The Journal of Veterinary Medical Science

NOTE

Internal Medicine

Diagnosis of a sublaryngeal abscess in a Japanese Black calf using computed tomography

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J. Vet. Med. Sci.
82(10): 1497–1501, 2020
doi: 10.1292/jvms.20-0384

Received: 22 June 2020
Accepted: 12 August 2020
Advanced Epub:
2 September 2020

ABSTRACT. A 76-day-old Japanese Black calf presented with severe stridor, resenting palpation of the laryngeal region. Endoscopic examination revealed an expansile process restricting the esophageal and tracheal lumina caudal to the arytenoid cartilage, hyperemia and edema of the pharyngeal mucosa, right arytenoid cartilage swelling and displacement, and marked airway obstruction. The absence of an endotracheal wall abnormality impeded a definitive diagnosis. Computed tomography (CT) revealed a mass (CT value: 40–45 HU) caudal to the arytenoid cartilage, causing tracheal stenosis and esophageal displacement. The presence of gas in the mass suggested the presence of an abscess. Diagnosis of deep retropharyngeal lesions by conventional endoscopic and ultrasonographic examinations may be challenging; CT can then provide more comprehensive diagnostic information on a lesion.

KEY WORDS: computed tomography, Japanese Black calf, prognosis, stridor, sublaryngeal abscess

Conventional imaging modalities, including ultrasonography, radiography, and endoscopy, are commonly used for diagnostic purposes in small and production animal medicine [1, 4, 13, 16, 17].

Recent reports suggest that computed tomography (CT) is increasingly used to replace or augment the diagnostic imaging work-ups in small [2, 5, 8, 9] and large animal patients [12, 14–16, 18]. However, reports of CT-based diagnoses, specifically in cattle, appear to be mainly limited to intra-abdominal abnormalities, with only one report on upper respiratory tract diseases [11]. Herein, we report a case wherein CT was used to determine the precise location and characteristics of a sublaryngeal abscess in a Japanese Black calf.

A 76-day-old female Japanese Black calf presented with marked inspiratory stridor that had been present for at least 21 days. The calf had a history of poor growth, a coarse hair coat, and a depressed general demeanor. The rectal temperature, heart rate, and respiratory rate were 39°C, 64 beats per min, and 30 breaths per min, respectively. Palpation revealed no rib fractures or swelling of the palpable body lymph nodes, such as the parotid, retropharyngeal, mandibular, superficial cervical, and subiliac nodes; the calf exhibited a pain response to palpation of the laryngopharynx, although no soft tissue swelling of this region was appreciated.

Hematology and blood chemistry analyses revealed an elevated packed cell volume (48.5%; reference range: 22–23%) and decreased blood urea nitrogen (5.9 mg/100 m*l*; reference range: 20–30 mg/100 m*l*), serum creatinine (0.6 mg/100 m*l*; reference range: 1.0–2.0 mg/100 m*l*), and serum chloride concentrations (87.9 mmol/*l*; reference range: 97–111 mmol/*l*).

Blood gas analysis revealed an elevated carbon dioxide partial pressure (8.7 kPa; reference range: 6.3–6.5 kPa) and a decreased oxygen partial pressure (8.8 kPa; reference range: 12.3–13.1 kPa). The oxygen saturation (94%; reference range: 95.3–96.5%) was slightly decreased.

Based on these findings, an obstructive lesion involving the laryngopharynx was suspected. Radiographs were taken using a portable X-ray unit (PX-20HF, Kenko, Osaka, Japan) with the following parameters: 70 kV, 1.8 mAs, and 1-m film-focus distance. Images of the pharynx and larynx acquired using a computerized radiography unit (Regius Sigma, Konica Minolta, Tokyo, Japan) showed the presence of a mass with a diameter of 3–4 cm caudal to the arytenoid cartilage (Fig. 1). An opaque soft tissue mass

