

**COMPARATIVE EVALUATION OF SINGLE AND DOUBLE STAGE
DIAPHRAGMATIC HERNIORRHAPHY IN BUFFALOES**

THESIS

Submitted

in partial fulfillment of the requirements for the Degree of

MASTER OF VETERINARY SCIENCE

IN

VETERINARY SURGERY AND RADIOLOGY

BY

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2018

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I hereby declare that the experimental research work and interpretation of the thesis entitled “**COMPARATIVE EVALUATION OF SINGLE AND DOUBLE STAGE DIAPHRAGMATIC HERNIORRHAPHY IN BUFFALOES**” or part thereof has not been submitted for any of the other degree or diploma of any university, nor the data have been derived from any thesis or publications of any university or scientific organization. The sources of material used and all assistance received during the course of investigation have been duly acknowledged.

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ACKNOWLEDGEMENT

*Coming together is a beginning, keeping together is a process and working together is **SUCCESS**. There is a different kind of feeling or rather say, enthusiasm when everyone comes together and performs a task. For every act to be successful, not only the actors but the supporting cast behind the scenes plays an equal great role in its success. The same goes behind the successful completion of this thesis and I hereby, take this opportunity to thank all those involved in some way or the other. Above all I would take this opportunity to thank Almighty God for giving me the strength to complete my research work.*

*At this inexplicable moment, I take this opportunity to extend my deep sense of gratitude and word of appreciation towards those who helped me during the pursuit of my present study. Among these, I am grateful to express my indebtedness to my major guide **Dr. A. H. Ulemale**, Associate Professor, Department of Veterinary Surgery and Radiology, Krantisinh Nana Patil College of Veterinary Science, Shirwal, a decent and disciplined personality, for his valuable guidance, deliberative discussion, constructive criticism and suggestions, throughout the entire course of this study and completion of this manuscript.*

*My sincere thanks to **Dr. Ajit S. Ranade sir**, Associate Dean, Krantisinh Nana Patil Veterinary College, Shirwal.*

*I wish to express my heart-felt gratitude to the members of advisory committee, **Dr. R. V. Suryawanshi** (Assistant Professor, Department of Veterinary Surgery and Radiology), **Dr. S. N. Jadhav** (Assistant Professor, Department of Veterinary Biochemistry), **Dr. C.D. Bhong** (Assistant Professor, Department of Veterinary Public Health) and **Dr. G. D. Wankhede** (Assistant Professor, Department of Veterinary Clinical Medicine, Ethics And Jurisprudence), for their sincere advice, constructive appreciation, valuable suggestions and kind cooperation during my study.*

*I would fail in my duty if I do not recall my mentors **Dr. Ankush Parihar**, **Dr. Sachin Vanjari** and their respective teams for their scientific advice, constant inspiration and for the timely help.*

*I am also thankful to **Dr. Tejas Shende, Dr. Ajit Mali, Dr. Gokul Sonawane, Dr. Y. B. Jadhav and Dr. Khandagale** for their valuable and timely help.*

*I acknowledge my special thanks to **Dr. Shivshankar Chikodi and Dr. Jignesh Patel** for their moral support, sympathy and great help during my entire research work.*

*I fall short of vocabulary in expressing my deepest feeling to my colleagues **Dr. Shambhavi Sabnis, Dr. Sarasi Mirajkar, Dr. Ranjeet Magdum, Dr. Chetan Vanjari, Dr. Ranjan** and my juniors **Dr. Supriya Ingale, Dr. Niyati Bajekal, Dr. Omkar Gajrlwar, Dr. Gowri Haveri, Dr. Karen D'silva, Dr. Komal Dhaktode, Dr. Hemant Kumar, Dr. Rajvi Kadam, Dr. Pushpanath Chougale, Dr. Amol Kawhale, Dr. Surekha Lotlikar, Dr. Aboli Lakhpati, Dr. Suchitra Mali, Dr. Utkarsh Rajhans, Dr. Amit Kshirsagar, Dr. Jayneel Parpani, Dr. Madhura Naik, Dr. Pooja Bomble**. Also my undergraduate friends **Manish Bale, Ganesh Khutal, Rhishikesh Jagtap, Shubham Raut, Harshal Shete, Kishore Gorewad** and many more to whom I can not forget for their love and sincere help during my research work and for their direct or indirect contribution for my research work. I wish to thank staff of the department of clinics, Mr. **Sachin Mote, Dilip mama, Magar mama and Mote mama** for their joyful company and help during my entire study.*

*I am deeply indebted to my loving **aai, baba, aaji, Bageshree** and my entire family members without whose blessings, I could not have reached so far.*

Having expressed these thoughts, I am aware that such an acknowledgement in no way projects the depth or extent of my gratitude to the few mentioned and whole of unmentioned help extended. To all who deserve such thanks, I apologise for the omission and inadequacy of these written words.

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LIST OF ABBREVIATIONS

%	: Per cent
@	: At the rate
°F	: Degree Fahrenheit
≤	: Less than or equal to
≥	: More than or equal to
=	: Equal
BPL	: Below Poverty Line
B. wt.	: Body weight
CK	: Creatine Kinase
cm	: Centimeter
CRE	: Serum Creatinine
cumm	: Cubic millimeter
DH	: Diaphragmatic Hernia
DLC	: Differential leucocyte count
EDTA	: Ethylene Diamine Tetra Acetic Acid
<i>et al.</i>	: et alia
etc.	: et cetera
g %	: Gram percentage
g	: Gram
gm/dl	: Gram per deciliter
Hb	: Haemoglobin
HCl	: Hydrochloric acid
Hrs	: Hours
i. e.	: That is
i/m	: Intramuscular

Inj.	: Injection
IPPV	: Intermittent Positive Pressure Ventilator
i/v	: Intravenous
kg	: Kilogram
L	: Liter
LDH	: Lactate Dehydrogenase
Liq.	: Liquid
mg	: Milligram
mg/kg	: Milligram per Kilogram
min.	: Minute
ml	: Milliliter
mm	: Millimeter
mm/hr	: millimeter per hour
NDDB	: National Dairy Development Board
nmol/ml	: Nano mole per milliliter
No.	: Number
PCV	: Packed cell volume
Pre-op	: Pre-operative
Post-op	: Post-operative
S. E.	: Standard error
Sr. No.	: Serial Number
SSI	: Surgical Site Infection
TEC	: Total Erythrocyte count
TLC	: Total leucocyte count
TRP	: Traumatic reticuloperitonitis
TVCC	: Teaching Veterinary Clinical Complex
U/ ml	: Unit per milliliter

$\mu\text{mol/L}$: Micro mol per litre

Viz. : Namely

Wt. : Weight

CHAPTER I

INTRODUCTION

India is predominantly an agricultural country and about 70 per cent of its population is dependent on income from agriculture and animal husbandry. Buffalo is the skeletal base of Indian livestock economy. The world's buffalo population is distributed in 40 countries as 20 recognized breeds. According to the latest census, India has 190.9 million cattle and 108.7 million buffaloes (NDDB, 2012). Diaphragmatic hernia in buffaloes in India has been reported from all over the country resulting in great economic loss (Deshpande *et al.*, 1977). Diaphragmatic hernia is one of the major surgical conditions of bovine with high incidence in buffaloes (Krishnamurthy *et al.*, 1985).

Diaphragmatic hernia is a chronic wasting and inflammatory disease, characterized by multi-organ dysfunctions (Bisla *et al.*, 2002). Neonatal diaphragmatic hernia may be congenital or acquired. Buffaloes are more prone to diaphragmatic hernia than cattle, because pericardiophrenic vessels and golgi tendon organs (function as the pressure receptors) had been found missing in buffaloes diaphragm (Singh *et al.*, 2006). These findings along with a poor blood supply indicate decreased efficiency of the musculotendinous junction in resistance to tension and stretch. Thus, making the buffaloes diaphragm prone to rupture at the right ventromedial thinnest part. In addition, elastin and myosin content of buffalo diaphragm is lesser than that of cattle. Along with this, collagen content of buffalo diaphragm is much lesser than cattle which reduces elasticity of diaphragm.

The intra-abdominal pressure had been reported to be higher in buffaloes than that of cattle (Singh *et al.*, 2006). Traumatic reticulo-peritonitis might be another factor for occurrence of diaphragmatic hernia. Sometimes, a localized inflammation due to penetrating metallic reticular foreign body followed by abscess formation produces a weak point in the diaphragm and subsequently, an increase in intra-abdominal pressure may predisposes herniation of the reticulum into thoracic cavity (Singh *et al.* 1979).

Traumatic hernias are caused by mechanical factors such as pregnancy and falls or forceful contractions during parturition. Generally, violent trauma and increase of intra-abdominal pressure constitute main causes of diaphragmatic

hernia in animals. It occurs due to either increased intra-abdominal pressure during advanced pregnancy or at the time of parturition (Krishnamurthy, 1993). Diaphragmatic hernia is a serious digestive disorder of buffaloes which involves rupture in the diaphragm at the musculotendinous junction with subsequent herniation of the abdominal organs into the thoracic cavity (Singh *et al.*, 2006).

In chronic cases, herniated reticulum through the diaphragm develops adhesions with hernial ring and/or abdominal floor (Behl *et al.*, 1997 and Sahu *et al.*, 2003). This adhesion with reticulum and diaphragm puts pressure on heart and lungs which reduces the inspiration and expiration, aided venous engorgement and stagnant ischemia in various internal organs (Bisla *et al.*, 2002). In diaphragmatic hernia cases disarrangement in the normal alignment of the cardia and reticulo-omasal opening with distortion of oesophageal groove prevents the eructation of ruminal gases resulting in recurrent tympany (Krishnamurthy *et al.*, 1985).

The approach of herniorrhaphy is either through trans-thoracic (Krishnamurthy *et al.*, 1980) or post-xiphoid trans-abdominal approach (Bisla *et al.*, 2003a and William *et al.*, 2003). The surgery is performed under general anesthesia with intermittent positive pressure ventilation (Mirakhur *et al.*, 1983) or under sedation without intermittent positive pressure ventilation (William *et al.*, 2003). The limitation of Intermittent positive pressure ventilation (IPPV) technique is that it cannot be used at the field level, since it is not feasible to carry to the farmer's door step.

The most common and widely used surgical method in diaphragmatic hernia consisting of exploratory rumenotomy on first day through left flank region in standing position followed by diaphragmatic herniorrhaphy via post-xiphoid approach in dorsal recumbency on next day (double stage) as described by (Singh *et al.*, 2006). As both the procedures are being performed on two days, consecutively, it leads to double surgical stress, increase treatment cost and increased chances of surgical site infection (SSI). Under field condition, this causes higher mortality in buffaloes which contribute to great losses in terms of milk and money, especially to farmers belonging to below poverty line (BPL) as this animal is the major source of their livelihood of rural India.

By considering the above facts, the present study encouraged to attempt the newer surgical approach for management of diaphragmatic hernia i.e. both rumenotomy and herniorrhaphy are performed through the single surgical incision/window (single stage) via post-xiphoid approach in dorsal recumbency, so

that animal will not bear double surgical stress and chances of surgical site infection (SSI) will be reduced drastically. The main aspect of this study is to reduce the treatment cost of owner and stabilize the productivity of animals. The present clinical study was undertaken with the following objectives,

1. To evaluate the single stage diaphragmatic herniorrhaphy in terms of clinical signs, recovery times and post-surgical complications with double stage diaphragmatic herniorrhaphy.
2. To study the haemato-biochemical parameters.

CHAPTER-II

REVIEW OF LITERATURE

The available literature pertaining to history, incidence, etiology, clinical signs, diagnosis, surgical treatment and other pathophysiology of diaphragmatic hernia in buffaloes are reviewed as follows:

- 1) Epidemiological incidence.
- 2) Etiology & predisposing factors.
- 3) Clinical signs & symptoms.
- 4) Haematological profile.
- 5) Biochemical profile.
- 6) Other diagnostic techniques.
- 7) Surgical repair of Diaphragmatic hernia.
- 8) Prognosis and recovery rate.

2.1 Epidemiological incidence

Deore and Jahagirdar (1971) studied 100 animals (63 buffaloes and 37 cattle) subjected to rumenotomy at Veterinary Polyclinic, Pune. Out of those 100 cases, 16 animals (12 buffaloes and 4 cattle) were positive for diaphragmatic hernia. Among these 12 buffaloes, 11 were females and 1 was male. On the other hand among 4 cattle, 2 were females and 2 were males. Out of total 13 females, 3 buffaloes were advanced pregnant (last trimester), two buffaloes and one cow were recently calved.

Prasad *et al.* (1977) studied 42 cases of diaphragmatic hernia in buffaloes at Veterinary College, Ludhiana. They found that, among them 21 buffaloes were at the peak of their lactation, 12 had recently calved and 9 were in various stages of pregnancy (2 to 7 ½ months). They also classified those animals in 2 age groups. Out of 42 buffaloes, 5 were below 5 years of age and 37 were from 5-10 years of age.

Nigam *et al.* (1980) reported the occurrence of diaphragmatic hernia in 25 buffaloes at Veterinary College, Hisar. Out of these, 2 were heifers and remaining 23 were adult buffaloes in which 6 were pregnant and 11 were recently parturated.

Deshpande *et al.* (1982) analyzed 3,724 cases of rumen disorders in bovines during the period of January, 1973 to December, 1978 at Veterinary College, Hisar. Out of those, 113 cases of diaphragmatic hernia were detected. The study revealed that out of 113 cases, 105 (92.92%) cases occurred in buffaloes while only 8 (7.08%) cases were reported in cattle. Further, it was observed that the incidence was significantly high in females (96.40%) as compared to males (3.60%). Amongst 113 cases, 111 (98.20%) cases were of adult age group while only 2 (1.80%) were heifers.

Krishnamurthy *et al.* (1983) analyzed 140 cases of diaphragmatic hernia at Veterinary College, Hisar, out of which, 139 buffaloes and one buffalo bullock was ranging in age group from 2-10 years. History revealed that out of 139 buffaloes, 8 were heifers, 63 had the history of calving (37 cases were within 60 days post-partum), 41 were pregnant (11 cases were below 5 months of pregnancy and 30 cases were more than 5 months pregnant) and 3 had the history of abortion.

Krishnamurthy *et al.* (1985) reported that diaphragmatic hernia was more frequent in adult female buffaloes (5-9 years of age) than young heifers, buffalo bulls and cattle. They found a positive correlation between the incidence of the disease and the calving season. The condition was more frequently seen in late gestation or soon after calving.

Usturge and Bhokare (1989) reported 15 clinical cases of diaphragmatic hernia including 11 buffaloes and 4 cows at Veterinary College, Parbhani. Out of 15 adult animals, 11 were recently parturated, 2 were pregnant and 2 were in dry period.

Saini *et al.* (2001) evaluated 205 cases (204 females and 1 male) of buffaloes with diaphragmatic hernia during the period of 1980 to 1994 at Veterinary College, Ludhiana. Majority of the affected animals (75.70%) were in the age group of 5-8 years. Heifers comprised 5.96% whereas, 46.90% animals were non-pregnant.

Bisla *et al.* (2002) analyzed the incidence of diaphragmatic hernia in 45 buffaloes during the period of October, 1998 to September, 1999 at Veterinary College, Hisar. Out of those, 12 were pregnant, 31 were non-pregnant buffaloes and 2 were heifers.

Sahu *et al.* (2003) evaluated the clinical parameters of 72 buffaloes suffering with diaphragmatic hernia during the period of 2000 to 2001 at Veterinary

College, Hisar. Out of which 67 were adult buffaloes and 5 were buffalo heifers. The incidence was reported to be 19% in pregnant buffaloes and 44% after calving.

Mohindroo *et al.* (2007) studied 20 buffaloes with reticular diaphragmatic hernia at Veterinary College, Ludhiana. Out of 20 buffaloes, 8 were in advanced pregnancy, 8 were recently calved and 4 were in late lactation.

