COMPARATIVE EVALUATION OF SINGLE STAGE AND DOUBLE STAGE DIAPHRAGMATIC HERNIORRHAPHY FOR REPAIR OF DIAPHRAGMATIC HERNIA IN BUFFALOES

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ABSTRACT

The present clinical study was conducted on 18 clinical cases of buffaloes suffering with diaphragmatic hernia and divided into two groups consisting of nine buffaloes in each group *viz* Group A buffaloes underwent by single stage diaphragmatic herniorrhaphy while Group B buffaloes operated by double stage diaphragmatic herniorrhaphy. Overall affected buffaloes were aged between 3.5 to 9 years (6.41±04); 13 buffaloes (72.22%) were reared under free range grazing system; higher incidence was in advance buffaloes (44%) and duration of illness was 4 to 35 days (15.27±2.54). Diaphragmatic hernia was diagnosed on basis of thoraco-abdominal radiography and auscultation of reticular sound in thoracic cavity.

Haematobiochemical changes include neutrophilia (49.44±3.84); lymphopenia (38.88±2.22); and there was significant increase in level of 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. Buffaloes from Group A, underwent single stage diaphragmatic herniorrhaphy i.e. rumenotomy as well as diaphragmatic herniorrhaphy from same surgical incision *via* Postxiphoid approach. Whereas Group B buffaloes underwent routine left flank rumenotomy on first day (standing position) and trans-abdominal herniorrhaphy was performed in dorsal recumbency *via* Postxiphoid on next day. Out of 18, two buffaloes were succumbed to death during surgical procedure due to respiratory failures or collapse and remaining sixteen buffaloes were recovered uneventfully. To conclude, single stage diaphragmatic herniorrhaphy allows easy access to rumen for retrieval of foreign bodies, breaking of adhesions and repositioning of herniated contents, affordable to farmers and less suffering of animals as compared to double stage method for repair of diaphragmatic hernia in buffaloes.

Keywords: *Bubalus bubalis*, buffaloes, herniorrhaphy, rumenotomy, auscultation, radiography

INTRODUCTION

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

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buffaloes diaphragm (Singh *et al*., 2006). The approach of herniorrhaphy *via* post-xiphoid was most common and widely used method for repair of diaphragmatic hernia in buffaloes consisting of exploratory rumenotomy on first day through left flank followed by diaphragmatic herniorrhaphy *via* post-xiphoid approach on next day (double stage).

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). By considering the above facts, the present study was encouraged to attempt the newer surgical approach for repair of diaphragmatic hernia i.e. both rumenotomy and herniorrhaphy was performed through the single surgical incision (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.

MATERIALS AND METHODS

The present clinical study was conducted on 18 clinical cases of buffaloes suffering with diaphragmatic hernia and symptoms such as recurrent tympany, partial to complete anorexia, sudden drop in milk production, scanty faeces, suspended rumination, cachexia and non-responsive to medical treatment. All animals were subjected to anamnesis and clinical observations like respiratory rate, heart rate, body temperature, auscultation of reticular sound in thoracic region, feeding status, rumination pattern, ruminal motility, ruminal pH, etc. Blood sample were drawn from all eighteen buffaloes for haemato-biochemical studies and confirmatory diagnosis was made on basis of radiographic examination. They were divided into two groups, consisting of nine animals in each group, *viz*. Group A, comprised of buffaloes operated by single stage diaphragmatic herniorrhaphy whereas Group B buffaloes subjected to double stage diaphragmatic herniorrhaphy.

Group A buffaloes were prepared aseptically after sedation with inj. Xylazine 0.01 mg/kg intramuscularly, in dorsal recumbency and about 15 to 20 cm crescent shaped incision were taken on caudal to the xiphoid cartilage by separating muscles and peritoneum with blunt scissor. After laparotomy, ventral sac of rumen was brought to incision and fixed with McLintock's rubber ring. Ruminal ingesta were evacuated gently and reticular foreign bodies were removed. Rumenotomy incision was sutured by double inversion with chromic catgut No. 1. Secondly adhesions between reticulum and diaphragm were separated bluntly and reticulum was repositioned back into abdominal cavity. Hernial dent was sutured with nylon by using lockstitch suture pattern without intermittent positive pressure ventilator.

