twisted to the right, the abomasum remains in place. The right flank is usually distended and pinging may be heard on percussion.

Fox (1965) advocated that in the left displacement of abomasum, the usual signs are those of chronic ketosis except that faeces tend to be puttylike or loose and there is a depression in the left para lumbar fossa (unless the distended abomasum extends to that region).

He explained that displacement to the right is less common and the signs are similar to those of the left displacement but the onset may be more sudden and anorexia and diarrhoea more severe. The diagnostic ping is heard on the right instead of the left, and the abomasum may extend into the area of the right paralumbar fossa and be identified by rectal palpation.

Gibbons (1966a) described that the clinical signs in

displaced abomasum are partial anorexia, gradual loss of condition, poor milk production, decreased peristalsis and a soft, mucoid stool.

Gibbons (1966b) described about the displaced abomasum and stated that in case of abomasal torsion, the onset resembles that of simple indigestion, but more severe clinical manifestations soon occur. The signs include anorexia, anxious depression, elevated pulse rate, a normal or subnormal temperature and some times mild colicky signs such as recumbency and treading with the rear legs. A scanty foetid diarrhoea soon develops, and bloody fluid may be present in the faeces. Percussion over the normal liver area reveals an increased resonance, since the liver is pushed medially by the distended abomasum. Auscultation over the same area will disclose gas sounds. A definite diagnosis may be established by rectal palpation of the ballooned organ in the right flank region.

He further concluded that abomasum is rarely displaced to the right and appears as a distended organ in the right posterior portion of the abdomen. The clinical signs resemble torsion of the abomasum but are less acute.

Mather and Dedrick (1966) suggested that the torsion, dilatation or right displacement of abomasum can best be differentiated from left displacement by demonstrating a gas-distended viscus on the right side by use of auscultation and percussion and the absence of a ping on the left side.

Neal (1966) described that once torsion has occurred, the animal's condition rapidly deteriorates and exhibit the same symptoms as that of an acute abdominal catastrophe. There is complete inappetence milk yield is reduced, the animal is extremely dull and obviously in severe pain. Pulse rate is elevated, defaecation is in abeyance. Distention of the right sublumbar fossa increases, giving the animal a distinctly asymmetrical appearance when viewed from behind. The condition is rapidly progressive and death inevitably supervenes within a few days from a combination of toxæmia and shock. In some cases rupture of the organ occurs, resulting into sudden death.

The tenseness of the swelling in the right sublumbar fossa is almost diagnostic. On rectal examination, the bowel is usually found to be empty except for a small quantity of blood stained mucous. The grossly distended abomasum can be felt as a tense spherical swelling, extending backwards almost to the pelvic inlet. On auscultation of the right flank with simultaneous ballottement, loud, resonant, splashing sounds are clearly heard. If auscultation is performed and at the same time, the last rib is percussed sharply, a much louder bell-like ringing is heard.

Poulsen (1967) studied the clinico-biochemical changes which take place in the left dilatation and displacement of the abomasum.

He observed that the animals were often dehydrated and showed symptoms of anaemia when the disease was of long standing

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duration.

Boucher and Abt (1968) advocated that right-sided abomasal dilation usually causes vague signs of indigestion for several weeks and is characterised by a profoundly ill state, with signs of severe dehydration. It is diagnosed by palpating the distention rectally in the right flank region and by the high-pitched "ping" detected on simultaneous percussion and auscultation over the right rib cage.

They observed that in torsion, deterioration is rapid and there are signs of complete anorexia, uneasiness or mild colic, a "strained" expression and increased dehydration during the next 24 - 48 hours. The right side of the abdomen is distended, scanty faeces may be stained with mucous and blood and the rumen is immotile.

Blood and Henderson (1968) described about the dilatation and torsion of the abomasum. They explained that abomasal dilatation is some times called right displacement.

They further stated that in torsion there is sudden onset of abdominal pain with kicking at the belly, depression of the back and crouching. The heart rate is increased to 100 to 120/minute, the temperature is subnormal and ruminal movements are absent. The faeces are soft and dark in colour and become blood strained or melaenic in the ensuing 48 hours. They are usually passed in moderate quantity but there may be profuse diarrhoea. The abdomen

is distended in the right flank and auscultation and percussion reveal tympany and the tinkling notes of a distended abomasum. Fluid movements may be heard on succussion. No food is taken but the animals are usually thirsty. Distention of the abomasum may be detectable on rectal examination. Death usually occurs due to shock and dehydration.

In simple dilatation the onset is more insidious and is marked by inappetence, slight ruminal tympany, a moderate increase in heart rate upto 90/minute and a normal temperature. There is no acute abdominal pain. Ruminal movements are depressed but still present and the faeces are pasty and dark in colour. There is distention of the abdomen on the right side. The wall is tense and the viscus is filled with gas and fluid. Rupture of the abomasum may occur and cause the sudden death of the animal.

Vlachos et al. (1969) reported the case of left abomasal displacement in dairy cows and found remittent anorexia, selective appetite, reduction in milk yield, loss of condition, scanty faeces of dark discolouration and watery to putty-like consistency.

Gabel and Heath (1969) described that right sided torsion of the abomasum is characterised by severe dilatation in the right flank associated with acute signs of disease with melaena. Auscultation and percussion of the right paralumbar fossa and rectal palpation were described to be helpful in diagnosis. They further stressed that the torsion occurs around the transverse axis, which may be clockwise or counter clockwise.

Naik and Mehendale (1969) recorded a case of sinistral displacement of abomasum in a buffalo and found that there was slight depression in appearance but the standing posture, temperature, pulse and respiration were normal. The abdominal pain was not evident. The faeces were dark green and scanty. The paralumbar fossa was shunken and there was feeble ruminal movement but there was absence of ruminal stasis. The typical sounds were discernible on auscultation and percussion of the corresponding regions.

Fox (1970) reported a case of abomasal torsion in a cow and found rapid pulse (100-110) and a preference for sternal, recumbent position.

(B) HAEMATOLOGICAL AND BIOCHEMICAL ASPECT.

Marriott (1923) reported that in protracted and severe haemoconcentration, red cells are destroyed and serum proteins are reduced.

Marre and Jarrett (1955) reported the level of haemoglobin as 9.4 gm/100 ml of blood in the cow suffering from abomasal displacement with peptic ulcer.

Roy et al. (1959) observed that the calves suffering from diarrhoea there was a decrease in serum sodium and an increase in potassium level and suggested that the death of the calves could have been due to cardiac arrest as a result of high concentration of potassium.

Espersen and Simesen (1961) observed the accumulation of fluid in the obstructed viscus followed by severe shock and dehydration in case of acute abomasal torsion. They further reported that in case of subacute abomasal torsion there is gradual development of alkalosis and dehydration. Alkalosis develops because of increased secretion of hydrochloric acid.

Espersen (1964) studied the clinical cases of abomasal displacement and reported that the animals with melaena are anaemic, when the condition is associated with dilatation and displacement of the abomasum to the right.

Robertson (1965) observed that in case of abomasal dilatation or twist to the right; packed cell volume and haemoglobin are high; anaemia usually follows readjustment of fluid balance. Hyponatraemia and hypokalaemia are common, whereas in cases of left displacement of abomasum he found that the packed cell volume and haemoglobin, serum sodium, potassium and chloride usually lie within normal limits. The dehydrated animal showed haemoconcentration with increased packed cell volume and haemoglobin levels. The cows with trapped abomasum secrete copious quantities of gastric juice, alkalosis with hypochloraemia, hyponatraemia and hypokalaemia will be found. The alkalosis may vary from mild to severe.

Dalton et al. (1965) studied the effect of diarrhoea on plasma sodium, potassium and chloride concentration in experimental calves. The sodium, potassium and chloride concentration on the

first day of the experiment was 140 ± 5 , 4.9 ± 0.4 and 98 ± 3 mEq/L and on the 10th day of experiment 125 ± 9 , 4.8 ± 0.7 and 91 ± 11 mEq/L respectively. Significant lower values of plasma sodium, potassium and chloride due to diarrhoea in calves were observed.

Fisher (1965) studied in calves, the effect of diarrhoea on the plasma chloride concentration. It was significantly lowered in both the surviving and dying diarrhoeic calves as compared to the normal non-diarrhoeic calves, there being no significant difference between surviving and dying calves. He further reported the plasma bicarbonate concentration as 28.8 ± 2.4 , 21.6 ± 2.5 and 8.9 ± 2.7 m.moles/litre for non-diarrhoeic, diarrhoeic surviving and diarrhoeic dying calves respectively.

Robertson (1966) reported on the basis of the laboratory test of blood of cows with left displacement of abomasum, that the maximum number of cows showed hypokalaemia and hypochloraemia probably due to electrolyte loss as a result of diarrhoea and hypersecretion by displaced abomasum. Presumably, alkalosis might be due to hypochloraemia. He also observed elevated haemoglobin in 17% cases and recorded the normal mean value of haemoglobin as 12.2 gm/100 ml (ranging 7.3 to 16.2 gm/100 ml) and abnormal values ranging from 8.0 to 14.0 gm/100 ml.

He further reported the range of serum sodium and potassium as 132 - 152 and 3.9 - 5.8 mEq/L respectively, in case of abomasal displacement. He also determined the normal value of serum sodium and potassium in cattle as 122.0 - 153.0 mEq/L and

1.5 - 11.2 mEq/L with an average of 138.9 mEq/L and 4.09 mEq/L respectively.

Poulsen (1967) observed dehydration accompanied by loss of salts, hypokalaemia and changes of the acid-base balance towards a metabolic alkalosis in case of animals with the dilatation and left displacement of abomasum.

