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Tortoises, turtles and terrapins. The approach to common clinical presentations in practice Mini Series

Session Three: Common conditions, anaesthesia and surgery of chelonians

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Session three – 'Analgesia, anaesthesia, common medical and surgical conditions of chelonians'

Analgesia

Lesions that are painful in mammals are also likely to cause pain in lower vertebrates. Clinical signs of pain tend to be limited but can include withdrawl into the carapace, restlessness, aggression and increased respiratory rate. Quantifying the effectiveness of analgesics can be difficult as a result.

Analgesia works best prior to a painful stimulus and multimodal analgesia aims to reduce side effects of any one drug class. Side effects may limit the use of some agents depending on the clinical presentation of the patient (this is often used as a reason for neglecting analgesia). Consider how current analgesia regimens will influence anaesthesia protocols – they may need modification.

Non steroidal anti-inflammatory drugs should be used as a routine, once hydration has been performed. Care in patients with renal disease. Meloxicam is the first choice agent at 0.2mg/kg every other day by injection. Oral dosing may be effective after five doses of 0.2mg/kg every other day.

Reptiles do posses and endogenous opioid system with nociceptive receptors similar to mammals. Opioid analgesics are used frequently in reptiles. Doses used are - Butorphanol 0.4 – 2mg/kg, Buprenorphine 0.02 – 0.2 mg/kg. Morphine 0.4 – 2.0 mg.kg parenterally and tramadol orally 10 mg/kg every four days.

Local anaesthetics are underused. Human preparations are available. These can be sprayed onto wounds or injected into surgical fields. The maximum dose to administer is 2mg/kg lidocaine, which is quick acting, in combination with 1mg/kg bupivacaine, which has a longer duration of action. Dilution of local anaesthetics in saline may help to reduce overdosing in small specimens.

Anaesthesia

Chelonians have a very low metabolic rate so gastrointestinal motility is slow. Most patients are anorexic, otherwise starve for 24 hours. Practically do not give any assist feeding from the day before.

Ectotherms are dependant on external heat sources to regulate their body temperature. Hypothermia in these patients can lower their metabolic rate and excessively prolong recovery from anaesthesia. Hypothermia also reduces their ability to handle other drugs and prevents them from thermoregulating.

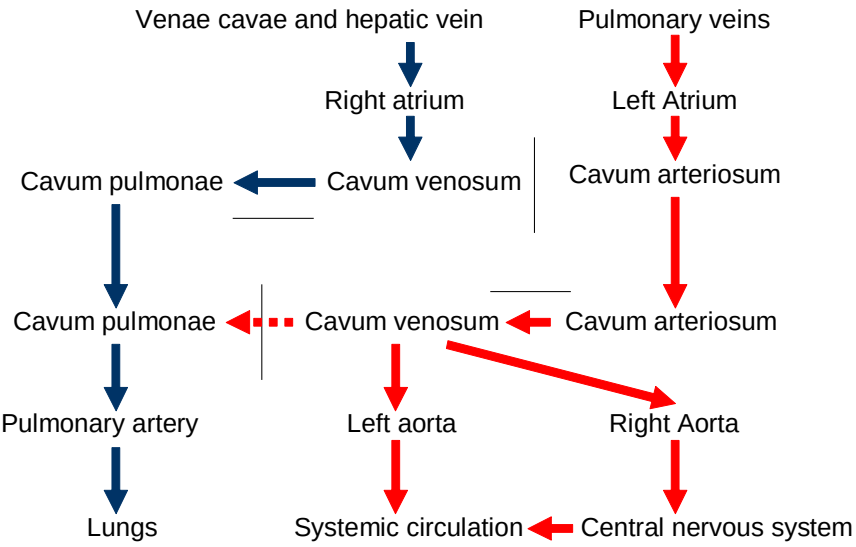
Pre medication with dexmedetomidine or ketamine can be used. These can enhance analgesia and should be considered. Alfaxalone can also be given intramuscularly in belligerent animals.

Respiratory anatomy and physiology have influences on the methods of anaesthesia appropriate in chelonia. Tortoises have a simple glottis at the base of their fleshy tongue. Their trachea is made of solid tracheal rings and the trachea bifurcates very proximally. In some species this can be at the base of the skull and others at the thoracic inlet. This means that endotracheal tubes should be uncuffed and short such that one bronchus is not inadvertently intubated. The bronchi course dorsally into the lungs. This limits the ability of a tortoise to clear respiratory secretions. The lungs are multi-chambered and split into up to 15 regions.

