A VN’s anaesthesia role: premedication and monitoring

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Nurses have an important role in every aspect of anaesthesia. Part one of this article (VNT15.09) discussed the preparation of equipment and patient assessment. Part two discusses premedication, monitoring and recovery from anaesthesia.

Premedication

Figure 1. A properly trained veterinary nurse is the most important monitor for patients under anaesthesia. Image: AHT.

Nurses are commonly expected to prepare and administer premedications (under the direction of a vet) and, as such, a good understanding of the objectives of premedication and the drugs used is highly beneficial. The objectives of administering premedication are to:

- Reduce anxiety and stress: reduced anxiety and sedative effects aid IV catheter placement and allows for a calm induction of anaesthesia. This creates a more pleasant experience for the patient and anaesthetist.

- Reduce the amount of anaesthetic agents required: many drugs used for premedication will significantly reduce the amount of the induction and maintenance agents. As the side effects of most anaesthetic drugs are dose-dependent, being able to use less induction and maintenance agent means fewer pronounced side effects.
- Provide analgesia: pre-emptive analgesia (administering analgesia before the painful stimulus occurs) reduces a patient's response to pain. It also makes pain much easier to control than administration after the painful stimulus has already occurred.
- Help provide a smooth recovery from anaesthesia: many drugs used for premedication will last into the recovery period, aiding a smooth, calm recovery. This is not only pleasant for the patient, but also ensures it does not injure itself or cause surgery site trauma.

Drug classes commonly used for premedication include phenothiazines, alpha-2 agonists, opioids and benzodiazepines.

Phenothiazines

Table 1. Advantages and disadvantages of acepromazine

Advantages	Disadvantages
Good anxiolytic	Vasodilation and subsequent hypotension
Antiemetic	Hypothermia
Antiarrhythmic	Reduces platelet aggregation
Weak antihistamine	Cannot be reversed
Long duration of action	Long duration of action
	Boxer sensitivity (lower doses usually used)

Table 1. Advantages and disadvantages of acepromazine.

Phenothiazines provide sedation and reduce anxiety (anxiolysis). The licensed phenothiazine in the UK is acepromazine (ACP), which is administered by IM or IV injection. It is long acting (six to eight hours) and its sedative effects are enhanced when combined with opioids.

ACP is unsuitable for some patients – especially those that are hypovolaemic or have coagulopathies. Giant breeds are more sensitive to the effects than others, so lower doses are

usually used in these breeds. Adverse effects (syncope) have also been reported in some boxers, so lower doses are used (**Table 1**).

Alpha-2 agonists

Xylazine, romifidine, medetomidine and dexmedetomidine are the alpha-2 agonists licensed for use in the UK for small animals. They cause dose-dependent sedation, which can be profound at high doses, and provide additional analgesia. Doses required for premedication are much lower than those for heavy sedation. They can be administered by IM or IV injection.

Alpha-2 agonists have profound dose-dependent cardiovascular effects, meaning their use is reserved for healthy patients. Duration of action is dose-dependent, but generally short, and the effects can be antagonised by administration of atipamezole (medetomidine and dexmedetomidine). Premedication with alpha-2 agonists dramatically reduces the doses of induction and maintenance agents.

Benzodiazepines

No benzodiazepines are licensed for animals use. Their main advantage is providing good anxiolysis and muscle relaxation with minimal cardiovascular effects. They may reduce the amount of induction and maintenance agents required.

In healthy patients, administration of benzodiazepines often causes unwanted excitement (even when combined with an opioid), meaning they are best reserved for neonatal or “sick” patients.

Opioids

Full mu opioid agonists (methadone) provide excellent analgesia and excellent pre-emptive analgesia. Partial mu opioid agonists (buprenorphine) may also be used for procedures requiring mild to moderate analgesia. Opioids can be used alone – particularly in patients where other sedatives may be contraindicated – but are more commonly combined with a sedative such as ACP or medetomidine to enhance their sedation.

NSAIDs

NSAIDs can also be administered as part of the premedication to provide pre-emptive analgesia. They provide good analgesia, but their potential side effects mean they should only be administered preoperatively in healthy patients. They are contraindicated in patients with renal disease and hypovolaemia. Only some NSAIDs are licensed for perioperative use – for example, meloxicam and carprofen.