Randhawa and Singh (2007) reported the case of diaphragmatic hernia in a 2½ year old non-pregnant buffalo heifer diagnosed by clinical signs and contrast radiography technique.

Chaudhari *et al.* (2009) studied 338 clinical cases of cattle and buffalo for recording the incidences of gastro-intestinal tract affections in bovine at Veterinary College, Udgir. All these cases were having the history of tympany (acute/chronic/recurrent). All animals were subjected to radiography of reticulo-thoracic region in lateral recumbency. They recorded the incidence of diaphragmatic hernia in 6.50 per cent of animals.

Khan (2009) reported total 371 cases of diaphragmatic hernia in female buffaloes during the period of January, 1999 to December, 2008 at Veterinary College, SardarKrishinagar, Gujarat. Out of 371 cases, 28 (7.55%) were below 4 years of age, 312 (84.09%) were between 4-9 years of age and 31 (8.36%) were above 9 years of age. He also observed that, amongst those 371 cases, 188 (50.67%) buffaloes were pregnant, 161 (43.40%) were lactating buffaloes whereas 20 (05.39%) were pregnant heifers and 2 (00.54%) were non pregnant heifers. Analysis of data revealed that 80.30 per cent cases were noticed during the period between August to February which was the season of advanced stage of pregnancy and period of parturition for buffaloes.

2.2 Etiology and Predisposing factors

Deore and Jahagirdar (1971) diagnosed 16 cases as diaphragmatic hernia during rumenotomy in cattle and buffaloes. They opined that foreign bodies as well as congenital defects in diaphragm might be the etiological factors and advanced pregnancy and recent calving had aggravated the condition.

Singh *et al.* (1979) operated a rare case of diaphragmatic hernia having double hernial ring in a buffalo at Veterinary College, Ludhiana. They reported that recent parturition coupled with strenuous contractions could have resulted in the

weakness of the diaphragm and sharp nails present in reticulum might have resulted in its rupture and subsequent herniation of reticulum through both sites.

Singh *et al.* (1980) discussed the possible etiological factors of diaphragmatic hernia in buffaloes. They studied 58 buffaloes subjected to surgical repair. They concluded that the innate weakness of the buffalo diaphragm was one of the major factors responsible for a high incidence of diaphragmatic hernia in buffaloes. Traumatic reticulo-peritonitis might be another factor. A localized inflammation followed by abscess formation produces a weak point in the diaphragm and increase intra-abdominal pressure during certain situations like parturition, might have induced herniation of the reticulum. A combination of these factors might be the probable reason for the resultant diaphragmatic hernia in buffaloes.

Krishnamurthy *et al.* (1983) studied 76 buffaloes including 16 healthy buffaloes and 60 buffaloes suffering from the diaphragmatic hernia. They found that hernia mostly occurred in the right side of the diaphragm at musculo-tendinous junction. An inherent weak spot at transitional zone of musculo-tendinous junction with increased intra-abdominal pressure together, might have created a tension along the right ventral tendinous part of the diaphragm against the trans-thoracic low pressure. The condition might get aggravated in cases such as violent fall, tympany, pregnancy or straining at the time of parturition.

Venkataravanappa and Krishnamurthy (1984) measured the intrapleural pressure and intraperitoneal pressure of healthy adult buffaloes, pregnant buffaloes at different stages and healthy adult cows. They observed that there was no significant difference in the mean intraperitoneal pressure. The mean intrapleural pressures in healthy buffaloes/cows and pregnant buffaloes were 4.84 ± 0.383 , 6.30 ± 0.494 and 3.32 ± 0.325 cm H₂O, respectively, which significantly varies from animal to animal. They also found that the mean relative pressure difference (difference between intraperitoneal and intrapleural pressure) varies significantly between healthy buffaloes (8.16 ± 0.817 cm H₂O) and healthy cows (5.50 ± 0.26 cm H₂O), however it varies non-significantly between pregnant buffaloes and non-pregnant buffaloes. As there was significantly higher relative pressure difference in buffaloes as compared to cows, greater pressure was being exerted on diaphragm in buffaloes. They opined that increase in the relative pressure difference across the diaphragm (due to tympany or violent fall) might be acting as the predisposing factor for the diaphragmatic hernia.

Krishnamurthy *et al.* (1985) analyzed that, innate weakness of the diaphragm, chronic and repeated trauma by the foreign bodies, physical forces like advanced stage of pregnancy, forceful contractions at the time of parturition, accidents, violent fall and tympany as the main etiological factors responsible for diaphragmatic hernia in buffaloes. Physical forces increase the tension over the diaphragm. Tympany was a common problem in high milker buffaloes and was associated with the consumption of more concentrate ration or legume fodders.

Sobti *et al.* (1989) noted two cases of diaphragmatic hernia in buffalo bulls at Veterinary College, Ludhiana. There was no radiographic evidence of the presence of foreign material nor was any recovery following rumenotomy. Since the animal was male, so there was no chance of pregnancy and parturition. This study supported the theory that it was the inherent weakness of the musculature of the diaphragm which caused diaphragmatic tear and subsequent herniation of reticulum.

Singh *et al.* (2006) investigated that as compared to cattle, the occurrence of diaphragmatic hernia was more in buffalo. Furthermore, they found that the right ventromedial tendinous zone of the buffalo diaphragm was thinner (0.85 mm) than that of left (1.35 mm). Apart from this, the pericardiophrenic vessels and golgi tendon organs which function as the pressure receptors had been found missing in buffalo diaphragm. Also buffalo diaphragm has poor blood supply. All these findings indicate decreased efficiency of the musculotendinous junction with regards to registering of and resistance to tension and stretch, thus making the buffalo diaphragm prone to rupture at the right ventromedial thinnest part. They also reported the percentage dry matter elastic content of sternal and costal part of diaphragm to be 13.85 ± 4.56 and 9.00 ± 1.86 in buffalo and 17.57 ± 4.24 and 16.14 ± 3.66 in cattle. The myosin content in sternal and costal parts of diaphragm were 7.12 ± 1.25 per cent and 8.44 ± 1.77 per cent in buffalo and 3.59 ± 0.79 per cent and 3.33 ± 0.77 per cent in cattle, respectively, which indicate the tension on the tendinous part of the buffalo diaphragm is more during inspiration and contractility of the muscular part of buffalo diaphragm is much higher than that of cattle. The intra abdominal pressure had been reported to be higher in buffaloes than that of cattle. In addition to these etiological factors, increased intra-abdominal pressure due to advanced pregnancy, straining during parturition, tympany, violent fall, chronic cough and straining due to any reason could act as exciting factors for diaphragmatic hernia.

Singh *et al.* (2006) reported that, Buffaloes are susceptible to DH than other ruminant species and this is due to the anatomical differences of buffaloes diaphragm. A relatively small tendinous portion of the diaphragm resulting in innate weakness, making this species more prone to such condition

Randhawa and Singh (2007) studied various etiological factors of diaphragmatic hernia in buffaloes. Those included chronic and repeated trauma from the foreign bodies, inherent weak diaphragm at the musculotendinous junction, increased intra-abdominal pressure in advance stage of pregnancy and due to increased tension over diaphragm at the time of parturition due to forceful straining.

2.3 Clinical signs and symptoms

Prasad *et al.* (1977) recorded clinical signs in 42 buffaloes having diaphragmatic hernia. Most of the cases invariably had a history of chronic recurrent tympany which was not responding to the medicinal treatment, suspended rumination, persistent anorexia and scanty pasty faeces. There was no fever in any of the animals. Auscultation of the ventral thorax revealed splashing reticular sound.

Sethuraman and Rathor (1979) observed that, buffaloes with diaphragmatic hernia exhibited the symptoms like dullness, anorexia, decreased ruminal motility, recurrent tympany, foetid/rancid odour of ruminal content, constipation, abdominal respiration and abduction of fore limbs. The colour and consistency of rumen content was changed to greenish brown, grayish white or clay colored and pasty or syrupy with more frothiness and air bubbles. The pH of ruminal fluid was acidic (5.2 - 6.8) in nature.

Singh *et al.* (1979) operated a buffalo suffering with diaphragmatic hernia showing recurrent tympany, persistent anorexia and suspended rumination as the clinical signs. On rumenotomy, they found frothy ruminal content which was alkaline (pH 9.0) in nature.

Akbar and Kumari (2006) investigated the effect of changes in pH on rumen metabolism and production in lactating Murrah buffaloes. They revealed that in lactating buffaloes suffering from primary indigestion, ruminal pH is one of the most important factors. Any deviation in ruminal pH causes different kinds of indigestion

which disrupt the rumen environment resulting in reduced metabolic activities and ultimately inhibiting milk production.

Deshpande *et al.* (1983) studied 49 buffaloes of Murrah breed suffering with diaphragmatic hernia. The buffaloes were showing clinical signs like recurrent tympany, deprived appetite, regurgitation of frothy ruminal contents, brisket oedema, progressive loss of condition, weakness, scanty/pasty faeces, dehydration, sunken eyes and drop in milk yield. Clinical examination revealed rectal temperature, pulse rate and respiration rate were within normal range. Auscultation of thorax revealed the anterior displacement of heart. On an average, there was increased ruminal motility but force of contraction and frequency was found dependent on the severity of bloat.

Krishnamurthy *et al.* (1983) examined 140 cases of diaphragmatic hernia in buffaloes showing clinical signs like recurrent tympany and drop in milk yield (all animals), brisket oedema in 6 buffaloes, chronic cough in 12 buffaloes, constipation/diarrhoea in 63 buffaloes, respiratory distress, regurgitation of feed material through mouth and nostril and abduction of limbs while walking in 2 buffaloes.

Krishnamurthy *et al.* (1985) found that the animals affected with diaphragmatic hernia exhibit clinical signs like progressive emaciation, weakness, dehydration, dry patchy skin with rubbed off hair, drop in milk production, recurrent tympany with or without regurgitation of feed, reduced rumination, intermittent constipation/diarrhoea, brisket oedema and chronic cough. Involvement of the oesophageal groove due to reticular herniation and ventral fixation of the reticular floor due to adhesions cause derangement in the normal alignment of the cardia, oesophageal groove and reticulo-omasal opening. This prevents the eructation of ruminal gases which results in distension of the rumen (tympany).

Marudwar *et al.* (1986) successfully repaired diaphragmatic hernia in 4 animals (3 buffaloes and 1 cow) at Veterinary College, Nagpur. They observed that all animals had the history of recent parturition, anorexia, recurrent tympany (not responding to conventional treatment), ruminal atony and loss of condition and production. Rumenocentesis revealed frothy nature of contents. Reticular gurgling sounds were very evident on auscultation of the thoracic cavity at the 6th intercostal space on the left side. The rectal temperature, respiration rate and heart rate were ranged between 100.8 - 101.5 ° F, 36 - 40 per minute and 35 - 50 beats per minute, respectively.

Nassimi *et al.* (1986) observed the physiological reactions associated with diaphragmatic hernia in adult buffaloes at Veterinary College, Hisar. They recorded 3 major parameters viz. pulse rate, respiration rate and rectal temperature at 5 stages i. e. before rumenotomy, next day of rumenotomy, next day of herniorrhaphy, 5th day and 9th day after herniorrhaphy. The pulse rate was 53.57 ± 0.69 , 55.08 ± 1.15 , 65.88 ± 3.77 , 68.12 ± 3.85 and 66.26 ± 2.73 pulse per minute at corresponding time interval. The respiration rate at corresponding time interval was 11.97 ± 0.23 , 15.04 ± 0.74 , 20.55 ± 1.83 , 18.58 ± 1.70 and 17.07 ± 1.86 respirations per minute. On the other hand, the rectal temperature was 37.22 ± 0.06 , 37.44 ± 0.13 , 37.33 ± 0.20 , 37.45 ± 0.16 and $37.61 \pm 0.25^\circ\text{C}$ at corresponding time interval.

Behl *et al.* (1997) recorded 15 cases of buffaloes suffering with diaphragmatic hernia at Veterinary College, Hisar. They divided animals in two categories namely buffaloes with abomasal reflex (6 animals) and buffaloes without abomasal reflex (9 animals). Abomasal reflex was considered when rumen fluid chloride concentration was more than normal range i.e. $> 30\text{mmol/L}$. They also studied the rumen fluid pH in those cases. The rumen fluid pH was 6.48 ± 0.42 and 7.28 ± 0.46 in buffaloes with abomasal reflex and without abomasal reflex, respectively.

Saini *et al.* (2001) enlisted the clinical findings of diaphragmatic hernia in 205 cases that survived after surgical correction out of 285 buffaloes. Among those 205 survived cases, 82.50 per cent had history of constipation, 71.10 per cent had recurrent tympany and inappetence for 15-30 days, 2.50 per cent had regurgitation of feed and 1 per cent had brisket oedema.

Tagra *et al.* (2001) checked the clinical parameters in 7 buffaloes suffering with diaphragmatic hernia at Veterinary College, Hisar. According to their study, the temperature, pulse rate, respiratory rate and ruminal motility were $100.1 - 101.6^\circ\text{F}$, 41 - 48 per minute, 12 - 21 per minute and 5 - 7 per three minute, respectively. Tympany was present in six cases. Ruminal content was hard in one, frothy in 3 and watery in 3 buffaloes. Pre-treatment rumen fluid pH was 6.81 ± 0.05 . Skin fold persistence test was above normal (> 2.8 sec.) in all the 7 cases.

Bisla *et al.* (2002) studied 45 buffaloes affected with diaphragmatic hernia and reported the clinical signs like progressive weakness, reduced milk production, partial to complete anorexia, recurrent tympany, scanty and pasty faeces. In 2 animals, there was no history of tympany, while one animal was passing loose

faeces. There was Hypothermia in 15 cases, whereas 2 cases had fever. Respiratory distress/dyspnoea and hypercapnia were observed in 13 cases, which might be due to adhesions of reticulum with the diaphragm and lungs. Bradycardia was present in 24 cases, whereas 3 cases had tachycardia.

Sahu *et al.* (2002) examined the various clinical parameters in 25 buffaloes suffering with diaphragmatic hernia and compared it with normal healthy animals. The respiration rate and rectal temperature of affected buffaloes were found to be within the normal range. However, in most of the cases, the heart rate was slightly lower (52 ± 2.0 beats/min) than normal (60-70 beats/min).

Bisla *et al.* (2003a) studied the clinical parameters in buffaloes suffering with diaphragmatic hernia at various stages i.e. prior to rumenotomy, during herniorrhaphy and at 1, 24 and 48 hours after herniorrhaphy. The heart rate was 48 ± 03 , 57 ± 05 , 52 ± 06 , 59 ± 07 and 60 ± 07 beats/min. at respective time interval. The rectal temperature was 99.3 ± 0.48 , 97.0 ± 0.45 , 98.0 ± 0.42 , 99.2 ± 0.43 and 99.0 ± 0.34 °F at respective time interval. However, the respiratory rate was 13 ± 01 , 22 ± 02 , 17 ± 03 and 13 ± 01 breath/min. prior to rumenotomy and at 1, 24 and 48 hours after herniorrhaphy, respectively.

William *et al.* (2003) reviewed 11 cases of diaphragmatic hernia in bovines including 6 buffaloes and 5 cows at Veterinary College, Namakkal. The common symptoms reported were recurrent tympany, persistent anorexia, scanty faeces and loss of milk production.

Narale *et al.* (2006) studied diaphragmatic hernia in 196 buffaloes during the period of 1994 to 1997 at Veterinary College, Parbhani. According to their study, clinical signs recorded along with status of animal regarding pregnancy or parturition, were drop in milk yield, anorexia and recurrent tympany with loose, scanty and pasty faeces. On auscultation of thorax, muffled cardiac sounds were noticed and reticular sounds were audible at 4-5th inter-costal space at the right side of the thorax in all the cases.

