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Foreign Body Syndrome in Buffaloes (*Bubalus bubalis*): An Emerging Threat

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Abstract: Among several diseases of the bovine fore stomach, foreign body syndrome due to ingested foreign bodies in the buffaloes specially traumatic reticuloperitionitis and allied conditions has emerged out as a major problem affecting the productivity of the buffaloes and economy of the farmers of buffalo rearing countries worldwide. Foreign body syndrome (Iron mongery disease) can be defined as various conditions originating from ingestion of foreign bodies, typically a metallic objects, such as pieces of wire or a nail (Hardware disease) but sometimes non-metallic objects like stiff broom-bristles or sharp pieces of plastics and their lodgment into the reticulum, due to anatomical predisposition. Buffalo population in 1997 was 91.78 million which was 55% of the total world population and major contributor to the annual milk production of the country (FAO, 1999). The estimated growth rate in buffalo population from 1992-1999 was 10%. Thus signifies the reviewing of this condition in buffaloes and causes of emergence and related condition associated or resulting from it. The available literatures on various aspects of Foreign Body Syndrome in buffaloes have been reviewed under different headings.

Key words: Buffalo, foreign body syndrome, emergence, etiology, symptoms, diagnosis and treatment

Incidence

In India the incidence of Foreign Body Syndrome were reported by various workers from different parts of India. Higher incidence in India may be attributed to practice of livestock rearing based on hand feeding (Blood and Hutchin, 1955) compared to pasture rearing. Ramprabhu *et al*. (2003) reported incidence of 23.38% in buffaloes suffering from traumatic reticuloperitonitis and allied syndrome. Among the buffalo breeds highest (23.88%) were recorded in Murrah-cross buffaloes. Singh *et al*. (1993) reported higher incidence of foreign body syndrome in buffaloes compared to cattle in the same area. However such breed difference was due to proportion of breed available in the area. Higher incidence has been reported in recently calved buffaloes (Ramprabhu *et al*., 2003) and that too older buffaloes (Singh *et al*., 1983) compared to lactating and dry buffaloes. Sharma *et al*., (1994) reported an incidence of 87% in dairy buffaloes and 93% in buffaloes over 2 years of age in 1400 necropsies carried out. They also reported that out of 1400 necropsies carried out, 58 % of the lesions were caused by wires, 36% by nail and 6% by miscellaneous objects. Buffaloes quite commonly ingest foreign bodies (Sobti *et al*., 1987). Deshpande *et al*. (1982) has reported 636 cases of foreign body syndrome out of a total 3724 cases of rumen disorder in bovines. High incidence of TRP has been reported compared to other allied syndrome of foreign body syndrome in buffaloes. Pregnancy is not an important risk factor; though contribute to further penetration of lodged foreign body (Williams, 1955). Incidence of Foreign body has been reported from different parts of world by various workers

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in livestock (Rehage *et al*., 1995). The effect of calving and dystocia are not important factors (Hansen, 1953).

The condition tends to be more common during drought because animals are grazing closer to the ground or are being fed harvested material that is contaminated with foreign objects, such as short ends of baling wire. However, Grohn and Bruss (1990) reported no variation in incidence related to season. Reinforcement wire from tyres that have been cut in half and used as drought feeders has also been found at post-mortem. The disease presents considerable difficulty in diagnosis because ruminal atony and abdominal discomfort may occur in other diseases. The various conditions originating from Foreign Body Syndrome are traumatic reticulitis, traumatic reticuloperitonitis (Local and diffuse), traumatic pericarditis, diaphragmatic hernia. Other minor complications are reticular abscess, vagal indigestion or Hoflands Syndrome, hepatic abscess, splenic abscess, rupture of left gastro-epiploic artery, traumatic pneumonia and pleurisy, mediastinal abscess (Radostits *et al*., 2000).

