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Western Australian Veterinary Emergency & Specialty

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Beyond Basic Vitals Presented by Chantelle Alexander

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Beyond Basic Vitals

Canine and Feline

Presented by Chantelle Alexander RVN

By the end of this presentation

- Comfortably obtain ‘advanced vitals’.
- Familiarise yourself with the baseline or normal values for various vital signs.
- Better understand the equipment used to obtain these vials.
- Reflect on the vitals obtained and take actionable steps to enhance patient care.
- Aim to leave with at least one valuable new skill or piece of information from today's session

Regardless of how a patient presents to the clinic, whether they are critically unwell or relatively stable, the vitals you obtain and the process you follow should remain fairly consistent.

Maintaining a systematic approach in gathering the patient's vital signs ensures no detail is overlooked, while providing a solid foundation for effective data collection and recognition of abnormal.

Patient Vital Abbreviations

RR/RE:	**Respiratory Rate/Respiratory Effort**
HR/PR:	**Heart Rate/Pulse Rate**
MM:	**Mucous membrane (colour)**
CRT:	**Capillary Refill Time**
SPO_2:	**Saturation of Peripheral Oxygen/ Oxygen Saturation**
NIBP:	**Non-invasive Blood Pressure**

More Abbreviations

Invasive Blood Pressure	IVP
End Tidal Carbon Dioxide	$ETCO_2$
Electrocardiogram	ECG
Abdominal or Thoracic Focused Assessment with Sonography for Trauma, Triage, and Tracking	aFAST/ tFAST

Distance Examination

Distance examinations will tell you a LOT about your patient, some of the key areas may include;

- Can your patient rest comfortably?
- Do they respond normally to stimuli and their surroundings?
- Are they maintaining a normal posture?
- Are they orthopneic, and unable to lay down?
- Are they walking with a normal gait? Any signs of lameness, worsening paresis -> paralysis?
- Is their breathing noisy (e.g., stertor, stridor) or are they coughing?
- Are they experiencing any difficulty with respiratory rate or effort?
- Is there any blood, vomitus, urine, or faeces in their bed?
- Does the patient have a normal thirst and appetite? PU/PD, hyporexia, inappetence?
- Any anisocoria or facial drooping?
- Any swelling or bruising?

How to Perform a Distance Examination

<u>Most importantly: a distance exam should be performed at a distance</u>

Start with your patient's level of consciousness and mentation;

- BAR: Bright, Alert and Responsive to stimuli
- QAR: Quiet, Alert and Responsive (still aware, but not as happy/active)
- Depressed/dull/lethargic: patient prefers to sleep, response to stimuli is normal
- Hyperactive: responses to stimuli are inappropriate
- Obtunded: slow response to stimuli
- Stuporous: only responds to noxious stimuli
- Comatose: no reaction to all stimuli, noxious or other

Mentation and Level of Consciousness (LOC)

Changes in mentation or LOC can be due to;

- Stress/anxiety
- Pain
- Medications (actions or interactions)
- Hypoperfusion
- Traumas (increased ICP)
- Hypoglycaemia
- Electrolyte imbalances
- Anaemia/bleeding
- Metabolic disease
- Progression or worsening of disease

Trending mentation can help determine if your patient requires additional attention or interventions.

What do I do if my patient has an altered or changed mentation or LOC?

If a patient experiences a deteriorating LOC, act quickly, it can be an emergency!

- Check all perfusion parameters (HR, PR, BP, MM, CRT). We'll cover specifics with these a little later….
- Check the patient's pain scale
- Check medication doses and frequency
  - including times opioid patches are active,
  - CRI rates and concentrations.
- Check baseline bloods (electrolytes, PCV/TS, BG)
- Perform an aFAST/tFAST, any signs of worsening or progressing effusions?

RR/RE

Sneak up on the patient! We want a ‘resting’ respiratory rate and effort.

Normal values (Canine and Feline):
<40 breaths/min

I personally count the number of inspiratory breaths (breaths in) over 15 seconds and multiply by 4 to express the value in breaths per minute.

Tachypnoea:	Abnormally rapid breathing
Bradypnoea: “Bray-DIP-nee-uh”	Abnormally slow breathing rate

Some other abnormalities may include;

- **Increased inspiratory or expiratory effort**
- **Dyspnoea**: difficulty or laboured breathing
- **Orthopnea** (postural changes to maximise ventilation)
- **Stertor:** low pitched “snoring” of nasopharynx (Brachycephalic airway disease)
- **Stridor**: loud breathing = large airway disease (nasal passages, trachea, larynx/pharynx)
    - Inspiratory noise or difficulty = extra thoracic upper airway disease (laryngeal paralysis)
    - Expiratory noise or difficulty = intrathoracic tracheal disease

The Oxygen Dissociation Curve

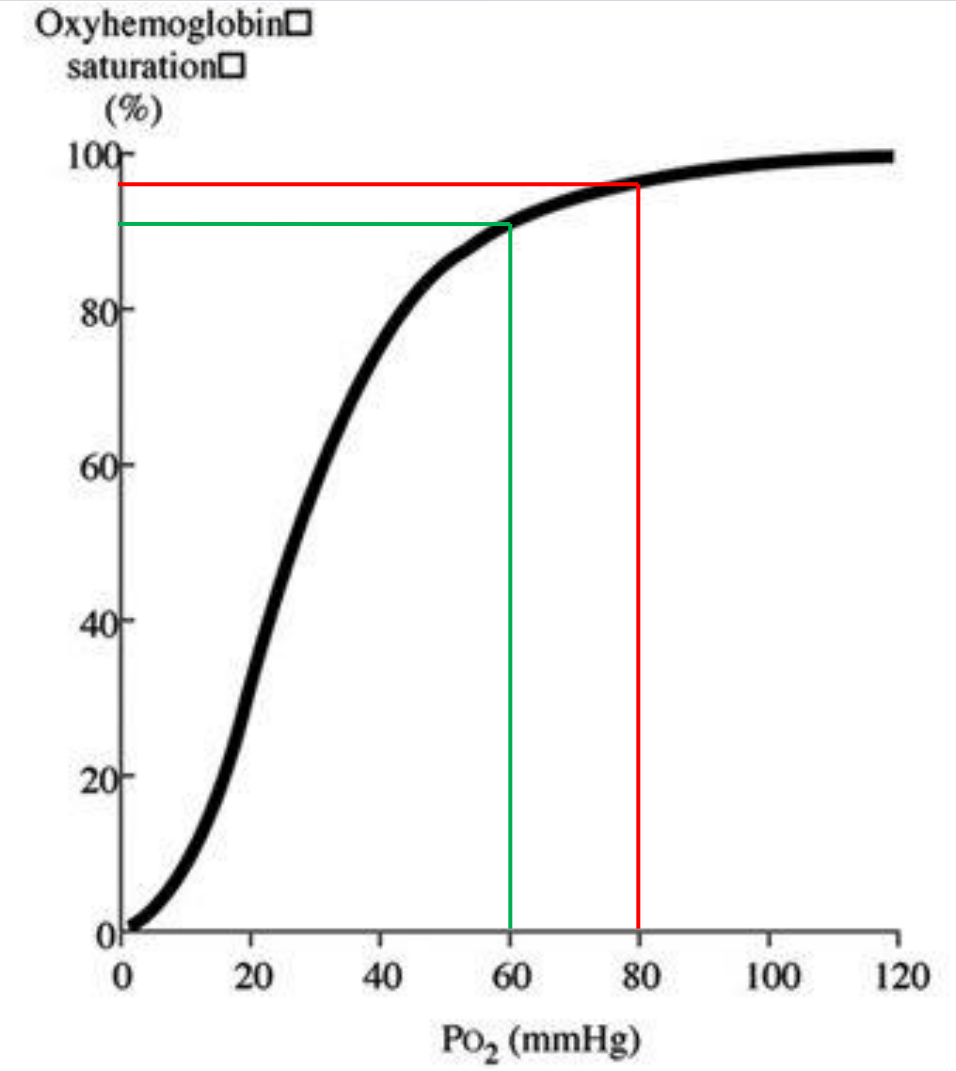
Before we talk about SPO_2, lets quickly revise the Oxygen Dissociation Curve in relation to SPO_2 readings

It's important to remember, your patient's SPO_2 isn't a true reflection of their ability to ventilate. SPO_2 is how we measure the patient's oxygen saturation levels. The gold standard for determining a patient's ventilation status, is to measure their **arterial** oxygen partial pressure (PaO_2), pH and carbon dioxide partial pressure ($PaCO_2$), using a blood gas analyser. However, these units can be very costly and may not be readily available in all practice settings.

The Oxygen Dissociation Curve is a graph that shows the relationship between the amount of oxygen carried by hemoglobin in the blood (oxygen saturation) and the partial pressure of oxygen (PaO_2) in the blood.

Graph Details:
The x-axis represents the partial pressure of oxygen (PaO_2), usually measured in mmHg.
The y-axis represents the percentage of haemoglobin that is saturated with oxygen (% saturation)

Shape of the Curve:
The curve has a sigmoidal (S-shaped) form.
Steep Part: At low PaO_2 (like in tissues needing oxygen), a small drop in PaO_2 leads to a large release of oxygen from haemoglobin.
Flat Part: At high PaO_2 (like in the lungs), haemoglobin holds onto oxygen strongly even if the PaO_2 changes a bit.



Oxygen disassociation curve

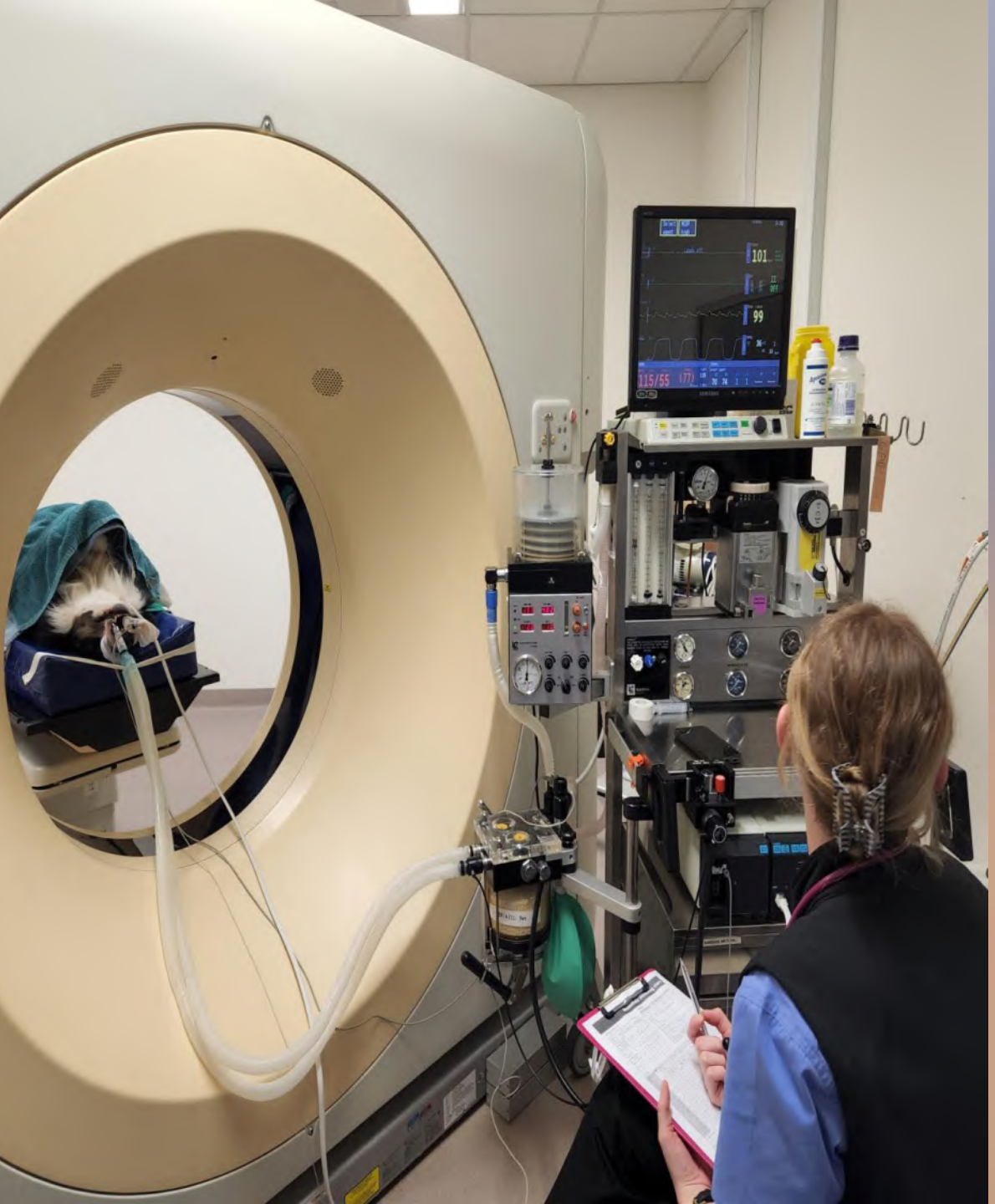
Most patients under anaesthesia are breathing 100% and their corresponding PaO_2 should be around 500 mmHg with normal lung function

In general, although there are slight variations between species;

- a PO_2 of 100 mmHg is equivalent to an SPO_2 of 98%
- a PO_2 of 80 mmHg to an SPO_2 of 95% (Red)
- a PO_2 of 60 mmHg to an SPO_2 of 90% (Green)
- a PO_2 of 40 mmHg to an SPO_2 of 75%.