Monitoring

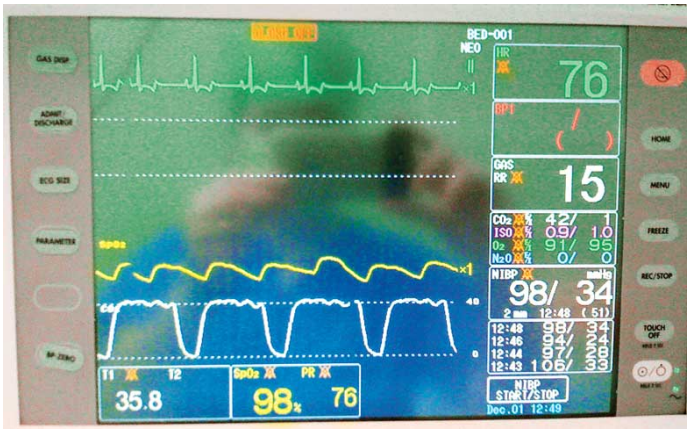

Figure 2. A multiparameter monitor. Note the green ECG trace and heart rate at the top, yellow pulse trace from the pulse oximeter and SpO_2 reading and white capnograph trace with $ETCO_2$.

A properly trained VN is the most important monitor (**Figure 1**). Hands-on techniques should not be abandoned due to a multiparameter monitor. All monitoring methods available should be used to build up a complete picture of what is happening (**Figure 2**). Basic vital signs must be monitored, including respiratory rate, depth and pattern, peripheral pulse rate and quality, and body temperature. Extra monitoring equipment may allow you to monitor blood pressure, haemoglobin saturation, inspired and expired carbon dioxide (CO_2) and the electrical activity of the heart (ECG).

To monitor depth of anaesthesia, suppression of reflexes, such as the cranial nerve reflexes (palpebral reflex), peripheral nerve reflexes (anal tone) and muscle relaxation (jaw tone, eye position), can all be used. Monitoring autonomic functions, such as respiratory rate, heart rate and blood pressure, can give an indication of anaesthetic depth, although these are not specific and can be affected by other factors.

Body temperature

Anaesthetised animals cannot thermoregulate and temperature monitoring should be performed in every patient. Steps should be taken to prevent hypothermia. Hypothermia under anaesthesia and in the recovery period is significant due to many well-established side effects.

It has a central depressant effect reducing the amount of inhalation agent required, prolonging drug metabolism and recovery from anaesthesia, causing reduced ventilation and interfering with haemostasis and increasing wound healing/infection rates.

Cardiovascular monitoring

Peripheral pulses should be palpated preferentially as they are more sensitive to changes in IM volume compared to central pulses. Reduced or poor pulse quality probably indicates peripheral vasoconstriction due to hypovolaemia, haemorrhage, hypothermia or fear. The pulse rate should be counted to ensure it matches the heart rate to check for pulse deficits seen with arrhythmias.

Heart rate and rhythm

Heart rate and rhythm can also be assessed using an oesophageal stethoscope or ECG. Oesophageal stethoscopes are simple and easy to use, allowing the heart to be heard from a distance when the thorax is otherwise inaccessible. An irregular heart rhythm may be heard, but an ECG will be required to identify arrhythmia.

It is important to remember oesophageal stethoscopes and ECGs used alone provide no information on tissue perfusion or cardiac output. Bradycardia is a heart rate of less than 50bpm to 60bpm in dogs and less than 100bpm to 120bpm in cats, although comparing the heart rate before and during anaesthesia is more useful to determine its significance.

Bradycardia is common under anaesthesia due to the cardiovascular depressive effects of anaesthetics. Bradycardia should be treated if it is causing hypotension. Other causes of bradycardia may include the use of alpha-2 agonists, hypothermia and vagal stimulation. Tachycardia may be caused by inadequate anaesthetic depth, pain, shock, haemorrhage and arrhythmias. Tachycardia reduces cardiac output and myocardial oxygenation so should be treated.

Mucous membrane colour and capillary refill time

Examining mucous membrane colour provides a crude assessment of tissue perfusion and oxygenation. Pale mucous membranes or prolonged capillary refill time indicates vasoconstriction due to alpha-2 agonist use, shock, anaemia or haemorrhage, but should be used along with assessment of other parameters.

