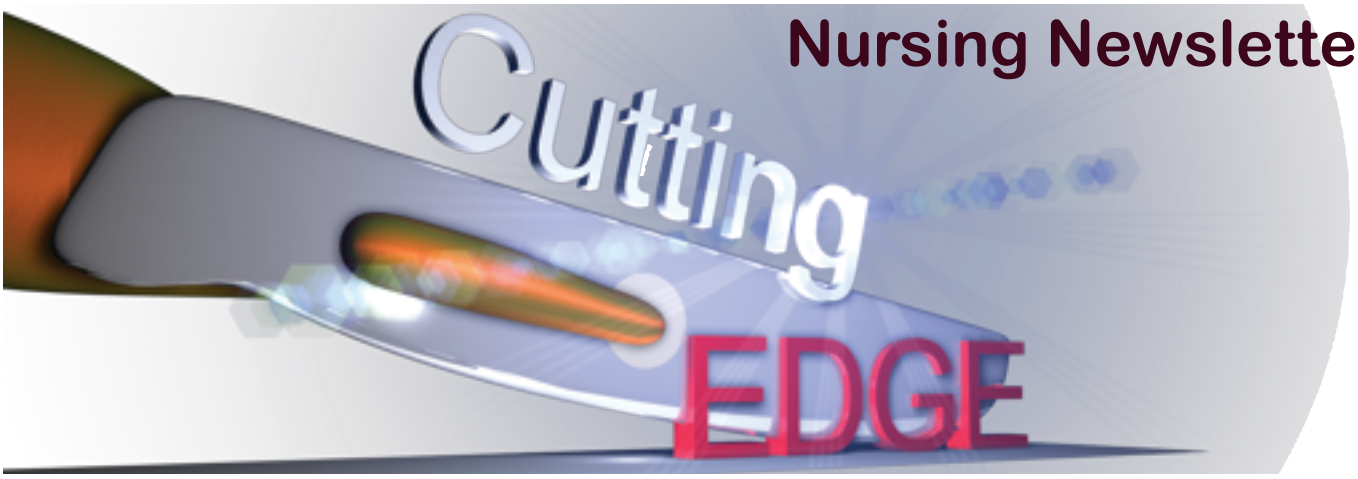


Nursing Newsletter

February 2010 Edition 5

Welcome to the latest Torrington Orthopaedics Newsletter for Veterinary Nurses.

In this edition of our nursing newsletter we will be looking at monitoring blood pressure in anaesthetised animals. This topic will also be discussed at the CPD evening to be held on the 24th March.

Why Monitor?

Monitoring an animal in the peri-anaesthetic period is critical as all current sedative and anaesthetic agents will depress vital organ systems. Side effects, such as cardiovascular and respiratory depression, occur at therapeutic doses and are therefore significant every time an animal is anaesthetised. These effects are potentially life threatening and need to be monitored so action can be taken before any problems occur. A lot of anaesthetic deaths can be avoided by good patient monitoring, both human and machine.
Monitoring equipment is useful to augment the senses of the anaesthetist, free the anaesthetist's hands and allow continuous assessment of multiple parameters, it should never replace a dedicated person continuously monitoring the animal.

Blood Pressure Monitoring

Blood pressure monitoring is an under utilised tool in veterinary practice, especially in anaesthetised animals and is a useful adjunct to the more commonly used monitoring.
Hypotension is a common problem during anaesthesia in companion animals and should be avoided where possible. Monitoring blood pressure under anaesthesia can help to detect and prevent some common intra and post-operative complications.

What is Arterial Blood Pressure?

Arterial blood pressure is the force of blood on the walls of the vessels and can be measured as the product of cardiac output and systemic vascular resistance.
Blood Pressure = Cardiac Output (CO) x Systemic Vascular Resistance (SVR)
= Heart Rate (HR) x Stroke Volume (SV) x SVR.
Each of these components will therefore have an effect on the blood pressure.
Although we measure blood pressure it does not tell us about the more important value, perfusion. Currently we can not routinely measure perfusion and have to use blood pressure as the best available measure.
The blood pressure is regulated by endogenous (internal) systems. There are 3 main systems:

- The baroreceptor reflex: Baroreceptors are pressure receptors located in various organs of the body. These alter the mean arterial blood pressure by altering the inotropy (force of contraction), the speed of contraction and the peripheral resistance.
- Renal compensation via the renin-angiotensin system: This system is the kidneys' compensation for a drop in blood pressure or blood volume. The release of renin leads to the formation of angiotensin II, which is an endogenous vasoconstrictor. This is a long term system. The formation of angiotensin II or high potassium

