

A white horse is shown in profile, facing right, with its mouth wide open, revealing its teeth. The horse is standing in a field with a large pile of yellow hay in the foreground. The background is a soft-focus landscape with green grass and a line of trees under a pale sky. The text "Ventriculocordectomy" is overlaid in a dark green, italicized serif font across the horse's neck and head area.

Ventriculocordectomy

Lab 8

Indication

- Recurrent Laryngeal Neuropathy (Laryngeal Hemiplegia) occurs in horses from a few months to 10 years of age and older, with large breed horses (prevalence 2.6% Thoroughbreds and 35% draught breeds) more commonly affected than small-breed horses or ponies.

Indication

- Horses with RLN cannot achieve maximal abduction of the affected arytenoid cartilage, and as negative inspiratory pressure increases, the rima glottidis progressively reduces in size.
- Subsequently resulting in hypoxemia, hypercarbia and metabolic acidosis develop more rapidly than in normal horses with the same workload, causing early musculoskeletal fatigue and poor performance.

Indication

RLN can be result of:

- Perivascular laryngeal vein injection
- Guttural pouch mycosis
- Trauma from injuries or surgical procedures of the neck
- Strangles abscessation of the head and neck
- Impingement by neoplasms of the neck or chest.
- Organophosphate/ lead toxicity
- Plant poisoning
- Hepatic encephalopathy
- CNS diseases
- Idiopathic

