Anesthesia for dentistry

Presented by :

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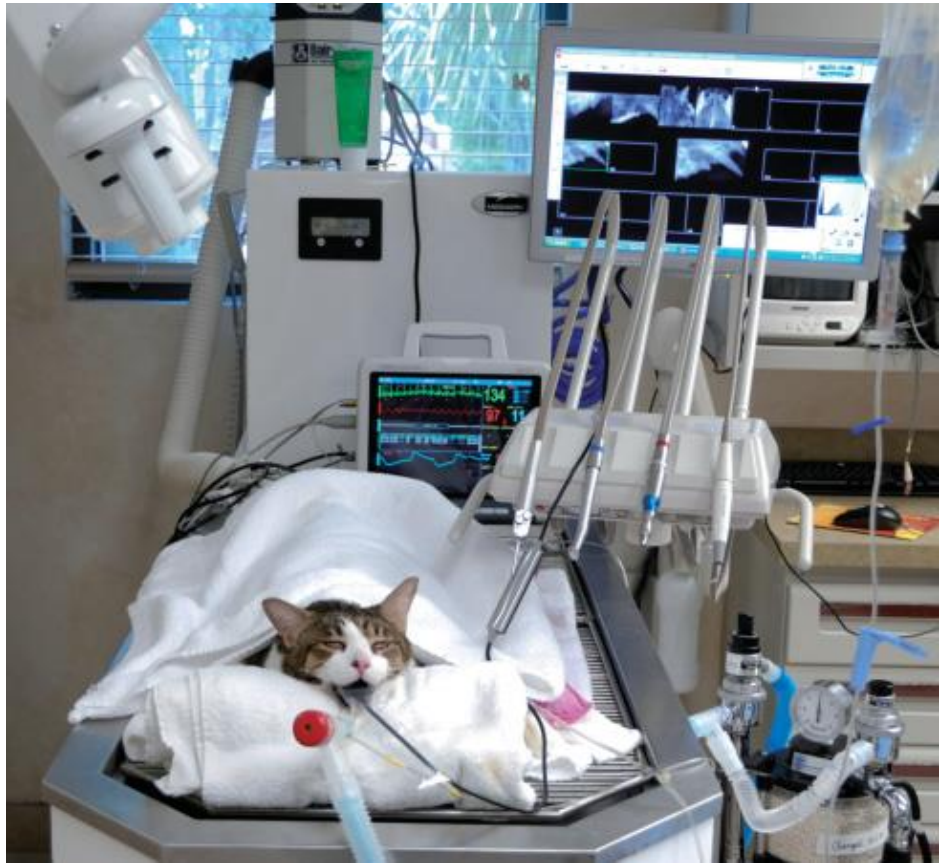
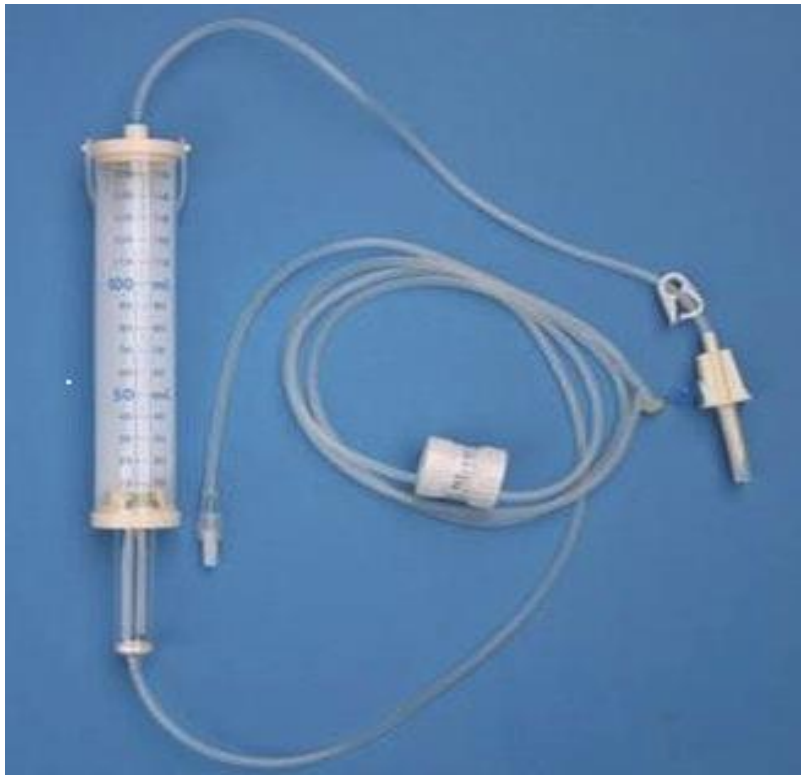


Preparation



Cats are more prone to **fluid overload** because of their lower circulating blood volume (60–65 ml/kg vs 80–90 ml/kg), especially when occult cardiac disease is present

Cats may appear to be clinically healthy with no signs of **azotaemia**, but still may already have lost 50–75% of functioning nephrons

Trends in **creatinine values over time** provide good information on renal function when levels are still within normal range; an increase over time is very likely the result of a decrease in renal function

Hypokalaemia, especially levels <3.0 mmol/l, should be corrected by the administration of fluids spiked with potassium(0.5 mmol/kg/h)

Fluid therapy should form part of **the (pre-)anaesthetic protocol** to ensure adequate circulating blood volume and organ perfusion and to optimise electrolyte concentrations and acid–base status

Potassium supplementation

Table 1 Guidelines for intravenous potassium supplementation in cats

Plasma K (mmol/l)	mmol of KCl to add to 500 ml of fluids	mmol of KCl to add to 1 l of fluids	Maximum infusion rate (ml/kg/h)*
<2.0	40	80	6
2.1–2.5	30	60	8
2.6–3.0	20	40	12
3.1–3.5	14	28	18
3.6–5.0	10	20	25

*Fluids should still be administered at the guidelines rate of 3–5 ml/kg/h, such that K^+ overdose is highly unlikely.
From DiBartola SP. Disorders of potassium: hypokalemia and hyperkalemia. In: Fluid, electrolyte, and acid-base disorders in small animal practice, 4th ed. Elsevier, 2012, p 107

Anaesthesia

Peripheral alpha-1 receptors results in vasodilation, which may contribute to intraoperative hypotension and hypothermia

Alpha-2 adrenoceptor agonists dexmedetomidine and medetomidine provide reliable sedation, contribute to analgesia and can be reversed with atipamezole

Left ventricular outflow tract (LVOT) obstruction, which is typically seen in **hyperthyroid cats** with a **systolic murmur, medetomidine** rather than **acepromazine** may be the drug of choice, as a reduction of peripheral vascular resistance by acepromazine may worsen the LVOT obstruction

Chronic hypertension, mean arterial blood pressure (MAP) during anaesthesia should be maintained at slightly higher values than normal (80–90 mmHg instead of 60–70 mmHg), as the lower limit for **autoregulation of organs** such as the kidneys and brain will be higher in these patients

Ketamine is not recommended in patients with conditions for which an increase in myocardial oxygen demand should be avoided (eg, **hypertrophic cardiomyopathy**)

Etomidate (0.5 – 1.5 mg/kg IV) is the induction drug of choice for patients that have cardiovascular disease or arrhythmias (except A - V dissociation) because cardiac output and blood flow to the kidneys are maintained

Co-induction

Table 2 Drugs used for (co-)induction of anaesthesia in cats

Drug	Dose	Route
Diazepam	0.2–0.3 mg/kg	IV
Midazolam	0.2–0.3 mg/kg	IV
Propofol	4–6 mg/kg	Slowly IV to effect
Alfaxalone	1–3 mg/kg	Slowly IV to effect
Fentanyl	5 µg/kg	IV

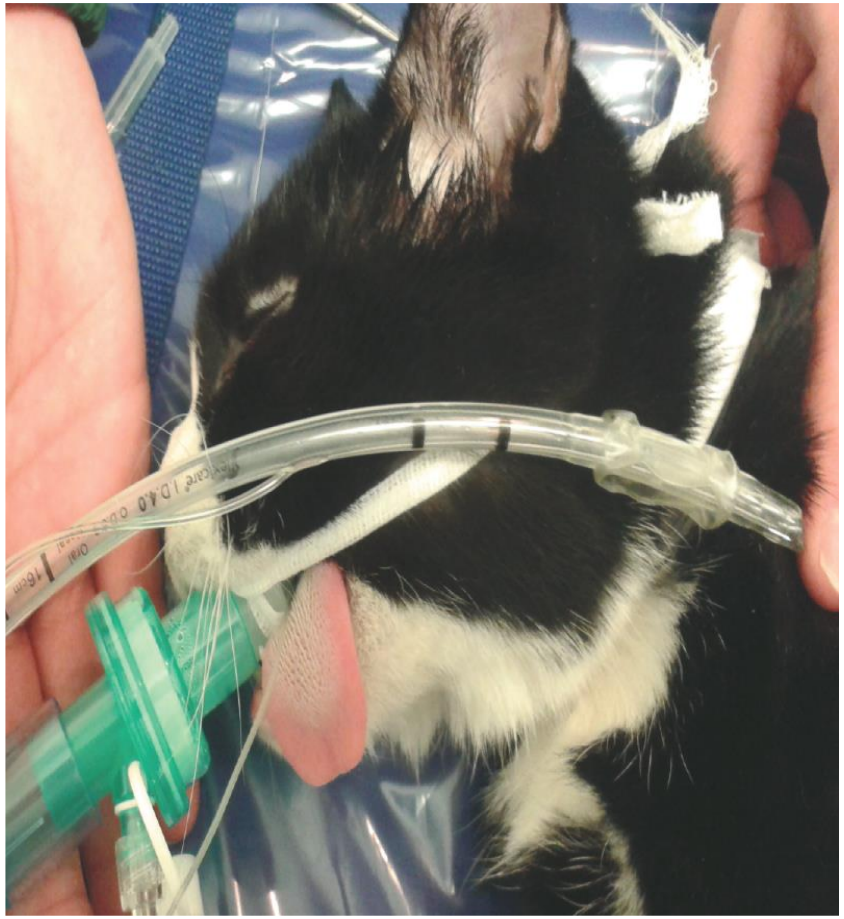
IV = intravenous

When a **painful condition** already exists or a painful procedure is planned, an **opioid** should form the mainstay of the pre-anaesthetic protocol, especially in patients in which non-steroidal anti-inflammatory drugs (**NSAIDs**) are contraindicated

Premedication with an opioid is advised due to its calming effect and **minimal cardiovascular compromise**

Local and regional anesthesia not only help decrease pain before, during, and after surgery, but also result in less inhaled general anesthesia due to **decreased hyperventilation**

Intubation



All cats placed under anesthesia for oral assessment and **treatment must be intubated** and the airway secured with an inflatable cuff

The **endotracheal tube** should be secured before the cuff is inflated

ETT that is too long will result in increased **mechanical dead space and rebreathing**

The feline upper respiratory tract is very sensitive and prone to damage and **laryngealspasm**

Lidocaine 2% **(0.1–0.2 ml)** results in the application of 2–4 mg

Because lidocaine is well absorbed through the mucous membranes, it is important to consider **the total dose applied**, especially if local anaesthetic agents will be part of the anaesthetic protocol at a later stage (ie, nerve blocks)

It is critical that anytime **the head is moved from side to side** during assessment or dental treatment, the endotracheal tube be disconnected from the anesthesia machine and reconnected after the new position is reached

Intravenous Therapy

Not only to compensate for **ongoing losses** and potential **haemorrhage** but also to counteract any relative **hypovolaemia** resulting from anaesthetic agent induced hypotension

Lower rates such **as 3–5 ml/kg/h** are often sufficient, with a reduced risk of fluid overload

Crystalloid fluid **bolus** of 5 ml/kg can be infused over 5–10 mins, and repeated if necessary

Table 3 Guidelines for intravenous support of arterial blood pressure during anaesthesia in cats

Fluid/drug	Dose	Comments
Crystalloids	5–10 ml/kg/h 5 ml/kg bolus over 5–10 mins	
Colloids	1–3 ml/kg/h 1–2 ml/kg over 5–10 mins	Risk of volume overload
Dopamine	2–10 µg/kg/min	Start at 5 µg/kg/min
Dobutamine	2–10 µg/kg/min	Start at 2–5 µg/kg/min

Intraoperative Analgesia

No real benefit of one **volatile agent** over the other but in lowest possible level

IV administration of **fentanyl** (2–5 mcg/kg bolus or 5–10 mcg/kg/h continuous rate infusion)

ketamine (0.2–0.5 mg/kg bolus or 10 mcg/kg/min continuous rate infusion)

Administration of these analgesic agents, especially as a bolus, may result in respiratory depression and the need for temporary (manual) **ventilatory support**

Body temperature

Cats are prone to **hypothermia** due to their high body surface area to volume ratio

It is much easier to **prevent** hypothermia than to treat it

In addition to the increased infection rate seen in hypothermic patients, there is increased risk of fatal ventricular arrhythmias in patients with **body temperatures < 33 ° C**

Airway protection

The use of **large throat packs** in cats can result in venous obstruction, causing swelling of the tongue and oral mucosa

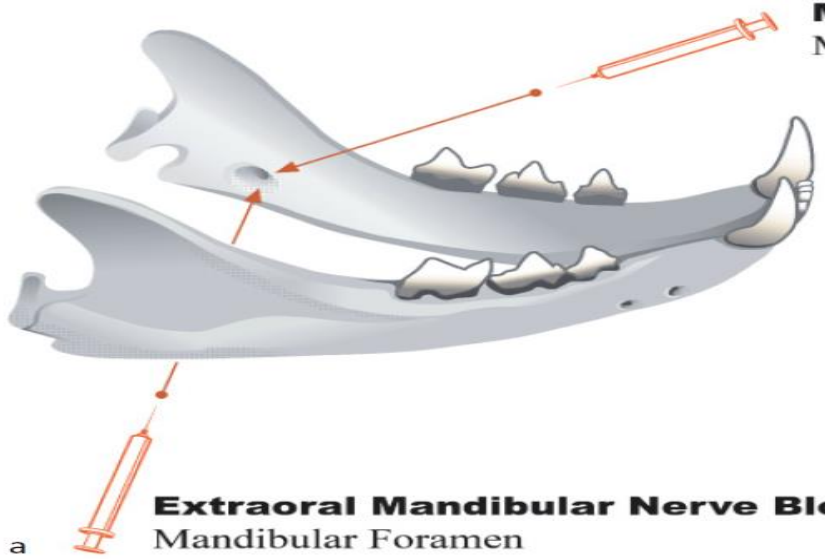
Avoid fluid **flowing back i**nto the pharynx, larynx and trachea, the cat should be positioned with the nose **angled slightly down** during recumbency, and the head should be supported a little below body level when turning the patien

The maxillary and mandibular nerves

For dental and oral surgery, the two nerves that require blocking are the maxillary nerve for the upper dental arcade and the inferior alveolar nerve (branch of the mandibular nerve) for the lower arcade

Table 4 Desensitised structures after successful nerve blockade. The principal nerve blocks are shown in bold

Nerve blocked	Desensitised structures
Maxillary	Ipsilateral maxilla and incisive bone (and teeth and soft tissues), and also hard and soft palates
Infraorbital (*within* the infraorbital canal)	**Ipsilateral maxillary second, third and fourth premolar teeth, canine and incisor teeth and the associated soft tissues, skin of the muzzle and upper lip**
Mandibular	**Ipsilateral body of mandible (teeth, bone and soft tissues), skin of lower lip and rostral intermandibular tissues**
Mental (at middle mental foramen)	Soft tissues rostrally only


Mandibular Nerve Block
Mandibular Foramen
Extraoral Mandibular Nerve Block
Mandibular Foramen

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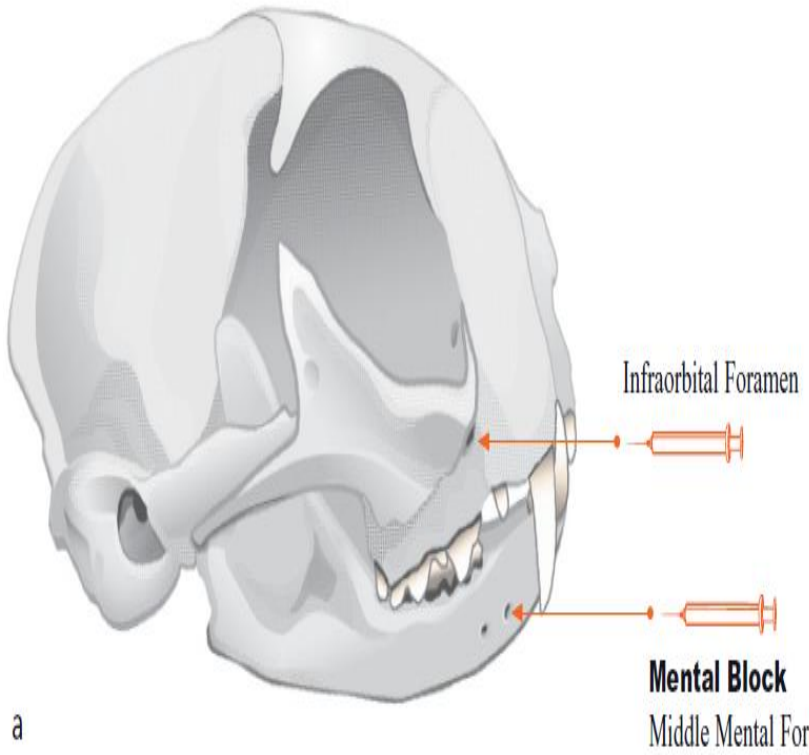
Infraorbital Foramen
Mental Block
Middle Mental Foramen