He further reported that the animals often showed symptoms of anaemia when they had a displacement of the abomasum after a longer period of disease. This anaemia was in some cases combined with a dehydration.

Boucher and Abt (1968) reported severe dehydration and markedly decreased serum potassium and chloride in cases of right sided abomasal dilatation.

Svendsen (1969) reproduced right sided abomasal displacement experimentally in three cows by injection of VFA in the organ together with insufflation with nitrogen gas and found rapid dehydration and also hypochloraemia and hypokalaemia alkalosis.

Gabel and Heath (1969) found alkalosis and hypochloraemia in case of twisted abomasum and explained that this is due to large quantity of fluid high in chloride ion.

Poulsen (1970) studied the cases of abomasal dilatation to either side with atony in cows and found disturbed acid-base balance, metabolic alkalosis associated with hypokalaemia and

hypochloraemia.

Schotman (1970) reported the blood chloride concentration of normal cows ranged from 96 - 107 mEq/L. He further observed that the metabolic alkalosis was frequently associated with hypochloraemia.

Murtuza (1972) reported the normal value of serum sodium, potassium, chloride, plasma bicarbonate and total serum protein as 142.33 ± 1.41 , 4.47 ± 0.12 , 91.96 ± 1.10 mEq/L, 31.73 ± 0.9 mEq/L and 5.62 ± 0.11 gm/100 ml respectively in buffalo calves.

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MATERIALS AND METHODS

MATERIALS AND METHODS

MATERIALS.

Selection of experimental animals :

For the present study eighteen apparently healthy male buffalo calves aged about 1 - 1½ years were selected. All the experimental animals were maintained on the same nutritional plane and in the same environmental condition. The animals were procured at different intervals of time.

Suturing materials :

1. Silk ligature (twisted) No. 1.
2. Black braided silk thread No.2 (Ethicon).

Design of the experiment :

(i) The present experiment was conducted on eighteen male buffalo calves. The animals were divided randomly into three groups, each group consisting of six animals.

Group - I : In this group of animals, right displacement of abomasum was created experimentally.

Group - II : Torsion of the abomasum was created in this group.

Group - III : This group was kept as control and only laparotomy was performed.

- (ii) Clinical, haematological and biochemical examinations were made pre and post operatively in each animal of all the groups.
- (iii) Post-surgically, clinical examinations viz. palpation, rectal examination, percussion and auscultation and ballottement and auscultation were conducted to ascertain the magnitude of deviations. To confirm the presence of displaced and distended abomasum in the right flank, pH test was also carried out. Temperature, pulse and respiration were recorded daily both morning and evening.
- (iv) For haematological and biochemical examinations, the following blood constituents were estimated :
 - (a) Haemoglobin per cent.
 - (b) Serum sodium.
 - (c) Serum potassium.
 - (d) Serum chloride.
 - (e) Total serum protein.
 - (f) Plasma bicarbonate.
- (v) Post-operatively, the blood samples were taken at 48 hours interval for haematological as well as biochemical estimation.

METHODS.

Pre-operative considerations :

Before proceeding with operation, the animals were kept under observation for one week during which period temperature, pulse and respiration were recorded at regular intervals. Routine faecal examinations were carried out and it was found that all the animals were free from helminthiasis and other parasitic infections. Hence, it was opined that the animals were in a reasonable state of health.

Operative procedures :

I) Preparation of the animal on the previous day of operation :

One buffalo calf was selected randomly, from the animals kept under observation, for operation to be performed on the next day. Light diet was given in the morning and afternoon. Food and water were withheld twelve hours before operation. An area of skin, at the usual site of laparotomy in the right flank was clipped, shaved and washed with soap and water. Again, this area was painted with spiritous mercurochrome and the animal was kept confined in a separate stall.

II) Preparation on the day of operation :

Chloral hydras was given orally in the dose of 12 - 14 gms about half an hour before operation. The animal was restrained

in the left lateral recumbency and the site was prepared lege artis. A linear infiltration using 2% procaine hydrochloride solution was given at the proposed line of incision. Then the area was finally painted with mercurochrome and draped.

Operation :

A vertical skin incision about six inches long was made in the right flank. Then corresponding incisions were made through the layers of muscles and peritoneum to expose the abdominal cavity. The left hand was introduced into the abdominal cavity in downward and forward direction to reach near the 9th rib for grasping the terminal smaller pyloric part of the abomasum.

For the production of displacement in group I, the abomasum was drawn towards the incision line and its body was anchored at different places with the internal wall of the right paralumbar fossa. The anchoring was accomplished with atraumatic curved needle using silk No.1 as ligature^(Fig. 1). To help retain the displaced abomasum a portion of omentum was also anchored simultaneously with the above area.

For creation of torsion in group II, the abomasum was drawn towards the incision line and the pyloric part of abomasum was twisted on its long axis with the help of both hands. A twist of about 360° was given clockwise. To keep the abomasum in twisted condition, the ensuing folds formed by the twisting of the organ were tied and anchored together on all sides using threaded atraumatic curved needle^(Fig. 2). Besides, the omentum was split horizontally

to facilitate the torsion of the pyloric part of the abomasum.

In group III, only laparotomy was performed and no further manoeuvring was done.

The incisions were closed by adopting two tier technique in which peritoneum and muscles were sutured together with silk ligature No. 1, while the skin was sutured separately by black braided silk No. 2 (Ethicon) in horizontal mattress fashion. The suture line of the skin was cleaned and painted with Terramycin liquid (Pfizer). Then a protective gauge strip was placed over the line of incision using stay sutures.

Post-operative care and management :

After operation the animals were maintained in clean stalls and provided with sufficient bedding. They were also provided food and water adlibidum. Temperature, pulse and respiration were recorded daily both morning and evening. All the animals of Group I, II and III received 1.25 gms of Streptomycin and 10 lacs Penicillin every day upto 5th post-operative day.

In group III, the skin sutures were removed on the 8th post-operative day.

Haematological and Biochemical examinations :

Collection of blood samples :

The blood was drawn directly by jugular venipuncture.

The serum was collected from the blood samples obtained and were kept for biochemical analysis.

Haemoglobin :

Haemoglobin was estimated by Heilmeyer - Sundermann method (1954) that represents 16 gm = 100%.

Serum sodium and potassium:

Sodium and potassium in the serum were determined by Flame photometer (Systronics make) as described by Haw et al. (1965).

Total serum protein :

Estimation of total serum protein was done by Colorimetry as recommended in "Bausch and Lomb clinical methods and Calibrations manual (Cat. No. 33-29-46)" of Bausch and Lomb spectronic 20 instrument.

Serum chloride :

Serum chloride was estimated by the method of Schales and Schales cited in SIGMA Technical Bulletin No.830 published in June 1974 by Sigma Chemical Company, Missouri (U.S.A.).

Plasma bicarbonate :

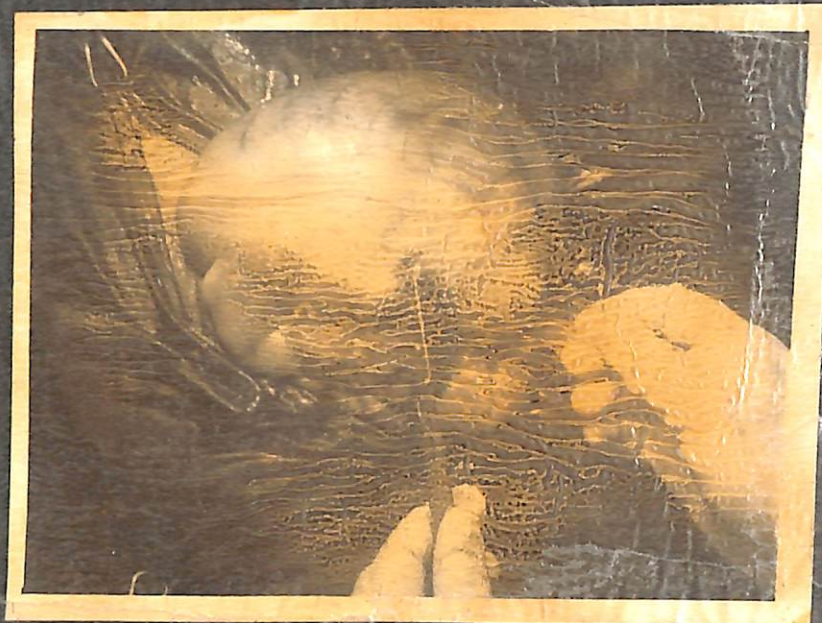
Plasma bicarbonate was estimated by Van Slyke (1922) method as described by Hawk et al. (1965)

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OBSERVATIONS AND RESULTS

OBSERVATIONS AND RESULTS

Clinical, haematological and biochemical studies were made on eighteen male buffalo calves, which were divided randomly into three groups, I, II and III, of six animals in each. Different diagnostic methods were utilized to ascertain the clinical manifestations exhibited by the animals of different groups. Haematological and biochemical aspects of diagnosis, taking different parameters, were also made pre and post operatively in each animal of all the groups to assess the magnitude of deviations.

(A) CLINICAL ASPECT OF OBSERVATIONS.

G R O U P - I

In this group of animals, right displacement of abomasum was produced experimentally. All the animals survived beyond 192 hours but not more than 216 hours except the animal Nos. 5 and 6 which died after 168 and 36 hours respectively.