Anatomy

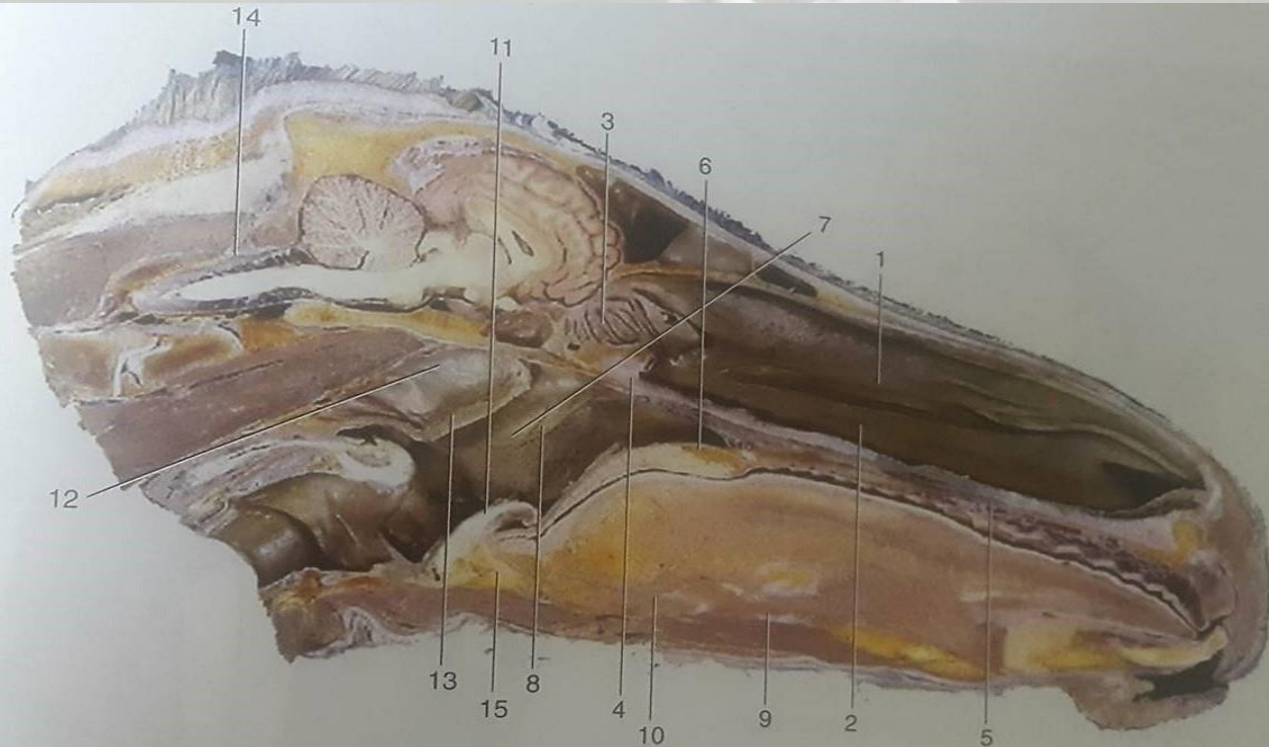


Figure 18-11 Median section of the head; most of the nasal septum has been removed. 1, Dorsal nasal concha; 2, ventral nasal concha; 3, ethmoidal conchae; 4, right choana; 5, hard palate with prominent ridges (rugae); 6, soft palate; 7, nasopharynx; 8, pharyngeal opening of auditory tube; 9, geniohyoideus; 10, genioglossus; 11, epiglottis; 12, medial wall of guttural pouch; 13, pharyngeal muscles; 14, cerebellomedullary cistern; 15, basihyoid.



Figure 18-26 A, Endoscopic view of equine nasopharynx. 1, Epiglottis; 2, laryngeal entrance; 3, pharyngeal recess; 4, entrance to auditory tube. B, Endoscopic view of larynx. 1, Arytenoid cartilage; 2, left and right vocal folds.

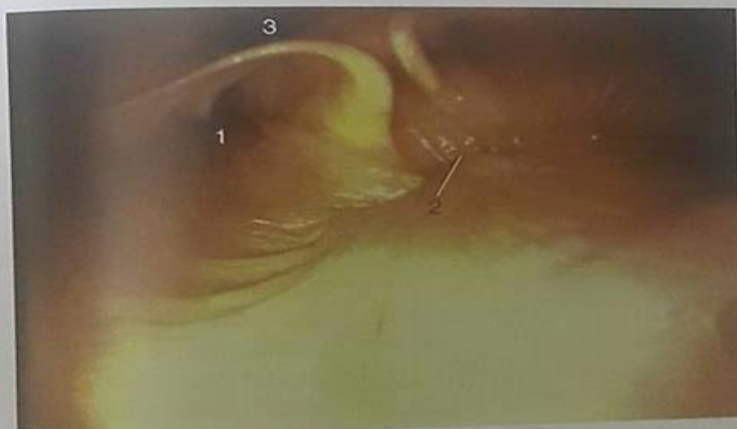


Figure 18-27 Endoscopic view of the caudal part of equine nasopharynx (foal). 1, Entrance to auditory tube; 2, closure of the intrapharyngeal ostium between the nasopharynx and laryngopharynx (during swallowing); 3, cartilage flange supporting the auditory tube.

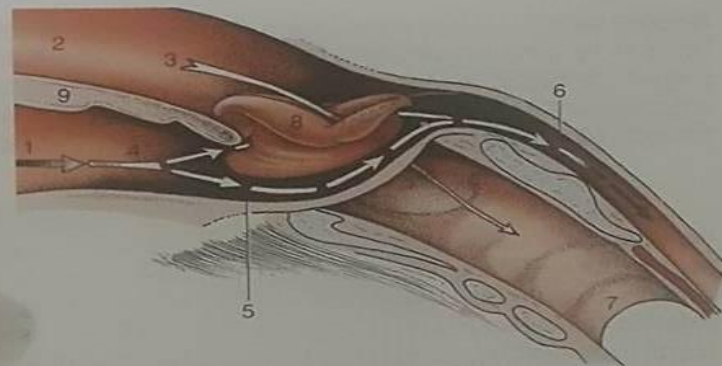


Figure 18-28 The communications of the pharynx, rostrally with the oral and nasal cavities, caudally with the esophagus; schematic. The *broken arrows* mark the digestive pathway; the *unbroken arrow* marks the respiratory pathway. 1, Oral cavity; 2, nasal cavity; 3, nasopharynx; 4, oropharynx; 5, laryngopharynx; 6, esophagus; 7, trachea; 8, epiglottis, laryngeal entrance; 9, soft palate.