Mechanical ventilation (life support) should be considered for patients who have severe hypoxaemia (<60 mmHg) who don't improve despite supplemental oxygen.

Having a general knowledge of these correlations can be helpful in understanding your pulse oximetry data.



SPO_2

Normal value: > 96%

There are two main types of pulse oximeter devices:

1. Transmittance and
2. Reflectance

A transmittance probe works by shining light **through** tissue, a reflectance probe measures the light that is **reflected** back from the tissues

Both units work by measuring how much light is absorbed by haemoglobin in the blood.

Haemoglobin comes in two forms:

- **Deoxyhaemoglobin (Hb)**: Haemoglobin without oxygen.
- **Oxyhaemoglobin (O_2Hb)**: Haemoglobin with oxygen.

The two forms absorb light waves differently. The pulse ox device uses these values to determine the oxygen saturation in the patient's blood

How Transmittance SpO_2 Probes Work

Light Emission:

The probe contains light-emitting diodes (LEDs) that emit light at two specific wavelengths: one in the red spectrum (around 660nm) and one in the infrared spectrum (around 940nm). These wavelengths are selected because oxyhemoglobin (O_2Hb) and deoxyhemoglobin (Hb) absorb these wavelengths differently.

Light Transmission:

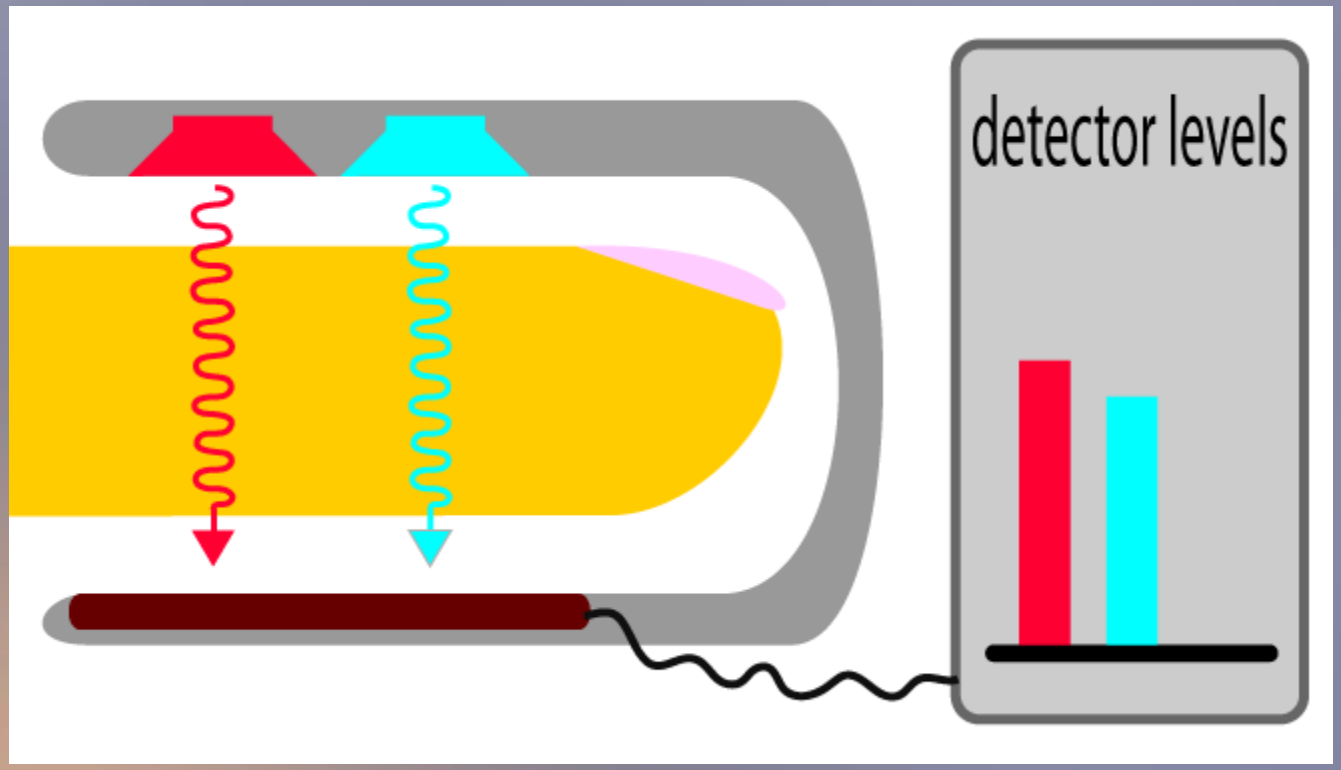
The probe is placed on a relatively thin part of the body, like the tongue, ear or the webbing in-between the toes, vulva or prepuce and the LEDs shines **through** the tissues.

Light Detection:

On the opposite side of the probe, there is a photodetector that captures the light that has passed through.

Calculation:

The device calculates the ratio of the absorbed red and infrared light. Since the absorption characteristics of oxyhaemoglobin and deoxyhaemoglobin are different at these wavelengths, the pulse oximeter can determine the percentage of haemoglobin that is oxygenated (SpO_2) based on this ratio.



How equipment works.com

Common sites for transmittance probes:

- Tongue (not on a Chow Chow breed!)
- Lip
- Pinna
- Prepuce (one side of the clip is usually placed internally)
- Vulva (one side of the clip is usually placed internally)

How Reflectance SpO_2 Probes Work

Light Emission:

The probe contains light-emitting diodes (LEDs) that emit light at two specific wavelengths: one in the red spectrum and one in the infrared spectrum. These wavelengths are chosen because oxyhaemoglobin (O_2Hb) and deoxyhaemoglobin (Hb) absorb these wavelengths differently.

Light Reflection:

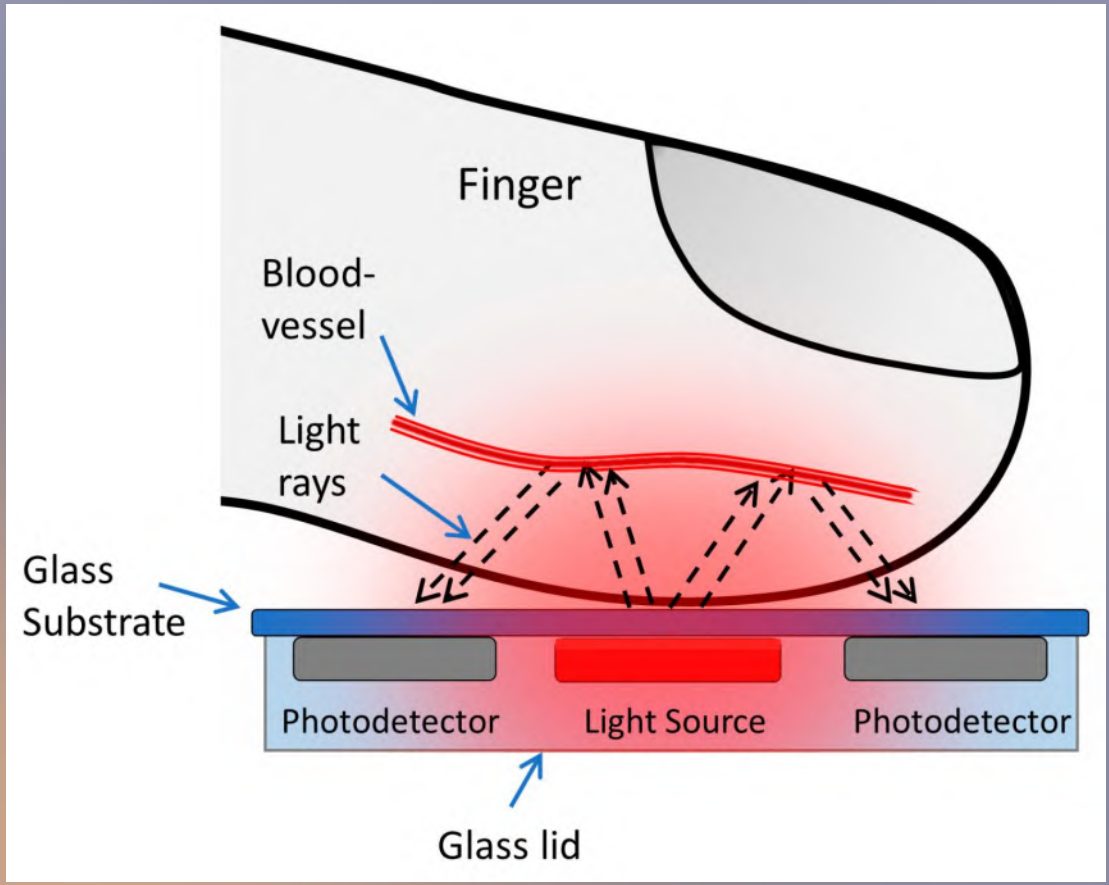
The emitted light penetrates the skin and underlying tissues. Some of this light is absorbed by the blood and tissues, and some is reflected back to the sensor.

Detection:

A photodetector within the probe captures the reflected light. The amount of light that is reflected back varies depending on the oxygenation level of the blood.

Calculation:

The device then calculates the ratio of the absorbed red and infrared light. Since oxyhaemoglobin and deoxyhaemoglobin absorb light differently, this ratio can be used to determine the percentage of haemoglobin that is oxygenated (SpO_2).



A reflectance SpO_2 probe works by using the principles of light absorption and reflection to measure the oxygen saturation in the blood.

Common sites

- Inguinal area over the femoral pulse
- Lip
- Tail base
- Rectally (internally)
- Pinna

SPO_2 Waveforms

Pulse oximetry measurements should only be trusted if the monitor displays:

- A matching pulse rate and
- Uniform, consistent waveform

The waveform is a graphic interpretation of the peripheral pulse wave, which is called a photoplethysmograph “photo-pleth-is-mo- graph”(PPG). The PPG is generated using the pulse oximeter’s 660 nm light wave to create an “image” of the pulse, and the PPG’s amplitude directly corresponds to pulse quality at the site.

SPO_2 readings can be affected by;

- Motion (panting, shaking, trembling)
- Low perfusion
- The presence of hair
- Dark pigment
- Positioning during procedures (ie difficult to keep a reflectance probe on the tongue during a dental procedure)
- Bright surgical lights
- Anemia
- Jaundice can cause interference with red and infrared light
- Obesity or significant oedema
- Decreased cardiac output

Critically ill animals often experience decreased peripheral perfusion due to:

- **Hypovolemia:** Low blood volume.
- **Decreased Cardiac Output:** Reduced amount of blood the heart pumps.
- **Changes in Vascular Tone:** Alterations in the contraction and relaxation of blood vessels.

So SPO_2 readings can be inaccurate because of these factors

To obtain an accurate SPO_2 reading, it is important to choose a suitable site.

Most recent studies have shown the mucous membranes generally yield the most reliable results.

Troubleshooting while obtaining an SPO_2 reading:

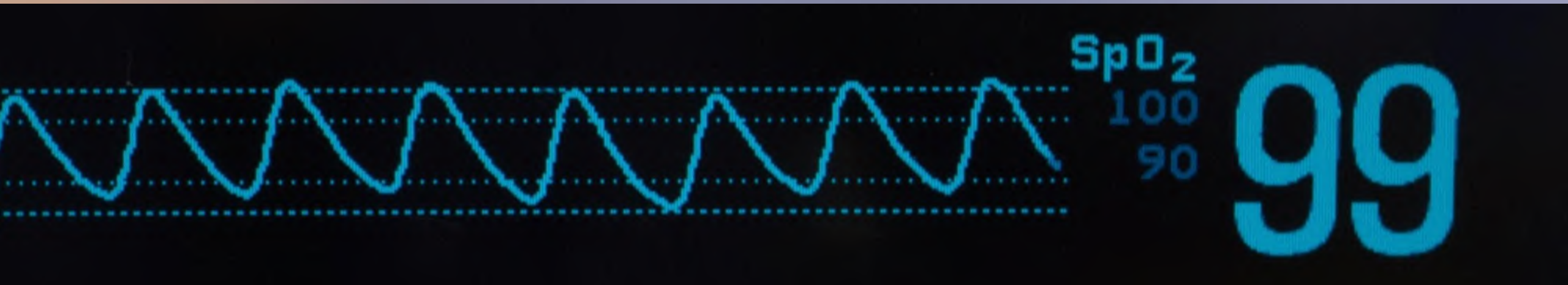
If the monitor doesn't give a reading;

- Is the monitor on and charged?
- Is the probe attached to the patient?
- Is the site on the patient clean? Do I need to clip hair?
- If it is a mucous membrane, is it moist?
- Is the patient warm?
- Is the patient hypovolemic or peripherally vasoconstricted?
- Does the patient have heart disease?

Hot tip:

If the patient is in respiratory distress, an SPO_2 reading is NOT the priority. Instead supplement oxygen and notify a vet!

If the patient isn’t distressed: attempt another reading at a different location



In summary; what do we do if your patient is exhibiting any abnormalities with their RR/RE

1. Alert the vet, start supplementing oxygen and have intubation equipment readily available,
2. Try to identify the change so the vets have an idea of urgency and what your concerns are; tachypnoea, bradypnea, dyspnoea, orthopnoea, stertor or stridor,
3. Check SPO_2 (if possible)
4. Check arterial blood gas to confirm ventilation status (if possible)
5. Check rectal temperature,
6. Check other perfusion parameters including MM colour, CRT, HR, PR & BP
7. May need to assess/reassess IVFT or medications (specifically opioids)
8. Check IVC for patency, nothing worse than trying to get IV access in a patent in respiratory crisis

Pain scales

Pain is an individual experience, and how it manifests in observable and measurable behaviors and can vary from patient to patient.

