Migration of extraluminal tracheal ring prostheses after tracheoplasty for treatment of tracheal collapse in a dog

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Case Description—An 8-year-old castrated male Yorkshire Terrier was evaluated because of a 1-month history of inspiratory dyspnea that began 2.5 years after placement of extraluminal tracheal ring prostheses for tracheal collapse.

Clinical Findings—Physical examination revealed severe inspiratory dyspnea. Cervicothoracic radiography revealed a soft tissue opacity within the lumen of the cervical portion of the trachea at approximately the level of the fifth cervical vertebra. Tracheobronchoscopy revealed 2 prosthetic rings protruding into the tracheal lumen.

Treatment and Outcome—The dog was anesthetized, and the 2 protruding tracheal ring prostheses were removed via separate tracheotomies. Tracheoscopy was performed after surgery, and a third prosthetic ring that was found freely floating within the tracheal lumen was removed with an endoscopic grasping forceps. The dog recovered without complications. Dyspnea resolved within the first 2 weeks after surgery. Follow-up examination performed 6 months after surgery revealed that the dog was breathing normally, with no dyspnea or coughing reported by the owner.

Clinical Relevance—Migration of extraluminal tracheal ring prostheses should be included in the differential diagnoses for any dog with dyspnea or persistent coughing after surgical correction of cervical tracheal collapse. Surgical removal of the protruding prosthetic rings, without provision of additional tracheal support, was a viable treatment option in this case. (J Am Vet Med Assoc 2013;243:102–104)

A 8-year-old castrated male Yorkshire Terrier with a 1-month history of progressive inspiratory dyspnea was evaluated at the Las Vegas Veterinary Specialty Center. Approximately 2.5 years prior, 9 extraluminal prosthetic tracheal rings had been placed for treatment of collapse of the cervical portion of the trachea. At that time, preoperative tracheobronchoscopy revealed grade III tracheal collapse with no substantial intrathoracic or mainstem bronchus collapse. Tracheal ring prostheses were placed as described, by use of 5 to 6 interrupted sutures of 4-0 polypropylene to secure each ring. The prosthetic rings were placed at approximately 1-cm intervals from the larynx to the cranial intrathoracic portion of the trachea. Gentle cranial traction was applied to the trachea to allow placement of 2 rings on the cranial intrathoracic portion of the trachea. Nine-millimeter-diameter prosthetic rings were selected for implantation in this case. No specific measurements of tracheal diameter were made; however, the implanted rings could be rotated on the trachea prior to suturing, with no tracheal luminal compression. The dog recovered from surgery with no complications. The client reported complete resolution of coughing within 1 month after the original procedure.

Approximately 2.5 years after surgery, the dog began to have frequent, progressive episodes of severe coughing and inspiratory dyspnea. The dog often vomited and defecated during these episodes, but never lost consciousness. Episodes were reported to last approximately 20 minutes each and occurred 2 or 3 times/d. Treatment with prednisolone, trimetrazine, and hydrocodone resulted in no improvement in clinical signs. Cervicothoracic radiography performed by the referring veterinarian revealed a soft tissue opacity in the lumen of the cervical portion of the trachea at approximately the level of the fifth cervical vertebra (Figure 1). Differential diagnoses for the tracheal narrowing at that time included collapse between 2 prosthetic rings, intratracheal tumor, focal granulation tissue formation, and implant failure or breakage. Results of CBC and serum biochemical profile were unremarkable except for mildly increased alkaline phosphatase activity (203 U/L; reference range, 5 to 131 U/L) and platelet count (668 × 10³ platelets/µL; reference range, 170 × 10³ platelets/µL to 400 × 10³ platelets/µL). Physical examination revealed severe inspiratory dyspnea and stridor. Palpation of the trachea elicited coughing. Other results of the physical examination were unremarkable.

