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Rabbit Nursing: Anaesthesia and Critical Care Mini Series

Session One: Pre-operative assessment and stabilisation

Molly Varga BVetMed DZooMed MRCVS
RCVS Recognised Specialist in Zoo and Wildlife Medicine

Nursing Rabbits- Session 1

Introduction

As prey animals, rabbits are good at disguising illness, often until it is too late. In nursing terms this may mean that your patient is more ill that you expect and much less stable than you would like, particularly when undergoing anaesthetic procedures. The aims of this course are to encourage nursing staff to gain reliable baseline data, and combine this with clinical pathology results to enable an accurate health status of their patients to be determined. Nurses will also learn how to provide appropriate fluid therapy via several routes, as well as calculating fluid deficits, ongoing losses and maintenance requirements in order to formulate a suitable fluid therapy plan. In the same manner, nutritional requirements and support feeding will be discussed in detail, again allowing for a suitable nutritional plan to be devised. Finally pain recognition and the methods we use to treat pain in rabbits will be considered in detail, to allow nursing input into appropriate analgesic plans for our rabbit patients.

What is baseline data?
•Respiratory rate
•Heart rate
•Gut motility
•Body weight
•Body Condition Score (BCS)
•Hydration status
•Capillary Refill Time (CRT)
•Body temperature

Respiratory rate
•What is normal?
•Stated as 30-60 breaths per minute
•Can visualise nasal movements as well as chest excursions
•Take a visual respiratory rate before the rabbit is even touched
•Look at depth of breathing as well as rate
•Paradoxical breathing
•Remember circumstances are everything- get a good baseline once the rabbit is calm and used to you
•This means that you may need to check the respiratory rate several times before you can be confident you have an accurate answer.

Heart rate
•Normal heart rates are between 120-300 depending on the circumstances and size of the rabbit.
•Take the heart rate as soon as you start the initial rabbit examination and certainly before anything painful is attempted.
•Ideally make certain that the heart rate matches the pulse rate- ie there is a good pulse produced for every beat.
•Check for murmurs and abnormal rhythms and highlight these in your pre-anaesthetic assessment/ongoing clinical notes
•Remember circumstances are everything- get a good baseline once the rabbit is used to you.
•This means you may have to check the heart rate several times before you can be confident you have an accurate answer.

Gut motility
•Most rabbits will have consistent gut sounds, audible on both sides of the abdomen
•These can be checked by placing your stethoscope on either side of the abdomen behind the ribcage and in front of the hind leg
•Stressed rabbits will often have reduced gut sounds
•Normal rabbits guts will move at least every 30-40 seconds
•Remember circumstances are everything- you will get a better more accurate idea of gut motility once the rabbit is calm and used to you handling it

Body weight
•An accurate body weight is a basic essential that should be checked every time the rabbit is examined
•There are a couple of pitfalls in terms of bodyweight.
•The gut is approximately 1/3 of the body volume- therefore bodyweight can appear to drop rapidly if a rabbit is not eating
•Large volumes of fluid can be retained in the gut leading to dehydration and electrolyte abnormalities if the gut isn't working- often these rabbits will not change weight rapidly- but they will be compromised

Body condition score
•BCS is a tool for determining whether an animals weight is appropriate to its body size
•In rabbits it is most useful when examined with reference to the bodyweight.
•There are instances where bodyweight will not change but the BCS does

Hydration status
•Normal animals with access to water should be able to maintain normal hydration
•Any rabbit that is not eating should be assumed to be 5% dehydrated at least
•Skin tent may be useful but older animals may have a fibrous dermal shield over their shoulders making this more challenging
•A prolonged skin tent is associated with 10% dehydration
•Mucous membrane wetness is more useful and consistent – they will become tacky at 7-10% dehydration
•Eyes may become sunken and dry looking- 10-12% dehydration

Capillary refill time
•CRT is a useful indicator of how efficiently the cardiovascular system is working
•A mucous membrane that is blanched by digital pressure should regain its normal colour within 2 seconds
•Delayed or prolonged capillary refill may be associated with poor cardiac output or hypovolaemia

American Society of Anesthesiologists Health Status Classification
•Class 1 – fit and healthy, no systemic disease.
•Class 2 – mild to moderate systemic disease only.
•E.g. skin tumour, chronic arthritis, fracture without shock.
•Class 3 – severe systemic disease, causing mild symptoms / limiting activity, but not incapacitating.
•E.g. moderate hypovolaemia, anaemia or pyrexia, mild to moderate heart failure.
•Class 4 – severe systemic disease that is a constant threat to life.
•E.g. severe uraemia, toxaemia, hypovolaemia, heart failure.
•Class 5 – moribund patient that is not expected to survive 24 hours with or without the operation.
•E.g. extreme sepsis / shock.