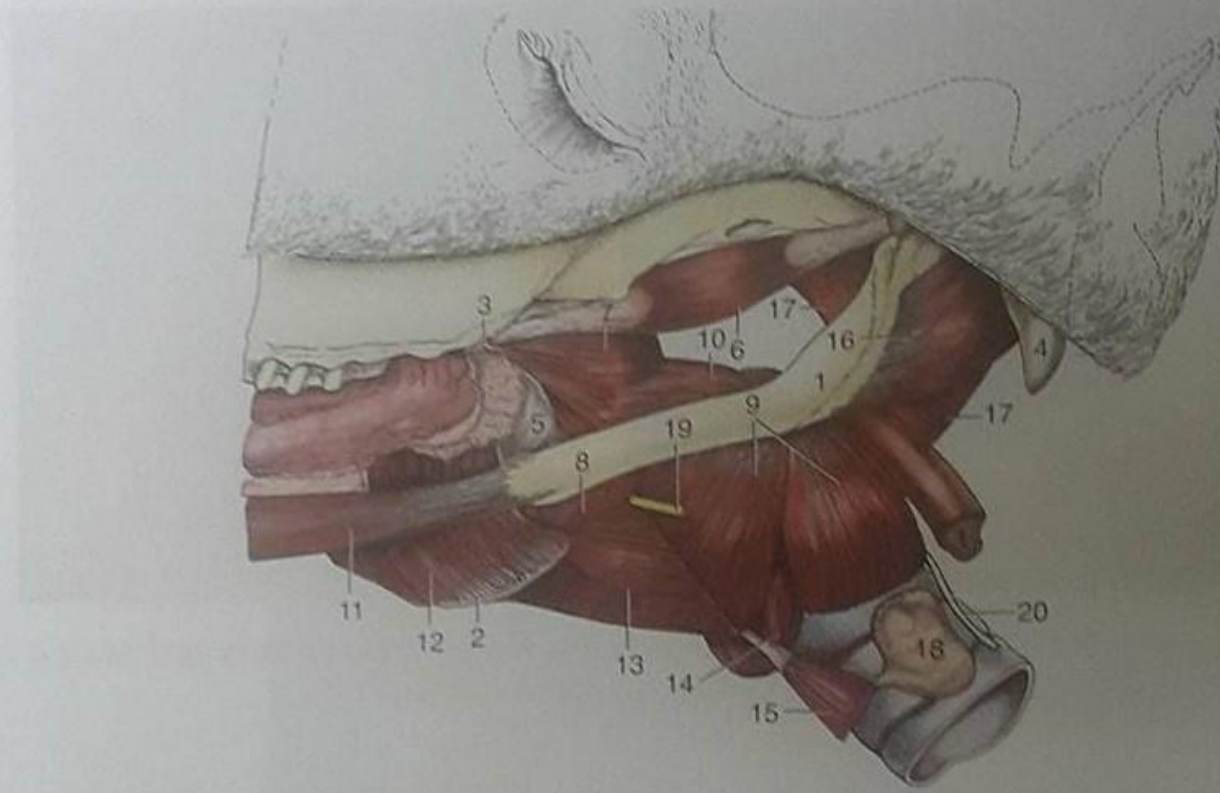


Figure 18–29 Muscles of the pharynx, soft palate, and hyoid apparatus. 1, Stylohyoid; 2, thyrohyoid; 3, hamulus of pterygoid bone; 4, paracondylar process; 5, buccopharyngeal fascia; 6, tensor veli palatini; 7, rostral pharyngeal constrictor; 8, middle pharyngeal constrictor; 9, caudal pharyngeal constrictor (thyropharyngeus and cricopharyngeus); 10, stylopharyngeus caudalis; 11, styloglossus; 12, hyoglossus; 13, thyrohyoideus; 14, cricothyroideus; 15, sternothyroideus; 16, occipitohyoideus; 17, longus capitis (stump); 18, thyroid gland; 19, cranial laryngeal nerve; 20, caudal (recurrent) laryngeal nerve.

