TRACHEAL TRAUMA: FIXING IT

Jolle Kirpensteijn, DVM, PhD, DACVS, DECVS
Gert ter Haar, DVM, DECVS
Faculty of Veterinary Medicine
Utrecht University
Utrecht, The Netherlands

INTRODUCTION
Traumatic injury to the trachea is not very common in small animals, but can be the result of bite wounds to the neck, gunshot, car or motor accidents, tracheostomy wash procedure, overinflation of endotracheal cuffs (especially in cats), in conjunction with thoracic trauma, after bronchoscopy, during or after surgery of the trachea or during jugular venous puncture. Non-perforating wounds to the trachea can be caused by choke collars and other blunt trauma to the trachea. Full tracheal transection of the intrathoracic trachea has been described after blunt trauma.

CLINICAL SIGNS
Tracheal trauma can be associated with a plethora of clinical signs including dyspnoea, coughing, progressive emphysema, external wounds and with pneumothorax or pneumomediastinum. Laceration of the tracheal wall, cartilage or annular ligament, will cause subcutaneous and/or mediastinal emphysema in dogs and cats. Depending on the location of the trauma. With cervical tracheal trauma the subcutaneous emphysema may involve only the peritracheal region or may involve the entire subcutaneous area of the body. Pneumomediastinum may be present with a cervical or intrathoracic lesion. Some animals show minimal signs except for mild subcutaneous emphysema, that slowly progresses into massive emphysema (Michelin man syndrome). Airway obstruction may be caused by aspiration of blood, intrapulmonary hemorrhage or frank airway disruption.

DIAGNOSIS
Radiographs should be taken of the traumatized areas to determine the location and extent of the tracheal trauma and to evaluate pneumomediastinum, pneumothorax, lung contusions, rib fractures and other possible complications of cervical or thoracic tracheal trauma. The exact location of the tracheal laceration is usually not found on the radiographs however because the emphysema obscures radiographic detail. In case of tracheal avulsion, the radiographs will usually reveal the separation of the tracheal rings referred to as a “pseudo-tracheal” sign. Some authors state that bronchoscopy is the method of choice for documenting tracheal rupture. For more detailed pre-operative information, computed tomographic scanning can be necessary, especially with trauma to the larynx.

EMERGENCY THERAPY
In cases of severe dyspnoea, a rapid anaesthesia and endotracheal placement (even through the damaged trachea) may be life-saving. With the patient stabilised, a definite plan for further diagnostic work-up and therapy can be made. If the subcutaneous air collection is regressing and there are no signs of pulmonary distress, it is usually recommended that the patient be cage rested, which allows the emphysema to regress by slow absorption, mild sedation, and occasionally by aspiration and wrapping the body with elastic bandages, being careful not to mechanically restrict respiration. In case of large wounds, thorough wound debridement and lavage are performed after assessment of the total damage. As much of the trachea is spared, except when obvious demarcation is present. Sometimes it is better to use secondary closure of the tracheal wound in combination with temporary tracheostomy.

EMERGENCY TRACHEOSTOMY
Temporary Tracheostomy
Temporary tracheostomy includes the introduction of a tracheal cannula that will be left in place until the airways are patent. Silastic tracheal cannulas or stainless steel cannulas with an inner cannula that can be removed and cleaned are preferred. Temporary tracheostomies require inhalation anaesthesia in all patients, including emergency cases. The patient is placed in dorsal recumbency with a pillow under the neck. A transverse skin incision of approximately two centimetres is made over the trachea at the midpoint between the larynx and the thoracic inlet. The subcutaneous fat and the left and right sternothyroid and sternohyoid muscles are divided in the midline by blunt dissection. Care should be taken not to damage the tracheal veins, which lie immediately lateral to the trachea on both sides. A small self-retaining wound retractor is inserted into the wound to expose the trachea. The ligament between two adjacent rings in incised with a no. 11 scalpel. A small forceps is placed on one of the tracheal rings beside the incision. The forceps is locked tight to provide a firm hold on the tracheal ring. This is done to prevent the piece that will be removed from slipping into the trachea. The scalpel is then used to make a circular incision around the forceps. A round piece of tracheal cartilage and intercartilage ligament is removed to produce an opening of the same size and shape as the tracheal tube or cannula. If the window is made too large, air may leak around the cannula and subcutaneous emphysema will form. The oropharyngeal endotracheal tube is removed and replaced by a silastic endotracheal cannula that is inserted through the tracheal window. If the tracheostomy is performed prior to a more extensive procedure an endotracheal tube is used instead.
be replaced by a cannula at the end of the procedure. The cannula is sutured to the skin with four sutures. In addition, two cotton ribbons are attached to the wings of the tracheal cannula and the tied around the neck. The cannula is left in place until the upper airway is patent. Silastic cannulas have an inner cannula that should be cleaned every two hours. After removing the cannula, the tracheostomy wound is not sutured, but left open to heal spontaneously. Healing is usually rapid because the incision was made parallel to the natural skin folds, which will result in good apposition of the wound margins.

