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Esophageal obstruction in water buffalo (*Bubalus bubalis*): a retrospective study of 44 cases (2006–2013)

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Abstract: The purposes of this study were to report the types, causes, and clinical findings of esophageal obstructions in water buffaloes and to verify the role of radiography in diagnosis as well as the evaluation of the proposed treatment management and outcome after treatment. Forty-four buffaloes with esophageal obstruction were used in the study. Esophageal obstruction was significantly more frequent in females than males. Buffaloes at 1–3 years of age were significantly more liable to the disease than those of other ages. Complete obstruction was more frequent than partial obstruction. Intraluminal obstruction was more prevalent than extraluminal. Obstruction at the cervical portion was more frequent than those at pharyngeal region and cardia. Radiography was confirmative in 41 buffaloes (93%). Manipulative treatment was successful in 6 buffaloes (13%) and surgical intervention for cervical esophageal obstructions was carried out by exposure of the cervical esophagus (n = 3), cervical esophagatomy (n = 25), or surgical correction of periesophageal cellulitis (n = 2), while surgical treatment of thoracic esophageal obstruction was carried out via laparorumenotomy (n = 8). In conclusion, early diagnosis, proper application of manipulative or surgical interventions, and postoperative follow-up are the fundamental factors for successful outcomes of esophageal obstruction in water buffaloes.

Key words: Water buffaloes, esophageal obstruction, esophagatomy, periesophageal cellulitis, esophageal exposure

1. Introduction

Esophageal disorders are relatively uncommon in large animals. Esophageal obstruction is the most frequently encountered clinical presentation in bovine and it may be intraluminal or extraluminal (1,2). Intraluminal obstruction or "choke" is the most common abnormality and usually occurs when foreign objects, large feedstuff, medicated boluses, trichobezoars, or esophageal granuloma lodge in the lumen of the esophagus (3–5). Rare cases of extraluminal obstruction occur when pressure is exerted on the esophagus by the neighboring organs, tissues, or space-occupying lesions (6).

Esophageal obstructions in bovine commonly occur at the pharynx, the cranial aspect of the cervical esophagus, the thoracic inlet, or the base of the heart (2,7). Diagnosis of such problems depends on the history of eating particular foodstuff and clinical signs as bloat, tenesmus, retching, and salivation. External palpation may be used to confirm those located in the cervical esophagus (1). Besides the clinical signs and external palpation, additional diagnostic tools may help to determine the location of an obstruction; these include manual oral examination, probangs or stomach tubes, esophageal endoscopy, esophageal ultrasonography, and radiography of the cervical and thoracic esophagus. Survey or contrast radiography is a confirmative diagnostic tool that may elucidate the etiology of the esophageal obstruction (6).

Various conservative treatments have been described for the management of esophageal foreign bodies in bovines. Treatments comprise percutaneous external esophageal massage, passage of a stomach tube, Thygesen's probang or an inflated endotracheal tube, and endoscopic removal of the foreign bodies (4,8). In spite of the good results obtained by these methods, surgical intervention is still necessary if the animal is economically valuable and if conservative treatment fails (3,9).

There are few published studies describing the clinical findings and treatments in bovines with esophageal obstruction, and these have mainly included smaller numbers of animals (4,9–14). They also fail to make correlations between conservative or surgical interventions and outcome. Thus, our objectives were to report the causes, locations, and clinical signs of esophageal obstructions in buffalo and to justify the role of radiography in diagnosis,

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as well as to assess both manipulative and surgical treatments and to determine criteria for prognosis.

2. Materials and methods

2.1. Animals (patient selection and clinical examination)

Medical records of all buffaloes (n = 44) admitted to the veterinary teaching hospital of Kafrelsheikh University, Egypt, between January 2006 and October 2013 because of esophageal obstruction were reviewed. Buffalo were 9 months to 6 years of age (median: 2.4 years) and included 32 females and 12 males. The case history, etiology, clinical signs, diagnosis, treatment, and prognosis of the disease were recorded. The cases were presented either with an established diagnosis by a referring veterinarian (n = 9) or diagnosed at the veterinary teaching hospital (n = 35).