Pre-anaesthetic blood sampling
•Why bother?
•Rabbits are prey animals and hide illness well until they are really unwell
•Allows confirmation that findings on physical examination are accurate
•Gives confidence that an animal is physically able to cope with the procedure being planned
•Does it change anything? In a large retrospective study done in humans- pre- anaesthetic blood screening had little impact on whether a procedure was performed but did impact more on how a procedure was performed

Haematology
•Many unwell rabbits become slightly anaemic which can impact on the rabbits ability to adequately oxygenate (PCV is normally 35-45%)
•It is rare to get a very elevated white cell count in a rabbit that is believed to be well, however it is possible that there is a shift in the white cell count that reveals an increase in heterophils compared to lymphocytes. Rabbits are normally lymphocyte dominant, so an increase in heterophils suggests active infection or inflammation

Electrolytes
•Potassium- both elevated and depressed potassium levels can affect cardiac function- abnormalities must be addressed and corrected prior to anaesthesia
•Calcium- many rabbits have high blood total and ionised calcium levels. This may be secondary to diet, and the rabbits unique calcium metabolism. Low calcium levels should be addressed prior to anaesthesia
•Phosphorus- phosphorus levels may be elevated or depressed by renal disease in rabbits- it may be the first sign that something is going wrong with the kidneys. Because some drugs are excreted renally this could impact choice of anaesthetic

Enzymes
•Creatine kinase (CK)- levels increase with tissue damage- may even be handling
•Aspartime aminotransferase (AST)- elevations suggestive of liver inflammation- but not specific for this, there is AST in muscle as well
•Lactate dehydrogenase (LDH)- may be associated with both liver and muscle damage
•Gamma glutamyl transferase (gamma GT)- may be associated with liver damage or poor sample quality
•Alkaline phosphatase (AlkP)- associated with poor bile flow around the liver and potentially with reduced liver function

Metabolic by-products
•Creatinine- good indicator of the efficiency of glomerular filtration
•Urea- by product of protein metabolism maybe elevated due to poor renal filtration or by bleeding into the gut. Is often low in rabbits due to their diet. Neither creatinine or urea are very good indicators of renal function on their own
•Glucose- may be elevated or severely depressed in unwell rabbits. Elevation has been noted in some cases of gut obstruction
•Total protein- may be elevated in animals that are dehydrated but depressed if the animal has been anorexic or if there is poor hepatic function. Many anaesthetic drugs are very protein bound and their effects may be altered if total protein levels are abnormal

Venous access
•Marginal Ear Vein
•Lateral Saphenous Vein
•Jugular Vein
•Cephalic Vein

Marginal ear vein
•Suitable for collection of small volumes of blood or placement of intravenous catheters
•Do NOT use the central artery
•Over use maybe associated with ischaemic necrosis of the lateral portion of the ear- it is a recognised risk
•Use of topical local anaesthetic gel (EMLA) may make use easier as rabbits tend to resent this

Lateral saphenous vein
•Useful for collection of larger volumes of blood
•NB can get significant haematoma post-phlebotomy if pressure is not adequately applied afterwards
•Very superficial and prone to ‘blowing’ so less useful for placement of intravenous catheters
•Most rabbits tolerate use of this vein very well

Jugular vein
•Useful for collection of large volumes of blood
•It is not generally useful for intravenous catheterisation
•Female or obese rabbits may have a large dewlap that gets in the way of being able to visualise and access this vein
•May be used for central venous catheter placement

Cephalic vein
•May be used for collection of small volumes of blood or for intravenous catheter placement- particularly in larger individuals
•Most rabbits tolerate this well

Fluid therapy
•Crystalloids
•Hypertonic Saline
•Colloids
•Blood products?
•Subcutaneous
•Intravenous
•Intra-osseous
•Intra-peritoneal

Crystalloids
•Crystalloids: resuscitation and maintenance. Good in shock as alkalising.
•Sterile fluids that are generally the same tonicity (strength) as blood
•Saline, Ringers, Lactated Ringers, glucose saline
•Can be given at 2-4ml/kg/minute

