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Surgico-therapeutic management of diaphragmatic hernia in buffalo: A review of 8 cases

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Abstract

The present study was conducted on eight clinical cases of diaphragmatic hernia in buffalo. All the animals had a history of dyspnea, recurrent tympany, partial to complete anorexia, come out of regurgitated materials from mouth and nose and suspended rumination. Diagnosis was confirmed by clinical findings, abnormal heart sound, hematological examination, radiographic examination and exploratory laparotomy. The CBC showed an elevated neutrophil count, presence of toxic neutro-phil, low lymphocyte count. All eight cases were managed surgically under sedation and local analgesia, through post xiphoid approach ring in the diaphragm was identified and repaired using continuous lock stitch suture technique with non-absorbable silk No.3. Overall success rate of diaphragmatic hernia was 75% in 6 animals out of 8 animals. Two animals were died on the 1st day of intra-operative and 7th days post-operatively.

Keywords: Diaphragmatic hernia, exploratory laparotomy and post xiphoid

Introduction

Diaphragmatic hernia (DH) is defined as the passage of abdominal viscera into the thoracic cavity through a congenital or acquired defect in the diaphragm (Athar *et al.*, 2010; Bellavance *et al.*, 2010) [2, 4]. It is one of the thoracoabdominal disorders inducing mortality in buffaloes (Mohindroo *et al.*, 2007) [14]. It has been reported in large ruminants (Sahu *et al.*, 2003; Saini *et al.*, 2007) [20, 22] and mainly occurs due to increased intra-abdominal pressure during advanced pregnancy or at the time of parturition (Krishnamurthy, 1993) [10]. It may occur as a result of trauma or progressive weakening of the diaphragm adjacent to a hardware perforation and reticuloperitonitis (Krishnamurthy *et al.*, 1998) [12]. Buffaloes are more prone to diaphragmatic hernia than cattle, because pericardiacophrenic vessels and golgi tendon organs (function as the pressure receptors) had been found missing in buffaloes diaphragm (Singh *et al.*, 2006) [28]. The occurrence of DH is common in pregnant buffalo as compared to heifer and non-pregnant buffalo. If untreated, DH may induce mortality in buffaloes (Mohindroo *et al.*, 2007) [14]. Treatment of the disease in cattle or buffaloes is rarely successful except where adhesions of the reticulum with the hernial ring and the thoracic organs are not firm or extensive (Hall 1963; Trout *et al.*, 1967) [7, 33].

Material and Methods

The present study was conducted on 8 clinical cases of diaphragmatic hernia in buffalo presented to the Akhand Jeev Maitry Dham Panjrapol Sodal Veterinary Hospital, Banaskantha, Gujarat. History of cases regarding age and sex of the animal, body weight, status of pregnancy, recurrent tympany, passed scant pasty feces, reduced milk production and ineffective symptomatic treatment, unthrifty, debilitated, dehydrated and auscultation revealed muffled sound in thoracic region were also reported. The diagnosis was confirmed on the basis of history, clinical examination, abdominal palpation and abdomino-centesis as per case status.

Radiological diagnosis: The radiological examination for the diaphragmatic hernia can be performed using ALENGER Large Animal X-ray machine having maximum mA of 600 and KVP of 150. The radiological examination is performed in left standing position with forward stretched forelimbs in cases of diaphragmatic hernia. Exposure factors in the range of 130-150 mAs and 90-100 KVP at a film focal distance of 90-100 cm are required for diagnosis of diaphragmatic hernia in buffaloes.

The images of radiographs are processed in the computer radiography system. The following findings are recorded upon the radiological examination in cases of diaphragmatic hernia i.e. nature of foreign body (metallic or non-metallic), location of foreign body (reticular, diaphragmatic and pericardial position, status of diaphragmatic line (intact or discontinued) and circumscribed swelling of soft tissue density (reticulum) within the thorax or cranial to diaphragm (Fig. 1-2).