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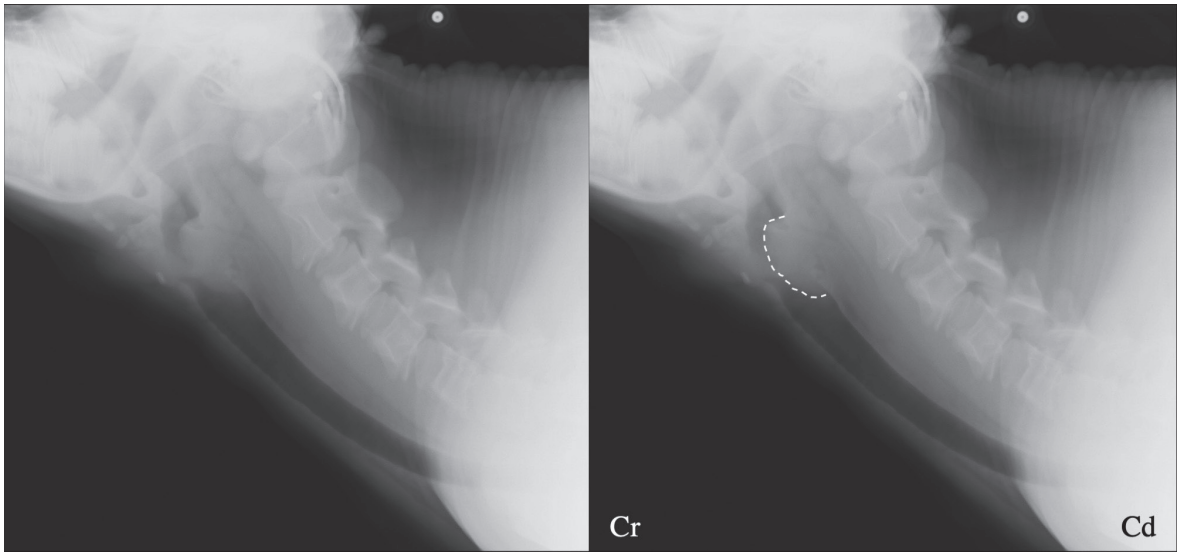

Fig. 1. Radiograph taken in the standing position centered on the pharynx, larynx, and cranial portions of the trachea. An opaque soft tissue mass (right, dotted line) with a convex ventral border is located at the dorsal border of the trachea, which has a narrowed lumen. The gas depicted on computed tomography is not observed in this radiograph. In addition, the mass is superimposed with the tracheal lumen just caudal to the arytenoid cartilages. The mass effaces the borders of the dorsal aspect of the larynx and surrounding soft tissues with possible origin from the larynx, esophagus, trachea, or retropharyngeal structures. Cr, cranial; Cd, caudal