The difficulty in vet med is our patients can't tell us they are in pain, so we need to assess physiologic and behavioral responses or changes.

Physiologic responses may include:

- Tachycardia (high heart rate)
- Tachypnoea (high respiratory rate)
- Hypertension (high blood pressure)
- Pyrexia (high temperature)
- Mydriasis (dilation of the pupils)

It's important to note: in order to complete a comprehensive assessment of an animal's pain and overall condition, we need to integrate physiological data with our behavioral observations. There are limitations of each method, when used in isolation.

In ECC, we use the Colorado State University pain charts

Colorado State University

Date _____

Time _____

Colorado State University
Veterinary Medical Center
Canine Acute Pain Scale

Rescore when awake	☐ **Animal is sleeping, but can be aroused - Not evaluated for pain** ☐ **Animal can't be aroused, check vital signs, assess therapy**

Pain Score	Example	Psychological & Behavioral	Response to Palpation	Body Tension
0		☐ **Comfortable** when resting ☐ **Happy, content** ☐ Not bothering wound or surgery site ☐ Interested in or curious about surroundings	☐ **Nontender** to palpation of wound or surgery site, or to palpation elsewhere	Minimal
1		☐ **Content to slightly unsettled** or restless ☐ **Distracted easily** by surroundings	☐ **Reacts to palpation** of wound, surgery site, or other body part by **looking around, flinching,** or **whimpering**	Mild
2		☐ Looks **uncomfortable** when resting ☐ May **whimper** or cry and may **lick or rub wound** or surgery site when unattended ☐ Droopy ears, **worried facial expression** (arched eye brows, darting eyes) ☐ **Reluctant to respond** when beckoned ☐ **Not eager to interact** with people or surroundings but will look around to see what is going on	☐ Flinches, whimpers cries, or guards/pulls away	Mild to Moderate **Reassess analgesic plan**
3		☐ **Unsettled, crying, groaning, biting or chewing** wound when unattended ☐ **Guards or protects** wound or surgery site by altering weight distribution (i.e., limping, shifting body position) ☐ **May be unwilling to move all** or part of body	☐ May be **subtle** (shifting eyes or increased respiratory rate) if dog is too painful to move or is stoic ☐ May be **dramatic**, such as a sharp cry, growl, bite or bite threat, and/or pulling away	Moderate **Reassess analgesic plan**
4		☐ **Constantly groaning or screaming** when unattended ☐ May bite or chew at wound, but unlikely to move ☐ **Potentially unresponsive** to surroundings ☐ **Difficult to distract** from pain	☐ **Cries at non-painful palpation** (may be experiencing allodynia, wind-up, or fearful that pain could be made worse) ☐ May react aggressively to palpation	Moderate to Severe **May be rigid to avoid painful movement** **Reassess analgesic plan**

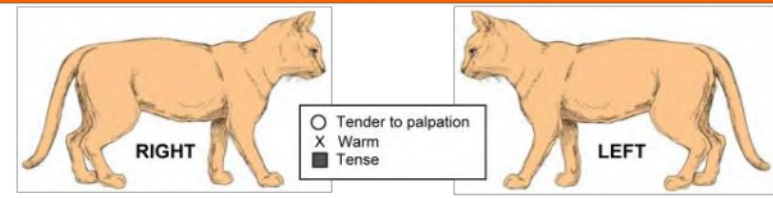
Comments _____

Supported by an Unrestricted Educational Grant from Pfizer Animal Health

Colorado State University

Colorado State University
Veterinary Medical Center
Feline Acute Pain Scale

Pain Score	Example	Psychological & Behavioral	Response to Palpation	Body Tension
No Score		❑ **Animal is sleeping and cannot be evaluated**		
0		❑ **Content and quiet** when unattended ❑ **Comfortable** when resting ❑ Interested in or **curious** about surroundings	❑ **Not bothered** by palpation of wound or surgery site, or to palpation elsewhere	Minimal
1		❑ **Signs are often subtle and not easily detected in the hospital setting**; more likely to be detected by the owner(s) at home ❑ Earliest signs at home may be **withdrawal from surroundings or change in normal routine** ❑ In the hospital, may be content or **slightly unsettled** ❑ **Less interested** in surroundings but will look around to see what is going on	❑ May or may not react to palpation of wound or surgery site	Mild
2		❑ Decreased responsiveness, **seeks solitude** ❑ **Quiet**, loss of brightness in eyes ❑ **Lays curled up or sits tucked up** (all four feet under body, shoulders hunched, head held slightly lower than shoulders, tail curled tightly around body) with eyes partially or mostly closed ❑ **Hair coat appears rough** or fluffed up ❑ May intensively groom an area that is painful or irritating ❑ Decreased appetite, **not interested in food**	❑ **Responds aggressively or tries to escape** if painful area is palpated or approached ❑ Tolerates attention, may even perk up when petted as long as painful area is avoided	Mild to Moderate **Reassess analgesic plan**
3		❑ Constantly **yowling, growling, or hissing** when unattended ❑ May bite or chew at wound, but **unlikely to move** if left alone	❑ **Growls or hisses at non-painful palpation** (may be experiencing allodynia, wind-up, or fearful that pain could be made worse) ❑ **Reacts aggressively** to palpation, **adamantly pulls away** to avoid any contact	Moderate **Reassess analgesic plan**
4		❑ Prostrate ❑ Potentially **unresponsive** to or unaware of surroundings, difficult to distract from pain ❑ Receptive to care (even mean or wild cats will be more tolerant of contact)	❑ **May not respond** to palpation ❑ **May be rigid to avoid painful movement**	Moderate to Severe **May be rigid to avoid painful movement** **Reassess analgesic plan**



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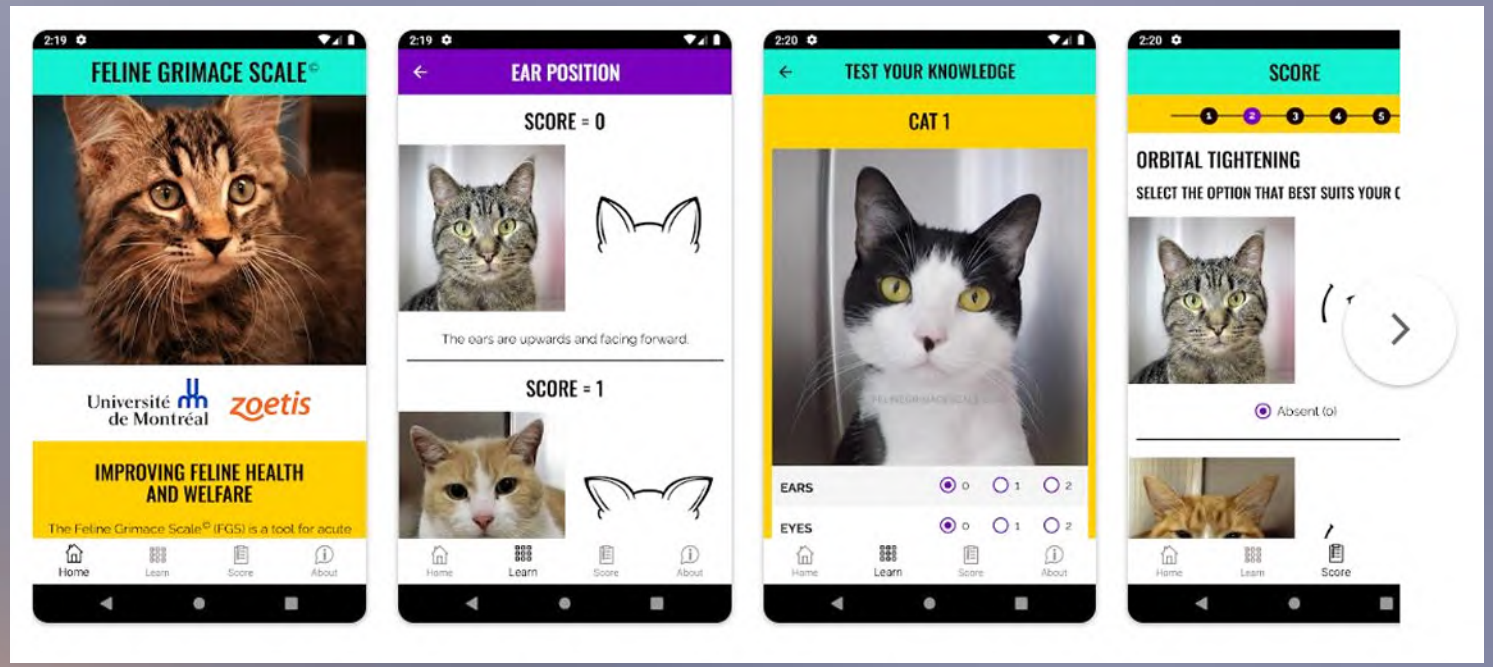


Zoetis and the University of Montreal have also created an app which asks the user to input specific data about a cat's facial features and makes an assessment of their current pain status

They claim "This application is a quick and easy-to-use tool for assessment of acute pain in cats based on changes in facial expressions. This tool underwent rigorous scientific validation and it was shown to be valid and reliable for the evaluation of pain in cats with different medical and surgical conditions, using both image- or real-time evaluation"

Heart Rate (HR)

Species	Bradycardia (HR <)	Tachycardia (HR >)
Canine	60 bpm	140 bpm
Feline	140 bpm	200 bpm

Have you ever had a patient who's tachycardic or bradycardic? Do you remember the cause?

Tachycardic Hypovolemia, hypoxemia, hypotension, drugs, toxins, fever, excitement, exertion, heart disease and pain

Bradycardic increased vagal tone, severe electrolyte disturbances, hypothermia, drugs or medications, or disturbances of the cardiac conduction system

It's important to not only obtain a heart rate but also listen for any abnormalities in heart rhythm or cardiac murmurs. After obtaining the heart rate, keep your stethoscope in place and palpate the femoral or dorsal pedal pulse.

At each check, we should also assess the patient's pulse quality and check for any signs of pulse deficits, which may indicate the presence of cardiac arrhythmias. We will cover this in more detail later.

Pulse Quality and Deficits

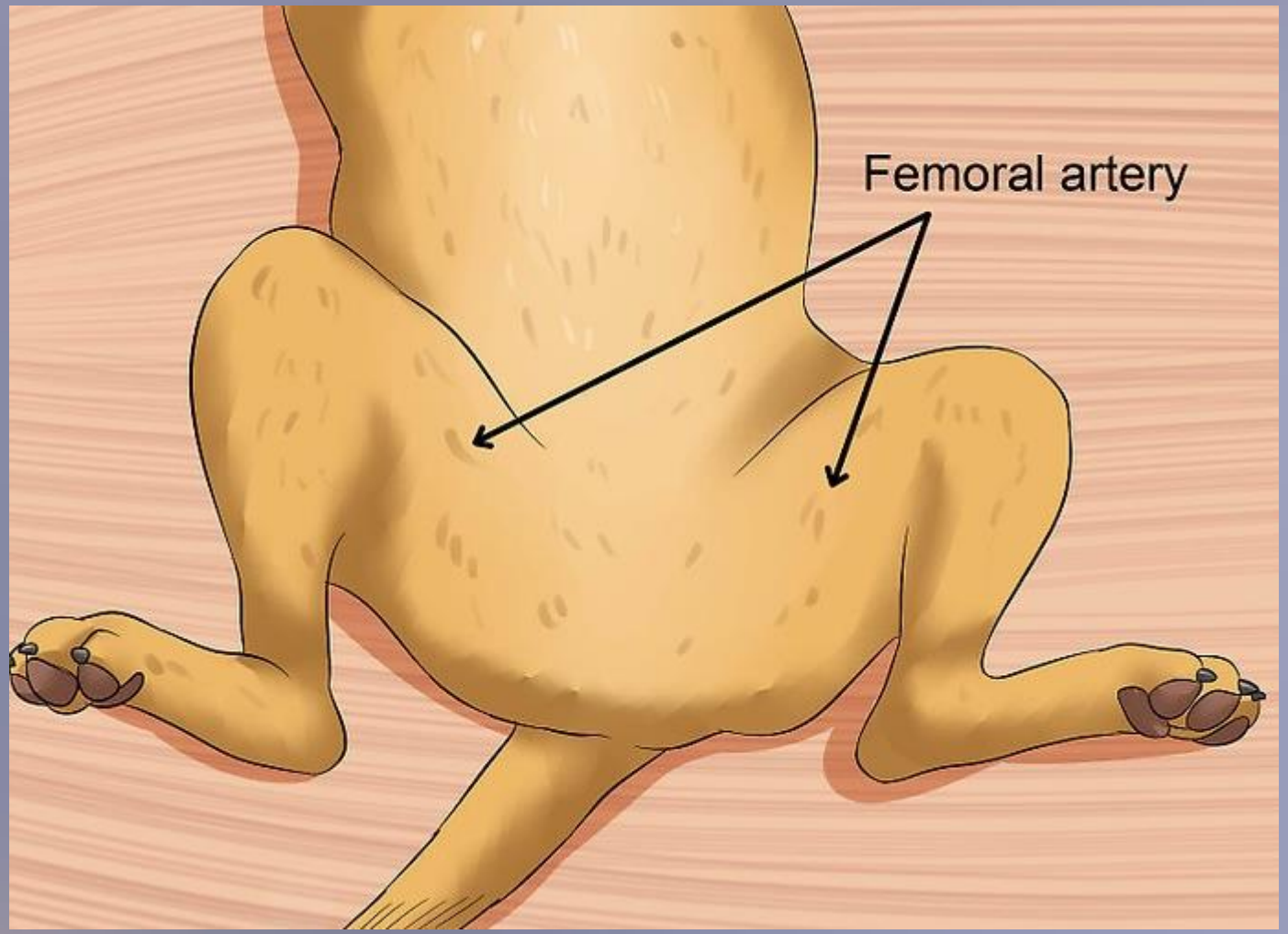
The femoral and dorsal pedal arteries are typically the ones we palpate when assessing the pulse quality of a patient.