Singh *et al.* (2006) mentioned that diaphragmatic hernia involves a rupture in the diaphragm at the musculotendinous junction with subsequent herniation of the abdominal organs into the thoracic cavity. They observed that the clinical symptoms usually associated with diaphragmatic hernia in buffaloes were persistent anorexia, recurrent tympany, suspended rumination, scanty pasty faeces, progressive weakness, gradual decrease in the milk yield, dehydration, intermittent constipation or diarrhoea, respiratory distress and brisket oedema.

Bisla and Singh (2006) recorded the clinical parameters in buffaloes suffering with diaphragmatic hernia and treated with manganese chloride prior to surgical correction. In healthy buffaloes, the heart rate was 60 - 70 beats/min., whereas in diseased buffaloes, prior to rumenotomy, during diaphragmatic herniorrhaphy and 1 hour post-diaphragmatic herniorrhaphy, it was 64 ± 06 , 76 ± 14 and 81 ± 12 per minute, respectively. Similarly the rectal temperature was 99 - 102°F in healthy buffaloes, while in diseased buffaloes prior to rumenotomy, during diaphragmatic herniorrhaphy and 1 hour post-diaphragmatic herniorrhaphy it was 99.6 ± 0.9 , 98.0 ± 0.9 and 96.5 ± 0.9 °F respectively. However, the respiration rate was 12 - 16 per minute in healthy buffaloes, while in diseased animal prior to rumenotomy and 1 hr. post-diaphragmatic herniorrhaphy it was recorded 18 ± 02 and 17 ± 05 per minute, respectively.

Randhawa and Singh (2007) observed the clinical signs of diaphragmatic hernia in a buffalo heifer which includes recurrent frothy tympany, suspended rumination, drum like sound on percussion of left flank, anorexia, generalized emaciation, respiratory distress and mucous coated scanty faeces. The temperature was within normal range but the heart rate was 80 beats per minute (tachycardia) with loud and thumping heart sounds. Auscultation of the right thoracic cavity revealed reticular sounds cranial to the 6th rib.

Attia (2016) studied twelve buffaloes with a history of anorexia, tympany, reduction of milk production with no response to previous medical treatment were reported in egyptian buffaloes with diaphragmatic hernia and concluded that, hemato-biochemical analysis is of additional value in the diagnosis of diaphragmatic hernia in buffaloes.

2.4 Haematological analysis

Sethuraman and Rathor (1979) observed Hb, PCV and TLC in 9 buffaloes affected with diaphragmatic hernia. They found their mean levels as 10.2 g per cent, 32.0 per cent and 16,240 per cumm, respectively. They also observed neutrophilic leukocytosis with lymphopenia and eosinopenia. The DLC showed 47.3 per cent lymphocytes, 47.5 per cent neutrophils, 3.7 per cent eosinophils and 1.5 per cent monocytes.

Deshpande *et al.* (1983) analyzed the clinico-haematological changes in 49 buffaloes of Murrah breed suffering with diaphragmatic hernia. The estimated mean values of TLC, Hb concentration, PCV, lymphocyte count and neutrophil count were 90.86 ± 559.57 per cumm, 10.49 ± 0.26 g per cent, 34.96 ± 1.14 per cent, 39.96 ± 1.81 per cent and 53.83 ± 2.07 per cent, respectively. The slightly decreased value of Hb was due to impaired digestion and low intake of feed (inappetence) and fluids.

Krishnamurthy *et al.* (1983) examined 140 cases of diaphragmatic hernia in bovines. They carried out haematological examination for Hb, PCV, TLC and DLC. Among those, 10 per cent animals showed either a fall in Hb or an increase in PCV value. The mean values for lymphocyte and neutrophil count in affected animals were found to be 41 per cent and 55 per cent, respectively (60 per cent and 30 per cent in normal animals).

Krishnamurthy *et al.* (1985) calculated the mean values of Hb (g %), PCV (%), TLC (per mm^3), neutrophils count (%) and lymphocytes count (%) in apparently normal buffaloes. The values obtained were 12.2 ± 0.26 , 30.0 ± 1.89 , 9330 ± 458.41 , 36 ± 2.62 and 57 ± 2.65 , respectively; while these values in diaphragmatic hernia affected buffaloes were 11.1 ± 0.14 , 32.0 ± 0.62 , 9646 ± 391.52 , 54 ± 1.11 and 42 ± 1.05 , respectively.

Marudwar *et al.* (1986) successfully performed surgical repair of diaphragmatic hernia in 3 buffaloes and measured the haematological parameters. The Hb, PCV, neutrophil, lymphocyte, eosinophil and monocyte counts ranged between 11.2 - 13.2 g percent; 30 - 36 percent; 59 - 65 percent; 31 - 34 percent, 2 - 4 percent and 2 percent, respectively.

Kaur and Singh (1994) carried out a comparative study between haematological parameters of buffaloes having diaphragmatic hernia (16 cases) and normal healthy buffaloes (16 animals) at Veterinary College, Ludhiana. The Hb concentration (10.2 ± 0.2 g %), TEC (5.5 ± 0.2 million/ mm^3) and PCV (30.6 ± 0.8 %) were significantly low. The TLC were markedly elevated (14.3 ± 0.7 thousand per mm^3) and DLC revealed marked neutrophilia (56.1 ± 2.3 %) and lymphopenia (40.3 ± 2.1 %) in diseased buffaloes.

Tagra *et al.* (2001) recorded the abomasal reflex in 7 out of 32 buffaloes suffering with diaphragmatic hernia. They also examined the 7 cases for biochemical parameters. There were no significant changes in Hb concentration among pre-operative (13.74 ± 0.37 gm/dl) and post-operative at 24 hour ($13.34 \pm$

0.38 gm/dl), 48 hour (13.17 ± 0.36 gm/dl), 72 hour (13.17 ± 0.34 gm/dl) and 96 hour (13.17 ± 0.34 gm/dl) interval. However, there was significant reduction in post-operative PCV level at 24 hour (34.57 ± 0.75 %), 48 hour (33.71 ± 1.10 %), 72 hour (33 ± 1.29 %) and 96 hour (32.71 ± 0.81 %) interval when compared with pre-operative (37.86 ± 0.83 %) values.

Bisla *et al.* (2002) compared Hb, PCV and ESR of buffaloes having diaphragmatic hernia (n = 45) with normal healthy animals (n = 8). The mean levels of Hb, PCV and ESR in diseased animal were 14.50 ± 0.78 g per cent, 40.00 ± 2.80 per cent and 28.00 ± 8.40 mm/hour, respectively; while these values in normal healthy animals were 12.00 ± 1.67 g per cent, 30.00 ± 3.35 per cent and 62.00 ± 2.10 mm/hour, respectively. The estimated values of Hb, PCV and ESR in diseased animals were significantly high when compared with normal healthy animals. They stated that elevated values of Hb, PCV and ESR were due to dehydration. The elevated value of PCV might also be due to splenic contraction in stress.

Sahu *et al.* (2002) studied the PCV in 25 diaphragmatic hernia affected buffaloes and found that it was significantly higher (43.7 ± 1.45 %) than normal level (30.0 ± 3.35 %).

Bisla *et al.* (2003a) analyzed Hb and PCV in buffaloes suffering with diaphragmatic hernia. The mean value of Hb before the rumenotomy was 14.20 ± 0.97 g per cent. However, the mean values of PCV before rumenotomy, 30 minutes, 24 hours and 48 hours after herniorrhaphy were 38.7 ± 2.64 , 34.8 ± 2.35 , 34.4 ± 1.95 and 40.0 ± 3.10 per cent, respectively.

Bisla and Singh (2006) studied haematological parameters in buffaloes suffering with diaphragmatic hernia. They treated those buffaloes with manganese chloride prior to diaphragmatic herniorrhaphy. The estimated values of Hb and PCV were found significantly high before surgery (15.60 ± 0.93 g % and 44.00 ± 4.64 %) as compared to index value (12.00 ± 1.67 g % and 30.00 ± 3.35 %) and did not change much post-operatively (14.00 ± 0.87 g % and 42.25 ± 2.59 %).

Narale *et al.* (2006) analyzed haematological parameters in 196 buffaloes suffering with diaphragmatic hernia. The Hb (8.92 ± 0.18 g %), PCV (26.4 ± 0.76 %), TEC (4.78 ± 0.15 million/ cmm) and lymphocyte count (46.08 ± 1.86 %) were significantly low while TLC (7.71 ± 0.11 thousand/ cmm) and neutrophil count (51.25 ± 1.81 %) were significantly high when compared with healthy control group. They observed non-significant variation in monocytes (1.33 ± 0.14 %) and eosinophils

count (1.33 ± 0.14 %). These parameters were stabilized to normal by the 8th post-operative day.

Khan (2009) recorded haematological parameters like Hb, PCV, TLC and DLC in 12 buffaloes suffering with diaphragmatic hernia. He estimated all these parameters prior to rumenotomy (at 0 hour), prior to herniorrhaphy (at 24 hours) and at 48, 72 and 96 hours after rumenotomy. All these parameters were decreased significantly at 24, 48, 72 and 96 hours after rumenotomy. Whereas, leukocytosis and neutrophilia observed at 24, 48, 72 and 96 hours after rumenotomy.

Patel (2011) recorded haematological parameters like Hb, PCV, TLC and DLC in 22 buffaloes suffering with diaphragmatic hernia before rumenotomy (at 0 hour), before herniorrhaphy (at 24 hours) and at 48, 72 and 96 hours after rumenotomy. All these 22 buffaloes were divided in three groups (I-control, II-MnCl₂ @ 1 mg/kg body wt treated and III -MnCl₂ @ 5 mg/kg body wt treated). Mean values of Hb and PCV showed significant decrease at 48, 72 and 96 hours observations in group II only, while Hb was significantly changed in group III at these stages. These parameters when compared between the groups, significant changes were seen at 0, 24 and 72 hours observations of Hb between group II and III. The mean values of TLC were increased gradually in all the groups after operation without significant change, except at 72 hours of group II animals. Neutrophilia and lymphocytopenia were noticed in all the groups after herniorrhaphy which were obvious as a normal physiological response to the traumatic injuries.

2.5 Biochemical analysis

Rose *et al.* (2009) conducted clinical study on buffaloes suffering from diaphragmatic hernia (DH) and traumatic reticuloperitonitis (TRP) with the aim to investigate the effect of these diseases on plasma enzymes. The blood plasma was used to measure AST, ALT, LDH, CK, ALP and ACP enzymes. In the animals suffering from diaphragmatic hernia the AST (P0.05) and CK (P 0.01) were significantly higher than control animals. The levels of LDH also increased in the diseased cases but the increase was statistically nonsignificant. There was no significant change in the levels of ALP and ACP enzymes. Though the values of AST and LDH and CK enzymes increased in buffaloes suffering from TRP but the

increase was statistically nonsignificant. They concluded that, disturbed metabolism in DH and TRP cases have altered various plasma enzymes and useful in diagnosis and possible supportive remedial measures in these disorders.

Brancaccio *et al.* (2010) studied biochemical markers of muscle damage following intense recumbency and concluded that alteration in metabolic and mechanical factors. Serum levels of skeletal muscles enzymes (creatine kinase, lactate dehydrogenase, myoglobin and aspartate aminotransferase) or proteins are markers of functional status of muscle tissues and vary widely in both pathological and physiological conditions. They recommended estimation of various muscle enzymes will provide better information about the muscular damage.

Marianne *et al.* (2012) Studied creatine kinase and exercise related muscle damage. They suggested that appearance of CK in serum following low to moderate intensity exercise represents disturbances to muscle energy process.

Dawood and Hussary (2012) reported alterations in some biochemical parameters associated with traumatic reticuloperitonitis (TRP) in the local buffaloes at Nineveh Governorate. Ninety six blood samples were collected from female buffaloes divided into three groups, the first group represented the control group and it included 16 clinically healthy animals , the second group included 40 animals suffered from acute TRP , finally the third group consisted of 40 animals represented chronic TRP . The results showed that TRP whether acute or chronic caused significant elevation in the activities of the following enzymes, aspartate aminotransferase (AST), alanine aminotransferase (ALT) lactate dehydrogenase (LDH) , creatine kinase (CK) , gamma glutamyl transferase (GGT), alkaline phosphatase (ALP) when compared with control group. It was concluded that TRP in buffaloes causes changes in some biochemical parameters in the serum.

Abd Ellah *et al.* (2014) observed based on a review of the literature, that reference intervals for water buffalo (*Bubalus bubalis*) serum biochemistry and hematology have not previously been published. Their study was done to establish reference intervals for water buffalo heifers. A total number of 127 clinically healthy buffalo heifers (1-2 years old) were included in the study. Animals were examined at buffalo farms that belong to Assiut Governorate, Egypt. Three types of samples were collected: serum samples for biochemical analysis, whole blood samples for haematological analysis and faecal samples for parasitological examination. Biochemical analysis included serum total proteins, albumin, total globulins, alpha,

beta and gamma globulin levels, and aspartate aminotransferase, alanine aminotransferase, gamma glutamyl transferase, creatine phosphokinase and lactate dehydrogenase activity. In addition to the above, serum creatinine, urea, total bilirubin, direct bilirubin, indirect bilirubin, sodium, potassium, chloride, magnesium, calcium, phosphorus, copper, zinc, iron, triglycerides, high density lipoprotein, low density lipoprotein, very low density lipoprotein, glucose levels and 20 haematological variables were measured. The 95.0% reference intervals were calculated by removing the upper and lower 2.5% of the interval for each serum biochemical constituent to give the 2.5 and 97.5 percentiles. Confidence intervals were calculated for each reference limit. Reference intervals from the current study were compared with established values for cows. The current study is as far as could be determined the first that establishes reference intervals for the serum biochemical and haematological parameters in water buffalo heifers.

2.6 Other diagnostic techniques

Prasad *et al.* (1977) diagnosed 42 buffaloes suffering with the diaphragmatic hernia based on auscultation of reticular sound in thoracic region, blood picture (Neutrophilia with leukocytosis) and by plain and contrast radiographic examination using barium meal. Plain radiographs were suggestive of herniation of reticulum which was confirmed on contrast radiography.

Deshpande *et al.* (1982) recorded total 3724 cases of rumen disorders in bovines. They suspected 636 cases for foreign body syndrome and when radiological examination was done, 87 cases were found positive for diaphragmatic hernia. Out of the 87 positive cases, 57 showed presence of one or more metallic foreign bodies in the herniated portion of the reticulum. Another 26 cases of foreign body syndrome was confirmed as diaphragmatic hernia during exploratory laparo-rumenotomy. Thus a total of 113 cases of diaphragmatic hernia were detected out of 636 cases of foreign body syndrome.

William *et al.* (2003) reported diaphragmatic hernia in 11 animals which includes 6 buffaloes and 5 cows. They diagnosed it on the basis of history, clinical signs, radiological examination and biochemical profile. The confirmative diagnosis, location and size of hernia ring and nature of hernial contents were confirmed during laparo-rumenotomy.

Narale *et al.* (2006) carried out a study on different diagnostic methods of diaphragmatic hernia in 196 suspected clinical cases of buffaloes. They used Plain and contrast radiography, trypsin inhibitor spot test, auscultation of reticular sound and exploratory laparo-rumenotomy to diagnose the condition. Plain and contrast radiography of reticulo-phrenic area was done by restraining animal in left lateral recumbency and placing the cassette on an area from 5th rib backward to sternum upward by using 75-90 kVP, 64-80 mAs and FFD 100-110 cm. Trypsin inhibitor spot test was found helpful for accessing the inflammatory mediators in blood. Auscultation of reticular sounds was done at 5th inter-costal space at the right side of thorax. Exploratory laparo-rumenotomy was found very useful and practical method for confirmative diagnosis of diaphragmatic hernia

2.7 Surgical repair of Diaphragmatic Hernia

Prasad *et al.* (1977) surgically repaired diaphragmatic hernia in 42 buffaloes. Repair of diaphragm i.e. herniorrhaphy was done 4-8 days following laparo-rumenotomy. Surgical anaesthesia was achieved by administration of 6 per cent chloral-hydrate and 5 per cent thiopentone sodium. Positive pressure ventilation was maintained by using mechanical ventilator. In 20 cases, air mixed oxygen was used, whereas in the remaining 22 animals, only compressed air was employed. Post-xiphoid, trans-abdominal approach for surgical repair of the diaphragm, withdrawal of herniated reticulum following severing of adhesions and suturing of diaphragm with continuous lock stitch suture pattern was carried out.