2.2. Manipulative treatment

After sedation of the animal by xylazine HCl (0.05 mg/kg, IV) (Xylaject, Adwia Pharm. Co., Egypt), manipulative trials were made to push the obstructing object aborally towards the rumen by the use of a stomach tube or Thygesen's probang or to maneuver it orally (pushing the obstructing object by thumb or fingers toward the oral cavity) so that it could be withdrawn from the mouth. This procedure was repeated gently two or three times and further trials were stopped because of fear of esophageal perforation. Ruminal trocarization through the left paralumbar fossa was performed in 18 animals to relieve a severe ruminal tympany prior to attempting removal of the foreign body.

2.3. Surgical techniques

Surgical intervention was conducted when the manipulative procedures to remove the foreign body had failed (Figures 1A–1F). Cervical esophageal obstruction was treated via exposure of the cervical esophagus without esophagatomy (n = 3) or cervical esophagatomy (n = 27), while the thoracic esophageal obstruction was corrected via laparorumenotomy with extraction of the obstructing foreign bodies through the cardia (n = 6). Periesophageal cellulitis was treated through surgical drainage and removal of foreign body metal magnets deeply situated in the cranial aspect of the neck muscles (n = 2).

Cervical esophageal exposure or esophagatomy was performed in right lateral recumbency under the influence of light sedation using xylazine HCl (0.05 mg/kg, IV) and linear local infiltration analgesia using 2% lidocaine (Debocaine 2%, Al Debiky Pharm. Co., Egypt) (Figure 1B). In the upper two-thirds of the neck, a longitudinal skin incision was made at the ventrolateral aspect of the neck between the sternocephalicus muscle and trachea, whereas in the lower third of the neck the incision was made between the jugular vein and the sternocephalicus muscle directly over the seat of obstruction. After exposure of the esophagus, attempts were made to push the obstructed objects by direct manipulation toward the pharynx (external taxis). Esophagatomy was performed when external taxis to move the foreign body had failed. Umbilical tape was applied proximal and distal to the obstruction to prevent contamination of the surgical area and also to prevent the movement of the mass. A longitudinal incision was made just cranial to the site of obstruction and the obstructing mass was squeezed cranially towards the incision site and removed using large Allis tissue forceps or sponge forceps (Figures 1C–1E). The surgical wound of the esophagus was closed in 2 layers with polyglactin 910 (USP 1) using Lambert sutures followed by a simple continuous suture pattern. The mucosa and submucosa was the first layer and the musculosa with adventitia was the second one. The surgical site was flushed with sterile normal saline and the cervical muscle layer was closed with a simple continuous pattern of polyglactin 910 (USP 2). Skin was then closed in a routine manner using silk suture (USP 2). Laparorumenotomy was performed through the left paralumbar fossa under the effect of light sedation with xylazine HCl and paravertebral analgesia using 2% lidocaine in a standing position.

2.4. Postoperative care

Benzyl penicillin (12,000 U/kg intramuscularly) and flunixin meglumine (Flunixine, Norbrook Laboratories, UK; 1.1 mg/kg, IV) were administered for 5 days. Buffaloes were discharged 48 h postoperatively. Food was withheld for 48 h postoperatively. During this period the animals were maintained with 0.9% saline and 5% glucose solution (2 mL kg^{-1} h^{-1} IV). After that, a soft diet was advised and then roughages were introduced gradually from day 7 postoperatively. Antiseptic dressing of the suture site was done by povidone iodine solution. Sutures were removed on 12th postoperative day (Figure 1F).

2.5. Follow-up information

Follow-up information was obtained via telephone contact with veterinarians and owners for at least 6 months after surgery.

2.6. Statistical analysis

Data analyses were performed using a commercial statistical software program (GraphPad Prism for Windows version 5.0, GraphPad Software Inc., San Diego, CA, USA). Chi-square and Fisher's exact tests were used to assess the variables associated with esophageal obstruction in buffaloes. Results were presented as P-values and confidence interval (CI) at 95%. The results were considered significant at $P < 0.05$.

