Subtotal or partial unilateral arytenoidec- tomy for treatment of arytenoid chondritis in five calves

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**Case Description**—5 calves were evaluated for abnormal respiratory noise associated with variable degrees of respiratory distress.

**Clinical Findings**—Tachypnea and inspiratory dyspnea were detected at initial evaluation in all calves. Endoscopic evaluation of the upper respiratory tract revealed enlarged and immobile arytenoids. Radiographic (n=3) and computed tomographic (1) evaluation of the laryngeal area revealed images that were indicative of a large soft tissue mass at the level of the arytenoids obstructing the rima glottis. A presumptive diagnosis of arytenoid chondritis was made.

**Treatment and Outcome**—A tracheostomy tube was placed in all calves. Medical treatment (with antimicrobials and anti-inflammatory drugs) was attempted in 4 calves after initial evaluation. Unilateral arytenoidec- tomy via a laryngotomy was performed under general anesthesia in all calves. Dysphagia and coughing were the most frequent postoperative complications. Three calves survived at least 6 months after the procedure. One calf died of a perforated abomasal ulcer 3 months after the surgery. Another calf died suddenly 1 month after the surgery of an undetermined cause.

**Clinical Relevance**—Unilateral arytenoidec- tomy was a viable surgical treatment for arytenoid chondritis in calves. Further research in a larger number of affected cattle is needed to determine the advantages or disadvantages of this procedure over other surgical techniques. (*J Am Vet Med Assoc* 2009;235:420–425)

A 10-week-old female Holstein calf (calf 1) was evaluated because of dyspnea of 10 days’ duration. The owner had treated the calf with enrofloxacin, tilmicosin, and flunixin meglumine. No improvements were observed. At the time of admission, the calf weighed 45 kg (99 lb) and was tachypneic (respiratory rate, 60 breaths/min) and tachycardic (heart rate, 150 beats/min). The calf was in severe dyspnea. After surgical preparation, a temporary tracheostomy was performed, and a tracheostomy tube (9 mm in diameter) was placed in the upper third of the neck. Tube placement resulted in immediate relief of the dyspnea. Endoscopy was performed by use of a 1-m-long, 9-mm-diameter endoscope. The scope was inserted through the right nostril into the ventral meatus. It was slowly advanced into the nasopharynx, where enlarged and immobile arytenoids were viewed (Figure 1). A lateral projection radiographic image of the head was obtained and revealed a soft tissue density occluding the lumen of the larynx (Figure 2). The lungs were radiographically normal. A presumptive diagnosis of bilateral arytenoid chondritis was made.

The calf was treated for 10 days with cefiofur sodium (2.2 mg/kg [1 mg/lb], SC, q 12 h), dexamethasone (10 mg, IV, days 4 and 6), and sodium iodide (70 mg/kg [31.8 mg/lb], IV, days 4 and 6). Eight days after the beginning of treatment, the condition of the calf had not improved as evidenced by continued respiratory distress in response to obstruction of the tracheostomy tube. Endoscopic evaluation also revealed no improvement of the condition. Because of the nature of the lesions, it was concluded that the calf would not improve appreciably with medical treatment alone. Partial unilateral arytenoidec- tomy was scheduled.

Prior to surgery, food was withheld from the calf for 12 hours. A 16-gauge indwelling catheter was placed aseptically into the right jugular vein. General anesthesia was induced by use of a 5% solution of guaifenesin and ketamine (2 mg/mL) administered IV to effect. The tracheostomy tube was replaced by an endotracheal tube, and general anesthesia was maintained with isoflurane gas vaporized in 100% oxygen through a circular system. The calf was placed in dorsal recumbency, and the ventral portion of the neck and head was shaved and prepared for aseptic surgery. A ventral midline skin incision starting just cranial to the thyroid cartilage and extending caudally to the second tracheal ring was made. The paired sternothyrohyoideus muscles were bluntly separated to expose the cricothyroid membrane and the thyroid and cricoid cartilages. The cricothyroid membrane was incised. With a scalpel blade, two-thirds of the ventral portion of the thyroid cartilage was incised. A self-retaining Weitlaner retractor was used to expose the laryngeal mucosa. An abscess was palpated on the caudal aspect of the left arytenoid. A partial arytenoidec- tomy including en bloc removal of the abscess was performed on the left arytenoid. First, the cornicu-
the laryngeal mucosa was left unsutured. The thyroid cartilage was sutured with 2.0 polydioxanone in a simple interrupted pattern. The skin incision was left to heal by second intention. The endotracheal tube was replaced by the tracheostomy tube. The calf was carried to its stall, where it recovered uneventfully. Prior to the surgery, the ceftiofur sodium had been replaced by procaine penicillin G (22,000 U/kg [10,000 U/lb], SC, q 12 h for 10 days). Flunixin meglumine (1 mg/kg [0.45 mg/lb], IV, q 24 h) was given for 4 days after surgery.