Krishnamurthy *et al.* (1980) carried out surgical repair in 10 cases of diaphragmatic hernia in bovines through trans-thoracic approach (through 6th rib resection). The rumenotomy was performed not only to evacuate the ruminal content and foreign bodies but also to know the exact location and size of hernial ring and extent of herniation. Under general anaesthesia (6 % chloral hydrate followed by 5 % thiopentone sodium intravenously) and after applying intermittent positive pressure ventilation, incision was taken over the 6th rib after infiltration of 2 per cent lignocaine hydrochloride. Thoracic cavity was approached, adhesions were separated and reticulum was reduced into the abdominal cavity, then the hernial ring was closed by continuous lock stitch suture pattern with black braided silk # 4. All the animals were recovered uneventfully; however transient signs of

radial nerve paresis were seen for a short period of 2-12 hrs in almost all animals due to prolonged lateral recumbency.

Nigam *et al.* (1980) carried out diaphragmatic herniorrhaphy in 25 animals either by transabdominal or transthoracic approach after exploratory laparotomy. About half an hour before anaesthesia, the animal was given 200 to 250 mg of prednisolone acetate intramuscularly. Anaesthesia was achieved by six per cent chloral hydrate and 5 per cent thiopentone sodium. After Tracheal intubation the intermittent positive pressure ventilation was carried out. For transabdominal approach they restrained the animals (12 buffaloes) in dorsal recumbency and made 25 to 35 cm incision parallel to costal arch starting from midline, about 5 cm below the xiphoid cartilage. The adhesions between the reticulum and the diaphragm ring were severed by blunt dissection. After the reticulum was separated from hernial ring and thoracic organs, it was retracted to the abdominal cavity. The hernial ring was sutured by lock stitch pattern using braided silk # 4. The abdominal wound was closed by routine method. For transthoracic approach they restrained the animals (13 buffaloes) in dorsal recumbency and made 25 cm incision midway on the 6th rib and extended downwards to the costochondral junction. About 25 cm of rib was removed with the help of wire saw after incising the longissimus dorsi and serratus ventralis muscles. The adhesions of the reticulum with lungs, pericardium and pleura were separated carefully by blunt dissection. Reticulum was reduced into the abdominal cavity and the hernial ring was closed by lockstitch using braided silk # 4. Finally the thoracic cavity was closed in the routine manner.

Marudwar *et al.* (1986) carried out surgical repair of diaphragmatic hernia in 4 animals (3 buffaloes and one cow) under local analgesia. Diaphragmatic herniorrhaphy were performed through the crescent shaped post-xiphoid incision without intermittent positive pressure ventilator (IPPV). The surgery was performed under tranquilization with 60 mg of triflupromazine and local infiltration of 2 per cent lignocaine HCl. All the animals were recovered and got up within 2 - 4 hours after surgery.

Gahlot *et al.* (1989) performed a comparative clinical trial employing subperiosteal resection of 6th, 7th or 8th rib for transthoracic diaphragmatic herniorrhaphy in adult buffaloes. All the animals were subjected to laparotomy (for complete evacuation of ruminal contents and removal of foreign bodies) 48 hours prior to herniorrhaphy. Herniorrhaphy was performed under

sedation and general anaesthesia followed by intubation with tracheal tube. The 7th rib resection thoracotomy was found to be most ideal with minimal incisional haemorrhage, direct accessibility to diaphragm and herniated reticulum, easy separation of adhesions, required comparatively less operation time and did not cause post-operative lameness. Apart from these things, the injuries to the surgeon's hand could be minimized in the 7th rib resection thoracotomy as the hernial ring was in a watchable access.

Usturge and Bhokare (1989) successfully repaired the diaphragmatic hernia in 15 animals (11 buffaloes and 4 cows) either by trans-abdominal or by trans-thoracic approach using chloral hydrate sedation and local anaesthesia. For trans-abdominal approach, they restrained the animals in semilateral recumbency and opened the abdominal cavity through a skin incision of 20-25 cm starting from the midline about 10 cm below the xiphoid cartilage and running parallel to the costal arch. The adhesions between the hernial ring and reticulum were severed by blunt dissection. After the reticulum was completely freed from the adhesion with hernial ring, pleura, mediastinum and lungs, it was retracted to the abdominal cavity. The rent in the diaphragm was repaired by lock stitch pattern using braided silk # 3. The abdominal cavity was closed by routine method. Out of 12 cases operated through trans-abdominal approach 10 animals recovered uneventfully after surgery. Trans-thoracic approach was undertaken for those animals where foreign bodies were located in the thoracic cavity on radiographic examination. For trans-thoracic approach they restrained the animals in the left semilateral recumbency and resected the right six thoracic ribs to open the thoracic cavity. The foreign bodies embedded in the thoracic organs and adhesions were separated with fingers and scissors. The herniated reticulum was pushed back into the abdominal cavity and hernia ring was opposed by lock stitch pattern using braided silk # 3. The thoracic cavity was closed in routine manner. Out of 3 cases operated through trans-thoracic approach, 2 animals recovered uneventfully after surgery.

Sharma *et al.* (1996) performed diaphragmatic herniorrhaphy in 70 buffaloes (60 adult buffaloes and 10 heifers) through trans-abdominal (in 55 cases) and trans-thoracic (15 cases) approaches. Trans-abdominal approach with the animal in supine position facilitated simple, quick, minimal haemorrhage and rapid closure of the hernial ring. However, visibility of hernial ring and adhesion was less, more chance of pneumothorax and negative pressure could not be established at the end of operation in trans-abdominal approach. Trans-thoracic approach

provided better visibility and easy removal of foreign bodies from the fibrous tract but it was found time consuming with more haemorrhage.

Saini *et al.* (2001) operated 285 buffaloes for diaphragmatic hernia. Rumenotomy was performed under local infiltration anaesthesia and diaphragmatic herniorrhaphy was performed under general anaesthesia through post-xiphoid approach using intermittent positive pressure ventilation (IPPV) in dorsal recumbency. Out of 285 buffaloes operated for diaphragmatic hernia, 205 (204 females and 1 male) (71.9 %) had survived. Among the survived animals 5.96 per cent were heifers and 46.9 per cent were non-pregnant buffaloes.

Singh *et al.* (2002) compared the linea alba incision with paracostal and post-xiphoid abdominal incisions to approach diaphragm for herniorrhaphy in 35 buffaloes. Linea alba incision (17.0 ± 0.6 cm in length) was taken (in 21 cases) at mid ventral line, starting just 7-9 cm posterior to the xiphoid cartilage and extending up to umbilicus. Paracostal incision (21.0 ± 0.5 cm in length) was taken (in 7 cases) just caudal to the xiphoid cartilage and running parallel to the costal arch. Post-xiphoid semilunar incision (19.0 ± 1.4 cm in length) was taken (in 7 cases) just 6-7 cm behind the xiphoid cartilage covering both right and left area to linea alba. Among these three ventral abdominal incisions for diaphragmatic herniorrhaphy, the linea alba incision was found to be the most suitable due to less operative time, minimum bleeding and absence of post-operative complications.

Sahu *et al.* (2003) underwent two stage surgical correction of diaphragmatic hernia in 72 buffaloes. In first stage, they performed laparorumenotomy by standard method and in second stage diaphragmatic herniorrhaphy through post-xiphoid trans-abdominal approach under general anaesthesia. General anaesthesia was achieved after premedication with triflupromazine @ 0.3 mg/kg i/m followed half an hour later by 6 per cent chloral hydrate @ 30-40 mg/kg i/v and induction and maintenance of anaesthesia with 5 per cent thiopentone sodium. The animal was intubated and the tube was connected to the intermittent positive pressure ventilator. Out of 72 buffaloes underwent surgery, 29 (40 %) died during or immediate post-operative period. Most of the buffaloes that died (22 out of 29) during the recovery from anaesthesia had lung lesions. Extensive and tough adhesions in abdominal and thoracic cavities were also responsible for the death in 13 buffaloes.

William *et al.* (2003) performed diaphragmatic herniorrhaphy and hernioplasty under xylazine sedation (@ 0.10 mg/kg i/v) in 6 non-pregnant animals

(3 buffaloes and 3 cows) and under detomidine sedation (@ 40 µg/kg i/v) in 5 pregnant animals (3 buffaloes and 2 cows). Diaphragmatic herniorrhaphy was performed through trans-abdominal approach at right post-xiphoid region, 2 inches behind the para-costal area and 6-8 inches above the milk vein, without using intermittent positive pressure ventilator (IPPV). To approach the abdominal cavity, under local infiltration of 2 per cent lignocaine HCl, a long crescent shaped incision was made after securing the animal on dorsal recumbency. After entering the abdominal cavity, herniated reticulum was separated by blunt dissection and repositioned and the hernial ring was closed by using black braided silk # 1 in an interlocking suture pattern. Hernioplasty was performed in 2 buffaloes with polypropylene mesh and 2 cows with nylon mesh. Prednisolone acetate @ 100 mg/kg was given half an hour before surgery in all the non-pregnant animals and ringer's lactate and 5 per cent dextrose @ 15 ml/kg/h in all the animals. Out of 6 non-pregnant animals sedated with xylazine, one cow died during surgery and other one (having double hernial ring) died due to concurrent reticular abscesses and septicemia. Out of 5 pregnant animals which were sedated with detomidine, one buffalo aborted, developed metritis and incisional hernia. They concluded that diaphragmatic herniorrhaphy in bovine without IPPV were possible at field conditions.

Patel (2011) performed two stage surgical correction of diaphragmatic hernia in 22 buffaloes. In first stage rumenotomy by standard technique and in second stage diaphragmatic herniorrhaphy was performed. Diaphragmatic herniorrhaphy was performed by post-xiphoid trans-abdominal approach without using intermittent positive pressure ventilator under sedation with xylazine hydrochloride @ 0.1 mg/ kg body weight intramuscularly, after restraining the buffaloes in dorsal recumbency. Out of 22 buffaloes operated, 14 survived and 8 died during or immediate post-operative period. Unilateral diaphragmatic herniorrhaphy can be carried out with high success rate (77.77 %) without using positive pressure ventilation. In field condition diaphragmatic herniorrhaphy can be performed successfully without positive pressure ventilation.

Patel *et al.* (2011) performed Single Stage Herniorrhaphy in a 6 years old Mehasana buffalo with history of recurrent tympany and partial off feed since last two months. On the basis of history and clinical signs the case was confirmed as diaphragmatic hernia. Next day Single Stage Diaphragmatic Herniorrhaphy was performed. It was done under the sedation with xylazine @ 0.1 mg/kg

intramuscularly and local infiltration with lignocaine HCl at post-xiphoid cartilage. The buffalo was restrained in semi-lateral recumbency. The crescent shaped incision was taken caudal to xiphoid cartilage and laparo-rumenotomy was carried out. Then through same incision, 4 inch long and 2 inch wide hernial ring at right side of diaphragm was closed with braided silk no. 2 in lockstitch manner and rest of the surgical wound was sutured in standard techniques.

2.8 Prognosis and recovery rate

Adetunji *et al.* (1984) tried sedation with xylazine followed by halothane anaesthesia in 125 cattle. They reported that 10 cattle showed regurgitation of ruminal contents with or without aspiration. The use of xylazine/halothane was judged to be clinically satisfactory and did not produce an unacceptable complication rate, although it is evident there is a significant risk associated with general anesthesia in ruminants.

Bisla *et al.* (2004) corrected 10 buffaloes cases of diaphragmatic hernia by the trans-abdominal diaphragmatic herniorrhaphy along with effects of ascorbic acid @ 7.5 g in one litre of 5 per cent dextrose isotonic saline was administered intravenously just after laparo-rumenotomy, prior to herniorrhaphy and then at 24 hr and 48 hr intervals post-herniorrhaphy. Ascorbic acid has controlled post-operative mortality and complications. They concluded that ascorbic acid can be included in the treatment schedule of buffaloes subjected to diaphragmatic herniorrhaphy to overcome oxidative stress post-operatively.

Bisla and Singh (2006) operated five buffaloes for diaphragmatic herniorrhaphy along with infusion of manganese chloride @ 10 mg/kg/hr i.v. in one litre dextrose saline, in buffaloes, prior to diaphragmatic herniorrhaphy causes prolonged tachycardia, non-significant temperature rise, restlessness, salivation, frequent urination and defecation that may lead to mortality of all five animal post-operatively.

Khan (2009) operated 12 buffaloes for diaphragmatic hernia in which 8 had survived and 4 died during surgery. Out of 3 buffaloes which had single large hernial ring at the center of diaphragm, 2 died during surgery due to respiratory failure. He concluded that diaphragmatic herniorrhaphy can be performed in field condition even if positive pressure ventilator is not available and the success rate depends on the location of hernial ring.

Patel *et al.* (2011) operated a buffalo with right sided Diaphragmatic Hernia using Single Stage Diaphragmatic Herniorrhaphy technique which recovered and survived successfully.

Khan (2009) operated 12 buffaloes for diaphragmatic hernia repair in which 8 buffaloes had survived and 4 died during surgery. Out of 3 buffaloes which had single large hernial ring at the center of diaphragm, 2 died during surgery due to respiratory failure. He concluded that diaphragmatic herniorrhaphy can be performed in field condition even if positive pressure ventilator is not available and the success rate depends on the location of the hernial ring.

Patel (2011) operated 22 buffaloes for diaphragmatic hernia repair, out of which 14 survived and 8 died immediate post-operative period. Out of these 22 buffaloes, the hernial ring was located on right side in 17 cases while left side in one case. Amongst these 18 unilateral diaphragmatic hernia cases, 14 (77.77 %) were survived till the observations of one month indicating good survival rate in unilateral diaphragmatic herniorrhaphy in buffaloes without using positive pressure ventilation.

CHAPTER-III

MATERIAL AND METHODS

The present research work was conducted on the clinical cases of buffaloes referred to Teaching Veterinary Clinical Complex (TVCC) of K.N.P College of Veterinary Science, Shirwal, Dist- Satara and cases referred to Government Veterinary polyclinics, Veterinary mini polyclinics, Veterinary dispensaries of Satara, Sangli, Kolhapur and Solapur districts of Western part of Maharashtra were included in present study.

3.1 Design of Study

The present clinical study was conducted on 18 clinical cases of buffaloes which were presented with signs and symptoms resembling with the symptoms of diaphragmatic hernia. These cases were further subjected to collection of detailed history, clinical observations, blood examination and radiographic examination for confirmatory diagnosis. The buffaloes which were diagnosed positive for diaphragmatic hernia, were divided into two groups, consisting of nine animals in each group, viz. Group A, comprised of buffaloes operated by Single Stage Diaphragmatic Herniorrhaphy. While group B included buffaloes operated by Double stage Diaphragmatic Herniorrhaphy and depicted in table 1.

Table 1. Design of clinical study (n=18).

Group	Particulars	No. of cases
A	Buffaloes operated by Single stage Diaphragmatic herniorrhaphy.	9
B	Buffaloes operated by Double stage Diaphragmatic herniorrhaphy.	9

3.2 Preoperative Assessment Of Patients

3.2.1 Selection of animals

Clinical cases of buffaloes presented to TVCC and other veterinary polyclinics and dispensaries were screened for various digestive disorders and

other ailments. Only suspected cases of diaphragmatic hernia were included in present study and they were subjected to the collection of detailed history, physical, clinical, haemato-biochemical and radiographic examination prior to surgery.

