Disorders of the upper airway occur commonly in brachycephalic breeds of dogs. Chief client complaints include excessive respiratory noise, reduced exercise tolerance, heat intolerance, and dyspnea. Cyanosis also may be observed. Since multiple airway abnormalities may occur in the same dog, a systematic and thorough approach to patient evaluation is essential for proper management. Brachycephalic breeds with upper airway disorders present both anesthetic and surgical challenges to the clinician. Diagnosis and management of the following upper airway disorders are reviewed: stenotic nares, elongated soft palate, everted laryngeal saccules (laryngeal collapse), and hypoplastic trachea.

**Patient evaluation**

Evaluation of the patient with upper airway disorders should include a thorough history, physical examination, radiographic examination, and pharyngoscopic, laryngoscopic and tracheoscopic evaluation in the anesthetized patient. Determine the frequency, severity, and pattern of occurrence of dyspnea and excessive noise when obtaining the history from the client. Note the occurrence of cyanotic episodes, as this may indicate the presence of more severe or multiple abnormalities.

Physical examination focuses on the cardiopulmonary systems, yet does not exclude other body systems. Inspect the external nares looking for axial deviation of the dorsolateral nasal cartilage, and evaluate function of the nares. Observing the dog at rest and breathing with a closed mouth will help determine if air is moved effectively through the nose. Placing a clean microscope slide in front of the nares with the animal breathing through the nose will also provide an estimate of air flow through each nostril. Auscultate the thorax and upper airway. Lateral cervical radiography emphasizing soft tissue detail may help delineate an elongated soft palate. Perform pharyngoscopy, laryngoscopy, and tracheoscopy in the anesthetized patient, being prepared to proceed with surgery after the evaluation.

**Pre-surgical management**

Anesthesia in the brachycephalic breeds requires diligent pre-anesthetic preparation and attentiveness to detail during and after anesthesia. Points of emphasis include avoiding regurgitation or vomiting, providing pre-anesthetic oxygenation, rapidly inducing anesthesia, gaining rapid control of the airway, and administering a single dose of corticosteroid preoperatively.

Regurgitation and vomiting is observed relatively commonly following general anesthesia administration in dogs undergoing upper respiratory surgery. Regurgitation poses two risks to the patient: aspiration pneumonia and reflux esophagitis. Post-anesthetic regurgitation may be minimized by withholding food from the dog for 18 to 24 hours prior to anesthesia. Water is usually withheld for 4 to 6 hours before surgery, also. The use of pre-anesthetic metoclopramide (0.2-0.4 mg/kg, SQ) may have beneficial effects on reducing the incidence of postoperative vomiting and regurgitation.

Use of a corticosteroid (e.g., dexamethasone, 0.1-0.2 mg/kg, IV or SQ) immediately prior to pharyngeal or laryngeal surgery in the brachycephalic dog may reduce postoperative swelling. The author embraces such practice, as it seems to positively impact ventilation in the immediate postoperative period.

**Anesthesia**

Oxygen (5 L/minute) should be administered via face mask or rebreathing hose for at least 5 minutes immediately prior to anesthetic induction to dogs that do not resist its delivery. Anesthesia should be rapidly induced with an injectable agent (e.g., propofol), to enable rapid and atraumatic endotracheal tube placement. Brachycephalic breeds are not good candidates for the use of inhalation anesthetics as induction agents, because they can develop significant difficulties before the endotracheal tube is placed. Employ adequate laryngoscopic viewing to efficiently accomplish endotracheal intubation. Choice of endotracheal tube size (diameter and length) should reflect the diameter of the trachea and the length of cervical region. Avoid excessively large or long tubes. When properly placed, the endotracheal tube should extend from the tip of the nose to the thoracic inlet and be slightly smaller than the tracheal diameter. After minimally inflating the endotracheal tube cuff, secure the tube with a section of roll gauze tied behind the animal’s head. Maintain endotracheal intubation for as long as possible during recovery from anesthesia.

**Diagnosis**

**Stenotic nares**

The nose contributes 80% of the total airway resistance during inspiration. Diagnosis of stenotic nares is made by physical examination. Reduced air flow through the stenotic nostrils is noted when the dog is closed mouth breathing. Reluctance to breathe through the nose may also be noted. The wing of the nostril may be mildly, moderately, or severely deviated medially. Affected dogs often are restless and anxious, especially when restrained.
**Elongated soft palate**
An elongated soft palate usually produces signs of excessive respiratory noise, particularly when the animal is sleeping. The redundant soft tissue in the pharynx projects into the larynx and causes stridor in symptomatic dogs. Make a definitive diagnosis of elongated soft palate during pharyngoscopic evaluation. An elongated soft palate extends more than 3 mm caudal to the tip of the epiglottis. The elongated soft palate often is thickened and has an inflamed tip.

**Everted laryngeal saccules (Stage I laryngeal collapse)**
Everted laryngeal saccules are a secondary disorder of the upper respiratory tract. Everted saccules produce excessive noise, primarily on inspiration and possibly dyspnea. This abnormality seems to develop due to the generation of strong negative intra-laryngeal pressures during inspiration. Everted laryngeal saccules may accompany any or all of the other brachycephalic upper respiratory disorders. History is often not particularly helpful in presumptively diagnosing everted laryngeal saccules, although recent evidence of exercise or heat intolerance may be noted. Laryngoscopic examination in the anesthetized patient reveals redundant mucosa just rostral to the vocal folds near the floor of the larynx. Everted saccules are usually white and glistening and obscure the vocal folds. Their prominence may vary with the degree of inspiratory effort. The laryngeal opening is smaller, particularly its ventral aspect.

**Hypoplastic trachea**
Hypoplastic trachea is observed fairly commonly in Bulldogs and some other brachycephalic breeds. If the trachea is severely hypoplastic, the animal's respiratory function may be almost continuously compromised. Diagnosis is made following lateral cervicothoracic radiographs and/or tracheoscopy.

**Surgery**

**Stenotic nares**
Surgical repair of stenotic nares involves the excision of a portion of the lateral alar fold and approximation of the adjacent tissues. A vertical (or elliptical) wedge of tissue is excised from each lateral alar fold. Hemorrhage is controlled with local pressure and reapposing the wound edges. Simple interrupted or mattress sutures (e.g., 3-0 poliglecaprone 25) are placed to enlarge the size of the nostril.