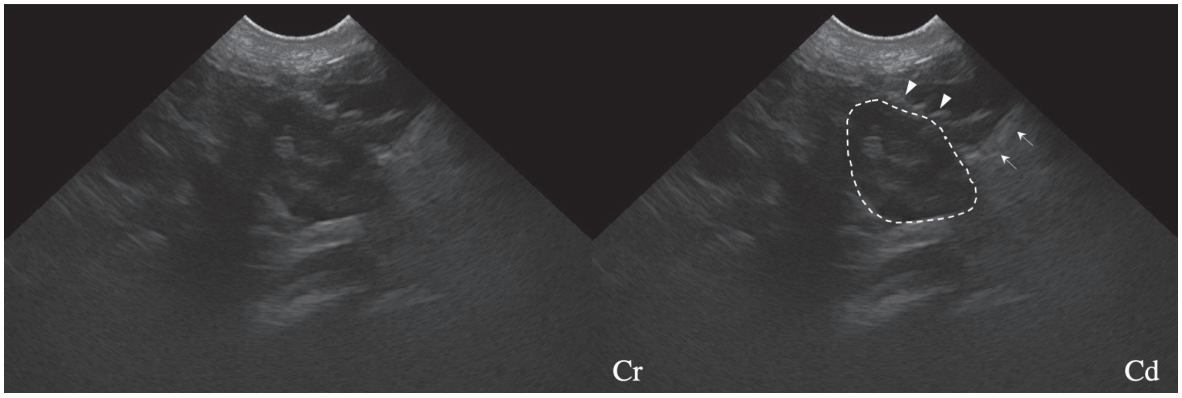

Fig. 2. Ultrasonographic image obtained using a micro-convex probe (8.0 MHz) oriented in the sagittal plane allowed visualization of a mass with an approximate diameter of 4 cm and a nonuniform poorly marginated, heterogeneous echotexture. The mass is positioned ventrally to the arytenoid cartilage (arrowheads) and cranially (Cr) to the thyroid cartilage (arrows).

with a convex ventral border was located at the dorsal border of the trachea, which had a narrowed lumen. The gas depicted on CT was not observed in this radiograph. In addition, the mass was superimposed with the tracheal lumen just caudal to the arytenoid cartilages. The mass that appeared to originate from the roof of the larynx or the connective tissues between the larynx and esophagus was likely the cause of the stridor. We performed ultrasonographic imaging (8.0-MHz convex probe, MyLab One VET, Esaote, Maastricht, Netherlands) and examined the oropharynx as follows. First, we scanned in transverse planes for the cranioventral windows around the larynx and identified the body of the basihyoid bone. Next, we scanned in longitudinal planes for the midventral window and identified the basihyoid bone and the thyroid cartilage. Finally, we scanned in a longitudinal plane for the lateral window (right and left) and identified the cricoid cartilage. The examination revealed a mass with a reverberation artifact, a nonuniform echogenicity, and a diameter of 4 cm, caudal to the oropharynx and larynx, which was consistent with the radiographic findings (Fig. 2). Fine-needle aspiration using a 23-G needle under ultrasonographic guidance confirmed the cartilage-like tissue but did not help specify the nature of the lesion. Endoscopy of the pharynx, larynx, and esophagus using an endoscope with a diameter of 9 mm and a working length of 140 cm (KARL STORZ GmbH & Co., KG, Tuttligen, Germany) identified congestion and edema of the pharyngeal mucosa and swelling and displacement of the air passage to the side of the corniculate process of the right arytenoid cartilage; it also confirmed marked airway obstruction (Fig. 3). However, there was no observed abnormality involving the inner tracheal wall.

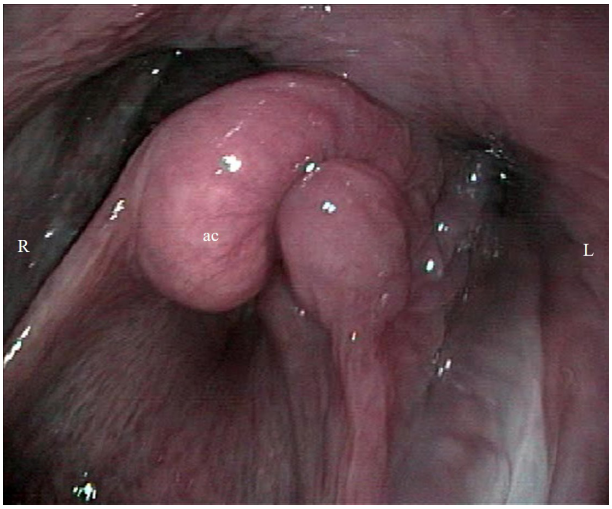

Fig. 3. Endoscopic view of the larynx. The arytenoid cartilages are asymmetrical, and the right arytenoid cartilage is swollen and deformed with displacement to the air passage, which confirmed marked airway obstruction. Moreover, mild hyperemia and edema of the pharyngeal and laryngeal mucosae are visible.