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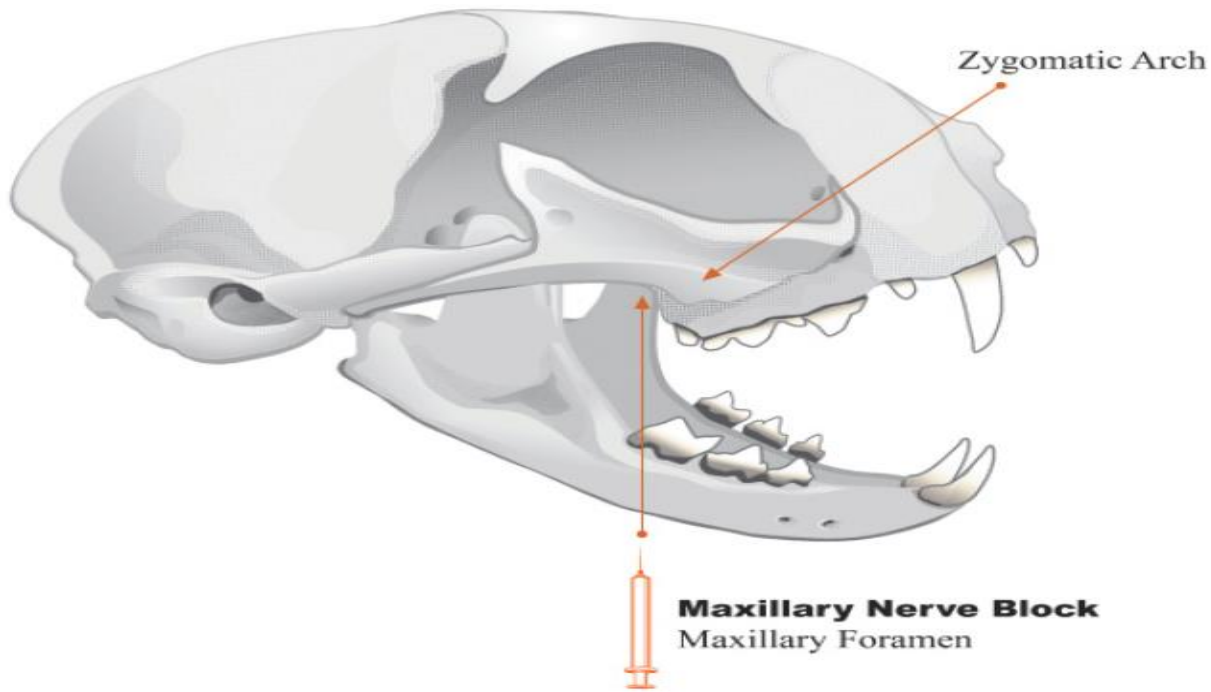
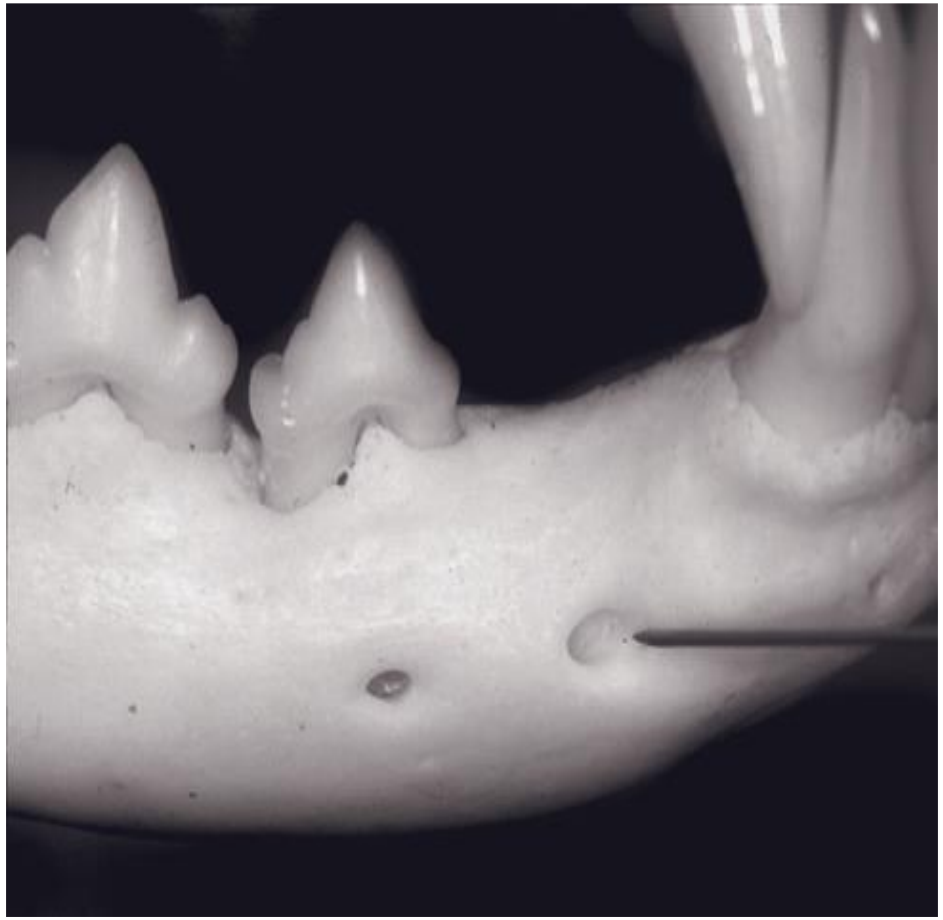
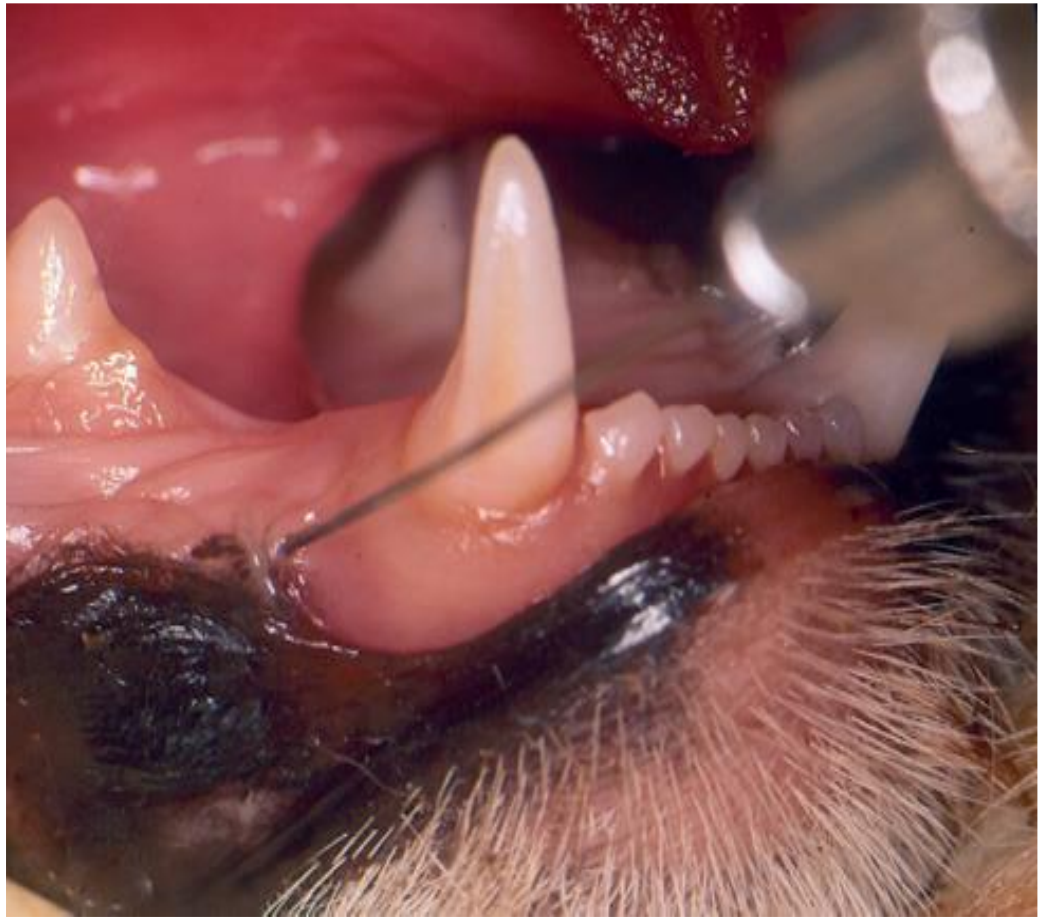
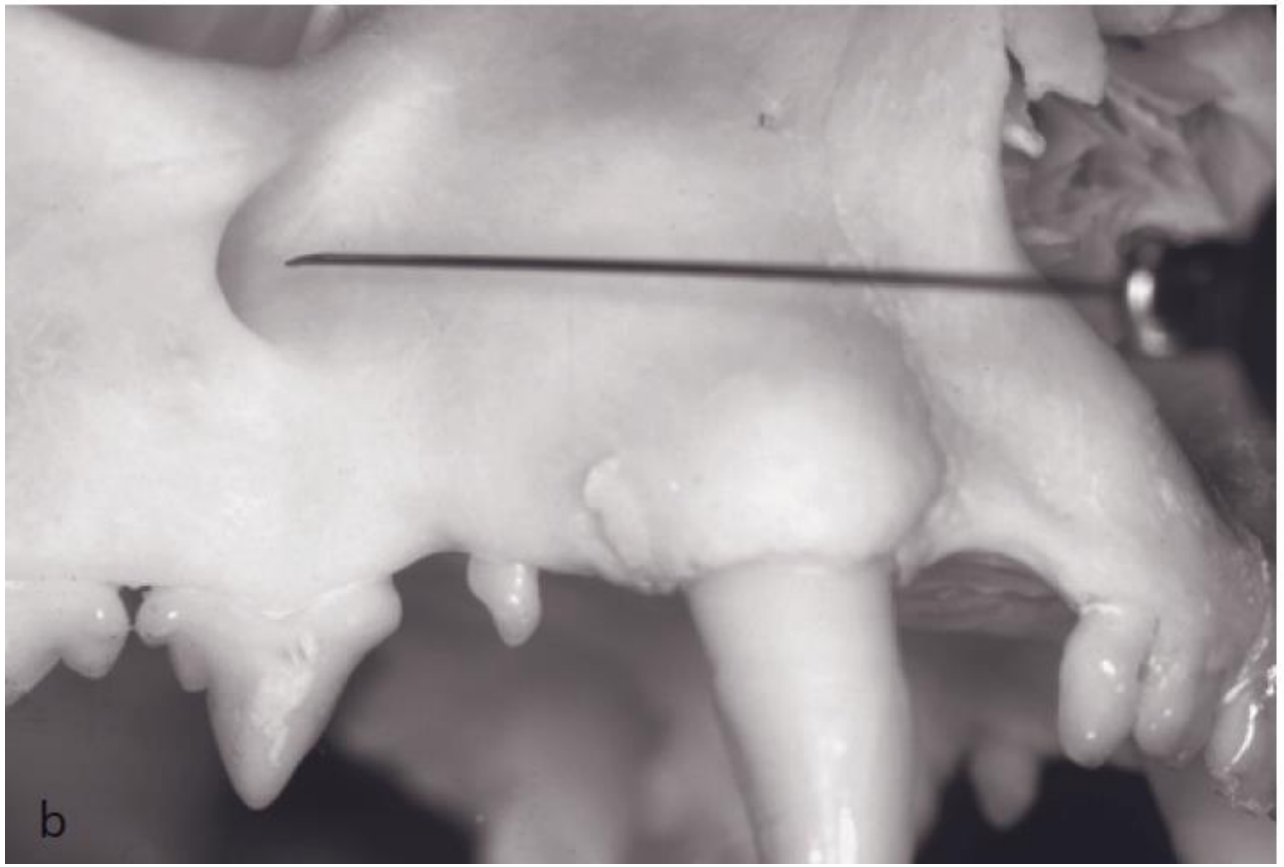