**Elongated soft palate**
Repair an elongated soft palate via an oral approach with the intubated patient positioned in sternal recumbency. A properly placed mouth gag and suspension of the patient's upper jaw assist the surgery. A soft palate is considered to be elongated if its free end extends beyond the caudal border of the palatine tonsils. Alternately, the end of the soft palate should not interfere with the movement of the epiglottis. Excise the redundant portion of the soft palate after placing stay sutures in its lateral edges near the proposed level of resection. These stay sutures help minimize trauma to the tissues and guide the line of excision. Use Metzenbaum scissors to incise part of the soft palate starting laterally and proceeding medially. After incising about one-half of the width of the soft palate, begin placing sutures in the incised edge of the palate to appose oral and nasal epithelial surfaces of the cut edge of the soft palate. A synthetic absorbable suture (e.g., 4-0 poliglecaprone 25) is placed using a simple continuous pattern to achieve mucosal apposition. Incise the remainder of the width of the soft palate, discarding the redundant portion of the palate, and complete the closure. Verify accuracy of excision prior to the removal of the stay sutures and mouth gag.

**Everted laryngeal saccules**
Excise everted laryngeal saccules through an oral approach. Use a mouth gag and properly position the patient to assist the surgery. The author prefers to maintain tracheal intubation, provided that the dorsally-deviated endotracheal tube permits adequate visibility and access to the ventral larynx. Long handled instruments (Debakey tissue forceps and fine-tipped Metzenbaum scissors) aid the procedure. Temporary removal of the endotracheal tube or tracheostomy endotracheation may aid visibility and surgical efficiency. Grasp the everted mucosa with Debakey tissue forceps, excise the redundant mucosa as near its base as possible using Metzenbaum scissors, and discard the excised tissue. Inspect for any evidence of remnants of the saccule; remove such remnants in a similar fashion. Hemorrhage is usually minimal.

**Hypoplastic trachea**
There is no clinically tested surgical treatment for hypoplastic trachea. Owners should be notified that respiratory signs may persist in patients with severely hypoplastic trachea, even following successful repair of other disorders. The veterinary clinician should also be prepared to modify endotracheal tube selection in those anesthesia patients with hypoplastic trachea.

**Postoperative considerations**
Brachycephalic patients require close observation during their post-anesthetic recovery. Recovery should be as smooth and controlled as possible. Preoperative tranquilization (e.g., 0.1 mg/kg acepromazine, IV) may help prolong the recovery process. Delay endotracheal tube removal as long as possible. A temporary tracheostomy may be necessary in selected patients, if pharyngeal or laryngeal swelling is experienced. Offer water a few hours after the patient is fully awake. Delay offering food until the next day.
**Summary**

The anesthetic and surgical management of the brachycephalic dog with upper airway disorder(s) require proper planning and diligence to be successful. Such planning and attentiveness to detail should include complete patient evaluation, proper selection and use of perianesthetic drugs, efficient, atraumatic surgery, and close observation during the anesthetic recovery period.

**References**


Pre-surgical considerations
Traumatic diaphragmatic hernia should be suspected in any animal with known or suspected trauma, recent or not, that is presented with dyspnea. Pathologic effects of the diaphragmatic hernia are due to negative impact on cardiorespiratory dynamics and on herniated organs themselves. Physical examination of a patient with traumatic diaphragmatic hernia of recent origin often reveals signs of shock. Treatment of shock, including use of intravenous fluids is generally the first therapeutic intervention. Thoracic auscultation of the animal with traumatic diaphragmatic hernia often reveals abnormal breath sounds and possibly other sounds (e.g., borborygmus) over at least part of the thorax. Heart sounds may be either louder or more muffled than normal, depending on the position of the heart and the presence of tissue interposed between the heart and ribs. Thoracic percussion may also reveal areas of reduced resonance. Abdominal palpation may accentuate the animal's dyspnea and reveal an ‘empty’ abdomen. Elevation of the animal's forequarters may result in improved ventilation due to shifting of abdominal viscera back into the abdomen.

Pre-surgical considerations for the patient with traumatic diaphragmatic hernia include blood volume replacement and support, ventilatory support, possible antimicrobial use, and close observation. Repair of a traumatic diaphragmatic hernia is undertaken as soon as the patient has been adequately stabilized after the initial injury. The author’s target is 24 to 48 hours after injury, unless herniation of the stomach is acutely negatively affecting ventilation. Diaphragmatic hernia has a higher priority than definitive fracture repair. Intravenous fluid replacement may not be as aggressive as in other shock patients because of the risk of pulmonary edema. Volume of fluid replacement is guided by cardiovascular parameters (e.g., capillary refill time, pulse quality, mucous membrane color, and central venous pressure) and respiratory parameters (e.g., ventilatory rate and effort, auscultatory findings, and pulse oximetry). Ventilatory support, including housing the animal in a high oxygen environment and positioning the patient with the forequarters elevated is important prior to surgical repair. Removal of pleural effusion may also improve ventilation in selected cases. Antimicrobials may be used perioperatively to prevent infection-related pulmonary problems. Every patient with traumatic diaphragmatic hernia needs close observation, since rapid changes in ventilatory function may occur. Patients not responding to pre-surgical management or experiencing deterioration despite appropriate management may be surgical candidates within 36 hours of injury.

Anesthetic considerations
Anesthetizing the patient with traumatic diaphragmatic hernia often presents challenges. The reduction in ventilatory reserves caused by the trauma and the presence of abdominal viscera within the thorax makes controlling patient ventilation throughout the anesthetic episode both necessary and critical. Specifically, the pre-induction administration of oxygen is beneficial, provided the patient tolerates such administration without resistance. Rapid intravenous induction of anesthesia, maintenance of a patent airway through rapid,atraumatic endotracheal intubation, assisted (or controlled) ventilation, and appropriate patient positioning are indicated in the traumatic diaphragmatic hernia patient. Severe hyperventilation resulting from inattentiveness to patient positioning and reliance on spontaneous patient ventilation may occur shortly after anesthetic induction. Maintaining slight elevation of the patient's forequarters during surgical preparation and surgery is also helpful. Anesthetic induction using inhalation agents is not recommended because of the precarious ventilatory status of the patient.

Surgical management
After a standard preparation of the ventrum of the patient (extending from manubrium to the pubic pectin), drape the ventral abdomen to expose the midline. Create a midline skin incision from the xiphoid process to caudal to the umbilicus. Continue controlled patient ventilation during the surgical procedure, since communication between the pleural cavity and the atmosphere occurs on entry into the abdomen. Consider administration of an appropriate volume of intravenous fluids (e.g., 10 ml/kg/hr) and, particularly in long-standing hernia situations, an aqueous corticosteroid (e.g., 4 mg/kg dexamethasone or 30 mg/kg methylprednisolone) prior to the manipulation of abdominal viscera. Such pre-treatment may reduce the incidence of re-expansion pulmonary edema after surgery.