In Group B buffaloes underwent routine rumenotomy procedure under local infiltration anaesthesia on the first day through left flank incision in standing position and next day operated for herniorrhaphy *via* post-xiphoid approach. Post-operatively, all buffaloes received Inj. Dicrysticine-5 gm; Inj. Meloxicam 0.2 mg/kg and inj. B-complex-10 ml intramuscularly for seven days. Clinical data were analyzed as per method described by Web Agri Stat Package 2.0 (WASP) developed by ICAR Research complex, Goa.

RESULTS AND DISCUSSION

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%). It shows that instrumental physiological phenomenon i.e. "parturition" aggravated the diaphragmatic pathology in eight cases which leads to diaphragmatic hernia and depicted in Table 1 and these findings coincides with finding of Sahu *et al.* (2003). Plain radiography of all eighteen buffaloes was conducted and was found to be positive for metallic foreign bodies into reticulum (Figure 1 and 2). 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, industrialization, urbanization, metabolic disorders, and voracious feeding habits which play a vital role. Similar radiographic reports were cited by William *et al.* (2003); Narale *et al.* (2006); Athar *et al*. (2010) in their studies.

Clinically all buffaloes showed partial to complete anorexic, recurrent tympany, regurgitation, atonic rumen, cachexia (Figure 3) and sudden drop in milk production in present study and in accordance with Singh *et al*., 2006; Athar *et al*., 2010; Abdelaal *et al*., 2014. 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.

The mean ruminal pH recorded in Group A and Group B was 7.8±0.33 and 8.45±0.21, respectively and it was restored after surgical correction of diaphragmatic hernia in both the groups. Similar findings were recorded 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.

Haematological examination revealed neutrophilia (49.44±3.84) and lymphopenia (38.88±2.22) pre-operatively in both the groups of buffaloes but it was restored to normal range post surgically on 7th day (Table 2). Similar findings have been recorded previously by Sethuraman and Rathor (1979); 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. Biochemical findings includes significant increase in serum creatinine (3.19±0.37), creatine kinase (595.14±47.24) and lactate dehydrogenase (1968.596±172.88) in Group A buffaloes indicative of chronic inflammatory changes at cellular level. Similar observations were also made by Rose *et al.* (2009); Brancaccio *et al.* (2010). Marianne *et al.* (2012) Studied creatine kinase and exercise related muscle damage and suggested that appearance of CK in serum following low to moderate intensity exercise 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 (Table 3).

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

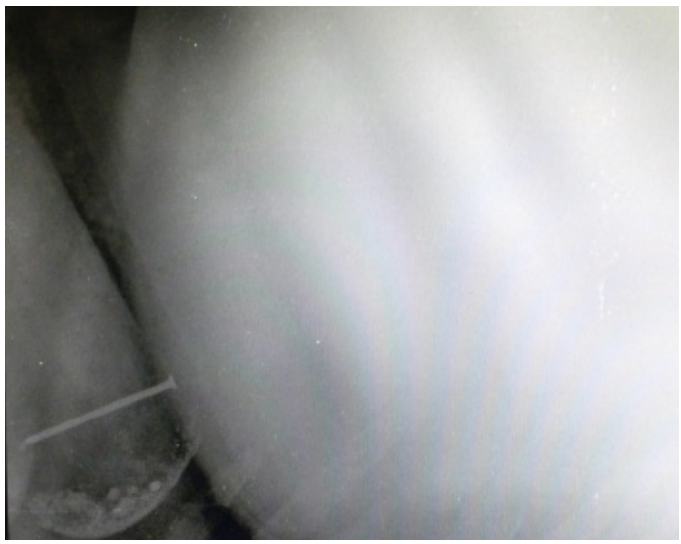

Figure 1. Lateral radiograph of thoraco-abdominal area showing herniation of reticulum along with penetrating metallic foreign body (nail) in buffalo.