Zygomatic Arch
Maxillary Nerve Block
Maxillary Foramen

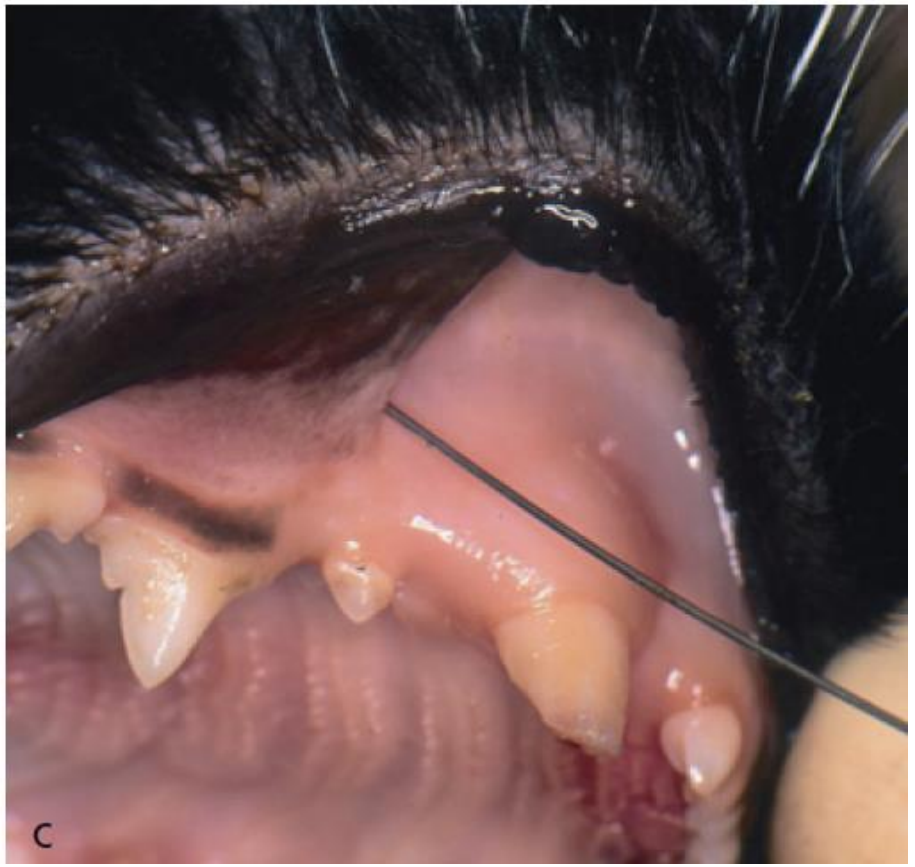
Middle mental nerve block



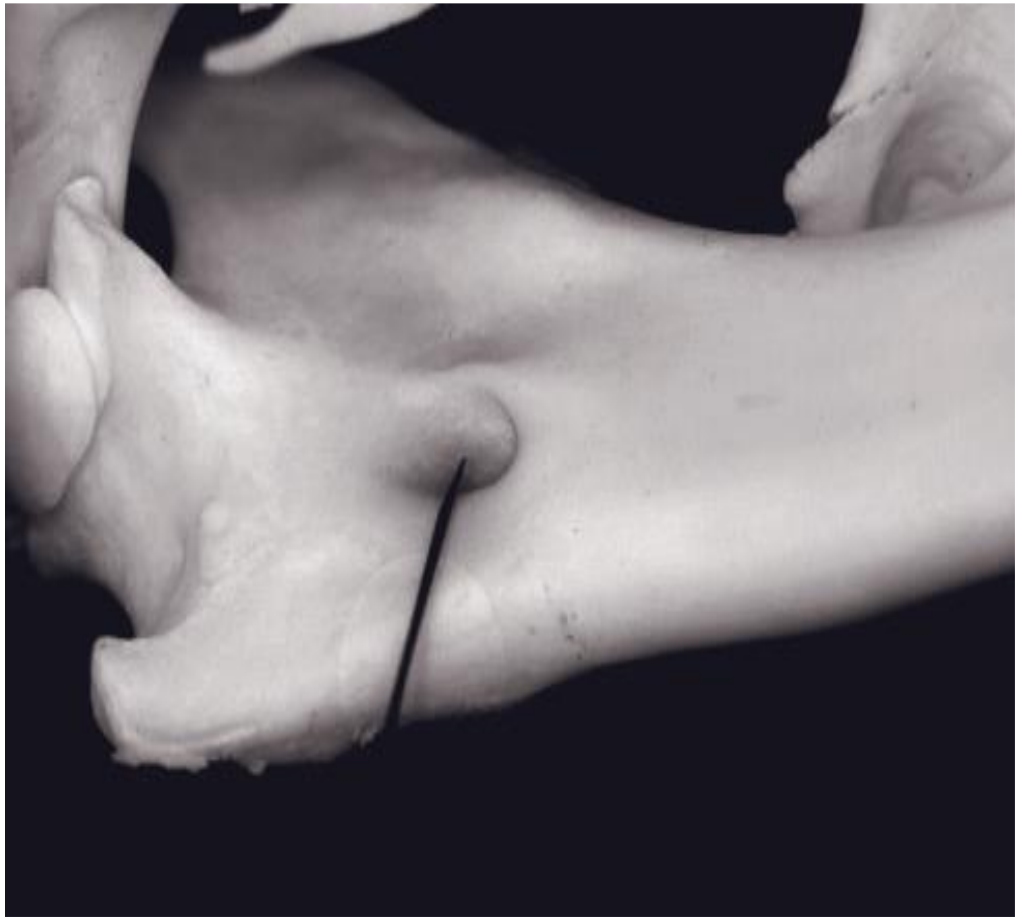


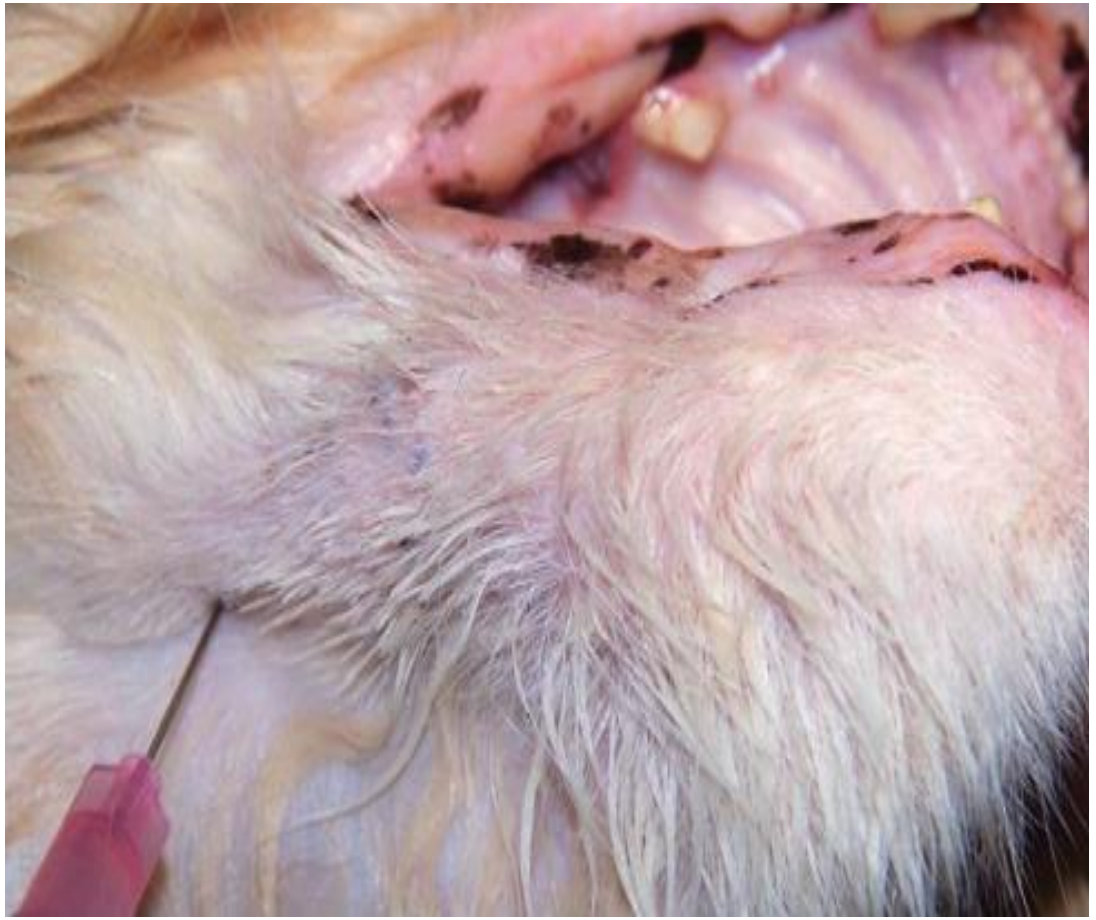
Infraorbital nerve block





Mandibular nerve block





Complications

Direct nerve trauma is a concern, there is an increased risk of nerve trauma if needles are inserted into foramina

In human dentistry, the most common nerve trauma is to the **lingual nerve** (66% of reports), occurring during anaesthesia of the inferior alveolar nerve

Attempts to block the inferior alveolar nerve will also successfully block the lingual nerve that provides sensory innervation to the rostral two thirds of the tongue, and this may result **in self trauma in the recovery period**

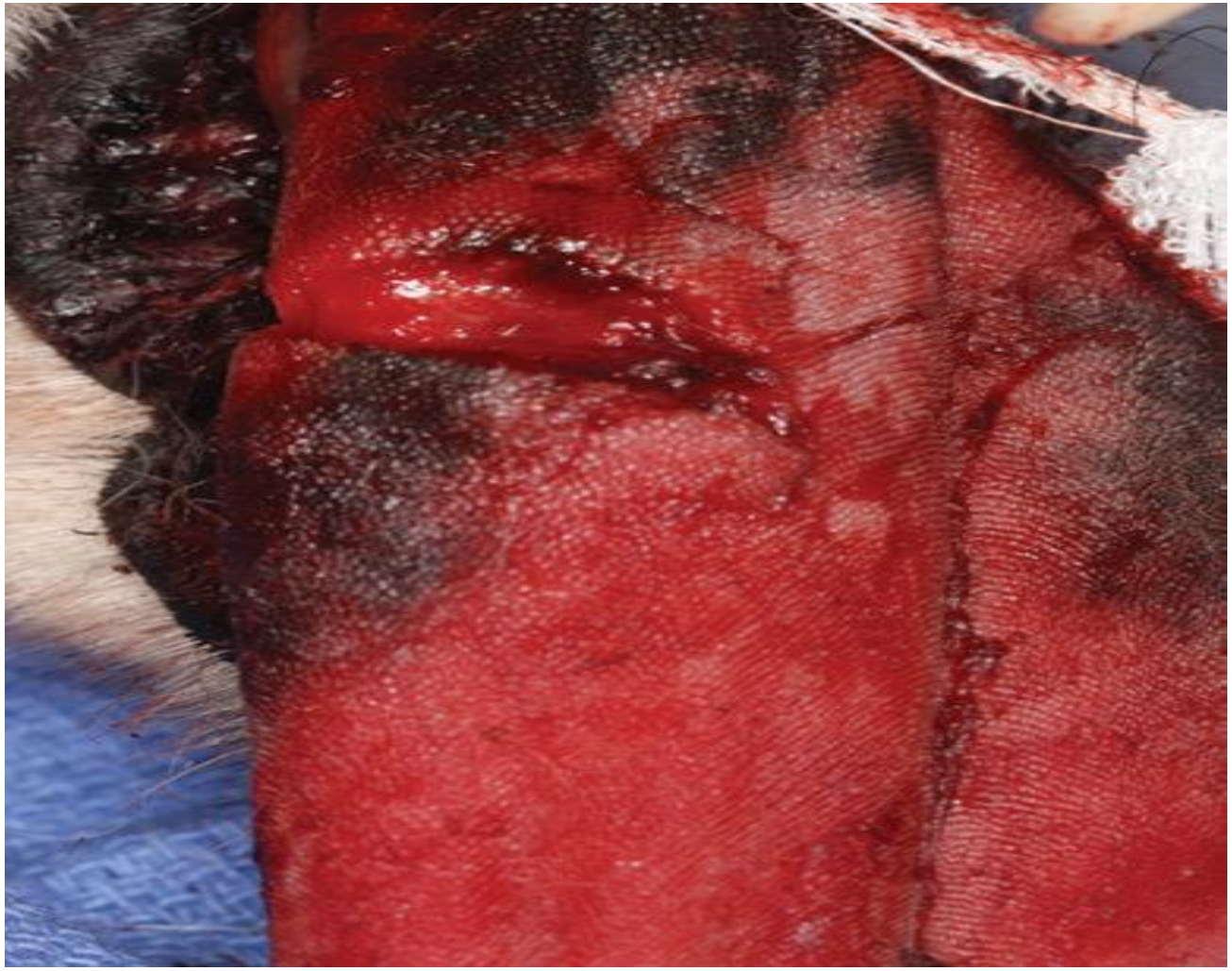
The needle is inserted into **the muco- buccal fold** 'above' or 'below' the roots of the target tooth and is advanced until bone is touched, after which local anaesthetic is injected and diffuses through the adjacent cancellous bone to produce anaesthesia of the pulpal nerve

This is a commonly used technique in human paediatric patients for maxillary teeth because the maxilla is more porous in young patients and is more porous than the mandible

Gingivitis may also preclude injection through inflamed/infected tissues

Always ensure the patient is disconnected from the breathing system prior to turning to avoid **tracheal damage** (tracheal tears can easily occur, especially in cats, usually involving the dorsal tracheal ligament

Self trauma



Pain management

Increased stimulation of N-methyl-d-aspartate **(NMDA) receptors** within the CNS and, in turn, an exaggerated response (central sensitisation or ‘wind-up)

Central sensitisation is the presence of **allodynia** (in which a normally non-painful stimulus is experienced as painful) and **hyperalgesia** (a painful stimulus elicits an abnormally strong pain reaction)

Pre-emptive administration of analgesic agents before a painful stimulus is the ideal, the aim being to prevent the development of central sensitisation

Morphine may result in vomiting, especially in non-painful cats; its IV administration can potentially result in histamine release

Meloxicam, piroxicam and robenacoxibare less likely to accumulate in cats,as their metabolism does not involve these enzymes

Compared with dogs, cats produce high concentrations of **O-desmethyltramadol**, which has a high affinity for the mu receptor

When oral surgery is planned, use of an opioid in premedication, as well as intraoperatively, will provide pain control **while waiting** for the regional nerve block to take effect

Multimodal analgesia

Consider the use of non steroidal anti - inflammatory drugs (NSAIDs) prior to the procedure wherever there is evidence of periodontitis, gingivo stomatitis, or osteomyelitis

Table 5 Analgesic agents for use in cats

Drug	Dose	Route	Comments
Buprenorphine	0.02 mg/kg q6–8h	IV, IM, SL	~~SC route~~ not recommended due to unreliable uptake and efficacy
Methadone	0.2–0.5 mg/kg q3–6h	IV, IM	Use lower dose for IV route
Morphine	0.2–0.5 mg/kg q3–6h	IV, IM	Use lower dose for IV route
Pethidine	2–5 mg/kg q2h	IM	Do not give by IV route
Fentanyl	2–5 µg/kg 5–10 µg/kg/h	IV	Give during surgery
Tramadol	3–5 mg/kg q12h	PO	
Dexmedetomidine	0.5–2.5 µg/kg 0.5–1 µg/kg/h	IM, IV	Lower dose for IV route
Medetomidine	1–5 µg/kg 1–2 µg/kg/h	IM, IV	Lower dose for IV route
Carprofen	4 mg/kg	IV, SC	One-off dose
Meloxicam	0.2 mg/kg first dose (SC); follow-up doses q24h per body weight (PO)	SC PO	Try to taper down oral dose to effect for chronic use
Ketamine	5–10 µg/kg/min 0.2–0.5 mg/kg bolus	IV	
Amantadine	3–5 mg/kg q24h	PO	

IV = intravenous, IM = intramuscular, SL = sublingual, PO = oral, SC = subcutaneous

Local anesthetics for Nerve blocks

Performing a local anaesthetic technique in or around a location of suspected neoplasia is also a contraindication, to avoid spreading of **neoplastic cells**

limit penetration of the **periosteum**, the needle should be positioned so that the bevel remains parallel to the bony surface and is directed towards the nerve to maximally expose the nerve to the anaesthetic agent

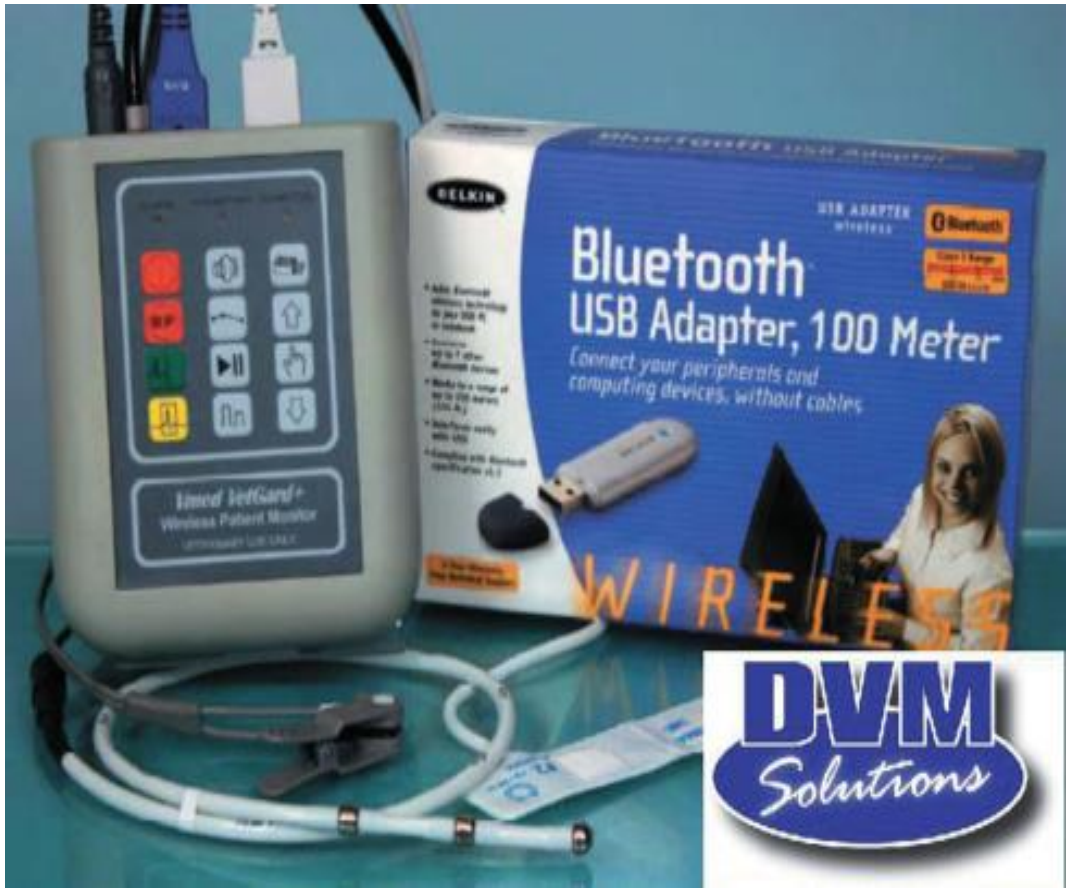
Different local anaesthetic agents can be used in the same patient but their systemic toxicity is **additive**: the maximum dose per agent should be reduced accordingly

Table 6 Onset time, duration of action and maximum recommended dose of local anaesthetic agents used for local nerve blocks in cats

Drug	Onset time (mins)	Duration of action (h)	Maximum recommended dose (mg/kg)
Lidocaine	5–15	1–2	6
Mepivacaine	5–15	1.5–2.5	10
Bupivacaine	10–20	4–6	2*
Ropivacaine	10–20	3–5	3

*Caution is required as toxicity has been reported at lower doses (see box on page 32)

Wireless monitor with esophageal probe



Heart rate in the anesthetized dog and cat.[7]

Canine Patient

Normal 70-120/min

Intervention Required: < 60 or > 140/min

Feline Patient

Normal 130-170/min

Intervention Required: < 80 or > 200/min

Handheld device to evaluate arterial blood gas values in a clinical setting

Blood pressure in the anesthetized dog and cat.[7]