Incise the abdominal wall on the midline, and excise the fat-filled falciform ligament. Consider extending the abdominal wall incision paracostally along the affected side, particularly when repairing defects in the dorsal diaphragm. Visibility of the diaphragmatic defect is enhanced by placing a pediatric Balfour retractor over the towel-protected abdominal incision and using

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malleable retractors to manipulate the abdominal viscera. Remove abdominal or pleural fluid by suction. Carefully retract the abdominal viscera from the thorax using gentle traction. Delay final, definitive positioning of the viscera until the diaphragmatic defect is closed. Inspect the lungs and pleural cavity after the herniated contents have been retrieved from the pleural cavity. Avoid immediate re-inflation of remaining atelectatic areas of the lung, as this may enhance the potential for re-expansion pulmonary edema. Thoroughly evaluate the entire diaphragm to determine the extent and number of rents present.

Close the diaphragm using a simple continuous pattern of synthetic absorbable suture material (e.g., 2-0 polydioxanone). Start at the least accessible part of the defect, taking care to avoid traumatizing or constricting the caudal vena cava, hepatic veins, aorta or esophagus. On closing the diaphragmatic defect, remove residual air from the pleural cavity either by thoracentesis performed through the diaphragm (e.g., 14 or 16 gauge over-the-needle catheter) or by placing a thoracostomy tube. Explore the abdomen, with particular attention given to the previously displaced tissues. Repair lesions as needed. Close the abdomen after definitive replacement of the abdominal viscera.

**Postoperative considerations**
Postoperative considerations include ventilatory support, analgesic administration, and close observation. Continue ventilatory support until the patient is adequately ventilating spontaneously. Take particular care when administering positive pressure ventilation during and after surgery, because trauma to the lungs from overzealous ventilation is a distinct possibility. Re-expansion pulmonary edema following re-oxygenation of chronically collapsed lungs is a major cause of perioperative death, particularly in animals with long-standing (chronic) diaphragmatic hernias. Reperfusion injury, with release of superoxide radicals that are not effectively scavenged, is thought to result in increased pulmonary capillary permeability and pulmonary edema. Assist spontaneous ventilation in the postoperative patient by maintaining the patient in a forequarters-elevated position and the appropriate use of analgesics. Nasal oxygen administration may also be beneficial.

Opioid analgesics smooth the immediate postoperative recovery period and assist ventilation by controlling pain. Close observation of the postoperative diaphragmatic repair patient is indicated to react appropriately to the patient's changing status. Offer small feedings on the first postoperative day. Limited patient activity is indicated at least until suture removal.

**Prognosis**
Approximately 15% of animals die before presentation for anesthesia and surgical correction. Induction is a critical phase of anesthesia. Inadequate ventilation is a potential cause of intraoperative death. Survival to discharge approximates 90% of cases in recent case series. Complications may be observed in up to 50% of patients, with cardiorespiratory issues seen soon after surgery and issues relating to herniated tissues (e.g., gastrointestinal perforation or obstruction) being more delayed.

**References and suggested reading**
Conditions of the external ear
The primary indications for external ear surgery in dogs are unresponsive or recurrent otitis externa (especially with otitis media), polyps or neoplasia of the external ear canal, and trauma and avulsion of the auricular and annular cartilages.

Otitis externa
Base the type of ear surgery to perform on the extent and severity of otic disease present as determined by otoscopic and radiologic (including computerized tomographic [CT]) examinations. Rupture of the tympanic membrane on otoscopic exam or evidence of otitis media on radiologic (CT) exam is usually treated with a total ear canal ablation with lateral bulla osteotomy (TECA with LBO). Palpation of the external ear canal determines the presence of calcification or proliferation of the otic cartilages. Calcification of otic cartilages is usually an indication for performing a TECA with LBO.

Owner’s expectations also may influence the decision as to which procedure to perform. Those clients seeking to avoid the continued need to treat their pet's ears should be appraised of a TECA with LBO. Functional hearing loss after bilateral TECA with LBO may be complete; however, little change from the pet’s preoperative status may be noted.

Lateral ear resection
Lateral ear resection is the least invasive surgical procedure of the external ear canal; it has been used in dogs for over 40 years. It may be indicated in the patient with chronic non-proliferative otitis externa that has failed to respond adequately to appropriate medical management. Lateral ear resection may also be used to gain access for excisional biopsy of masses involving the vertical ear canal. The goal of lateral ear resection is to provide access to the horizontal ear canal. The medial wall of the vertical ear canal and the entire horizontal ear canal remain after lateral ear resection.

Following surgical preparation of both sides of the pinna, ear canal and lateral periotic region, drape the site to expose the entire pinna. Measure the level of the horizontal ear canal by inserting a forceps or probe into the vertical portion of the ear canal. Create a "U"-shaped skin incision so that its width just exceeds that of the vertical canal and its length extends approximately 2 cm below the junction of the vertical and horizontal ear canals. Dissect the skin flap and leave it attached dorsally to assist in the cartilage incisions. Bluntly and sharply dissect the subcutaneous tissue and the parotid salivary gland to expose the lateral wall of the vertical ear canal. Create parallel incisions in the lateral cartilage to the level of the horizontal ear canal using scissors. Start the rostral incision at the tragohelicinc incisure, and start the caudal incision at the intertragic incisure. As most canine ear canals curve slightly rostrally, curve both cartilaginous incisions slightly rostrally to maximize exposure of the horizontal canal. Deflect the incised flap of vertical canal ventrally, trim it to the appropriate size, and suture the edges of the cartilaginous flap to the skin. Carefully appose the skin and ear canal epithelium with monofilament, nonabsorbable sutures (e.g., 3-0 polypropylene).

Vertical ear canal ablation
The vertical ear canal ablation also has the goal of providing access to the horizontal ear canal, but it results in excision of the entire vertical ear canal. Indications for performing a vertical ear canal ablation are similar to those for lateral ear resection, but also include proliferative (granulomatous) otitis externa involving only the vertical ear canal, neoplasia of the vertical ear canal only, and possibly traumatic separation of the auricular and annular cartilages. Because a vertical ear canal ablation results in removal of more diseased tissue compared to that removed by a lateral ear resection and potentially reduced postoperative pain compared to a lateral ear resection, a vertical ear canal ablation may be preferable to a lateral ear canal resection. The vertical ear canal ablation procedure seems to be technically easier to perform than a lateral ear resection, and a more precise opening to the horizontal canal is created more consistently.

