An obstructive upper respiratory emergency in a pregnant Belgian blue heifer

Noodinterventie en nazorg van een obstructieve bovensteluchtwegaandoening bij een drachtig Belgisch-witblauw rund

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ABSTRACT

In this case report, the surgical intervention and aftercare are described of an upper airway obstruction in a two-and-a-half year old, seven-months pregnant Belgian blue heifer. The animal had been referred to the Clinic for Ruminants (University of Liège) for complaints of stridor and dyspnea and suffered from necrotic laryngitis, complicated by the formation of an obstructive granuloma. Emergency tracheotomy was performed to save the life of the cow and its calf. Through the use of a self-retaining cannula, the modified tracheotomy site could be kept patent until the calf was born and the pathology resolved two months after admission. Healing of the larynx was checked and documented by use of nasal and retro-tracheal endoscopy.

SAMENVATTING

In deze casus worden de chirurgische interventie en nazorg van een bovensteluchtwegobstructie beschreven bij een zeven maanden drachtige Belgisch-witblauwe vaars. Het dier werd binnengebracht in de runderkliniek van de Universiteit van Luik met klachten van stridor en dyspnee en leed aan necrobacillose, gecompliceerd door de vorming van een obstructief granuloom in de larynx. Een gewijzigde tracheotomie werd uitgevoerd om het leven van de koe en het ongeboren kalf te redden. Door middel van een zelfborgende canule kon de tracheotomieopening gedurende twee maanden opengehouden worden, tot het kalf geboren werd. De genezing van de larynx werd opgevolgd door het gebruik van nasale en retro-tracheale endoscopie.

INTRODUCTION

When confronted with respiratory distress and stridor in beef cattle, necrotic laryngitis (also known as laryngeal chondritis or calf dyphteria) caused by *Fusobacterium necrophorum* (*F. necrophorum*) is often a primary suspect (West, 1997; Milne et al., 2000; Pardon et al., 2018). This is especially the case in the Belgian blue cattle breed (BBCB), given the predisposition of double muscled animals to develop this disease. Due to their narrowed upper airway anatomy, air passes through at a higher velocity, which increases mucosal lesions colonized thereafter by bacteria. Furthermore, their relatively smaller lung capacity causes an increased breathing rate, which amplifies the lesion risk (West, 1997; Pardon et al., 2018). However, as the name calf dyptheria suggests, it is generally a calfhood disease and is not seen that often in adult cattle (Pardon et al., 2018). As such, other causes of mechanical or functional obstruction of the upper trachea or larynx should also be considered in the case of an adult animal with respiratory issues and stridor.

Other differentials include infectious bovine rhinotracheitis (IBR), a necrotizing airway condition caused by Bovine Herpes Virus 1. IBR can cause a similar presentation of respiratory distress and stridor due to the collection of necrotic debris and pseudo membranes in larynx and trachea (West, 1997). In the past, making the distinction between IBR and necrotic laryngitis was an essential part of the clinical examination of a cow suffering from stridor (Anderson and St Jean, 2008). In recent years, also thanks to the im-