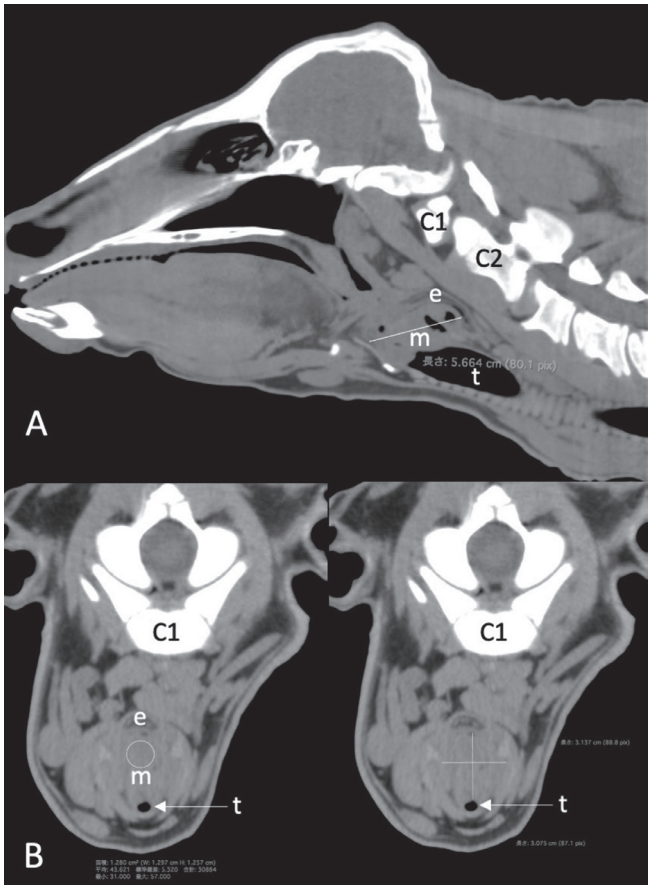

Fig. 4. Two-dimensional reconstruction computed tomographic image. The cranial region is positioned to the left and caudal region to the right on the sagittal plane (A). The anatomical left side is oriented to the right side and anatomical right side to the left on the transverse plane. Sagittal and transverse (B) plane computed tomographic images of the cranial cervical region show a laryngeal mass (m) of 5.7 × 3.2 × 3.1 cm that bulges into the tracheal lumen (t) and displaces the esophagus (e) dorsally.

As a definitive diagnosis could not be reached, CT was performed using the 80-row multi-detector row helical CT unit (Aquilion Prime SP/SPREAD, Canon, Ohtawara, Japan) to further describe the lesion and determine the exact extent and involvement of the surrounding structures. The CT imaging parameters were as follows: tube voltage, 135 kV; tube current, 250 mA; tube rotation time, 0.5 sec/rotation; slice thickness, 1.0 mm; and field of view, 500 mm. Digital Imaging and Communications in Medicine data were sent to a viewer (Newton OsiriX, Newton-Graphics, Sapporo, Japan) to measure the CT number and length of the lesion. CT revealed a mass located between the trachea and esophagus immediately caudal to the arytenoid cartilage (Fig. 4A and 4B). The lengths of the maximum major axis of the lesion in the sagittal section, maximum major axis of the lesion in the transverse image, and orthogonal thereto were measured. The measured dimensions of the mass were 5.7 × 3.2 × 3.1 cm. The mass compressed the tracheal lumen over a length of approximately 3 cm and displaced the esophagus dorsally. We measured the CT values for the areas in the region of interest of 50 mm^2 (not including the gas), and the CT value of the mass was 40–45 HU. The CT value of the mass and the presence of gas within the mass indicated that it was an abscess. The cranial thyroid artery and recurrent pharyngeal and laryngeal vagal nerves were located on both of the ventral sides of the mass. Surgical options to remove or drain the abscess were not explored, as the associated risks of inadvertent damage to important neurovascular structures or the esophagus were deemed too high.