Fig 1: Lateral thoraco-abdominal radiograph showing herniation of reticulum into thoracic cavity in a buffalo



Fig 2: Lateral radiograph of thoraco-abdominal area showing herniation of reticulum with presence of penetrating metallic foreign body (wire) in buffalo



Fig 3: Preparation of surgical site aseptically for rumenotomy



Fig 4: Exposure of rumen and removal of ruminal content and foreign body manually



Fig 5: Positioning of buffalo



Fig 6: Removal of adhesion between reticulum and diaphragm

Surgical procedure of Diaphragmatic herniorrhaphy:

Exploratory laparo-rumenotomy in standing position was done in the all cases to remove the contents of rumen. Metallic foreign bodies were found in rumen and reticulum was removed. Diaphragmatic herniorrhaphy was done on same day through postxiphoid approach. The all animals were restrained in dorsal recumbency and sedation (xylazine @ 0.1 mg/kg) and local anaesthesia (lignocaine HCl 2%) was given at surgical site. A postxiphoid semi lunar laparotomy incision was given. The hernial ring was palpated and adhesions with reticulum were freed cautiously. The reticulum was reposed back to abdominal cavity. The hernia ring was closed with continuous lock stitch pattern using non-absorbable suture material with silk no. 3. Muscles and skin were sutured by routine manner (Fig. 3-8).



Fig 7: Closing of hernial ring with non



Fig 8: Complete closure of operation site absorbable silk no. 3

Hemato-biochemical parameters: For the estimation of hemato-biochemical studies, 10 ml blood was collected in each animal from jugular vein using aseptic syringe and stored in sterile vial containing EDTA. The haematological parameters such as hemoglobin (Hb) by Sahli's hemoglobin meter, total leucocytic count (TLC) by Haemocytometer and differential leucocytic count (DLC) by using Giemsa's staining were estimated from the fresh blood sample as per standard technique.

Postoperatively, antibiotic Cetiforce-SB (Ceftriaxone + Sulbuctum) @ 4.5 gm/animal was administered once a day, for 5-7 days, Meloxicam @ 0.2-.05 mg/kg body weight IM was administered once a day for 3 days. Parenteral therapy included like dextrose saline (2lit), normal saline (1 to 2lit), Ringer's lactate (1lit), metronidazole (500ml) and combined preparation of Cyanocobalamin and butaphosphon (Inj. Metaways) were administered for 4-6 days. Skin sutures were removed on the 14th days postoperative.

Result and Discussion

The present study was conducted on 8 clinical cases of diaphragmatic hernia in buffalo presented to the Akhand Jeev Maitry Dham Panjrapol Sodal Veterinary Hospital, Banaskantha, Gujarat. All the cases included in the study were recorded for case history and clinical finding (Table 1).

Table 1: Detail clinical cases history

S. No.	Sex	Age in yr	Pregnancy Status	Parity Status	Body Status	Tympany	Other symptoms
1	Female	4 yr	5 month	1 st	300kg	Recurrent	Partial anorexia
2	Female	5 yr	After Parturation	2 nd	400kg	-	Anorexia, Scanty feces
3	Female	8 yr	After Parturation	4 th	550kg	Recurrent	Complete anorexia, Scanty feces
4	Female	10 yr	After Parturation	4 th	450kg	Recurrent	Complete anorexia, Scanty feces
5	Female	6 yr	After Parturation	2 nd	450kg	-	Complete anorexia, Scanty feces
6	Female	4 yr	6 month	1 st	400kg	Recurrent	Partial anorexia
7	Female	5 yr	7month	2 nd	450kg	Recurrent	Complete anorexia
8	Female	7 yr	9 month	3 rd	500kg	Recurrent	Moderate anorexia, Scanty feces
Range		4-10yr	5-9 month	1 st -4 th	300-500 kg		
Mean± SE		6.1± .74		2.3± 42	437.5± 26		

In the present study, all animals were female. The higher incidence of diaphragmatic hernia in adult recently calved and advanced pregnant cows and buffaloes have been reported (Prasad *et al.* 1977, Krishnamurthy *et al.* 1983, Singh *et al.* 1980a, Steiner *et al.* 1992, Saini *et al.* 2007) [18, 11, 25, 11, 22].