Systolic Pressure

Normal: 110-160 mmHg

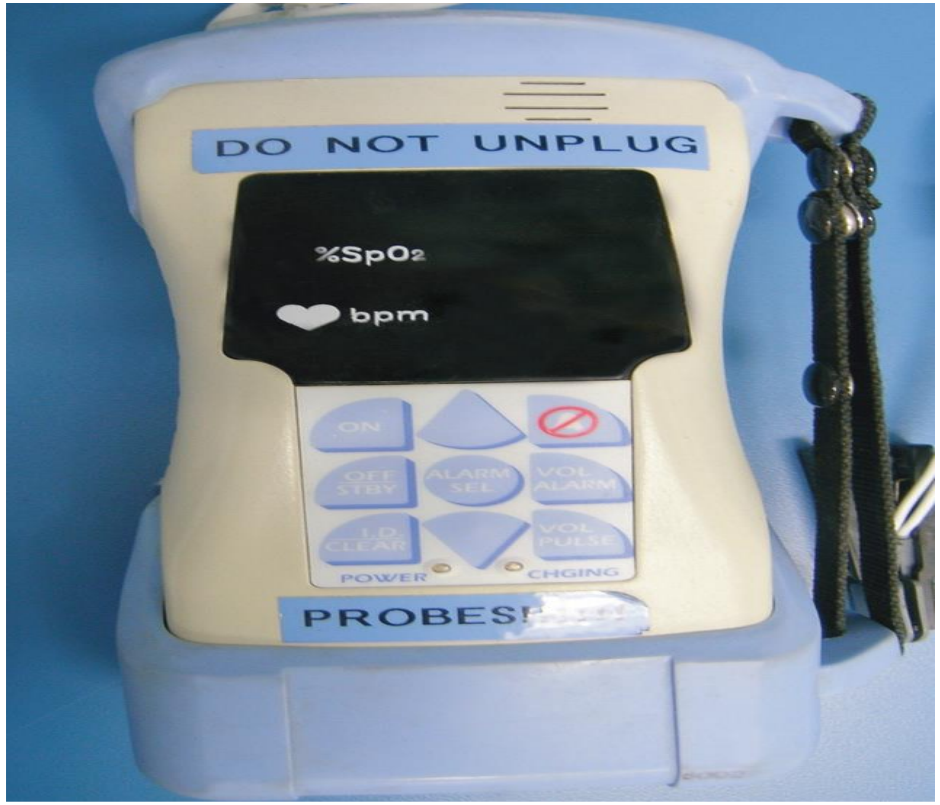
Intervention Required: < 90 or > 170 mmHg

Mean Pressure

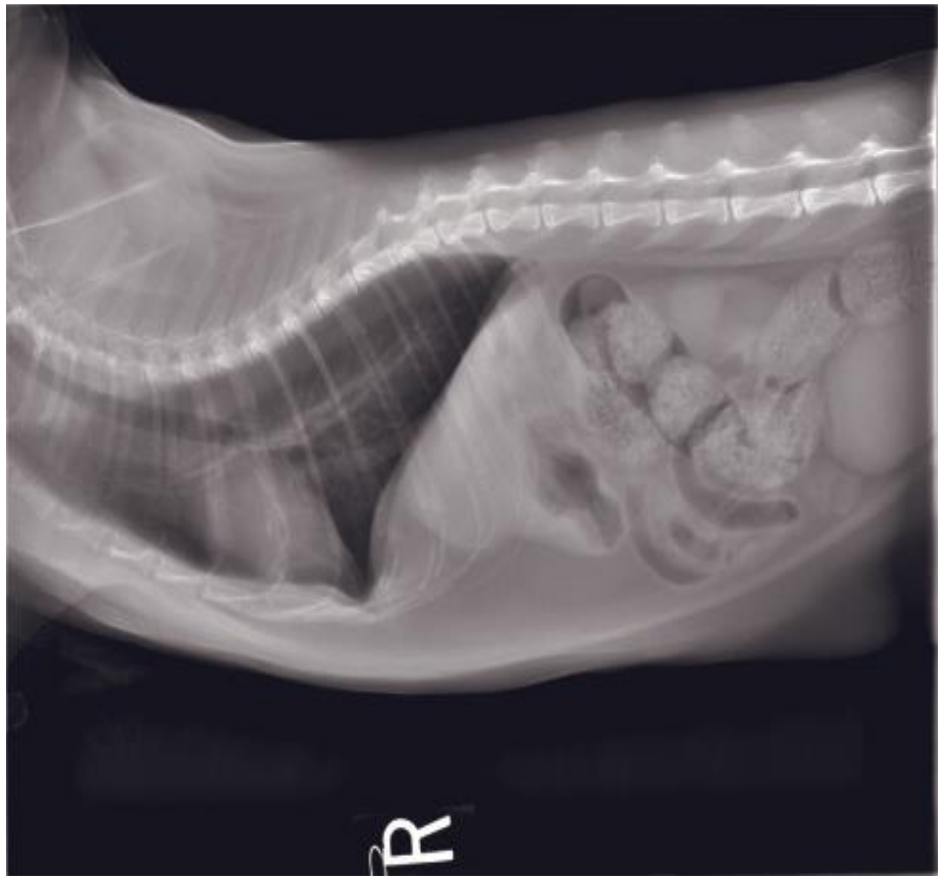
Normal: 60-100 mmHg

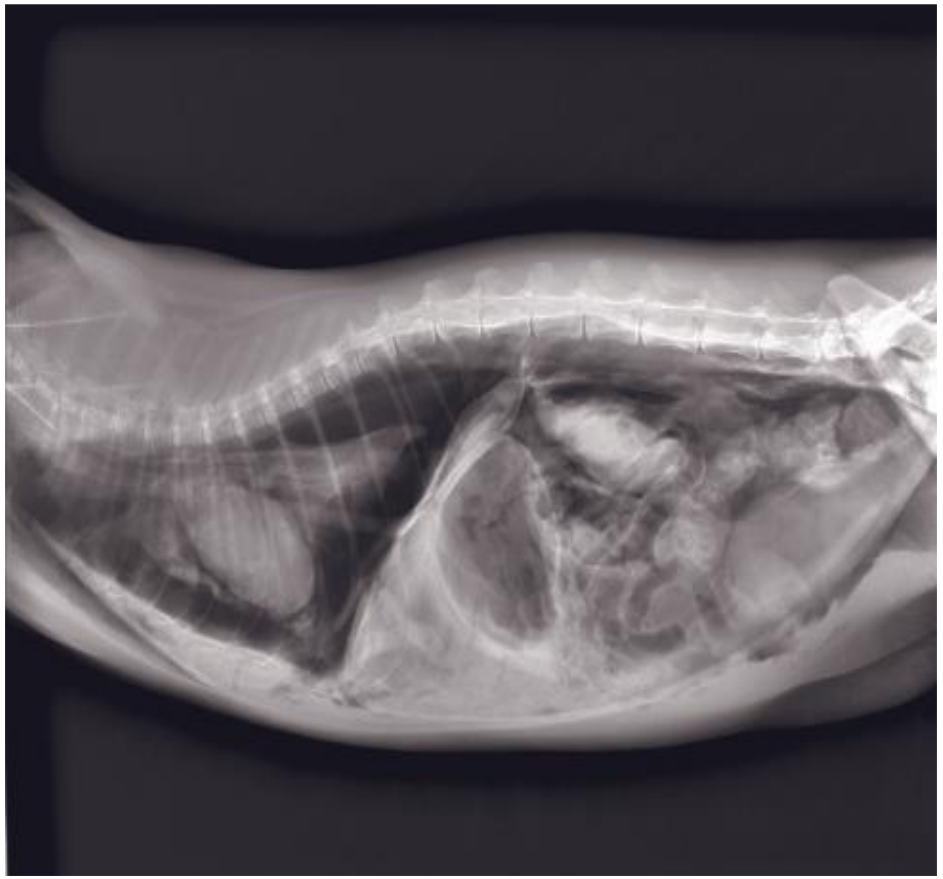
Intervention Required: < 70 or > 130 mmHg

Preanesthesia blood pressure evaluation



Pneumothorax,pneumomediastinum, and pneumoabdomen secondary to endotracheal tube – induced tracheal tear

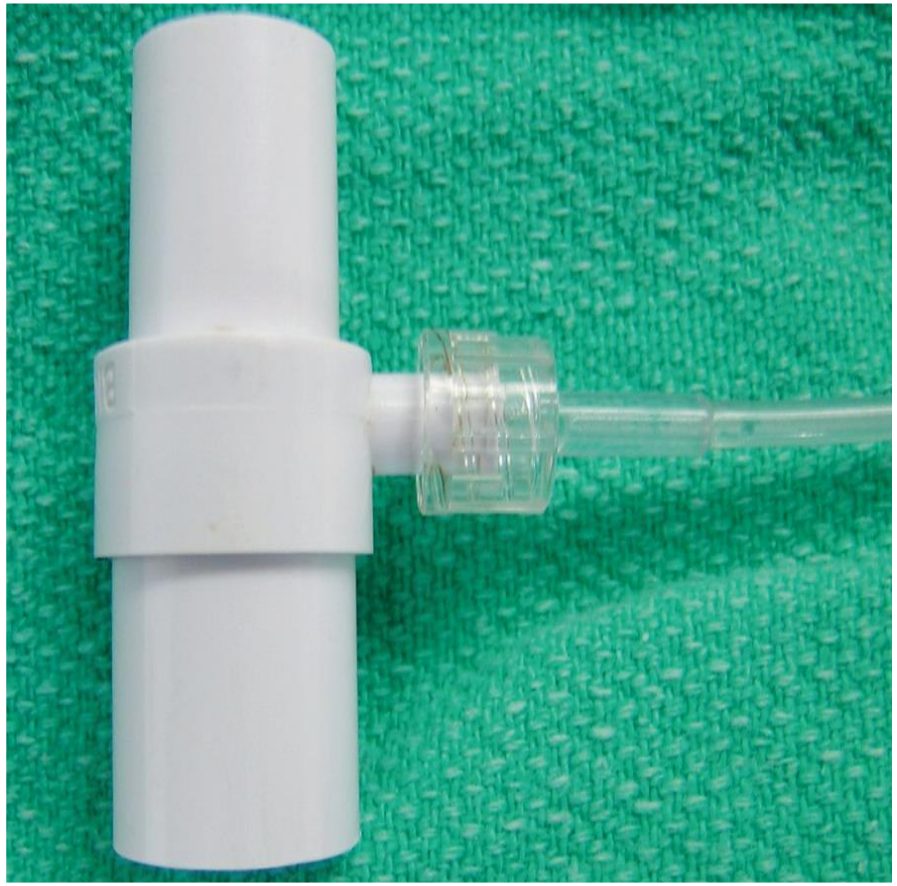




Patient warmer

It is much easier to prevent hypothermia than to treat it(33)

Side stream End-tidal CO2 sampling adaptor



Respiratory rates in the anesthetized dog and cat.[7]

Canine Patient

Normal: 8-15 breaths/min

Intervention required: <8 breaths/min

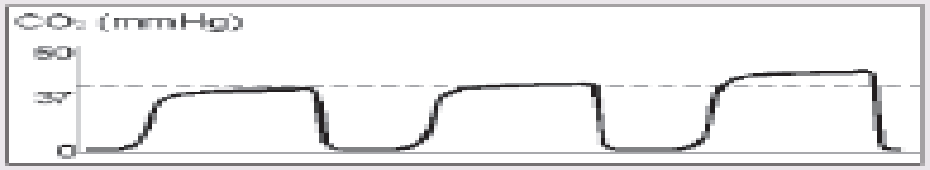
Feline Patient

Normal: 12-18/min

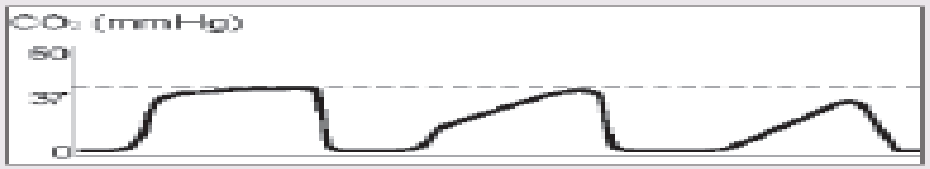
Intervention required: <10 breaths/min

Monitor display

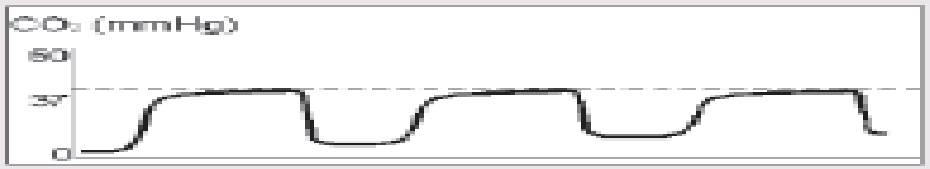
B Increasing $etCO_2$ (hypoventilation)



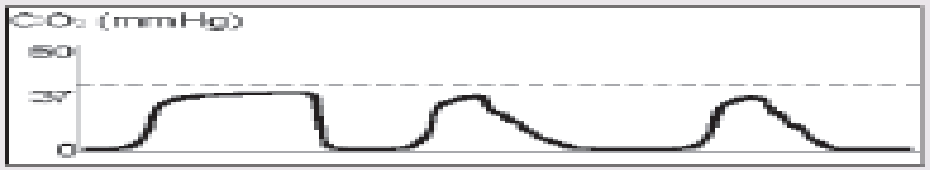
C Abnormal (shark fins) upstroke (airway and/or endotracheal tube obstruction)



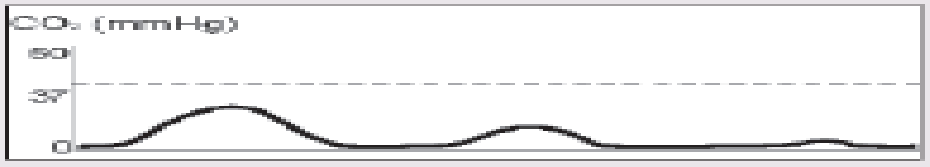
D Baseline does not return to zero (check equipment)



E Abnormal down stroke (check endotracheal tube cuff)



F No carbon dioxide values recorded (apnea, cardiac arrest, airway obstruction, equipment disconnect, esophageal intubation)



End tidal (etCO2) measurements in the anesthetized dog and cat.[7]

