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

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3

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22 Abstract

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

38

39 Background

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

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

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

67 Case presentations

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

70 Case 1

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

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

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

107 **Case 2**

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

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

142 **Case 3**

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

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

169 **Case 4**

170 A 8½-year-old German Fleckvieh cow was admitted to the clinic the day after the owner gave
171 a calcium bolus with the help of a balling gun. When discharging the gun, the cow had jerked
172 back and started coughing right after the procedure was done. The cow calved that same
173 night without difficulties but increased salivation and repeated coughing were noted. The
174 owner noticed part of the bolus in the bedding later that day. The herd veterinarian was
175 notified because the animal refused to eat and kept coughing the next day; he referred the
176 cow to the clinic immediately. On examination the animal showed dull demeanor and soft
177 moaning, the head was kept in an extended position and severely increased salivation was
178 present. Further findings included a firm swelling in the upper third of the neck of about 15 x
179 15 x 20 cm and the presence of feed particles in both nostrils. The animal was dyspnoeic
180 with bilaterally increased lung sounds. Bilateral emphysema of the dorsal lung field was also
181 diagnosed. Normal ructus was present and ruminal tympany was not observed. Examination
182 of the oral cavity revealed no abnormalities. Radiographs were taken of the neck region and

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

201 Conclusions

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

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

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

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

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

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

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

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248 Authors' contributions

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

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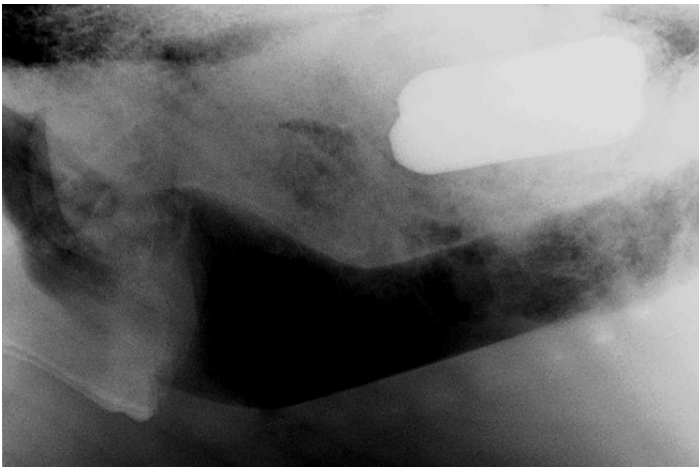
258 References

- 259 1. Sampson JD, Spain JN, Jones C, Carstensen L: **Effects of calcium chloride and calcium sulfate**
260 **in an oral bolus given as a supplement to postpartum dairy cows.** *Vet Ther* 2009, **10**(3):131-
261 139.
- 262 2. Robinson DL, Kappel LC, Boling JA: **Management practices to overcome the incidence of**
263 **grass tetany.** *J Anim Sci* 1989, **67**(12):3470-3484.
- 264 3. Sprinkle JE, Cuneo SP, Frederick HM, Enns RM, Schafer DW, Carstens GE, Daugherty SB, Noon
265 TH, Rickert BM, Reggiardo C: **Effects of a long-acting, trace mineral, reticulorumen bolus on**
266 **range cow productivity and trace mineral profiles.** *J Anim Sci* 2006, **84**(6):1439-1453.
- 267 4. Ballweber LR, Brown J, Hawkins JA, Bechtol DT, Black S, Alva R, Plue RE: **Comparison of**
268 **ivermectin SR bolus, benzimidazole anthelmintics, and topical fenthion on productivity of**
269 **stocker cattle from grazing through feedlot.** *Vet Ther* 2000, **1**(3):192-198.
- 270 5. Braun U, Lischer C, Koller U, Muller R, Geissbuhler U: **Imaging findings in a cow with a**
271 **retropharyngeally displaced magnet.** *Vet Radiol Ultrasound* 1999, **40**(2):162-163.
- 272 6. Braun U, Salis F, Gerspach C, Feige K, Sydler T: **Pharyngeal perforation in three cows caused**
273 **by administration of a calcium bolus.** *Vet Rec* 2004, **154**(8):240-242.
- 274 7. Mannion PA, Jackson PG, White RA, Herrtage ME: **Oesophageal injury associated with the**
275 **administration of an anthelmintic bolus to calves.** *Vet Rec* 1997, **140**(13):331-334.
- 276 8. West HJ, Noble KM, Knottenbelt DC, O'Brien PM: **Anthelmintic coils in cattle causing**
277 **pharyngeal and oesophageal perforation.** *Vet Rec* 1996, **139**(2):44-45.
- 278 9. Adams GP, Radostits OM: **Balling gun-induced trauma of the pharynx in feedlot cattle.** *Can*
279 *Vet J* 1988, **29**(4):389-390.
- 280 10. Harwood D, Hepple S: **Drenching/bolus gun injuries in sheep.** *Vet Rec* 2011, **168**(11):308-
281 309.
- 282 11. Macrae AI, Barnes DF, Hunter HA, Sargison ND, Scott PR, Blissitt KJ, Booth TM, Pirie RS:
283 **Diagnosis and treatment of retropharyngeal injuries in lambs associated with the**
284 **administration of intraruminal boluses.** *Vet Rec* 2003, **153**(16):489-492.
- 285 12. Davidson HP, Rebhun WC, Habel RE: **Pharyngeal trauma in cattle.** *Cornell Vet* 1981, **71**(1):15-
286 25.
- 287 13. Farrow CS: **Radiology of pharyngeal balling gun injuries.** *Vet Clin North Am Food Anim Pract*
288 1999, **15**(2):391-395, vii.
- 289 14. Kenney DG, Weldon AD, Rebhun WC: **Oropharyngeal abscessation in two cows secondary to**
290 **administration of an oral calcium preparation.** *Cornell Vet* 1993, **83**(1):61-65.
- 291 15. Ross CE, Rebhun WC: **Megaesophagus in a cow.** *J Am Vet Med Assoc* 1986, **188**(6):623-624.
- 292 16. Smith B: **Pharyngeal trauma/abscess.** In: *Large Animal Internal Medicine.* Edited by Smith B.
293 St. Louis, Missouri: Mosby; 1996.
- 294 17. Anderson DE, St Jean G: **Surgery of the upper respiratory system.** *Vet Clin North Am Food*
295 *Anim Pract* 2008, **24**(2):319-334, vii.
- 296 18. Dirksen G: **Krankheiten im Rachenbereich [Diseases of the pharynx].** In: *Innere Medizin und*
297 *Chirurgie des Rindes* Edited by Dirksen G, vol. 4. Berlin: Parey; 2002: 381-385.