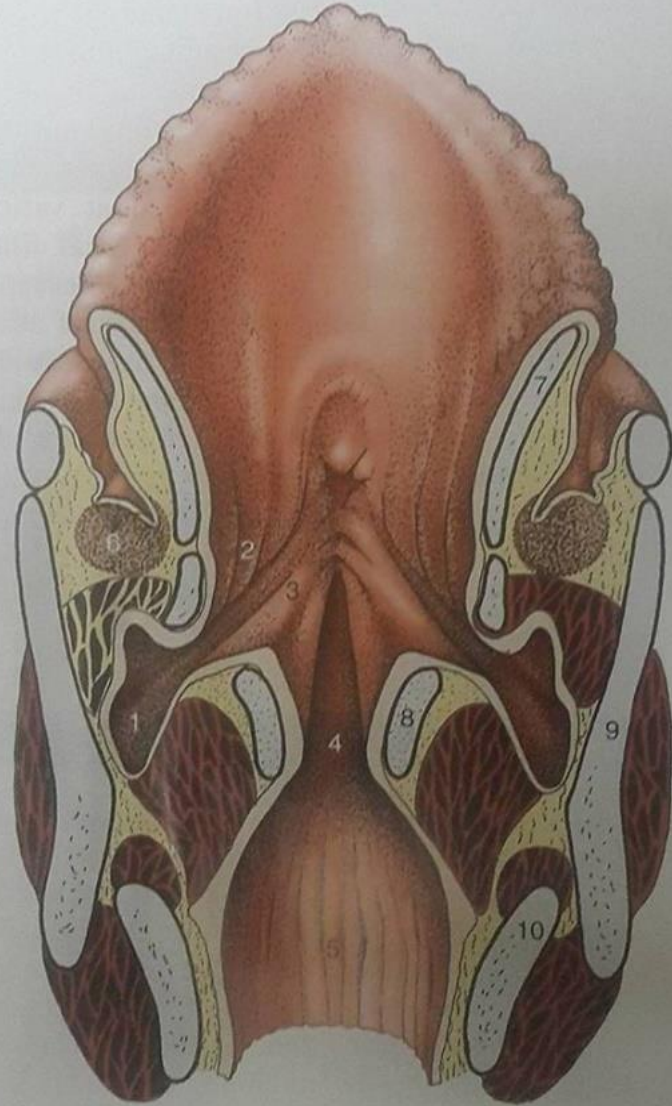


Figure 18–35 Dorsal section of the larynx. 1, Laryngeal ventricle; 2, vestibular fold with ventricularis; 3, vocal fold with vocalis; 4, glottic cleft; 5, infraglottic cavity; 6, caudal end of palatine tonsil; 7, epiglottic cartilage; 8, arytenoid cartilage; 9, thyroid cartilage; 10, cricoid cartilage.

Anatomy

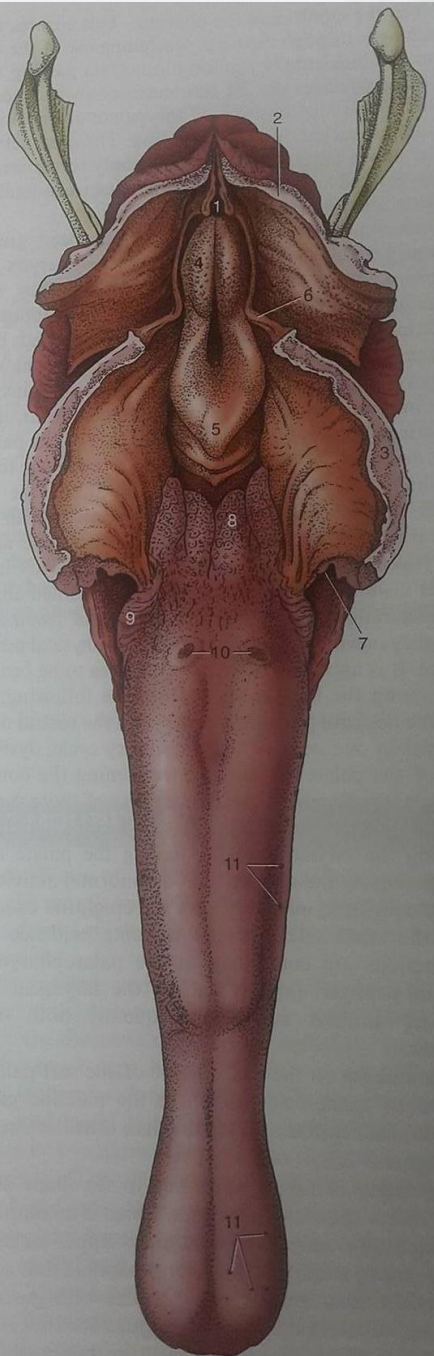


Figure 18–16 The tongue and pharynx; the latter has been opened dorsally to expose the entrance to the larynx. *1*, Entrance into esophagus; *2*, dorsal wall of nasopharynx (split in median plane); *3*, soft palate (split in median plane); *4*, corniculate process of arytenoid cartilage; *5*, epiglottis; *6*, free border of soft palate, continued caudally by palatopharyngeal arch; *7*, palatoglossal arch; *8*, lingual tonsil; *9*, foliate papillae; *10*, vallate papillae; *11*, examples of fungiform papillae.