The dog was anesthetized for tracheoscopy and examination of the proximal portion of the airway. Laryngeal examination revealed normal arytenoid cartilage function. Tracheoscopy revealed 2 prosthetic rings protruding into the tracheal lumen, 1 at a site corresponding to the caudal to the first. A small (4 × 3 × 3 mm) soft tissue mass was associated with the more cranial of the 2 rings. The remaining cervical aspect of the trachea was adequately supported with the prosthetic rings that were still in place. No intrathoracic tracheal or bronchial collapse was identified. Moderate inflammation and mucosal edema were...
noted in the region of the soft tissue mass. The remainder of the trachea, both cranial and caudal to the protruding prostheses, was mildly inflamed with only mild mucosal edema. Sutures identified within the tracheal lumen were covered by nonreactive mucosa. Generalized mucosal thickening was not appreciated on tracheoscopic examination. The dog was prepared for surgery, and a ventral midline approach was made to the cervical portion of the trachea. The sites of tracheal ring migration were easily palpated as a compressible region of the trachea. Because of the scar tissue around the original tracheoplasty sites, numbering the prosthetic rings was not possible without excessive peritracheal dissection. A 3-mm circumferential tracheotomy was performed through the annular ligament at approximately the level of the fifth cervical vertebra, and a loose tracheal ring prosthesis was removed from the tracheal lumen. The soft tissue mass was sharply excised from the tracheal lumen with Metzenbaum scissors prior to routine closure of the tracheotomy. Two additional tracheotomies were performed approximately 2 to 3 cm cranial to the thoracic inlet in regions of the trachea that seemed, on the basis of palpation, to be unsupported by prostheses. Several intact polypropylene sutures (from the original prosthetic ring placement) were found at the second tracheotomy site, but the prosthetic ring was not found in the lumen. A second prosthetic ring was removed from the third tracheotomy. One normally positioned prosthetic ring was identified between the first and second tracheotomy sites. The second and third tracheotomy sites involved adjacent prosthetic rings. Closure of the tracheotomies was performed with simple interrupted sutures of 4-0 polydioxanone. The endotracheal tube was positioned proximal to the cranial tracheotomy site following closure of all tracheotomies, and breathing was observed for several minutes. No substantial collapse of the trachea was seen during any portion of the breathing cycle. The trachea only collapsed when direct manual compression was applied to the trachea at the sites of prosthesis removal. Tracheoscopy was repeated following surgery, and the prosthetic ring previously unaccounted for was found freely moveable within the tracheal lumen. This third prosthetic ring was removed with an endoscopic retrieval device. The trachea was closely examined at the regions where prostheses were removed. Grade 1 tracheal collapse was noted at the sites of prosthesis removal. A single 0.25 mg/kg (0.11 mg/lb) dose of dexamethasone sodium phosphate was given IV prior to recovery. A laryngeal examination was performed during recovery from anesthesia. Normal arytenoid cartilage function was noted bilaterally. The soft tissue mass lesion excised from the tracheal lumen was submitted for histologic examination.

The dog recovered well following surgery. Supplemental oxygen was provided for the first 24 hours after surgery. For the first 24 hours after surgery, acetylcysteine (0.025 mg/kg [0.011 mg/lb]) and hydromorphone (0.05 mg/kg [0.023 mg/lb]) were administered IV as needed for sedation and analgesia, respectively. Tramadol and amoxicillin-clavulanic acid were administered PO beginning the day after surgery. The client was informed of the risk of future tracheal collapse at the sites of prosthesis removal and advised to return for evaluation if coughing returned. The dog was hospitalized for 2 days after surgery, during which time occasional mild coughing was noted. Histologic evaluation of the intraluminal mass revealed inflamed and ulcerated polypoid tissue with no signs of infectious organisms or neoplasia. The client reported occasional coughing episodes at home that resolved after 1 week. The last follow-up examination was performed 2 weeks after surgery. At that time, the dog had returned to its normal routine; no dyspnea, stridor, or coughing was noted on physical examination, and no medications were being administered. A telephone interview was performed 6 months after surgery, at which time the owner reported that the dog was breathing normally with no further dyspnea or coughing.