All the animals recovered well from the effect of narcosis within 2 hours of surgery but they showed little inclination for feed and were found dull and depressed with gradual loss of condition. Gradually inappetence developed and the animals went on complete off-feed nearly two days before death. The intake of water was found

to be increased considerably but during this period rumination remained almost suspended. Temperature, pulse and respiration showed no significant changes in the beginning but as the condition deteriorated with the lapse of time, the pulse became weak, feeble and accelerated. By 4th day, the symptoms of dehydration with shunken eyes and dry coat became more evident. The animals showed reluctance towards movement and preferred to remain sitting or lying in sternal recumbency_(Fig. 3). While standing the animals did not show any abnormal posture.

The animal Nos. 1, 3 and 4 had foetid diarrhoea of dark green colour, whereas the animal No. 2 had stool of normal consistency and colour devoid of any abnormal odour. On the contrary, the animal No. 5 passed pelleted and mucous coated faeces. But the quantity of faeces remained scanty in almost all the animals of this group. The urine passed by these animals were very much below the normal quantity. On examination the rectum was found empty except for a little quantity of faeces and mucous.

External examination of the right flank revealed distinct bulging immediately posterior to the last rib as well as distention of the right abdomen_(Fig. 4). Whereas animal No. 3 exhibited slight distention of the right lower abdominal wall. When viewed, standing posterior to the animals, both flanks were found asymmetrical with considerable bulging in the right flank.

Palpation of the swelling revealed tenseness. While percussion of the right flank area revealed tympanitic sound. Auscultation at the approximate juncture of the middle and upper

thirds of the right flank and the anterior border of the last rib, a tympanic high-pitched tinkling was heard at an interval of about 3 minutes. Ballottement and auscultation revealed splashing sound whereas percussion and auscultation produced hollow resonant sound. There were feeble and irregular ruminal movements which, with the lapse of time, turned into complete stasis before death. The pH test of aspirated fluid from the distended region gave acidic reaction, which evidenced the presence of displaced abomasum.

G R O U P - I I

A clockwise twist of abomasum of about 360° was created experimentally in the animals of this group. All the animals survived beyond 96 hours but not more than 120 hours.

All the animals recovered uneventfully from the effect of narcosis within 2 hours of operation. A day after operation, almost all the animals showed marked anorexia but there was slight inclination for water. The animals were found dull and depressed with suspended rumination. Temperature remained near normal but the pulse was weak, feeble and accelerated (95-100/minute) along with slight increase in respiration. The animals also revealed the symptoms of dehydration which was evidenced by inelastic and dull skin with shunken eyes. The animals showed disinclination towards movement and preferred to remain sitting or lying in sternal recumbency like the animals of group I. All animals of this group did not show any abnormal posture while standing, except the animal No.2

where arched back was noticed.

The quantity of faeces remained scanty in almost all the animals. The animal Nos. 3 and 4 voided faeces of normal consistency and colour whereas the animal Nos. 1, 2, 5 and 6 passed very loose, dark and foetid faeces. All the animals were found micturiting the decreased volume of urine than usual. On examination, the rectum was found empty except for a little quantity of mucous.

The external examination of the right flank region revealed marked swelling and distention in all the animals except in animal No. 3 where it was not much distinct. The general appearance of the abdomen when viewed from behind, gave an impression of lopsideness with considerable bulging of the right flank.

On palpation of the right flank area the animals evinced pain. When the stethoscope was pressed firmly into the right paralumbar fossa, and percussion were performed by snapping a figure on the area of the fossa and on the last two ribs, a high-pitched pinging sound was heard. Auscultation of the right flank area revealed typical high-pitched fluid sound. Simultaneous ballottement and auscultation of the right flank produced splashing sound in the vicinity of paralumbar fossa. Percussion of the distended right flank gave rise to resonant sound. The rumen was completely atonic and ruminal sounds were not audible at all. The pH test of the aspirated fluid from the bulging area of the right flank, revealed acidic reaction which confirmed the presence of distended abomasum.

G R O U P - I I I

This group was kept as control and only laparotomy was performed.

All the animals recovered well from the effect of narcosis within 2 hours and started taking food and water as usual. The animals passed normal faeces and urine. All the clinical examinations were done in each animal and nothing abnormal could be detected. The animals did not exhibit any untoward symptoms as in Group I and II and recovery took place uneventfully.

(B) BIOCHEMICAL ASPECT OF OBSERVATIONS.

Haemoglobin :

In group I and III, there was non-significant fall of Hb%. The maximum fall by 8.92 % at 144 hours was observed in group I, where abomasum was displaced. In group II there was non-significant rise of Hb% and the maximum rise by 5.4% was recorded at 48 hours. In group III, where only laparotomy was performed, there was non-significant rise of Hb% by 2.30% at 192 hours (Table I to VI).

Serum sodium :

Here also, there was a fall of serum sodium level in all the groups, though it was statistically non-significant. The maximum

fall by 2.40% and 3.24% were recorded in group I and II at 192 hours and 96 hours respectively. However, laparotomized buffalo calves showed a negligible rise by 0.07% at 144 hours (Table I to VI).

Serum potassium :

The statistical analysis of group I and II showed a highly significant ($P < 0.01$) fall of serum potassium level. In case of experimentally produced abomasal torsion the maximum fall (41.17%, $P < 0.01$) was recorded at 96 hours of observation, whereas in case of abomasal displacement there was a highly significant ($P < 0.01$) gradual fall of serum potassium level and the maximum fall 38.32% was observed at 192 hours.

In group III, where only laparotomy was performed, the serum potassium level showed a transient fall at 48 hours (1.77%) followed by a rise, which was maximum at 144 hours (6.07%). Though, this fall and rise gave non-significant result on statistical analysis (Table I to VI).

Total serum protein :

Total serum protein in group I and III, where abomasal displacement and laparotomy were performed respectively, showed non-significant changes in protein level. Here in group I, there was a fall by 1.79% at 48 hours followed by a gradual rise. Whereas, in group III, the fall was recorded upto 96 hours (5.14%) and then

there was a gradual rise.

It is worthwhile to note here, in case of group II where abomasal torsion was produced, the fall in serum protein level was significant ($P < 0.05$). The maximum fall was recorded at 96 hours (12.50%) (Table I to VI).

Serum chloride :

The statistical analysis revealed a highly significant ($P < 0.01$) fall in group II, a significant fall in group I ($P < 0.05$) and non-significant change in group III.

In group I, the maximum fall was recorded at 192 hours (11.71%) and was gradual, whereas the maximum fall in group II was recorded at 96 hours (28.20%).

In group III, the non-significant fluctuations in serum chloride level were observed. There was rise upto a period of 96 hours followed by a negligible transient fall (0.09%) observed at 144 hours and then a rise by 0.55% (Table I to VI).

Plasma bicarbonate :

It was very interesting to note that in case of abomasal displacement and torsion (group I and II), the level of plasma bicarbonate was highly significantly ($P < 0.01$) raised causing alkalosis. In case of laparotomy (group III) the level of plasma bicarbonate was raised, but it was non-significant.

In case of group I, the rise was gradual and maximum rise was recorded at 192 hours (34.31%). In group II, the early increased alkalosis was recorded (70.90%) at 96 hours of observation. Here, in abomasal torsion early alkalosis was produced than the abomasal displacement, whereas in laparotomized animals the alkalosis was non-significant (Table I to VI).

In all these observations Hb% and serum sodium level showed no significant changes. When the results of serum sodium, potassium, total protein, chloride and plasma bicarbonate were compared in group I and II, it was observed that there were a loss of sodium, potassium and chloride with concurrent increase in plasma bicarbonate level.

TABLE - I
Table showing the changes in blood picture of experimentally displaced abomasum in buffalo calves.

Name of the blood constituents.	Before operation	After producing abomasal displacement			
	Normal	48 hours	96 hours	144 hours	192 hours
Haemoglobin (gm%) \pm S.E.	8.96 \pm 0.48 (5)	8.26 \pm 0.93 (5) -7.81(%)	8.96 \pm 0.75 (5) 0.00	8.16 \pm 0.96 (5) -8.92(%)	8.23 \pm 1.51 (4) -8.15%
Serum sodium (mEq/L) \pm S.E.	141.40 \pm 2.80 (5)	138.80 \pm 2.92 (5) -1.84%	139.00 \pm 2.86 (5) -1.63%	138.60 \pm 3.66 (5) -1.98%	138.00 \pm 3.49 (4) -2.40%
Serum potassium (mEq/L) \pm S.E.	4.75 \pm 0.36 (5)	3.94 \pm 0.18 (5) -17.05%	3.38 \pm 0.77 (5) -28.84%	3.16 \pm 1.01 (5) -33.47%	2.93 \pm 0.25 (4) -38.32%
Total serum protein (gm%) \pm S.E.	5.60 \pm 0.22 (5)	5.52 \pm 0.16 (5) -1.79%	5.64 \pm 0.14 (5) +0.71%	5.68 \pm 0.17 (5) +1.43%	5.75 \pm 0.22 (4) +3.57%
Serum chloride (mEq/L) \pm S.E.	94.75 \pm 1.48 (5)	87.17 \pm 2.81 (5) -8.02%	84.04 \pm 3.17 (5) -11.39%	83.80 \pm 1.37 (5) -11.55%	83.70 \pm 2.83 (4) -11.71%
Plasma bicarbonate (mEq/L) \pm S.E.	27.40 \pm 0.58 (5)	32.98 \pm 1.73 (5) +20.07%	36.58 \pm 1.40 (5) +33.58%	34.86 \pm 1.90 (5) +27.37%	36.80 \pm 2.28 (4) +34.31%

Number in parenthesis indicates the number of observation.
% + or - = + (rise), - (fall) from normal value.

TABLE - II

Table showing analysis of variance in respect of blood picture of abomasal displacement in buffalo calves.