The calf was treated using antibacterial and anti-inflammatory drugs. From day 1 to day 5, 40,000 IU/kg procaine penicillin G (Kyoritsu Seiyaku Inc., Tokyo, Japan) was intramuscularly administered twice per day, while 0.2 mg/kg dexamethasone (Kyoritsu Seiyaku Inc.) was intravenously administered as a daily dose. However, the condition of the calf gradually worsened, and an emergency tracheotomy was performed on day 6 after the calf had acutely developed severe dyspnea. Subsequently, nebulization with kanamycin sulfate (Kyoritsu Seiyaku Inc.) and clenbuterol (Boehringer Ingelheim Japan, Tokyo, Japan) was performed. Although this led to a transient temporary improvement, the calf's respiratory symptoms and general condition again deteriorated from day 12. Owing to the poor prognosis, the calf was euthanized and submitted for postmortem examination on day 17.

Upon postmortem gross examination, a mass of approximately 4 cm in diameter was found caudal to the arytenoid cartilages following careful dissection through the surrounding tissues (Fig. 5A and 5B). The mass had formed between the tracheal adventitia and the trachealis, immediately caudal to the larynx, and protruded into the tracheal lumen, thereby restricting the airflow and creating turbulences that caused the observed inspiratory stridor. In addition, the mass contained yellowish-white cheese-like pus within (Fig. 5C). Histologically, the mass was continuously generated in granulation tissue from the detached part of the arytenoid cartilage and appeared to originate from the dorsal aspect of the larynx, involving the paired arytenoid cartilages as well as the cricoid cartilage. The pus with gram-positive bacteria filled the core of the abscess and was covered with granulation