Factors attributed to emergence of Foreign Body Syndrome

- Rapid industrialization and rapid civilization has resulted in increased incidence of the Foreign Body Syndrome, due to spread of metallic and non-metallic garbage and waste and thus more incidence of these cases are reported in highly industrialized and urbanized areas such as Punjab, Haryana and other big cities.
- Due to intensive system of Livestock rearing for maximal production, high-rise in deficiency state especially of calcium, phosphorus and micro-minerals, has resulted in perverted appetite, which is one important factor for intentional ingestion of foreign objects.
- In our country, buffaloes and cattle rearing are generally based on backyard rearing or organized dairy farms based on stall-feeding. Thus the chance of occurrence of Foreign Body Syndrome is more as maximal intake of foreign bodies is via chaffed feed.
- Advancement in diagnostic methods such as use of ultrasonography, radiography, ferroscopy and other biochemical methods has greatly enhanced the efficiency of veterinarian to diagnose cases which were not earlier diagnosed.

Etiology

The typical foreign body is a metallic object, such as a piece of wire or a nail, often greater than 2.5 cm in length (Rebhun, 1995). But sometimes non-metallic objects like stiff broom-bristles or sharp pieces of plastics and their lodgment into the reticulum, due to anatomical predisposition has also been reported (Krishnamurthy *et al*., 1998). A large number of adult dairy buffaloes have metallic foreign bodies in their reticulum without signs of clinical disease and occasionally non-perforating foreign bodies such as ball bearings, stones, coins may be passed out in faeces. It is likely that a predisposing factor in otherwise normal buffalo, such as tenesmus or a gravid uterus, causes migration of the foreign body into the reticular wall (Rebhun, 1995). In addition vigorous contraction of reticulum aided by the movement of diaphragm make the thin potential foreign body to penetrate through the reticular wall at different sites and in varying direction (Williams, 1955). Consequently resulting in different sequels. Buffaloes are clumsy and indiscriminate feeder and they take a nail or some other metallic objects into their mouth and it passes beyond the dorsum of the tongue, they do not seem to be able to split it out and in most cases reaches abomasum. Apart from this some animals suffer from mineral deficiencies seem to relish objects with a mineral or metallic taste. Swallowed foreign bodies may lodge in the upper esophagus and cause obstruction in the esophageal groove and vomiting but in most instances they pass to the reticulum. Many lie there without causing any harm but the honeycomb like structure of the reticulum provides many sites for fixation of the foreign body and contractions of the reticulum

are sufficient to push a sharp-pointed object through the wall. Buffaloes are prone to Diaphragmatic hernia due to foreign bodies (Deshpande *et al*., 1982). The anatomical differences (relatively small tendinous portion of the diaphragm resulting in innate weakness) have been attributed to such predisposition (Krishnamurthy *et al*., 1983 and Singh *et al*., 1980). In addition, the estimated growth rate of buffalo population (10%) from 1992-1999 was higher compared to cattle population (2.42%) in India (FAO, 1999) and bulk of the total milk production (55%) is dependent on buffaloes.

Complications of TRP

Reticular abscesses are a common complication of TRP. Also, if the foreign body migrates through the diaphragm and into the pericardium, it can result in septic pericarditis and congestive heart failure (Krishnamurthy *et al*., 1985). Less common complications include reticular fistulation, vagal indigestion, diaphragmatic hernia, traumatic pleurisy, pneumonia, rupture of gastroepiploic artery, diaphragmatic abscess, formation of abscess on the lateral and ventral wall of abdomen in which foreign body lodges (Rebhun, 1995; Kohli *et al*., 1982; Sobti *et al*.,1987).

Clinical Findings

Characteristically imaginary band about 20 cm wide covering the ventral third of the abdomen from the left to the right side with the cranial border of the band being the point just caudal to the xiphisternum (Pole test). This area should be probed with at least 6 deep palpation on both sides of the abdomen while listening with a stethoscope over the trachea for evidence of a grunt (Begg, 1950). Pinching the withers to cause depression of the back and eliciting a grunt is also an effective diagnostic aid except in large adult cows and bulls; for these the sharp elevation of a solid rail held horizontally under the abdomen is a useful method for eliciting a grunt (Wither test). The grunt is usually heard 2-3 sec before primary ruminal contraction can be felt through the left flank (Williams, 1955). This is also known as 'wire grunt' (Hansen, 1953). The localized peritonitis may spread to cause diffuse peritonitis or may remain localized and cause subsequent damage including vagus indigestion and diaphragmatic hernia (Radostitis *et al*., 2000).