3. Results

3.1. Signalment and case details

Esophageal obstruction was significantly more frequent in females than males (P < 0.001; CI at 95%: 2.7–18.9), as 72% (n = 32) of the affected buffaloes were females and 28% (n = 12) were males. The occurrence of esophageal obstruction was significantly affected by age. Buffaloes at 1–3 years of age were significantly more liable to the disease than those at other ages (P < 0.001; CI at 95%: 0.09–0.6) (Table 1).

Complete obstruction was more frequent than partial obstruction (P < 0.001; CI at 95%: 8.91–87.6). Thus, 37 (84.1%) buffaloes had complete obstruction and 7 (15.9%) had partial obstruction. Intraluminal obstruction was more prevalent than extraluminal (42 vs. 2; P < 0.001; CI at 95%: 59.2–328.0).

The site of esophageal obstruction varied significantly among buffaloes (chi-square test, P < 0.01). Obstruction at the cervical portion was more frequent than at the pharyngeal region (32 vs. 2, P < 0.001; CI at 95%: 1.3–4.1) and cardia (32 vs. 10, P < 0.001; CI at 95% 3.44–23.8). Obstruction at the cardia was also significantly more common than at the pharynx (10 vs. 2, P < 0.05; CI at 95%: 0.03–0.7).

In the cervical portion, complete obstruction was more frequent at the midcervical region than the lower cervical region (26 vs. 4, P < 0.001; CI at 95%: 2.5–4.9). Extracted foreign bodies were sugar beet (n = 18), corn cups (n = 3), turnip (n = 3), onion (n = 2), rolls of ropes (n = 2), and leather pieces (n = 1). Incomplete extraluminal obstruction by periesophageal cellulitis in the upper cervical region (n = 2) was also recorded (Table 1). Intraluminal obstruction

Table 1. Summary data for 44 buffaloes with esophageal obstructions.

Variable	Number of buffaloes	%
Sex		
Male	12	27.3
Female	32	72.7
Age		
<1 year	8	18.2
1–3 years	30	68.2
>3 years	6	13.6
Type of obstruction		
Complete	37	84.1
Incomplete	7	15.9
Intraluminal	42	95.5
Extraluminal	2	4.5
Seat of obstruction		
Pharyngoesophageal junction	2	4.5
Cervical region	32	72.7
At the cardia	10	22.7
Cause of obstruction		
Large feed particles	20	45.5
Roll of ropes	1	2.25
Plastic bags with food materials	20	45.5
Periesophageal cellulitis	2	4.5
Pedunculated granuloma	1	2.25

was seen at the pharyngoesophageal junction by transversally lodged metal magnets (n = 2).

At the thoracic esophagus (n = 10), complete intraluminal obstruction (n = 7) was seen at the level of the cardia by sugar beet (n = 3), potato (n = 2), and plastic bags with accumulated food materials (n = 2). However, incomplete intraluminal obstruction (n = 3) was observed at the level of the cardia by rubber pieces, plastic sheeting, and pedunculated granuloma (Table 1).

3.2. History and clinical presentation

The history of all cases included the presence of anorexia, copious drooling of saliva, intermittent regurgitation, inability to swallow, and tympany. The common presenting signs varied according to the type of obstruction. In complete obstruction, acute severe bloat (n = 37), ptyalism (n = 35), and respiratory distress (n = 24) were the main findings. Other signs less frequently seen were arching of the neck (n = 6), protrusion of the tongue (n = 4), and restlessness (n = 2).

In cases with incomplete obstruction, recurrent ruminal tympany that resolved temporarily upon passage of a stomach tube (n = 3) was the initial symptom. Body temperature on admission ranged between 37.1 and 39.2 °C (median: 38.4 °C). The heart rate and respiration rate ranged between 44 and 84 beats/min and 16–40 breaths/min, respectively (median: 52 beats/min and 28 breaths/min, respectively).