Diagnosis

- Ensure to obtain a **thorough history** (roaring noise during exercise).
- **Distance examination** should be done as well.
- **Physical examination** should include:
- Palpation of the neck and larynx because horses with significant RLN have palpable atrophy of the left CAD muscle, which manifests as a percutaneous prominence of the muscular process of the arytenoid cartilage

Diagnosis

- Palpation of the larynx for congenital malformation and evidence of arytenoid chondritis.
- If there is suspicion of previous laryngeal surgery, clipping of the hair is advised to allow visual confirmation of palpable laryngotomy or laryngoplasty scars.

Diagnosis

- **Laboratory Test** should be done:
 - Horses < 4 years old and healthy:
 - ✓ Packed cell volume (PCV)
 - ✓ Total protein
 - Horses > 4 years old or those that are systemically ill:
 - ✓ Complete blood count (CBC)
 - ✓ Chemistry
- **Ultrasound examination** can identify arytenoid cartilage movements but patient cooperation is essential for successful interpretation of this diagnostic mode

Diagnosis

- A **definitive diagnosis** of RLN is made on **endoscopic examination** when there is partial or complete loss of abductor function on the affected side of the larynx. The grading scheme are as follows.

Diagnosis

Grade	Description	Subgrade	Description
I	All arytenoid cartilage movements are synchronous and symmetrical, and full arytenoid cartilage abduction can be achieved and maintained.		
II	Arytenoid cartilage movements are asynchronous and/or larynx is asymmetric at times, but full arytenoid cartilage abduction can be achieved and maintained.	A	Transient asynchrony, flutter, or delayed movements are seen.
		B	There is asymmetry of the rima glottis much of the time owing to reduced mobility of the affected arytenoid cartilage and vocal fold, but there are occasions, typically after swallowing or nasal occlusion, when full symmetrical abduction is achieved and maintained.
III	Arytenoid cartilage movements are asynchronous and/or asymmetric. Full arytenoid cartilage abduction cannot be achieved and maintained.	A	There is asymmetry of the rima glottis much of the time owing to reduced mobility of the affected arytenoid cartilage and vocal fold, but there are occasions, typically after swallowing or nasal occlusion, when full symmetrical abduction is achieved <i>but not</i> maintained.
		B	There is obvious arytenoid abductor muscle deficit and arytenoid cartilage asymmetry. Full abduction is never achieved.
		C	There is marked but not total arytenoid abductor muscle deficit and arytenoid cartilage asymmetry with little arytenoid cartilage movement. Full abduction is never achieved.
IV	Complete immobility of the arytenoid cartilage and vocal fold.		

Diagnosis

- Trackside endoscopy immediately after strenuous exercise has been used to help establish a diagnosis of recurrent laryngeal neuropathy, but it is **not a reliable technique**.
- **Treadmill videoendoscopy** or “over-ground” videoendoscopy is the **“gold standard” for accurate diagnosis**.

Equipment

- Stall
- Halter
- Cotton
- Gauze
- Needle and syringes
- Chlorohexidine
- Iodine
- Alcohol
- Surgical drape
- General surgery pack
- Self-retaining retractor (Gelpi, Weitlaner, or Hobday's roaring retractor)
- Laryngeal bur
- Tracheostomy tube
- Laser with fiber (980-nm diode laser with 3 m/600-m fiber preferred)
- Protective eyewear

Ventriculectomy *(Sacculectomy)*

- Ventriculectomy: the removal of the mucosal lining of the laryngeal ventricle located caudal to the vocal cord.
- This eliminates noise and can have some beneficial effects on performance.
- It is **not recommended sole procedure** for race horses with advanced RLN because this surgery doesn't produce abduction of the arytenoid cartilage.

Ventriculocordectomy

- Ventriculocordectomy is a ventriculectomy in addition to the removal of the small wedge of the tissue from the leading edge of the vocal cords.
- These two procedures can be done under general anaesthesia and standing in a stall.

A white horse is shown in profile, facing right, with its mouth wide open, revealing its teeth. The horse is standing in a field of yellow hay. The background is a blurred green field with trees in the distance. The text "Preparation for the surgery." is overlaid on the image in a green, italicized font.

Preparation for the surgery.