Name of the blood constituents	Sources	df	S.S.	M.S.	'P'
Hb (gm %)	Between groups	4	3.27	0.82	0.19 NS
	Within groups	19	79.65	4.19	
	Total.	23	82.92		
Serum sodium (mEq/L)	Between groups	4	32.76	8.19	0.17 NS
	Within groups	19	909.20	47.85	
	Total.	23	941.96		
Serum potassium (mEq/L)	Between groups	4	10.03	2.51	15.68**
	Within groups	19	3.13	0.16	
	Total.	23	13.16		
Total serum Protein (gm%)	Between groups	4	0.13	0.03	0.18 NS
	Within groups	19	3.20	0.17	
	Total.	23	3.33		
Serum chloride (mEq/L)	Between groups	4	437.45	109.36	3.87*
	Within groups	19	535.86	28.20	
	Total.	23	973.31		
Plasma bicarbonate (mEq/L)	Between groups	4	287.42	71.86	5.55**
	Within groups	19	245.95	12.94	
	Total.	23	533.37		

** = Significant at 1% level (P 0.01)

* = Significant at 5% level (P 0.05)

NS = Non-significant.

TABLE - III

Table showing the changes in blood picture of experimentally produced abomasal torsion in buffalo calves.

Name of the blood constituents.	Before operation		After producing torsion	
	Normal		48 hours	96 hours
Haemoglobin (gm%) \pm S.E.	9.45 \pm 0.60 (6)	-	9.96 \pm 1.18 (6) +5.40%	9.86 \pm 0.53 (6) +4.33%
Serum sodium (mEq/L) \pm S.E.	141.80 \pm 1.51 (6)	-	138.20 \pm 1.70 (6) -2.54%	137.20 \pm 1.45 (6) -3.24%
Serum potassium (mEq/L) \pm S.E.	4.25 \pm 0.15 (6)	-	3.34 \pm 0.30 (6) -21.41%	2.50 \pm 0.27 (6) -41.17%
Total serum protein (gm%) \pm S.E.	5.63 \pm 0.14 (6)	-	5.10 \pm 0.14 (6) -8.90%	4.90 \pm 0.22 (6) -812.50%
Serum chloride (mEq/L) \pm S.E.	91.99 \pm 0.62 (6)	-	86.97 \pm 5.90 (6) -5.43%	66.02 \pm 3.1 (6) -28.20%
Plasma bicarbonate (mEq/L) \pm S.E.	28.08 \pm 0.40 (6)	-	37.38 \pm 1.50 (6) +33.10%	48.00 \pm 0.82 (6) +70.90%

Number in parenthesis indicates number of observation.

% + or - = + (rise), - (fall) from normal value.

TABLE - IV

Table showing analysis of variance in respect of blood picture of abomasal torsion in buffalo calves.

Name of the blood constituents	Sources	df	S.S.	M. S.	'F'
Hb (gm %)	Between groups	2	0.90	0.45	0.11 NS
	Within groups	15	61.72	4.11	
	Total.	17	62.62		
Serum sodium (mEq/L)	Between groups	2	72.45	36.23	2.49 NS
	Within groups	15	218.50	14.56	
	Total.	17	290.95		
Serum potassium (mEq/L)	Between groups	2	9.19	4.60	8.21**
	Within groups	15	0.84	0.56	
	Total.	17	10.03		
Total serum protein (gm%)	Between groups	2	1.72	0.86	4.77*
	Within groups	15	2.72	0.18	
	Total.	17	4.44		
Serum chloride (mEq/L)	Between groups	2	2278.13	1139.07	12.40**
	Within groups	15	1377.55	91.84	
	Total.	17	3655.68		
Plasma bicarbonate (mEq/L)	Between groups	2	1191.75	595.88	90.69**
	Within groups	15	98.61	6.57	
	Total.	17	1290.36		

** = Significant at 1% level (P 0.01)

* = Significant at 5% level (P 0.05)

NS = Non-significant.

TABLE - V

Table showing the changes in blood picture in laparotomized buffalo calves.

Name of the blood constituents.	Before operation	After performing laparotomy			
	Normal	48 hours	96 hours	144 hours	192 hours
Haemoglobin (gm%) \pm S.E.	8.68 \pm 0.48 (6)	8.48 \pm 0.53 (6)	8.62 \pm 0.54 (6)	8.56 \pm 0.47 (6)	8.86 \pm 0.35 (6)
	-	-2.30%	-0.69%	-1.15%	+2.30%
Serum sodium (mEq/L) \pm S.E.	139.20 \pm 1.01 (6)	138.80 \pm 1.32 (6)	138.80 \pm 0.83 (6)	139.30 \pm 1.38 (6)	139.20 \pm 1.01 (6)
	-	-0.29%	-0.29%	+0.07%	0.00
Serum potassium (mEq/L) \pm S.E.	3.95 \pm 0.15 (6)	3.88 \pm 0.16 (6)	3.99 \pm 0.28 (6)	4.19 \pm 0.20 (6)	4.13 \pm 0.15 (6)
	-	-1.77%	+1.01%	+6.07%	+4.55%
Total serum protein (gm%) \pm S.E.	5.83 \pm 0.30 (6)	5.66 \pm 0.13 (6)	5.53 \pm 0.19 (6)	5.86 \pm 0.38 (6)	6.06 \pm 0.31 (6)
	-	-2.91%	-5.14%	+0.51%	+3.90%
Serum chloride (mEq/L) \pm S.E.	86.45 \pm 2.01 (6)	86.52 \pm 2.10 (6)	86.54 \pm 1.90 (6)	86.37 \pm 2.16 (6)	86.93 \pm 2.40 (6)
	-	+0.08%	+0.10%	-0.09%	+0.55%
Plasma bicarbonate (mEq/L) \pm S.E.	28.53 \pm 0.38 (6)	28.88 \pm 0.65 (6)	28.76 \pm 0.51 (6)	28.65 \pm 0.45 (6)	28.76 \pm 0.62 (6)
	-	+1.40%	+1.05%	+0.70%	+1.05%

Number in parenthesis indicates the number of observation.

% + or - = + (rise), - (fall) from normal value.

TABLE - VI

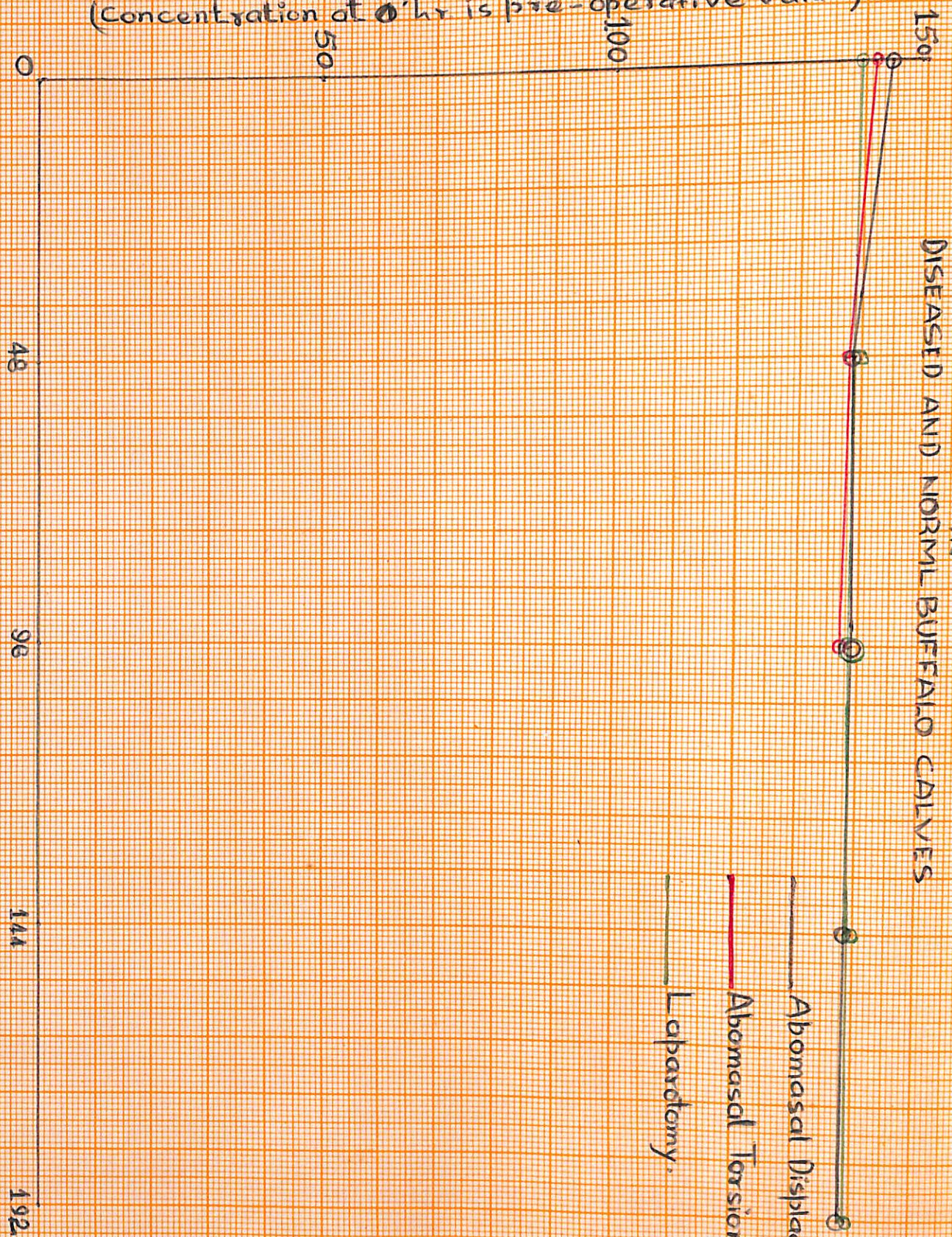
Table showing analysis of variance in respect of blood picture in laparotomized buffalo calves.