There is a record of iatrogenic reticulitis which occurred as a result of the oral administration of intra-ruminal anthelmintic boluses which may have lodged in the reticulum and become filled with other foreign objects ingested by the animal, resulting in a syndrome similar to acute traumatic reticuloperitonitis (Sharma *et al*., 1994).

Diagnosis

Complete Blood Count (CBC)

The CBC in a buffaloes with TRP can vary depending on whether the peritonitis is acute or chronic and localized or diffuse. In general, animal with persistent purulent inflammation have leukocyte counts ranging from 5,000-15,000 cells/μL, with neutrophilia (unsegmented neutrophils) (Churchill, 1950). Although lymphocytes are the predominant leukocyte circulating in healthy cattle, endogenous corticosteroid release secondary to stress may cause lymphopenia by cell redistribution; circulating lymphocytes do not re-enter the lymphatics but become sequestered in lymphoid tissue and bone marrow (Latimer *et al*., 2003). Affected animal also will show hyperfibrinogenemia, with fibrinogen concentrations greater than 1,000 mg dL^{-1} (Ducharme and Fubini, 2004). Fibrinogen is an acute phase and in cattle may be the best indicator of acute inflammation because fibrinogen concentrations often increase prior to development of neutrophilia (Latimer *et al*., 2003).

Some buffaloes with acute, localized peritonitis will have CBCs within normal reference intervals, while others will have a degenerative left shift. Buffaloes with acute diffuse peritonitis, the onset is sudden with complete anorexia and a marked drop in milk yield. Sub acute abdominal pain is common in most cases and the animal is reluctant to move. Walking, particularly downhill, is often accompanied by grunting. Most animals prefer to remain standing for long periods. Arching of the back occurs in some of cases along with the appearance of tenseness of the back and the abdominal muscles so that the animal appears gaunt or 'tucked-up'. Defecation and urination cause pain and accompany usually with grunting. This results in constipation, scant feces and in some cases retention of urine. In others there is recumbency and reluctance to stand.

Regurgitation, kyphosis, abduction of elbows (Matteson *et al.,* 1953; Pinset, 1962), pellety dung, poorly digested fiber, recurrent bloat, Brisket edema, muffling heart sounds were the various symptoms observed by Ramprabhu *et al*. (2003). The general behavior and attitude of all the animals were unsettled. The rectal temperature varied from 38.95 to 39.45°C in cows and 38.43 to 39.50°C in buffaloes. The heart rate was between 44.90 and 89.00 in cows and 78.75 and 82.00 min^{-1} in buffaloes and the respiratory rate varied between 32.64 and 39.45 in cows and 30.14 and 39.50 min^{-1} in buffaloes. Ruminal motility reduces in all cases. Out of the five grunt tests conducted, scootch test (70.15%), reticular grunt (67.16%) and xiphisternum percussion (64.18%) were found to give highest positive results in TRP and allied syndrome (Ramprabhu *et al*., 2003). Sometimes, trembling of muscles over the left side on the back of elbow, occasionally over rumen and rarely on both sides is reported (Bardwell and Udall, 1927).

A moderate systemic reaction is common in acute localized peritonitis. In acute localized peritonitis the clinical sign commences 24 h after the penetration (Kingrey, 1955). The temperature, the heart rate is about 80 min^{-1} and the respiratory rate about 30 min^{-1}. Temperatures above 40°C (104° F) accompanied by heart rates greater than 90 min^{-1} suggest severe complications. Rumination is absent and reticulo-rumen movements are markedly depressed and usually absent. In 75% cases with induration of medial reticular wall due to traumatic injury, the normal tension receptor activity is abolished and hypomotility of rumeno-retuicular occurs (Leek, 1969). The rumen may appear to be full because of the presence of a free-gas bloat with moderate distension of the left paralumbar fossa (Radostitis *et al*., 2002).

