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Balling gun-induced trauma in cattle: clinical presentation, diagnosis and prevention

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Abstract: Pharyngeal trauma in cattle can occur during the administration of oral medication using a balling gun. The number of cases of severe complications due to bolus application that have been referred to our hospital has increased from nil between 1996 and 2008 to three or four per year. In our experience, reports by bovine veterinarians of patients with severe and often fatal pharyngeal trauma, which were not referred to the clinic, have become more common in recent years as well. The incidence of this complication is likely to be higher than this number of referrals suggests. Diagnosis without the help of imaging techniques, such as radiography and endoscopy, may be difficult, especially in cases where exploration of the pharynx cannot be carried out, or is unable to confirm the absence or presence of a lesion. Prognosis is often poor in cases where perforation has been confirmed. Boluses are increasingly administered by the owners or farm personnel without the supervision of a veterinarian. In order to prevent losses due to balling gun-induced injuries, the veterinarian plays a crucial role in giving advice to his clients. Five cases of cattle suffering from varying degrees of balling gun-induced trauma are presented, and consideration is given to incorrect application techniques.

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Balling gun- induced oropharyngeal trauma in cattle: an illustration of clinical cases.

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Abstract

The medical history, clinical findings, diagnostic procedures and treatment of four adult cattle suffering from balling gun induced traumata are illustrated. All animals had been administered boluses by laymen. Some of the animals had reportedly shown defensive movements during the procedure. All affected cattle showed reduced appetite promptly after the procedure. At presentation, dyspnea and swelling of the throat were evident in three patients. Increased salivation was observed in two animals. Diagnosis was aided in all cases by endoscopic examination. Three animals had to be euthanized due to the severity of the lesions or the lack of improvement despite surgical and medical treatment. One cow was discharged from the hospital two weeks after successful removal of a broken bolus from the animal´s esophagus. This report illustrates that it is of marked importance that veterinarians give adequate advice on the correct use of balling guns prior to their use by the producer, and that they are able to recognize complications and the respective clinical symptoms of oropharyngeal or esophageal traumata. Additionally, they should be able to inform the owner about the treatment options and prognosis when suspecting a perforating lesion after bolus administration.

Background

The oral application of drugs for disease prophylaxis or treatment is a widespread, inexpensive treatment route in the cattle industry. Possible indications include calcium supplementation around the time of calving for the prevention or adjunctive treatment of hypocalcemia [1], the use of magnesium boluses for the prevention of grass tetany in pastured animals located in endemic areas [2] as well as the application of selenium, copper and cobalt in the form of single or combined trace mineral slow-release pills [3]. Not only minerals and trace minerals but also anthelmintic drugs can be administered in the form of an intraruminal bolus [4]. Several other areas of application are propagated by the animal

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feed industry, ranging from boluses targeting indigestion and rumen health to boluses supplying extra energy for fresh cows. Magnets constructed to prevent traumatic reticuloperitonitis are also given the same way as the products described previously. Apart from reports about severe pharyngeal injury after the administration of some of the above mentioned boluses [5, 6] cases or perforation have been described after the use of anthelmintic boluses [7, 8] and antimicrobial boluses [9] in cattle as well as drenching and bolus gun induced injuries in sheep [10, 11] have been published. In all reports mechanical devices were used. Although some information on the correct use of the mechanical devices used to deliver the capsules may be available to the farmer (e.g. product label), an understanding of the anatomical situation and the physiological process of swallowing as well as possible complications during the oral administration of boluses is often lacking. Apart from those pills containing regulated drugs and which are only available with veterinary prescription, they can easily be obtained in a feed store or ordered online by the farmer.

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Forceful application, especially when animals show strong defensive reactions, can lead to severe traumata including perforation of the pharynx or esophagus, tissue damage with subsequent necrosis or choke. This report describes the clinical signs, radiological and endoscopic exams as well as surgical and postmortem findings of four cases of traumata associated with the administration of boluses to adult animals admitted to our clinic between April of 2009 and April of 2011.

Case presentations

All cases were seen at the Clinic for Ruminants with Ambulatory and Herd Health Services at the Centre for Clinical Veterinary Medicine, University of Munich, Germany.

