Surgery IVENTA

The Trachea: Diseases & Surgery

Cheryl S. Hedlund, DVM, MS
Diplomate, American College of Veterinary Surgeons
Veterinary Clinical Sciences
School of Veterinary Medicine
Louisiana State University
Baton Rouge, LA 70803

Tracheal obstruction and disruption are the major indications for tracheal surgery. Causes of tracheal obstruction include congenital abnormalities, stenosis, neoplasia, or foreign bodies. Signs of tracheal obstruction are usually not obvious until luminal compromise approaches 50% and are recognized as progressive inspiratory or expiratory dyspnea. Active or athletic animals show signs of dyspnea with less reduction of lumen diameter. Dyspnea at rest and cyanosis during exercise are seen as lumen size approaches 10-15% of normal. Penetrating foreign bodies, blunt trauma, or animal bites may disrupt tracheal integrity causing dyspnea, hemoptysis, subcutaneous emphysema, pneumomediastinum and/or pneumothorax. Diagnosis of upper airway disease is pursued by obtaining an accurate history, physical examination, minimum data base, radiographs, endoscopy, culture, cytology, serology, and biopsy. Advanced imaging (cat scan, magnetic resonance imaging, and ultrasonography) may also be helpful in determining the location and extent of a lesion.

Surgical Principles: Tracheal surgery should result in healing without subcutaneous emphysema, stenosis, or mucostasis. Tracheal reconstruction should provide a fully epithelial-lined, laterally rigid airway, and healing should be prompt and predictable. Avoid the use of intraluminal tubes, stents or reactive, nonabsorbable suture material. These materials may interfere with mucociliary transport, cause mucosal ulceration and result in granuloma formation. Avoid tension at the surgical site as it may lead to dehiscence and stenosis. Reduce suture line tension by tracheal mobilization, tension relieving sutures, annular ligament incisions and head...
restraint. Tracheobronchial infections can result from mucostasis and an inadequate cough reflex. Mucostasis occurs after vagus or recurrent laryngeal nerve damage if the cough reflex is lost. Mucostasis also occurs with trauma to the tracheal mucosa.

The normal tracheal lumen is classified as a clean contaminated environment. Ideally, culture and antibiotic susceptibility should be determined prior to invading the tracheal lumen. Minimize postoperative infections by administering appropriate preoperative antibiotics to patients with known tracheal infections or giving prophylactic antibiotics to prevent infections.

Prior to surgery accurately identify the level and length of the lesion to be resected or by-passed. Depending on the degree of tracheal elasticity and tension, approximately 20% to 60% of the trachea may be resected and direct anastomosis achieved. This information may modify the operative exposure and the mobilizing procedures which are planned. Incisions should occur through healthy tissue as healing of inflamed or diseased tissue is unpredictable.

Anesthesia: Patients with compromised respiration are high anesthetic risks. Respiratory and cardiac failure may occur during anesthetic induction. Avoid problems by keeping the animal quiet and calm, and by oxygenating during the immediate preanesthetic period. Anesthetic induction should be smooth and rapid so that the anesthetist can gain control of the airway. The endotracheal tube should extend into the distal trachea beyond the site of obstruction or disruption. If the tube cannot be passed beyond the obstruction, position it just proximal to the mass. Alternatively, a tube tracheostomy distal to the lesion or high frequency ventilation may be used for anesthetic and/or oxygen delivery. Have available sterile endotracheal tubes and hoses for intubation of the distal trachea or mainstem bronchi during tracheal resection.

Approach: The approach is determined after identifying the level and length of the lesion to be resected or by-passed. Approach the cervical trachea through a ventral midline incision. Limited exposure of the cranial 3-4 cm of the thoracic trachea may be obtained utilizing this approach by blunt dissection of the loose areolar mediastinal tissue and traction on the cervical trachea. Approach trachea lying within the thoracic inlet by adding a partial sternotomy to the ventral cervical approach, by a lateral 3rd, 4th, or 5th intercostal thoracotomy, or both. The cranial thoracic trachea is usually approached through the right 3rd or 4th intercostal space. Approach to the distal thoracic trachea and carina through a right 5th intercostal lateral thoracotomy Dissection planes should be directly against the tracheal cartilage to preserve recurrent laryngeal nerves and as much segmental blood supply as possible.
Techniques:

**Tracheostomy** is a procedure used to create an opening into the tracheal lumen to facilitate air passage. Tracheostomy is performed as an elective procedure to by-pass the upper airways or as an emergency procedure for patients with acute upper respiratory obstruction. Two general types of tracheostomy have been described. First, **tube tracheostomy**, in which a tube is inserted into the tracheal lumen through a tracheotomy incision. Tube tracheostomies are usually maintained for a short time (hours to days). Second, **permanent tracheostomy**, in which a stoma is created in the ventral tracheal wall by suturing the tracheal mucosa to the skin. Permanent tracheostomies are maintained for life or until surgically closed. Tracheostomy tubes are not necessary for stomal or luminal patency when permanent tracheostomases are created.