Pain can be elicited by deep palpation of the abdominal wall just caudal to the xiphisternum. Palpation is done using short, sharp pushes with the closed fist or knee and also have a degenerative left shift. In chronic cases, a mature neutrophilia is common (Rebhun, 1995). Neutrophilia in the absence of leukocytosis was indicative of diffuse traumatic reticuloperitonitis (Misra and Angelo, 1974; Schilling, 1929). There is daily periodic shift of TLC from higher to lower or vice-versa (Matteson *et al*., 1953) and a definite neutrophillic shift to left is observed as the continuous progress from normal to acute diffuse peritonitis (Williams, 1955). Neutrophilia has also been observed in a buffalo with extra-reticular fibrous nodules (Sobti *et al*., 1987).

Serum Biochemical Profile

The most common chemistry abnormality associated with TRP is hyperproteinemia with a hyperglobulinemia. Total protein concentration greater than 10 mg dL^{-1} is highly suggestive of TRP (Ducharme and Fubini, 2004). In one study, cattle suspected of having TRP that also had a total plasma protein concentration of 100 g L^{-1} (10 mg dL^{-1}) had an 83% chance of having TRP. The specificity at 10 mg dL^{-1} was 96.2% and was found to increase as total plasma protein concentration increased (Dubensky and White, 1983). Highly significant increase in globulin and fibrinogen levels and decreases in albumin and Plasma Protein: Fibrinogen ratio (PP: F) was recorded (Ramakrishana *et al*., 1979; Dimopoullous , 1970; Prathaban,1983).

Other chemistry abnormalities associated with TRP may include hypochloremia, hypokalemia and metabolic alkalosis; these abnormalities are secondary to ruminal hypomotility. Decreased rumen function cannot maintain normal plasma/rumen chlorine gradients and ruminal chloride ions increase. Chloride ions also can become sequestered in cases of severe ruminal hypomotility (Ducharme and Fubini, 2004). Metabolic alkalosis occurs secondarily. Hypokalemia results primarily by anorexia, but may be potentiated slightly by ion exchange caused by the alkalosis. With alkalosis, intracellular H^+ ions can be exchanged for extracellular K^+ ions, decreasing serum potassium concentrations. This effect is minor as compared with K^+ ion shifts associated with acidosis (Latimer *et al*., 2003).

The changes in haematological values and biochemical parameters such as elevation of fibrinogen, aspartate aminotransferase and alkaline phosphatase are suggestive of inflammatory changes in the body not only traumatic reticulo-peritonitis. Although the haematological examination is of considerable value as a diagnostic aid in TRP, these alterations are non-specific and can also be seen in association with other bacterial infections following severe stress (Benjamin, 1985). In Sulkowitch test animals having lowered calcium were detected positive for TRP (Prathaban, 1983).

Abdominocentesis

Normal peritoneal fluid of an adult cow is straw-colored, clear and odorless. Protein and fibrinogen concentrations can vary from 1.0-3.0 g dL^{-1} and 100-500 g dL^{-1}, respectively. The nucleated cell count should be less than 10,000 cells μL^{-1}. The majority of nucleated cells are non-degenerate neutrophils and mononuclear cells. At least 10% of the nucleated cell population should consist of eosinophils (House *et al*., 1992). Turbid samples or samples containing gross pus or fibrin is indicative of peritonitis, at least locally. It is, however, normal for bovine peritoneal fluid to clot upon standing. Nucleated cell count, cell percentages and character of cells present can be suggestive of disease. If a sample contains immature, degenerative, or toxic neutrophils, purulent peritonitis can be suspected. Samples with greater than 40% neutrophils or less than 10% eosinophils are also indicative of purulent peritonitis. Intra-nuclear bacteria and degenerate neutrophils indicate septic peritonitis (House *et al*., 1992).