Case 1

A 10-year-old male valuable German Fleckvieh breeding bull was presented to the clinic two days after oral administration of two mineral boluses. The caretakers that had performed the procedure did not report about any defensive reaction of the animal. Starting the day after

the administration, the bull was noted off-feed. The referring veterinarian had observed a discrete swelling around the larynx which became progressively larger. On presentation, the bull was alert and showed no signs of respiratory distress although he coughed spontaneously. He exhibited a firm, doughy and poorly delimitable enlargement of the upper third of the ventral cervical region of about 30 x 30 x 40 cm in size. The oral cavity was explored manually and a perforation site of the oropharyngeal mucosa with a 3 cm-diameter was detected on the dorsolateral aspect of the pharynx. On laterolateral radiographs, two boluses located at the dorsal aspect of the larynx and proximal esophagus were visible (Figure 1). Ultrasonographic examination revealed several small fluid-filled caverns between the muscles of the neck and a distinct subcutaneous edema. Endoscopy of the larynx and esophagus was carried out to complete the examination and revealed a lesion of about 2.5 cm in diameter lined with feed particles located on the right dorsolateral aspect of the esophageal opening. Attempts to retrieve the object manually through the oral cavity failed because they could hardly be reached with the finger tips and not be grasped with forceps. Inhalation anaesthesia was instituted and the boluses were extracted surgically with a lateral approach to the right ventral neck area. The skin incision was located ventral to the jugular vein, which was isolated by blunt dissection and lifted together with the external carotid artery and the vagal nerve to approach the esophagus. Blunt dissection of the muscles was used until the boluses could be located and extracted manually (Figure 2). The oropharyngeal laceration was not palpable through the incision. The wound was drained and left open to heal by second intention. Recovery from anaesthesia was uneventful and the bull was treated with antimicrobials and antiphlogistics (procaine penicillin G at 30,000 IU/kg i.m., ketoprofen at 3 mg/kg i.v.). He received intravenous fluids initially and was held off feed for five days following surgery. He was offered finely chopped hay starting on day six and the animal started to eat and drink. Unfortunately, feed particles were noted in the surgical wound four days later. A noise could be heard regularly during each ructuation process, and the bull was again off feed. A second general anaesthesia was instituted and the pharyngeal wound was sutured from intraorally under endoscopic guidance. Wound dehiscence was

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however observed four days after the second surgery and the bull deteriorated continuously despite intensive medical treatment. He was euthanized 27 days after admission. On necropsy, a 29 x 22 x 3 cm wide cavern filled with feed material was found. An incidental finding was the presence of several chronic abomasal ulcerations that were up to 12 x 4 cm in size.

Case 2

A 3½-year-old German Fleckvieh cow was referred to the clinic with a history of inappetence and respiratory symptoms. The cow was housed in a free stall barn and had received a calcium bolus at the time of calving, four weeks prior to presentation. The bolus had been administered by the owner who did not observe obvious signs of disease until two weeks after the event when labored breathing and a distinct swelling in the area of the larynx were noted. Fever (40.0°C) and anorexia were also present at this time and malodorous breath was noted. The herd veterinarian had prescribed a five-day course of systemic antimicrobial treatment and antiphlogistic therapy (cefquinom sulfate at 1 mg/kg, flunixin meglumine at 2.2 mg/kg) one week prior to admission, but no clinical improvement was achieved. On presentation, the cow was alert but nervous and showed severe respiratory distress exhibiting open-mouth breathing while keeping her neck extended. Severely increased salivation was striking. Fever of 40.8°C was also noted and bronchopneumonia of the cranioventral lung aspects as well as pulmonary emphysema were diagnosed. No swelling of the laryngeal area was noted on palpation. Radiographs of the larynx and proximal trachea showed a thickening of the tracheal borders with narrowing of the tracheal lumen. Extensive gas lucencies could be appreciated dorsal to the trachea within the soft tissue of the upper neck region (Figure 3). Ultrasonography revealed the presence of hyperechoic material in the rostral third of the tracheal lumen. A tracheoscopy was performed and yellow-green material was seen directly behind the glottis. The tracheal mucosa was abnormal in color and texture with several pale plaques adhering to the surface and the existence of numerous craterlike indentations. The patient was hospitalized and received an initial anti-inflammatory treatment

(dexamethasone at 0.15 mg/kg) and systemic antimicrobial treatment for seven days (procaine penicillin G at 25,000 IU/kg). The rectal temperature was within normal limits a few hours after initiation of treatment and signs of respiratory distress subsided dramatically. Over the next six days, an improvement in clinical signs was recorded but the animal´s condition deteriorated rapidly on day eight when the cow exhibited life-threatening dyspnea. The animal was euthanized the same day due to the poor prognosis. Necropsy and histopathology demonstrated a laryngitis and severe tracheitis with necrotization and bleeding of the thickened mucosa as well as inflammation and degradation of the tracheal rings of the proximal 10 cm of the trachea. Especially the dorsal pharyngeal area was inflamed and edematous. The tracheal lumen was almost completely obstructed by the presence of a blood clot most likely stemming from an intratracheal hemorrhage of the severely thickened mucosa (Figure 4). Bronchopneumonia of the craniolateral lung aspects was confirmed.