Blood pressure

Blood pressure is dependent on cardiac output and systemic vascular resistance. The former is dependent on heart rate and stroke volume. If either one of these decreases then the cardiac output decreases. Mean arterial blood pressure (MABP) in the range of 60mmHg to 150mmHg allows blood flow to the brain and kidney to be auto-regulated, keeping them adequately perfused. When MABP falls below about 60mmHg (hypotension), tissue perfusion is reduced and organ damage may occur, with the kidneys and brain especially susceptible.

Blood pressure is often linked to depth of anaesthesia, with decreasing blood pressure corresponding to a deepening plane of anaesthesia. Hypotension under anaesthesia can occur for

many reasons, but in most patients is likely due to excessive anaesthetic depth. If a patient is hypotensive under anaesthesia, the VN should assess anaesthetic depth and reduce it, if possible, before discussing additional steps with the vet such as intravenous fluid therapy. Other causes of hypotension under anaesthesia include haemorrhage, severe bradycardia and sepsis.

Pulse oximetry

A pulse oximeter indicates the percentage of haemoglobin saturated with oxygen. It is useful for patients with lung/pleural space disease or in the recovery period when the patient is breathing room air and to detect equipment problems such as inadequate oxygen supply.

It is important to remember the pulse oximeter is a late indicator of hypoxaemia – especially if the patient is breathing 100 per cent oxygen. Vasoconstriction of tissue will often prevent a reading from being obtained. The probe should be placed across any well-perfused area of tissue (such as the tongue, pinna or prepuce).

Remember, the peripheral capillary oxygen saturation reading is only reliable when the pulse oximeter is displaying a heart rate or plethysmograph trace that corresponds to the pulse rate (check by palpation).

Respiratory monitoring

It is important the respiratory system is monitored closely under anaesthesia as anaesthetic agents cause dose-dependent respiratory depression.

Ventilation can be assessed by observing the patient's respiratory rate, depth and character, and by use of capnography. The respiratory character should be assessed by observing the chest throughout anaesthesia.

Capnography

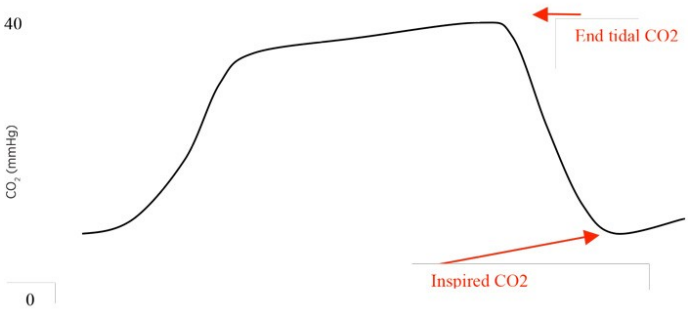

Figure 3. A normal capnograph trace showing one breath.

Capnography measures CO_2 levels in the breath throughout the ventilatory cycle. The CO_2 levels are represented as a wave form (capnograph) and the CO_2 at the end of expiration is displayed as the end tidal carbon dioxide ($ETCO_2$). In patients with normal lung function, the $ETCO_2$ closely reflects the arterial partial pressure of CO_2.

The capnograph is primarily used as a respiratory monitor and, where a patient hypoventilates, the $ETCO_2$ will increase, leading to hypercapnia (increased CO_2 in the blood). As the lungs are reliant on cardiac output and circulation to bring the CO_2 to the lungs for excretion, capnography can also be used indirectly as a guide to cardiac output (**Figure 3**).

Normal $ETCO_2$ is 35mmHg to 45mmHg, although under anaesthesia 45mmHg to 55mmHg is not uncommon and is generally well tolerated.

Recovery from anaesthesia

Recovery is one of the most critical anaesthesia periods and patients should continue to be monitored in the postanaesthetic period. The level of monitoring required depends on the animal's health and the procedure. Patients should be in continuous view until recovered.

Healthy animals that have undergone simple procedures still require continuous one-to-one monitoring, at least until the trachea has been extubated and the patient is raising its head. After that, the animal should still be in view of staff, kept warm and made comfortable in a calm, stress-free environment.

The most important parameters to monitor are ventilation, cardiovascular status, level of consciousness and temperature. These should be monitored every 5 to 10 minutes initially, with the frequency reduced over time.

Good communication is vital and instructions, including analgesia and fluid therapy, should be clearly written.

A nurse's role in anaesthesia – assessing pre-anaesthetic and preparation advice (part 1)