Name of the blood constituents	Sources	df	S.S.	M. S.	'F'
Hb (gm %)	Between groups	4	0.50	0.13	0.09 NS
	Within groups	25	35.13	1.41	
	Total.	29	35.63		
Serum sodium (mEq/L)	Between groups	4	1.20	0.30	0.4 NS
	Within groups	25	192.67	7.71	
	Total.	29	193.87		
Serum potassium (mEq/L)	Between groups	4	0.39	0.98	1.21 NS
	Within groups	25	2.03	0.81	
	Total.	29	2.42		
Total serum protein (gm%)	Between groups	4	0.99	0.25	2.27 NS
	Within groups	25	2.65	0.11	
	Total.	29	3.64		
Serum chloride (mEq/L)	Between groups	4	1.11	0.28	0.01 NS
	Within groups	25	684.39	27.38	
	Total.	29	685.50		
Plasma bicarbonate (mEq/L)	Between groups	4	0.42	0.11	0.06 NS
	Within groups	25	43.11	1.72	
	Total.	29	43.53		

NS = Non-significant.

COMPARATIVE LEVEL OF SERUM SODIUM IN DISEASED AND NORMAL BUFFALO CALVES

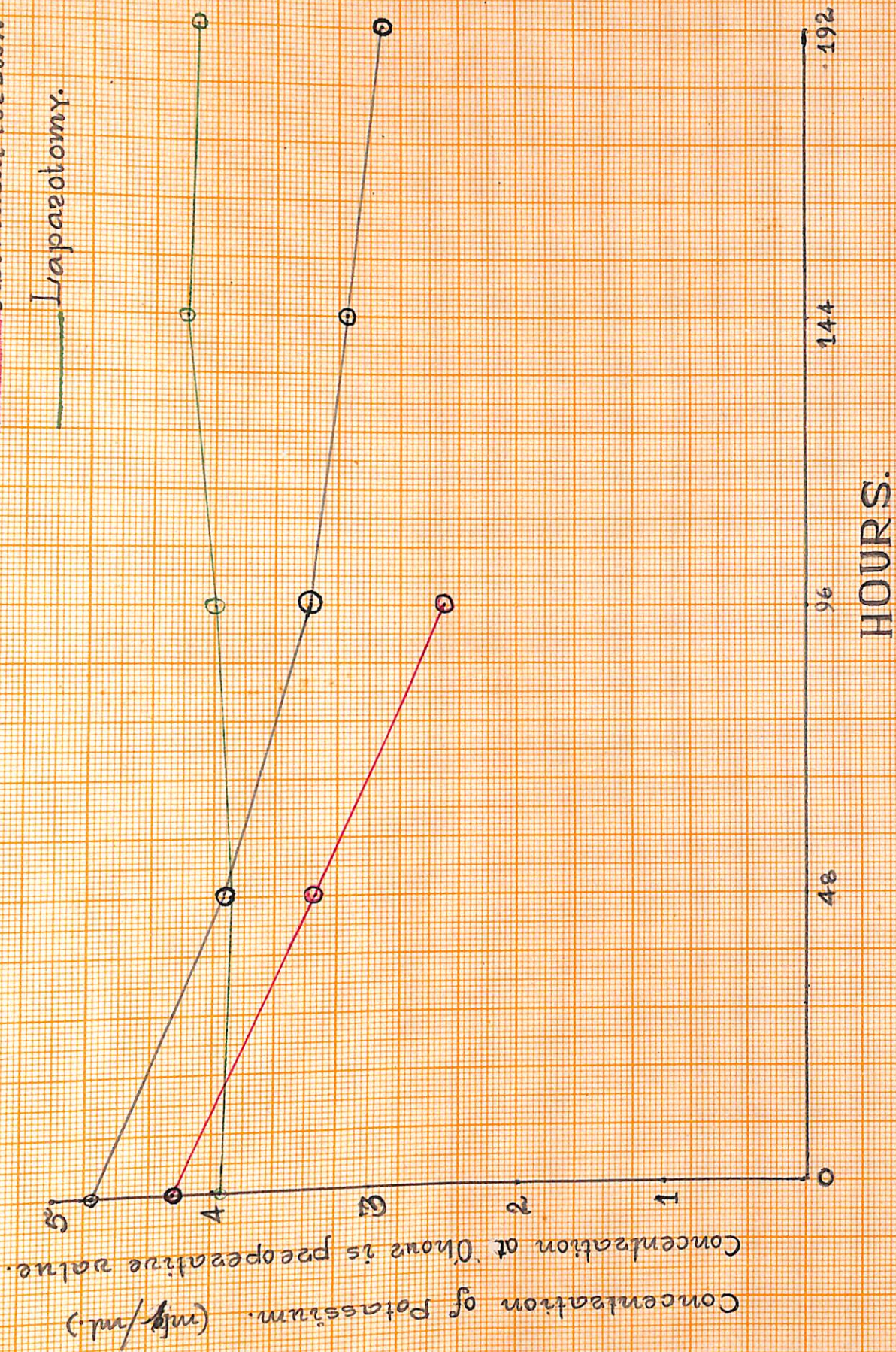
CONCENTRATION OF SERUM SODIUM (mEq/L)
(Concentration at 0 hr is pre-operative value)



HOURLS
(Concentration at 48 hrs. & onward is post-operative value)

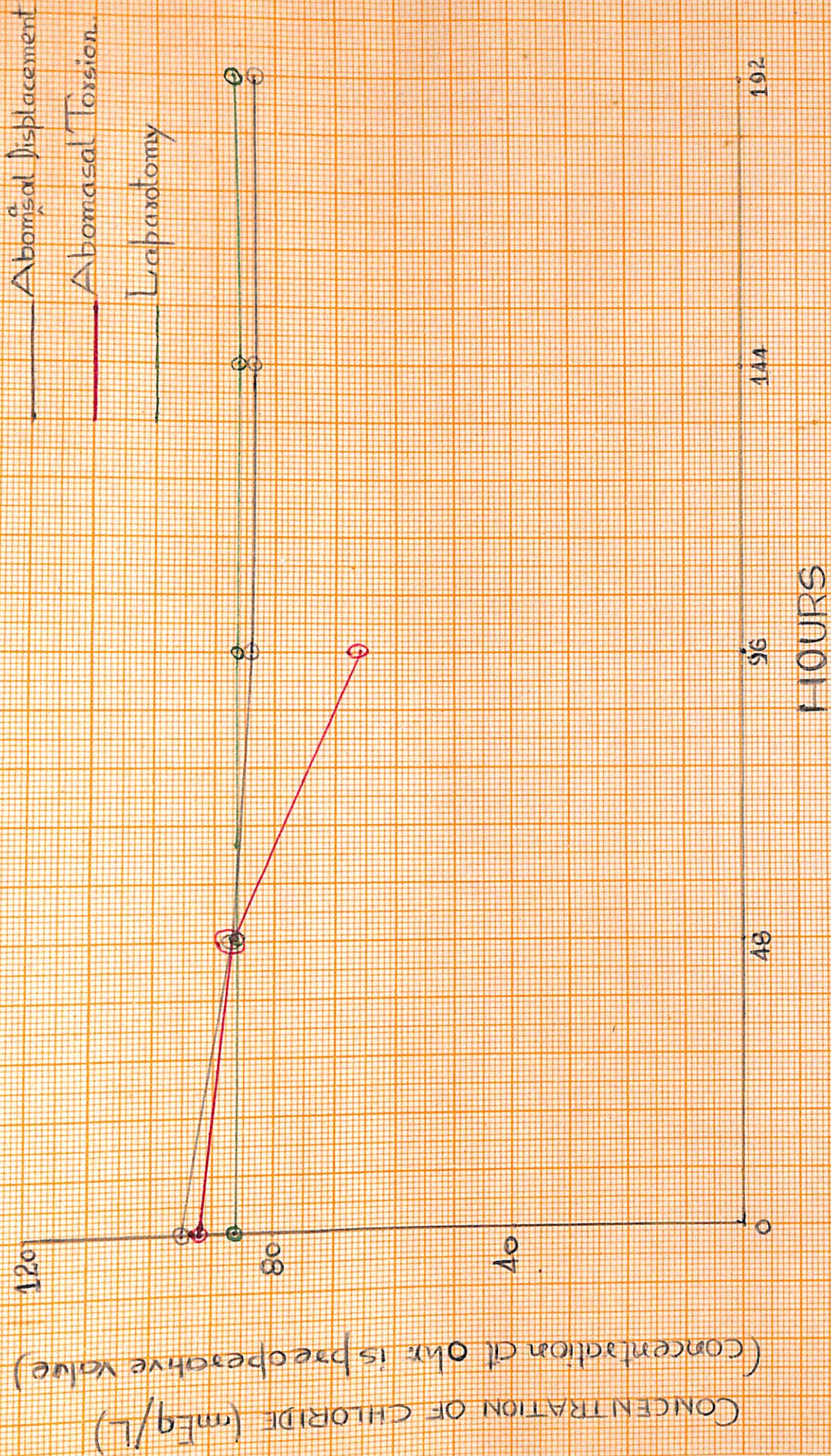
CONCENTRATION OF SERUM POTASSIUM IN DISEASED AND NORMAL BUFFALO CALVES.