Out of 38 buffaloes for which the duration of the obstruction was recorded, 10 (26%) were referred to the hospital within 6 h from recognition of the obstructive episode, 15 (39%) between 6.1 and 24 h, and 8 (22%) between 24.1 and 48 h, whereas 5 animals (13%) suffered from chronic obstruction (more than 48 h in duration).

3.3. Clinical and radiological diagnostic findings

Diagnosis was based on history, clinical signs, visual examination, palpation, probing, and survey radiography. Cases of complete intraluminal obstruction at the cervical esophagus were easily diagnosed by observing the swelling from the outside (n = 14) (Figure 1A) and palpation of the object in the left ventrolateral aspect of the neck (n = 19). Stomach tubing or passing of a probang was confirmative in all cases of intraluminal complete obstruction of the cervical or thoracic esophagus (n = 37).

Plain radiography was confirmative in 41 (90%) of 44 buffaloes (Figure 2). In the other 3 cases, plain radiography failed to determine the site of obstruction because of the superimposition with shoulder regions and the radiolucency of the foreign objects (pieces of rubber and plastic treads). Radiographs of the upper cervical region of 2 buffalo revealed generalized soft tissue swelling with ventral displacement of the trachea and larynx. A large radiopaque masse (metal magnet) was present midway between the cervical vertebrae and the trachea. Extensive free gas was evident within the esophagus as well as in the periesophageal tissue, where it was associated with higher density, granular mottling suggestive of an accumulation of ingesta, and severe inflammation.

3.4. Treatment and outcome

Manipulative trials were successful to push the obstructing object aborally towards the rumen by use of Thygesen's probang or a stomach tube (n = 4) or to maneuver it orally so that it could be withdrawn from the mouth (Table 2).

Surgical treatment of cervical esophageal obstruction was successfully carried out through exposure of the cervical esophagus, cervical esophagatomy, or surgical drainage and removal of deeply situated foreign objects (metal magnets) causing periesophageal cellulitis, and all buffalo except for one recovered without any postoperative complications. Signs of esophageal fistula were recorded for one buffalo that underwent cervical esophagatomy. This animal was readmitted to the clinic 1 month after discharge and recovered following a second surgical interference to correct the esophageal fistula (Table 2).

Treatment of thoracic esophageal obstruction was carried out by laparorumenotomy with complete recovery in 7 of 8 animals. Foreign bodies were extracted from the caudal part of the thoracic esophagus cranial to the cardia. The other animal was sent to the slaughterhouse because of the presence of pedunculated granulation mass at the cardia (Table 2).

From a technical point of view, the surgical interventions were quickly and easily performed. Long-term follow-up (about 6 months) of the cases revealed complete recovery and absence of complications at the esophagatomy site in all cases.

4. Discussion

In bovine veterinary practice, esophageal obstruction caused by foreign objects is considered one of the most important emergency surgical conditions that require immediate intervention, as blockage of the esophagus will cause severe threatening bloat. Bovine are more frequently affected by esophageal obstruction than other animals, and this is attributable to their peculiar feeding habits (1,2).

Intraluminal obstruction of the esophagus in ruminants is popularly referred to as choke, which may occur due to attempts to swallow vegetables, whole fruits, or foreign objects (7,15–23). The results of our study showed that intraluminal blockade of the esophagus occurs by sugar beet, corn cups, turnip, onion, potato, leather masses, rubber objects, metal magnets, ropes, plastic sheets, plastic bags with accumulated food materials, pieces of cloth, and pedunculated granuloma. From our point of view, the nature of foreign bodies depends on the environment where the animals are reared. Ingestion of small sugar beets was found to be the main cause of obstruction in