Three days after surgery, the calf had increased lung sounds on auscultation of the thorax and a mild increase in body temperature (39.7°C [103.5°F]). At that time, vegetative material was observed on endoscopic evaluation within the trachea. Florfenicol (40 mg/kg [18.2 mg/lb], SC, once) was administered to treat aspiration bronchopneumonia. Eight days after surgery, the larynx was evaluated by use of endoscopy. The inflammation had decreased substantially, and the tracheostomy tube was removed. After removal of the tube, the calf was monitored hourly for signs of respiratory distress. The tracheostomy incision was allowed to heal by second intention. This image was obtained during maximal inspiration. The vocal cords appear necrotic (small arrow). Contact (kissing) lesions are visible between the arytenoids (medium size arrow).

late process was removed. The mucosa ventral and caudal to the arytenoid cartilage was then incised and the abaxial portion of the cartilage was bluntly dissected. The body of the arytenoid was cut from the muscular process and removed. The redundant mucosa and necrotic vocal cord were excised. The incision through the laryngeal mucosa was left unsutured. The thyroid cartilage was sutured with 2.0 polydioxanone in a simple interrupted pattern. The skin incision was left to heal by second intention. The endotracheal tube was replaced by the tracheostomy tube. The calf was carried to its stall, where it recovered uneventfully. Prior to the surgery, the ceftiofur sodium had been replaced by procaine penicillin G (22,000 U/kg [10,000 U/lb], SC, q 12 h for 10 days). Flunixin meglumine (1 mg/kg [0.45 mg/lb], IV, q 24 h) was given for 4 days after surgery.

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anesthesia as described for the first calf. An abscess was found and removed on the left arytenoid. *Arcanobacterium pyogenes* was grown from bacteriologic culture of the abscess. Histologic evaluation of the removed cartilage and surrounding soft tissue revealed severe laryngeal myositis and fasciitis. Administration of procaine penicillin G (22,000 U/kg, SC, q 12 h) was continued for 10 days and flunixin meglumine (1 mg/kg, IV, q 12 h) for 3 days.

The calf had severe inflammation of the laryngotomy site the day after surgery. Milk was noticed coming out of the site when the calf was nursing from a bottle. The calf was then trained to drink from a bucket, which solved the problem. Three days after surgery, the tracheostomy tube was frequently obstructed by mucus and necrotic debris. The tube was cleaned 4 times a day at that time. The nasopharynx was scoped and the larynx appeared patent. The tube was then removed. The calf did not develop any respiratory distress. The calf was discharged from the hospital 10 days after removal of the tube.

At the farm, the calf was seen coughing frequently. The calf was readmitted to the veterinary hospital 11 weeks after surgery. The owner reported that the calf was having intermittent periods of depression and was not doing well enough to keep up with the other calves. Since the first admission, the calf had gained 32 kg (70.4 lb) but appeared thin. Abnormal lung sounds were auscultated over the cranioventral area of the thorax. Endoscopic examination of the larynx revealed healed mucosa and a patent airway. A stricture was found in the proximal third of the trachea, where the temporary tracheostomy had been performed. The calf died 2 days after readmission. A healed larynx, stricture at the tracheostomy site, severe bronchopneumonia with abscess formation, and ruptured abomasal ulcers within the omental bursa were observed at necropsy.

A 10-week-old female mixed-breed beef calf (calf 3) was evaluated because of difficulty breathing of 3 weeks’ duration. The calf had been treated with long-acting cefiolur (cefiofur crystalline free acid) and flunixin meglumine without substantial improvement. At the time of admission, the calf weighed 38 kg (85 lb) and was tachypneic (respiratory rate, 60 breaths/min), and had a heart rate of 90 beats/min. The calf was severely dyspneic. A temporary tracheostomy was performed and a tracheostomy tube placed. The nasopharynx of the calf was evaluated by use of endoscopy. The left arytenoid was enlarged and immobile. The vocal cords appeared necrotic and collapsed. A lateral projection radiographic image of the head revealed a large soft tissue opacity at the level of the larynx. The thoracic cavity appeared radiographically normal. A presumptive diagnosis of left arytenoid chondritis was made.