General Anaesthesia

- Restrict food 12 hours prior surgery.
- **Premedication:**
- Tetanus Antitoxin
- Antibiotics
- Anti-inflammatory therapy:
 - ✓ Phenylbutazone(4.4 mg/kg IV)
 - ✓ Flunixin meglumine (1.1 mg/kg IV)
- alpha-2 agonists are commonly used. Please refer to the table below for a list.

Drug	Indications	Dosage	Comments
Acepromazine/ May be used with any opioid or alone.	Sedation	Ace: 0.03–0.06 mg/kg Butorphanol: 0.01–0.04 mg/kg, IV or IM Morphine (0.03–0.09 mg/kg IV or IM)	Acepromazine at a dose of 0.05 mg/kg IV or IM can be used for mild sedation that lasts approximately 90 minutes and begins within 15–20 minutes. ² Acepromazine should not be used after recent treatment with organophosphate anthelmintics. Due to its alpha-adrenergic blocking effect, this drug should not be used in cases of hypovolemic shock, except when volume replacement has been adequate and when peripheral vasodilation to increase perfusion is desired.
Detomidine Detomidine/opioid	Sedation	4–20 µg/kg IV Detomidine: 5–20 µg/kg Butorphanol: 0.01–0.04 mg/kg, IV or IM Morphine: 0.03–0.09 mg/kg, IV or IM	Cardiovascular effects are longer lasting than with xylazine or dex/medetomidine. Duration of 60–120 minutes. ⁵ Detomidine can be administered with a loading dose of 7.5 µg/kg IV followed by constant rate infusion to effect.
Medetomidine	Sedation	5 µg/kg IV	Similar/slightly longer duration than xylazine. ⁵ As with other alpha-2 agents it may be infused intravenously to effect to achieve the desired length of sedation.
Romifidine	Sedation	40–120 µg/kg IV	Produces sedation of a similar duration to detomidine and longer than xylazine. ⁵
Xylazine	Premedication and standing sedation	1.1 mg/kg IV ⁷⁹ 0.3–0.6 mg/kg IV for preanesthetic	Bradycardia and transient cardiac arrhythmias (usually atrioventricular block) occur when xylazine is given intravenously. At high doses, significant ataxia may complicate standing procedures. Animal behavior under heavy sedation may be unpredictable. Good for short procedures.
Xylazine/ Acepromazine	Sedation	Xylazine: 0.5 mg/kg Ace: 0.05 mg/kg IV	Addition of acepromazine, similar to opioids, results in more reliable sedation. However, this is considered "off-label" use.
Xylazine/ Butorphanol tartate		Xylazine: 0.3–1 mg/kg Butorphanol: 0.01–0.05 mg/kg IV	Xylazine in combination with opioids facilitates restraint and minimizes sudden arousal seen with xylazine alone.
Xylazine/ morphine		Xylazine: 0.3–1 mg/kg Morphine: 0.03–0.9 mg/kg IV ^{80,81}	

General Anaesthesia

- ***Induction:*** can be done using ketamine and tiletamine. Guaifenesin combined with ketamine can also be used.
- Guaifenesin is a muscle relaxant and acts at the level of the internuncial neurons in the spinal cord and brainstem. It also has minimal depressant effect on the respiratory and cardiac system with appropriate dose.
- The drug is administered as a 5% solution in dextrose or as a 10% solution in sterile distilled water.

General Anaesthesia

Drug	Dosage	Comments
Guaifenesin/ketamine	5–10% solution of guaifenesin IV (50–100 mg/kg) followed by bolus of ketamine (1.8–2.2 mg/kg)	Excellent for debilitated patients. Provides relatively smooth induction of anaesthesia with little cardiopulmonary depression. ²⁹ In healthy patients, a low to moderate dose of an alpha-2 agent may be administered prior to induction with guaifenesin and ketamine.
Tiletamine/zolazepam (Telazol®)	0.7–1.0 mg/kg IV	Given following sedation with alpha-2 agonist drugs or guaifenesin. Considered to have superior induction quality and produce greater muscle relaxation than some other agents, but is also associated with a prolonged ataxia during recovery. ⁶²
Xylazine/ketamine	1.1 mg/kg xylazine IV followed 2–3 minutes later by 2.2 mg/kg ketamine IV	This regimen provides anaesthesia for a short duration (12–15 minutes) and eliminates the need for large-volume administration through a catheter or needle. Induction is smooth when xylazine takes effect before ketamine is administered. Disadvantages include the short duration, maintenance of reflex activity, and inability to judge anaesthetic depth. Active palpebral, corneal, and swallowing reflexes are maintained; passing an endotracheal tube can be difficult. Diazepam (0.02–0.1 mg/kg) concurrently with ketamine will reduce reflex activity and facilitate intubation. ⁶³ Other alpha-2 agents (romifidine 80–100 µg/kg), detomidine 20–30 µg/kg) may be similarly used with benzodiazepines (diazepam or midazolam) and ketamine.