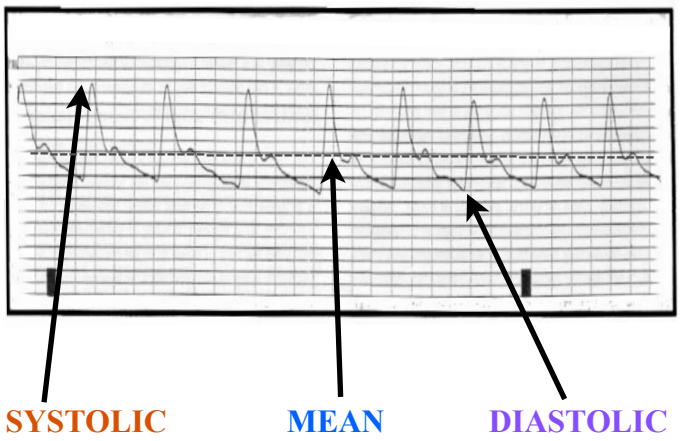
levels leads to the release of aldosterone (a steroid hormone from the adrenal cortex).

- Aldosterone: This stimulates sodium retention and potassium excretion in the kidneys. This leads to increased fluid retention and therefore increased arterial blood pressure.

These 3 mechanisms are linked and can all be targeted pharmacologically.

Components of Blood Pressure

The main components of the arterial blood pressure are systolic, mean and diastolic pressure. These can be demonstrated on the blood pressure waveform shown below:



(This is what is typically seen on invasive blood pressure monitors)

The systolic blood pressure is the highest pressure reached during the cycle. It is predominantly determined by the stoke volume (how much blood is pumped out of the left ventricle in one cycle) and the arterial compliance (related to the arterial vascular tone and the distensibility of the arteries).

The diastolic blood pressure is the lowest pressure reached in the cycle. It is determined by the heart rate and the systemic vascular resistance (the vascular tone).

The mean blood pressure is the average pressure over the cardiac cycle. This does not mean half way between the systolic and diastolic pressures but it is half the area under the blood pressure curve. If the blood pressure curve were a perfect triangle then it would be:

Mean blood pressure = Diastolic blood pressure + (systolic pressure - diastolic pressure) / 3.

Often the mean blood pressure is closer to the diastolic pressure as the waveform is often tall and narrow.

The mean blood pressure is physiologically the most important as this is the pressure that determines the driving force of blood that is vital for the perfusion of tissues.

Measurement

Arterial blood pressure can be measured in many different ways. These can be divided into 2 broad categories; non-invasive (indirect) and invasive (direct) blood pressure.

Non-invasive Blood Pressure (NIBP).

Non-invasive (or indirect) arterial blood pressure can be measured using different methods. Most of these methods involve the use of a blood pressure cuff. The cuff width used should be 0.4-0.6 x the circumference of the appendage used (e.g. limb or tail) and placed at the level of the heart. If the cuff is too loose or narrow then the readings will be falsely high, whereas if the cuff is too wide or too tight the readings will be falsely low. The cuff should also be fitted nicely around the limb, if too tightly or loosely applied then the readings will be inaccurate.

All of the non-invasive methods in use in veterinary science are intermittent and most are not instantaneous as they often have to be measured over several cardiac cycles.

Sphygmomanometery

This is the technique most commonly used in the doctors surgery and hospitals. A cuff is placed upon an appendage and the pressure in the cuff measured. The pulsatile flow in a distal artery is detected by palpation, a stethoscope, pulse oximeter, another cuff (oscillotonometry) or with a Doppler ultrasound probe. The pressure in the cuff is increased until the pulse is abolished. The pressure in the cuff is then slowly released and the return of flow detected by the chosen method.

The pressure at which the flow is first detected is the systolic pressure and is the easiest pressure to measure. The diastolic pressure can be detected but is usually more subjective. The mean pressure can be calculated as previously shown on this page.

This method is simple and inexpensive. However, it only reliably measures the systolic pressure, is

intermittent and is affected by thick hair and fat. When using Doppler with this method it is not very accurate (+_10 mmHg) and in cats it is suggested that you add 14.7 mmHg to the reading to obtain a more accurate systolic pressure. The Doppler method has a lot of advantages in small animal anaesthesia; there is an audible component that allows monitoring of the heart rate as well; the sound changes with changes in blood pressure and can give an audible indication of any potential problems and therefore act as an early warning system; quick and easy to set up and not dramatically affected by movement. As this method only measures systolic blood pressure it is not as useful as those that measure mean blood pressure, also as there is no consistent relationship between the systolic and mean pressures the mean can not be estimated from the systolic.