— Abomasal displacement.
 — Abomasal torsion
 — Laparotomy.



(Concentration at 48 hrs. onward is post operative value.)

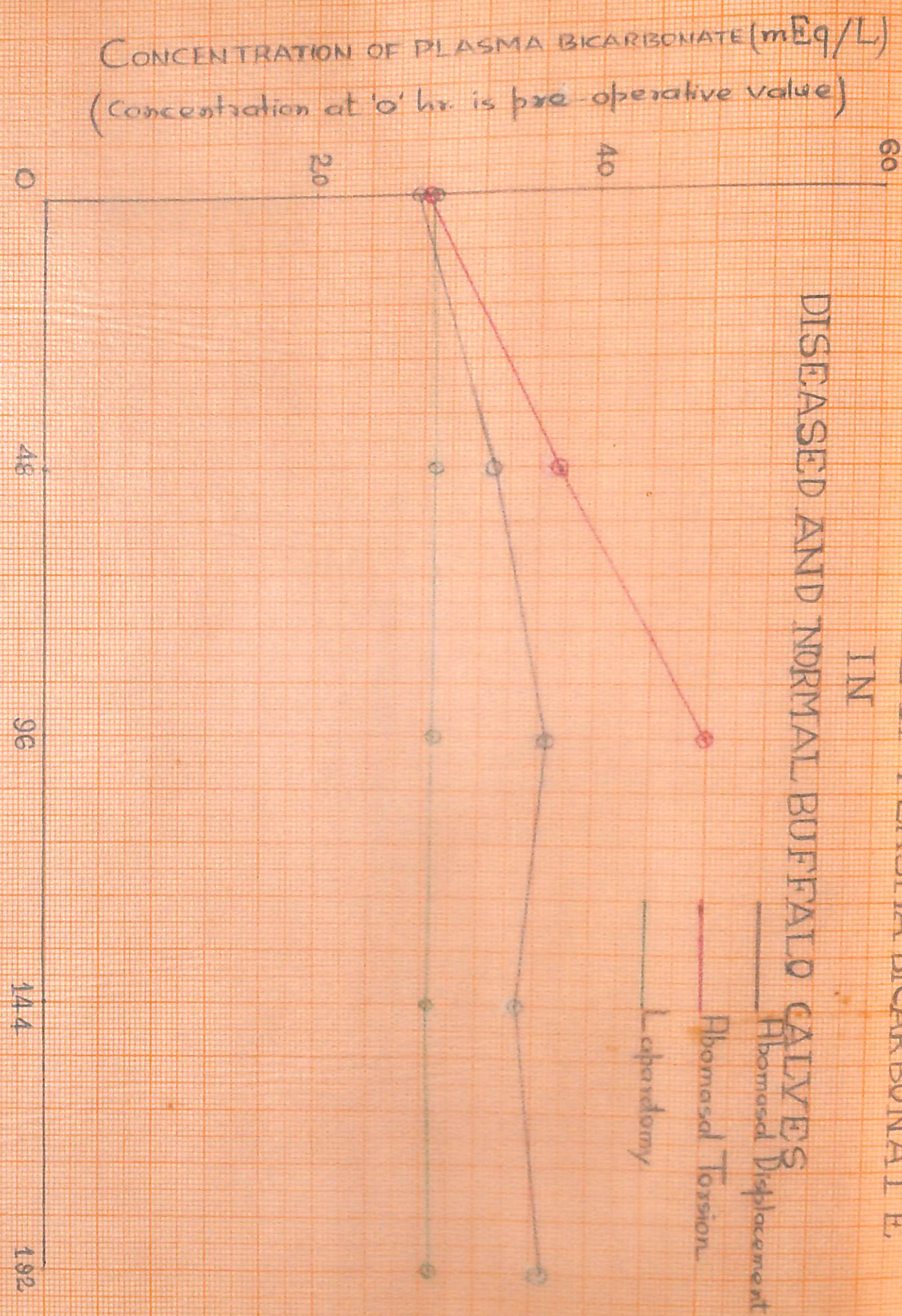
COMPARATIVE LEVEL OF SERUM CHLORIDE IN NORMAL AND DISEASED BUFFALO CALVES



(Concentration at 0 hr is preoperative value)
(Concentration at 48 hours & onward is postoperative value)

COMPARATIVE LEVEL OF PLASMA BICARBONATE

IN DISEASED AND NORMAL BUFFALO CALVES



Concentration at 48 hrs & onward is post-operative value

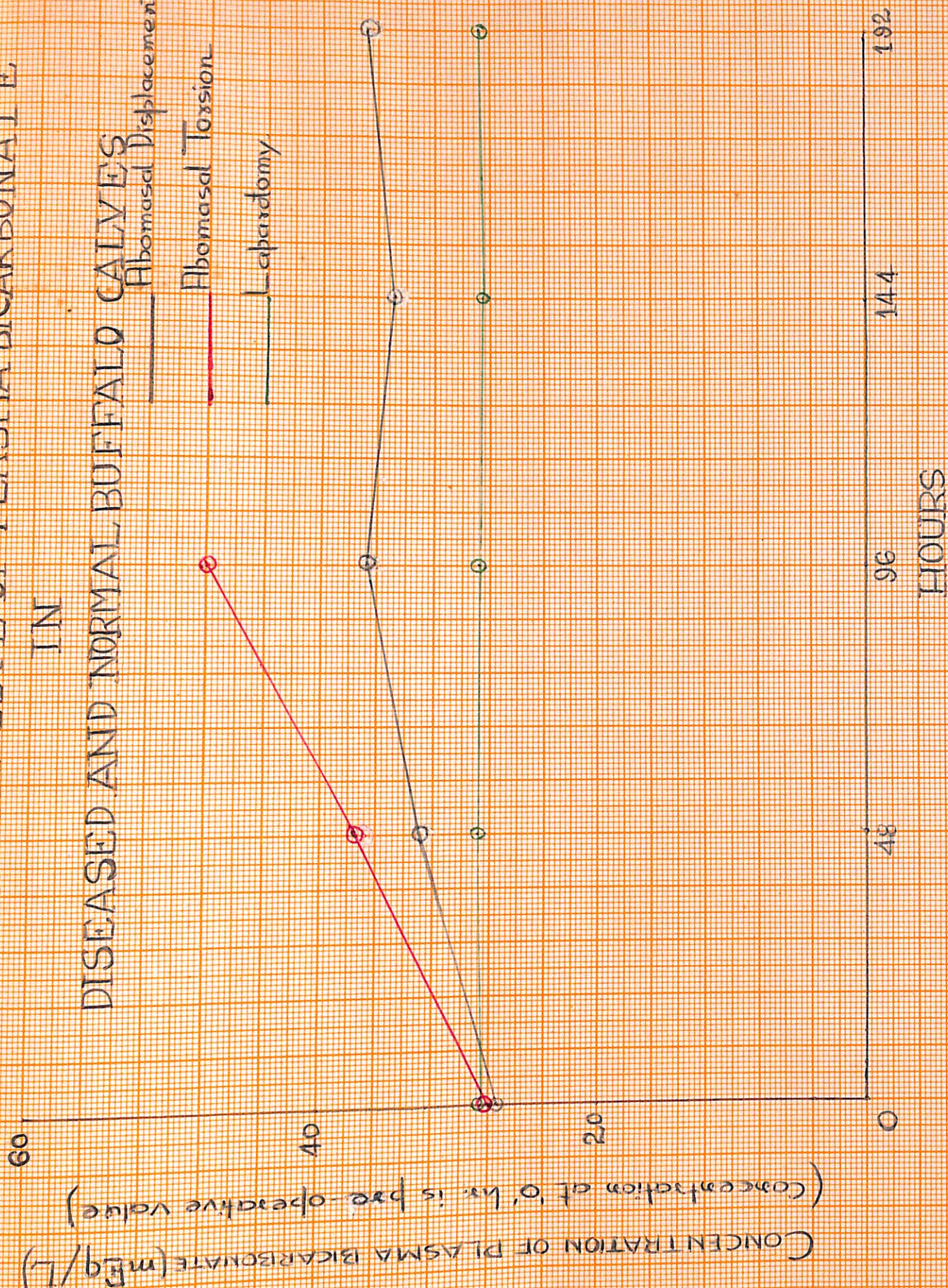
COMPARATIVE LEVEL OF PLASMA BICARBONATE IN

DISEASED AND NORMAL BUFFALO CALVES

Abomasal Displacement

Abomasal Torsion

Laparotomy



Concentration at 48 hrs. & onward is post-operative value

DISCUSSION

function within the body. They showed gradual inappetence and nearly two days before the death they were completely off-feed. Albert and Ramey (1964) and Robertson (1965) also found the similar observation. Ford (1950), Begg (1950), Moore ^{et al.} (1954), Sippel (1959), Pinsent (1962) and Fox (1965) too observed anorexia in their studies. Onset of anorexia might have resulted due to production of toxæmia which decreased the hunger contractions of the stomach. During the course of observation, the animals were found dull and depressed which are in agreement with the observations of Marr and Jarrett (1955), Tutt et al. (1959), Robertson (1965) and Naik and Mehendale (1961). In author's opinion, the animals might have expressed such demeanour probably due to pain or associated toxæmia. The intake of water was found to be increased considerably which might be due to concomittent dehydration. However, Hortig (1961) reported that the animal refuses to drink in case of abomasal dilatation. Ruminations were found to be almost suspended which coincide with the findings of Begg and Whiteford (1956), Pinsent et al. (1961) and Pinsent (1962). In author's opinion, the atony of the rumen was a contributing cause of suspended rumination. The animals under study did not exhibit any significant changes in temperature, pulse and respiration which are almost similar to the findings of Marr and Jarrett (1955), Begg and Whiteford (1956), Robertson (1965) and Naik and Mehendale (1969). As the condition of the animals deteriorated with the lapse of time, the pulse became weak, feeble and accelerated. The above findings of the authors corroborate with that of Marr and Jarrett (1955) and Espersen (1964). However,

Pinsent et al. (1961) found normal temperature and pulse. Weak, feeble and increased pulse rate might be the result of either toxæmia, pain and dehydration or combinations of the above. Dull and inelastic skin with shunken eyes were noticed in all the animals during the course of clinical observations which did not differ with the findings of Espersen (1964). Albert and Ramey (1964) also reported about the shunken eyes associated with abomasal displacement. Robertson (1965) found dehydration with inelastic skin in his observation. These symptoms occurred due to starvation resulting into dehydration.