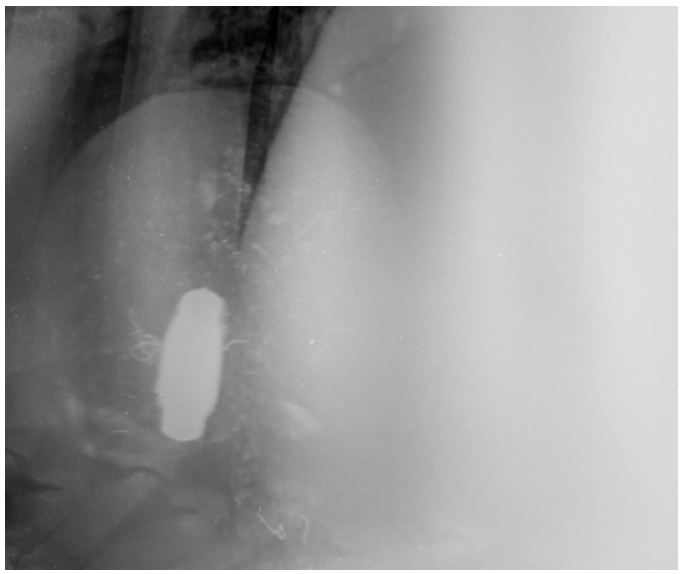

Figure 2. Lateral radiograph of thoraco-abdomen in buffalo showed diaphragmatic hernia with presence of magnet with attached metallic wire in reticulum.

Figure 3. A 7 year old pregnant emaciated buffalo suffering with diaphragmatic hernia characterized by cachexia, severe dehydration and suspended rumination.

Figure 4. Fixation of McLintock's rubber ring to rumen of buffalo with D. H. (Double stage diaphragmatic herniorrhaphy) in supine position.

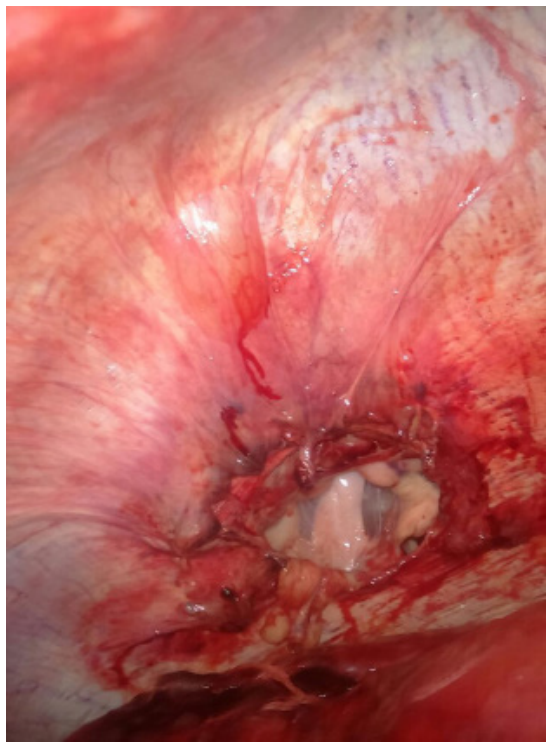

Figure 5. Photograph showing gross appearance of diaphragmatic ring or dent during operation.