Normal cytological findings do not exclude TRP since bovines tend to wall-off inflammation in the peritoneal cavity, making it more difficult to diagnose local peritonitis. Abdominocentesis for evaluation of TRP should be performed at the ruminal-reticular recess to increase the chance of obtaining a diagnostic sample (House *et al*., 1992). Adult ranges should not be used to evaluate peritoneal fluid obtained from younger animals (Anderson *et al*., 1995) as reference ranges for calves vary significantly from adult. The most notable difference between normal peritoneal samples in calves versus adult is the protein concentration and percentages of neutrophils and eosinophils.

Laparoscopy and Metal Detection (Ferrosope) : Right flank laparoscopy using a flexible fiberoptic laparoscope, 14 mm diameter and 1120 mm working length, is a reliable diagnostic aid for the presence of traumatic reticuloperitonitis.

Metal detectors were used at one time to aid in the diagnosis of traumatic reticuloperitonitis (Formston, 1949; Luenberger *et al*., 1978) and in rapid collection of data on incidence of foreign body in the fore-stomach of the ruminants (Radostitis *et al*., 2000). Ferrous metallic foreign bodies can be detected with metal detectors but the instruments are of limited use because most normal diary bovines are positive for metal over the reticular area (Churchill, 1950; Williams, 1955; Carroll and Robinson, 1958).

Radiographic Findings

Radiological examination of the reticulum with the animal in dorsal recumbency (dorsal reticulography) is an accurate diagnostic method for the evaluation of cattle with suspected traumatic reticuloperitonitis (Singh *et al*., 1983; Braun *et al*., 1993). An X-ray machine with a capacity of 1000-

1250 mA and 150 kV is needed. The major advantages of radiography are that metallic foreign bodies can be visualized and their position determined. Radiography as an aid in the diagnosis of the conditions includes a typically positioned foreign bodies, abnormal gas shadows in the region of the reticulum and depression in the cranio-ventral margin of the reticulum (Partington and Biller, 1991). Small gas inclusion or gas bubbles over a fluid interface in the region of the reticulum are pathogenic for the condition, resulting from gas-producing bacteria involved in the abscess formation or from compartmentalization of gas from the reticulum (Fubini *et al*., 1990). Some of the associated lesions like phrenic abscess, reticular abscess, cardiophrenic adhesions and pneumothorax can also be diagnosed (Kohli *et al*., 1982). An accumulation of gas-fluid interface outside the gastrointestinal tract and intra-abdominal masses are typical finding in cattle with traumatic reticulo-peritionitis (Braun *et al*., 1993). They reported the sensitivity of radiographic diagnosis of TRP to be 76% sensitive, 93% specific, 85% accuracy, 92% positive predicative and 80% negative predictive.

Ultrasonographic Findings

Ultrasonography is useful for observing reticular motility and for recognizing fibrinous deposits, abscess and accumulation of fluids (Braun *et al*., 1993; Kaske *et al*., 1994). However, metal foreign bodies and magnets cannot be visualized and radiography remains the best method for this purpose. The reticulum and adjacent organs of cattle and buffaloes can be examined with ultrasonography using a 3.5 MHz linear transducer applied to the ventral midline of the thorax over the 6th and 7th inter-costal spaces and from the left and right sides of the midline (Braun and Gotz, 1994). The reticulum can be visualized in more than 90% of cows in spite of interference by the ribs and sternum. A healthy bovine reticulum appears as half moon shaped structure with a smooth contour that contract at regular interval in ultrasonography. Ultrasonography examination includes observation of reticular motility during three-minute period, of reticular contours and of adjacent structure such as the diaphragm, anterior dorsal blind sac of rumen, the ventral sac of the rumen, the spleen, omasum, abomasum and liver. In cows with disturbed reticular motility, biphasic contractions are slower than normal or indistinct and the numbers of contractions are reduced. Fibrinous changes appear as echogenic deposits, sometimes accompanied by hypoechogenic fluid. Abscesses have an echogenic capsules with hypoechogenic center (Braun *et al*., 1993; Braun *et al*., 1998) and for observing the soft tissue changes in peri-reticular area, it is the best. Ultrasonography can also detect adhesions of segments of intestine to the abdominal wall (Tucker *et al*., 1996) and left displacement of abomasum which presents similar symptoms to foreign body syndrome (Braun *et al*., 1997). Ultrasonography of reticulum is a useful aid in diagnosing traumatic reticuloperitionitis in buffaloes and supplements the results of clinical and radiographic examinations.