Prepare and drape the affected ear as described for lateral ear resection. Create a vertical skin incision directly over the vertical ear canal to the level of the horizontal ear canal. Make a circular incision surrounding the opening of the ear canal and connect the vertical incision. Make this circular incision to include the proliferative tissue that surrounds the opening of the ear canal. Take care when incising the skin and cartilage of the anthelix so just the cartilage and not the deeper tissue is incised. Dissect the entire vertical ear canal from the surrounding tissue to the level of the horizontal canal using blunt and sharp dissection. The horizontal ear canal begins just proximal to the junction of the auricular and annular cartilages. Excise the vertical ear canal by scalpel, creating an opening into the horizontal ear canal. When incising the ventral aspect of the cartilage, create a small drain board, as apposing the horizontal canal cartilage and skin is aided and potential for stricture of the opening of the ear canal is reduced. Appose the epithelium of the horizontal ear canal as accurately as possible to the surrounding skin with monofilament, nonabsorbable sutures (e.g., 3-0 polypropylene). Close the dorsal aspect of the skin incision in the shape of a "T", using the same suture material.
Surgical correction of traumatic separation of the auricular and annular cartilages results in the creation of a horizontal opening in the horizontal ear canal, similar to that resulting from a vertical ear canal ablation. Locate the blind end of the horizontal ear canal (proximal end of the annular cartilage) by sharp and blunt dissection. Flush the secretion-filled horizontal ear canal, and appose the epithelium of the horizontal ear canal to the surrounding skin with sutures. The vertical ear canal, which is separated from the rest of the ear canal, may be left undisturbed or excised. The horizontal ear canal in cases of traumatic separation of the auricular and annular cartilages tends to be shorter than that following a standard vertical ear canal ablation. Thus, tension on the suture line between skin and otic epithelium tends to be greater, making postoperative stricture more likely.

**Total ear canal ablation with lateral bulla osteotomy**

Total ear canal ablation is the most invasive surgery of the external ear, yet it is most likely to be curative when combined with a lateral bulla osteotomy procedure. Indications for performing a TECA with LBO include proliferative otitis externa involving both the horizontal and vertical ear canals, most cases of periotic abscessation, severe, non-responsive otitis externa accompanied by otitis media, calcification of the otic cartilages (especially annular cartilage), and neoplasia of the horizontal ear canal. Total ear canal ablation results in excision of the entire external ear canal. The goals of this procedure are to surgically excise all diseased tissue (infected and/or neoplastic), including epithelium of the tympanic bulla, and to eliminate clinical signs associated with otitis externa and media.

Prepare and drape the affected ear as described for lateral ear resection. The skin incision and initial dissection are identical to those for the vertical ear canal ablation. Continue dissection around the entire horizontal ear canal until the junction of the annular cartilage and the skull is reached. Take great care when dissecting around the horizontal ear canal, particularly in the calcified ear canal, to avoid damaging the facial nerve. Positively identify and protect the facial nerve, which courses rostrally just ventral to the horizontal ear canal. Carefully excise the ear canal from the skull with scalpel blade, chisel, or rongeurs. Since otic epithelium continues into the bony ear canal for 5 to 10 mm before the tympanum is reached, excise all remaining otic epithelium. Use rongeurs, bone curette, and alligator forceps to remove all of the epithelial tissue. Use rongeurs to remove the ventrolateral wall of the osseous bulla and bony ear canal. Access to the middle ear cavity (tympanic cavity) enables flushing and gentle curettage of this area. This step is critical to a long-term successful outcome. Completely evacuate the tympanic cavity. Close the incision after administering a bupivacaine splash block.

Possible complications following TECA with LBO include temporary or permanent facial nerve injury (resulting in partial or complete facial paralysis), sympathetic nerve injury (resulting in Horner’s syndrome), hearing loss, and partial pinna necrosis.

**Results**

Results following otic surgery depend, largely, on proper patient selection, avoiding technical errors, identification and treating systemic disease(s), accurately assessing the extent of ear disease and conscientious postoperative management. Failure following lateral ear resection has been shown to be as high as 47%. Long-term results following vertical ear canal ablation may be more favorable than those for lateral ear resection. Results following total ear canal ablation without bulla osteotomy have been discouraging, with recurrence of periotic abscessation being a common complication. Results following total ear canal ablation with lateral bulla osteotomy are quite favorable.

**Conditions of the middle ear**

The primary indications for middle ear surgery in dogs include unresponsive otitis media (usually in concert with otitis externa) and removal of inflammatory polyps. Pain is the primary clinical sign associated with otitis media; however, head shaking, ear scratching, otic discharge, head tilt, vestibular signs, and Horner’s syndrome also may be observed.

Physical examination, including otoscopic evaluation and radiologic (including computerized tomographic [CT]) evaluation confirms the diagnosis. Otoscopically, attempt to visualize the tympanic membrane prior to and after irrigating the external ear canal. Exudate or masses within the external ear canal may obliterate the tympanic membrane. The tympanic membrane may be reddened, bulge into the ear canal, or be ruptured. Radiographs of the skull should be made to evaluate the tympanic bullae. Lateral, ventrodorsal, oblique, and open-mouth projections of the skull can be made. Radiographic views which provide helpful information are the oblique and open-mouth projections. Computed tomographic evaluation of the tympanic bulla is particularly helpful with distinguishing fluid density from that caused by tissue.

The anatomy of the tympanic bullae in dogs includes a connection between the tympanic cavity and the pharynx by the auditory tube. The normal tympanic bullae appear as a thin shell of bone with an intraluminal air density. With disease and chronicity, the tympanic bullae become sclerotic and thickened, and the tympanic cavity may contain a fluid- or tissue-density. Sympathetic fibers in the middle ear are present on the dorsal aspect of the bulla; they are relatively unresponsive to surgical trauma in the dog.
Otitis media

Otitis media is a relatively common disease that may go unrecognized. It frequently accompanies chronic otitis externa. Otitis media may be diagnosed on otoscopic exam by seeing changes in the tympanic membrane. Such changes may include loss of integrity, change in color (becoming more opaque and grey), and change in shape (becoming more convex and bulging). Radiographic (especially CT) assessment of the tympanic bullae is quite helpful in diagnosing otitis media. Radiographs are more helpful in assessing duration of middle ear disease, as tympanic bullae become sclerotic with chronicity.

Inflammatory polyps

Inflammatory polyps are benign, pedunculated growths that may occur rarely in the middle ear or external ear canal of dogs. Site of origin is believed to be the mucosa of the tympanic cavity. Inflammatory polyps may extend from the tympanic cavity through the tympanic membrane into the external ear canal. Otitis media accompanies inflammatory polyps within the tympanic bulla, but it is unclear whether the infection initiated the polyp growth or is secondary to its presence. Clinical signs observed depend on the size and location of the polyp. Otic polyps result in signs of otitis externa and/or otitis media. Thoroughly evaluate the external ear canal otoscopically and by palpation.

Treatment

Treatment of otitis media often involves a combination of medical and surgical techniques. Accurate microbiologic assessment of the tympanic cavity is critical to success. If otitis media accompanies chronic otitis externa, a total ear canal ablation with lateral bulla osteotomy is usually indicated. If primary otitis media is present, a myringotomy may be indicated. Myringotomy may be considered both a diagnostic and a therapeutic procedure. Puncture the pars tensa portion of the tympanic membrane at the five or seven o’clock position using a spinal needle or a small Steinmann pin. Use a 3.5 F polypropylene catheter to aspirate fluid from the tympanic cavity for culture and susceptibility testing. Gently flush the tympanic cavity with warm saline until the escaping fluid is clear. Choose an appropriate systemic antimicrobial agent based on susceptibility testing results. Continue therapy for approximately 4 weeks.