Among the affected buffaloes, higher incidence of D.H. were recorded in recent parturated (n=4; 50%) animals and equal incidence (n=2; 25%) were recorded in mild pregnant and advance pregnant buffaloes. It shows that instrumental physiological phenomenon i.e. "parturition" aggravated the diaphragmatic pathology in four cases which leads to diaphragmatic hernia and these findings similar with finding of Sahu *et al.* (2003) [20] and Saini *et al.* (2001a) [23]. Athar *et al.* (2012) [3] also reported that 51.8% animal had recently parturated followed by 22.2% advance pregnancy and remaining of animals was different stage of lactation in his study. A high incidence of diaphragmatic hernia was reported in buffaloes in periparturient stage (Singh *et al.* 2006) [28].

Most of animals, that were included in present study, were moderate age ranged from 4-10 years with a mean of 6.1± .74 yr which was accordance to the Athar *et al.* (2012) [3] and Abdelaal *et al.* (2014) [1]. Ghanshyam *et al.* (2020) [6] also reported that the overall affected buffaloes were aged between 3.5 to 9 years with a mean of 6.41±0.4yr. Pal, (2017) [16] also observed that the animals suffering from diaphragmatic hernia

had mean age of 5.33 ± 2.0 ranging from 3.5-11 years.

Clinically all buffaloes showed partial to complete anorexic, scanty feces, recurrent tympany in six animals while rest of the animals did not show any tympany or had a single episode of tympany during illness, regurgitation, atonic rumen and sudden drop in milk production in present study which were accordance of the Singh *et al.* (2006) [28], Krishnamurthy, *et al.* (1983) [11], Athar *et al.* (2012) [3] and Abdelaal *et al.*, 2014 [1]. Herniation leads to the fixation of reticulum to the ventral diaphragm causing impairment of the function of oesophageal groove which leads to the achalasia of the reticulo-omasal sphincter may result in recurrent tympany associated with the disease (Radostits *et al.* 2000) [19].

The body weight of the animals, in present study, ranged from 300-500kg with a mean value of 437.5± 26 kg. Similar finding was reported by Abdelaal *et al.* (2014) [1].

Auscultation of the ventral thorax revealed splashing reticular sounds. Cardiac sounds were muffled in 5 cases. Respiratory distress and abnormal lung sound in cases of diaphragmatic hernia has been also cited (Deshpande *et al.*, 1981) [5]. Moreover, signs of cardiac involvement were previously recorded (Szabo and Fischetti, 2014) [31]. This might be due to lung irritation or heart displacement by herniated reticulum. Additionally, positive pain tests referred to high DH prevalence following traumatic reticuloperitonitis (Saini *et al.*,

2007; Athar *et al.*, 2010) [22, 2].

Plain radiography of all eight buffaloes were conducted and was found to be positive for metallic foreign bodies into reticulum in six case while in two cases did not reveals any penetrating metallic foreign body in reticulum which was accordance to the Singh *et al.* (1977) [26]. In the present study, lateral thoraco-abdomen radiograph of all animals showed, break in the continuity of diaphragmatic line and sac like structure cranial to diaphragm either with metallic foreign bodies or without it which resulting in confirmatory to diaphragmatic hernia. Similar finding were reported by Hussain *et al.* (2020) [8]. Athar *et al.* (2010) [2] conducted a study on 101 animals suffering from thoraco-abdominal disorders. Out of which, 27 animals (26 buffaloes and 1 cow) were diagnosed with diaphragmatic hernia based on clinical signs, radiography, ultrasonography and left flank laparorumenotomy. A sac-like structure cranial to the diaphragm was observed in 18 cases (66.67%). Plain radiographs revealed a demarcated diaphragmatic line and presence of metallic foreign bodies in a sac-like structure located cranial to diaphragm whereas contrast radiography showed passage of contrast agent into herniated reticulum located cranial to diaphragm in cases of diaphragmatic hernia in bovine (Saini *et al.* 2007) [22]. 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) [36]; Narale *et al.* (2006) [15]; Athar *et al.* (2010) [2] in their studies.