Discussion

The dog described in the present report had an unusual complication with tracheal perforation and prosthetic tracheal ring migration 2.5 years after surgery. A case of tracheal perforation secondary to suture irritation from closure of the longus colli muscle following ventral slot decompression has been reported in the veterinary literature.2 Although the tracheal perforation reported in that case occurred only 8 weeks after initial surgery, that report is supportive of the notion that extraluminal tracheal ring prostheses may induce long-term wear on the trachea and eventually result in perforation. During the breathing cycle, the trachea undergoes substantial movement,3 especially at the thoracic inlet, which might contribute to chronic inflammation and irritation at the free ends of the prosthetic rings or suture tags and ultimately create tracheal perforations, as reported here.
When suturing the extraluminal prosthetic rings to the trachea, it is critical to take full-thickness bites through the trachea to prevent suture pull-out and dislodgement of the prosthetic ring. The prefabricated prosthetic rings used in the dog of this report are designed with regularly spaced small indentations on the lateral surfaces. Sutures should be placed over these indentations and firmly secured to prevent rotation of the prosthetic rings after placement. Sutures placed outside the indentations might not have the same security and may have resulted in migration and tracheal perforation as reported here. Although it was impossible to evaluate each suture during tracheoscopy, numerous sutures were identified in the tracheal lumen. The sutures formerly securing 1 prosthetic ring, which was found free within the tracheal lumen, were intact and did not appear grossly different from the other intact sutures examined. This tracheal ring prosthesis may have gradually slipped through its sutures and perforated the tracheal lumen with the incomplete end of the prosthetic ring.

Polypropylene mesh implants are commonly used in human reconstructive surgery and result in implant-related erosions in 1% to 2% of cases.4,5,6 Polypropylene implants induce a mild but persistent foreign body reaction in recipient tissues in multiple species,7 so it is logical to assume that similar chronic foreign body reactions occur in dogs that receive polypropylene implants. Histologically, the mass removed from the tracheal lumen in the study reported here had features consistent with chronic inflammation and the tissue reaction induced by a foreign body. No evidence of infectious organisms or neoplasia was found. These findings suggest that a chronic foreign body reaction was the etiology of the multiple tracheal perforations.

Avascular tracheal necrosis is a known complication of extraluminal tracheal prosthesis placement for treatment of tracheal collapse in dogs.8,9 Reports9,10 of clinically important tracheal necrosis, however, have been almost exclusively limited to cases associated with spiral polypropylene prosthesis placement. To the authors’ knowledge, only 1 case of histopathologically confirmed tracheal necrosis following the placement of handmade polypropylene ring prostheses has been reported in the veterinary literature.11 Additionally, only 1 case series has been reported in which the commercially available ring prostheses used in the case reported here were used, and no cases of tracheal necrosis were reported in that series.12 All reported cases of clinically important, histopathologically confirmed tracheal necrosis have occurred within the first 14 days following prosthesis placement.10–12 Although tracheal necrosis remains an important consideration for postoperative management of patients treated via placement of extraluminal tracheal prostheses, it is unlikely to have contributed to the development of the tracheal perforations reported in the present case.

The protruding tracheal ring prostheses were not replaced following their removal because of concerns regarding the integrity of the trachea following tracheotomy. The authors felt that replacing the prosthetic rings immediately after performing a tracheotomy could result in further tracheal perforation. No specific information is available in the veterinary literature regarding the likelihood of tracheal collapse following extraluminal prosthetic ring removal. If cervical tracheal collapse recurs, options for treatment include both the placement of additional extraluminal prostheses and the placement of an intraluminal self-expanding nitinol stent. Although concerns remain regarding future tracheal perforation following reimplantation with extraluminal prostheses, no information is available in the veterinary literature regarding the potential success rates for either extraluminal or intraluminal procedures in this particular scenario.

The dog of this report vomited and defecated during episodes of severe coughing and dyspnea; although the cause was not determined, these actions may have been the result of increased intra-abdominal pressure caused by forceful coughing. Vomition and inappropriate defecation were not seen during hospitalization or following removal of the protruding prostheses, so further diagnostic tests were deemed unnecessary.

The rare complication encountered in this case was discovered only through the use of recheck tracheoscopy, although thoracic radiography revealed findings suggestive of an intraluminal soft tissue mass. The chronic movement of the extraluminal tracheal ring prosthetics and chronic mild foreign body reaction to the rings were the presumed causes of the tracheal perforation and subsequent intraluminal migration of the prosthetic rings, and removal of those rings resulted in resolution of clinical signs.

a. Polypropylene tracheal ring prosthetics, small (9 mm diameter), New Generation Devices, Glen Rock, NJ.

References