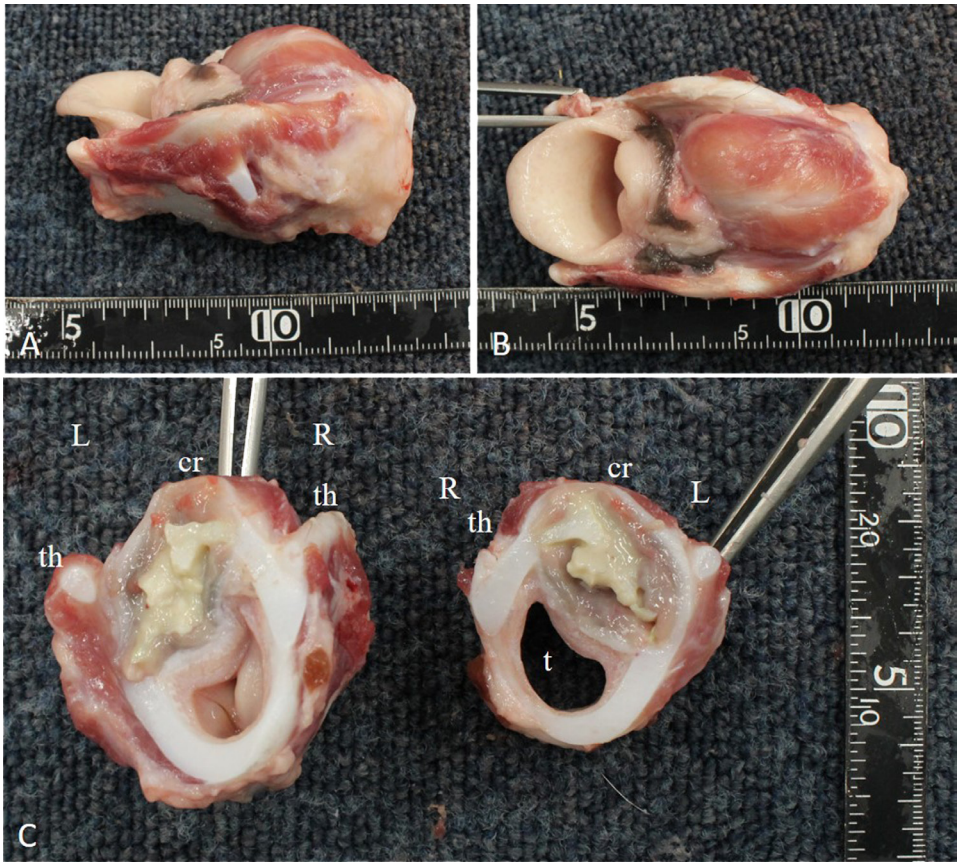

Fig. 5. Postmortem images of the isolated larynx showing severe necrotic laryngitis with abscess formation in the dorsal part of the larynx, involving the arytenoid cartilages and cricoid cartilage, and restricting the lumen of the trachea. The left (A) and dorsal (B) aspects are shown. Furthermore, two transverse cross-sections (C) through the abscess are shown in two planes, approximately 1 cm apart and caudal to the arytenoid cartilages. The cricoid (cr) and (th) thyroid cartilages, tracheal lumen (t), and left (L) and right (R) sides are indicated.

tissue infiltrated with an abundant number of neutrophils, lymphocytes, and plasma cells. There was no evidence of a foreign-body penetration in the esophagus nor the larynx. The postmortem findings were similar to the antemortem CT findings.

The pus was aseptically collected and subjected to aerobic and anaerobic cultures at 37°C for 24 hr in a 5% sheep blood agar medium. Anaerobic culture was performed in an anaerobic jar with Anero Pack (Mitsubishi Gas Chemical Co., Inc., Tokyo). The strains isolated from the aerobic and anaerobic cultures were identified as *Trueperella pyogenes* and *Fusobacterium necrophorum* using BD BBLCRYSTAL GP (BD Japan, Tokyo, Japan) and BD BBLCRYSTAL ANR (BD Japan), respectively. A drug susceptibility test, performed as described by the Clinical and Laboratory Standards Institute, showed that *T. pyogenes* was sensitive to penicillin, kanamycin, cefazoline, and gentamicin, while *F. necrophorum* was sensitive to cefazolin and gentamicin.

Upper airway inflammation is more commonly observed in young cattle [4, 10], especially calves, and is usually caused by bacterial infection due to mucosal lesions following mechanical damage during feed intake of roughage or by foreign bodies [4, 16, 19]. Necrotic laryngitis is a common disease in calves [4, 19]. The main clinical signs of necrotic laryngitis include dyspnea, stridor, and loss of appetite [4, 16, 19]. Stridor occurs in chronic cases, including those involving deformations and necrosis of the laryngeal cartilages and laryngeal abscess formation. However, it is often difficult to determine antemortem if laryngeal abscesses have formed. Treatment using antibacterial agents and anti-inflammatory agents can be successful in the early stages of the disease but is less effective in more advanced, chronic cases [3, 10, 16, 19]. Surgical management of necrotic laryngitis is often followed by mucosal hyperplasia and subsequent bronchial stenosis, which may not only prolong the treatment period but also negatively impact the overall prognosis [3, 6, 7, 10, 15].

The risks of inadvertently damaging vital neurovascular structures, including the anterior thyroid artery; pharyngeal branch of the vagus nerve, which is involved in respiratory function and swallowing; and recurrent laryngeal nerve, make the complete removal of an abscess in this region a high-risk procedure. This also reflects the importance of obtaining comprehensive and detailed information regarding the nature, exact location, and extent of the lesion, including the involvement of adjacent vital anatomical structures. As demonstrated in this case, CT can complement and augment the diagnostic information provided by conventional imaging modalities and may allow a more complete and accurate diagnosis. This is of particular interest in advanced cases that have failed to respond to prolonged medical treatment and when a possible surgical intervention is considered. In such cases, CT helps not only with further defining the prognosis but also with planning the surgical access and assessing the risks

of such an intervention. However, its use in cattle is limited to highly valuable cattle and by inspectable parts using expensive equipment and the need for general anesthesia and off-label drugs.

ACKNOWLEDGMENT. The authors would like to thank the staff and student assistants for caring for the heifer during hospitalization.

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