Palpating peripheral pulses can aid in assessing circulatory and perfusion status.

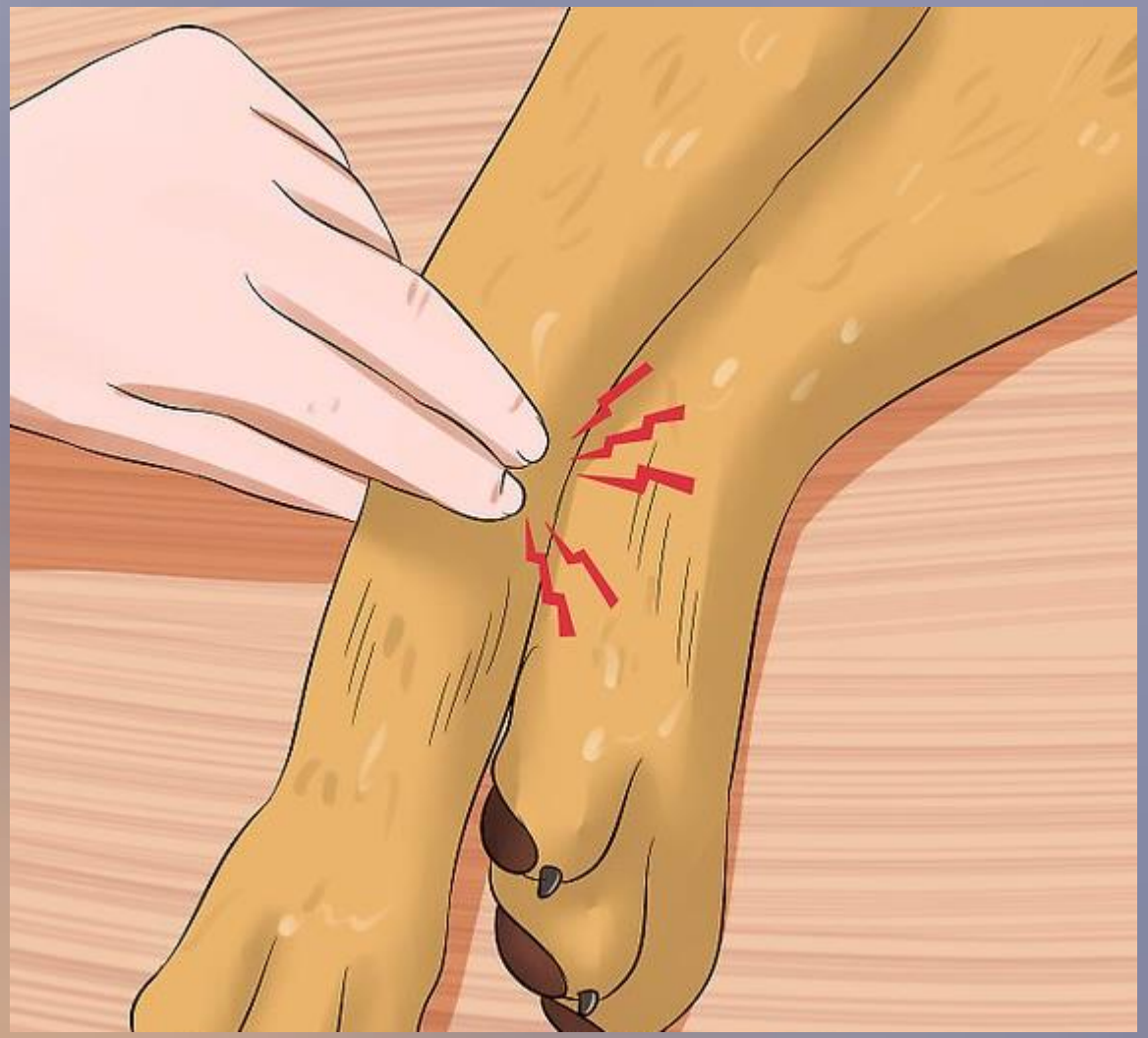
As well as detecting hypotension pulse palpation can detect arrhythmias, peripheral vasoconstriction, and decreased cardiac output.

Pulse pressure is the difference between systolic and diastolic blood pressure. The strength and quality of these palpated pulses can provide insights into the patient's circulatory status and underlying health conditions.

Typically, strong and palpable pulses that match each heartbeat indicate adequate cardiac output and intravascular volume.



Picture taken from https://www.wikihow.pet/



Picture taken from https://www.wikihow.pet/

In patients with early stages of shock, pulse pressure and blood pressure might remain normal due to compensatory mechanisms- such as tachycardia. However, when a reduction in pulse pressure is detected, it can be an indicator that shock has progressed.

The dorsal pedal artery is most easily felt between the second and third metatarsal bones, just below the hock.

A detectable dorsal metatarsal (pedal) pulse suggests the patient's systolic pressure is 80mmHg or higher. The absence of these pulses **strongly** suggests hypotension.

It's recommended you use the pads of your index and middle fingers rather than your thumb to palpate the patient's pulse. This is because your thumb has its own pulse, which can interfere with detecting the patient's pulse.

Standard Actions:

Alert vet for life-threatening changes
Immediate notification if HR falls below or rises above specified thresholds and the pulse quality is not detectable, thready, bounding or different to the heart rate.

Attach an ECG
If there is an arrhythmia, you may consider applying ECG dots/pads for ongoing monitoring for patient comfort.

Check baseline bloods
Baseline blood work may include PCV/TS, electrolytes, BG. If possible and there are concerns about the patient's ventilation, then check an blood gas analysis.

Check BP, MM color, CRT, SPO_2, Temperature & pain score
Ensure other perfusion parameters fall within normal ranges, and pain-score the patient concurrently.

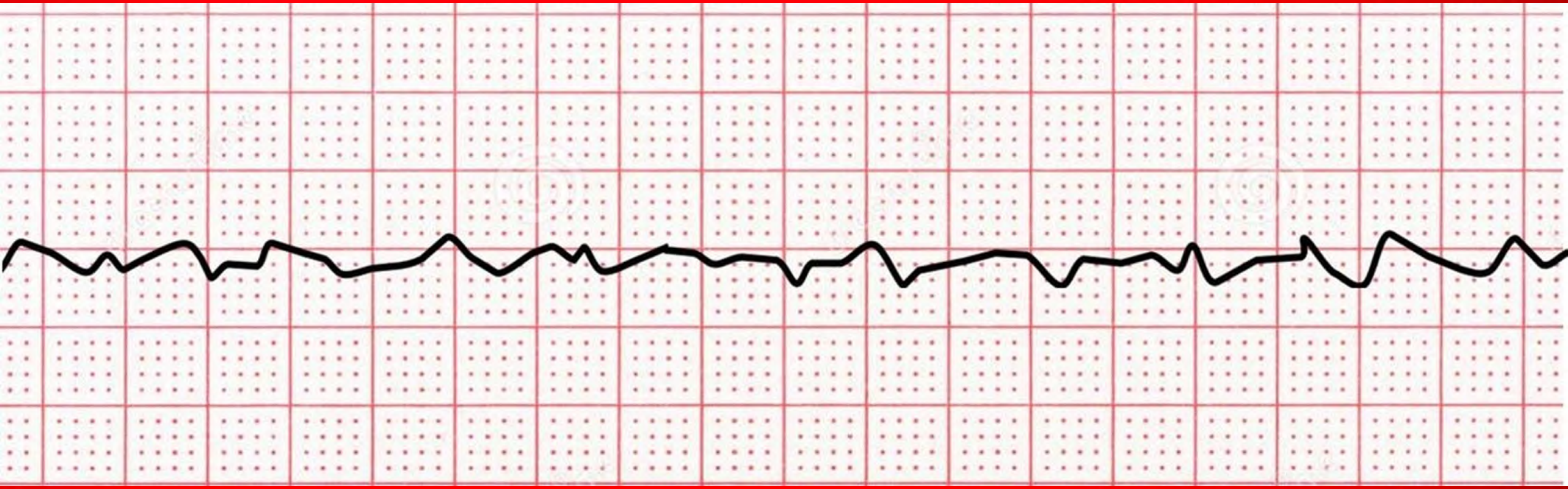
Check analgesics and other CRIs
Verify medications are at the correct dose, concentrations for continuous rate infusions (CRIs) particularly analgesics and other medications like potassium chloride.

Perform an aFAST and tFAST
If there is free fluid within a cavity, check coagulation profiles (CBC, PT, aPTT or ACT) then the vet may choose to sample the fluid if the lab values fall WNL

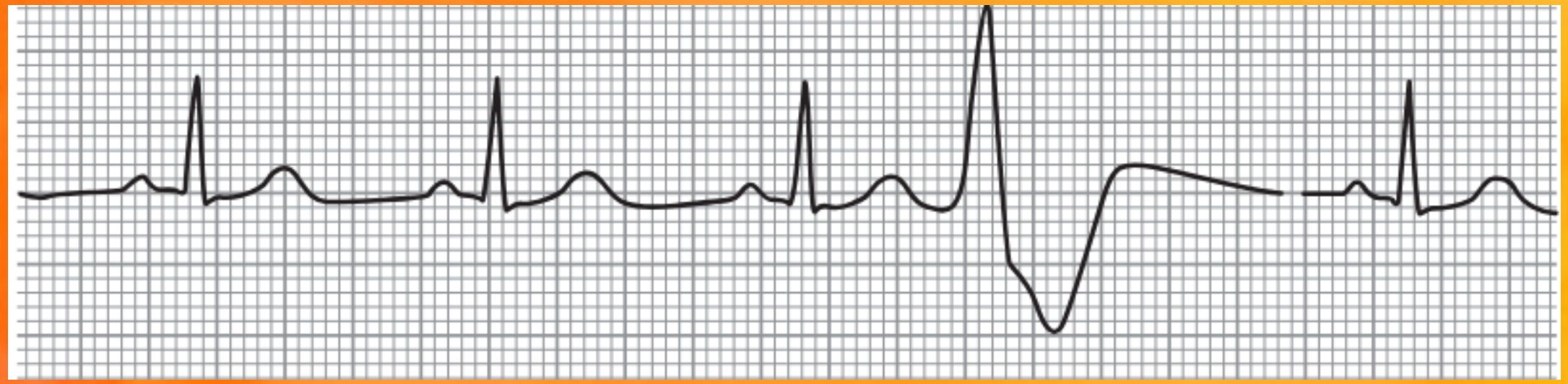
Electrocardiogram (ECG)

The heart's contractions are initiated by electrical signals produced by specialised cells within its walls. By positioning electrodes on the skin, an ECG can detect these electrical impulses and convert them into visual recordings called electrocardiograms

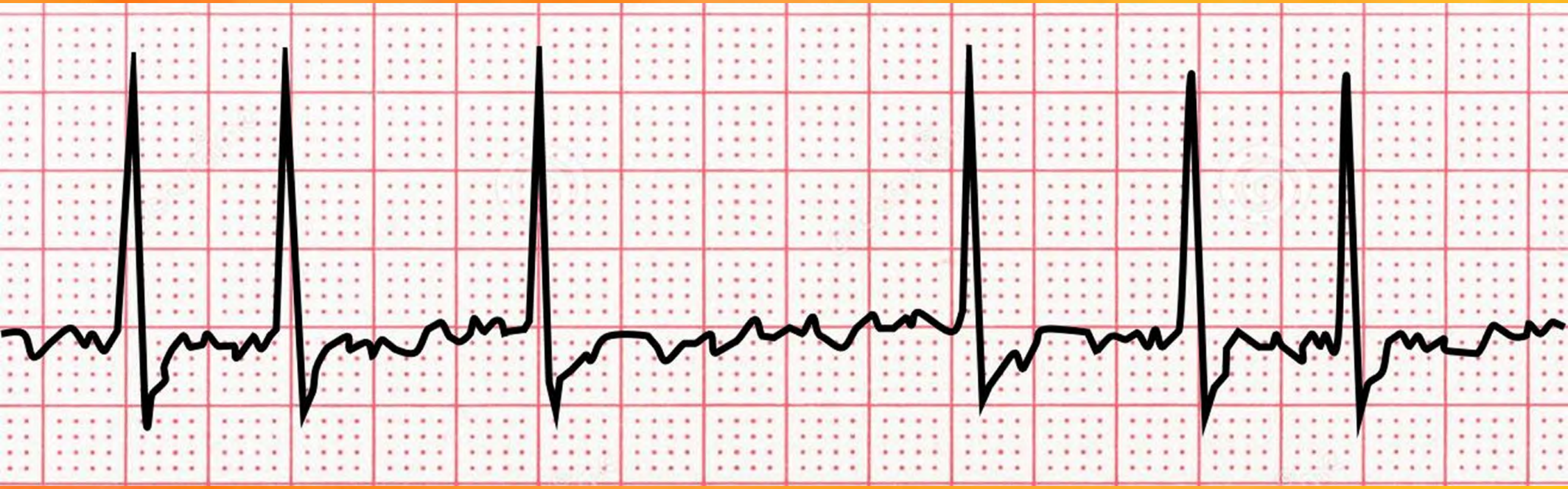
Today we’re not going to focus on assessing or diagnosing problems on ECG traces, but we’re going to play a little game called normal or abnormal;



Ventricular fibrillation: Abnormal, usually associated with cardiac arrest



Ventricular premature complex (VPC): Abnormal, but as an intermittent occurrence, not necessarily life threatening



Atrial fibrillation (Afib): Abnormal, most animals with Afib, have some kind of underlying cardiac disease

Sinus tachycardia: Normal rhythm, but a fast rate.