In present study, haematological examination revealed neutrophilia (52.14 ± 2.84) and lymphopenia (36.18 ± 12) pre-operatively in all buffaloes but it was restored to normal range post surgically on 10th days. Similar findings have been recorded previously by Sethuraman and Rathor (1979) [24]; Kaur and Singh (1994) [9] in their study and they noted, marked neutrophilia ($56.1 \pm 2.3\%$) and lymphopenia ($40.3 \pm 2.1\%$) in buffaloes suffering with diaphragmatic hernia. The mean value Hb and PCV levels were recorded to be $7.1 \pm 4.1\%$ gm/dl and $24.1 \pm 2.03\%$ respectively which were less than normal range which was accordance to the Talekar *et al.* (2018) [32]. Contrary to these findings, Krishnamurthy *et al.* (1983) [11] and Athar *et al.* (2012) [3] reported that the normal range of Hb level in case of diaphragmatic hernia suggested that animals were not profoundly dehydrated. Kumar *et al.* (2012) [13] also reported that the survived animals had normal mean hemoglobin 11.67 ± 0.50 g/dL, mild leukocytosis ($10025 \pm 730/\mu\text{l}$) with neutrophilia ($50.17 \pm 3.35\%$).

In present study, incidence of diaphragmatic hernia was more recorded in right side in 7 animals while in the centre recorded in only one animal. Athar *et al.* (2012) [3] also reported that hernia ring was situated in the right hemidiaphragm in 24 animals and in 3 cases toward the extreme right side. Moreover, Radostits *et al.* (2000) [19] were of the opinion that most cases of diaphragmatic hernia occur because of weakening of the diaphragm by lesions of traumatic reticuloperitonitis in right side. In the buffaloes, the right ventromedial tendinous zone is much thinner and pericardiophrenic vessels have been found to be missing and thereby predisposing the diaphragm to innate weakness (Tyagi 2020) [34].

In present study, exploratory laparo-rumenotomy in standing position was done in the all cases to remove the contents of

rumen. Metallic foreign bodies were found in rumen and reticulum was removed. Similar finding was recorded by Athar *et al.* (2012) [3]. The hernia ring was closed with continuous lock stitch pattern using non absorbable suture material with silk no. 3. Though various techniques have been suggested for closing the vent in the diaphragm, the continuous lock stitch proved to be more satisfactory than interrupted mattress sutures (Vig 1972; Singh 1974) [35, 79] or synthetic patches (Vig 1972) [35]. Diaphragmatic herniorrhaphy was done on same day through postxiphoid approach in all cases of present study. However, Athar *et al.* (2012) [3] also performed diaphragmatic heniorrhphy on the next day after ruminotomy operation. Under this hospital condition, 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 also reported by Ghanshyam *et al.* (2020) [6] and Singh *et al.* (1977) [26]. Patel *et al.* (2011) [17] who performed single stage herniorrhaphy in a 6 years old Mehasana buffalo without ventilator and said animal recovered successfully.

Six animals were survived after surgery and made uneventfully recovery. The overall percentage survival was 75%. In present study, one buffaloes were succumbed during repair of diaphragmatic hernia due to respiratory collapse because of unavailability of positive pressure ventilator. Similar finding was reported by Ghanshyam *et al.* (2020) [6]. Total mortality was found in two cases in present study. The mortality may be due to prolonged duration of surgery because much time was used to break tough or fibrous adhesions of herniated reticulum to the diaphragm and lungs or pericardium. Breaking adhesions manually sometimes cause rupture of the pleura which might have lead to death due to severe respiratory distress in the recovery phase. Similar finding was reported by Athar *et al.* (2012) [3]. The presence of other accompanying disorder such as fibrinous peritonitis, aspiratory pneumonia and traumatic reticulitis was unfavourable factor for survival of diaphragmatic hernia (Saini *et al.* 2007) [22].

Complications: Hard inflammatory swelling was recorded at post-xiphoid skin incision in two animals, however swelling resolved spontaneously after post-operative care. Abscess formation at suture site and partial wound dehiscence was observed in one case only which might be associated with unhygienic conditions prevalent at owner's farm house and use of silk for suturing muscles and skin. Majority of the abscessed wounds were managed successfully which was accordance to the findings of Kumar *et al.* (2012) [13]. A few retrospective studies on this condition were found in cows (Saini *et al.* 2001b) [21] and buffaloes (Prasad *et al.* 1977, Saini *et al.* 2001a) [18, 23]. However, study conducted by Saini *et al.* (2001a) [23] reported a very low incidence of complicated wound healing (8.8%) in buffaloes operated for diaphragmatic hernia

Conclusion

From the present study, it was concluded that after diaphragmatic herniorrhaphy majority of the pregnant and lactating buffaloes could achieve their production and reproduction performance without any significant surgery-related complications. Diaphragmatic herniorrhaphy was done on same day through postxiphoid approach after ruminotomy was more favourable and good outcome of these cases. All 4

animals which were in the later stages of pregnancy eventually had a normal parturition. The milk yield was reported to be normal and animals had no postpartum complications. Pregnant bovines operated for diaphragmatic hernia are not predisposed to recurrence of diaphragmatic hernia during subsequent calving.