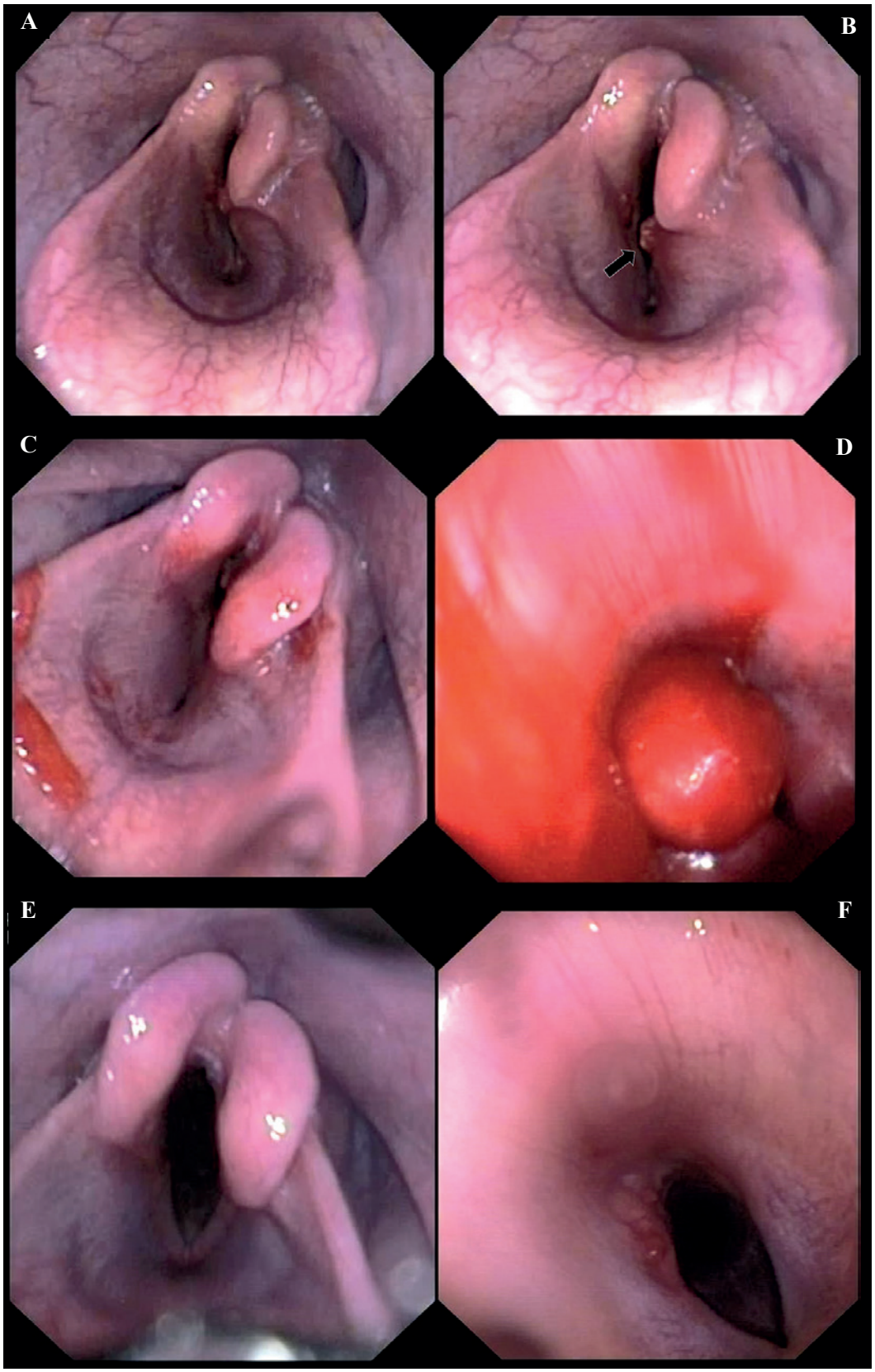

Figure 1. Endoscopy images of day 1 (A and B); Day 25 (C and D) and day 50 (E and F). Day 1: A. Frontal (antegrade) view during inhalation on day 1. B. Frontal view during exhalation on day 1. The black arrow indicates the necrotic debris on the left arytenoid. Note the divergence of the left arytenoid over the midline, and the minimal difference of the laryngeal opening between inhalation and exhalation. Day 25: C. Front view of the larynx at day 25, left arytenoid still diverged. Airway opening still very narrow. D. Caudal (retro-tracheal) view of the larynx, with a large granuloma present adhered to the left side. Day 50: E. Front view of the larynx at day 50, left arytenoid still diverged. Airway opening cleared. F. Caudal view of larynx, barely any trace of the D25 mass left.

mense efforts done in the eradication of this disease in Belgium, clinical cases of IBR have become exceedingly rare (ARSIA, 2021).

While tracheal obstruction due to a foreign body could also be a (rare) possibility of stridor, coughing should be expected due to tracheal irritation. Tracheal or laryngeal compression from an extra-tracheal or extra-laryngeal process, such as a phlegmon after tracheal perforation or a retropharyngeal abscess, are more likely suspects of stridor, but generally come with visible swelling (Anderson and St. Jean, 2008). Tracheal collapse has been described in cattle, albeit in young animals (West, 1997). Tumors of the respiratory tract, such as laryngeal lymphomas, have been described to cause stridor as well (Gleiter et al., 1995; Lardé et al., 2014).