Sinus bradycardia: Normal rhythm, but a slow rate.

Ventricular tachyarrhythmia (VT): Abnormal- can be life threatening!

Sinus arrhythmia: Normal, typically a result of variations in vagal tone associated with respiration

If you hear anything abnormal on auscultation or there are notable pulse deficits you need to;

- Alert the vet!
- Attach an ECG.
- Check other perfusion parameters including BP, MM colour & CRT.
- Check medications (specifically those on a CRI) are at the correct dose, concentration and rate.
- Check IVC for patency.
- Confirm resuscitation status.

If there are any concurrent signs of hypoperfusion (hypotension, poor pulse quality, slow CRT, muddy MM) with a dysrhythmia then it is an emergency! Act quickly!

Blood Pressure (BP)

Precise and accurate blood pressure (BP) measurements are an integral part of a patient's care plan.

Monitoring a patient's blood pressure is crucial for ensuring tissues receive sufficient oxygen.

Measuring and trending a patient's blood pressure gives valuable information about their cardiovascular health and can guide treatment decisions

There are different ways to obtain a patient's blood pressure, we'll discuss the pros and cons to both NIBP & IBP methods and how best to obtain **accurate** results.

Normal values	Systolic	Diastolic	Mean
Dogs	100-160 mmHg	80-120 mmHg	90-120 mmHg
Cats	120-150 mmHg	70-130 mmHg	100-150 mmHg

Non-Invasive Blood Pressure (NIBP)

The 2 noninvasive methods for obtaining blood pressure readings are

1. Oscillometric and
2. Doppler ultrasonography

Prior to taking any readings either with the doppler or oscillometric machines, you need to position the patient appropriately, select an appropriate reading site, and choose an appropriate cuff size.

The most common locations to obtain a blood pressure a reading is;

- Proximal to the carpus on thoracic limbs
- Proximal to the hock on a pelvic limb, or
- At the base of the tail

Blood pressure is typically referenced; "..To the level of the right atrium (RA)".

This means the measurement site (where the cuff is placed) should be as close as possible to the RA's horizontal plane. In an ideal world, a patient should be in a lateral recumbency while obtaining NIBP readings.

However, if that's not possible (because the patient is anxious or in respiratory distress etc), and the cuff sits lower than the RA, then the readings will be artificially high.

If the cuff is placed higher than the RA, then the readings will be lower.

If the vertical distance between the cuff and the RA is 10 cm or more, the Advanced Monitoring and Procedures for Small Animal Emergency and Critical Care manual recommends the following correction factors in table 10.5

Table 10.5 Correction factors for a vertical distance of ≥10 cm (4 inches) between the RA and the pressure cuff

If the Cuff is . . .	Then . . .
≥10 cm *below* the RA	*Subtract* 0.8 mm Hg for every 1 cm the cuff is below the RA
≥10 cm *above* the RA	*Add* 0.8 mm Hg for every 1 cm the cuff is above the RA

RA, right atrium.

BP Cuff Selection

In dogs:

- The cuff size should be approximately 40% the circumference of the limb

In cats:

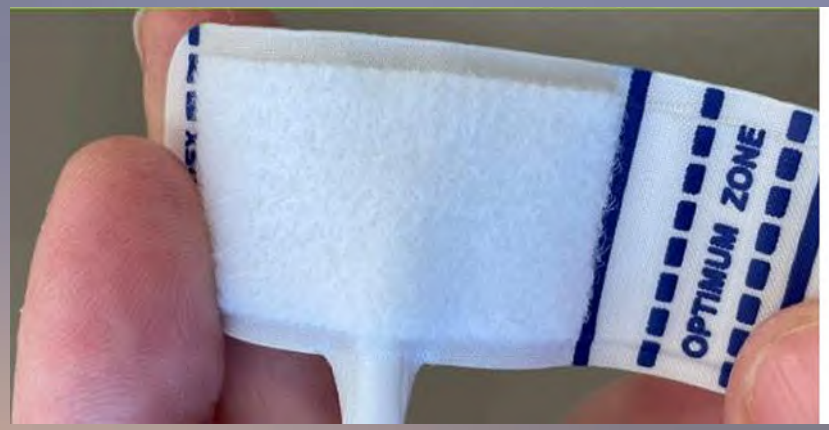
- The cuff size should be approximately 30%–40% the circumference of the limb.

Some BP cuffs will have reference lines in-built

If the cuff size is too small, there can be erroneously high BP readings. Conversely if the cuff is too large, the readings may be erroneously low.

It's important to align the 'artery' line on the blood pressure cuff with the artery in your patient. This ensures that the cuff's bladder is correctly positioned, allowing for proper compression and decompression of the vessel. As a result, your blood pressure readings will be accurate and reliable

Ideally, we shouldn’t secure the cuff with tape as it can restrict airflow to the blood pressure cuff’s bladder and cause inaccurate readings. However, in the event the velcro is damaged and it can’t be replaced, use a VERY small amount of tape to secure the end in place, don’t wrap the circumference of the cuff.

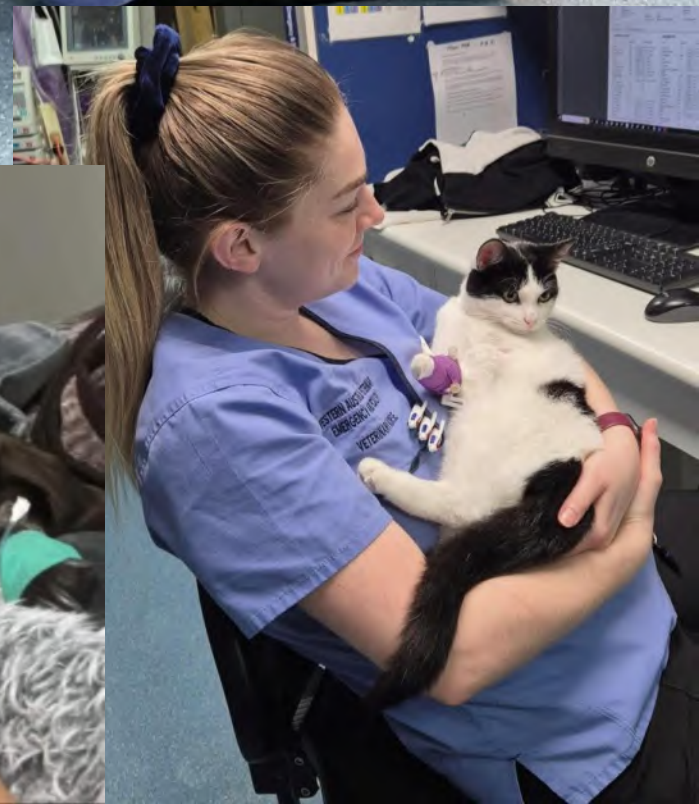


According to the ACVIM (American College of Veterinary Internal Medicine) guidelines there are some key factors which will influence the accuracy of a blood pressure reading.

- Calibration of the BP device should be tested semiannually either by the user, when self-test modes are included in the device, or by the manufacturer.
- The procedure must be standardised.
- The environment should be isolated, quiet, and away from other animals. Generally, the owner should be present. The patient should not be sedated and should be allowed to acclimate to the measurement room for 5-10 minutes before BP measurement is attempted.
- The animal should be gently restrained in a comfortable position, ideally in ventral or lateral recumbency to limit the vertical distance from the heart base to the cuff (if more than 10 cm, a correction factor of +0.8 mm Hg/cm below or above the heart base can be applied).
- The cuff width should be approximately 30%-40% of circumference of the cuff site.
- The cuff may be placed on a limb or the tail, taking into account animal conformation and tolerance, and user preference.
- The same individual should perform all BP measurements following a standard protocol. Training of this individual is essential.
- The measurements should be taken only when the patient is calm and motionless.
- The first measurement should be discarded. A total of 5-7 consecutive consistent values should be recorded. In some patients, measured BP trends downward as the process continues. In these animals, measurements should continue until the decrease plateaus and then 5-7 consecutive consistent values should be recorded.
- Repeat as necessary, changing cuff placement as needed to obtain consistent values.
- Average all remaining values to obtain the BP measurement.
- If in doubt, repeat the measurement subsequently.
- Written records should be kept on a standardised form and include person making measurements, cuff size and site, values obtained, rationale for excluding any values, the final (mean) result, and interpretation of the results by a veterinarian

Are all those steps always possible in a clinical setting…..

Not always, but there are some steps we can take to make our patient's more comfortable and obtain accurate readings..



When obtaining oscillometric values

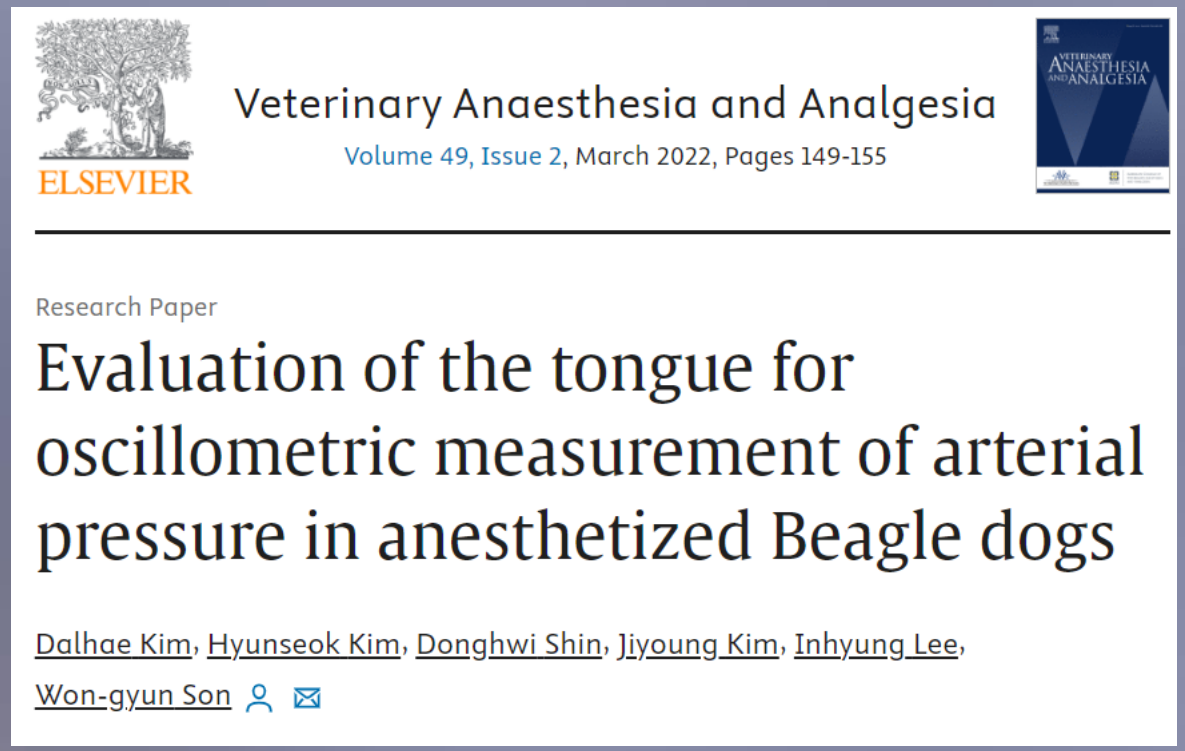
At WAVES, in the ECC department, we typically aim for a minimum of 3 readings with <20% variability in the values obtained

We tend to obtain vitals bedside, prior to walking the patient.