The animals showed little inclination towards movement and preferred to remain sitting or lying in sternal recumbency. To alleviate pain and uneasiness the animals had adopted such posture. Weakness, due to starvation may also be a contributory factor. While standing, the animals did not show any abnormal posture, which is in agreement with the findings of Naik and Mehendale (1969). However, Sippel (1959) observed a "roached" back stance in the animal having abomasal displacement.

The animal Nos. 1, 3 and 4 passed loose, foetid and dark green stool whereas animal No.2 excreted faeces of normal consistency and colour devoid of any abnormal odour. The animal No.5 passed pelleted faeces coated with mucous. But the quantity of faeces remained scanty in almost all the animals of this group. Robertson (1965) observed the variable consistency of scanty faeces with dark green colour. Naik and Mehendale (1969) also reported

about the dark green and scanty faeces, whereas Begg (1950) and Begg and Whiteford (1956) observed scanty faeces with normal consistency and colour. Moore et al. (1954) observed scanty faeces of a soft, pasty nature. Pinsent et al. (1961) also reported about normal or watery faeces. The passage of scanty amount of faeces correlates with the intake of food as well as disturbances in the normal physiological function of the alimentary tract caused by displaced abomasum. Pelleted faeces may be a prodromal symptoms of constipation probably because of reduced intestinal motility causing faeces to become hard, dry and small bulk. However, Hortig (1961) and Robertson (1965) reported constipation in case of abomasal displacement.

On examination, the rectum was found empty except for a very small quantity of faeces and mucous in all the animals. Espersen (1964) also made the similar observations, the mucous being present in the rectum. Marr and Jarrett (1955) also found abnormally empty rectum.

The external examination of the right flank revealed distinct bulging immediately posterior to the last rib, which is in harmony with the findings of Begg and Whiteford (1956) and Pinsent et al. (1961). This bulging occurred due to the dilatation of the abomasum and at the same time distention of the lower right abdominal wall was evident, which revealed asymmetry of the flank. This finding was in accordance with the findings of Begg and Whiteford (1956) and Robertson (1965). Macleod (1960) and Pinsent (1962) also

observed the distended abomasum in case of abomasal displacement. Due to the accumulation of large quantity of gas and fluid, the abomasum had dilated and distended. As the distention also stimulates a further secretion of gastric fluid in the abomasum and ultimately exaggerates the condition.

Percussion of the right flank area produced tympanitic resonant sound in all the experimental animals. Begg (1950), Begg and Whiteford (1956), and Albert and Ramey (1964) also held the same views. This resonant sound occurred due to the presence of gas in the abomasum. Auscultation of the right flank area revealed a high-pitched tinkling sounds which were identical with the observations of Begg and Whiteford (1956), Tutt et al. (1959), Albert and Ramey (1964), Robertson (1965), and Naik and Mehendale (1969). The tinkling sounds were heard at an interval of about 3 minutes. Since, these sounds arose from gas bubbling through fluid in the trapped abomasum, they were irregular in occurrence. On the other hand, the auscultation and percussion revealed hollow resonant sounds, which supported the views points of Pinsent et al. (1961) and Robertson (1965). Auscultation and ballottement showed splashing sound, which also simulated the observations of Pinsent et al. (1961). This splashing sound was heard due to the accumulation of fluid in the abomasum. In all the animals, feeble and irregular ruminal movements were noticed during the course of observations. Begg and Whiteford (1956), Pinsent et al. (1961), Robertson (1965) and Naik and Mehendale (1969) also found the similar observation. The feeble and irregular ruminal movements gradually turned into

complete stasis before death. Observations of Marr and Jarrett (1955), Pinsent et al. (1961), Robertson (1965), and Naik and Mehendale (1969) also coincide with the above findings of the author, barring ruminal stasis. But on the other hand, Ford (1950) could observe complete ruminal stasis. However, Robertson (1965) advocated that complete ruminal stasis is rare. Feeble and irregular ruminal movements may be due to toxæmia. The stomachs of the ruminants are closely interrelated anatomically and functionally, so the disease of one usually affects the others, thus disturbed abomasum might have played a role in altering the normal ruminal movements. The acidic nature of the fluid aspirated from the bulging of the right flank indicated that the abomasum was present in an abnormal position.

G R O U P - II

Torsion of the abomasum was created experimentally in the animals of this group. All the animals died between a period of 96 to 120 hours after the production of abomasal torsion. The clinical findings tallied with those of group I except the severity of clinical manifestations were markedly acute in this group.

The animals started manifesting symptoms after 24 hours of operation. They showed marked anorexia with slight inclination for water and they were found dull and depressed. Fincher (1927), Rechardson (1956), Pinsent (1962), Neal (1966) observed similar symptoms. Blood and Handerson (1968) also described about anorexia

and thirst. Rumination remained suspended in all the animals, which is in agreement with the observation of Neal and Pinsent (1960) and Pinsent (1962). The animals showed normal temperature but respiration and pulse were observed to be elevated and these findings were identical with that of Fincher (1927), Steere (1959), Halhead (1961), Pinsent (1962) and Neal (1966).

The animals manifested the symptoms of dehydration, evidenced by shrunken eyes, inelastic and dull skin which almost tallied with the findings of Albert and Ramey (1964) and Boucher and Abt (1968).

The animals also exhibited reluctance to move and preferred to sit or to remain in sternal recumbency, which was suggestive of weakness or abdominal pain or both. The observation of Fox (1970) closely correlated with the authors' findings. None of the animals showed abnormal posture while standing except animal No. 2 which had arched back stance.

The quantity of faeces eliminated by the animals remained scanty in almost all the animals. However, Orfeur (1961) found normal quantity of faeces passed by the animals in case of abomasal torsion. Scanty elimination of faeces might have occurred due to complete cessation of food intake and disturbed normal physiological functions of the digestive tract caused by torsion of the abomasum. The animal Nos. 3 and 4 voided faeces of normal consistency and colour and these observations are in accordance with that of Neal and Pinsent (1960). On the contrary, the faeces passed by the

animal Nos. 1, 2, 5 and 6, were very loose, dark and foetid. These findings of the present study are in agreement with the observations of Steere (1959), Neal and Pinsent (1960), Halhead (1961) and Orfeur (1961). All the animals showed the signs of oliguria which was probably due to concomittent, dehydration.

On examination, the rectum was found empty except for little mucous. This observation was similar to those of Richardson (1956) and Pinsent (1962).

The external examination of the right flank region revealed marked bulging as well as distention in all the animals except in animal No.3 where it was not very much distinct. Steere (1959), Halhead (1961), Pinsent (1962), Albert and Ramey (1964), Robertson (1965), Mather and Dedrick (1966) and Boucher and Abt (1968) also made similar observations which almost tallied with the observations of the author.

The animals evinced pain on palpation of the right flank area. Steere (1959) too experienced similar type of manifestation. Percussion and auscultation, in the vicinity of right paralumbar fossa and last two ribs, yielded a high-pitched pinging sound, and such type of sound was also recorded by Albert and Ramey (1965). Auscultation of the right flank area revealed a typical high-pitched fluid sound which was also found by Neal and Pinsent (1960). Simultaneous ballottement and auscultation of the right lower abdominal wall produced splashing sound which also corroborates with the findings of Neal and Pinsent (1960) and Neal (1966).



Percussion over the last rib on the right side gave a resonant sound. Halhead (1961) also held the similar views.

Many workers, viz. Richardson (1956), Albert and Ramey (1964), Robertson (1965), Mather and Dedrick (1966), Boucher and Abt (1968) and Gabel and Heath (1969) recorded more or less similar type of sounds on percussion, auscultation, percussion and auscultation and ballottement and auscultation of the distended and dilated abomasum. The rumen was found to be completely atonic and ruminal sounds were not audible at all. Richardson (1956) and Boucher and Abt (1968) also obtained the similar findings. The acidic nature of the fluid aspirated from the bulging area of the right flank suggested the presence of dilated abomasum in an abnormal position.

(B) HAEMATOLOGICAL AND BIOCHEMICAL ASPECTS.

The results of biochemical parameters have been presented in Table I to VI.

Haemoglobin :

In the animals of group I, in which right-sided abomasal displacement was produced, the Hb% revealed non-significant fall. Similar observation was made by Poulsen (1967), who reported that the animals often showed symptoms of anaemia when they had a displacement of abomasum after a longer period of disease, generally

some times after calving. He further observed that the anaemia was in some cases combined with dehydration. Espersen (1964) also recorded anaemia in case of right-sided abomasal displacement associated with melaena. However, Robertson (1965) reported that the haemoglobin usually lies within normal limits in case of left displacement of abomasum. He further reported that the dehydrated animals showed haemoconcentration with increased haemoglobin level. Marr and Jarrett (1955) found the haemoglobin gm% level as 9.4 in case of abomasal displacement associated with peptic ulceration in a cow. Robertson (1966) observed the normal mean value of haemoglobin as 12.2 gm% (ranging from 7.3 to 16.2) and abnormal value ranging from 8.0 to 14.0 gm% in case of left displacement of abomasum.