Oscillometry

This is an automated version of the cuff with mechanised inflation and deflation of the cuff. Pressure sensors in the machine detect the pressure changes as the cuff deflates. The changes in the pressure in the cuff are used to detect diastolic, mean and systolic pressures and usually also the pulse rate (which is very useful in helping determine the accuracy of readings).

This method is useful as it is automated and therefore the anaesthetist is free to concentrate on the patient. This can also be programmed to take measurements at set intervals. These devices are generally more expensive than the manual methods and do not work well under “abnormal conditions” (which is when you will need it most) e.g. arrhythmias, bradycardia and hyper/ hypotension.

How to use an NIBP cuff

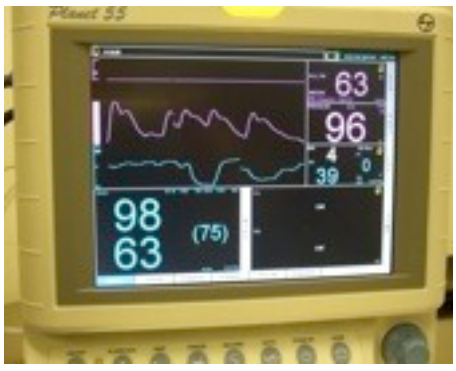
1. Select an appropriate appendage e.g. Limb or tail.

2. Select an appropriately sized blood pressure cuff. This should be 0.4-0.6 x the circumference of the appendage. Most modern BP cuffs will have an acceptable range marked on them.

3. Place the blood pressure cuff around the appendage, ensure the cuff fits into the range.

4. Some cuffs have a marker to show where to place the cuff in relation to the artery.

5. Wrap the cuff around the appendage and attach to the appropriate monitor.



6. Get the reading on the monitor.

Others

There are other methods that are not currently used in veterinary medicine.
Plethysmography. This uses the waveform produced by a pulse oximeter to measure blood flow.
Penaz technique, also called the Finapress, that combines the use of a cuff and plethysmography and gives a continuous reading (i.e. beat to beat), but this may interfere with tissue perfusion if used for prolonged periods.

Invasive Blood Pressure

This requires the catheterisation of an artery, which requires skill. The arterial catheter is connected via non-distensible tubing to a calibrated (strain-gauge) transducer or aneroid manometer tubing. The transducer converts the pressure to an electrical signal which can be displayed on a monitor as a waveform and numerical values.
There are a few potential problems with this method as it is invasive e.g. trauma to the vessel, haematoma, emboli, infection, haemorrhage, necrosis of the distal limb and damage to peri-arteriolar structures (e.g. nerves). The device must be zeroed before use at the level of the heart and calibrated regularly.
The advantages of this method are that, when used with a transducer, it gives you beat-to-beat information (i.e. is continuous and instantaneous) and accurate values. Invasive blood pressure monitoring also allows easier arterial blood pressure monitoring.
This is an accurate determination of the mean arterial blood pressure, but is not as accurate for systolic and diastolic pressures (this is due to the damping in the system, due to the swings from high to low).

Invasive Blood Pressure monitor.

What to do about hypotension

The aim is to keep systolic ABP > 90mmHg, mean ABP > 60mmHg (ideally 80 mmHg) and diastolic ABP > 40 mmHg. Sympathetic stimulation, by lowering the anaesthetic depth inappropriately, should not be used to correct hypotension as this will not help correct, and may even worsen, the potential consequences of hypotension.
To maintain blood pressure several things can be done; assess anaesthetic depth, fluids and drugs.
Too deep an anaesthetic depth is a very common cause of hypotension. If there is a low blood pressure then the anaesthetic depth should be assessed and lightened where possible. Often more analgesia can be given to enable the isoflurane % to be lowered and therefore increase blood pressure.
Fluid administration alone is often enough to correct hypotension. To start, a bolus of 10-20ml/kg IV can be given and then reassess in 5 mins. This should not be done in cases with diseases where excess fluid is potentially harmful e.g. if the animal has heart disease.
Drugs can be used to correct hypotension, but these are often not commonly available in veterinary practice and should always be used with care. Drugs that can be used include; dobutamine, dopamine and phenylepherine.

Wednesday veterinary & nursing CPD events at Torrington Orthopaedics

24th March	Anaesthesia of Cardiac Patient.	28th April	Orthopaedic Instrumentation.
16th June	Clinical Assessment of the Orthopaedic Patient.	14th July	In & Out, Tubes & Drains.
22nd Sept	Pelvic Fractures.	13th Oct	Nursing Pelvic Trauma.
8th Dec	Cervical Spinal Lesions.	Interested?	Call us or e mail cpd@torvet.co.uk

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