References

1. Abdelaal A, Gouda S, Ismail A, Gomaa M. Reticular diaphragmatic hernia in Egyptian buffaloes: clinical, hemato-biochemical and ultrasonographic findings. *Pak Vet J.* 2014;34(4):541-544.
2. Athar H, Mohindroo J, Singh K, Kumar A, Raghunath M. Comparison of radiography and ultrasonography for diagnosis of diaphragmatic hernia in bovines. *Vet Med Int.* 2010. Article ID 9398 <http://dx.doi.org/10.4061/2010/939870>.
3. Athar H, Mohindroo J, Singh K, Singh T, Raghunath M. Surgical management of diaphragmatic hernia in bovine. *Indian Vet. J.* 2012;89(8):124-126.
4. Bellavance A, Banneville-Hebert A, Desrochers A, Fecteau G. Surgical correction of a diaphragmatic hernia in a newborn calf. *Can Vet J.* 2010;51:767-769.
5. Deshpande KS, Krishnamurthy D, Nigam JM, Sharma DN. Pathanatomy of herniation of the reticulum through the diaphragm in the bovine. *Can Vet J.* 1981;22:234-236.
6. Ghanshyam PG, Vinayak SR, Hiroji UA. Comparative evaluation of single stage and double stage diaphragmatic herniorrhaphy for repair of diaphragmatic hernia in buffaloes. *Buffalo Bulletin.* 2020 Oct-Dec;39:4.
7. Hall RF. *Vet. Med.* 1963;58:328.
8. Hussain SA, Turkar S, Randhawa SNS. Recurrence of reticulo-diaphragmatic hernia in a pregnant murrha buffalo. *Buffalo Bulletin.* 2020 April-June;39:2.
9. Kaur T, Singh B. Clinico-pathological changes associated with diaphragmatic hernia and foreign body syndrome in buffaloes. *Indian J Anim. Sci.* 1994;64(10):1018-1021.
10. Krishnamurthy D. Hernia. In: *Ruminant Surgery*, Ed. Tyagi RPS and Singh J CBS Publishers and Distributors, 1993, 225-237.
11. Krishnamurthy D, Nigam JM, Deshpande KS, Peshin PK, Singh SC, Sharma DN. Bovine diaphragmatic hernia: An analysis of 40 clinical cases. *Indian Vet. J.* 1983;60:10-11.
12. Krishnamurthy K, Radhakrishnamurthy P, Janardhana TV, Sreenu M. Nonmetallic foreign body induced traumatic reticulopericarditis in a crossbred cow. *Ind. Vet. J.* 1998;75:347-348.
13. Kumar A, Saini NS, Mohindroo J, Sangwan V, Mahajan SK, Raghunath M, *et al.*, Long term outcomes of survivors of diaphragmatic herniorrhaphy in crossbred cows and buffaloes. *Indian J Anim. Sci.* 2012;82(9):971.
14. Mohindroo J, Kumar M, Kumar A, Singh SS. Ultrasonographic diagnosis of reticular diaphragmatic hernias in buffaloes. *Vet Rec.* 2007;161:757-758.
15. Narale NL, Bhokare AP, Shelar RR. Diagnostic parameters of diaphragmatic hernia in buffaloes. *RVJI.* 2006;2(1):24-28.
16. Pal M. Comparative evaluation of ultrasonographic, radiological and surgical findings in cases of diaphragmatic hernia, reticular abscess and traumatic reticuloperitonitis in buffaloes. Ph.D. Thesis, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, 2017.
17. Patel JB. Therapeutic management of oxidative stress during diaphragmatic herniorrhaphy without positive pressure ventilation in buffaloes. M.V. Sc. Thesis, Sardar Krushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat, India, 2011.
18. Prasad B, Singh J, Ramakumar V, Sharma SN, Rathor SS, Kohli RN. Surgical repair of diaphragmatic hernia in buffaloes-An analysis of 42 cases. *Indian Veterinary Journal.* 1977;54:656-660.