Hypertonic saline
•Hypertonic saline works synergistically with colloids in resuscitation 3-5ml/kg over 10 minutes
•Sterile solution that is higher in strength/concentration than blood
•The high concentration draws fluid into the cardiovascular system allowing volume and pressure to be maintained
•The positive effect is relatively short acting, and hypertonic saline MUST be used in conjunction with crystalloids

Colloids
•Colloids: For resuscitation, rather than rehydration
•Allow a reduced crystalloid dose (40-60%) Intravascular volume expanders.
•Can expand blood volume by 1.4x
•Administer with crystalloids to avoid interstitial volume depletion 20ml/kg for hetastarch

Blood products
•Not as good as other fluids for improving blood flow to organs.
•Not usually for emergency resuscitation.
•Indicated if need albumin, coagulation factors, platelets or red blood cells, >20% blood volume lost.
•Aim to get a PCV > 25% 10-20ml/kg PLUS other resuscitation fluids
•NB issues surrounding collecting blood from other animals

Subcutaneous fluids
•Rabbit skin has a ‘fracture plane’ under the dermis. This means that the skin is more loosely attached compared to other species
•This in turn means that fluid can be injected under the skin more easily and probably with less pain
•Not suitable for severely dehydrated or volume depleted animals but very useful and effective for routine procedures
•The addition of ‘Hyaluronidase’ an enzyme that breaks down the ‘glue’ between cells, makes fluid uptake very much more efficient

Intravenous fluids
•The ‘Ideal’ for fluid therapy as large volumes can be given rapidly in a controlled fashion directly into the circulation.
•As previously mentioned there are several suitable veins
•The size of some patients means that keeping the fluids running without a syringe driver or low volume infusion pump is challenging and the catheter can tend to block
•Some rabbits become distressed when attached to an IV line and get tangled up, even to the point of near strangulation
•Consider repeat small boluses of fluid rather than a drip if needed

Intra-osseous fluids
•The most useful yet underused method for getting vascular access, especially in very small of very collapsed patients
•You can put anything into a bone that you would put into a vein
•A catheter (spinal catheter or hypodermic needle) is used to push through the end of a long bone (femur or tibia usually) and get access into the medullary cavity
•Fluids can then be infused directly into the medullary cavity and these fluids go directly into the circulation
•NB initial placement and initial injection can be painful

Intra-peritoneal fluids
•Commonly suggested as a route for fluid therapy in lots of small exotic pets including rabbits
•Very useful if all else fails, but there are a couple of serious disadvantages
•Rabbits are diaphragmatic breathers, placing a large volume of fluid into the peritoneal cavity increases pressure on the diaphragm and can restrict breathing
•Rabbit guts are very large and dilated, it is very easy to cause damage and even peritonitis using the intraperitoneal route
•Use only if all other options are exhausted

Calculating fluid rates
•Maintenance fluid requirements
•Mammals 75-100 ml/kg/day
•Deficit calculation
•BW (g) x % dehydration = deficit (ml)
•Replacement of deficit
•24-48 hrs (birds/mammals)
•Ongoing losses- eg discharge from wounds/burns, increased respiratory rate in respiratory disease, diarrhoea, polyuria, must be added into the fluid provision

•**Therefore: Maintenance + % Deficit being replaced that day + Ongoing losses = daily requirement**

Nutritional support
•Any rabbit that is not eating has the potential to become seriously unwell very rapidly
•Any rabbit that is not eating should be assumed to be at least 5% dehydrated
•Once it has been established that there is no gut blockage, then assist feeding can commence alongside treatment of the cause of anorexia
•While some rabbits will respond to hand feeding and treat foods, usually some form of supported feeding is required.
•The easiest way to do this is by filling a syringe with an appropriate diet and syringing this directly into the side of the rabbits mouth.