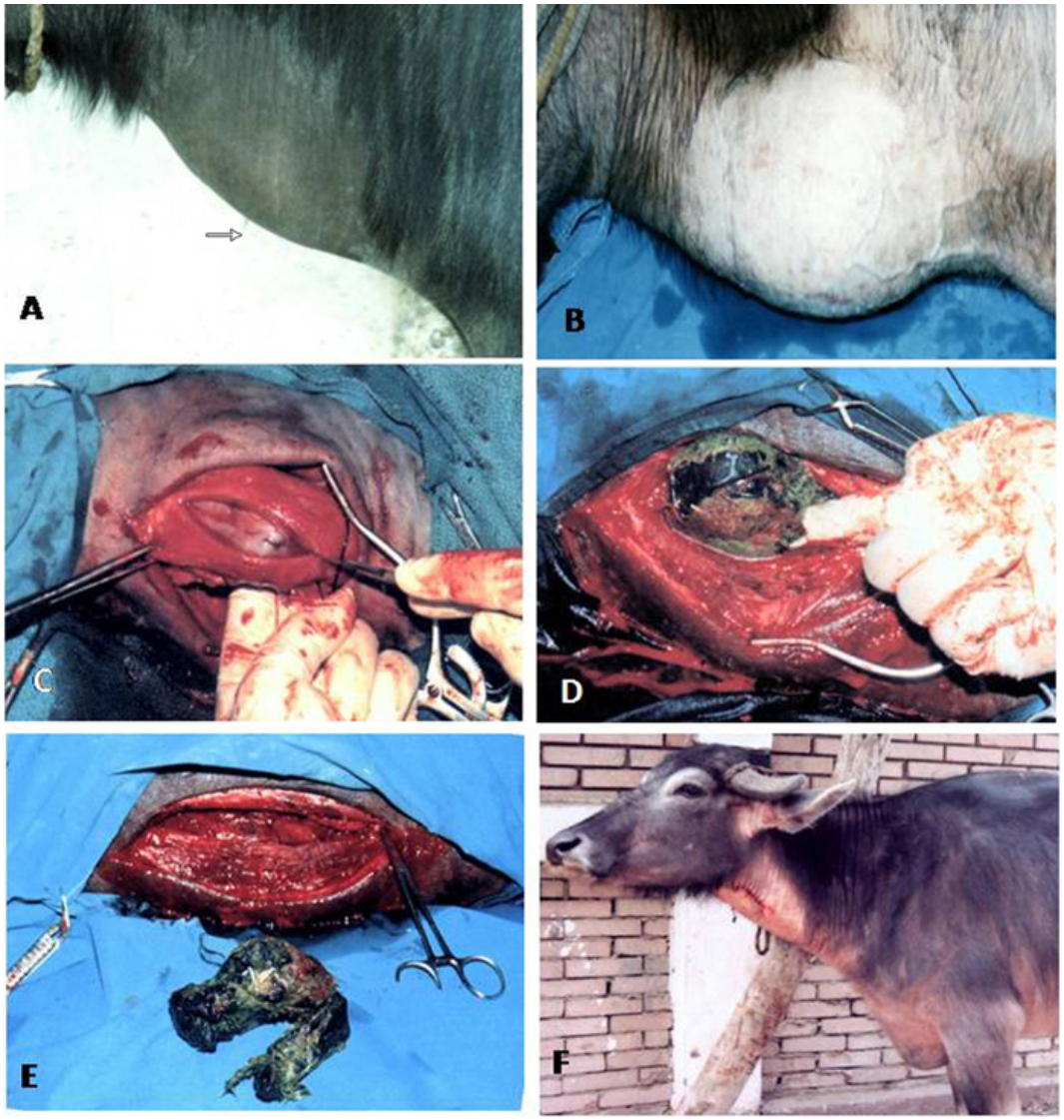

Figure 1. Esophageal obstruction (arrow) at the midcervical region in a buffalo (A) and the site of esophageal exposure or esophagatomy prepared (B); a longitudinal esophageal incision performed just cranial to the site of obstruction (C); a foreign body appeared at the esophagatomy incision (D) and a leather mass was extracted from the cervical esophagus (E); the operation site after surgery (F).

the present study. The sugar beet is one of the main crops grown in Kafrelsheikh Province. Sugar beets and tops are very palatable to buffaloes and are readily consumed.