19. Radostits OM, Gay CC, Hinchcliff KW, Constable PD. In: *Veterinary Medicine; A Text Book of the Disease of Cattle, Horses, Sheep, Pigs and Goats.* 10th edition. Saunders Elsevier, 2000, 455-456.
20. Sahu A, Chawla SK, Krishnamurthy D. Diaphragmatic herniorrhaphy in buffaloes: clinical evaluation of 72 cases. *Indian Journal of Veterinary Surgery.* 2003;24:33-34.
21. Saini NS, Sobti VK, Singh SS, Singh KI, Bansal PS, Bhatia R. Diaphragmatic hernia in cows: A study of 10 clinical cases. *Indian Journal of Veterinary Surgery.* 2001b;22:52-53.
22. Saini NS, Kumar A, Mahajan SK, Sood AC. The use of ultrasonography, radiography and surgery in the successful recovery from diaphragmatic hernia in a cow. *Canadian Veterinary Journal.* 2007;48(7):757-759.
23. Saini NS, Sobti VK, Mirakhur KK, Singh SS, Singh KI, Bansal PS, *et al.* Survivors of diaphragmatic hernia in buffaloes (*Bubalus bubalis*). *Indian J Anim. Sci.* 2001a;71:839-40.
24. Sethuraman V, Rathor SS. Clinical, haematological and biochemical studies on secondary indigestion in bovines due to traumatic reticulitis and diaphragmatic hernia. *Indian J Anim. Sci.* 1979;49(9):703-706.
25. Singh J, Dhablania DC, Prasad B, Rathor SS. On the etiology of diaphragmatic hernia in buffaloes. *Japanese Journal of Veterinary Science.* 1980a;42:89-91.
26. Singh J, Prasad B, Kumar R, Kohli RN, Rathor SS. Treatment of diaphragmatic hernia in buffaloes. *Australian Veterinary Journal.* 1977;53:473-75.
27. Singh J, Prasad B, Khianey NK. Diaphragmatic hernia with double hernial ring in a buffalo. *Indian Vet. J.* 1979;56:141-143.
28. Singh J, Fazili MR, Chawla SK, Tayal R, Behl SM, Singh S. Current status of diaphragmatic hernia in buffaloes with special reference to etiology and treatment: A review. *Indian J Vet. Surg.* 2006;27(2):73-79.
29. Singh S. *Cinical and Experimental Studies on Foreign Body Syndrome in Buffaloes with Special Reference to Diaphragmatic Hernia.* Ph.D. Dissertation, Punjab Agricultural University, Ludhiana, India, 1974.
30. Steiner A, Edeid M, Fluckiger M. Diaphragmatic hernia in a cow. *Agri-Practice.* 1992;13:37-40.
31. Szabo DI, AJ Fischetti. What is your diagnosis? Peritoneopericardial diaphragmatic hernia. *J Am Vet Med Assoc.* 2014;244:157-159.
32. Talekar SH, Chaudhary MP, Gamiti KS, Katara KP, Soni Manish. Surgical management of diaphragmatic hernia in four jaffarabadi buffaloes and two gir cow. *International Journal of Science, Environment and Technology.* 2018;7(2):684-688.
33. Troutt HF, Fessler JF, Page EH, Amttutz HE. *J Am. vet. med. Ass.* 1967;151:14-91.
34. Singh J, Singh S, Tyagi RPS. In: *Veterinary Surgery; A*

Text Book of the Surgical Disease of Cattle, Buffaloes, Sheep and Goats. 2nd edition. CBS Publisher & Distribution, 2020, 344-345.

35. Vig MM. Studies on the Diagnosis and Repair of Experimentally Induced Diaphragmatic Hernia in Buffaloes, Ph.D. Dissertation, Haryana Agricultural University, Hissar, India. Vig MM and Tyagi RPS. Indian vet. 1972-1974;1(51):461.
36. William BJ, Dharmaceelan S, Arunprasad A, Rajendran N, George RS. Diaphragmatic herniorrhaphy/plasty under xylazine/detomidine sedation and local analgesia in bovines: A review of 11 cases. Indian J Vet. Surg. 2003;24(1):16-18.