Indications for tube tracheostomy include obstructive lesions or surgical procedures of the head and neck, or the need for respiratory support via ventilation and aspiration of secretions. Tube tracheostomy is performed aseptically using a ventral cervical midline incision from the cricoid cartilage and extending 2-3 cm caudally. Transverse tracheotomy through the annular ligaments between the 3rd and 4th, or 4th and 5th tracheal cartilages is recommended. Risk of subglottic stenosis is greater if the annular ligament incision is made proximal to 3rd annular ligament space. The tracheostomy tube should be nonreactive and 1/2 the lumen's size. The tube is secured by suturing it to the skin or tying it to gauze that is tied around the neck.

Patients with tracheostomy tubes need to be observed closely and have their tubes cleaned frequently to prevent asphyxiation secondary to obstruction or dislodging of the tube. Sterile technique should be used during tube cleaning. Gagging, retching, and vomiting may occur during suctioning due to vagal stimulation. Tracheostomy tubes are removed when an adequate airway or spontaneous ventilation is established. The site is allowed to heal by second intention.

Permanent tracheostomy is indicated in animals with upper respiratory obstruction causing moderate to severe distress during minimal exertion or at rest, and in which other treatment modalities are not feasible. Most permanent tracheostomies have been performed in patients with impairment of the laryngotracheal apparatus, usually laryngeal paresis or paralysis with collapse, or laryngeal masses. Permanent tracheostomies have also been performed in animals with nasal tumors, laryngeal adhesions, tracheal disruption or following laryngectomy.

Permanent tracheostomy is performed through an 8-10 cm ventral midline incision. A tunnel is created by dissecting bluntly around the dorsal aspect of the trachea 3-4 cartilages distal.
to the larynx. Using this tunnel the sternohyoid muscles are apposed dorsal to the trachea with one or two horizontal mattress sutures. This deviates the trachea to the level of the skin reducing tension on the mucosa-to-skin sutures. Beginning with the second or third tracheal cartilage, a rectangular segment of the ventral tracheal wall 3-4 cartilage widths long and 1/3 the circumference of the trachea in width is excised. Redundant skin adjacent to the stoma is excised. Remaining skin is sutured directly to the external tracheal fascia laterally and to the annular ligaments proximal and distal to the stoma with a series of interrupted intradermal sutures. An "I" or "H" shaped incision is made in the mucosa. Simple interrupted or continuous sutures (4-0 polypropylene or polydioxanone) are placed approximately 2 mm apart to appose the mucosa to the edges of the skin, forming a tracheostoma.

Management of permanent tracheostomies is usually less demanding than tube tracheostomies. The tracheostoma should be inspected for mucus accumulation every 1-3 hours; cleaning should be performed when mucus begins to occlude the tracheostoma or respiratory efforts increase. Animals not having severe secretory infections or tracheitis usually accumulate a moderate amount of mucus during the first 7-14 days after surgery. The cleaning interval increases to every 4-6 hours by 7 days following surgery. After the first month, tracheal secretions are expected to be mild and stomal cleaning required twice daily. Hair is clipped from around the stoma to prevent matting with mucus. Exercise and housing is limited to clean areas and swimming must be prohibited. The majority of postoperative complications involve stomal occlusion from skin folds or stenosis.

**Tracheal Reconstruction:** Operable obstructions and disruptions are usually reconstructed via anastomosis. An end-to-end technique should be used to avoid luminal compromise. Mobilize the trachea only enough to allow resection of its diseased portion and apposition of the transected ends without tension. Using the split cartilage technique, one cartilage at each end of the portion of trachea to be resected is split circumferentially into halves. Continuity is re-established by apposing the split cartilages and dorsal tracheal membrane with simple interrupted sutures (3-0 or 4-0 polypropylene) placed 2-3 mm apart. To help relieve tension on the anastomotic site place three to four retention sutures. Other techniques which may be needed to relieve tension on the anastomotic site include partial thickness annular ligament incisions or mainstem bronchi release and reimplantation. Following lavage of the area, the incision is closed routinely. Alternatively, an annular ligament anastomosis technique may be used which apposes intact adjacent cartilages. Apposition of intact tracheal cartilages often allows one cartilage to partially override the other which leads to mucosal incongruity, second intention healing and ultimately stenosis at these
sites. The split-cartilage technique is preferred because it is easier to perform and results in more precise anatomic alignment with less luminal stenosis than other end-to-end techniques. Postoperatively prevent full extension of the neck by placing a suture from the chin to the manubrium or by fixing a muzzle or halter to a harness for two to three weeks. Restrict exercise for two to four weeks.

Complications after tracheal resection and anastomosis may include coughing, hemorrhage, voice change, fistula formation and cartilage malacia. Dehiscence occurs if there is too much tension or neck movement after surgery. Subcutaneous emphysema, acute respiratory distress, hemoptysis and subcutaneous swelling are signs of dehiscence. Partial dehiscence or gaps between mucosal edges require second intention healing which may lead to tracheal stenosis. Excessive dissection during surgery may lead to ischemic necrosis of the remaining trachea. Traumatizing the recurrent laryngeal nerve during surgery or injury may cause laryngospasms, laryngeal paresis, or laryngeal paralysis.

**Tracheoplasty** using extraluminal rings or intraluminal stents is employed in advanced tracheal collapse or nonresectable stenosis cases. Intervention is symptomatic rather than curative but improvement in the clinical condition can be achieved.