What to feed
•Types of diets available- there are powdered diets available from several companies that are suitable and nutritionally complete
•Remember that if the rabbit is dehydrated but the gut is working, fluid contained in the food is part of your rehydration plan
•What should you be looking for in terms of ingredients? Fibre, preferably long stem fibre, calcium content, protein content, pre/probiotics, vitamin C content
•Do you still offer normal food? Yes absolutely- offering favourite foods in particular will often encourage eating. Syringe feeding doesn't discourage voluntary feeding in most rabbits

How to feed
•General principals- make syringe feeding as stress-free as possible, use palatable foods, and stop if the rabbit gets at all distressed or fails to swallow the food.
•Do not overwhelm the rabbit by giving large mouthfuls, smaller regular mouthfuls 1-2ml each time are much safer. A rabbits whose mouth is too full and who is struggling may well aspirate mouth contents. This will not end well.
•Remember that the rabbits only blind spot is below the chin and this makes it very challenging for a rabbit to accept syringe feeding initially

•NB rabbits that are open mouth breathing should NOT be syringe fed until more stable

Nasogastric and pharyngostomy tubes
•NG and Px tubes are less commonly used in rabbits- the exception is where jaw movement is a problem ie a fracture or surgical site
•NB cheek teeth will continue to grow even if the mouth is by-passed so acquired dental disease is a significant risk
•Nasogastric tube placement also runs the risk of transferring Pasturella from the nasal cavity and nasopharynx leading to the potential for disease in the glottis/oesophagus
•Rabbits are obligate nasal breathers so blocking one nasal meatus with a tube is challenging
•There are very few suitable diets that will flow down an NG tube
•Px tubes run the significant risk of abscess formation at the insertion site
•Outside this, they are used exactly as in other species

Calculation of nutritional requirements

- K' is a value based on the relative metabolic rate of various taxonomic groups.
- Basal energy requirement (BER) in kcal/day= K x bodyweight(Kg)$^{0.75}$
- For placental mammals K=70
- In exotics medicine, we still need to use disease factors, patients with critical illness will require more calories. For example post anorexia, post trauma, cage rest , will require 1.25x BER, severe disease eg burns or sepsis may require 1.5-2.0x BER

Refeeding syndrome

- Occurs in animals that have been anorexic for a protracted period of time. Length of time that is relevant is species dependent.
- Suring a period of anorexia blood sugar stabilises but body glycogen stores are depleted.
- When the animal is fed the blood sugar peaks, insulin is released and the glucose is shunted intracellularly in order to replenish glycogen stores along with potassium and phosphorus.
- Leads to hypokalaemia and and hypophosphataemia- these lead to clinical signs particularly cardiac signs eg bradycardia well as neurological signs. Potentially fatal.

Signs of pain
•What is required in order to recognise pain on the part of owners and veterinary staff?

•Ability
•Opportunity
•Motivation

•Provision of analgesia requires empathy, compassion, legal availability of suitable drugs, evidence base for their use and an understanding of the negative impact of pain.

Physiological parameters
•Increased respiratory rate
•Increased heart rate
•Reduced or absent gut sounds
•Elevation or depression of core temperature
•Blood pressure elevation
•NB these are prey animals so how you maintain them in hospital and how/when/in which order these parameters are measured matters.

Behavioural and postural reactions
•Lack of alertness/reduced mentation/lack of interest in surroundings
•Hiding
•Shifting/throwing themselves around/unable to get comfortable
•Sitting in a hunched position

•Failure to use/move certain parts of the body
•Head pressing
•A lot of these signs are noted fairly late on in the pain/disease course
•Perhaps more subtle signs are needed in order to recognise pain earlier

Grimace Scale
•Using the 5 facial action units and scoring these from 0 (not present) to 2 (obviously present)
•Orbital tightening: A normal rabbits eyes will be widely open and the rabbit will be aware of and interested in its environment. A painful rabbit will often partially or fully close its eyes and in cases of severe pain the eyeballs appear to be withdrawn into the head.
•Cheek flattening: A normal rabbits cheeks will be relaxed and the whiskers will protrude giving information about the environment. A painful rabbit will suck in its cheeks making the whiskers lie flat across the face, and giving the face an angular, pinched appearance.
•Nose shape: A normal rabbits nose is constantly twitching and the nostril slits (nares) are around 30 degrees from the horizontal. When a rabbit is painful the nostril slits are drawn upwards bringing them closer to a vertical position.
•Whisker position: A normal rabbits whiskers will stick outwards from the face, however these will be pulled in and flattened towards the cheek when a rabbit is painful.
•Ear position: Except in the case of lops, a rabbits ears are usually perpendicular to the head. Where a rabbit is painful the ears are pulled back to eventually become flattened towards the back and the sides of the body.