The calf was scheduled for a partial unilateral arytenoidectomy as described for the first 2 calves. Prior to surgery, during the same anesthesia episode, a computed tomographic scan was performed and revealed bilateral arytenoiditis (Figure 3). A mass presumed to be an abscess was seen protruding from the thyroid cartilage. Procaine penicillin G (22,000 U/kg, SC, q 12 h), florfenicol (20 mg/kg [9 mg/lb], SC, q 48 h for 2 treatments), and flunixin meglumine (1 mg/kg, IV, q 24 h for 3 days) administration was started immediately before surgery. The day following surgery, edema was present at the surgical site. The calf was nursing well from the dam without difficulty. One week after surgery, the calf had increased lung sounds on auscultation of the thorax. Procaine penicillin G was discontinued, and oxytetracycline (20 mg/kg, IV, q 24 h) was administered for 5 days. Thirteen days after surgery, the larynx was evaluated endoscopically and appeared patent. The tracheostomy tube was removed and the calf was sent home the following day. No respiratory distress was observed after removal of the tracheostomy tube. Six months after the surgery, the calf was doing well and gaining weight at the same rate as age-matched herdmates. No coughing or signs of pneumonia had been detected.

A 48-week-old female Gelbvieh heifer (calf 4) was evaluated because of suspected traumatic reticuloperitonitis. The heifer had an increased abdominal component to its breathing for the past 30 days. At the time of admission, the heifer weighed approximately 386 kg (850 lb) and was tachypneic (respiratory rate, 60 breaths/min) and tachycardic (heart rate, 96 beats/min). The heifer was slightly dyspneic. Radiography of the cranial portion of the abdomen and thoracic cavity was performed, and findings were unremarkable. The nasopharynx was evaluated endoscopically and revealed an enlarged pharyngeal septum and arytenoid cartilages. A presumptive diagnosis of pharyngitis and laryngitis was made. The heifer was treated with procaine penicillin G (22,000 U/kg, SC, q 12 h), flunixin meglumine (1 mg/kg, IV, q 24 h), and sodium iodide (70 mg/kg, IV).

The next morning, the inspiratory noise had increased in intensity, and the heifer was frequently seen open-mouth breathing. Endoscopy of the nasopharynx revealed increased inflammation of the arytenoids and epiglottis causing substantial occlusion of the rima glottis. Purulent discharge was abundant throughout the nasopharynx. A temporary tracheostomy was performed, and a tracheostomy tube was placed and resulted in immediate relief. Flunixin meglumine was dis-
continued 2 days after admission because fresh blood was found in the feces.

Five days after admission, endoscopy of the nasopharynx revealed decreased inflammation. The treatment was continued for 3 days, and the tracheostomy tube was removed. The following day, the heifer was again in severe respiratory distress. The tracheostomy tube was reinserted, and the heifer was sent home with instructions to continue procaine penicillin G administration for 14 days. Isoniazid (10 mg/kg [4.5 mg/lb], PO, q 24 h, for 14 days) was added to the treatment.

At the end of the treatment, the owner removed the tracheostomy tube. The heifer became dyspneic within 1 hour of removal. The owner reinserted the tube and decided to treat the heifer with antimicrobials for another month before coming back for reevaluation. Six weeks after the first evaluation, the heifer was reevaluated by use of endoscopy. A distinct mass was present on the left arytenoid cartilage. The pharyngeal septum was decreased in size, compared with the initial endoscopic evaluation. The tracheostomy tube was removed with the endoscope in place. The heifer became rapidly dyspneic, and no movements of the arytenoids were detected. A presumptive diagnosis of arytenoid chondritis with a possible laryngeal abscess was made. The heifer was scheduled for subtotal laryngectomy the following day. General anesthesia and the surgical preparation were similar to the other calves. The surgical technique was different because the corniculate and the muscular process of the arytenoid cartilage were preserved similar to subtotal arytenoidectomy described in horses.1 An abscess was found on the caudal and axial surface of the left corniculate process, and this was lanced and flushed with saline (0.9% NaCl) solution in situ. The laryngotomy site was sutured over a Penrose drain by use of 0 polypropylene in a cruciate pattern. The heifer was given procaine penicillin G (22,000 U/kg, SC, q 12 h, for 14 days) and flunixin meglumine (1 mg/kg, IV, q 24 h for 2 days) after surgery. The drain was removed 3 days after surgery.