3.2.2 Collection of history:

In present study, all eighteen cases of buffaloes suspected to be suffering from diaphragmatic hernia were subjected to collection of history which included physiological status, feeding pattern, duration of illness, etiological or predisposing factors, age, no. of parturition and evidence of concurrent diseases. These parameters are depicted in table 2.

3.2.3 Clinical observations:

The tentative diagnosis that the animal might be suffering from diaphragmatic hernia was made on the basis of clinical signs and symptoms such as recurrent tympany, partial to complete anorexia, sudden drop in milk production, scanty faeces, suspended rumination, cachexia (Plate 1) and non-responsive to medical treatment, which were suggestive of diaphragmatic hernia. Respiratory rate, heart rate, body temperature, auscultation of reticular sound in thoracic region, feeding status, rumination pattern, ruminal motility, ruminal pH, etc. were also evaluated before and after surgery and are depicted in table 3.

3.2.4 Haemato-biochemical Examination:

About 5 ml blood was collected aseptically from the jugular vein of the animal for haemato-biochemical examination. Haematological examination included haemoglobin (Hb %), Packed cell volume (%), Total erythrocyte count (million/cumm), Total leucocyte count (Thousand/cumm) and Differential leucocyte count (%). The values are depicted in table 4. Biochemical examination included serum creatinine (U/l), creatine kinase (U/l) and lactate dehydrogenase (U/l). The estimation was done on autoanalyzer (*FALCON 260*)¹(Plate 2), before surgical intervention in all selected animals to rule out inflammatory changes in muscle in diaphragmatic hernia. The values are depicted in table 5.

¹ ARK Diagnostic Pvt.Ltd.

3.2.5 Radiological examination:

After initial physical and clinical examination, all the animals were subjected to radiographic examination. The animal was restrained firmly in standing position or lateral recumbancy (Plate 3). In violent animals, Inj. Xylazine HCl² was given @ 0.01mg/kg in ear vein during radiography and x-ray of reticulum and diaphragm was taken to assess the extent and degree of reticular herniation into thoracic cavity, reticular foreign bodies or anything else.

3.3 Preoperative Medication

3.3.1 Prophylactic antibiotic:

Prophylactic therapy included Inj. Dicryticine-DS³-5gm and Meloxicam⁴ @ 2 mg/kg B. wt. Both the drugs were given intramuscularly in all buffaloes prior to surgery to prevent the anticipated postoperative sepsis and pain in both the groups of animals (Plate 4). Inj. Ringer Lactate⁵ and Inj. Dextrose⁶ was given intravenously in cases of dehydration and negative energy balance respectively, to restore the electrolyte and energy balance before surgical interventions.

3.3.2 Anaesthesia:

For easy restraining, all buffaloes were sedated with inj. Xylazine @ 0.01 mg/kg body weight intramuscularly along with local infiltration anaesthesia at and around surgical site with 2% Lignocaine hydrochloride⁷.

3.4 Surgical protocol: Group A

3.4.1 Pre-operative preparation:

The animals presented for herniorrhaphy were kept off fed at least 24 to 36 hours prior to surgery, to avoid intraoperative regurgitation of ruminal contents or aspiration pneumonia. All nine buffaloes were restrained on dorsal recumbency under sedation by tying forelimbs and hindlimbs separately.

²- Indian Immunological Pvt.Ltd. Hyderabad-500033

³- Zydus Animal Health, Division of Candila Health Care Ltd. Ahmedabad-380015

⁴- Intas Pharmaceuticals Ltd. Ahmedabad-382210

⁵ & ⁶- Fresenius Kabi, India Pvt. Ltd. Goa-403530

⁷- Neon Laboratories Ltd. Andheri Mumbai-400093

Post-xiphoid abdominal area was prepared for aseptic surgery by clipping, shaving and scrubbing the area with betadine scrub. The site was repainted with liquid povidone-iodine and covered with sterile drape.

3.4.2 Surgical procedure:

About 15-20 cm crescent shaped incision were taken on caudal to the xiphoid cartilage using surgical blade no. 24. Subcutaneous fat, muscles and peritoneum were incised to reach the peritoneal cavity. Diaphragm and reticulum were explored manually to assess the degree of herniation as well as adhesions, before opening of rumen. Ventral sac of rumen was grabbed with both the hands and stretched out through incision and fixed to the ventral wall of abdomen with stay sutures or McLintock's rubber ring (Plate 5). Ruminal ingesta were evacuated gently and reticular foreign bodies were removed. Evacuation of rumen helped for manipulation and provided more space for suturing of diaphragmatic dent (hernial ring). Rumen was sutured by inversion suture pattern i.e. cushing and lambert sutures using chromic catgut no. 1 and herniated reticulum and rumen were pushed posterior into the abdominal cavity after manual breaking of adhesions between reticulum and diaphragm.

Through the same incision under supine position, diaphragmatic ring or adhesions were severed with blunt dissection or manually and hernial ring was sutured with nylon by using lockstitch suture pattern without intermittent positive pressure ventilator. Peritoneum and muscles were sutured in single tier closure by simple interrupted sutures, by using catgut no. 2 and skin was sutured by simple interrupted suture with nylon.

3.5 Group B: Pre-operative preparation:

3.5.1 Pre-operative preparation and Surgical procedure:

In group-B, all nine buffaloes were kept off fed for 24-36 hrs on day one and left flank was prepared aseptically for rumenotomy procedure by giving local infiltration anaesthesia i. e. inverted L block with 2% lignocaine HCl. Unlike group A, rumenotomy was performed on the first day through left flank incision (posterior and parallel to the last rib) by following standard technique. Subcutaneous fat, muscles and peritoneum were incised to get access to the abdominal cavity. Rumen was grabbed and pulled out and 8-10 cm long incision was taken on ruminal wall. It was fixed to lateral wall of abdomen using stay sutures or

McLintock's rumenotomy ring (Plate 6). Ruminal contents were evacuated out and foreign bodies were removed from reticulum. Rumen was sutured by standard suturing technique (Cushing and Lambert sutures) using catgut no. 1. Peritoneum and Muscles were sutured by continuous lockstitch or simple interrupted suture pattern using catgut no. 2 and skin was sutured by simple interrupted suture pattern with nylon.

Next day, all animals were prepared for trans-abdominal laparotomy for herniorrhaphy on dorsal recumbency. Post xiphoid i.e. right cranial quadrant of abdomen were prepared for aseptic surgery by clipping, shaving and scrubbing the area. The site was painted with liquid povidone-iodine and covered with sterilized drape. Animal was restrained in supine position and crescent shape incision (15 - 20 cm in length) was given 5 cm caudal to the xiphoid cartilage. The adhesion between reticulum and diaphragm were served by blunt dissection under the guidance of hand and palm. The reticulum was separated from diaphragm and hernial ring was sutured by lockstitch suture pattern using non-absorbable suture material i.e. Nylon. Peritoneum and Muscles were sutured by continuous lockstitch suture pattern using catgut no. 2. Skin was sutured by simple interrupted suture pattern with nylon.

3.6 Post-operative care and management

The surgical wound was dressed daily with povidone iodine; Inj. Dicrysticine-5gm; Inj. Meloxicam @ 0.2mg/kg and inj. B-complex⁸-10ml was administered intramuscularly for seven days. As a supportive therapy, animals received inj. Ringer Lactate; Inj. Dextrose saline to combat the losses of electrolytes and energy during surgical interventions. Skin sutures were removed on 8th to 9th postoperative days. All eighteen operated cases of diaphragmatic hernia underwent routine observation of postoperative care that included healing pattern of surgical wound, complications, regain of milk yield, if any were recorded for a period of one month. Owners of animal were advised about the feeding schedule, care of surgical wound, etc. The following parameters were again recorded on 7th post-operative day;

⁸- Intas pharmaceutical Ltd. Ahmedabad-382210.

3.6.1 Clinical examination:

All animals were subjected to the postoperative clinical examination on 7th day. Rectal temperature, heart rate, respiration rate, auscultation of thoracic region, feeding status, rumination pattern, ruminal motility and pH was recorded to forecast the recovery of patient. The observations are depicted in table 3

3.6.2. Haemato-biochemical parameters:

About 5 ml of blood was drawn aseptically into EDTA and plain vial on 7th postoperative day from all eighteen animals and were analyzed for haemoglobin (Hb %), packed cell volume (PCV), total erythrocyte count (TEC), total leucocyte count (TLC), differential leucocyte count (DLC). The values are depicted in table 4. Separated serum sample was analyzed for estimation of serum creatine, creatine kinase (CK) and lactate dehydrogenase (LDH) to assess the recovery of damaged muscles. The findings are depicted in table 5.

3.7 Follow-up of surgical cases:

In present clinical study, a feedback of all eighteen cases of buffaloes was collected from respective owners after one month period, pertaining to the regaining milk yield, normal feeding, digestive disturbances, re-occurrence of disease, etc. via telephonic conversation and same were recorded.

3.8 Statistical Analysis:

The recorded data was analyzed using completely randomized design (CRD) and descriptive statistics as per Web Agri Stat Package 2.0 (WASP) developed by ICAR Research complex, Goa.

CHAPTER-IV

RESULTS AND DISCUSSION

The present study was carried out on eighteen clinical cases (buffaloes) presented with a history of thoraco-abdominal disorders, which were in different stages of pregnancy or parturated one. They were subjected to clinical, laboratory and radiographic examination and revealed herniation of reticulum into diaphragm. There were respiratory and digestive disturbances and sudden drop in milk yield.

4.1 Epidemiological incidence

In the present study, the age of affected buffaloes ranged from 3.5-9 (6.41±04) year and out of 18, 12 buffaloes were above five years age indicating that irrespective of age, the prevalence of diaphragmatic hernia in buffaloes was higher than other species, which might be due to lesser collagen content, elasticity and less blood supply to the diaphragm of a buffalo. Singh *et al.* 2006 also recorded similar observations.

Among the affected buffaloes, three were early pregnant (18%), five were mid pregnant (27%), two were advanced pregnant (11%) and 8 were recently calved (44%) as depicted in pie graph (Plate 7). This is suggestive that the incidence of diaphragmatic hernia is higher in parturated buffaloes which might be due to strenuous contraction or pressure exerted on diaphragm causes tear or weakness in diaphragm and eventually piercing of reticular foreign bodies during labor pain. Similar conclusions were drawn by Prasad *et al.* (1977); Singh *et al.* (1979) and Nigam *et al.* (1980) during their studies.

In present study, out of 18, 13 buffaloes (72.22%) were reared under free range grazing system and remaining were maintained in stall feeding system. Irrespective of rearing system of these buffaloes, the vulnerability of ingestion of metallic foreign bodies by the buffaloes might be due to presence of metallic foreign bodies in the concentrate feed, metabolic disorders, voracious feeding habits. Industrialization on the grazing lands or animals grazing in the areas where there is heavy industrialization, leading to accidental ingestion of metallic foreign body by the animal. During rumeno-reticular contraction, the piercing foreign body brings

about inflammatory changes in ruminal/reticular wall. It further pierces the wall of reticulum, then the diaphragm, leading to inflammatory changes in the diaphragm and diaphragmatic hernia sets in, in dairy buffaloes. Similar findings were recorded by Sharma and Pankaj Kumar (2006). It can be concluded here that, TRP develops as a consequence of perforation of reticulum. Cattle commonly ingest foreign objects because they do not discriminate metal material in feed and do not completely masticate the feed before swallowing.

4.2 Etiology and predisposing factors:

In present study, plain radiography of all eighteen buffaloes was conducted and were found to be positive for metallic foreign bodies into reticulum. The metallic foreign bodies retrieved included binding wire, nut and bolts, sewing needle, washer, stones, nails, pieces of metals, marble and also some non-metallic foreign bodies such as gunny bags, plastic material, etc. (Plate 8). In one case, the metallic foreign body (wire) was located in extra-reticular space directing ventrally towards the xiphisternum and was embedded into the adhesions. Whereas, in remaining cases, foreign bodies were directed towards diaphragm which could be exciting factor for setting inflammatory changes and weakening the diaphragm. Similar observations were also reported by Deore and Jahagirdar (1971); Singh *et al.* (1980) and Krishnamurthy *et al.* (1985) and concluded that, innate weakness of the diaphragm, chronic and repeated trauma by the foreign bodies were responsible for diaphragmatic hernia in buffaloes.

In present study, instrumental physiological phenomenon i.e. "parturition" aggravated the diaphragmatic pathology in eight cases which lead to diaphragmatic hernia and these findings coincides with finding of Sahu *et al.* (2003). They reported that, 44% occurrence of diaphragmatic hernia were common during act of calving.

Moreover, in the present study, reported cases of buffalo with diaphragmatic hernia were due to ingestion of metallic foreign bodies, as they do not use their lips for prehension like small ruminants.

Table 2. Epidemiological Study:

Case No.	Physiological status	Feeding pattern	Duration of illness	Etiological/Predisposing Factor	Age (Years)	No. of Parturitions
1	Pregnant (first trimester)	Free Range	7 days	Metallic Foreign Body-wire	3.5	0
2	Calved (10 days back)	Stall feed	8 days	Metallic Foreign Body	9	4
3	Calved (20 days back)	Free range	15 days	Metallic Foreign Body	7	3
4	Pregnant(second trimester)	Free range	30 days	Metallic Foreign Body-wire	6	2
5	Calved (2 months back)	Free range	35 days	Metallic Foreign Body	5.5	2
6	Calved (1.5 months back)	Free range	7 days	Metallic Foreign Body	7	3
7	Pregnant(second trimester)	Free range	30 days	Metallic Foreign Body	5	1
8	Pregnant(second trimester)	Free range	12 days	Metallic Foreign Body-nail	7	2
9	Pregnant (last trimester)	Stall feed	7 days	Metallic Foreign Body	7	2
10	Calved (2 months back)	Free range	20 days	Metallic Foreign Body	7	3
11	Calved (4 months back)	Free range	7 days	Metallic Foreign Body	5	1
12	Pregnant (first trimester)	Free range	4 days	Metallic Foreign Body-wire	3.5	0
13	Pregnant(second trimester)	Stall feed	7 days	Metallic Foreign Body	4.5	1
14	Pregnant(first trimester)	Free range	10 days	Metallic Foreign Body-nail	4	0
15	Calved (1 month back)	Free range	4 days	Metallic Foreign Body	8.5	4
16	Calved (3 months back)	Free range	12 days	Metallic Foreign Body	8	3
17	Pregnant (last trimester)	Stall feed	30 days	Metallic Foreign Body-wire	9	3
18	Pregnant(second trimester)	Stall feed	30 days	Metallic Foreign Body	6	1
Mean Values			15.27±2.54 days		6.41±0.4	1.94±0.3

4.3 Clinical findings:

The duration of illness in present study ranged between 4-35 days (15.27 ± 2.54) according to the history of illness received from animal owners and clinical findings of all eighteen buffaloes. The findings are depicted in table (table 2). All buffaloes were partially or completely anorexic, recurrent tympany, regurgitation (Plate 9), atonic rumen, cachexia depressed condition and sudden drop in milk production. Out of 18, 7 buffaloes had atonic rumen and remaining animals showed hypomotility which is considered to be a sign of indigestion and this might be attributed to the restricted contraction or motility of reticulum due to its herniation into thoracic cavity. Out of 18 cases, 11 buffaloes showed scanty faeces and were non responsive to medicinal treatment. These findings are in accordance with those reported previously by Singh *et al.* 2006; Athar *et al.* 2010 and Abdelaal *et al.* 2014.