Furthermore, nasopharyngeal and laryngeal granulomas causing severe stridor and respiratory distress have been described as a rare presentation of *Actinobacillus lignieresii* (*A. lignieresii*) infection (Angelo et al., 2009; Boileau et al., 2009). However, these are not the only causes of granuloma formation: other causes are external trauma to structures of the larynx, other infectious agents and foreign bodies (Anderson and St. Jean, 2008).

In this report, the surgical intervention and aftercare of an upper airway obstructive necrotic laryngitis in a two-and-a-half-year-old, seven months pregnant Belgian blue heifer is described.

CASE DESCRIPTION

A two-and-a-half-year-old BBCB heifer, seven months pregnant of an embryo-transfer fetus, was referred to the Clinic for Ruminants (University of Liège) in May 2020 with the complaint of stridor and dyspnea since more than three days, unresponsive to treatment with antibiotics (Ceftiofur Hydrochloride, Excenel®, Zoetis, USA) and non-steroidal anti-inflammatory drugs (Tolfenamic acid, Tolfine®, Vétoquinol, France). The animal was on pasture when the dyspnea was first noticed and as such, the exact duration of the symptoms was unclear. The farm had a history of necrotic laryngitis in adult cattle, and the year before, another adult pregnant cow had been brought to the clinic with similar symptoms.

The animal, weighing 597 kilos, presented a very audible inspiratory stridor on arrival at the clinic. Respiratory rate was increased to 48 breaths per minute with an exaggerated abdominal breathing pattern. Rectal temperature was high, at 40.2 °C. Heart rate was increased to 100 beats per minute. Upon further inspection, the stridor was clearly coming from the laryngeal region. The eyes and buccal mucosae were congested. Submandibular lymph nodes were swollen; no other swelling or morphological changes could be palpated. Pulmonary auscultation could not be performed due to the very loud laryngeal stridor. Endoscopy was performed the day of arrival. It revealed a deviated and swollen left arytenoid, which was coated with necrotic debris (Figure 1B). Barely any difference in laryngeal opening between inspiration and expiration could be seen (Figures 1A and 1B).

Due to respiratory distress and hyperthermia, which were considered life-threatening for both cow and unborn calf, the decision was made to perform a modified emergency tracheotomy. The head of the animal was fixed upright with the help of two ropes, extending the neck as much as possible without impeding respiration. After clipping, scrub and disinfection of the upper ventral region of the neck, 20 mL of procaine hydrochloride 4% + adrenaline (VMD®, Belgium) was injected subcutaneously in the region around the trachea. A second disinfection was performed before starting with the incision.

Next, the trachea was grasped in one hand and a central vertical incision of 10 cm of the skin and underlying subcutis was made between the second and third tracheal ring under the cricoid cartilage of the larynx with a 24-blade. Three cartilage rings of the trachea were then opened. The opened trachea was attached to the skin by use of single interrupted stitches connecting the tracheal mucosa to the skin with a 5/0 resorbable polyglycolic acid polyfilament suture material (Surgicryl® PGA, SMI AG, Belgium). After suturing, a stainless-steel, self-retaining cannula was inserted in the tracheotomy site to avoid premature closure of the created opening (Figure 2). Immediately following the opening of the trachea, the cow was able to breathe normally.

In the days following hospitalization, transabdominal ultrasound and rectal palpation confirmed the fetus was still alive. Respiratory rate and temperature of the cow remained within normal range. The owner preferred the cow to be hospitalized until the birth of the calf, foreseen fifty days after hospitalization. An antibiotic therapy with 10 mg/kg procaine benzyl penicillin monohydrate intramuscularly (Peni-

Figure 2. Two part stainless-steel, self-retaining cannula and cannula placement in the cow.

yet Vet®, Syva Laboratorios, Spain) was started the day of hospitalization for a treatment length of four weeks. Furthermore, 10 g of potassium iodide (KI) dissolved in water was drenched daily for ten days. The cannula was taken out twice daily to be cleaned and disinfected with chlorhexidine 0.05%, after which it was rinsed and placed back. At the same time, the external part of the tracheotomy opening was cleaned with cotton gauzes dipped in diluted chlorhexidine, after which the cow was made to cough by instilling 10 ml NaCl 0.9% in the tracheotomy opening to expel any detached crusts.