When we record the patient values into their record we typically express them as;

120/60 (80) #2 LF or 120/80/60#2LF

Advantages of oscillometric BP readings	Disadvantages of oscillometric BP readings
Quicker to obtain values compared to doppler and IBP readings	Relatively poor accuracy during peripheral vasoconstriction secondary to disease or medications
Easier to perform	Less accurate at extremely high and low pressures
Requires less technical expertise	Shape and size of limbs can affect readings
Can set to cycle at regular intervals for ongoing monitoring	Not truly a continuous monitoring technique compared to IBP



Veterinary Anaesthesia and Analgesia
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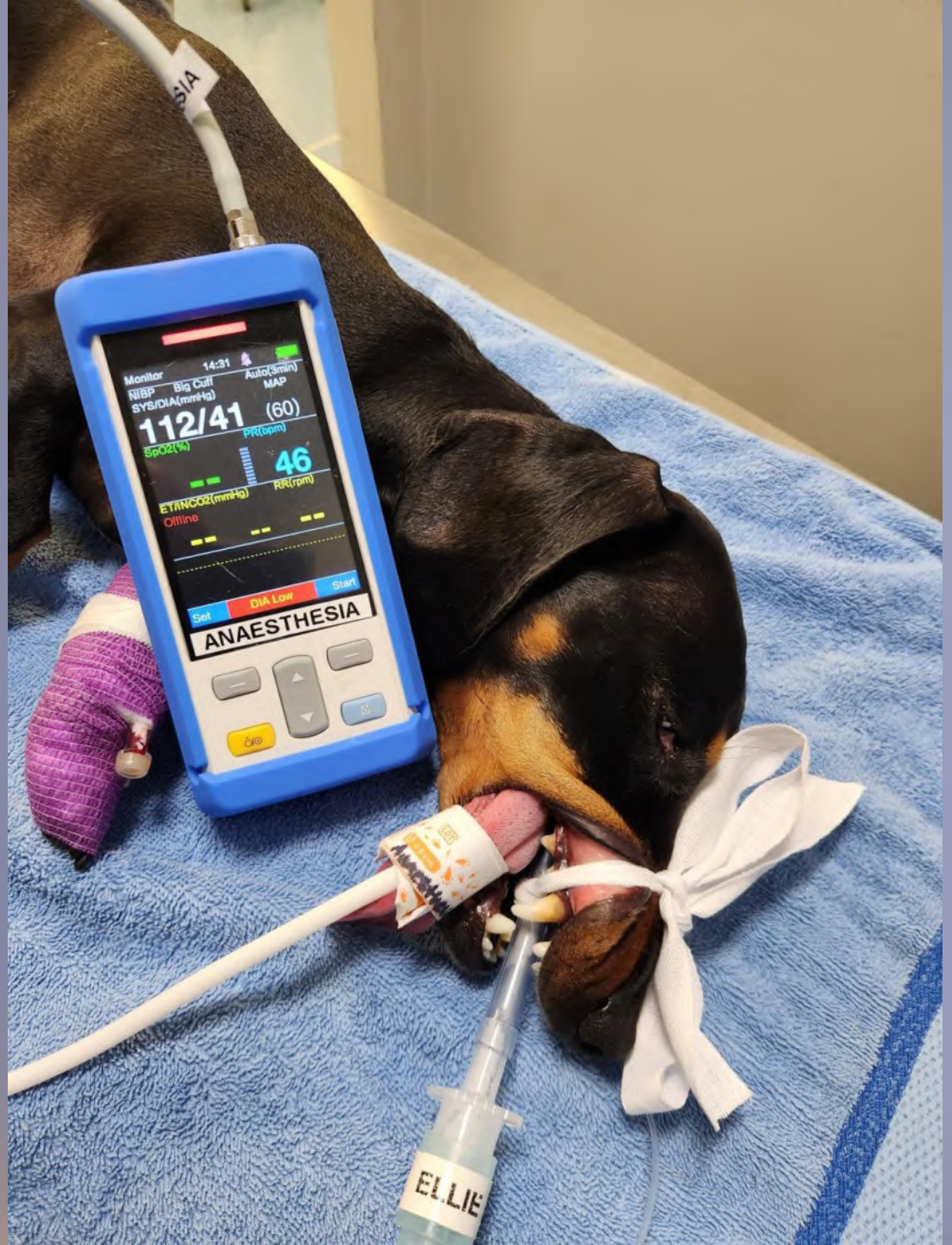
Research Paper

Evaluation of the tongue for oscillometric measurement of arterial pressure in anesthetized Beagle dogs

Dalhae Kim, Hyunseok Kim, Donghwi Shin, Jiyoung Kim, Inhyung Lee, Won-gyun Son

Interestingly this study highlighted that the tongue is a useful site for measuring oscillometric blood pressure in anesthetised Beagle dogs. There are reliable and repeatable in measuring both the MAP and DAP.

If you're ever in a pickle during a GA the dog's tongue could potentially replace other cuff placement sites and is suitable in assessing hypotension.


Monitor
14:31
Auto(3min)
NIBP
Big Cuff
MAP
SYS/DIA(mmHg)
112/41
(60)
PR(bpm)
SpO2(%)
46
RR(rpm)
ET/FiCO2(mmHg)
Offline
Set
DIA Low
Start
ANAESTHESIA

Troubleshooting Oscillometric Readings

Standard actions if patient parameters fall outside of normal values

1. Reflect on the values? Does it make sense to your patient and the clinical signs you are seeing?
2. Verify the oscillometric value by obtaining a doppler or IBP reading
3. Check other perfusion parameters including HR, PR, MM colour, CRT
4. Alert vet with all the above listed values
5. Check analgesic and other CRI's are at correct rates and concentrations
6. Check IVC for patency as the patient may require fluid boluses or vasopressors

NIBP: Doppler

The Doppler flow probe is one of the most commonly used blood pressure monitors in an ECC setting due to its accuracy in critically unwell patients compared to oscillometric readings.

It features a probe with a piezoelectric (“pie-e-zo-electric”) crystal that emit sound waves. These waves are reflected by the red blood cells (RBCs) in the pulsating arterial blood. When the sound waves bounce back from the cells, the probe detects them again, and the frequency shift caused by the movement of the cells is converted into an audible signal. By positioning a blood pressure cuff and sphygmomanometer above the probe, the patient’s blood pressure can be measured.

How to obtain a doppler reading

Cuff placement is important
We utilise:

- Mid-radius on either forelimb,
- Proximal to the hock on either hindlimb
- Tail base

Ensure the inflation tube is positioned over the artery to be occluded

Images from the American Association of Feline Practitioners

Which one of these images has the cuff positioned correctly?

Correct! The image on the left, the inflation tube is positioned over the artery and the image on the right it isn’t.

1. Collect necessary supplies.
2. Ideally we should position patient in lateral or sternal recumbency while holding the planned cuff site at approximately the level of the right atrium.
3. Clip hair from area over artery.
4. Secure a **deflated** cuff proximal to the artery and attach the sphygmomanometer. Cuff should be of a size that is approximately 40% of limb circumference in dogs or 30%–40% of limb circumference in cats. When measuring Doppler on the forelimbs, secure cuff on the radius. When measuring on the hind limbs, secure the cuff to proximal to the hock. If you need to use tape, only use a very small amount to keep the cuff in place.
5. Apply a healthy amount of ultrasonic gel to the surface of the Doppler probe (you can never have too much gel!)
6. Place gelled probe on the clipped skin overlying the artery, keeping the probe's cord parallel to the limb. Adjust with fine movements until the rhythmic "whooshing" arterial sound is audible.
7. Inflate sphygmomanometer to 30–40mmHg past the point at which the arterial sounds are no longer detectable.
8. Slowly deflate the cuff until the first sounds are detected, marking the systolic blood pressure.
9. **In between measurements allow cuff to completely deflate, allowing blood flow to return to the limb.**
10. The first measurement should be discarded and the average of three to seven consistent, consecutive readings recorded.
11. Make sure you remember to record results, cuff size, and cuff location in the patient's record for continuity.

A Comparison of Indirect Blood Pressure Monitoring Techniques in the Anesthetized Cat

NIGEL A. CAULKETT, DVM, MVetSc, Diplomate ACVA, SHAUNA L. CANTWELL, DVM,
and DOREEN M. HOUSTON, DVM, DVSc, Diplomate ACVIM

A study from 1998 showed, as a very basic summary; oscillometric readings provided the most accurate prediction of direct systolic pressure in comparison, doppler readings tended to provide a good prediction of mean arterial pressure in cats.

In summary

Advantages of Doppler BP readings	Disadvantages of Doppler BP readings
More accurate than oscillometric readings	Usually need a helper to assist with patient restraint
Less invasive for the patient than IBP readings	The sound may disturb or upset feline or nervous canine patients, if you don’t use headphones
	Patient movement can impair consistent readings

IBP Monitoring

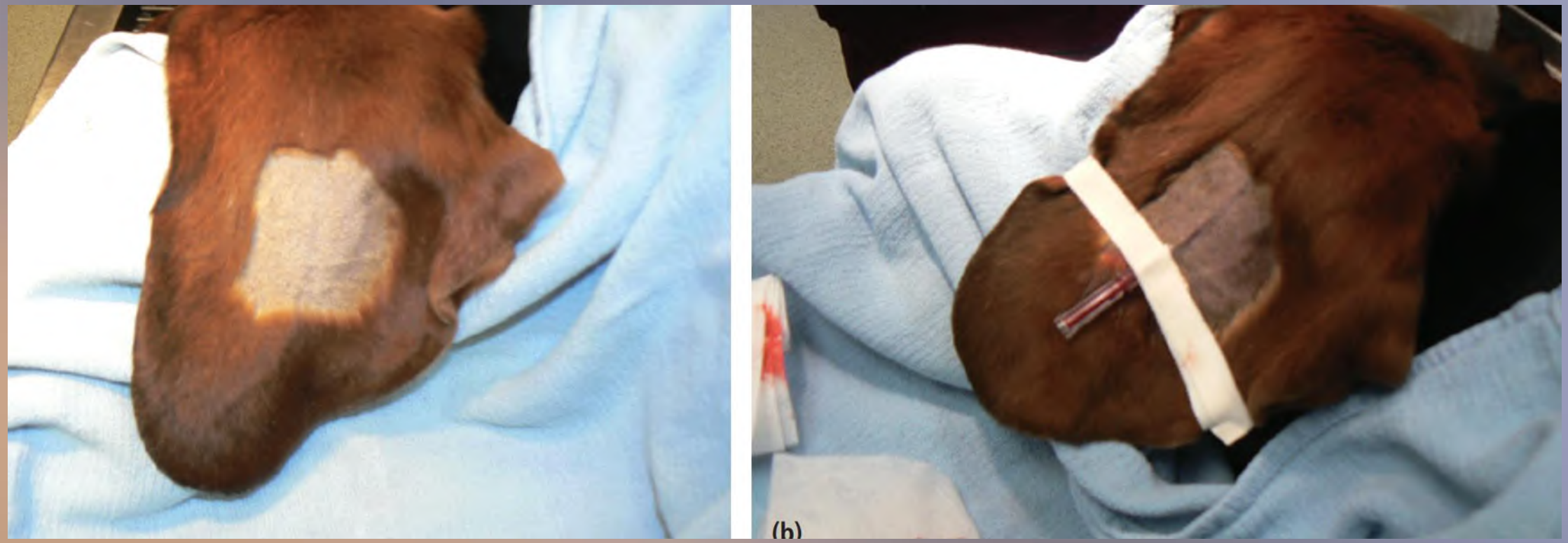
IBP measurements are the most accurate in both dogs and cats, whether awake or anesthetised. It's for this reason, we would typically reach for IBP monitoring in the following cases;

- Patients who present with severe hypovolemic or septic shock.
- Patients who are in congestive heart failure, and are receiving vasodilator medications.
- Patients being treated for severe hypotension requiring vasopressors.
- Patients receiving mechanical ventilation.
- Patents undergoing 'high risk' anaesthesia.

We don't typically utilise IBP monitoring for more stable, ambulatory patients because they are more likely to accidentally disconnect or remove an arterial line or catheter which increases the risk of arterial hemorrhage.

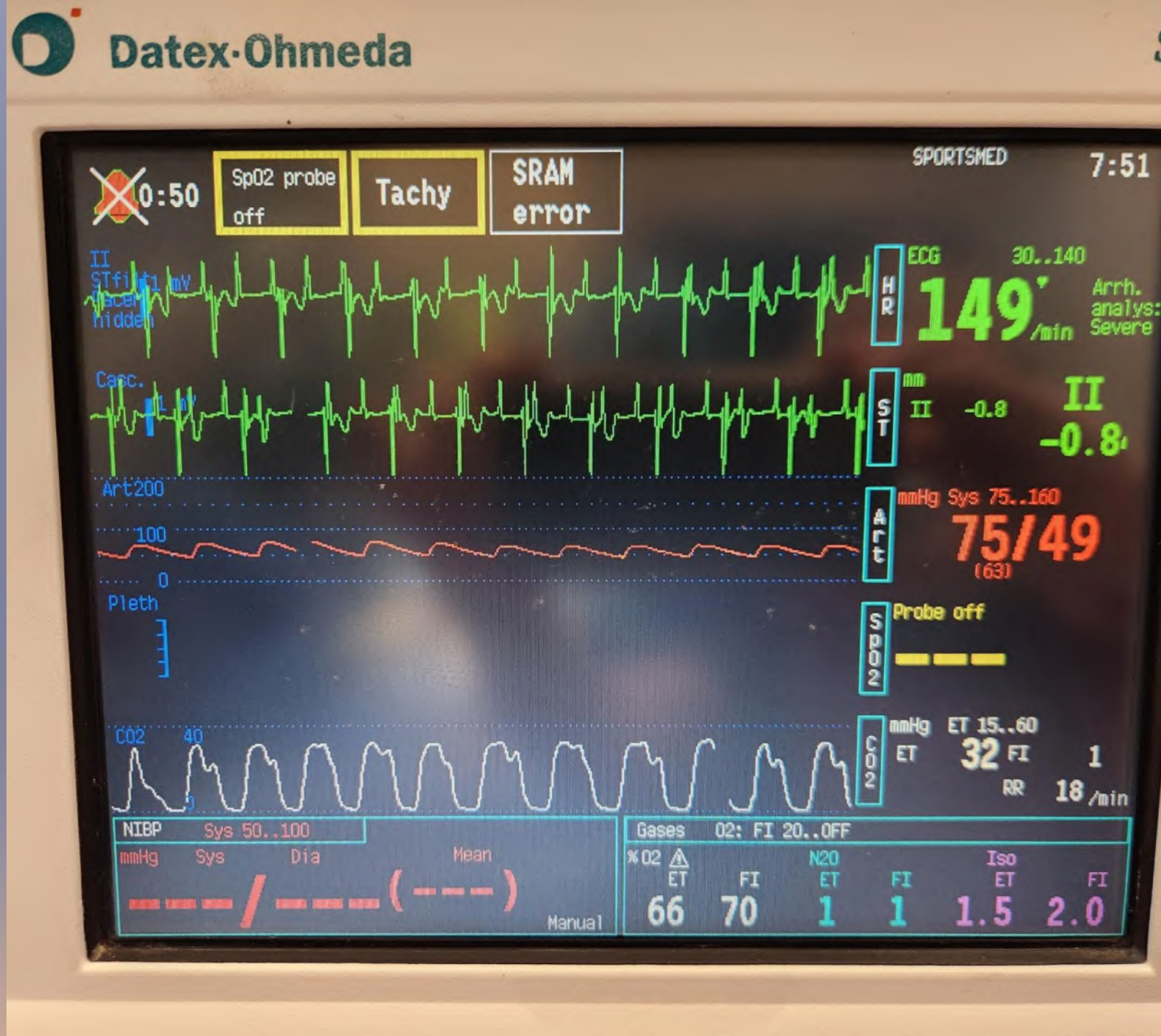
The first step in establishing IBP monitoring is obtaining arterial access

The most common arteries used for IBP monitoring in small animals are the dorsal pedal and femoral. In some occasions the auricular artery, which is located roughly through the midline of the patient's pinna's on the dorsal surfaces. This is particularly useful for blood hound and basset hounds.