Surgical treatment of otitis media usually involves performing a bulla osteotomy. The tympanic bulla may be approached surgically through two approaches: lateral or ventral. The lateral bulla osteotomy is usually reserved for cases with concurrent otitis externa that require a total ear canal ablation. Ventral bulla osteotomy is usually performed as a separate procedure. Ventral bulla osteotomy is more challenging in the dog than it is in the cat, but it provides better visualization and exposure of the ventral aspect of the tympanic cavity than does the lateral approach.

Position the paramedian skin incision midway between the angular process of the mandible and the level of the wings of the atlas. Dissect between the digastricus muscle (laterally) and the hypoglossal and styloglossal muscles (medially). Identify the tympanic bulla as a raised structure between the angular process of the mandible and jugular (paracondylar) process of the skull. Penetrate the tympanic bulla with a Steinmann pin (3/32 inch) and enlarge the opening with rongeurs. Obtain microbiologic and histologic samples from the tympanic cavity. Flush the tympanic cavity with warm saline solution, and carefully remove tissue and exudate by gentle curettage. Close the incision routinely.

Horner’s syndrome is an uncommon complication after ventral bulla osteotomy in dogs. Most signs of Horner’s syndrome will resolve within a few days postoperatively. Head tilt toward the affected side may persist postoperatively.

Summary

The middle ear of the dog can be accessed surgically via a lateral or ventral approach. The lateral approach is most often used in combination with total ear canal ablation, while the ventral approach is used as a stand-alone procedure. A ventral bulla osteotomy is more challenging to perform in the dog vs. the cat. Prognosis for resolution is better for inflammatory polyps than it is for neoplastic conditions. The prognosis for otitis media resolution depends, in part, on the duration of disease.

References and suggested reading


Surgery of the perineum of the dog is performed most frequently to remove tumors or to repair a perineal hernia. Perineal herniorrhaphy is the primary focus of this session.

Perineal neoplasia
Neoplasms of the canine perineum include anal sac tumors, including aperocrine gland adenocarcinoma of the anal sac, tumors of the perineal skin, including mast cell tumors, and perianal gland tumors. Surgical excision may be challenging due, in part, to the proximity of the anus, rectum and structures essential for fecal continence (e.g., caudal rectal nerve and anal sphincter muscle).

Perineal hernia
Perineal hernia is a failure of the supporting structures of the pelvic outlet to contain the viscera of the abdominal cavity and pelvic canal. Successful perineal herniorrhaphy is dependent on knowledge of the anatomy of the perineum. Goals include achieving adequate exposure, avoiding injury to vital structures, maximizing potential for success, and minimizing postoperative complications. Options for repairing a perineal hernia include the traditional technique and the internal obturator muscle transposition technique. Additional techniques that may be utilized include colopexy, cystopexy, deferent duct fixation, and use of prosthetic implants, including porcine small-intestinal submucosa [SIS] or polypropylene mesh.

Surgical anatomy
The perineum covers the pelvic outlet and surrounds the openings to the anal and urogenital canals. The principal structure of the perineum is the pelvic diaphragm, consisting of the coccygeal and levator ani muscles. Structures of surgical importance in the perineum include levator ani, coccygeal, internal obturator, and external anal sphincter muscles, pudendal nerve and vessels, sacrotuberous ligament, sciatic nerve, and caudal gluteal vessels. The levator ani and coccygeus muscles form the lateral boundary of the rectum and the medial boundary of the pelvic diaphragm. The coccygeal muscle lies just lateral to the levator ani muscle. Sutures are placed in the levator ani and coccygeal muscles when repairing a perineal hernia. The internal obturator muscle covers the obturator foramen and ischial table and forms the ventral aspect of the perineal region. The internal obturator muscle is frequently utilized when repairing a perineal hernia. The external anal sphincter muscle surrounds the anal canal and is innervated by the caudal rectal nerve, which leaves the pudendal nerve at the caudal border of the levator ani muscle and enters the anal sphincter muscle just medial to the anal sac. As the sole medial muscle, sutures are placed in the anal sphincter muscle during perineal herniorrhaphy.

The pudendal nerve and vessels course caudomedially across the dorsal surface of the internal obturator muscle. The pudendal nerve supplies the caudal rectal nerve, the sole motor supply to the external anal sphincter muscle. The sacrotuberous ligament extends from the lateral sacrum to the lateral angle of the ischiatic tuberosity. Suture incorporation of the sacrotuberous ligament may be used in either the conventional repair or the internal obturator muscle transposition technique. This ligament is also a surgical landmark for the location of the sciatic nerve, which lies just ventrolateral to it. The caudal gluteal vessels may be traumatized during either the conventional or internal obturator muscle transposition technique, particularly when placing sutures in the sacrotuberous ligament or transecting the tendon of the internal obturator muscle.

Clinical presentation
The typical presentation for dogs with perineal hernia is a middle-aged to older male dog (intact or neutered) with a unilateral or bilateral perineal swelling. Perineal hernia is much less commonly observed in female dogs or cats. With unilateral herniation, the contralateral pelvic diaphragm will often feel weaker than normal on rectal palpation. Hernial contents may include any of the following: serosangineous fluid, fat, rectal wall, prostate, urinary bladder, and, rarely, small intestine. Rectal abnormalities associated with perineal hernia include rectal deviation (flexure), rectal dilatation (sacculation), or rectal diverticulation. Definitive repair of the rectal abnormality at the time of perineal herniorrhaphy may be necessary in cases of diverticulation and excessive dilatation.

Preoperative preparation
Avoid use of enemas in the immediate preoperative period, as intraoperative contamination with liquid feces compared to formed feces is more likely. After anesthetic induction, digitally remove feces from the rectum. The anus may be closed with a purse-string suture after placement of a rectal tampon or left open for placement of a syringe case per rectum at surgery. The latter technique assists in identification of rectal abnormalities and the external anal sphincter muscle. Perioperative antimicrobials (e.g., cefazolin - 22mg/kg IV) may be used.
Traditional technique
Make a curvilinear skin incision lateral to the anus from the level of the tail head to that of the ischiatic tuberosity on the affected side. Expose the lateral rectal wall by bluntly dissecting medial to the levator ani muscle. Dissect adhesions between the hernia contents and surrounding structures. Identify and protect the pudendal artery, vein, and nerve. Reduce the hernia contents and maintain reduction using a gauze sponge placed on an Allis tissue forceps. Occasionally, excision of hypertrophied retroperitoneal fat or cystocentesis is necessary to achieve hernia reduction.