Case 3

A 4½-year-old Brown Swiss cow was referred to our clinic with anorexia and fever of several days duration. The animal had been given a combined calcium and phosphor bolus on the day of calving and the owner reported strong defensive movements; a few hours later a part of the bolus was found in the feed alley and the cow was breathing hard. Two days afterwards fever was noted (40.5°C) and the cow became anorexic. Antiinfective and antiphlogistic therapy were initiated by the herd veterinarian (procaine penicillin G at 20,000 IU/kg), metamizole at 40 mg/kg). On presentation six days after bolus administration, the cow was depressed and extended her neck constantly, coughing spontaneously. Feed material was visible in both nostrils which were constantly blared; breathing was labored and markedly abdominal. A discrete swelling of the cranial ventral neck region was visible. Palpation of this approximately 20 x 30 x 20 cm sized enlargement caused a pain reaction and revealed a doughy consistency. During examination of the oral cavity feed particles were noted in the pharyngeal area; the odor of the breath was unremarkable. Radiographs

showed extensive gas lucencies in the soft tissues around the trachea (Figure 5). An endoscopy of the larynx, esophagus and trachea showed a perforation of the pharynx dorsal to the esophageal entry which was about 5 cm in diameter and surrounded by feed material (Figure 4). This perforation lead to a cavity lined with feed material situated dorsally to the esophagus, it was easily explored with the endoscope and could be traced for a length of about 20 cm without resistance. Euthanasia was performed on the same day because the prognosis was estimated to be poor. On necropsy, perforation of the pharynx was confirmed (Figure 7). Separation of the tissues had extended parallel to the esophagus, creating a cavern with a tapered end. The margins of the orifice as well as the surface of the tissues were necrotized and lined with feed particles which could be traced along the mediastinum up to the base of the heart.. Further macrosocopic findings included severe emphysema of the lungs, pneumomediastinum and several abomasal ulcerations of about 3 mm diameter each.

Case 4

A 8½-year-old German Fleckvieh cow was admitted to the clinic the day after the owner gave a calcium bolus with the help of a balling gun. When discharging the gun, the cow had jerked back and started coughing right after the procedure was done. The cow calved that same night without difficulties but increased salivation and repeated coughing were noted. The owner noticed part of the bolus in the bedding later that day. The herd veterinarian was notified because the animal refused to eat and kept coughing the next day; he referred the cow to the clinic immediately. On examination the animal showed dull demeanor and soft moaning, the head was kept in an extended position and severely increased salivation was present. Further findings included a firm swelling in the upper third of the neck of about 15 x 15 x 20 cm and the presence of feed particles in both nostrils. The animal was dyspnoeic with bilaterally increased lung sounds. Bilateral emphysema of the dorsal lung field was also diagnosed. Normal ructus was present and ruminal tympany was not observed. Examination of the oral cavity revealed no abnormalities. Radiographs were taken of the neck region and

showed a clearly distinguishable foreign body within the lumen of the esophagus, obstructing the lumen almost entirely (Figure 8). Gas lucencies in the soft tissues were not present and it was assumed that perforation of the pharynx and esophagus had not occurred thus far. After the confirmation of the presence of a foreign body within the esophagus, an endoscopy of the pharyngeal region, esophagus and trachea was performed. No indication of perforation of the pharyngeal mucosa was seen. On examination of the esophagus, a mass of feed material was seen about 20 cm past the esophageal entrance, passage with the endoscope was unsuccessful. A few feed particles were visible on exploration of the trachea. Extraction of a 20 x 10 cm egg-shaped impacted feed mass was achieved with the help of a Thygesen probe. Part of a calcium bolus built the center of this feed agglomerate (Figure 9). Supportive therapy (intravenous fluids) as well as antimicrobial (cefquinom sulfate at 1 mg/kg) and antiphlogistic therapy (meloxicam at 0.5 mg/kg) were started because of suspected aspiration pneumonia. The animal was kept off-feed during the next two days after which the animal was offered corn silage and hay. Appetite and milk yield increased steadily during the hospital stay, fever was never present and the animal could be discharged 13 days later. Unfortunately, two months after discharge from the clinic, the cow developed non-treatable mastitis in one quarter and was sent to slaughter. The owner did not notice any abnormalities in feed intake, demeanor or breathing up to this point.