**Permanent Tracheostomy**

A permanent stoma of the trachea is sometimes the only solution when an obstructive disease of the upper airways is beyond treatment and a tracheal cannula has become a necessary condition for continuation of life. Home-care of a permanent tracheostomy is however elaborate and difficult.

After induction of anaesthesia, endotracheal intubation is performed via the oral route. Care should be taken that the cuff of the endotracheal tube is placed caudal to the planned site of the stoma and is adequately inflated. The dog or cat is placed in dorsal recumbency with a pillow under the neck. The procedure starts with a ventral midline skin incision directed lengthwise over the cervical trachea for eight to ten centimetres. The underlying tissues are separated in the midline and the left and right sternohyoid muscles are separated over the entire length of the skin incision. By suturing the left and right sternohyoid muscles together dorsal to the trachea, the ventral surface is elevated and exposed at the skin level. After a sufficiently large part of the tracheal ring has been removed (the width of a normal tracheostomy, but at least twice as long), two sutures are placed on one side to anchor the trachea to the skin. This procedure is repeated on the contralateral side. A piece of skin the size of the stoma is the removed. The cranial and caudal edges of the skin over the trachea are anchored to the trachea with one suture at each angle, the aim being to appose the skin to the tracheal mucosa. The most important part of the surgery then follows, this being the apposition of the skin and the tracheal mucosa by multiple interrupted sutures at the edge of the stoma. The tracheal cartilage should be included in several of these sutures for reliable support. The subcutaneous tissue and the skin cranial and caudal to the stoma are then closed routinely. Aftercare consists of careful removal of the crusts around the stoma while the sutures are in place (ten days). After this initial period, cleaning is needed less frequently. Instructions to the owner include clipping the hair around the stoma regularly and avoiding contact with dust, as well as the prohibition of bathing and swimming.

**TRACHEAL CLOSURE TECHNIQUES**

**Tracheotomy Closure**

If a small part of the trachea is affected, cartilage and mucosa can be debrided with care and the defect can be apposed using absorbable monofilament suture material (4-0).

**TRACHEAL RESECTION**

Severely damaged parts of the trachea will have to be resected, however tension on the remaining trachea must be kept to a minimum to prevent further complications. The amount of trachea that can be removed is described to be between 20-60 percent, but the author has not been satisfied with resections larger that 40% without major augmentation. Young animals have the obvious advantage of more elasticity of the trachea but are more prone to stenosis caused by tension. Fossum et al (2004) describes the split cartilage technique, which is also the authors’ preferred method. The affected trachea is approached through a ventral midline incision in the neck or through a lateral thoracotomy. The approach is identical to a tracheostomy and care has to be taken not to interrupt with the vascular supply of the trachea. The use of stay sutures before transaction is advised and an extra hand during the surgery for approximating the two tracheal ends is helpful. Cartilages are split in the middle using the ‘split technique’ using sharp transection and approximated with interrupted sutures that surround both split cartilages. Some authors describe Lembert fashion retaining sutures to decrease tension in the area or use specially designed muzzles to keep the dog from stretching its neck.

**POSTOPERATIVE MANAGEMENT**

The use of antibiotics is indicated because contamination of the area is often obvious. Also drainage of the loose connective tissues of the cervical area or by use of closed thoracic suction drains are suggested. Sufficient pain management is definitely in order. Endoscopic evaluation of the trachea may be indicated in cases where postoperative stenosis is expected.

**POSTOPERATIVE COMPLICATIONS**

Postoperative complications are common and include infection and dehiscence, stenosis, injury to the recurrent laryngeal nerve, emphysema, and fistula formation.

**References**