The mean ruminal pH recorded in group-A and group-B was 7.8 ± 0.33 and 8.45 ± 0.21 , respectively (Plate 10). The normal pH was restored after surgical correction of diaphragmatic hernia in both the groups of buffaloes and the values are depicted in table (table 3). In the present study, affected buffaloes showed alkaline ruminal pH which could be due to dietary changes, causing abnormal buffering mechanism in rumen that lead to impaction, indigestion, etc. Similar findings were noted by Akbar and Kumari (2006) and they analyzed that, any deviation in ruminal pH causes different kind of indigestion, which disrupts the rumen environment resulting in reduced metabolic activities and ultimately inhibiting milk production. Singh *et al.* (1979) also found alkaline pH of rumen in buffaloes affected with diaphragmatic hernia during rumenotomy.

Rectal temperature and respiratory rate in group-A and group-B were in normal range before and after surgical intervention in all animals. However bradycardia were recorded pre-operatively in all animals of group A and group B and it was restored on 7th day postoperatively. The values of heart rate recorded are presented in table (table 3). Bradycardia in present study, might be attributed due to displacement of heart away from chest wall which was an effect of reticular herniation. Similar findings were reported by Sahu *et al.* (2002) and Athar *et al.* (2010) during their course of study.

Table 3. Physiological Parameters:

Sr. No.	Parameter	Group A		Group B	
		Pre-op	Post-op	Pre-op	Post-op
1	Temperature (°F)	100.21±0.48	100.81±0.26	101.1±0.2	101.38±0.1
2	Heart Rate (per minute)	44±2.47	50.75±1.46	42.44±2.05	50±1.25
3	Respiratory Rate (per minute)	14.77±0.84	16.50±0.65	16.11±1.05	16.25±0.49
4	Ruminal pH	7.8±0.33	5.97±0.15	8.45±0.21	6.21±0.09

4.4 Radiographic Findings:

In present study, all eighteen buffaloes underwent routine radiological examination in right lateral recumbency or in standing position for confirmatory diagnosis of diaphragmatic hernia and revealed loss of continuity of diaphragmatic line and a portion of forestomach i.e. reticulum into the thoracic cavity that has herniated through the dent on ventrolateral diaphragm at the musculotendinous junction. Presence of metallic foreign bodies in the herniated portion of reticulum was a constant feature in 17 cases (Plate 11), except in one buffalo from group B, where in the metallic foreign body was found in the extra-reticular area directed towards xiphisternum and was embedded in the adhesions. Similar radiographic reports were cited by William *et al.* (2003), Narale *et al.* (2006) and Athar *et al.* (2010)

In the present study, among various diagnostic tools, radiography was an excellent tool for diagnosis of reticular foreign bodies as herniation of reticulum and loss of continuity of diaphragmatic line was clearly visible. This finding is corroborated with Prasad *et al.* (1977); Deshpande *et al.* (1982) and William *et al.* (2003), who diagnosed cases of diaphragmatic hernia by radiography.

4.5 Haematological Findings:

In present study, all buffaloes from both groups showed significant changes in differential leucocyte count i.e. neutrophilia (49.44 ± 3.84) and lymphopenia (38.88 ± 2.22) pre-operatively but it was restored to normal range post surgically on 7th day. The values are depicted in (table 4) and represented graphically (Plate 12). Similar findings have been recorded previously by Sethuraman and Rathor (1979) and Kaur and Singh (1994) in their study and they noted, marked neutrophilia (56.1 ± 2.3 %) and lymphopenia (40.3 ± 2.1 %) in buffaloes suffering with diaphragmatic hernia.

All animals showed non-significant decrease in the blood haemoglobin level (9.94 ± 0.64) which resumed its normal range post surgically. Lowered haemoglobin levels might be due to chronic anorexia and nutritional deficiency. Similar observation was also reported by Tagra *et al.* (2001) and Narale *et al.*

(2006). They reported that, altered haemoglobin parameters were stabilized to normal value by the 8th post-operative day.

Slight dehydration was recorded in few buffaloes in the present study pre-operatively suggestive of chronic inflammatory changes and anorexia during course of disease and was corrected with fluid therapy. These findings were corroborated with Narale *et al.* (2006).

4.6 Biochemical Findings:

The pre-operative values of serum creatinine, creatine kinase and lactate dehydrogenase of animals from group A were 3.19 ± 0.37 , 595.14 ± 47.24 and 1968.596 ± 172.88 respectively. Whereas, the pre-operative values of serum creatinine, creatine kinase and lactate dehydrogenase for group B were 3.15 ± 0.35 , 485.03 ± 48.82 and 1687.69 ± 139.54 respectively.

A significant increase in these values in both the groups of buffaloes recorded pre-operatively, indicated chronic inflammatory changes at cellular level. Similar observations were also made by Rose *et al.* (2009) and Brancaccio *et al.* (2010) and recommended that estimation of various muscle enzymes will provide better information about the muscular damage which also represents disturbances to muscle energy process.

The changes in biochemical values i.e. increase in serum creatinine; creatine kinase and lactate dehydrogenase in present study was restored to normal range on 7th post-operative day. The values are presented in table (table 5) and also by a graph (Plate 13). These values are indicative of inflammatory processes due to penetrating foreign bodies into reticulum and diaphragm and subsequently subsided after laparo-rumenotomy in the animals of both the groups.

Table 4. Heamatological Parameters:

Sr. No.	Parameter	Group A		Group B	
		Pre-op	Post-op	Pre-op	Post-op
1	Hb (g %)	9.94±0.64	10.07±0.51	9.38±0.30	9.65±0.31
2	PCV (%)	26.22±2.55	29.62±0.65	25.11±0.73	29.87±0.85
3	TLC (per cumm)	12366.66±1124.72	11525±768.52	13122.2±869.99	12100±841.55
4	TEC (million per cumm)	5.38±0.2	5.62±0.19	5.81±0.20	5.82±0.15
5	Neutrophil (%)	49.44±3.84	37.87±1.73	48.22±1.83	37.37±1.14
6	Lymphocyte (%)	38.88±2.22	47.37±1.99	39.33±1.16	50.87±1.40
7	Eosinophil (%)	2.44±0.80	1.37±0.37	2.33±0.5	1.12±0.12
8	Monocyte (%)	1.22±0.4	0.75±0.31	0.77±0.12	0.5±0.18

Table 5. Biochemical Parameters:

Sr. No.	Parameter	Group A		Group B	
		Pre-op	Post-op	Pre-op	Post-op
1	CRE	3.19±0.37	0.95±0.20	3.15±0.35	1.76±0.19
2	CK	595.14±47.24	47.62±7.50	485.03±48.82	66.70±17.07
3	LDH	1968.596±172.88	564.28±99.39	1687.69±139.54	754.02±114.58

4.7 Other diagnostic tools for diaphragmatic hernia

In the present study, auscultation of thoracic cavity was carried out in all the 18 cases from group A and group B. On the basis of reticular sound in between 5th and 6th intercostal space on right side, 1 buffalo from group A and 3 buffaloes from group B were diagnosed as suffering from herniation of reticulum into thoracic cavity through the diaphragm. These four cases were further subjected to plain radiography for re-confirmation and revealed herniation of reticulum into thoracic cavity. Present finding also corroborate with Prasad *et al.* (1977) and Narale *et al.* (2006), they reported that, 42 buffaloes and 196 suspected cases of diaphragmatic hernia were diagnosed by auscultation of reticular sound in thoracic region, blood picture (Neutrophilia with leukocytosis) and by plain and contrast radiographic examination using barium meal.

When auscultation was conducted in remaining 14 cases, the reticular sounds were not suggestive of diaphragmatic hernia which might be due to formation of adhesions of herniated reticulum with diaphragm and other surrounding organs.

4.8 Surgical repair of Diaphragmatic hernia

4.8.1 Pre-operative medication and anaesthesia:

All buffaloes in the present study received Inj. Dicryticine-DS-5gm and Inj. Meloxicam-10ml intramuscularly prior to surgery. Post-operatively, none of buffaloes showed post-surgical complications like stitch abscess, dehiscence of the surgical wound, peritonitis, etc. during follow-up period which might be due to prophylactic antimicrobial therapy that helped to combat intraoperative infection during surgical procedure. On the basis of laboratory findings and degree of dehydration (mild to moderate), Inj. Ringer lactate saline was given before and during surgical procedure, so as to avoid hypovolemic shock during the surgical procedure

In present study, all eighteen buffaloes were fasted for 24-36 hrs prior to the surgical procedure and sedated with Inj. Xylazine @ 0.01mg per kg intramuscularly to restrain on dorsal recumbency or standing position during surgical procedure. In group-A, during surgery, one buffalo showed regurgitation of ruminal contents even after 36 hrs of fasting which might be due to improper

digestion and emptying disorders. Similar observation was also recorded by Adetunji *et al.* (1984) and reported that, out of 125 animals, 10 cattle showed regurgitation of ruminal content with or without aspiration under xylazine and halothane anaesthetic protocol.

In the animals from both the groups, local infiltration anaesthesia i.e. inverted “L-block” or linear block was achieved by using 2% lignocaine hydrochloride and found to be more effective without any complication. The duration of local anaesthesia in the present study was about 90-100 minutes (Lumb and Jones, 1984)

4.8.2. Positioning and preparation of surgical site:

After sedation, buffaloes under group-A were restrained in dorsal recumbent position with fore and hind limbs extended separately and about 10-15 cm post xiphoid area was clipped, shaved and prepared by using liq. Dettol and povidone-iodine scrub for aseptic surgery. While in group-B animals, the left paralumbar fossa as well as post xiphoid area were also prepared aseptically as described above for carrying out rumenotomy and diaphragmatic herniorrhaphy procedure.

4.8.3 Surgical procedure:

In group-A buffaloes, laparo-rumenotomy procedure was performed via post xiphoid crescent shaped incision and it was found that the access to ventral sac of rumen was easier and quicker. Ruminal wall was exteriorized and fixed with the help of stay sutures or McLintock’s rubber ring. Ruminal contents were evacuated (Plate 14) and foreign bodies were retrieved from the herniated reticulum. Rumen was closed by double inversion suture pattern (cushing followed by lambert technique) with help of chromic catgut No.1. Reticulo-diaphragmatic adhesions were found in all buffaloes and were separated bluntly with the help of finger and palm cautiously. The free portion of herniated reticulum was retrieved slowly and was repositioned into the abdomen. The diaphragmatic ring or dent were located (Plate 15) and were sutured with the help of nylon no. 70 by continuous lockstitch suture pattern (Plate 16).

Out of 9, one buffalo died during surgical intervention due to respiratory collapse and remaining 8 cases recovered uneventfully after surgery. In present study, single stage diaphragmatic herniorrhaphy was found to be safe under field

conditions where there is non-availability of positive pressure ventilation system. It is a simple and reliable technique for repair of diaphragmatic hernia in buffaloes without complications. Similar findings were reported by Patel *et al.* (2011) who studied single stage herniorrhaphy in a 6 years old Mehasana buffalo without ventilator and said animal recovered successfully.

In group-B, all buffaloes underwent routine left flank rumenotomy (Plate 17) on first day, followed by trans-abdominal herniorrhaphy (double stage) which was performed in dorsal recumbency on next day (Plate 18). One buffalo succumbed due to respiratory collapse probably due to non-availability of positive pressure ventilator. Whereas, remaining animals recovered uneventfully. Similar findings were reported by William *et al.* (2003) and Patel (2011). They successfully performed two stage surgical correction of diaphragmatic hernia in buffaloes without ventilator and achieved favorable result without complications under field condition.

4.9 follow-up and recovery

In present clinical study, out of 18 cases, 2 buffaloes (11.11%), one each from group A and group B, died due to respiratory failure during surgical procedure. These two buffaloes would have been saved if there would have been a provision of ventilator. The present findings corroborate with the findings of Khan (2009), who operated 12 buffaloes for diaphragmatic hernia out of which, 8 survived and 4 died during surgery due to respiratory collapse. Patel (2011) operated 22 buffaloes for diaphragmatic hernia in which 14 survived and 8 died during immediate post-operative period since positive pressure ventilation was not used.

Sixteen buffaloes received Inj. Dicrysticine-5gm; Inj. Meloxicam 10ml and inj. B-complex-10ml intramuscularly daily for five days. Supportively animals under group-A was administered inj. Ringer Lactate; Inj. Dextrose saline to combat the losses of electrolytes and energy as two surgeries were to be performed. Skin sutures were removed on 8th and 9th post-operative day. None of buffaloes showed post-surgical complication or symptoms related to peritonitis, stitch abscess or toxemia during a follow-up period of one month.



Plate 1. 7 year old pregnant emaciated buffalo suffering from D. H.

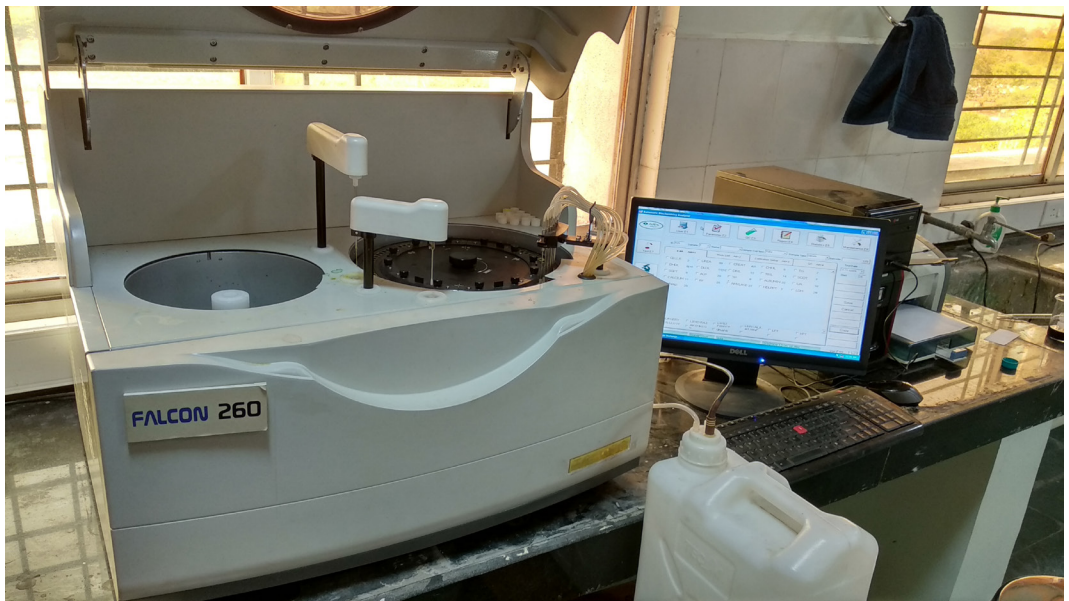


Plate 2. Biochemical autoanalyzer (FALCON 260)



Plate 3. Positioning of buffalo with D.H. for Radiography



Plate 4. Pre-operative medication including Antibiotic, Anti-inflammatory and Sedative drugs



Plate 5. Fixation of McLintock's rubber ring to rumen of Buffalo with D. H. (Single stage Diaphragmatic Herniorrhaphy)



Plate 6. Fixation of McLintock's rubber ring to rumen of Buffalo with D. H. (Double stage Diaphragmatic Herniorrhaphy)

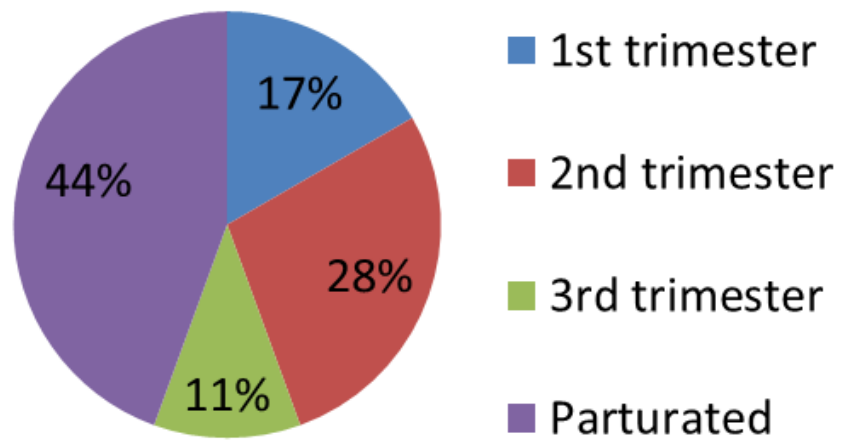


Plate 7. Pie graph showing incidence of D.H. in pregnant and lactating buffaloes



Plate 8. Photograph showing various metallic foreign bodies retrieved from reticulum of buffaloes with D.H.