Once the arterial catheter is in place, the pressure transducer and monitoring system is attached to the catheter and monitoring can begin

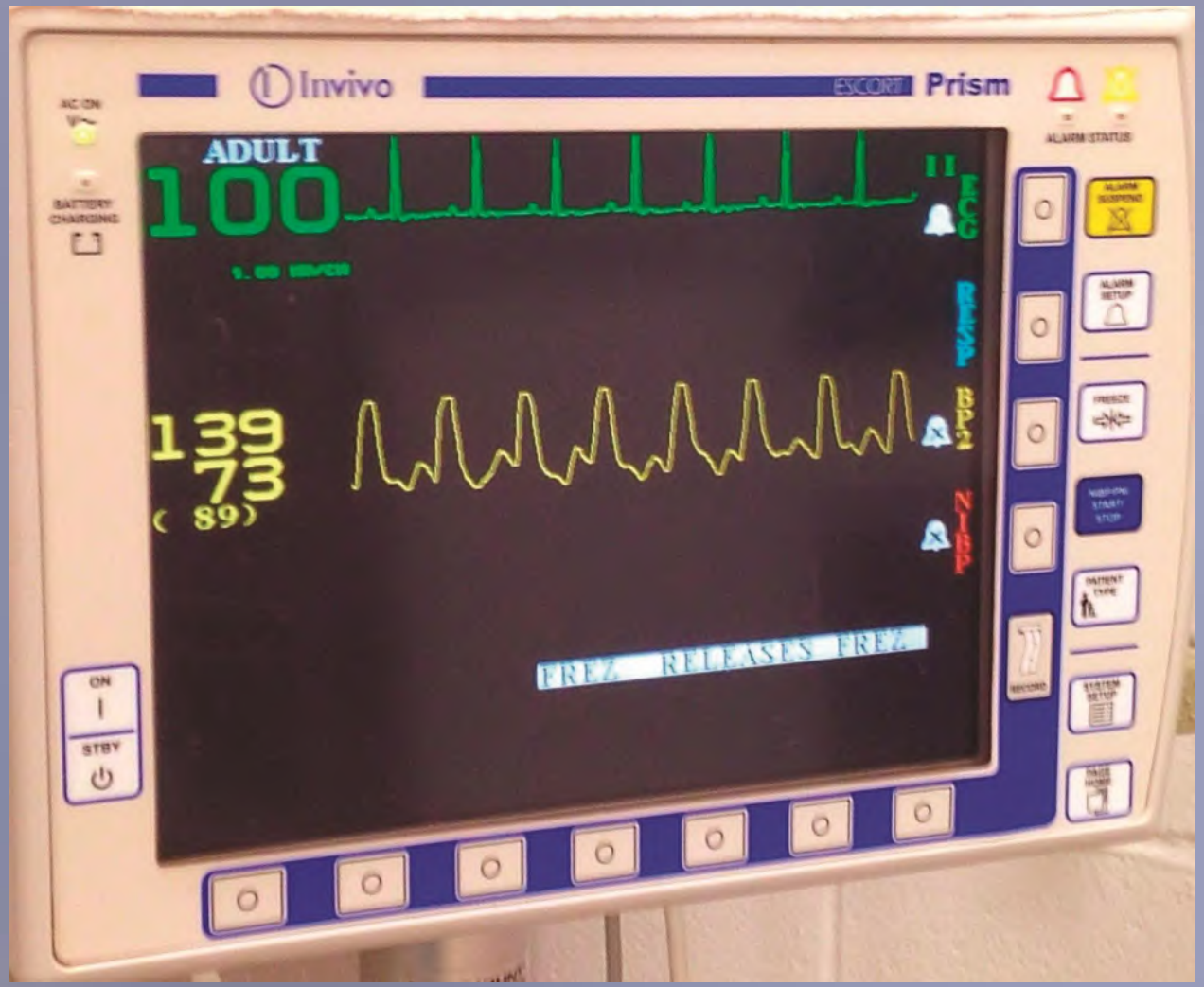
You **must** zero the transducer prior to obtaining a value. This sets a reference point (called a zero point) with which the pressure readings from the system are compared.



To zero the IBP system

1. Place the transducer at the level of the right atrium (RA) to best approximate central venous pressure.
2. Once the transducer is positioned, the stopcock is closed to the patient and opened to the atmosphere, and the “zero IBP” button is pressed.
3. The waveform line should flatten and the screen should read “0/0 (0).”
4. Once the zeroing is complete, closed the valve to the atmosphere and turn the tap open to the patient and the arterial waveform should appear on the screen.

Your waveform should look something like this..



Advantages of IBP readings	Disadvantages of IBP readings
Most accurate blood pressure reading	Requires arterial access, which can be technically difficult
Provides ‘real time’ constant blood pressure readings	Requires specialised equipment
	Requires constant observation and monitoring, to avoid arterial haemorrhage

ACVIM consensus statement: Guidelines for the identification, evaluation, and management of systemic hypertension in dogs and cats

Mark J. Acierno[1] | Scott Brown[2] | Amanda E. Coleman[2] | Rosanne E. Jepson[3] | Mark Papich[4] | Rebecca L. Stepien[5] | Harriet M. Syme[3]

The American College of Veterinary Internal Medicine (ACVIM) published an article in 2018 which has some interesting points that are of relevance to our topic;

- In humans, age-related increases in systolic blood pressure (SBP) and pulse pressure are well-documented. However, the effect of age on blood pressure in dogs and cats is less clear. Some studies have noted a small increase of 1-3 mm Hg per year in dogs, but this finding is not consistent across all research.

- There are significant interbreed differences in canine blood pressure. For instance, hounds (such as Greyhounds and Deerhounds) tend to have blood pressure levels that are 10-20 mm Hg higher than those of mixed breeds. Other breeds exhibit variations in blood pressure by 7-10 mm Hg, possibly due to differences in temperament. There is a recognised need for breed-specific blood pressure ranges to be developed for dogs. In contrast, breed does not appear to affect blood pressure in cats.

- Cats that are underweight have slightly lower blood pressure when measured with Doppler compared to cats of ideal body weight or those that are obese.

- Once hypertension is diagnosed and situational hypertension is ruled out, it's important to investigate potential underlying diseases or pharmacologic agents that could be causing secondary hypertension.

- Hypertension in pets is often silent, leading to gradual damage to target organs over time. This can cause pet owners to underestimate the importance of proper treatment and follow-up. Owners should understand that managing hypertension can significantly improve their pet's quality of life in the long term, even if the immediate benefits are not readily apparent.

In summary;

An isolated blood pressure reading is often not sufficient.

Instead, you should assess the patient's blood pressure as an average and or a trend and consider it in conjunction with other perfusion parameters and the patient's overall environment (stress, medications, general anesthesia etc).

Typically, oscillometric methods are used as the first line of measurement. If abnormal readings are obtained, it is advisable to use a Doppler to verify the results. If there is still concern after these checks, more invasive methods, such as arterial blood pressure (IBP) monitoring, may be required.

Factors such as cuff size, variations in technique, and the possibility of operator error can affect the reliability of the NIBP measurements. Therefore, consistency in your technique is crucial for obtaining accurate and reliable readings.

What do you think? Is this value for a large dog, normal or abnormal?

Normal

BP, is it normal or abnormal?

Abnormal! I'd be working on IV access and looking at those other parameters too!

Temperature

When dealing with a patient's temperature, you should assess the

- Body temperature, and
- Temperature of the patient's extremities

A study published in the JAVMA in 2014, highlighted "Although there was a positive correlation between axillary and rectal temperatures in both dogs and cats, the significant temperature gradient between the two methods suggests that axillary temperature should not be used as a substitute for rectal temperature".

Comparison of rectal and axillary temperatures in dogs and cats

Joana B. Goic, DVM; Erica L. Reineke, VMD; Kenneth J. Drobatz, DVM, MSCE

Normal Values;

High (rectal temperature)	**>39.3C**
Low (rectal temperature)	<37
Peripheral temperature	Cold -> cool -> warm -> hot

Peripheral temperature can be an indicator of core body temperature, the patient's perfusion and some disease indicators (hypothyroidism, FATE, spinal cord injuries)

Definitions

Hypothermia Low core body temperature

Hyperthermia High core body temperature secondary to exogenous (outside) causes

Pyrexia High core body temperature secondary to endogenous (internal) causes that cause fever

Hyperthermic patients warrant a different clinical approach from patients with pyrexia, both diagnostically and therapeutically

Table 1. Common differential diagnoses

Hyperthermia	True fever
Respiratory obstruction leading to an inability to dissipate heat (laryngeal paralysis or oedema, obstruction or tracheal collapse).	Infectious disease (bacterial, viral, fungal or protozoal).
Heat stroke – inability to dissipate heat (for example, excessive environmental temperature and/or humidity).	Inflammatory disease – non-infectious (for example, pancreatitis).
Exercise-induced hyperthermia – excessive muscular activity (increased heat production).	Neoplastic disease or paraneoplastic disease.
Pathologic (for example, malignant hyperthermia) or pharmacologic (for example, hydromorphine in cats) hyperthermia.	Tissue trauma/necrosis.
Prolonged seizure activity.	Immune-mediated disease (for example, polyarthritis).

To Cool or Not to Cool, That is the Question

As bizzare as it may sound, pyrexia or a true fever, may be advantageous for the patient. Numerous studies have shown that fever can shorten the duration and reduce the mortality of many infectious diseases. Consequently, treatment methods for feverish patients, such as total body cooling, **may actually be counterproductive**, as the patient will use energy to maintain the elevated core temperature. Such treatments should be reserved for non-febrile hyperthermia or when the patient's temperature exceeds 41ºC.

Severe hyperthermia above 41.6°C often causes cells to use more oxygen than can be delivered, leading to a decline in cellular function and integrity

So, if your patient has an abnormal temperature what can you do?

If it's high

1. Check catheter sites both venous and arterial- look for signs of phlebitis. Signs of phlebitis may include; pain, redness, swelling or discharge around the insertion site.
2. Check other perfusion parameters including HR, PR, BP, MM colour and CRT
3. Check surgical or wound sites including feeding tubes (o-tubes), cystostomy tubes, chest drains, JP drains etc and look for signs of infection or inflammation (heat, pain, redness, swelling or discharge)
4. Check indwelling urinary catheters
5. Notify vet, prepare equipment for aFAST/tFAST.

If it's low

1. Notify vet
2. Start active warming using bair-hugger, lined heat mats
3. Check other perfusion parameters including mentation, HR, PR, BP, MM & CRT
4. Run some baseline bloods including PCV/TS, BG, electrolytes
5. Check medications and other medication CRIs are infusing at correct dose and concentrations
6. Check IVC to confirm patency in case the patient requires fluid boluses or pressure support medications.

Bedside Ultrasounds
aFAST/tFAST

Abdominal or Thoracic Focused Assessment with Sonography for Trauma, Triage, and Tracking (aFAST/tFAST) is a quick and focused ultrasound scan used to check for free fluid and other obvious inconsistencies within the abdominal and thoracic cavities.

These scans are designed to detect the presence or absence of free fluid or air, assess the size and echogenicity of organs and structures, and observe normal movements. They are not typically performed by specialists but the emergency clinicians aiming to make a rapid diagnosis, or monitor patient's in their care.