Preplace sutures to improve visualization during their placement. Sutures should be synthetic, monofilament and either absorbable (e.g., polydioxanone or polyglyconate) or nonabsorbable (e.g., polypropylene or monofilament nylon) and of relatively large diameter (size 2-0 or 0). Place sutures between the levator ani and coccygeus muscles (dorsolateral), the external anal sphincter muscle (medially), the internal obturator muscle (ventrolateral), and possibly the sacrotuberous ligament (laterally). Incorporate fascia, if possible, when placing sutures. Five or more sutures usually are placed during this technique. Take care to avoid the sciatic nerve and caudal gluteal vessels when placing sutures in the sacrotuberous ligament. Take care to avoid the anal sac and rectal mucosa when placing sutures in the external anal sphincter muscle. Close the subcutaneous tissue with synthetic absorbable sutures (e.g., 4-0 monocryl) and skin with synthetic nonabsorbable sutures (e.g., 3-0 polypropylene).

Castration of the intact patient is performed because of its potential beneficial effect on prostatic size. In dogs in which fixation of the deferent ducts is to be performed, castration is performed prior to the ventral midline approach, and ligation techniques are modified as described below.

Internal obturator muscle transposition technique
The most common complication after perineal herniorrhaphy is recurrence of the hernia. Relatively recent techniques have been used to help reduce the incidence of recurrence after perineal herniorrhaphy. These techniques include transposition of the internal obturator muscle, recognition and repair of rectal abnormalities, colopexy, cystopexy, fixation of the ductus deferens, and use of supporting materials (e.g., SIS or polypropylene mesh). Each technique is not applicable to every case of perineal hernia; however, selected use of one or more of these techniques seems to reduce the potential for recurrence.

Transposition of the internal obturator muscle has been associated with a lowered incidence of recurrence compared to that seen with the conventional repair technique. The dorsally transposed internal obturator muscle fills the defect left after reducing the hernia contents. The dorsolateral aspect of the transposed internal obturator muscle (including its tendon) is sutured to the levator ani and coccygeus muscles, its medial aspect is sutured to the external anal sphincter muscle, and its lateral aspect is sutured to the sacrotuberous ligament. Tension on tissues, particularly the external anal sphincter muscle, appears to be less compared to when the traditional technique is used. Also, simultaneous bilateral repair using the internal obturator muscle transposition technique results in lower patient morbidity immediately postoperatively than that seen with the traditional technique.

Additional techniques
Rectal abnormalities that may accompany perineal hernia include deviation (flexure), dilatation (sacculation), and diverticulosis. Recognition and correction of these problems may reduce postoperative recurrence rates following perineal herniorrhaphy. Diagnosis of rectal abnormalities is presumptive after rectal examination, although confirmation may require radiologic evaluation (i.e., modified barium enema). Rectal deviation is usually treated effectively by combining a colopexy with repair of the hernia. Rectal sacculation is an outpouching of the rectal wall with enlargement of the rectal lumen. Repair involves inversion or excision of the redundant tissue and an inverting closure using synthetic absorbable sutures. Rectal diverticulum is protrusion of rectal mucosa through a defect in the muscularis. Repair involves inversion or excision of the protruding mucosa and closure of the muscular defect in the rectal wall using synthetic absorbable sutures.

Colopexy is performed via a ventral midline celiotomy. Its purpose is to stabilize the colon in a cranial position to prevent perineal herniation of the rectum and colon. Apply cranial traction to the Colon, create a 3- to 5-cm longitudinal seromuscular incision near the antimesenteric border of the distal descending colon. Make a similar incision through the transversus abdominis muscle on the left abdominal wall > 5 cm lateral to the ventral midline. Suture the colon to the left dorsolateral body wall using 5 to 6 interrupted sutures of synthetic nonabsorbable material (e.g., 3-0 polypropylene) in partial thickness fashion.

Fixation of the ductus deferens is performed to provide fixation of the prostate and urinary bladder within the abdomen. This technique is particularly useful when repairing a perineal hernia that contains a retroflexed urinary bladder. Fixation of the ductus deferens is performed only in neutered patients. If the patient is to be neutered at the time of fixation of the ductus deferens, modify the orchietomy technique such that the ductus deferens is ligated separately. Perform a ventral midline abdominal approach. If the urinary bladder is herniated, return it to its normal position. Identify each ductus deferens near its termination in the prostate gland. Retract each ductus from the inguinal canal, and provide moderate cranial traction to each deferent duct. Affix the deferent ducts to the ventrolateral abdominal wall using PDS or polypropylene suture. Perform a cystopexy by suturing the urinary bladder to the right abdominal wall. Incise the seromuscular portion of the urinary bladder as described for a colopexy (above). Make a similar incision...
through the transversus abdominis muscle on the right abdominal wall > 5 cm lateral to the ventral midline. Place 3 to 5 interrupted partial thickness sutures of synthetic nonabsorbable material to complete the cystopexy.

Prosthetic implants used during perineal herniorrhaphy include SIS and synthetic (polypropylene) mesh. Results with either material have been favorable, and complications have been minimal. Suture an ovoid piece of mesh in place over the transposed internal obturator muscle with synthetic absorbable sutures. Securely attach the mesh to the fibrous tissue adjacent to the ischium (especially ventromedial) to improve security of closure. Use of prosthetic implants may be reserved for recurrent hernias.

Postoperative management
Analgesia and sedation are provided immediately postoperatively to smooth the recovery from anesthesia. A low-residue diet can be used for the first few days after surgery. Stool softeners are recommended long-term to minimize stress on the repaired perineum during defecation. An Elizabethan collar or side brace may be necessary to control self-inflicted trauma.

Summary
Successful perineal hernia repair is facilitated by knowledge of the perineal anatomy. Hernial recurrence is minimized by identifying and treating accompanying rectal abnormalities, achieving a tension-free closure of the defect, usually through transposition of the internal obturator muscle, utilization of appropriate additional surgical techniques, and assuring effective long-term elimination of soft feces.

References
Thoracic Surgery with Focus on Surgical Approaches to Thoracic Wall Lesions
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Surgical approaches
Intercostal thoracotomy and median sternotomy are the two most commonly performed approaches to the thorax in small animals. Be sure to prepare a large enough area to allow placement of a thoracostomy tube such that it exits at least two intercostal spaces from the primary thoracotomy incision.

Intercostal thoracotomy
Use this approach to access a specific region of a hemithorax. This approach provides good access to the pulmonary hilus, heart, and limited portions of the mediastinum and ipsilateral thoracic cavity. While the third through the tenth spaces are theoretically accessible, the fourth through the sixth intercostal spaces provide the most reliable access to lung lobes and the heart.