In group II, where abomasal torsion was created experimentally, the animals showed non-significant rise in the level of haemoglobin. This rise of haemoglobin is in accordance with the finding of Robertson (1965), who observed high haemoglobin level in case of torsion of the abomasum.

The animals of group III, where only laparotomy was performed, did not reveal any statistically significant changes.

Serum sodium and potassium :

The animals with abomasal displacement showed a loss of serum sodium and potassium. The fall of serum sodium was statistically non-significant but the loss of serum potassium level was

highly significant ($P < 0.01$). Robertson (1965) also found hyponatraemia and hypokalaemia on blood analysis in animals having abomasal displacement with trapped abomasum. However, he further reported that serum sodium and potassium usually lie within normal limits in case of abomasal displacement. Robertson (1966) observed hypokalaemia in animals with left displacement of abomasum and reported that potassium loss was probably due to electrolyte loss as a result of diarrhoea. He recorded the range of serum sodium and potassium in case of displaced abomasum ranging from 132.0 to 152.0 mEq/L and 3.9 to 5.8 mEq/L respectively. He also reported the normal value of serum sodium and potassium in cattle ranged from 122.0 to 153.0 mEq/L and 1.5 to 11.2 mEq/L with an average of 138.9 mEq/L and 4.09 mEq/L respectively. Svendsen (1969) also found hypokalaemia in case of experimentally produced abomasal displacement. Poulsen (1967) observed dehydration accompanied by loss of salts with hypokalaemia in case of dilatation and displacement of the abomasum to the left.

The animals of group II also showed non-significant decrease in the level of serum sodium accompanied by a highly significant ($P < 0.01$) fall in the level of serum potassium. Robertson (1965) also obtained the similar findings and reported that hyponatraemia and hypokalaemia are common in case of abomasal dilatation or twist to the right. Boucher and Abt (1968) reported severe dehydration and markedly decreased serum potassium in case of right-sided abomasal dilatation. Poulsen (1970) studied the cases of abomasal dilatation to either side with atony in cows and found

hypokalaemia.

Roy et al. (1959) observed a decrease in serum sodium and an increase of potassium level in case of calves suffering from diarrhoea, whereas Dalton et al. (1965) observed significant lower values of plasma sodium and potassium in case of calves suffering from diarrhoea.

From the clinical observations of group I and II it is apparent that the animals manifested the symptoms of mild to profuse diarrhoea with loss of appetite accompanied by dehydration and so it is probable that hyponatraemia and hypokalaemia observed in the present study are due to loss of both the electrolytes as a result of diarrhoea and starvation.

The laparotomized animals (group III) did not show any statistically significant changes in serum sodium and potassium level.

Total serum protein :

The animals with abomasal displacement did not reveal any significant changes. However, they showed a fall by 1.79% at 48 hours followed by a rise by 0.71%, 1.43% and 3.57% at 96, 144 and 192 hours respectively. The work on this aspect is much more lacking, so far the available literature are concerned.

The animals of group II with abomasal torsion showed a significant ($P < 0.05$) fall in total serum protein concentration.

The fall was recorded by 8.90% and 12.50% at 48 and 96 hours respectively. Marriott (1923) reported that in protracted and severe haemoconcentration, red cells are destroyed and serum proteins are reduced. In the present study the significant decrease in the level of total serum protein might have occurred due to dehydration associated with haemoconcentration in calves with abomasal torsion.

The animals of group III, showed non-significant fall by 2.91% and 5.14% at 48 and 96 hours, respectively followed by non-significant rise by 0.51% and 3.90% at 144 and 192 hours respectively. So to say the level of total serum protein remained statistically unchanged in this group.

Serum chloride and plasma bicarbonate :

The serum chloride concentrations were significantly ($P < 0.05$) decreased in buffalo calves with abomasal displacement, whereas a highly significant ($P < 0.01$) increase was recorded in the level of plasma bicarbonate. Svendsen (1969) reported similar results in case of experimentally produced abomasal displacement. Robertson (1965) reported that the cows with trapped abomasum secrete copious quantities of gastric juice resulting into alkalosis (mild to severe) with hypochloraemia in case of abomasal displacement. However, he further reported that the serum chloride usually remains within normal limits in case of abomasal displacement. Robertson (1966) found in his observation that the maximum number of cows showed hypochloraemia probably due to hypersecretion by displaced abomasum. He further added that presumably, alkalosis

might be due to hypochloraemia. Poulsen (1967) observed a change of acid-base balance towards a metabolic alkalosis in case of animals with dilated and displaced abomasum to the left.

The animals of group II, with abomasal torsion showed a highly significant ($P < 0.01$) fall in the level of serum chloride while there was highly significant rise ($P < 0.01$) in the level of plasma bicarbonate. This increase of plasma bicarbonate may cause alkalosis. These findings of the author are in agreement with the observations of Gabel and Heath (1969) who found alkalosis and hypochloraemia in case of twisted abomasum and explained that this was due to large quantity of fluid high in chloride ion. Poulsen (1970) also made the similar observations and found disturbed acid-base balance and metabolic alkalosis with hypochloraemia. Boucher and Abt (1968) reported markedly decreased chloride level in cases of right-sided abomasal dilatation. Espersen and Simesen (1961) described that in case of subacute abomasal torsion alkalosis develops slowly. They further stated that alkalosis develops because of increased secretion of hydrochloric acid.

In the present study, alkalosis with hypochloraemia might have occurred due to the copious secretion of gastric juice in the displaced or twisted abomasum and also to some extent due to diarrhoea. Dalton (1965) observed, a significant fall in the level of plasma chloride in case of diarrhoeic calves. Fisher (1965) also observed significantly lower value of plasma chloride in case of diarrhoeic calves. However, Schotman (1970) found that

the metabolic alkalosis is frequently associated with hypochloraemia.

The animals of group III with laparotomy did not show any significant changes in the level of serum chloride and plasma bicarbonate.

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DISCUSSION AND CONCLUSION

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Abomasal displacement and torsion are unquestionably the most important surgical diseases of the bovine digestive tract, which present an intriguing and often frustrating problems in veterinary practice. It is only of recent years that the importance of the bovine abomasum as a focus of surgical diseases, has attracted the attention of veterinary surgeons. In past, several workers have recorded the incidence of abomasal displacement and torsion in cattle and have also tried to establish a confirmatory diagnosis of of these maladies based on the clinical, haematological and biochemical findings.

From available literatures, it appears that these diseases commonly occur in animals of exotic breeds. As per our present plan and policy, a considerable number of exotic breeds have already been introduced in our country for the development of cattle wealth. The prevalence of these diseases in some of the western countries might become a burning problem for our country as well, on account of inherent and predisposing factors. Keeping this aspect in view, the present studies were undertaken to solve the impending problem.

The entire work had been taken up in two parts. The first part comprised of clinical observations, whereas second part dealt with the haematological and biochemical studies. An attempt has been made to establish correlation between these diseases and

associated clinico-biochemical changes, so that an early and accurate diagnosis could be made to prevent the casualties in bovines

For the present study, eighteen healthy male buffalo calves were taken and divided into group I, II and III, consisting of six animals in each. In the animals of group I and II right displacement of abomasum and abomasal torsion respectively were created experimentally, whereas group III was kept as control. In this group only laparotomies were performed.

In group I, in which right sided abomasal displacement was produced, all the animals could survive between a period of 192 to 216 hours except the animal Nos. 5 and 6 which died after 144 and 36 hours post-surgically.

The animals started exhibiting clinical symptoms within 48 hours of production of abomasal displacement. In general, they showed gradual loss of appetite leading to complete anorexia followed by suspended rumination. The symptoms of dehydration were more marked with gradual loss of body condition. The temperature and respiration were normal, whereas pulse remained weak, feeble and accelerated. The animals mostly preferred sitting in sternal recumbency.

The animals voided scanty faeces of variable consistency, colour and odour. The rectal exploration revealed a little quantity of faeces along with mucous. Asymmetrical bulging of the flanks was discernible. Right flank region revealed atypical sounds on

perussion, auscultation, percussion and auscultation, and ballotement and auscultation. Ruminal atony was more explicit and the pH test of aspirated fluid from the bulging area of the right flank confirmed acidic reaction.

There was non-significant fall in Hb% and serum sodium level. Total serum protein level did not reveal any significant change. But serum potassium showed highly significant ($P < 0.01$) fall whereas, serum chloride decreased significantly ($P < 0.05$). A highly significant ($P < 0.01$) rise in plasma bicarbonate level was observed in group I.

The clinical findings of group II almost tallied with those of group I, except that the clinical symptoms were markedly acute in this group and all the animals died between a period of 96 to 120 hours after the production of abomasal torsion.

The concentration of Hb% and serum sodium did not reveal any significant change. Serum potassium and chloride showed a highly significant ($P < 0.01$) fall from their normal values, whereas a significant ($P < 0.05$) fall was observed in the level of total serum protein. But plasma bicarbonate showed a highly significant ($P < 0.01$) rise in the animals of this group.

The laparotomized animals of group III did not show any abnormal clinico-biochemical changes.

Hence, it was concluded from the present study that the

parameters discussed, would be very much helpful in diagnosing the cases of abomasal displacement and torsion in veterinary practice.

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