Conclusions

The administration of boluses is a common management tool and lesions such as the ones described in our case report have been diagnosed repeatedly [9, 12-17]. The infrequency with which this problem is reported might be explained partially by under diagnosing bolus induced traumata. We assume that the true incidence is higher than the literature would suggest [7]. In all cases consequences are severe and costly and rapid diagnosis is necessary to prevent the affected animals from unnecessary suffering. This emphasizes that a balling gun-induced oropharyngeal trauma is an important differential diagnosis in animals showing the clinical signs described in our study. Diagnosis can further be confirmed by

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radiographic and endoscopic examination as well as by careful exploration of the oral cavity. Apart from the ability to show gas pockets in the soft tissues surrounding the esophagus, it is often possible to identify the foreign body itself if its opacity differs from that of the soft tissue depicted on radiographs [7]. In case of suspected balling gun- induced injury the referral to an institution where these diagnostic techniques are available is recommended. Treatment of animals with balling gun injuries may not be economically feasible [5]. Reports about successful medical [7, 9] and surgical [5, 7, 8, 11] treatment of perforating injuries in animals are rare and performance of the animals is often described as impaired. Only one cow of the present report in which no perforation of the pharynx occurred could be treated successfully. In the bull of the present study, aspiration of air through the laceration during ructus most probably prevented closure of the pharyngeal wound. At each ructuation process, the pharyngeal wound was spread apart and feed particles could such enter the soft tissues. Additional supportive measures like rumenostomy feeding could have improved the general condition of the bull but would not have prevented contamination and wound dehiscence during ructuation. Adding to the poor prognosis, aspiration pneumonia may develop secondary to dysphagia and required careful consideration. The low chances of survival need to be discussed with the owner before treatment is initiated.

Concerning case 2, we could not determine conclusively if the administration of the bolus several weeks prior was responsible for the tracheal lesion since no remnant of the bolus was found in the trachea. Case history and clinical findings however made this etiology very likely. Pharyngitis in adult animals is more frequently associated with mechanical insults than with bacterial infections such as *Actinobacillus lignieresii* or viral infections such as Bovine Viral Diarrhea Virus [18] for which this animal tested negative in blood and tissues.

The extraction of the broken bolus from the esophagus in case 4 was successful. The sheathing of the rough edges with feed material may have been beneficial in this case as this could have prevented perforation. On the other hand we are unable to determine if the bolus

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alone, without the feed material, would have been stuck causing a choke at all or if it would ultimately have been swallowed.

The present study affirms that advice on the correct handling of a balling gun is needed in many cases in which laymen perform bolus administration without the supervision of a herd veterinarian.

Gentle pressure should be applied when delivering a bolus [7], especially when mechanical devices equipped with a ratchet mechanism are used [9]. Lifting of the head upwards and manual extension of the tongue both can interfere with the act of swallowing and should therefore be refrained from. The length of the mechanical device needs to be appropriate for the animal´s head and neck proportions. When treating young stock or animals of smaller breeds this fact and appropriate bolus dimensions need to be kept in mind.

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Authors´ contributions

All authors made substantial contributions to the acquisition of data presented. MM headed the study, SM was the main responsible for drafting the manuscript, KN contributed with substantial information as well as participating in the writing of this publication; all authors participated in the review process and added to the manuscript´s intellectual content. All authors have given final approval of the version to be published.