General Anaesthesia

- **Maintenance:** Intravenous maintenance on horses are done using a “triple drip” combination of guaifenesin, ketamine and an alpha-2 antagonist.
- Alternate options in horses include alpha-2 and dissociative combinations, alpha-2 and propofol combinations, benzodiazepine and propofol or ketamine combinations.

General Anaesthesia

Drug	Species	Dosage	Comments
Guaifenesin/ ketamine/ detomidine	Horses	Guaifenesin Ketamine: 2 mg/ml Detomidine: 0.02 mg/ml Initial infusion rate: 1–3 ml/kg/hr ⁸⁵	Generally administered to effect. Recommended not to exceed 100 mg/kg. 5–10% solutions of guaifenesin may be combined with any alpha-2 agent (xylazine, detomidine, dex/medetomidine, and romifidine). "Triple drip" can be used as an adjunct to inhalational anesthesia to reduce the concentration of inhalant required and potentially improve the quality of recovery from anesthesia, or it can be used to maintain anesthesia (total IV anesthesia). ⁸⁶ When used solely for anesthesia maintenance, use should be limited to 1 hour. The user should be aware that reflex activity may be maintained.
Guaifenesin/ ketamine/ medetomidine	Horses	10% Guaifenesin Ketamine: 2 mg/ml Medetomidine: 0.002 mg/ml Infusion rate: 1–3 ml/kg/hr	
Guaifenesin/ ketamine/ romifidine	Horses	10% Guaifenesin Ketamine: 2 mg/ml Romifidine: 0.05 mg/ml Infusion rate: 1–3 ml/kg/hr ⁸⁵	
Guaifenesin/ ketamine/ xylazine (GKX)	Cattle	5% Guaifenesin: 500 ml Ketamine: 1 mg/ml Xylazine: 0.05 mg/ml Infusion rate: 0.5–2.2 ml/kg ^{24,25}	
	Sheep and goats	10% Guaifenesin Ketamine: 2 mg/ml Xylazine: 0.1 mg/ml Infusion rate: 1–3 ml/kg/hr	
	Horses	5% Guaifenesin: 500 ml Ketamine: 1–2 mg/ml Xylazine: 0.5 mg/ml Infusion rate: 1–2 ml/kg/hr	
Isoflurane	Cattle/Horse	Initial oxygen flow rate of 5–8 L/min and vaporizer setting of 3–3.5% Maintain with oxygen flow rate of 3–5 L/min and 2–3% isoflurane for adult cattle and 1–2% in calves. ⁷⁹	Following injectable anesthesia induction and intubation guidelines based on use of a typical large animal anesthetic breathing circuit. Guidelines are as for small animals maintained on small animal anesthetic breathing circuit.
	Sheep, goats, and swine	Initial flow rate of 1–3 L/min and vaporizer setting of 2–3% isoflurane, which is decreased based on clinical signs.	

General Anaesthesia

- Ensure to carefully monitor the patient, including assessment of the anesthetic depth, reflex activity, cardio and respiratory systems.
- Fluid administration is done to support vascular volume.

Standing Anaesthesia

- The procedure can be done standing with the horse's head elevated.
- It can be sedated with a loading dose of detomidine (4mg IV) and butorphanol (10mg IV).
- Next local anesthesia of the skin and subcutaneous tissues is done.
- Following that a detomidine drip using 14mg added to 250ml of saline is used to maintain sedation during the procedure.
- 2 g of phenylbutazone is given intravenously to minimize postoperative laryngeal edema.
- Note that tetanus antitoxin and antibiotics are given prophylactically.

Preparation for the site

- The ventral laryngeal region is clipped in a rectangular pattern with straight edges starting caudal to the mandible and ending at the upper 2/3 of the neck.
- Clipping can be done with a #10 blade followed by a #40 blade.
- After which it is aseptically prepared/scrubbed, using Chlorohexidine solution followed by Iodine solution.
- If the horse is under general anaesthesia it will then be draped. If standing this step is skipped.