

## Canine Catch-Neuter-Return (CNR) Good Practice Guides

### Good standards of practice in anaesthesia and analgesia - Anaesthetic monitoring

#### Learning Outcomes:

1. Explain why the dog's airway must be monitored during anaesthesia
2. State the normal respiratory rate and heart rate for a dog
3. Explain how to use heart rate, peripheral pulse rate and quality and capillary refill time to assess the circulation of the dog during anaesthesia.
4. State four nerve reflexes which can be used to assess depth of anaesthesia
5. Detail the difference in heart rate, respiratory rate and nerve reflexes for adequate, light, pain and deep anaesthesia in a dog.
6. Explain how often dogs should be monitored when anaesthetised and why general anaesthetic monitoring sheets are useful.

Anaesthetic monitoring starts from the moment of anaesthesia induction and continues until the dog is conscious in recovery. This is because when anaesthetised, dogs are unable to protect their airway, regulate their body temperature, and the anaesthetic drugs used will affect the cardiovascular system. Anaesthetic monitoring is an area that is often overlooked, when the focus is on surgery once in the operating room. It is important to recognise that inadequate anaesthetic monitoring is a risk factor for anaesthetic death in dogs, and may also result in welfare compromise if the dog does not receive adequate anaesthesia.

In many parts of the world, anaesthesia is induced and monitored by para-veterinarians, community-based animal health workers, or veterinary assistants, under veterinary supervision. Regardless of the situation or location, it is important that there is:

- a) A dedicated person to monitor anaesthesia
- b) That person must have received adequate training in assessing the depth of anaesthetic, administering anaesthetic drugs under veterinary supervision, and detecting signs of distress or warning signs of anaesthetic problems.

During anaesthesia the following physiological parameters should be continuously monitored and recorded on the patient record or anaesthetic monitoring chart every 2-5 minutes:

1. Respiratory rate
2. Heart rate
3. Peripheral pulse rate and quality (Metatarsal or metacarpal)
4. Mucous membrane colour and capillary refill time
5. Nerve reflexes
6. Jaw tone
7. Temperature

In order to do this, a stethoscope, thermometer, patient record and most importantly an experienced dedicated anaesthesia monitoring person is required. By closely monitoring the dog and recording the physiological parameters during anaesthesia, it is possible to see trends and detect problems early. Action can be taken to prevent the situation worsening, avoid excessive depression of the dog and assess response to stimulus and procedures, namely PAIN! The anaesthetic chart is a valuable legal record of the anaesthetic, can provide useful patient information should the dog need future anaesthetics, and can enable review of standard operating protocols and staff training requirements.

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When monitoring anaesthesia, remember A-B-C-D:

1. A for airway
2. B for breathing
3. C for circulation
4. D for depth of anaesthesia

### Airway

Airway is first, because if the dog does not have a clear airway it will be unable to breathe, it may go into respiratory arrest and could die in a matter of minutes. By intubating the trachea with an endotracheal tube, the airway is kept open and clear. However, these endotracheal tubes can sometimes become blocked if the dog's neck is flexed compressing the tube or if something is blocking the end of the tube, so it is important that this is checked.

### Breathing

The dog may have a clear airway but the dog must also be breathing sufficiently to get enough oxygen into the lungs and then into the bloodstream to supply oxygen to the vital organs and tissues. Is the dog breathing? If so, what is the respiratory rate, and is it within normal limits? An adequately anaesthetised dog will have a respiratory rate of 8-20 breaths per minute. If the respiratory rate is below 5 or over 40 breaths per minute, the surgeon must be informed as this is abnormal and other vital parameters must be assessed to identify the cause. Also assess the dog for any respiratory effort, which could indicate a problem with the upper airway or a problem in the chest making it more difficult for the dog to breathe. Sometimes dogs are tied in position for surgery and this can cause significant problems. Tying the dog's front legs wide apart can limit expansion of the chest and prevent normal breathing.

### Circulation

Assess if the heart is beating at a rate that is normal for an anaesthetised dog of that size, and that it is pumping oxygenated blood all around the body. The normal heart rate for an adequately anaesthetised dog is around 60-120 beats per minute. Inform the surgeon if the heart rate is below 40 or over 160 beats per minute as this is abnormal and other vital parameters must be assessed to identify the cause.



Assessing the peripheral pulse rate and quality using the metacarpal or metatarsal pulse gives us valuable information about the blood pressure of the dog.

Photo 1 = Assessing the metacarpal pulse

Photo 2 = Assessing the metatarsal pulse

Weak pulses are an early indicator of problems such as low cardiac output and circulating blood volume, often caused by haemorrhage or dehydration, before changes in the heart rate can be

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detected. Generally, if the peripheral pulses are palpable the systolic arterial pressure is above 90mmHg, and so this is a good way of evaluating whether a dog is normotensive or hypotensive when you do not have access to equipment.

Look at the mucous membranes of the dog, as this will allow assessment of tissue perfusion to check that oxygenated blood is circulating to all of the tissues in the body.