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Figures

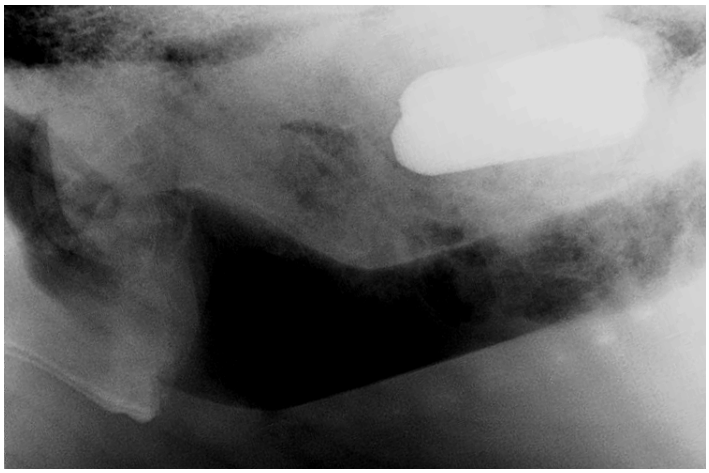

Figure 1 Laterolateral radiographic image of the upper neck region, animal in standing position, case 1. Note the two radiopaque structures located dorsal to the trachea. They represent the two mineral pills located outside of the esophagus. Diffuse gas shadows surround both boluses.

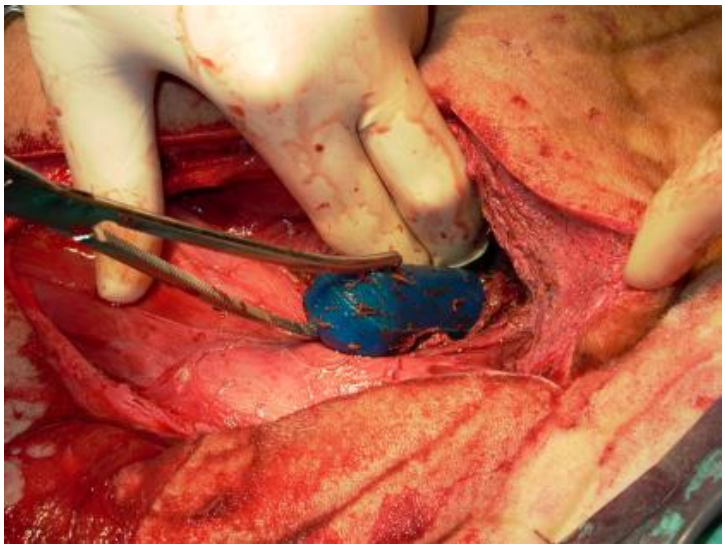

Figure 2 Surgical approach to the right ventral neck, case 1. Manual extraction of the second mineral bolus with the help of forceps.

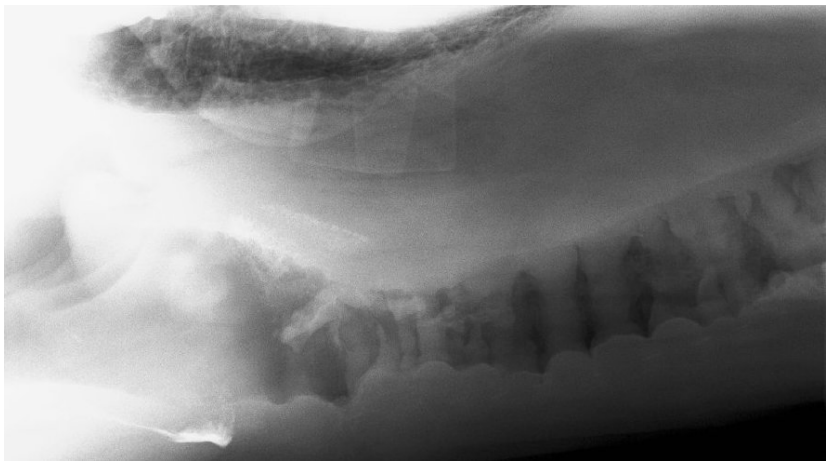

Figure 3 Laterolateral radiographic image of the upper neck region, animal in standing position, case 2. Discrete gas lucency located dorsal to the trachea as well as narrowing of the tracheal lumen is seen. The margins of the trachea are diffuse indicating thickening of the tracheal lining due to inflammation and necrosis of the mucosa.

Figure 4 Necropsy specimen, case 2. Blood clot occluding tracheal lumen. Immediately prior to euthanasia, the animal had shown a sudden onset of respiratory distress, coughing and loud tracheal stridor. Severe hyperemia, thickening of the tracheal mucosa and partial necrosis can be seen.