Treatment

The choice of treatment is largely governed by economics and the facilities and time available for surgery. Since reticular foreign bodies often migrate back into the lumen of the reticulum, conservative treatment can have good results. Conservative treatment consists of instillation of a magnet to recover or immobilize the metal foreign body (if iron-containing), by administration of antibacterial drugs to control the progression and possibly the oral administration of a magnet. The animal can be tied or sanctioned or confined in a box stall for several days. The immobilization facilitates the formation of adhesions and removal of the foreign body, may be further aided by standing the animal on an inclined plane (Sharma *et al*., 1994). Either made of a door or planks or by packing earth under the front feet of the animal. The front feet should be elevated about 25 cm above the floor (Radostits *et al*., 2002).

Feed, particularly the roughage should be reduced to about half. The response is often so good that the farmer is tempted to turn the cow loose before the allotted time and relapses frequently occur. Antimicrobials are administered parentally daily for 3-5 days. Sulfamethazine at the rate of 150 mg kg^{-1} body weight daily for 3-5 days provided good results in uncomplicated cases. Penicillin or broad spectrum antimicrobials given parentally daily for 3-5 days are also widely used with empirical success. For lactating dairy cattle, those antimicrobials with a short milk withdrawal period are desirable. The general effect appears to be good and a high rate of recovery is recorded with antimicrobials parentally combined with immobilization provided treatment is begun early. Bovines past their 6th month of pregnancy are likely to show incomplete recovery or relapse. Affected animal can also be treated with 3-7 days of systemic antibiotic therapy (ceftiofur, ampicillin, or tetracycline), stall rest and other supportive therapy as indicated. Affected animal should be re-evaluated in 48-72 h. If a magnet is already in place or conservative therapy is not successful, an exploratory laparotomy or rumenotomy is indicated for removal of the foreign body (Rebhun, 1995; Ducharme and Fubini, 2004). The recovery rate after surgery is likely to be much lower if only complicated cases are operated on. A rumenotomy, satisfactorily performed, is the best treatment but is unnecessary in many cases because of the tendency of the foreign body to fall back into the reticulum. The best general policy is to treat the animal conservatively for 3 day and if marked improvement has not occurred by that time to perform a rumenotomy.

Prevention

Prevention of TRP is preferred to either conservative medical treatment or surgery. Although one source does not believe magnets are an effective preventative measure (Eddy, 1992). The majority of clinicians agree that all cattle over one year of age should have a prophylactic magnet placed in the reticulum (Rebhun, 1995; Ducharme and Fubini, 2004; Ward and Ducharme, 1994). Following oral administration, most magnets do not enter the reticulum directly, but are first deposited in the cranial sac of the rumen before entering the reticulum following ruminal contractions (Ducharme and Fubini, 2004). Buffaloes should be kept away from construction sites and crop fields should be monitored for metal debris. Also, processed feed can be passed over magnets to recover any iron-containing foreign bodies prior to being fed to these animals.

Conclusions

Foreign body syndrome is becoming an emerging problem to livestock owners and farmers of our country greatly attributed to heavy industrialization and human habitation which has increase the chance of livestock to ingest such objects. Though modern diagnostic techniques have greatly enhanced the capabilities of veterinarians to diagnose such conditions, further enhancement and sophistication is needed as the prognosis of treatment and survival relies on early diagnosis of such conditions. Another important point to be looked upon is about use of prophylactic magnets which is not in practice in our country. Provision of livestock rearing away form such scrap infested areas will greatly reduce the incidence. Research in the area of diagnosis, treatment, prevention and control of various conditions arising as consequence to foreign body syndrome is the need of the hour. Mineral deficiencies and resulting state of pica has contributed much to the emergence of FBS in our country which must be seriously looked upon.

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