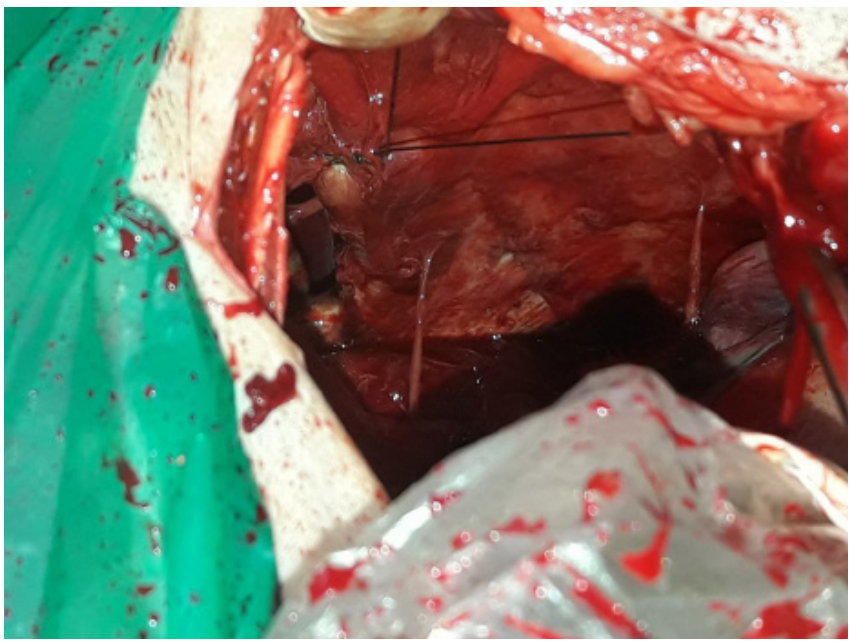

Figure 6. Photograph showing procedure of diaphragmatic herniorrhaphy in buffalo.

Table 1. Incidence, duration of illness, no of parturition and etiological factors for occurrence of diaphragmatic hernia in buffaloes.

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

Table 2. Mean values of haematological parameters of Group A and Group B buffaloes affected with diaphragmatic hernia.

Sr. No.	Parameter	Group A (Single stage D.H.)		Group B (Double stage D.H.)	
		Pre-operative (0^{th} Day)	Post-operative (7^{th} day)	Pre-operative (0^{th} Day)	Post-operative (7^{th} day)
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 3. Mean values of biochemical parameters of Group A and Group B buffaloes affected with diaphragmatic hernia.

Sr. No.	Parameter	Group A-(Single stage D.H.)		Group B (Double stage D.H)	
		Pre-operative (0^{th} Day)	Post-operative (7^{th} day)	Pre-operative (0^{th} Day)	Post-operative (7^{th} day)
1	Serum creatine (I/U)	3.19±0.37	0.95±0.20	3.15±0.35	1.76±0.19
2	Creatine kinase (I/U)	595.14±47.24	47.62±7.50	485.03±48.82	66.70±17.07
3	Lactate dehydrogenase (I/U)	1968.596±172.88	564.28±99.39	1687.69±139.54	754.02±114.58

the help of stay sutures or McLintock's rubber ring. Ruminal contents were evacuated (Figure 4) 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 (Figure 5) and were sutured with the help of nylon No. 70 by continuous lockstitch suture pattern (Figure 6).

Under field condition, single stage diaphragmatic herniorrhaphy was found to be safe where there is non-availability of positive pressure ventilation system for repair of diaphragmatic hernia in buffaloes. Similar findings were reported by Patel *et al*. (2011) who performed 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 on first day, followed by trans-abdominal herniorrhaphy (double stage) which was performed in dorsal recumbency on next day and recovered uneventfully according to the results of William *et al.* (2003); Patel (2011) for repair of diaphragmatic hernia in buffaloes.

In present study, two buffaloes were succumbed during repair of diaphragmatic hernia due to respiratory collapse because of unavailability of positive pressure ventilator and remaining sixteen buffaloes recovered uneventfully after surgery during follow-up period. Thus under field condition, repair of diaphragmatic hernia in buffaloes can be attempted *via* single incision method to reduce the cost of treatment and most important suffering of animals due to double surgical stress.

CONCLUSION

In present clinical study, the repair of diaphragmatic hernia in advance or recently calved buffaloes via single stage method was easier and more approachable as compared to double stage method in terms of ruminal evacuation, retrieval of reticular foreign bodies, separation of adhesions, and retrieval of herniated reticulum from thoracic cavity, etc. In Indian context, it was the first attempt in veterinary fraternity to introduce new approach for repair of diaphragmatic hernia in buffaloes,

more affordable to Indian farmers and it is also favor of animal due to less suffering or pain.

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