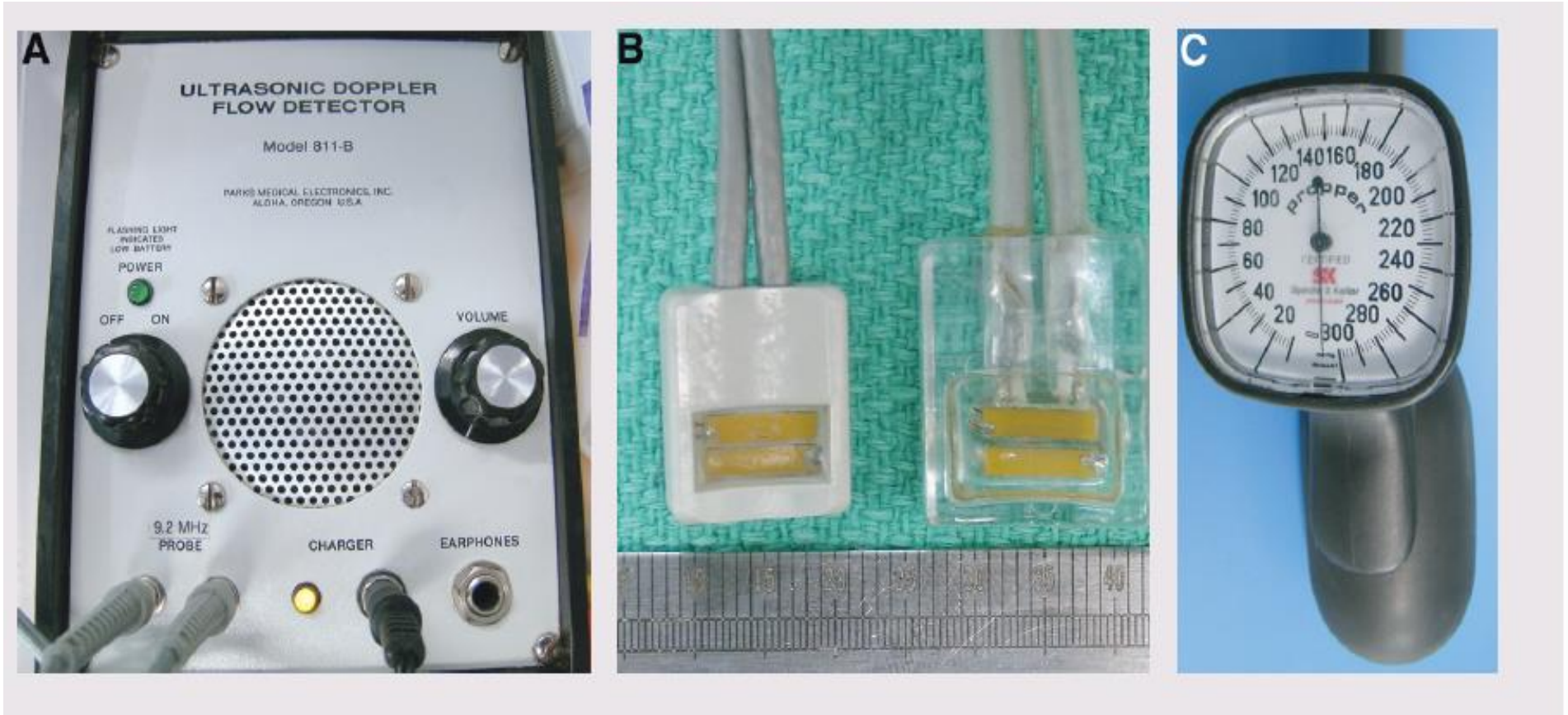
Normal: 35-45 mmHg

Intervention required: < 30 mmHg or > 60 mmHg

Critical: < 25 mmHg or > 70 mmHg

Doppler blood pressure monitoring device

Sphygmomanometer



Post-anaesthetic care

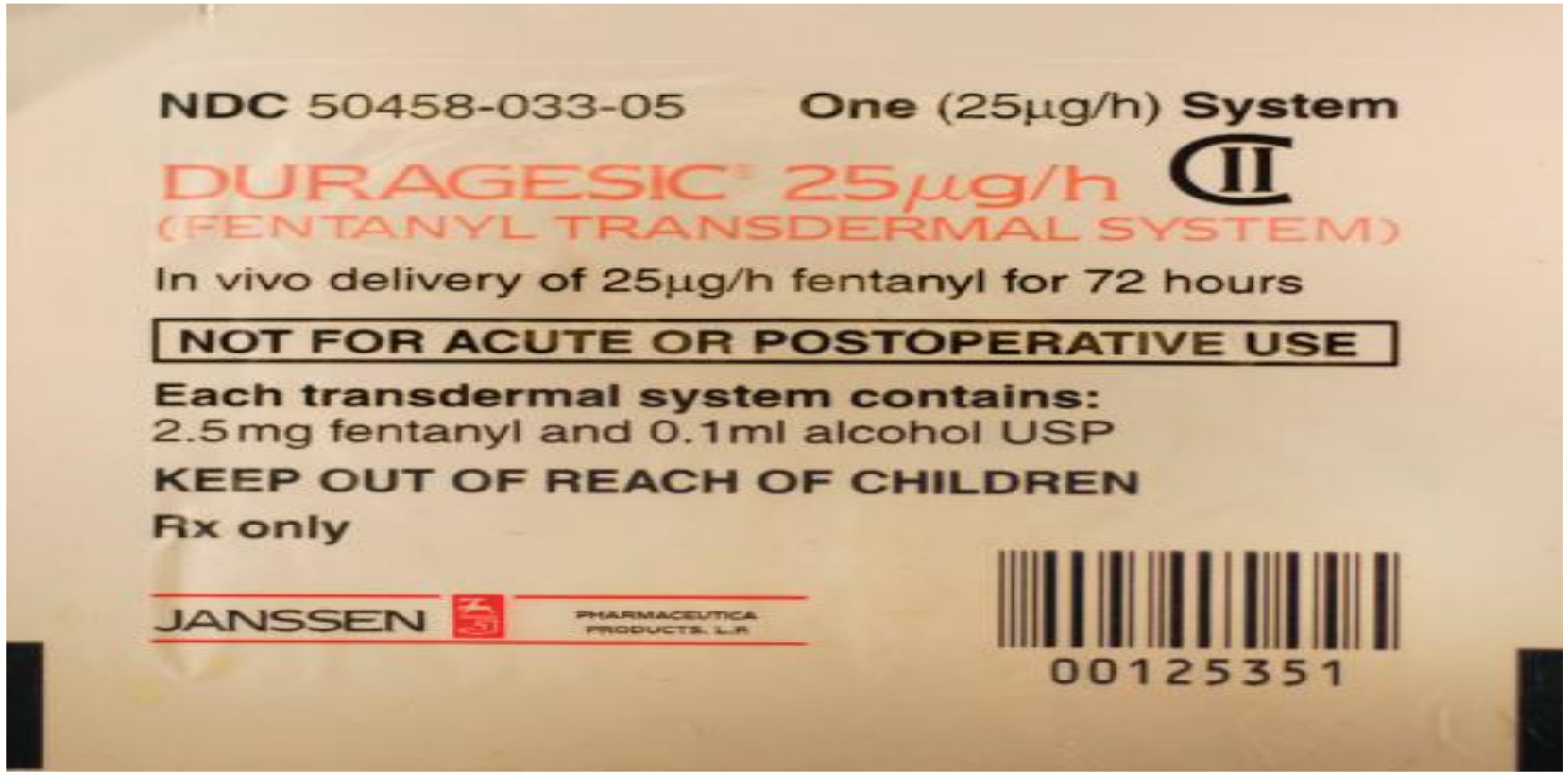
Patients often **still hypoventilate** in the immediate postoperative period because of **residual anaesthetic agents and hypothermia**, which further increases the risk of **hypoxaemia**

Good time for extubation is when **the 'ear flick reflex'** (an ear twitch in response to gentle tickling of the inner pinna) is re-established, which is often slightly before the gag and cough responses to the ETT in situ occur

Enrofloxacin is potentially **retinotoxic** in cats, and can result in acute and diffuse retinal degeneration

Disconnecting the ETT from the anaesthetic breathing system is recommended when changing the patient's position, because **rotation of the ETT** with an inflated cuff can cause tracheal damage

Fentanyl transdermal patch



Medication	Dosage
Bupivacaine	1–2 mg/kg regional block
Buprenorphine	0.005–0.03 mg/kg q 6–8 h SC, IM, IV, sublingual q 6–12 h
Butorphanol	0.2–0.4 mg/kg SC, IM, IV q 2–4 h 0.5–1 mg/kg orally q 6–8 h
Carprofen	1–4 mg/kg SC, preoperatively, then 2 mg/kg orally limit two days
Codeine	0.5–2.0 mg/kg orally q 6–12 h
Fentanyl	25 µg/kg/h transdermal patch Loading dose 1–2 µg/kg IV, then CRI 1–4 µg/kg/h IV
Gabapentin	3 mg/kg orally q 24h
Hydromorphone	0.02–0.05 mg/kg SC, IM, IV q 2–6 h
Ketamine	Loading dose 0.2–0.5 mg/kg IV, then CRI 10–20 µg/kg/min IV during surgery, then 2 µg/kg/min after surgery for up to 18 hours (60 mg ketamine in 1000 mL of Lactated Ringers Solution given at 2 mL/kg/h)
Ketoprofen	1–2 mg/kg IM or SC once, then 0.5–1 mg/kg PO, SC q 24h for a maximum of 5 days
Lidocaine	Maximum 2 mL total dose (0.25–0.5 mg/kg slow IV)
Medetomidine	1.0 µg/kg with equal volume of butorphanol IV (producing heavy sedation and not recommended if planning on proceeding to general anesthesia) Before surgery with atropine + opiate: 5–10 µg/kg IM After surgery used alone: 4–8 µg/kg IM After surgery with opiate: 2–4 µg/kg IM (After surgery, opiate is given at one-half the dose used in premedication; e.g., butorphanol at 0.2–0.4 mg/kg in premedication is used at 0.1–0.2 mg/kg after surgery)
Meloxicam	0.3 mg/kg SC once 0.2 mg/kg orally q 24h × 1 day, 0.1 mg/kg PO q 24h × 2 days (extra-label)
Morphine	0.05–0.2 mg/kg SC, IM q 4–6 h 0.02–0.1 mg/kg IV q 1–4h Postoperatively, CRI 0.1–0.3 mg/kg/h (morphine is delivered in 3–4 mL/kg/h fluids)
Oxymorphone	0.05–0.1 mg/kg SC, IV, q 1–3 h
Piroxicam	0.3 mg/kg PO q 24–72 h for a maximum of 7 days
Tramadol	4 mg/kg orally q 12 h

Mention

Familiarity with both the anaesthetic drug and technique is at least as important in providing ‘safe anaesthesia’ as the choice of a theoretically ideal, but unfamiliar, drug or technique

Equine dentistry

Intravenous catheter in place:

This will make drug administration easier and prevent the administration of the drug **perivascularly or even intra-arterially**

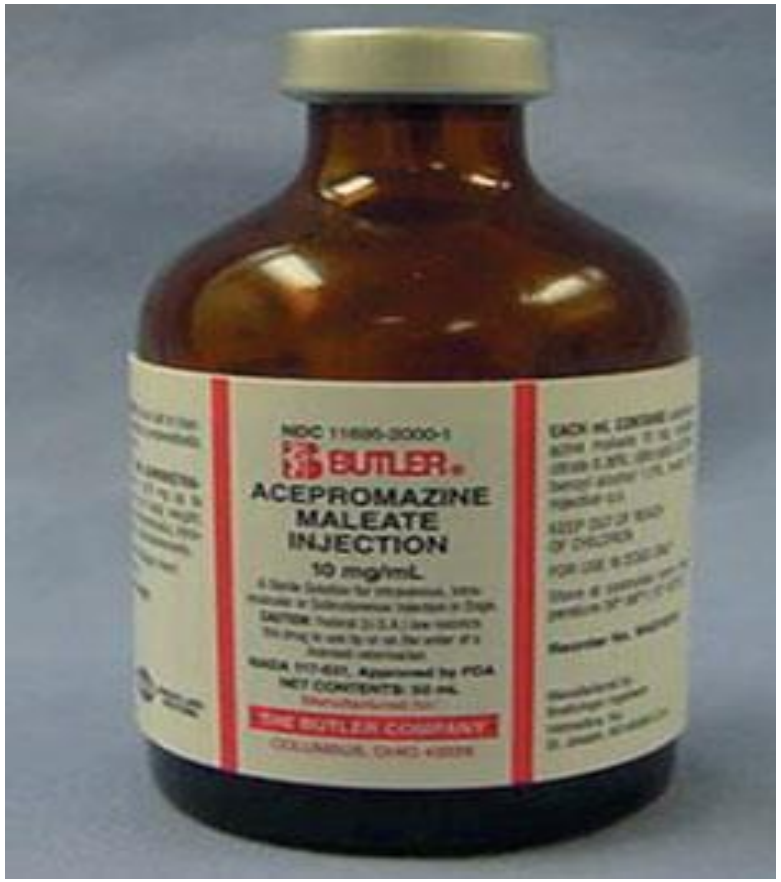
Intravenous catheter can be life saving for the administration of **reversal drugs or intravenous fluid therapy**

An intravenous catheter is mandatory if a constant rate infusion (**CRI**) is used for the sedation technique

Tranquilizers produce calming and behavior modification, but do not have analgesic properties

Sedatives are similar to tranquilizers in that they reduce excitement and induce calming, but in addition provide analgesia

Tranquilizers



It decreases mental alertness by depressing the **reticular activation center** of the CNS

The mechanism of action is centrally mediated via antagonism of the **dopamine-mediated synaptic transmission**

This blockade of dopamine and catecholamines explains how acepromazine can inhibit **opioid-induced excitement** as opioids will enhance the release of dopamine and norepinephrine in the CNS

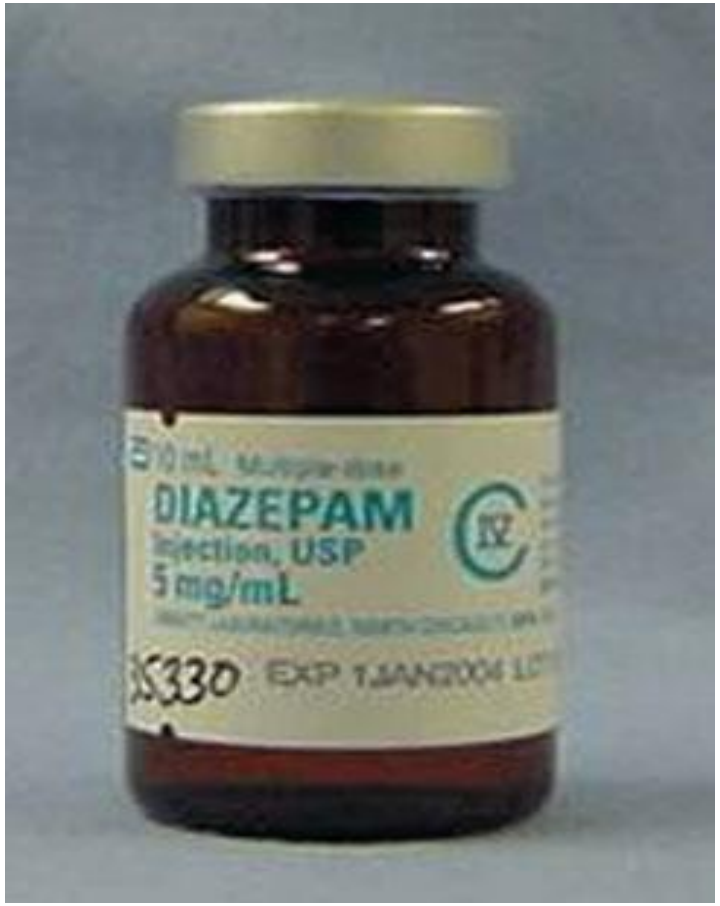
Hypotension is produced by the depression of the hypothalamus, peripheral alpha adrenoceptor blockade, and a direct vasodilatory effect on the blood vessels

Reduction in blood pressure is dose dependent and may produce reflex **tachycardia**, especially in horses with increased catecholamines as may occur with fear or stress

Acepromazine alpha blocking effect allows the **vasodilating beta 2** effects of epinephrine to predominate

Acepromazine has little effect on **blood gas tensions** or pH and no effect on respiratory rate

Diazepam



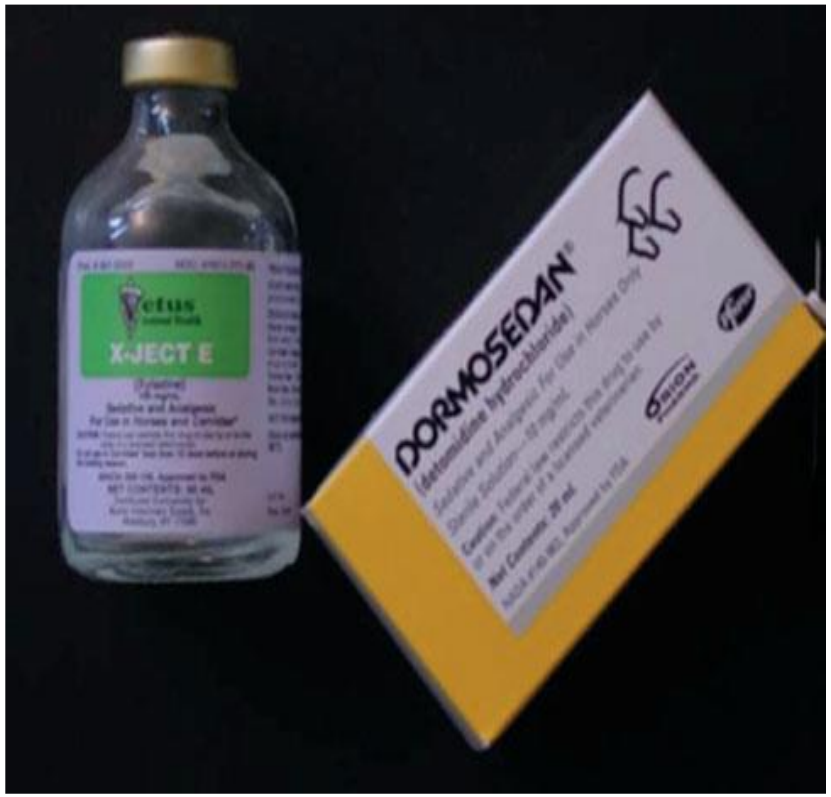
The principal action is in **the brainstem reticular formation** and it produces hypnotic, sedative, anxiolytic, anticonvulsant, and skeletal muscle relaxant effects

There are **minimal** depressant effects on the respiratory and cardiovascular systems

It has been used in combination with **alpha 2 agonists and opioids** as a

one-time injection to enhance relaxation and sedation for standing restraint

Alfa2 adrenoreceptor agonists



Stimulation in the CNS hyperpolarizes neurons and inhibits **norepinephrine and dopamine storage and release**, leading to a decrease in the discharge rate of central and peripheral neurons causing sedation, analgesia, and muscle relaxation

There will be dose-dependent decreases in respiratory rate and tidal volume which will **decrease the minute volume** leading to a decrease in oxygen partial pressure, PaO_2 values

There is a decrease in **pulmonary dynamic compliance**

There can also be marked relaxation of the **nasal alar and laryngeal muscles** predisposing to upper airway obstruction and respiratory stridor in some horses

The **cough reflex** is suppressed which can increase the danger of accumulation of foreign material in the trachea which is an important consideration in horses undergoing oral procedures

Alpha 2 agonists

Xylazine and detomidine produce a rapid and significant decrease in heart rate that is secondary to an increase in **vagal tone** and the decrease in CNS sympathetic output

The vagal reflex is from baroreceptor response to **hypertension**

The incidence of **atrioventricular block** is more persistent with detomidine

Stroke volume remains relatively unchanged but **cardiac output** decreases markedly

This hypertension is related to the stimulation **of alpha 1 and 2 receptors** on the vascular smooth muscle, resulting in arteriolar and venular constriction, which is then followed by a more prolonged decrease in blood pressure

Central alpha 2 adrenoceptors play a major role in the hypotensive effects of the alpha 2 agonists

Alpha2 agoniats

Xylazine is known to potentiate and increase the sensitization of the myocardium to catecholamines during halothane anesthesia

Analgesia from xylazine or detomidine generally lasts one-half to two-thirds the duration of sedation

The mechanisms of alpha 2 agonist-induced diuresis include increased glomerular filtration rate, inhibited antidiuretic hormone release, inhibited antidiuretic hormone response by renal tubules, and increased release of atrial natriuretic factor