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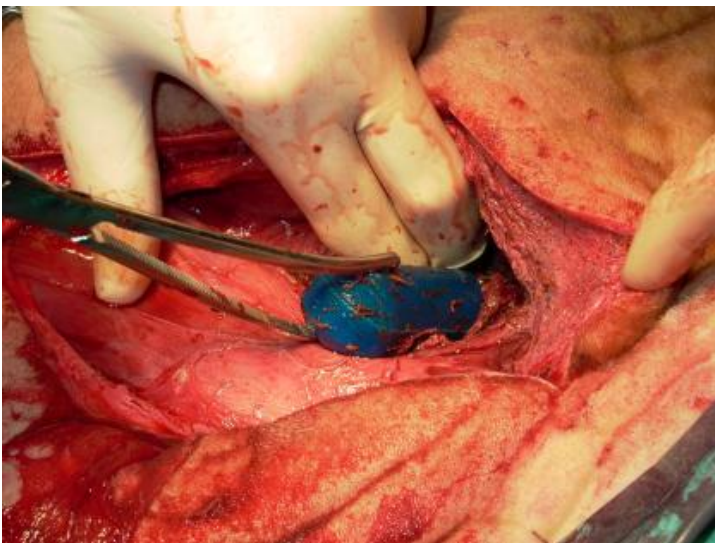
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300 **Figures**



301

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



306

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



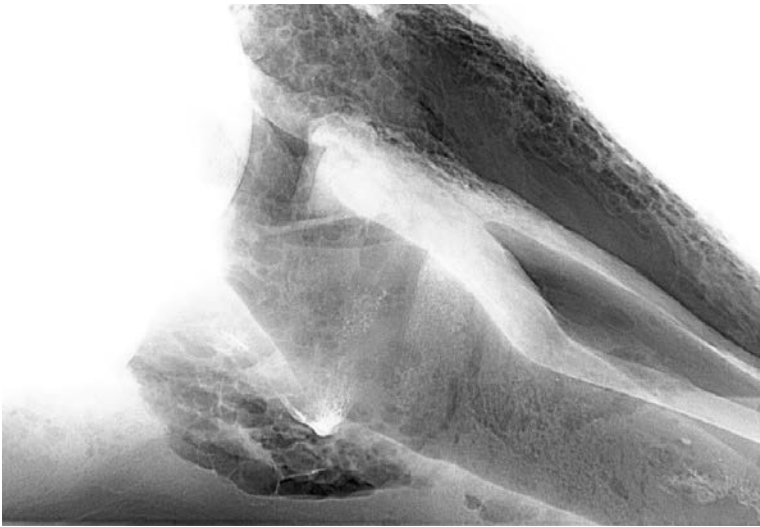
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310 **Figure 3 Laterolateral radiographic image of the upper neck region, animal in standing**
311 **position, case 2.** Discrete gas lucency located dorsal to the trachea as well as narrowing of
312 the tracheal lumen is seen. The margins of the trachea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



314

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



319

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



323

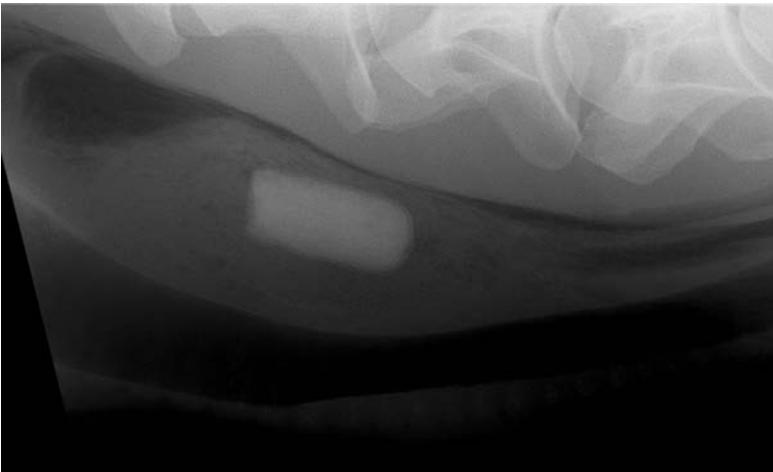
324 **Figure 6 Endoscopic image of the larynx, animal in lateral recumbency, case 3.** Note
325 the presence of a perforation of the pharyngeal mucosa dorsal to the arytenoids cartilages of
326 the larynx creating a cavity lined with feed particles.



327

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

330



331

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



336

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