Use the lateral thoracic radiograph to help determine the appropriate intercostal space to incise. Center the approach over the hilus of the affected lung not over the lesion (cranial lobe - 4th or 5th, middle lobe - 5th, caudal lobe - 6th intercostal space). Use a 4th intercostal thoracotomy incision to expose the heart in the dog. Use the 8th intercostal space to expose the caudal esophagus or thoracic duct.

Incise the skin parallel to the ribs from just ventral to the costovertebral junction to just dorsal to the sternum. Incise the latissimus dorsi muscle with scissors parallel to the skin incision. Verify intercostal space identification by counting caudally from the first rib. Incise the serratus ventralis muscle parallel to its fibers. Incise the intercostal muscles midway between ribs. Bluntly puncture the pleura to allow the lungs to fall away from the lateral thoracic wall before extending the intercostal incision with Mayo scissors. Insert rib retractors over laparotomy sponges to protect skin and muscle.

Alternatively, a muscle-sparing technique for lateral thoracotomy has been described. This technique is comparable in efficiency and visibility but results in less pain than the traditional technique. A Balfour retractor was used to provide retraction, with the side blades providing retraction of the ribs and the center blade providing dorsal retraction of the latissimus dorsi and serratus ventralis muscles. The author has no clinical experience with this approach.

Place a thoracostomy tube as described below. Close the intercostal space by pre-placing heavy (usually '0' suture) absorbable sutures circumcostally. Close the serratus ventralis and scalenus muscles as a separate layer (3-0 polydioxanone suture). Close the latissimus dorsi muscle separately while incorporating its fascia (3-0 polydioxanone suture). Close the subcutaneous tissue and cutaneous trunci muscle together (4-0 poliglecaprone 25 suture), and the skin (3-0 polypropylene).

Median sternotomy
Use this approach when exploring both sides of the thoracic cavity. Structures in the dorsal thoracic cavity (e.g., pulmonary hilus) are more difficult to reach through this approach. Median sternotomy may be combined with a ventral midline celiotomy or a caudal cervical approach. Exposing cranial or caudal mediastinal masses and performing a more complete subtotal pericardiectomy are potential indications for performing a median sternotomy. Avoid incising the entire length of the sternum, as postoperative sternal instability and pain seem to be increased compared to leaving at least one sternebra intact at either end.

Incise the skin, subcutaneous tissues and pectoral muscles over the sternum with a scalpel. Cut the sternum on midline with an oscillating saw, taking care to limit penetration of the saw blade. Protect the tissues with moistened laparotomy sponges, and position retractors (e.g., Finochietto retractors) to achieve adequate visibility and access.

Place a thoracostomy tube prior to closing the incision. Close the sternal incision by pre-placing stainless steel wire (approximately 20 gauge) in a figure-eight pattern to appose each incised sternebra. Close the pectoral muscles and subcutaneous tissues in separate layers. Close the skin in routine fashion.

Thoracostomy tube placement
A thoracostomy tube may be placed associated with a thoracotomy or as a separate procedure. Place a thoracostomy tube before closing the thoracotomy incision. Place the tube so that its skin exit point and thoracic wall entry point are off set. Cut additional holes in the thoracostomy tube near its end. Do not position the thoracostomy tube in the primary incision. Match the size of the tube to the patient size and its intended use (tube size in patients with pleural effusions generally should be slightly larger than those in patients with pneumothorax). Plan to have the tube enter the thoracic wall two intercostal spaces from (usually caudal to) the primary lateral thoracotomy incision. Tube placement during median sternotomy is more challenging, as tunneling of the tube can be more difficult. Position the fenestrated end of the thoracostomy tube at the level of the second sternebra and ventrally. Connect the exterior of the thoracostomy tube to a three-way stopcock using an adaptor. Use suture to secure the tube to the skin using a friction
suture pattern. Position a C-clamp on the tube below the three-way stopcock for added safety. Cover the thoracostomy tube with a bandage.

Commercially available trochar chest tubes are easier to insert because they contain a metal stylet. Risk of injury to underlying tissues may be increased when thoracostomy tubes are placed as a separate procedure compared to placing them in conjunction with a thoracotomy. Create a small skin incision slightly larger than the tube diameter at the dorsal aspect of the caudal thorax (usually 9th to 11th intercostal space). Advance the tip of the tube subcutaneously about two intercostal spaces before inserting the tube into the pleural cavity. Use a controlled thrust to insert the end of the tube just through the chest wall. Remove the trocar, and advance the tube so that its end is level with the second intercostal space and ventrally positioned. Quickly attach an appropriately-sized adaptor and 3-way stopcock in the end of the tube. Place a friction suture to hold the tube in place securely. Evacuate the pleural cavity, and bandage the thoracostomy tube in place.

Commercially available small bore wire-guided chest tubes are quite easy to insert as either a separate procedure or at the time of thoracotomy. Tube insertion is via the catheter-over-guidewire (modified Seldinger) technique. Such tubes include a normally closed bi-directional valve with leur adapters that prevents air from entering the chest.

**Conditions of the thoracic wall: trauma and neoplasia**

Rib fractures occur in small animals, particularly after blunt trauma. Most rib fractures are treated non-surgically with analgesics and bandage application. Penetrating thoracic wounds from dog fights often result in hidden trauma to underlying tissues. Many cases of penetrating thoracic wall trauma are treated non-surgically, in part, because of the potential for having severely traumatized deeper tissues that are questionable for closure. A traumatic event that may require surgical intervention is flail chest. Flail chest occurs when several adjacent ribs are fractured in at least two places and results in an unstable chest wall segment. The unstable (flail) segment moves paradoxically compared to the rest of the thoracic wall (i.e., in on inspiration and out on expiration). Stabilization of the unstable portion of chest wall improves ventilation. Place percutaneous sutures around the ribs and attach them to an external fixation device that spans the traumatized area.

Surgical resection with wide margins of grossly normal tissue is the treatment of choice for thoracic wall neoplasia. Full thickness resection of multiple ribs may require surgical reconstruction of the thoracic/abdominal wall by using synthetic material (e.g., polypropylene mesh). With tumors of the caudal thoracic wall, the diaphragm can be advanced cranial to the resection site. Such advancement may offer more options for closure of the surgical site.

Position an appropriately-sized (slightly larger than the defect) and shaped piece of polypropylene mesh to cover the defect. Suture the mesh to muscles at the edges of the defect, taking care to draw the mesh tightly across the defect. If the mesh is positioned over the thorax, place a thoracostomy tube, and cover the mesh with either thoracic wall musculature or an omental pedicle flap. Close the subcutaneous tissue and skin in a routine fashion.

**References and suggested reading**


The signalment of most cases of GDV include large to giant breed dogs in the age range of 10 months to 14 years. There is no sex predilection. Clinical signs are most commonly non-productive retching and abdominal distension but animals may present severely debilitated depending on the amount of time they have been affected. Physical exam findings include a distended, painful abdomen, nausea and or active retching. Other signs of illness depend on whether they are in compensatory, endotoxic or noncompensatory shock.