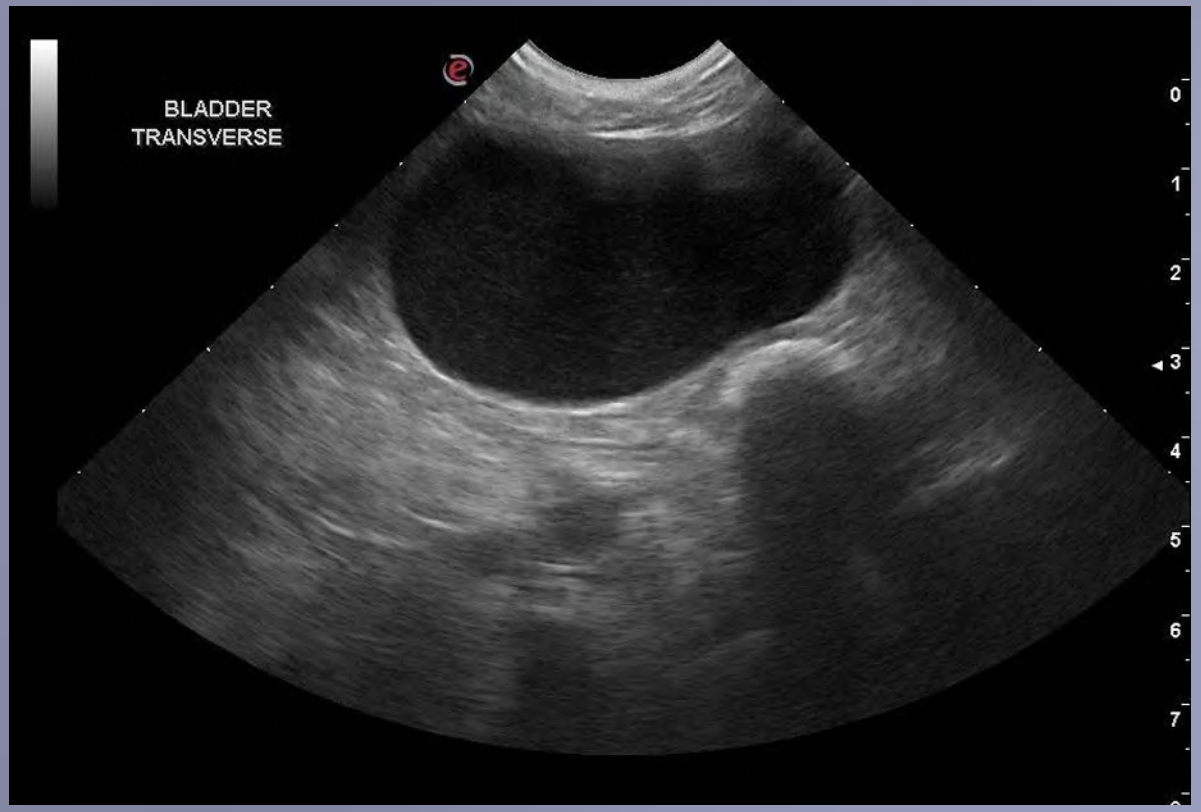


Image from: Today's Veterinary Practice

The aFAST examination typically involves assessing four quadrants of the abdomen: caudal to the xiphoid, cranial to the bladder, and the right and left dependent flanks.

The vets will often focus on the specifics. However, as nurses, we can assist by relaying abnormal vital signs, which may help the vets form a more complete diagnostic picture.

Its important to remember, on ultrasound images, fluid appears BLACK, while on x-rays, AIR is black.

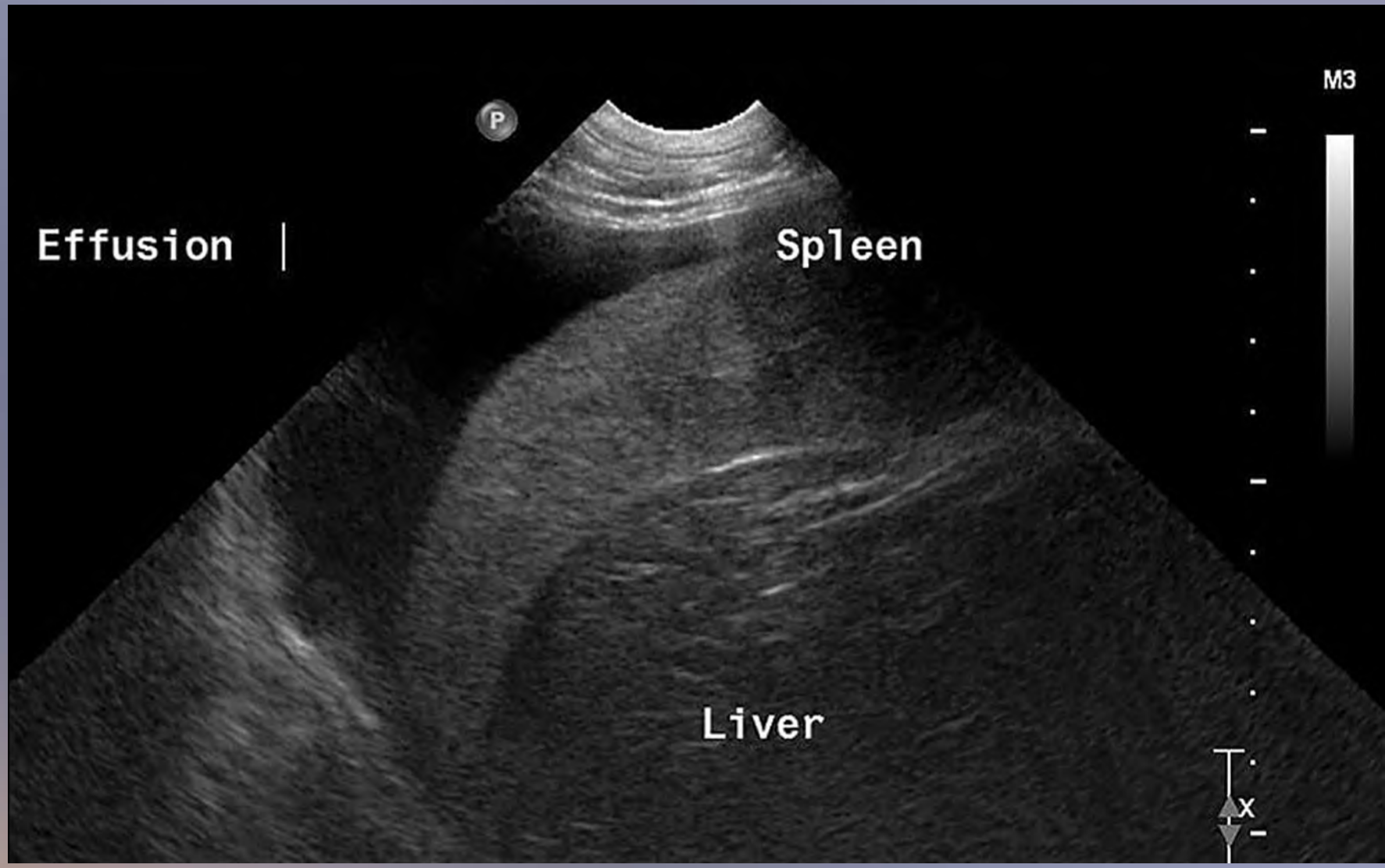
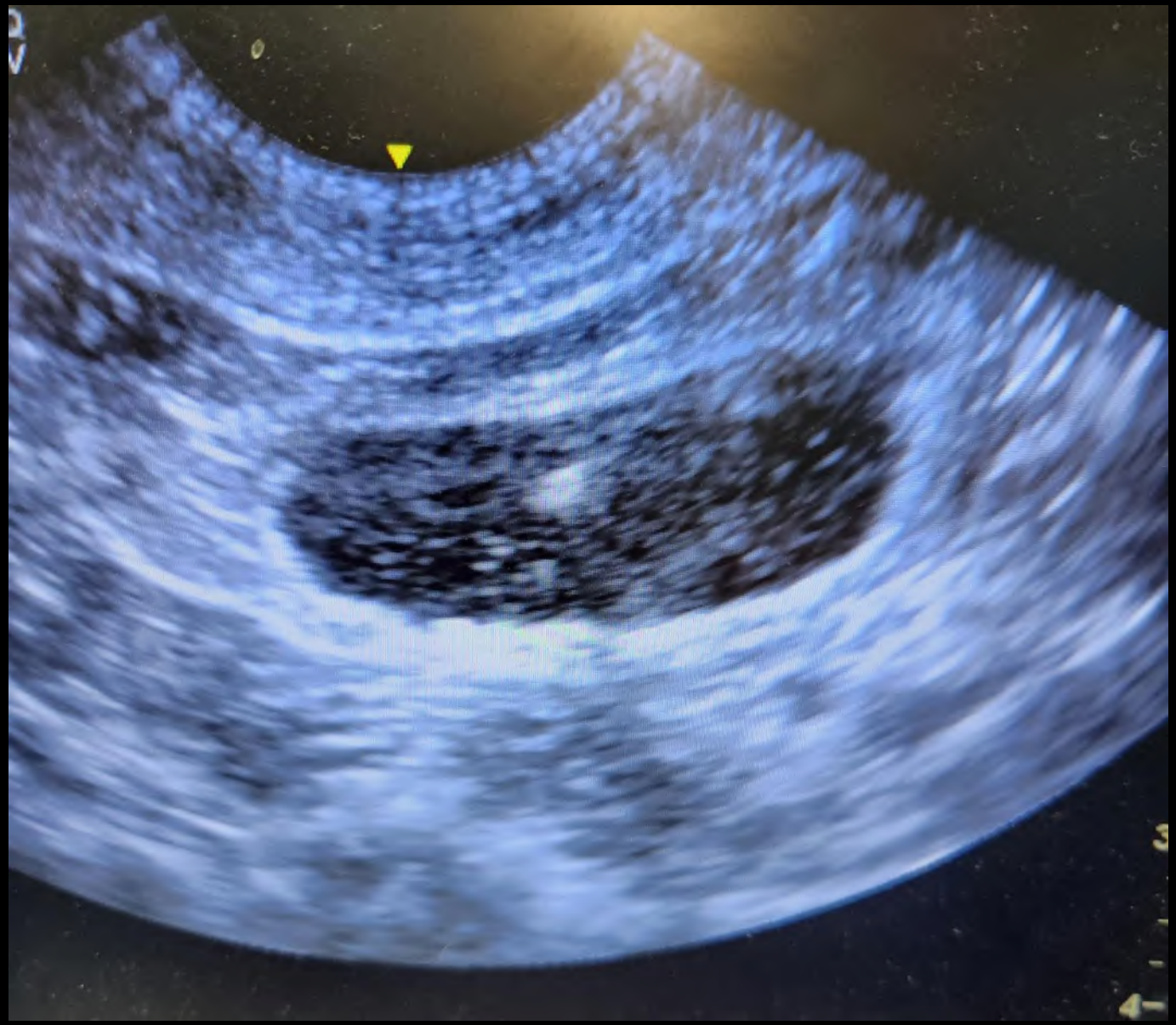


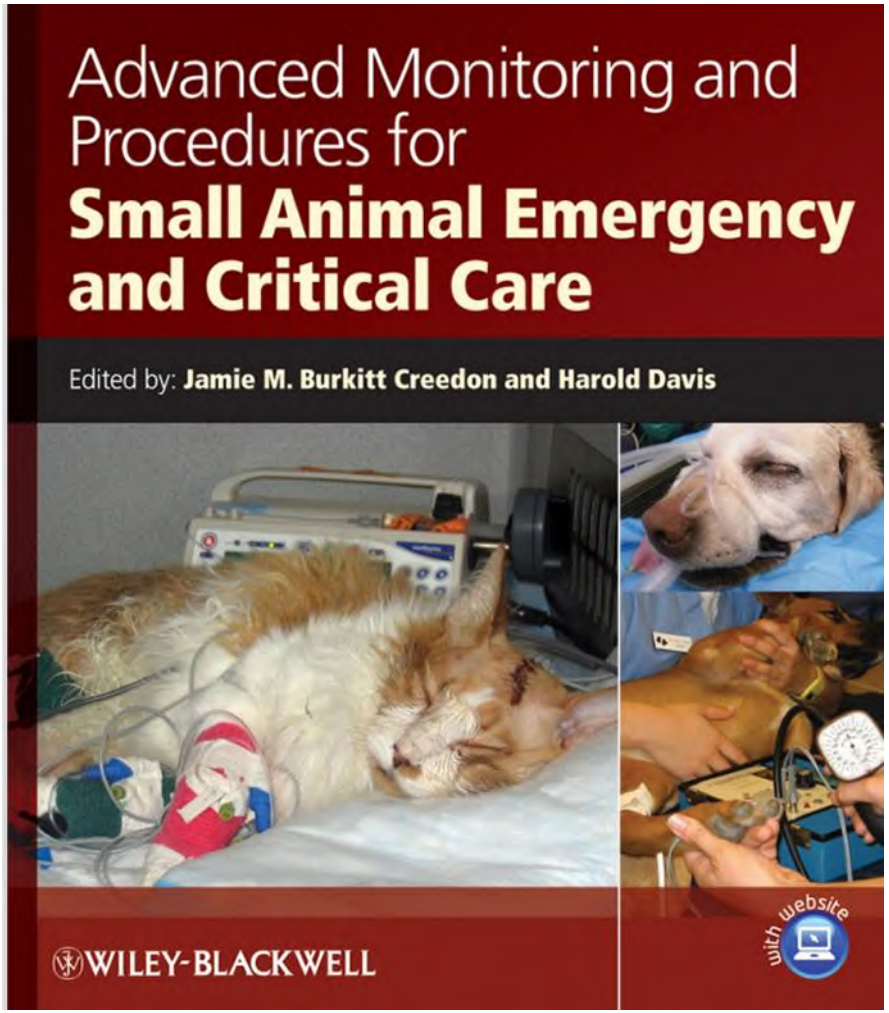
Image from: Today's Veterinary Practice




Datex·Ohmeda
CLINTON
5:14
Brady
SpO2 probe off
Lead II
HR
38
/min
ART
mmHg
100/66
(78)
Pleth 2
SpO2
Probe off
CO2
mmHg
ET
0
FI
0
RR
APN
Apnea
T1
°C
T1
21.7
NIBP
mmHg
Sys
Dia
Mean
Manual
Gases
O2%
N2O%
AAN
ET
79
0
FI
79
0
Invasive Pressures
Zero ALL
NIBP
Auto On/Off
Start Cancel
Recorder
Record Wave
Stop
Silence Alarms
Freeze
Take Snapshot
Alarms Setup
Record/ Print
ECG
NIBP
Invasive Pressures
Normal Screen
Help
Reset Case
Display Trends
Monitor Setup
Patient Data
Pulse Oximetry
Airway Gas
Others
ON
STBY

Questions?

Thank you for coming!



If you're looking for a great book to reference, majority of the information from today's presentation came from; "The Advanced Monitoring and Procedures for Small Animal Emergency and Critical Care" by J Burkitt & H Davis.