Inactive pain behaviours
•Behaviours that are rarely seen prior to painful stimulus but often afterwards
•Twitching
•Wincing
•Staggering
•Flinching
•Belly pressing
•Slow postural adjustments
•Shuffling gait

Pain scoring
•Using a combination of the previous factors to give an objective and often numerical assessment of an animals pain
•There is currently no composite pain scoring system validated and available for rabbits
•Research is ongoing J
•Currently we use a combination of grimace, inactive pain behaviours and physiological/behavioural parameters that is NOT validated but is welfare driven and seems to keep our patients comfortable

Non-steroidal anti-inflammatory drugs
•Meloxicam: COX-2 selective NSAID, associated with few side effects and a good safety profile in rabbits. Used primarily because of its liquid formulation.
•May affect the production of and willingness to eat caecotrophs in rabbits/rodents. Potential issues with gut ulceration and kidney function.
•Carprofen
•Ketofen
•Hydration status and renal function should be monitored carefully
•What about gastrointestinal side effects?

Opiates
•Morphine: mu receptor agonist, rarely used in rabbits
•Methadone: synthetic mu receptor agonist- increasingly used for very painful conditions
•Fentanyl: pure mu receptor agonist: can be used alone or in combination with fluanisone.
•Buprenorphine: partial mu receptor agonist- slow onset but good safety profile
•Butorphanol: mixed agonist/antagonist- ceiling effect- dose above which there is no additional effect: due to the rate of attachment/antagonism at the receptor level.

Miscellaneous analgesics
•Tramadol: activity at mu receptors, seratonin and adrenaline re-uptake inhibition, also alpha-2 adrenergic receptor agonist. Dose not known but appears to be very safe and effective for most species.
•Gabapentin: anti-convulsant that modifies the perception of neurogenic pain. Can see ataxia and sedation.
•Paracetamol: poorly understood mild analgesic effects. Can be used in combination with other analgesics and NSAIDs.
•Ketamine: at very low doses blocks NMDA receptors in the dorsal horn of the spinal cord blocking pain impulses from the peripheral to the central nervous system. Prevents wind-up pain.
•Alpha-2 receptor agonists: dorsal horn of spinal cord has many alpha-2 receptors. Useful in visceral, musculoskeletal and neuropathic pain.

Constant rate infusions
•Generally ketamine with other medications eg morphine and lidocaine
•Analgesia is delivered constantly and can be fairly precisely calculated and delivered depending on what each patient needs.
•Requires very good patient monitoring and a means of accurate fluid delivery ie an infusion pump or a syringe driver.
•Evidence base for use in rabbits is small but growing. Other species present more issues- intraosseous infusion with syringe drivers are possible, but challenging
•Really useful to prevent wind-up pain, and where planned interventions are likely to be painful

Non-drug analgesia
•Acupuncture: neuromodulation induced by direct nerve stimulation alters transmission of pain signals to spinal cord and brain. Well tolerated and safe.
•Transcutaneous electrical nerve stimulation (TENS): mild electrical current is used to provide pain relief by reducing the pain signals going to the brain. May also stimulate endorphin production. Well tolerated.
•Laser therapy: uses pulses of light to modulate inflammatory mediators leading to anti-inflammatory and analgesic effects. Apparently no side effects and very useful for chronic conditions. Contra-indicated where there is neoplastic tissue

Pre-emptive and multimodal analgesia
•This is the early provision of analgesia in situations that can be expected to be painful
•The use of more than one agent or modality to provide good analgesia with a reduced risk of side effects because lower drug doses are used
•These approaches make a lot of sense for a prey animal such as the rabbit
•Stress (eg pain) can lead to life threatening problems in many patients for example cardiac arrest, cardiomyopathy and oliguric renal failure, not to mention gut stasis. Avoiding these issues is the key to managing patients well within situations that are likely to be painful

Conclusions
An accurate assessment of patient status is crucial in achieving a good outcome for any intervention, whether elective or not. By achieving this, and having the knowledge and confidence to implement appropriate supportive care plans patient welfare will be supported and improved. The more time that is spent in nursing rabbits the more empathy the clinical nursing staff will feel with the species and the ability to recognise when something is ‘off’ is honed. Once an issue such as possible pain is recognised it can be treated, again leading to improved outcomes. As we shall see next time, good patient assessment, and comprehensive analgesia are the key factors in having a successful (and smooth!) anaesthetic intervention.