All doses of alpha 2 agonists can produce ataxia. This is marked after high doses of xylazine and detomidine, but there is considerably less ataxia with **romifidine**

Romifidine induced a sedative effect that was **less clearly dose-dependent**

Medetomidine appears to be a more potent analgesic than detomidine in horses, but causes less severe physiological alterations

Opioids

The **mu receptor** is responsible for potent analgesic effects, supraspinal analgesia, for mediating respiratory depression, miosis, and sedation but also for side-effects such as excitement

Kappa receptors contribute less intense analgesic effects than mu agonists

Heart and respiratory rates did not change significantly after administration of **butorphanol**

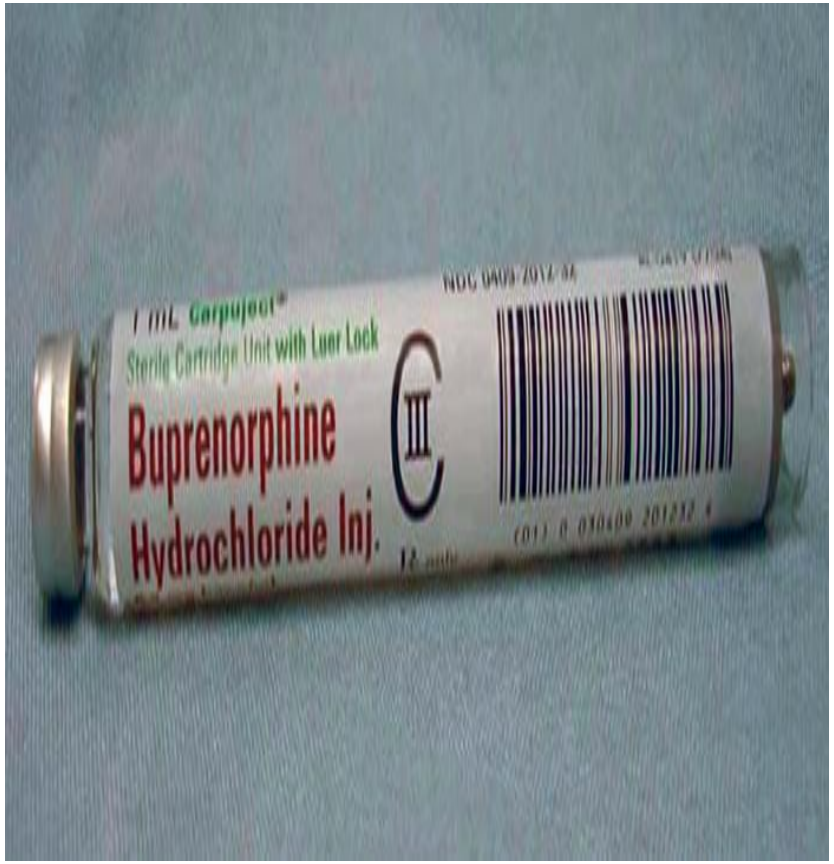
Opioid agonists produce analgesia at **low doses** but do not induce calming or sedation, and may increase the horse's response to sound, movement, and touch

They have profound effect when they are combined with **sedatives and tranquilizers**

Butorphanol, an agonist–antagonist, produces minimal effect on intestinal transit time and will reverse the effect of a previously administered mu agonist

Opioids should not be given to nonpainful horses without prior use of a sedative agent

Buprenorphine



Buprenorphine has **partial mu agonist effects**. It has minimal effect on the cardiovascular system and appears not to cause sedation by itself so it has been used in **combination with alpha 2 agonists**

Combinations

Neuroleptanalgesia refers to a combination of a tranquilizer or sedative combined with an opioid; it is characterized by two features, inattentiveness to the surrounding environment and profound analgesia

Xylazine and acepromazine is a common combination

Acepromazine will enhance the effect of the alpha 2 agonists but without the profound effects of an opioid
Xylazine at 0.55 mg/kg and acepromazine at 0.05 mg/kg has minimal hemodynamic and respiratory effects

Adding an opioid such as butorphanol to an alpha 2 agonist will produce profound and predictable sedation in **standing horses**

When using xylazine and morphine, give the morphine only **after** the horse is sedated from the xylazine
Xylazine at 0.66 mg/kg and morphine at 0.66 mg/kg is a safely used combination

Because xylazine does not last as long as morphine, as it wears off there may be some CNS excitement that can be treated with an additional dose of xylazine

Combinations

Detomidine lasts longer than xylazine so there is less likelihood of seeing excitement in a detomidine–opioid combination

Acepromazine can be added to the alpha 2-opioid combination to increase the degree of sedation and to smooth the return to normal consciousness

Alpha 2 agonists and opioids inhibit cholinergic and noncholinergic **airway constriction**

Ponies with COPD show a significant improvement in pulmonary function after intravenous administration of xylazine (0.5 mg/kg) and adult horses have no significant change in dynamic compliance of the lung after xylazine sedation (0.6 mg/kg)

The combination of romifidine and butorphanol provided better sedation than the combination using morphine

It is unwise to **antagonize** the alpha 2 agonists, xylazine, detomidine, romifidine, or medetomidine, when they are used in combination with moderate to large doses of opioid analgesics

Infusions

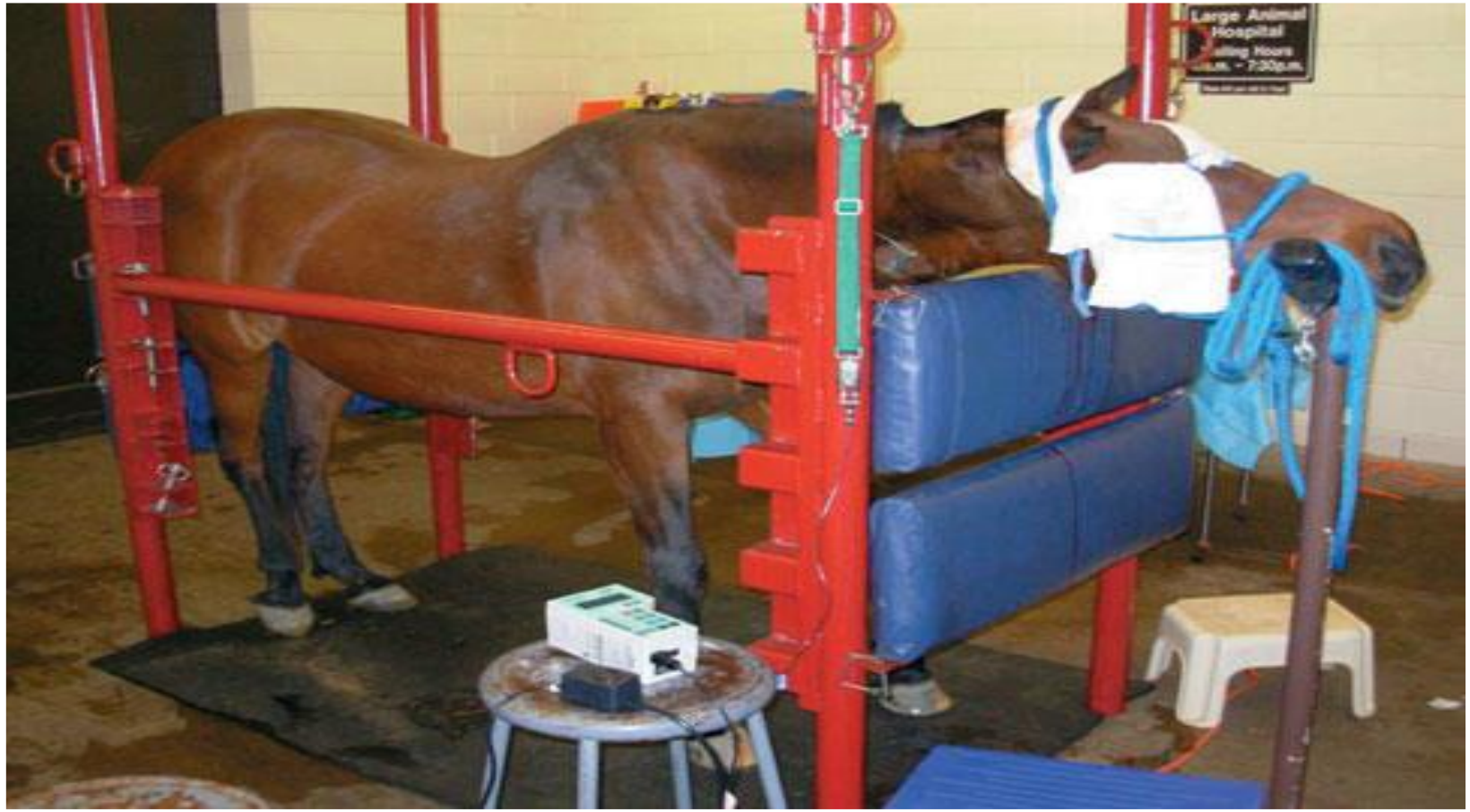
Providing sedation by CRI is one method of overcoming the **negative side-effects** of alpha 2 agonists

The combination of detomidine and buprenorphine has been used in horses and ponies for **standing laparoscopic surgery**

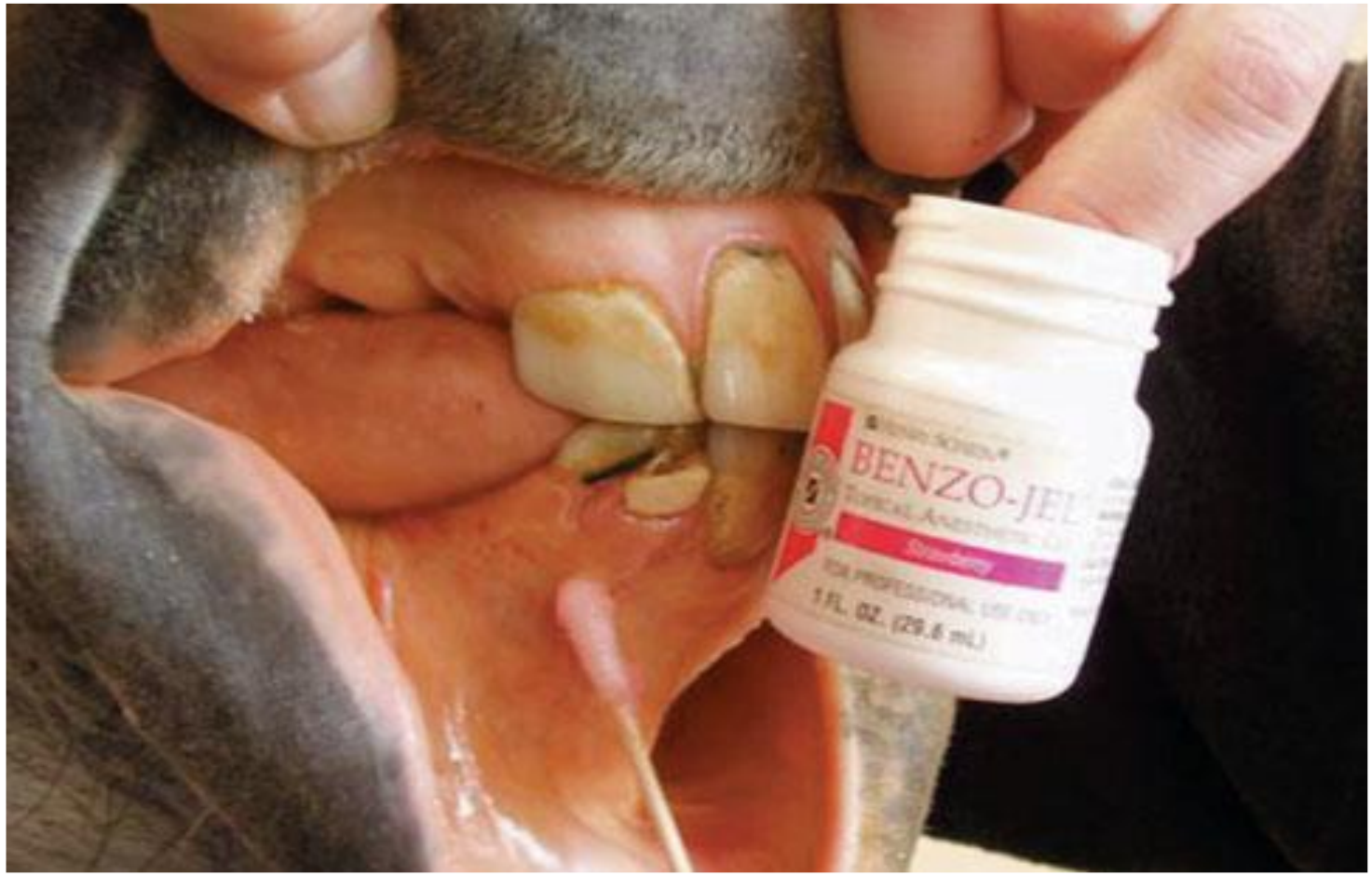
Deep sedation could lead to locomotor instability and this may be interpreted as **inadequate sedation**

Example: 500 kg horse at 0.4 mg/kg of ketamine = 200 mg of ketamine.
Fluid maintenance at 1 mL/kg/hr, so 500 mL/hr, a 5 L bag will last 10 hours.
200 mg of ketamine × 10 hours = 2000 mg of ketamine or 20 mL of ketamine added to the fluid bag.[28]

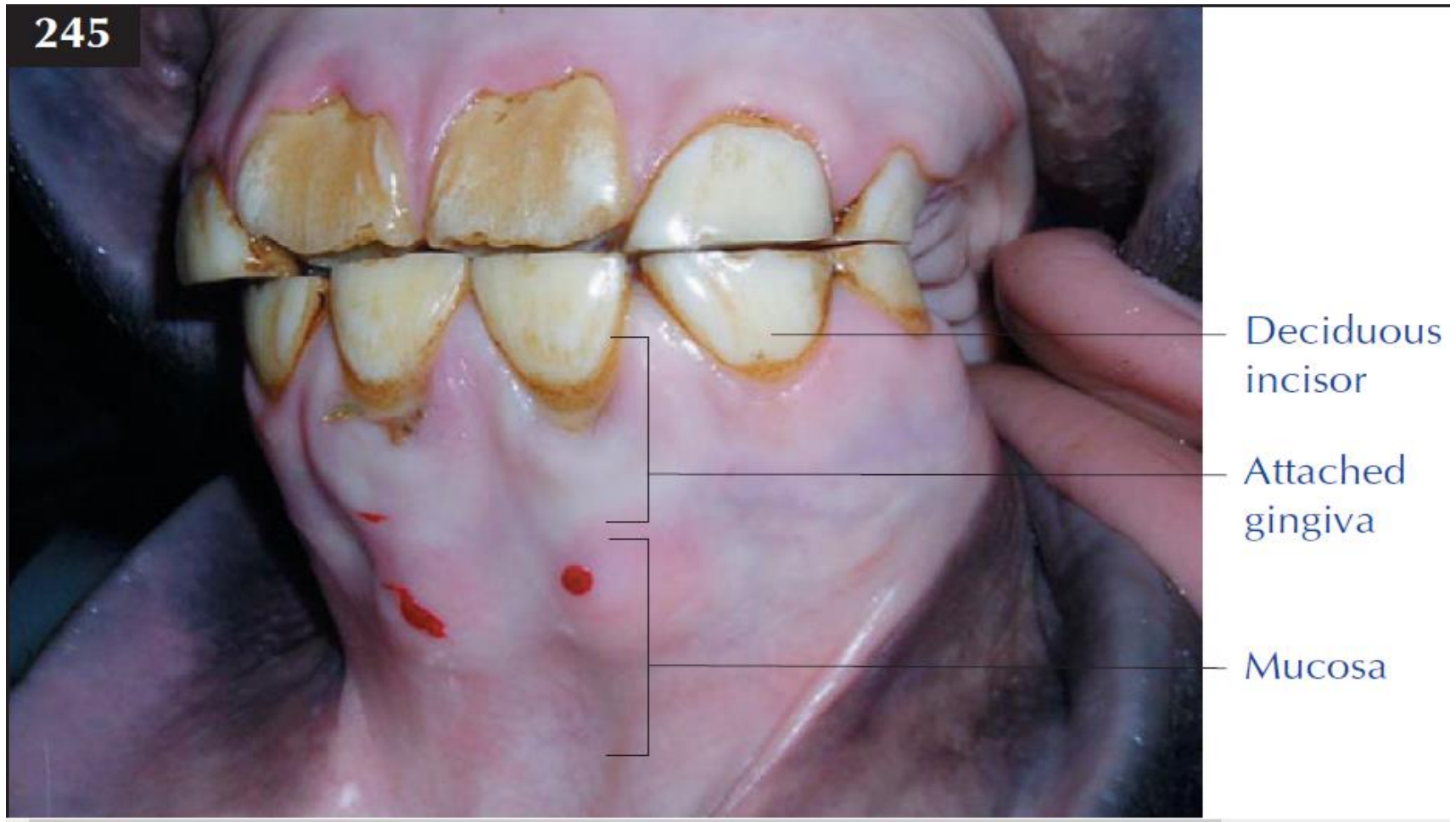
Padded head support is shown along with a syringe pump for CRI