Plate 9. Buffalo affected with D.H. showing regurgitation during course of treatment.

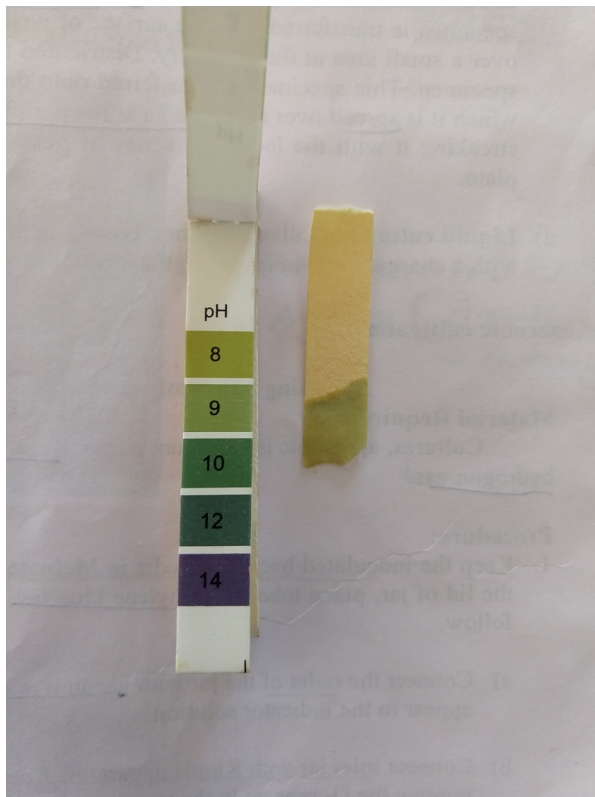


Plate 10. Buffaloes with D.H. from both groups showing alkaline ruminal pH during clinical evaluation.

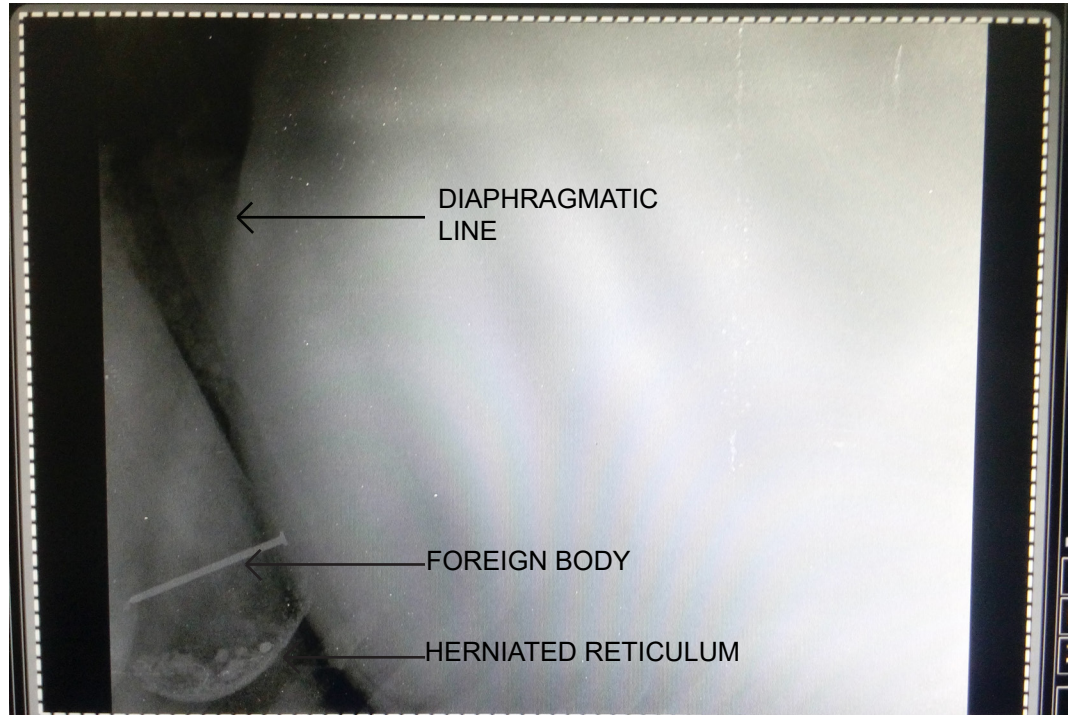


Plate 11. Lateral radiograph of thoraco-abdominal area showing herniation of reticulum along with penetrating metallic foreign body (nail) in buffalo.

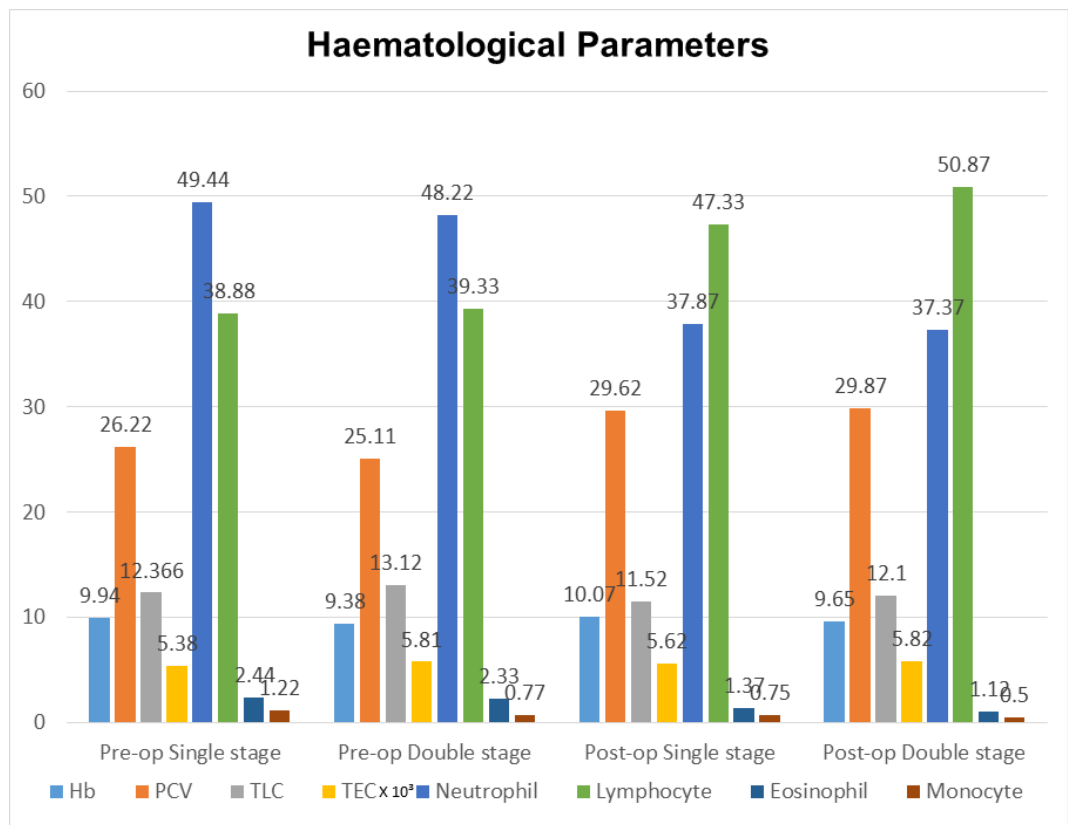


Plate 12. Graphical presentation of haematological changes in group-A and group-B

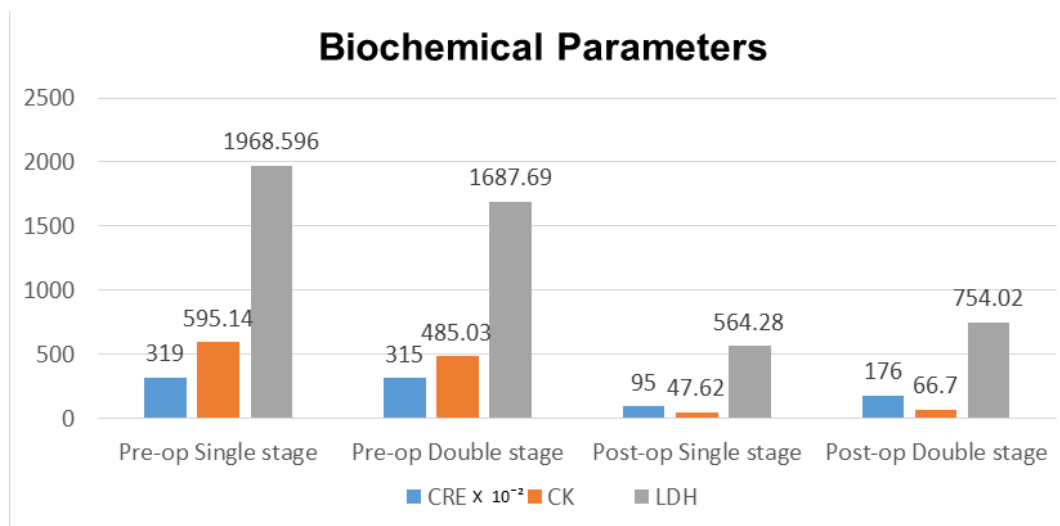


Plate 13. Graphical presentation of biochemical changes in group-A and group-B animals.



Plate 14. Evacuation of ruminal contents in single stage diaphragmatic herniorrhaphy.



Plate 15. Photograph showing gross appearance of diaphragmatic ring or dent during

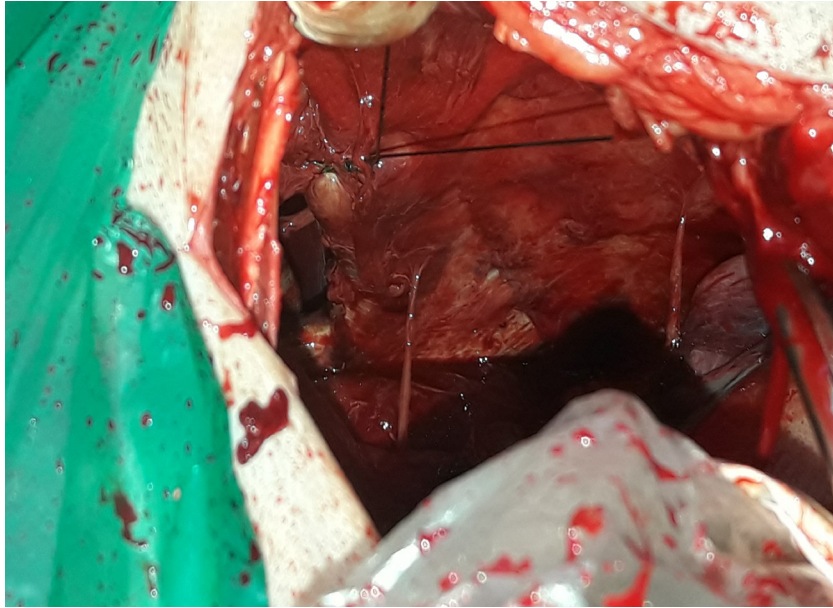


Plate 16. Photograph showing procedure of diaphragmatic herniorrhaphy in buffalo.



Plate 17. Rumenotomy procedure for retrieval of foreign bodies in group-B animals.



Plate 18. Post-xiphoid (trans-abdominal) approach for repair of diaphragmatic hernia in buffalo in group-B animals.

CHAPTER-V

SUMMARY AND CONCLUSIONS

The present study was carried out on eighteen clinical cases of buffaloes presented with history of thoraco-abdominal disorders which were in various stages of gestation and some were recent calvers. They were subjected to anamnesis, clinical, physical, laboratory and radiographic examination and revealed variety of metallic foreign bodies (penetrating and non-penetrating) in reticulum with diaphragmatic hernia. The affected buffaloes were aged between 3.5-9 years (6.41 ± 0.4). Out of 18 buffaloes, 12 buffaloes (66.66%) were more than five years age indicating that as the age advances, the buffaloes become more susceptible to diaphragmatic hernia. In addition, due to lesser collagen content, elasticity and poor blood supply to diaphragm, the buffaloes are inherently more prone to diaphragmatic hernia.

The distribution of diaphragmatic hernia in 18 clinical cases of buffaloes included early pregnant (18%); mid pregnant (27%); advanced pregnant (11%) and recently calved (44%). It can be concluded here that, the incidence is higher in parturated buffaloes due to strenuous contraction or forces exerted on diaphragm that causes tear or weakness in diaphragm. Out of 18, 13 buffaloes (72.22%) were reared under free range grazing system which accounts to vulnerability of ingestion of metallic foreign bodies by the buffaloes. The other predisposing factors were metabolic disorders and voracious feeding habits.

The duration of illness in present study was between 4-35 days (15.27 ± 2.54) and clinical findings were inappetence or anorexia, recurrent tympany, atonic rumen, cachexia, depressed condition and sudden drop in milk production. Out of 18, 7 buffaloes had atonic rumen and remaining showed hypomotility with alkaline ruminal pH (7.8 ± 0.33 and 8.45 ± 0.21) which may be attributed to dietary changes causing increased levels of ruminal tryptamine and tyramine, followed by impaction, diaphragmatic hernia and bloat. The alkaline pH of rumen was restored to normal range after surgical correction of diaphragmatic hernia.

Auscultation of thoracic cavity was carried out in all the 18 cases, out of which, 4 buffaloes were diagnosed as suffering from reticulo-pericarditis on the basis of hearing of reticular sounds between 5th -6th intercostal space on right side.

Whereas, in remaining cases, reticular sound could not be heard which might be due to reticular herniation and presence of adhesion to the surrounding structure which restricted reticular motility.

In all the animals, rectal temperature and respiratory rate was in normal range during the course of disease and surgical treatment. However, bradycardia was noticed pre-operatively in both the groups of animals and it was restored on 7th day postoperatively.

Radiographic examination revealed that all eighteen buffaloes had reticular metallic foreign bodies such as binding wire, nut and bolts, sewing needle, washer, nails, pieces of metal and also some non-metallic foreign bodies such as marbles, stones, gunny bags, plastic material etc. In present study, 12 animals showed break in continuity of diaphragmatic line but extent of herniation was not clearly visible, whereas remaining 6 animals showed a sac like projection into thoracic cavity which was suggestive of reticular herniation.

Haematological changes included neutrophilia (49.44 ± 3.84) and lymphopenia (38.88 ± 2.22) in all animals preoperatively, but it was restored to normal range post surgically on 7th day. Also, non-significant variation was recorded in haemoglobin level (9.94 ± 0.64) throughout the study.

Biochemical changes included significant increase in serum creatinine (3.19 ± 0.37); creatine kinase (595.14 ± 47.24) and lactate dehydrogenase (1968.596 ± 172.88) level in both the groups of buffaloes preoperatively indicating chronic inflammatory changes at cellular level. It was restored to normal level post surgically on 7th day.

All buffaloes in the present study received prophylactic antibiotic and NSAIDS i.e. Inj. Dicryticine-DS-5gm and Meloxicam-10ml intramuscularly prior to the surgery and it was observed that none of the buffaloes showed post-surgical complications during follow-up period.

All eighteen buffaloes were fasted for 24-36hrs prior to the surgical procedure and sedated with Inj. Xylazine @ 0.01mg per kg intramuscularly to restrain them on dorsal recumbency or standing position. In group-A, one buffalo showed regurgitation of ruminal contents even after 36 hrs of fasting during operation which could be due to improper digestion and emptying disorders. Local infiltration anaesthesia i.e. inverted "L-block" or linear block was achieved by using 2% lignocaine hydrochloride and it was found to be more effective without

complication. The effect of anaesthesia lasted for 90-100 minutes in animals of both the groups.