Assessing capillary refill time

The mucous membranes such as the gums or inside the lips should be a pink colour and if pressed with a finger, the colour should return within 2 seconds -this is called capillary refill time.

Ideally you should press the inside of the lip to check this as inflammation associated with gingivitis can affect the response. The mucous membranes colours and what they indicate are described in the table below.

Mucous membrane colour	Indicates
pink	Good tissue perfusion – an adequate blood supply is reaching the peripheral tissues
Pale pink/white	Poor tissue perfusion – there is not an adequate blood supply reaching the peripheral tissues. This may be due to dehydration or hemorrhage. However this can be difficult to assess as some anaesthetic drugs such as xylazine or medetomidine may cause constriction of the peripheral blood vessels which makes the mucous membranes pale.
Blue/purple	Cyanosis – insufficient oxygen being delivered to the tissues. This is an emergency situation as it can lead to cardiac arrest and death.
Yellow	Jaundice – indicates liver disease, bile flow obstruction or an increase in red blood cell destruction and circulating bilirubin
Brick red	Sepsis – indicates sepsis, fever, congestion, causes of extensive tissue damage

### Depth

The dog must be adequately anaesthetised throughout the surgical preparation and neuter surgery, and not be too lightly anaesthetised or too deeply anaesthetised. No one piece of information, for example heart rate, will provide adequate assessment of anaesthetic depth. Remember every patient is different and will have a different response to an anaesthetic procedure. Depth of anaesthesia is determined by vital signs and reflex activity. The amount of anaesthetic agent administered and surgical stimulation must also be taken into consideration.

The depth of anaesthesia is assessed using central nervous system reflexes:

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A central eye position with pupils dilated indicating a deep depth of anaesthesia. A central eye position with pupils constricted would indicate a light depth of anaesthesia

1. Eye position: The dog's eyeball will either be central and facing straight forwards indicating the dog may be too light or too deep under anaesthesia, or ventral and pointing downwards, indicating an appropriate depth of anaesthesia. Note that dogs anaesthetised with an Alpha 2 and Ketamine may have a central eye position even at adequate depths of anaesthesia



A ventral eye position indicating an adequate depth of or surgical anaesthesia

A ventral eye position indicating an adequate depth of or surgical anaesthesia

2. Palpebral or blink reflex: Gently touch the skin to the sides of the eye and observe if the dog blinks or not, adequately anaesthetised dogs should not blink.
3. Swallowing reflex: Observe the dog's neck for any swallowing activity, adequately anaesthetised dogs should not swallow.



4. Skeletal muscle tone: Gently open the dogs jaw with one hand by pressing your finger to the upper canine and your thumb to the lower canine to assess how easy it is to open the dog's jaw and thereby assess jaw muscle tone. Adequately anaesthetised dogs should not resist this but take care as if the dog is too lightly anaesthetised it may snap

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Parameter	Light anaesthesia	Pain during anaesthesia	Adequate anaesthesia	Deep anaesthesia
Eye position	Central	Rotated ventrally	Rotated ventrally	Central
Palpebral reflex	Present	Sluggish/absent	Sluggish/absent	Absent
Jaw tonicity	Present – careful!	Absent	Absent	Absent
Movement	Possible	Absent	Absent	Absent
Vocalisation	Possible	Absent	Absent	Absent
Heart rate	Usually increased	Increased	Usually decreased	Usually decreased
Respiratory rate	Usually increased	Increased	Usually decreased	Usually decreased
Blood pressure	Usually increased	Increased	Usually decreased	Usually decreased
Description	<p>If the dog is too lightly anaesthetized, the eye will be central, there will be a blink reflex, tense jaw tone and the dog might even start moving and swallowing. The heart rate and respiratory rate will usually increase also. This is unacceptable and inhumane as the dog will be able to feel pain. Ask the surgeon to stop surgery, administer more anaesthetic drug, continue to monitor and ensure the dog is adequately anaesthetised before continuing the surgery. It's important to note that if using dissociative anaesthetic drugs such as Ketamine, these nerve reflexes may be present even if the dog is adequately anaesthetised</p>	<p>The central nervous system will still receive signals of painful stimuli and cause central sensitisation to pain when the dog is anaesthetised, making it more difficult to treat the pain post-operatively. We must be able to recognise if the dog is painful when anaesthetised, as often this is confused with light inadequate anaesthesia. If the dog is painful but adequately anaesthetised, the nerve reflexes will show adequate anaesthesia but there will be an increased heart rate, respiratory rate and blood pressure. If the dog is painful further analgesia is required but the state of anaesthesia does not need to be deepened</p>	<p>All dogs must be adequately anaesthetised during any surgical procedure. With adequate anaesthesia, the eye will be rotated ventrally and there will be no blink reflex jaw tone or movement. The heart rate and respiratory rate usually decrease slightly, but remain within the normal range.</p>	<p>The dog can become too deeply anaesthetised which is very dangerous as the heart rate and respiratory rates will decrease and could result in insufficient tissue perfusion with oxygenated blood. All nerve reflexes will be absent and the eye position will be central. If the dog is too deeply anaesthetised on gaseous anaesthesia, the vaporiser should be turned down, but if on injectable anaesthesia you cannot give less, but may be able to reverse some of the drugs. The dog must be continually monitored and you must be ready to start emergency cardiac and pulmonary resuscitation</p>

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### Additional monitoring

The blink reflex in the dog should be absent in adequate anaesthesia, which means that the dogs will not be able to lubricate the surface of the eye and if the eye becomes dry it can develop infections or ulcers which are very painful for the dog. At the beginning of neuter surgery, the dog's eyes should be lubricated with specialised eye lubricant, a water-based lubricant, or by simply dripping sterile saline from a syringe onto the eye. Continue to check the dog's eyes when assessing the blink reflex and administer more lubricant or saline if required.