Many authors reported that extraluminal incomplete obstruction occurs when pressure is exerted on the esophagus by the neighboring organs, tissues, or space-occupying lesions such as large periesophageal abscesses, enlarged mediastinal lymph nodes and thymic form of lymphosarcoma, aortic tumors, or mediastinal lymphadenopathy (6). In the present study, periesophageal cellulitis was found to be the cause of extraluminal incomplete esophageal obstruction in the upper cervical region in two rare cases. The presence of metal magnets deeply situated in the cranial aspect of the neck muscles and dorsal to the esophagus caused periesophageal cellulitis, which was attributed to pharyngeal trauma and perforation induced by a traditional handmade balling gun. These perforations led to dissecting, fibrous tracts, which extended along the dorsum of the esophagus and trachea and occupied this space as far dorsally as the transverse processes of the cervical vertebrae. Surgical drainage and removal of the foreign objects would have been the only way to successfully treat these cases.

Obstruction of the esophagus occurs mostly at the pharyngeal entrance and cervical, thoracic, or cardiac portions of the esophagus (2). In the present investigation,

Figure 2. Lateral radiograph of the midcervical region in a 2.5-year-old buffalo, showing presence of an irregular soft tissue mass density ventral to the 2nd and 3rd cervical vertebrae (leather mass) and a gaseous radiolucency within the dilated esophagus cranial to the foreign body (A). Lateral radiograph of the upper cervical region in a 4-year-old buffalo, showing an oval metal foreign body (metal magnet) located between the cervical muscles just ventral to C3 rather than within the esophagus. Note gas and ingesta accumulation periesophageally (B). Lateral radiograph of the chest showing soft tissue density (arrow) at the level of the thoracic esophagus (plastic bag filled with ingesta), with ventral deviation of the trachea at the cardiac inlet (C).

Table 2. Intervention and outcomes of esophageal obstruction in 44 buffaloes.

Intervention	Outcome (n = 44)	%
Manipulative treatment		
Thygesen's probang or stomach tube	4	9.0
Pushing the obstructing object toward the oral cavity	2	4.5
Surgical treatment		
Exposure of the cervical esophagus	3	6.8
Cervical esophagatomy	25	56.8
Surgical correction of periesophageal cellulitis	2	4.5
Laparorumenotomy	8	18
Short-term outcome		
Recovered	43	97.3
Complication (esophageal fistula)	1	2.2

most obstructions were located in the midcervical region (n = 30) or at the cardia (n = 10). Less often, the obstruction was in the upper cervical region (n = 7), in the lower cervical region (n = 3), or just at the pharyngoesophageal junction (n = 1). The cervical part of esophageal wall is thicker; the lumen appears as a trumpet or rosette shape and that could be the reason for the high incidence of obstruction in the cervical part of the esophagus. The pressure exerted by the first rib and the trachea could act as a predisposing factor (22). Moreover, the foreign object, which might have been passed initially to the rumen, could have come back during the act of rumination towards the mouth and been caught half way (24).

In a previous report of an unusual case of choke, a large matted tangle of placenta entwined with silage was found sitting near the esophageal cardia (13). A similar finding was recorded in the present study. A plastic bag entwined with ingested food materials was found obstructing the thoracic esophagus at the cardia in 2 animals.

Esophageal obstruction in ruminants is a more serious condition than in the horse. Fatality and risk associated with complete esophageal obstruction in ruminants results from the inability of fermentative gases to escape the rumenoreticulum. In some cases, signs assumed to ruminal bloat, respiratory distress, and metabolic acidosis can be severe enough that they mask the primary underlying esophageal disturbance. Acute severe bloat and ptyalism are the classical signs of complete esophageal obstruction in ruminants, but there are other less specific clinical signs that occur with varying frequency (2). In this study,

acute severe bloat and ptyalism were the cardinal signs of complete esophageal obstruction. Chronic tympany was observed in cases of incomplete intra- or extraluminal obstruction. Passing of a stomach tube to the esophagus was diagnostic for complete esophageal obstruction in the current study. With this simple measurement, the site of obstruction can be easily determined.