After three weeks, it became evident that there was still an obstructive process present: when blocking the cannula or when taking it out for cleaning, a laryngeal stridor could be heard immediately. A second endoscopy performed 25 days after surgery showed less evidence of arytenoid necrosis, but still a clear divergence of the left arytenoid with a mass pushing behind it and with very little airway opening (Figure 1C). Attempts to pass the endoscope through the larynx were unsuccessful. The endoscope was then fed through the tracheotomy opening to have a back view of the larynx. With this technique, a granuloma-like mass attached to the left side of the larynx was visible (Figure 1D). As the cow was showing no signs of distress, and after explicit demands by the owner to limit the risk to the unborn calf, it was decided to wait with any attempts to remove the granuloma until the calf was born.

Forty-five days after hospitalization, the cow gave birth to a healthy calf by caesarian section (CS) as is common in BBCB. Fifty days after hospitalization, the endoscopy was repeated. Although there was still a clear deviation of the left arytenoid, the airway was completely clear, and the granuloma had completely disappeared (Figures 1E and 1F). The cannula was removed and within two days, the tracheotomy opening closed by second intention. Upon checkup one month later, both cow and calf were doing well and showed no further health issues.

DISCUSSION

When confronted with a dyspneic animal that presents a stridor, a single dose of dexamethasone is often the first treatment of choice. Its anti-inflammatory and swelling reducing properties work well in case of obstructive swelling due to necrotic laryngitis. However, in this case, the administration of dexamethasone was not an option due to the abortion risk that is inherent to corticoid use (Adams and Wagner, 1970). As such, because nonsteroidal anti-inflammatory drugs and antibiotic administration did not achieve sufficient results fast enough, the animal of the present case was referred to the ruminant clinic as an emergency. Even though the anamnesis only included stridor in the past few days, it can be hypothesized that the disease had been present for a longer period, given the presence of necrotic debris on the left arytenoid.

In this case, for the tracheotomy, a combination technique using a modified version of the permanent tracheostomy described by Goulding et al. (2003) combined with a stainless-steel, self-retaining cannula typically used in emergency tracheotomies, as described by Nichols (2008), was chosen. This combination was used because of previous unfavorable experiences after permanent tracheo(s)tomy in adult BBCB animals without cannula placement or with conventional tracheotomy tube placement: wounds and tubes would close too soon and animals would suffer recurrent respiratory distress or worse, or died of suffocation if not caught fast enough. This is probably due to the thickness of the sternohyoïdus and sternothyroïdus muscles in BBCB, or technical errors during the surgery. Self-retaining cannulas seem to keep the opening clean longer than other devices, possibly due to less buildup of crusts in the trachea around the opening (Nichols, 2008).

Because this cow was pregnant, laryngostomy under general anesthesia was not a good option based on the authors' experience due to the important anesthetic risk. This surgery could have been considered if this animal had been younger, as the prognosis is generally better than performing only tracheotomy, i.e. it allows for local curettage of the necrosis and abscesses if present (Gasthuys et al., 1992). A standing laryngo(s)tomy could possibly have given access to the granuloma as well and might as such have shortened the treatment length considerably. However, such a technique is very specialized and difficult to perform in the field. Given the urgency due to the important respiratory distress, the authors considered a combination of tracheotomy and a canule to be the best economic and feasible option on arrival. Afterwards, the owner requested conservative treatment until the birth of the calf.

It is unclear if the granuloma present at day 25 post surgery was already present on the day of the tracheotomy. In retrospect, the authors could have opted already on day one for retro-tracheal endoscopy of the tracheotomy hole to be able to make a full comparison of the healing process. On day one, the nasal endoscopy was concurrent with necrotic laryngitis: there was clear presence of necrosis on the arytenoids, which were so swollen, there was barely any airway opening left (Figures 1 A and 1B).