Temperature can be helpful in assessing the cardiovascular status of animals but is also important for a multitude of reasons, especially for the metabolism of anaesthetic drugs. Dogs are unable to regulate their body temperature when anaesthetised and the anaesthetic drugs and surgical preparation of the dog can cause heat loss. Body temperature commonly gets lower the longer the anaesthetic continues. It is much easier to prevent dog's becoming hypothermic or too cold than warm them once they are already cold. We can prevent heat loss by making sure the operating room is warm, minimising anaesthetic/surgery time, minimise wetting the fur during patient preparation, and use warm intravenous fluids. The dog's temperature should be between 38-39 degrees Celsius or 100-102.5 degrees Fahrenheit. If the dog's temperature begins to drop below this, hot water bottles can be created with regular water bottles or surgical gloves, which are often called 'hot hands', but be careful that the bottles are not too hot as this may result in thermal burns. If the dog becomes too hot or hyperthermic, potentially due to the use of heating aids or an increased metabolic rate due to light anaesthesia, then the dog can be cooled by wetting the skin with cold (not freezing) water, especially the pads of feet and ears.

Dog's temperature	Effect on the dog
38-39°C (100-102.5°F)	Normal
36°C (96°F)	Shivering will be noted in conscious dogs, but will not occur under anaesthesia
32-34°C (90-94°F)	Metabolic rates decrease, requiring less anaesthetic agent to maintain anaesthesia. Recovery may be prolonged due to decreased metabolic rate
28-30°C (82-86°F)	Little or no anaesthetic agents are required to maintain anaesthesia. Recovery will be prolonged. Metabolic acidosis may occur due to poor tissue perfusion.
>39°C (102.5°F)	Hyperthermia is less common than hypothermia during anaesthesia, but is as dangerous and must be addressed quickly to prevent the dog dying of heat stroke.

When checking the dog every 2-5minutes, you should also check that the intravenous cannula or butterfly needle is still in the vein, that there is sufficient isotonic crystalloid fluid in the bottle or bag, the giving set is not obstructed to allow the fluids to continue running, and that the drip rate is correct for the size of the dog.

During anaesthesia it is important not to tie the dog to the surgery table. Use positioning aids such as troughs, wedges or sandbags to prevent the dog rotating when positioned on its back. With an appropriate depth of anaesthesia, the dog will not move in response to surgical stimulation, so tying the dog down is not necessary and can be painful to the dog or constrict chest expansion if limbs are crossed over the chest. Once surgery is complete, the dog should be positioned in lateral recumbency, but anaesthetic monitoring should continue into recovery as this is one of the most dangerous times for anaesthetic death to occur.

A summary table of what to monitor on the dog every 2-5minutes during general anaesthetic:

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GA monitoring checklist	Adequate depth of anaesthesia - Check every 2-5 minutes
Respiratory rate	8-20bpm
Heart rate	50-120bpm
Peripheral pulse quality	Palpable = systolic arterial pressure >90mmHg
Mucous membrane + CRT	Pink, CRT <2seconds
Palpebral reflex	Absent
Eye position	Ventral
Jaw tone	Absent
Intravenous cannula/butterfly needle	Taped in place, no signs of swelling above insertion, patent when flushed with sterile saline
IVFT	Sufficient fluid in bottle, no obstruction of giving set, correct drip rate
Lubricate the eyes	Eye lubricant or sterile saline dripped onto eyes
Temperature	38-39°C (100-102.5°F)

### Checklist:

- ✓ Must have a suitably trained designated anaesthesia monitoring person
- ✓ Remember **A**irway-**B**reathing-**C**irculation-**D**epth
- ✓ Assess basic vital parameters every 2-5minutes and record on patient record
- ✓ Intubate to ensure dog has a clear airway
- ✓ Normal respiratory rate = 8-20 breaths per minute
- ✓ Normal heart rate = 60-120 beats per minute
- ✓ Strong pulses = good blood pressure
- ✓ Adequate anaesthesia = eye ventral, nerve reflexes absent, heart rate and respiratory rate within normal range
- ✓ Light anaesthesia = UNACCEPTABLE, dog will feel pain!
- ✓ Deep anaesthesia = dangerous, dog could die
- ✓ Lubricate the surface of the dogs eyes
- ✓ Monitor temperature, prevent dog getting too hot or too cold
- ✓ Do not tie the dog to the table!

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