Buffaloes from group-A, were operated by single stage diaphragmatic herniorrhaphy method. In general, the approach to the ventral sac of rumen was easier though fixation of McLintock's rubber ring or stay suture of muscles was found to be laborious procedure. Ruminant access was easier as evacuation of ruminal contents, retrieval of reticular foreign bodies, separation of adhesions, retrieval of herniated reticulum and suturing of hernial dent was simple, convenient and more approachable as compared to routine left flank rumenotomy as well as trans-abdominal (post-xiphoid) approach in all animals. In all these animals, recovery was uneventful.

In group-B, all buffaloes underwent routine left flank rumenotomy on first day and trans-abdominal herniorrhaphy was performed in dorsal recumbency on next day without complications but they required special attention like meticulous fluid therapy during recovery period, as surgical stress was more compared to the animals from group A.

In present clinical study, two buffaloes i.e. one each from two group died due to respiratory failures or collapse, probably due to non-availability of positive pressure ventilator during surgical treatment. None of buffaloes showed post-surgical complications or symptoms related to peritonitis, stitch abscess, toxemia for a period of one month during post-surgical follow-up with animal owners. Following conclusions were drawn from the results of the present clinical study:-

1. The incidence of diaphragmatic hernia was common between 3.5-9 years of age, especially in advanced pregnant as well as recently calved buffaloes.
2. The duration of illness was 4-35 days characterized by inappetence or anorexia, recurrent tympany, atonic rumen, cachexia, depressed condition and sudden drop in milk production.
3. Most common malady in buffaloes with diaphragmatic hernia was alkaline ruminal pH ranging between 7.8 ± 0.33 and 8.45 ± 0.21 leading to impaction and indigestion.
4. Clinically, presence of reticular sounds between 5th-6th intercostal space on right side with bradycardia may be considered as indicative of diaphragmatic hernia and it should be promptly correlated with radiographic examination.

5. Break in continuity of diaphragmatic line and sac like projection of reticulum into thoracic cavity, with or without metallic foreign bodies are radiographic features of diaphragmatic hernia.
6. Haematological findings included neutrophilia and lymphopenia whereas, biochemical changes included increased serum creatinine, creatine kinase and lactate dehydrogenase levels in both the groups of animals preoperatively, indicating inflammatory changes prevailing in the body.
7. Single stage diaphragmatic herniorrhaphy through ventral sac of rumen was easier though fixation of McLintock's rubber ring or stay suture to the rumen was laborious.
8. In single stage incision, access to rumen for evacuation, retrieval of reticular foreign bodies, separation of adhesions, and retrieval of herniated reticulum was simple, easier and convenient as compared to double stage diaphragmatic herniorrhaphy.
9. Single stage method of herniorrhaphy is more economical or affordable and convenient to the farmers. As there is only one surgical intervention, it is also in favour of the animal, due to less suffering.

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THESIS ABSTRACT

- a) Title of the thesis (in Capital letters) : COMPARATIVE EVALUATION OF SINGLE AND DOUBLE STAGE DIAPHRAGMATIC HERNIORRHAPHY IN BUFFALOES.
- b) Full name of students : Pendharkar Gandhar Ghanshyam
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- g) Total number of pages in the thesis : 47
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ABSTRACT

The present clinical study was carried out in eighteen clinical cases of buffaloes with diaphragmatic hernia, presented to TVCC of Krantisinh Nana Patil College of veterinary Science, Shirwal, veterinary polyclinic, mini-polyclinics and dispensaries of State Government and were divided in two groups consisting of nine animals in each group. In group-A, animals were operated for DH by single stage diaphragmatic herniorrhaphy while animals from group B with double stage method of diaphragmatic herniorrhaphy.

Buffaloes in the age group of 3.5 to 9 years were found to be suffering from DH (66.66%) and particularly those which were in advance stage of gestation or were recent calvers (44%). Out of 18, 13 buffaloes (72.22%) were reared under free range grazing system which accounted the vulnerability of ingestion of metallic foreign bodies by these animals. The duration of illness ranged between 4-35 days (15.27 ± 2.54) and clinical symptoms were inappetence or anorexia, recurrent tympany, regurgitation, atonic rumen, cachexia, depressed condition and sudden drop in milk production.

Clinical findings revealed normal body temperature and respiratory rates. Bradycardia was recorded preoperatively in all animals, but it was restored on 7th day postoperatively. In four buffaloes, reticular sound was heard on auscultation between 5th-6th intercostal space on right side. Ruminal pH of affected buffaloes was alkaline (7.8 ± 0.33 and 8.45 ± 0.21) in nature which may be attributed to dietary changes or indigestion. Plain radiography of thoraco-abdominal region showed break in continuity of diaphragmatic line and sac like projection into thoracic cavity suggesting reticular herniation with or without reticular metallic foreign bodies.

Haematology revealed neutrophilia (49.44 ± 3.84) and lymphopenia (38.88 ± 2.22) with nonsignificant alteration in haemoglobin level during course of disease. Serum Biochemistry showed significant increase in the levels of serum creatinine (3.19 ± 0.37); creatine kinase (595.14 ± 47.24) and lactate dehydrogenase (1968.596 ± 172.88) in both the groups of animals and was restored to normal level post surgically, on 7th day.

All animals were subjected to fasting about 24-36 hours and received inj. Dicryticine-DS-5gm and Meloxicam-10ml intramuscularly prior to the surgery. They were sedated with Xylazine @ 0.01mg/kg body weight intramuscularly and local

infiltration anaesthesia of inverted "L-block" or linear block was given with 2% lignocaine hydrochloride.

In single stage diaphragmatic herniorrhaphy, buffaloes were restrained on dorsal recumbency and 10-15 cm crescent shaped incision was taken caudally to xiphoid. The approach to the ventral sac of rumen was easier though the fixation of McLintock's rubber ring or muscles with stay suture was found to be laborious. Evacuation of ruminal contents, retrieval of reticular foreign bodies, separation of adhesion, retrieval of herniated reticulum and suturing of hernial dent was simple, easier and convenient as compared to routine left flank rumenotomy as well as trans-abdominal (post-xiphoid) approach in all animals.

In double stage diaphragmatic herniorrhaphy, all buffaloes underwent routine left flank rumenotomy on first day followed by trans-abdominal herniorrhaphy in dorsal recumbency on next day, without complications but they required special attention like meticulous fluid therapy during recovery period due to two surgical interventions.

Two buffaloes succumbed from each group due to respiratory failures, probably due to unavailability of positive pressure ventilator during surgical treatment. However, remaining buffaloes recovered uneventfully.

प्रबंध सारांश

१. प्रबंधाचे शिर्षक : म्हशींमध्ये श्वासपटलाचा अंतर्गळ शिवण्यासाठी एकस्तरीय व द्विस्तरीय शस्त्रक्रिया पद्धतीचे तुलनात्मक मूल्यमापन करणे.
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८. सरांशातील शब्दांची संख्या : ५१०
९. विद्यार्थ्यांची सही :
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सारांश

सदर शोध निबंध हा श्वासपटलाच्या अंतर्गळाने त्रस्त अशा अठरा म्हशींवर [] तिसिंह नाना पाटील पशुवैद्यकीय महाविद्यालय [] शिरवळ व राज्य शासनाच्या श्रेणी अ [] श्रेणी ब व श्रेणी क या दवाखान्यांमध्ये [] प्रत्येक गटात नऊ म्हशी याप्रमाणे दोन गटात विभागून करण्यात आला . गट अ मधील जनावरांमध्ये एकस्तरीय शस्त्रा [] द्वारे श्वासपटलाचा अंतर्गळ शिवण्यात आला तर गट ब मधील जनावरांमध्ये द्विस्तरीय शस्त्रा [] द्वारे श्वासपटलाचा अंतर्गळ शिवण्यात आला .

३.५ ते ९ वर्षे वयोगटातील म्हशी [] ६.६६% [] व मुख्यतः गर्भावस्थेच्या शेवटच्या टप्प्यातील किंवा नुकत्याच व्यायलेल्या म्हशी [] ४४% [] या श्वासपटलाच्या अंतर्गळाने त्रस्त असल्याचे आढळून आले . १८ पैकी १३ म्हशी [] २.२२% [] या मुक्त चराऊ पध्दतीत सांभाळल्या गेल्याने त्यांच्यात धातूच्या अखादय वस्तू खाण्याचे प्रमाण जास्त असल्याचे निदर्शनास आले . या आजाराचा कालावधी ४ - ३५ दिवसांदरम्यान दिसून आला व आजाराची लक्षणे ही चारा कमी खाणे [] खाणे बंद करणे [] वारंवार पोट फुगणे [] अर्धवट पचलेले खादय तोंडावाटे बाहेर येणे [] कोठीपोटाची हालचाल बंद होणे [] अशक्तपणा [] उदासीनता आणि दुग्ध उत्पादनात एकाएकी झालेली घट अशी आढळून आली .

वैद्यकीय नोंदींमध्ये शरीराचे तापमान व श्वसनगती योग्य प्रमाणात असल्याचे आढळले . शस्त्रा [] पूर्वी सर्व जनावरांचे हृदयाचे ठोके कमी होते [] परंतु शस्त्रा [] नंतर ७ व्या दिवाशी ते पुन्हा नियमित झाल्याचे दिसून आले . ४ म्हशींमध्ये उजव्या बाजूला ५व्या - ६व्या बरगडीमधील जागेत जाळीपोटाचा आवाज ऐकू आला . आजाराने प्रभावित म्हशींचा पोटाचा सामू हा अल्कधर्मी [] ७.८ ± ०.३३ व ८.४५ ± ०.२१ [] आढळून आला जो की खाण्यातील बदल किंवा अपचनामुळे असू शकतो . छाती व पोटाच्या क्ष - किरण चाचणीद्वारे श्वासपटल फाटून त्यातून पिशिवीसारखा भाग छातीत गेल्याचे दिसल्याने [] धातूच्या वस्तूंसहित किंवा धातूंच्या वस्तूविरहित जाळीपोटाचा अंतर्गळ झाल्याचे सूचित झाले .

आजाराच्या कालावधीत रक्ततपासणी दरम्यान न्युट्रोफील पेशींमध्ये वाढ व लिम्फोसाईट पेशींमध्ये घट झालेली दिसून आली . तर हिमोग्लोबिनच्या मात्रेत लक्षणीय बदल झाले नव्हते . जीवरसायन शास्त्रानुसार दोन्ही गटातील जनावरांमध्ये रक्तजलातील एटिनिन 3.19 ± 0.37 एटिनिन कार्बोनेज 195.18 ± 47.28 व लॅक्टेट डिहाइड्रोजेनेज 1968.596 ± 172.88 या घटकांमध्ये लक्षणीय वाढ झाल्याचे आढळले आणि शस्त्रांनंतर ७ व्या दिवशी हे घटक योग्य प्रमाणात आल्याचे आढळले .

सर्व जनावरे शस्त्रांपूर्वी २४ ते ३६ तास उपाशी ठेवण्यात आली व त्यांना इंजेक्शन डायल्ट्रीसीन डिएस् ५ ग्रॅम व मेलॉक्सिकॉम - १० मिली मानेच्या स्नायूत देण्यात आले . त्यांना झायलॅझिन हे उपशामक ०.०१ मिली ग्रॅम प्रति किलो शारीरिक वजनाच्या हिशोबाने स्नायूत देण्यात आले व २% लिग्नोकेन हाईड्रोक्लोराईड च्या सहाय्याने उलटा एल्ट किंवा सरळ रेपेत मर्यादित भागात भूल देण्यात आली .

एकस्तरीय शस्त्रांद्वारे श्वासपटलाचा अंतर्गळ शिवताना म्हशींना पाठीच्या कण्यावर झोपवण्यात आले व उरोस्थीच्या १० - १५ सेमी मागे चंद्रकोरीच्या आकाराचा छेद घेण्यात आला . यामधून पोटाच्या खालच्या कप्प्यात पोचणे सोपे गेले परंतू मॅकलिनटॉक रबर रिंग बसवणे किंवा स्नायूंना आधारासाठी टाके घालणे हे कष्टदायक असल्याने जाणवले . पोट मोकळे करणे जाळीपोटातून अखादय वस्तू बाहेर काढणे श्वासपटलाला चिकटलेले तंतूमय धागे सोडवणे अंतर्गळ झालेले जाळीपोट बाहेर काढणे व अंतर्गळ झालेला भाग शिवणे हे नेहमी डाव्या वाजूने केल्या जाणा-या पोटाच्या शस्त्रांपेक्षा तसेच उदरकळीच्या वाजूने उरोस्थीच्या मागून केल्या जाणा-या शस्त्रांपेक्षा साधे सोपे व सोयीस्कर असल्याचे आढळून आले .

द्विस्तरीय शस्त्रांद्वारे श्वासपटलाचा अंतर्गळ शिवताना सर्व म्हशींवर पहिल्या दिवशी नेहमीप्रमाणे डाव्या वाजूने पोटाची शस्त्रांमा करून दुस-या दिवशी उदरपोकळीच्या वाजूने श्वासपटलाला टाके टाकण्याची शस्त्रांमा कोणत्याही गुंतागुंतीशिवाय करण्यात आली . पण दोन शस्त्रांमा झाल्याने जलउपचार पध्दतीवर विशेष लक्ष द्यावे लागले .

शस्त्राक्षैदरम्यान पोझिटिव प्रेशर व्हेंटिलेटरच्या अनुपलब्धतेमुळे प्रत्येक गटातील एक
याप्रमाणे एकूण दोन म्हशींचा श्वासोच्छ्वास बंद पडल्याने मृत्यु झाला . मात्र बाकी सर्व म्हशी या
आजारातून मुक्त झाल्या .

VITA

Dr. Gandhar Ghanshyam Pendharkar, the author of the thesis was born on 20th June 1992, in Karad taluka of Satara district. Since childhood, he developed immense love for animals, while rescuing and rehabilitating them. He completed his schooling from D. K. Palkar High School, Karad in 2008. Since his school days, he was inclined towards biological sciences. He completed his junior college education from Yashwantrao Chavan College of Science, Karad, in 2010. His inclination to treat and nurture animals inspired him to become a Veterinarian. He went on to pursue his degree from Krantisinh Nana Patil College of Veterinary Science, Shirwal and successfully completed his B.V.Sc& A.H. degree in 2015. During these 5 years he actively participated in various activities and events organized by the college. He also represented university in Indradhanushya inter-university cultural competition in 'Indian Classical percussion solo' event at Nanded. The National Service Scheme (N.S.S.), Health and Vaccination camps organized by the college in Satara and Pune districts allowed him to attain more exposure in clinical studies and field practice.

To complete his desire of enhancing his professional skills, he went ahead to pursue his childhood dream of becoming a Veterinary Surgeon, from Krantisinh Nana Patil College of Veterinary Science, Shirwal. This college gave him great exposure to small as well as large animal surgery along with opportunities to learn more about diagnostic techniques with the help of the advanced infrastructure available in the Department of Veterinary Surgery And Radiology, and TVCC of the college. He proactively supported and participated in organizing various hands-on workshops like 'Equine colic, fracture repair and radiology and small animal Orthopedics' during his post-graduate degree programme.

He presented 2 abstracts and 1 poster in large animal session in ISVS, held at Tirupati in Dec. 2017. His strong analytical skills, observant-eye and professional approach, with an aspiration to work for the betterment of the Veterinary patients, greatly satisfied him and also satisfied the animal owners.

Apart from academics, he was always interested in trekking and listening to music. He further got an opportunity to pursue his master's research in 'Comparative evaluation of Single and Double Stage Diaphragmatic Herniorrhaphy in Buffaloes' which would ultimately benefit the society.