However, the mass present on day 25 is not as typical as what is normally seen in case of necrotic laryngitis, a disease caused by *F. necrophorum* (Pardon et al., 2018). It looks more like pharyngeal granulomas such as those described in the atypical *A. lignieresii* case reported by Boileau et al. (2009) and Angelo et al. (2009). If *A. lignieresii* indeed can be present in chronic laryngitis cases, this could also explain why

empiric results show improvement when supplementing affected cows with potassium iodide, a treatment commonly used in adult cows with necrotic laryngitis at the Clinic for Ruminants.

It remains remarkable that this farm has had at least two obstructive laryngitis cases in adult animals in as many years late in spring. Elevated (environmental) temperature could be a risk factor, causing an increased respiratory rate in an attempt to decrease body temperature. In the American bison, *Mycoplasma bovis* has been linked to outbreaks of necrotic pharyngitis, including laryngeal abscesses (Dyer et al., 2018). *M. bovis* presence was also confirmed on this farm, though not in this animal. However, no such connections between *M. bovis* and pharyngitis have been made in cattle before.

At day 25 post surgery, when the granuloma was seen on endoscopy, endoscopic removal could have been an option. In that case, a double endoscopy from both sides (nasal and retro-tracheal) with a cauterization loop and a prong might have been able to remove the granuloma safely without it being aspirated into the lungs. However, due to the perceived risk to the fetus, a conservative approach was preferred until the calf was born. In the meantime, the granuloma resolved itself. It remains unclear whether it resorbed or, more probable, it got detached and was coughed out.

Given the recurring laryngitis issues in this farm, herd-specific factors concerning therapy (molecule, treatment length), genetic predisposition, herd-specific bacteria or other (environment related) predisposing factors should be considered. Consistency of treatment length especially is an issue on this farm, which in itself leads to therapy failure, but could also lead to failure due to antimicrobial resistance selection. The molecule chosen by the herd veterinarian in this case (Ceftiofur) was probably selected for its registration as treatment of *F. necrophorum*-caused, interdigital necrobacillosis (Kausche et al., 2003). However, given its status as a third-generation cephalosporin, and its 'red' classification on the critical antibiotics list of the Antimicrobial Consumption and Resistance in Animals agency (AMCRA), the authors wish to underline the need for an early treatment of a sufficiently long time with a first-line antibiotic such as penicillin, or early surgical intervention, instead of opting for third-line antimicrobials (AMCRA, 2021). Furthermore, the use of these 'red' or critical antimicrobials is only permitted in Belgium in those cases where laboratory testing and antimicrobial resistance testing have shown the need for these kind of molecules (AMCRA, 2021), a condition that was not met in this case.

CONCLUSION

Modified tracheotomy can be used as a fast, economic and easily feasible technique to treat obstructive respiratory emergencies, even in larger cattle. The placement of a self-retaining cannula can help to keep open the created opening until the larynx has had the opportunity to heal, until pregnant animals have the chance to bear to term or until cattle under withdrawal times are cleared to be slaughtered. Retro-tracheal endoscopy of the tracheotomy opening can be considered in laryngitis cases that don't seem to progress favorably or don't resolve fast enough, to check for granulomas, abscesses or other obstructive processes.

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BELGISCHE DIKBIL of 'DUTCH-BUTTOCKED'?

"*In een deel van Yorkshire kozen de landbouwers gedurig rundvee met groote achterdeelen uit, tot zij een ras hadden gevormd dat zij 'dutchbuttocked' noemden, en de monsterachtige groote van de van de achterdeelen van het kalf was vaak voor de koe noodlottig en tal van koeien werden ieder jaar bij het kalven verlooren.*"

Een Hollandse (Dutch) dikbil dus. Waarom Hollands? En hoe kwam deze genetische aanleg in Belgische rassen terecht?

Citaat uit Darwin, Ch., *Het variëeren der huisdieren en cultuurplanten* (deel 1, p. 504 van de vertaling van de tweede Engelse uitgave uit 1875 van *Variation of Species of Animals and Plants under Domestication,* in 1890 uitgegeven door Cohen, Arnhem)**.** Darwin refereert bij deze passage aan Youatt, W., *Cattle: their Breeds, Management, and Diseases*, Londen, 1834 (Baldwin en Cradock), p. 284.

Luc Devriese