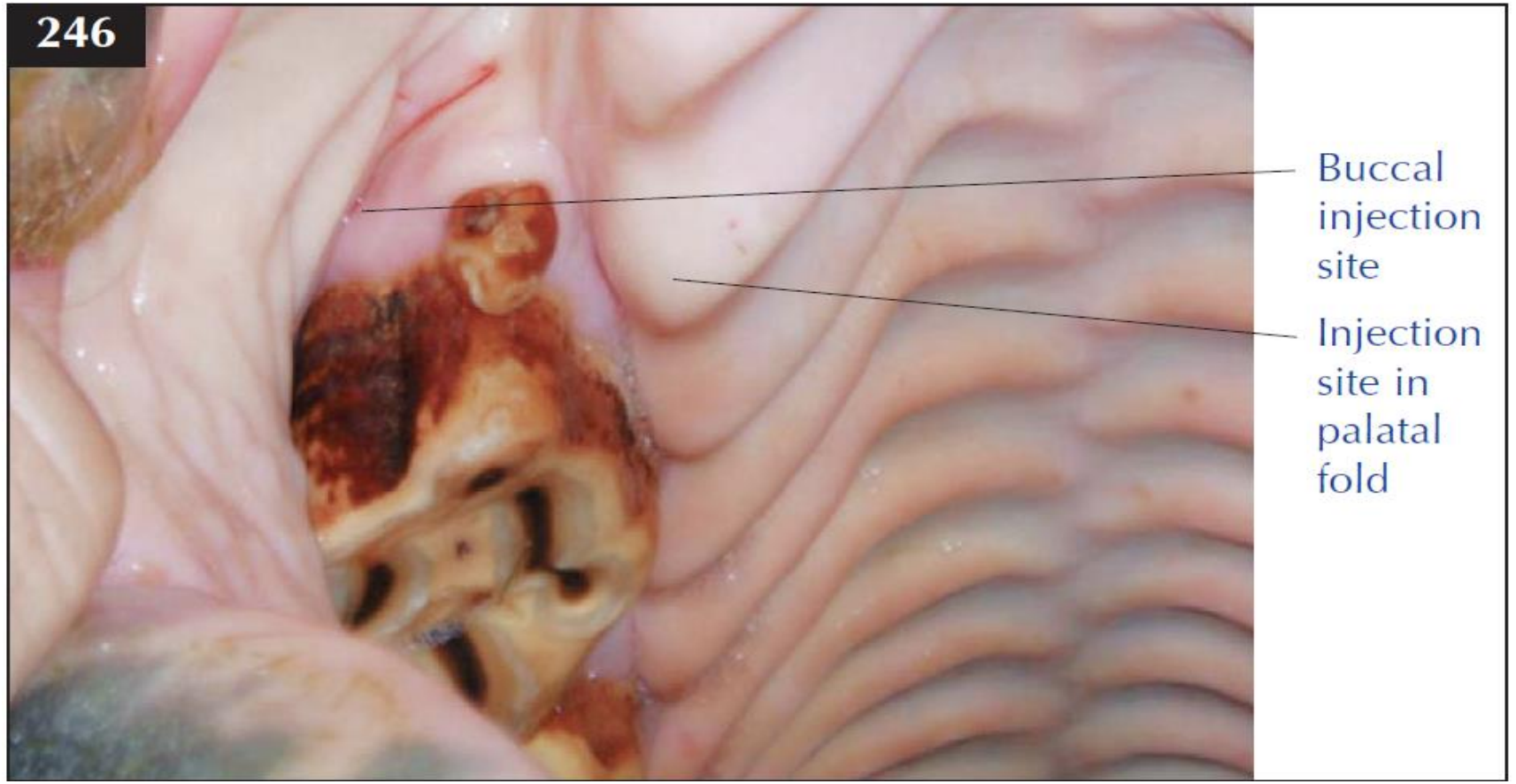
Topical application of benzocaine gel facilitates needle placement



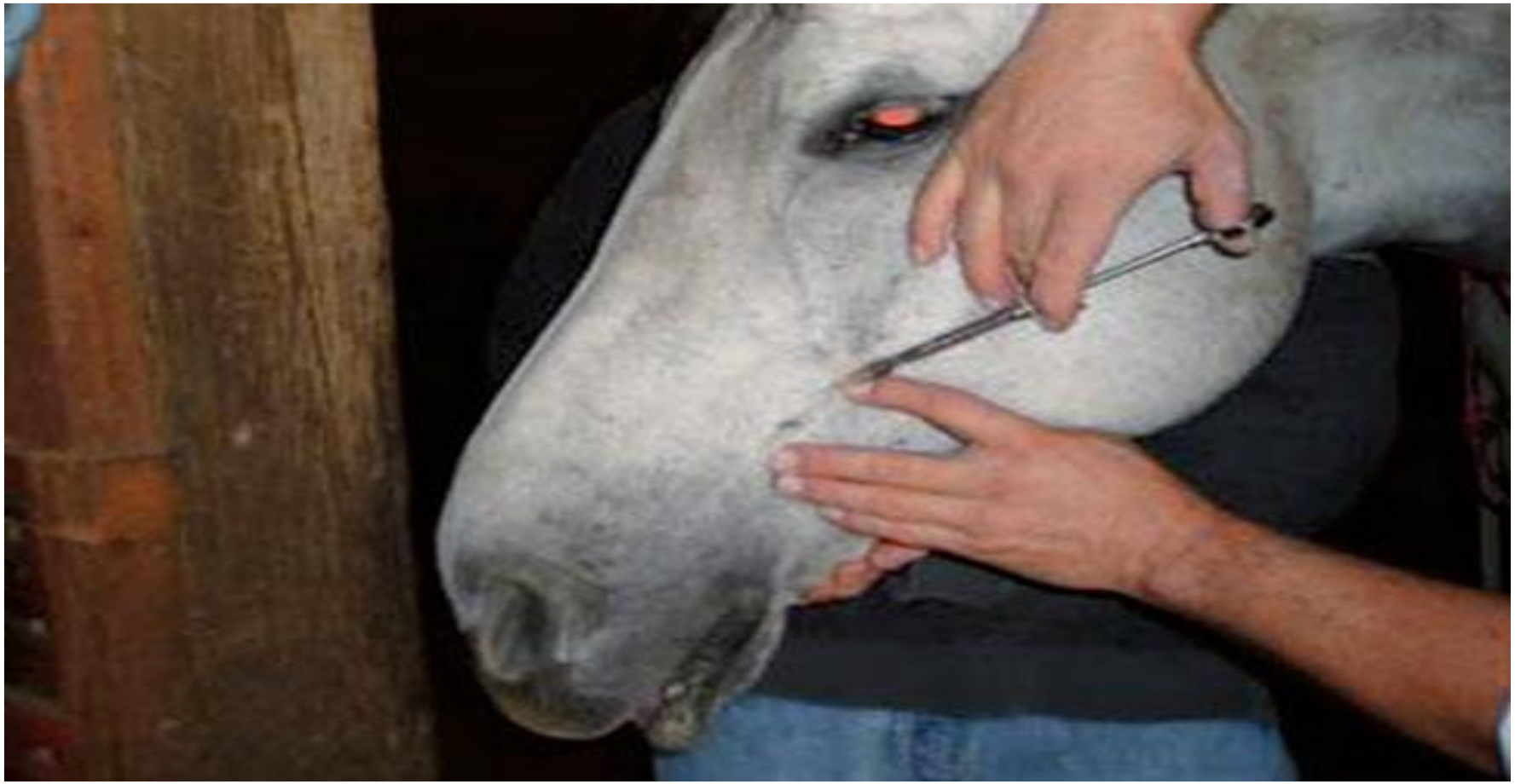
Submucosal injection site for supraperiosteal infiltration of local anesthetic agent



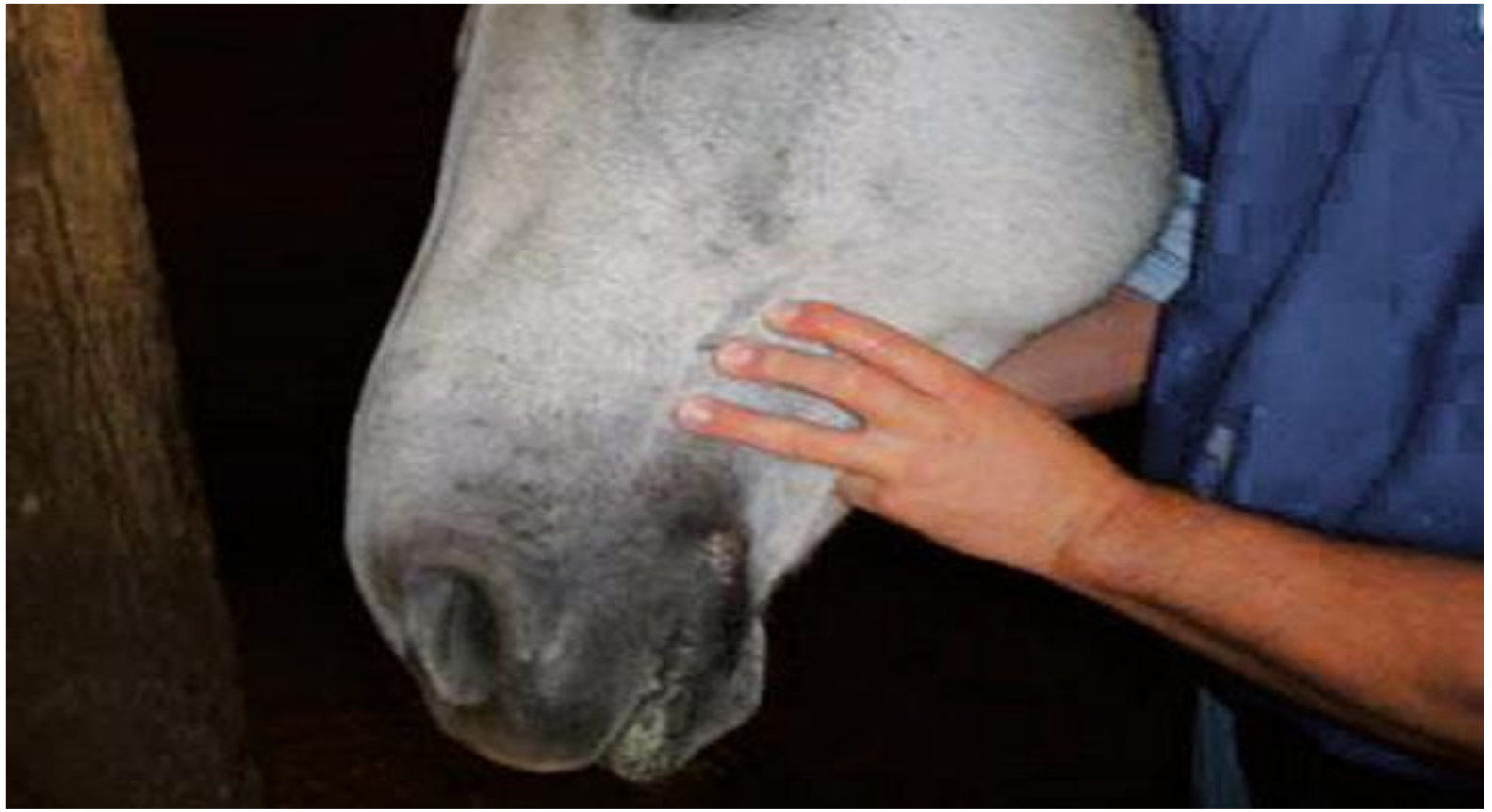
Palatal and buccal submucosal injection sites for infiltration of local anesthetic agent



Subcutaneous injection is used to block the pulp and periodontium of the upper left fourth premolar



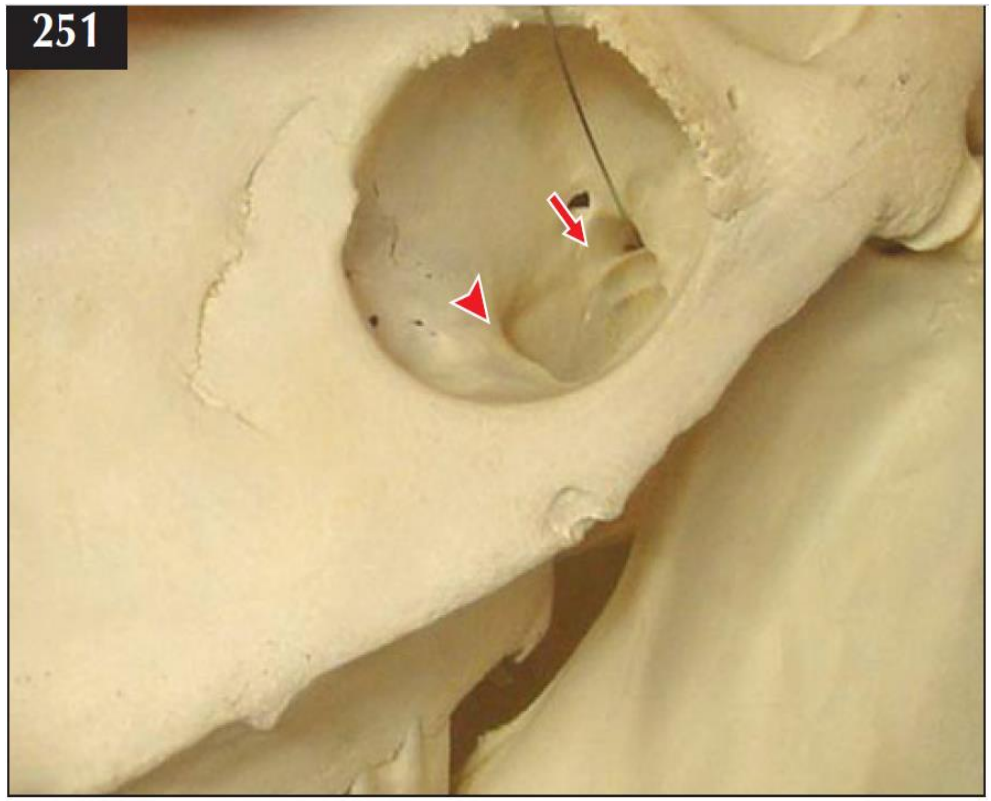
Subcutaneous injection of anesthetic can be used to desensitize teeth in geriatric patients. The dorsal reflection of the vestibule at the locations of the three premolars