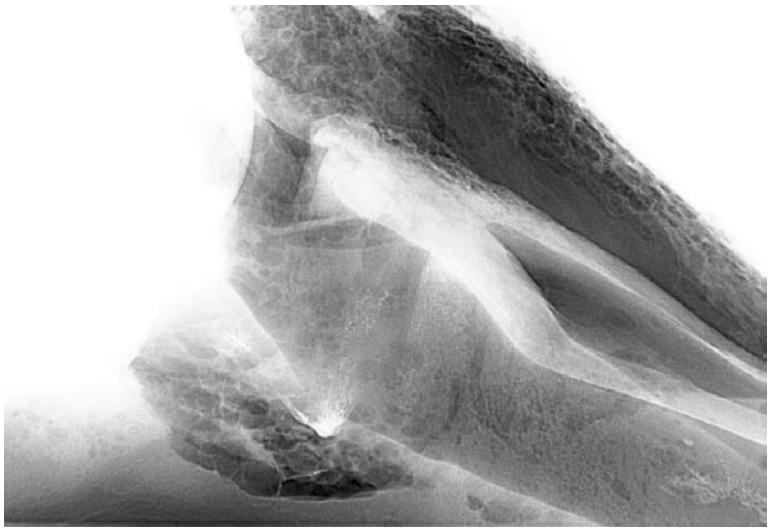

Figure 5 Laterolateral radiographic view of the upper neck region, animal in standing position, case 3. Note the significant gas lucency located dorsally and ventrally to trachea and pharynx.

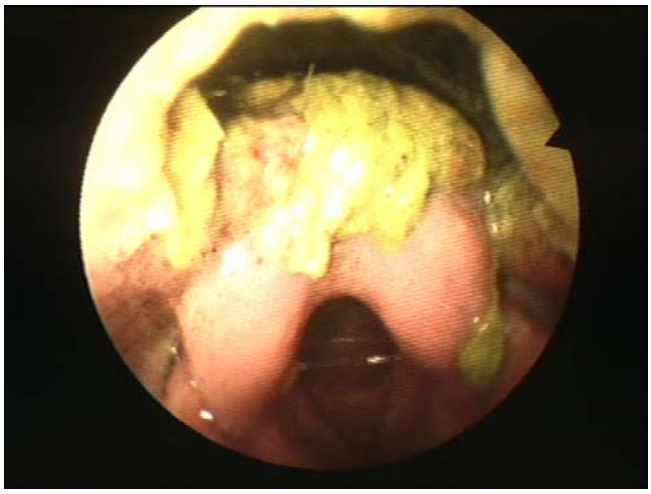

Figure 6 Endoscopic image of the larynx, animal in lateral recumbency, case 3. Note the presence of a perforation of the pharyngeal mucosa dorsal to the arytenoids cartilages of the larynx creating a cavity lined with feed particles.

Figure 7 Necropsy specimen, case 3. This perforation of about 5 cm in diameter was located on the dorsal aspect of the pharynx, close to the esophageal opening.

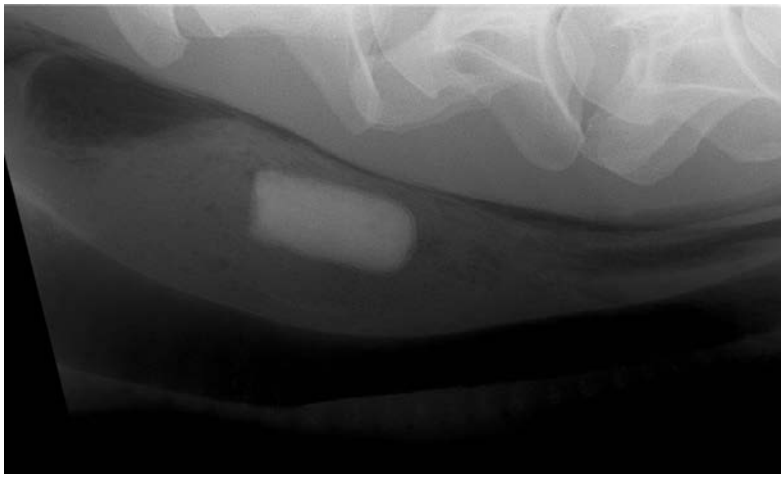

Figure 8 Laterolateral radiographic view of the neck, animal in standing position, case 4. Note the clearly distinguishable bolus-shaped foreign body surrounded by less radiodense material within the esophageal lumen, occluding it almost entirely. Narrowing of the tracheal lumen is visible.

Figure 9 Foreign body removed from the esophagus, case 4. A partial bolus enveloped in feed material is shown. This feed agglomerate had led to the animal choking due to a partial obstruction of the esophageal lumen.