Survey and especially contrast radiography has a value in diagnosis of various esophageal disorders in cattle (1,25). In our study, most cases of cervical and thoracic esophageal obstruction were diagnosed easily through survey radiography. Tracheal and lung radiolucency act as a negative contrast background for most kinds of foreign bodies either with high or low radiodensity. Esophagoscopy is more practical, safer, and often very informative. Unfortunately, endoscopy was not available in our study.

Aspiration pneumonia should be considered in all cases of esophageal obstruction in horses (26). The duration of esophageal obstruction prior to admission is a significant risk factor for aspiration pneumonia because the risk of aspiration pneumonia increases with an increase in duration of obstruction (27). Unlike in equines, no signs of aspiration pneumonia were detected in our cases.

Every esophageal obstruction should be treated as an emergency due to increased pressure on the esophageal mucosa by the obstructing material, which causes extensive tissue damage with consequent formation of scar tissue, stenosis, and even esophageal perforation (28). Several treatment options for intraluminal esophageal obstruction have been cited. They have been categorized as conservative and surgical treatments. Various conservative treatments have been described for the management of esophageal foreign bodies in ruminants. The objective is either to advance the object aborally so that it passes into the rumen or to manipulate the foreign body so that it can be extracted orally. However, ruminal bloat must be relieved before attempting removal of the foreign body. This is often accomplished by trocarization through the left paralumbar fossa in animals suffering complete esophageal obstruction, or by passing a stomach tube in those suffering a partial obstruction (1,2). Once the bloat has been relieved, the obstruction may be manually broken down via percutaneous massage or may resolve spontaneously due to the large volume of saliva present. Administration of a regional local anesthetic works by diminishing esophageal muscle spasms and thus facilitates external esophageal massage and removal of the foreign body (4,29). Instruments such as a stomach tube or Thygesen's probang extractor can be used to gently dislodge the obstructing object from the esophagus into the rumen; however, there is a danger of shifting the obstruction from the cervical to the thoracic region. There is also increased risk of lacerating the esophageal mucosa (29,30). Similarly, an inflated endotracheal tube passed into the esophagus may be used to administer hydropulsion and lavage in an attempt to relieve the obstruction (29). Alternatively, if the equipment is available, endoscopic removal of an esophageal foreign body may also be employed (1). In the present study, such manipulative trials were successful only in 12 cases and all suggestions were directed to correct the other cases through surgical intervention.

Surgical treatment of an esophageal obstruction is indicated when conservative treatment fails to resolve the problem; however, many surgeons go directly to surgical treatment as a sole solution. In bovine practice, an esophagatomy is indicated if the foreign object is embedded within the cervical esophagus (3,29). A laparorumenotomy is the recommended approach to a foreign body located at the cardia. Although esophagatomy is a well-established technique, the risk of postoperative complications associated with esophagatomy incisional dehiscence and fistula formation must be considered if pursuing this course of treatment (31). Several factors have been documented to be responsible for the high rate of complications associated with cervical esophageal surgery, which include the lack of a serosal layer, movement during food deglutition, reverse peristalsis, and an easily interrupted segmental blood supply (1,3). The present series has shown that surgical treatment of esophageal obstruction has a high success rate and the postoperative complications are not common, being recorded only in one case.

The long-term prognosis for buffalo that underwent surgical treatment was good, as approximately all animals had no problems after 6 months of follow-up. The prognosis is good for animals suffering from esophageal obstruction if they are treated within 2 to 12 h from the onset of clinical signs, but it worsens for those animals that are not identified within 24 to 48 h from the time of obstruction. This is attributable to secondary ruminal tympany as well as to inflammation and necrosis of the esophageal mucosa (2).

It can be concluded that esophageal obstruction in buffalo is a clinical emergency that needs prompt intervention. Intraluminal obstruction with feed particles at the cervical region is more likely to occur in buffalo above 1 year of age. Radiography may be a useful tool to identify atypical cases of esophageal obstruction. Early diagnosis, proper application of manipulative or surgical interventions in due time, and postoperative follow-up are the fundamental factors for successful outcomes.

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