Four days after surgery, the nasopharynx was endoscopically evaluated. Severe inflammation was found at the surgical site. The heifer was sent home with the tube in place at that time. The owner removed the tube 3 days later. After removal, the heifer had intermittent inspiratory noise for 10 days. However, the heifer never developed respiratory distress. The heifer attained normal stature, was bred, and was confirmed pregnant 6 months after the surgery. The owner reported that the heifer coughs more frequently than other age-matched herdmates.

An 8-week-old Gelbveih bull calf (calf 5) was evaluated because of difficulty breathing of 3 weeks’ duration. The owner had treated the calf with florfenicol, tulathromycin, tilmicosin, and dexamethasone without improvement. At the time of admission, the calf weighted 80 kg (176 lb), was mildly tachypneic (respiratory rate, 40 breaths/min), and had a heart rate of 120 beats/min. The calf was severely dyspneic. A temporary tracheostomy was performed and a tracheostomy tube placed. A tracheal wash was performed through the tracheostomy tube and sent for routine bacterial and anaerobic bacterial culture. Endoscopy of the nasopharynx revealed 2 enlarged and immobile arytenoids. A presumptive diagnosis of bilateral arytenoid chondritis was made. The calf was started on procaine penicillin G (22,000 U/kg, SC, q 12 h) administration and sent home with instructions to continue the penicillin administration until reevaluation. Arcanobacterium pyogenes was cultured from the tracheal wash and was found to be resistant to penicillin. The procaine penicillin G was replaced by ampicillin (10 mg/kg, IM, q 12 h) on the basis of bacterial culture and antimicrobial susceptibility testing results.

The calf was reevaluated 3 weeks after the initial evaluation and had gained 9 kg (20 lb) since the first visit. The owner reported that the calf had been doing well. He had noticed a malodorous discharge draining from the tracheostomy incision. Tilmicosin (10 mg/kg) was administered at that time. At the time of reevaluation, only mild swelling was present at the tracheostomy site. Endoscopy of the nasopharynx revealed no change in the previous endoscopic findings. The calf was scheduled for subtotal unilateral arytenoidectomy as described for calf 4 (closed laryngotomy site over a Penrose drain). The removed arytenoid was sent for histologic evaluation, and a lymphoplasmacytic infiltration of the cartilage was found.

Following surgery, ampicillin (10 mg/kg, IM, q 12 h) was given for 10 days, and flunixin meglumine (1 mg/kg, IV, q 24 h) was given for 3 days. The drain was removed 3 days after the surgery.

Six days after surgery, endoscopy of the nasopharynx was performed and revealed inflammation at the surgical site. The tracheostomy tube was left in place. At that time, a large swelling was noticed at the laryngotomy site. The 2 most ventral sutures were removed. Malodorous fluid was draining out of the incision. The incision was flushed with a diluted iodine solution. The next day, the calf was sent home. The owner was instructed to flush the wound once daily with the diluted iodine solution and to remove the tracheostomy tube 10 days later. The owner was instructed to keep the calf and the dam confined for at least 10 days after removal of the tube.

The tube was removed, and following the removal of the tube, the calf breathed normally. The calf and dam were turned out on pasture 10 days later. Ten days after being turned out, the calf was found dead. He had been seen daily since being out on pasture and appeared normal. No necropsy was performed.

Discussion

The purpose of this report was to describe surgical management of arytenoid chondritis in calves and to increase awareness and recognition of this disease. The literature appears limited regarding clinical diagnosis and management of arytenoid chondritis in calves. The paucity of literature suggests that the complication of arytenoid chondritis in calves following laryngeal necrobacillosis2 is under-recognized. The affected calves described herein provide insight into the diagnosis and surgical management of this disease condition.

The surgical technique described in this report (unilateral arytenoidectomy) was adapted from that de-
Arytenoidectomy has been avoided in ruminants because of concerns regarding compromise of the ability to protect the respiratory tract during rumination cycles. However, our experiences with the techniques as described in the literature for use in treatment of cattle having arytenoid chondritis have been suboptimal for long-term clinical response. These techniques include permanent tracheostomy and tracheolaryngostomy and provide marginal responses. The goal of the surgical technique used in the report presented here was to improve airflow, to lessen the intensity of long-term management after discharge from the hospital, and to improve the cosmetic outcome, compared with the aforementioned techniques.

Arytenoid chondritis is an occasional complication of upper respiratory disease in cattle. Failure to diagnose and offer surgical treatment for arytenoid chondritis in calves is likely associated with economic considerations and lack of awareness of this disease. Increased disease awareness would likely lead to increased recognition. Understanding of the surgical options for management of arytenoid chondritis will likely lead to improved management of calves of genetic importance and those perceived to have great economic value.