**Diagnosis**
Radiographs are considered the gold standard for diagnosing a GDV but should not be undertaken without medical stabilization of the patient. A right lateral position is the most illustrative view highlighting the “double bubble” or “smurf’s hat” of the stomach being split into two chambers. Other important findings on radiographs would include any evidence of free gas or mesenteric volvulus.

Blood work abnormalities include acid-base derangement, hemoconcentration, hyperlactatemia, a stress leukogram and a hypercoagulable state. Clinical chemistry changes that may be encountered include evidence of hepatocellular damage, biliary stasis, prerenal/renal insufficiency, blood loss, impaired glucose control and impaired electrolyte balance.

**Preoperative medical management**
Medical treatment initially consists of gastric decompression, IV fluid resuscitation and pain management. The goal is to stabilize the cardiovascular, respiratory and renal systems. Severe gastric damage is related to more severe gastric distension (not malpositioning) so decompression is of the utmost concern. Fluid therapy is initiated after placement of 1-2 large gauge IV catheters and usually begins with bolus shock therapy (45-90ml/kg) of crystalloids in combination with colloids (10-20ml/kg). Blood pressures should be monitored and if necessary supported with vasopressor administration to protect the renal system from ischemia. Ventricular arrhythmias are commonly seen in dogs suffering from GDV therefor a continuous EKG is applied on admission and postoperatively for at least 24-48 hours.

Gastric Decompression can be accomplished by two techniques and should be performed within 15-20 minutes of the patients diagnosis.

**Orogastric tube decompression**- this technique requires intubation of the patient to ensure protection of the airway. After intubation, a roll of tape is placed in the mouth caudal to the canines and an orogastric tube of appropriate diameter has lubricant applied to the outside and is gently passed down the esophagus. With the trachea intubated there is no chance of accidentally moving down the trachea. There will be significant resistance with the lower esophageal sphincter is encountered. Gentle rotation of the tube and blowing into the end of the tube can help overcome the pressure. Gastric contents should be seen and or smelt from the tube. Empty the stomach and leave the tube in place to keep the stomach decompressed until surgery.

**Trocar decompression**- Choose a large gauge over the needle catheter (10-14g). Clip and clean an area on the left or right cranial dorsolateral abdomen that has a tympanic feel when compression is applied. Avoid the spleen by feeling for a more solid structure during palpation. Insert the catheter with an abrupt pop and remove the stylet. An acrid odor will confirm placement into the stomach. Hold the hub firmly against the body wall while pushing inward to facilitate decompression. Remove the needle when no further air is escaping.

Pain management should also be initiated early on during the diagnosis and preoperative medical management as these patients are in severe discomfort. The use of opioids (Hydromorphone, Oxymorphone, Methadone) is recommended and can be easily administered once IV access has been achieved.

**Surgical management**
The goals of surgical treatment are to correct gastric and splenic positioning, determine gastric and splenic viability, and to prevent gastric malpositioning in the future.

- Surgical explore begins with derotation of the stomach. Upon entrance into the stomach, omentum is found overlying if the stomach is in the most common rotated position (180° clockwise around the long axis of the patient). To correct the rotation, the surgeon stands on the right side of the patient, the right hand grasps the stomach wall adjacent to the left body wall and left hand grasps the stomach adjacent to the right body wall. The right hand then pulls ventrally and toward the right body wall while the left hand pushes the stomach dorsally and to the left body wall. The gastro-esophageal junction is carefully palpated and visualized to ensure there is no remaining rotation. If a tube is not already in place one is placed now to aid in full decompression of the stomach.
Assessment of the stomach and spleen is then performed to ensure viability of these organs. The stomach is palpated for any areas of thinning and the color is assessed. Time is given for the color to improve as it commonly does once the rotation has been corrected. Gastric wall resection can be performed with stapling devices or by hand. The splenic vasculature is palpated for pulses. Once repositioned, the spleen should also be given 5-10 minutes for observation of improvement. If a splenectomy is deemed necessary this can be accomplished with vessel sealing devices, stapling devices or hand ligatures.

Once the stomach and spleen have been evaluated, a gastropexy is performed. Recurrence is reported to be as high as 80% for cases that are re-positioned alone. There are 10 different types of gastropexy possible.

- Incisional
- Tube
- Grid
- Belt-loop
- Circumcostal
- Incorporating
- Laparoscopic-assisted
- Laparoscopic
- Percutaneous
- Fundopexy

Incisional gastropexy is the most common and will be discussed in detail

- Technique relies on the healing of the edges of the gastric seromuscular incision to the edges of the peritoneum-transverse abdominus muscle.
- 3-5cm incision is made with a scalpel perpendicular to the long axis of the patient, or at an angle on the right ventrolateral body wall 6-8cm lateral to the celiotomy
- The incision extends through the peritoneum and the transverse abdominus muscle
- A 3-5cm incision in the serosa of the gastric wall at the antrum parallel to the longitudinal axis of the stomach is made next
- The most cranial incision lines are sutured first with 2-0 to 0 delayed absorbable or nonabsorbable taper needle in a continuous pattern originating dorsally.

Emergency temporary gastropexy has been reported if definitive surgical treatment cannot be provided for a delayed period of time. This entails heavy sedation with local anesthetics or preferably general anesthesia. The patient is clipped and prepped over the right paracostal region and a 10cm incision is made through the skin. The external abdominal oblique muscle is separated along muscle fiber lines, the internal abdominal oblique and transverse abdominal muscles are also separated. The stomach wall is identified and grasped and pulled towards the skin incision. The gastric wall is then sutured to the skin incision with 2-0 to 3-0 monofilament suture the full circumference of the incision. An incision is made in the center of the stomach and gas, fluid and particulates allowed to escape. The skin is coated liberally with TAB or sterile lubricant to prevent scalding from gastric contents.

Postoperative Management includes aggressive fluid therapy and continued analgesics. Monitoring for arrhythmias, hypotension, electrolyte and acid-base derangements are vitally important. Gastric protectants (H2-receptor antagonists, coating agents) for mucosal damage and anti-emetics (centrally or peripherally acting) are also administered. Food is usually withheld for 24 hours. Prokinetic medications such as metoclopramide and or erythromycin can be given to combat ileus. Recurrence of dilatation can still occur after gastropexy but no recurrences of volvulus have been reported with the incisional technique.

Postoperative complications include ongoing necrosis of the stomach leading to a septic abdomen, progression of preoperative shock leading to MODS, SIRS or ARDS, and even death.

Prognosis is mostly affected by early recognition and treatment. The need for gastric resection and poor lactate clearance have been associated with poor prognosis in some studies. Survival rates have been as high as 98% in patients without gastric necrosis and 66% in dogs with gastric necrosis.