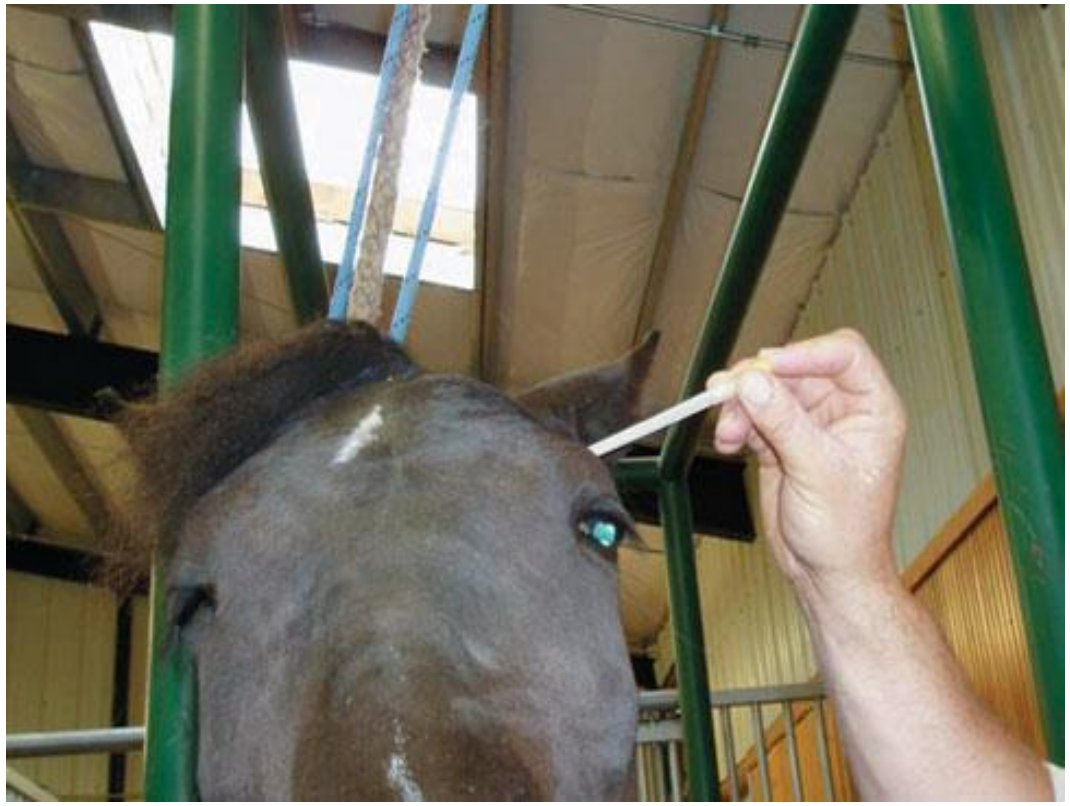


Open barrel syringes, a compule of anesthetic agent, and the threaded needle

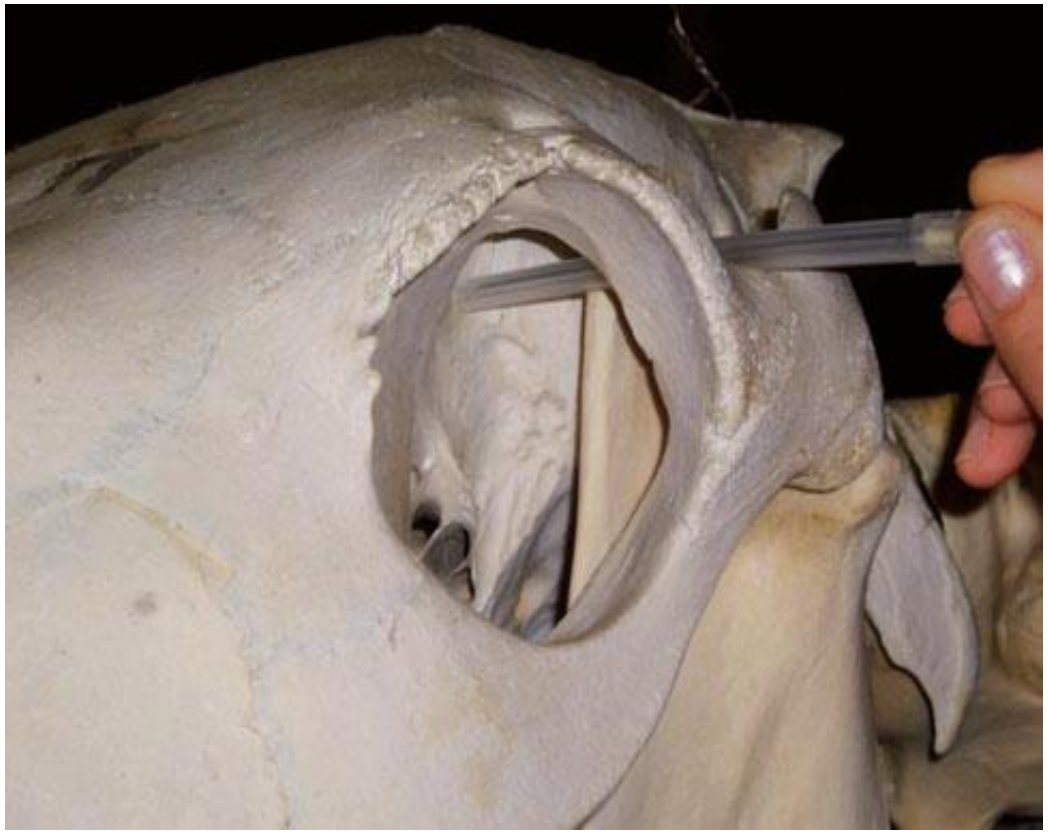
foramen rotundum

maxillary foramen

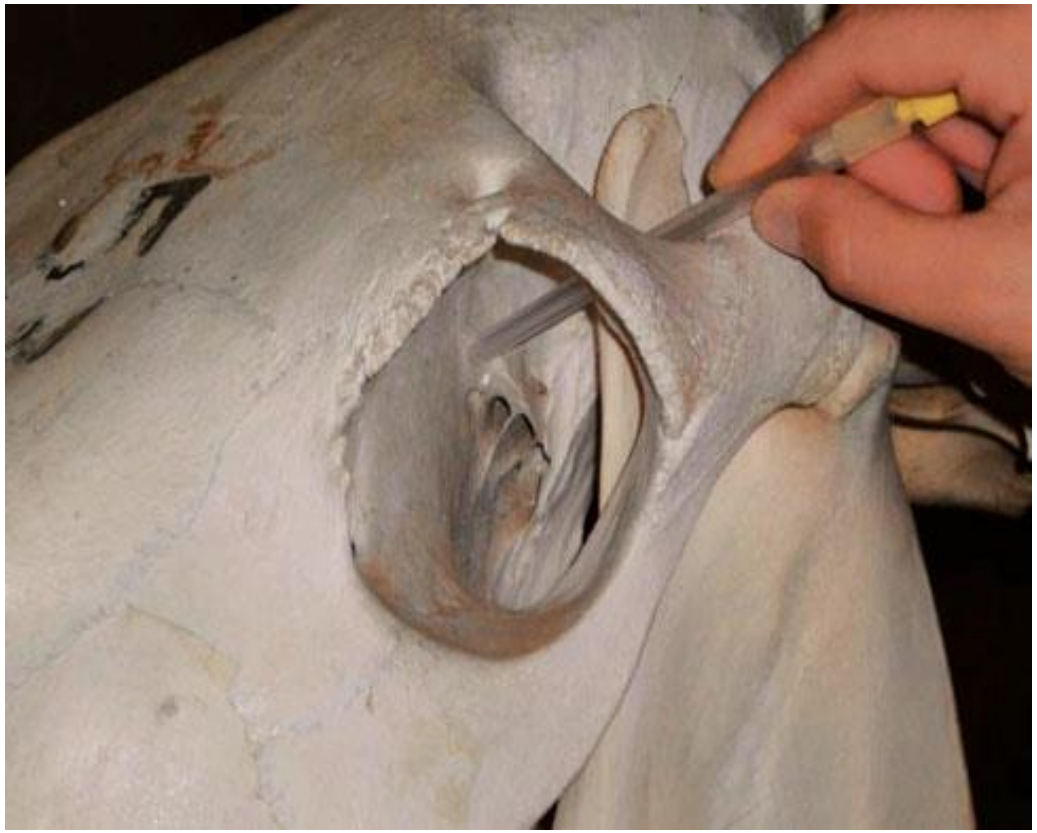




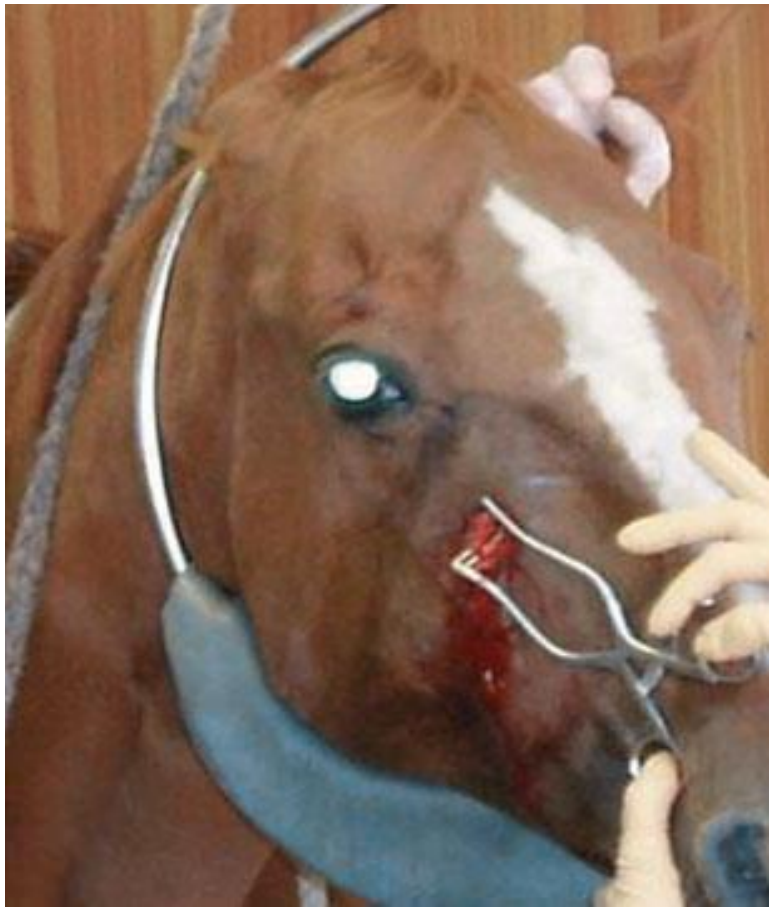
pterygoid fossa



foramen rotundum



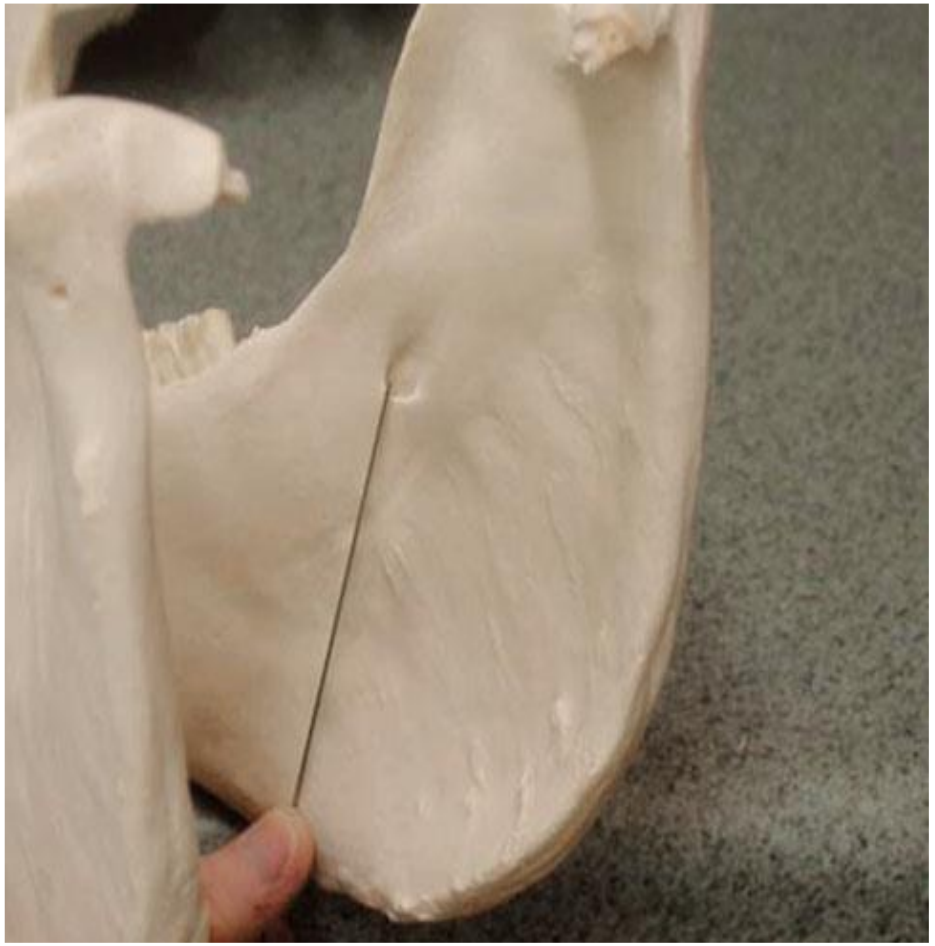
Pupil dilation



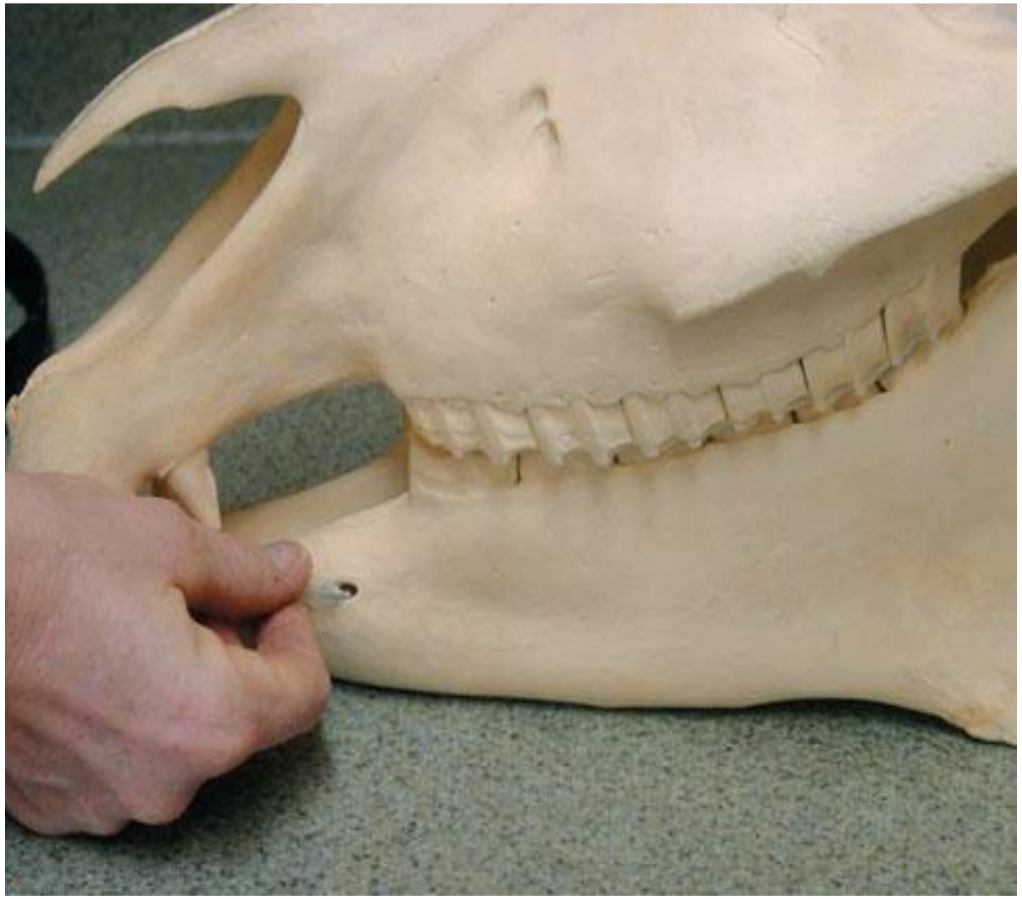
maxillary nerve block

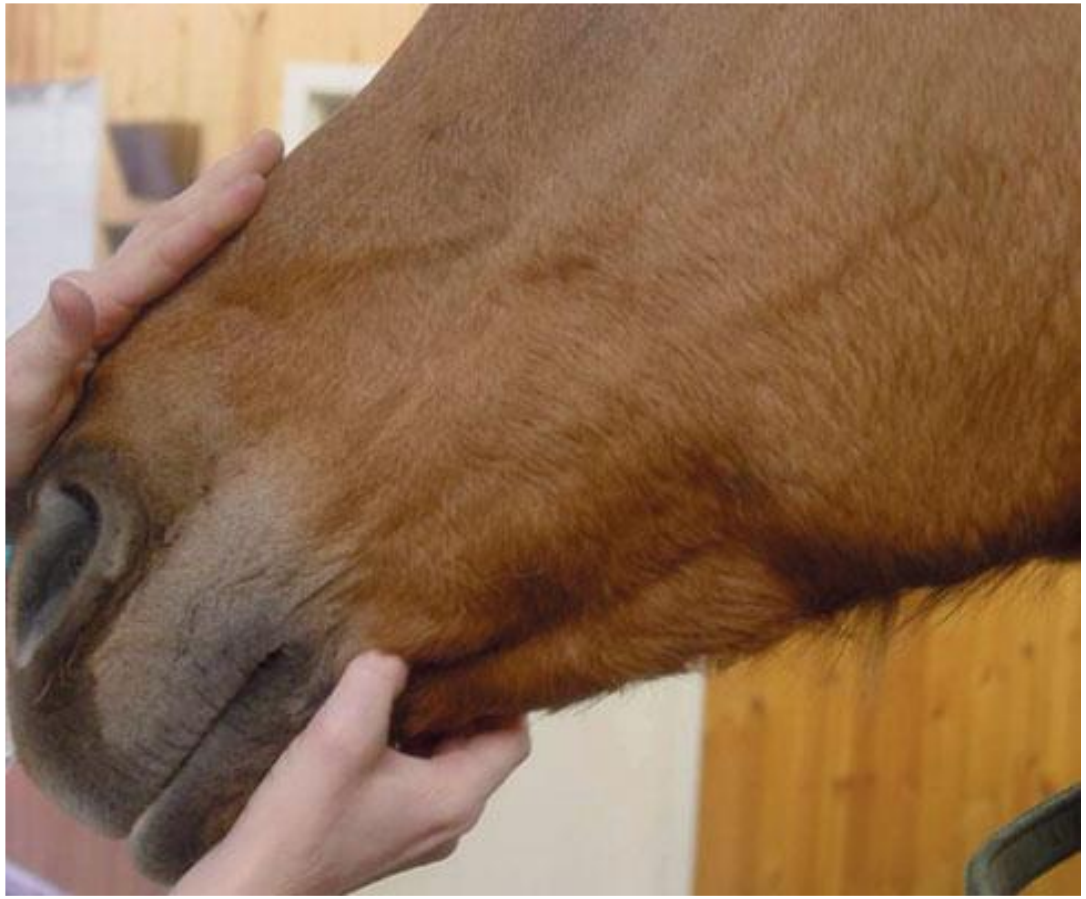
Infraorbital foramen

Mandibular foramen



Mental foramen





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