In this series of affected calves, 2 dairy calves and 3 beef breed calves were evaluated because of similar clinical signs of respiratory distress. In all calves, the condition was chronic in nature, and multiple antimicrobials had been given by the owner prior to admission. A presumptive diagnosis of arytenoid chondritis was made.

In calves, we felt that saving the muscular process preserved, and 2 calves had a subtotal arytenoidectomy with the corniculate and muscular processes preserved. The approach used in the last 2 calves of this report was a subtotal arytenoidectomy because of concern regarding risks for aspiration pneumonia during rumination and eructation cycles. Both the surgical approach and techniques were adapted from those used in horses. In racehorses, unilateral arytenoidectomy may be performed to treat arytenoid chondritis, unilateral laryngeal hemiplegia, or failed laryngoplasty surgery. In horses, a partial arytenoidectomy is needed to increase airflow at the level of the rima glottis. In calves, we felt that saving the corniculate process was desirable to minimize the risk for aspiration pneumonia during rumination. Calf 2 developed bronchopneumonia after a partial arytenoidectomy was performed. This calf had dysphagia in the early postoperative period. At that time, the calf was drinking from a milk bottle. It was then trained to drink from a bucket on the floor, after which the dysphagia seemed to resolve. Horses undergoing laryngeal surgery are frequently fed on the ground to allow drainage at the incision site and to decrease dysphagia. The same principle can be applied for calves not nursing from a dam. In this report, there are an insufficient number of surgically treated calves to conclude that subtotal arytenoidectomy is superior to partial arytenoidectomy.

The laryngotomy had to be modified from that described in horses. The cricothyroid ligament is shorter in cattle than in horses. The thyroid cartilage had to be incised to gain access to the arytenoid cartilages. The dissection of the arytenoid cartilages was similar to that described in horses, but in our calves, the mucosa lying over the cartilage was removed rather than being preserved for closure. This was necessary because of the damage inflicted on the mucosa by the disease process. In horses, closure of the laryngeal mucosa has been suggested with the goal to avoid the formation of exuberant granulation tissue or adhesions at the surgical site that might decrease the diameter of the rima glottis and therefore decrease the performance of the horse. However, complications, including seroma obstruction of the respiratory tract, have been associated with the closure of the laryngeal mucosa. Dehiscence of the suture line has been reported. Exuberant granulation was not seen in the larynx of calves of this report that were available for follow-up endoscopic examination.

Laryngotomy sites of 3 calves were left to heal by second intention. The other 2 calves had their incisions sutured after placement of a passive drain (Penrose drain). This technique has been described in horses. No more complications were associated with primary closure of the incision, compared with second intention healing. In our calves, it was thought that suturing the incision would decrease the amount of care needed in the postoperative period (ie, daily cleaning of the wound). However, calf 5 developed an incisional infection 6 days after suturing of the laryngotomy site, which needed to be open and flushed.

Postoperative complications were variable among calves. Cellulitis at the tracheostomy tube site was seen especially when the tube was positioned too ventrally on the neck. Early in the postoperative period, dysphagia, coughing, and incisional infection were observed. Complication rates associated with arytenoidectomy...
surgery appeared similar to complication rates associated with other surgical techniques used to treat arytenoid chondritis in cattle.3,4

Arytenoid chondritis is a difficult condition to treat medically in cattle.2 When medical treatment fails to resolve respiratory distress, surgical options include permanent tracheostomy,3,4 tracheolaryngostomy,3,4 or arytenoidectomy. Permanent tracheostomy is more difficult to perform accurately in cattle, compared with horses.3 The ventral aspect of the neck of cattle, which is shorter, more heavily muscled, and has excessive skin, compared with horses, makes this procedure difficult to perform. The tracheolaryngostomy is easier to perform, but success rates of 50% to 90% have been reported with this procedure3,4; death from asphyxia is a complication with this technique. Dehiscence of the surgical site and obstruction of the respiratory tract by granulation tissue or by incompletely healed arytenoid cartilages also have been described.3 In the calves of this report, by performance of a unilateral arytenoidectomy, positive outcomes were obtained as defined by the satisfaction of the owner for 3 of 5 calves. A larger number of affected cattle are needed to determine the true potential of this procedure as a treatment for arytenoid chondritis and to determine whether a subtotal arytenoidectomy (saving the corniculate process) is superior to a partial arytenoidectomy.

References