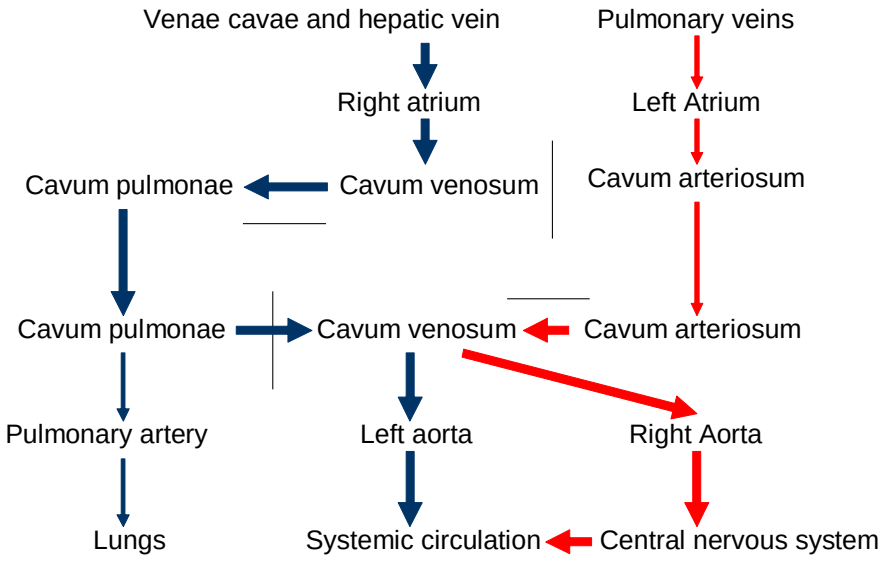
The heart is three chambered and consists of two atria and one ventricle. The ventricle is functionally split into three chambers. The cavum arteriosum receives blood from the left atrium. The cavum venosum receives blood from the right atrium. There is communication between these chambers during systole. In diastole there is no communication as the AV values occlude the communication. Blood exits the cavum venosum into the left and right aortae. Below these two chambers is the cavum pulmonae. Blood exits from here into the pulmonary artery.

This set up actually allows for a differential flow of blood depending on the animals physiological state.

When breathing the pressure on the pulmonary side of the circuit is lower than the systemic side.



As can be seen there is a small left to right shunt of blood. During breathing there is reduced parasympathetic tone. When breath holding (when diving for example) the parasympathetic tone is increased and this leads to vasoconstriction of the pulmonary artery and a reduction in heart rate. This leads to increased pulmonary resistance and a right to left shunt now occurs. This leads to a pulmonary bypass during diving.



As blood pH drops during a dive the Bohr Effect leads to increased offloading of O_2 to the tissues. Once this reaches a critical stage the pulmonary vessels dilate temporarily allowing reoxygenation of blood (and the uptake of O_2 is enhanced by increased pH). This in combination with cutaneous and pharyngeal respiration allows aquatic species to dive for long periods. Resistance to anoxia is high and hibernation can be possible even in hypoxic mud. In these circumstances a turtle may be seen swimming (under ice for example) to reoxygenate itself prior to once again submerging in the mud. Pharyngeal respiration is of greatest importance in soft shelled turtles. Aquatic turtles have survived in a nitrogen atmosphere for 27 hours.This means that mask induction is pointless as they can just shut the lungs out of circulation. Some authors suggest that maintaining a tortoise under injectable

anaesthesia is preferable to gaseous anaesthetics given the shunting reported above. However under anaesthesia the parasympathetic tone is lost leading to a reduced right to left shunt and so gaseous anaesthesia should be effective. Complications can occur such as ventilation perfusion mismatches or inadequate ventilation.

Anaesthesia protocols vary and a variety of agents have been used for induction. Propofol or alfaxalone at 5 – 10 mg/kg IV work well in chelonians. As there is no concern regarding lymph dilution any vein is fine for induction (jugulars, subcarapacial, and dorsal tail vein).

Although top up doses of intravenous agents can be used, I prefer to intubate and use gaseous anaesthesia for maintenance. It should be noted that use of an IV induction agent alone will give 10 – 20 minutes surgical time.

Even in tiny patients IV access is possible via the subcarapacial sinus so IM sedation/induction is generally not required.

Once the animal is sufficiently sedated intubation is possible. Small diameter endotracheal tubes are required and these should be short to avoid bronchial intubation. Customised tubes can be made from intravenous catheters. Endotracheal tubes as small as 1mm are commercially available. It is relatively easy to achieved intubation by waiting for a breath and inserting the tube when the glottis is open. Modified connectors using syringes can be used to ensure a tight fit and to reduce dead space.

A T-piece can be used for ventilation but there is variation in both the tidal volume and the rate of respiration can be variable. A mechanical ventilator avoids these problems. Respiration rate should be 6 breaths per minute. Initially higher ventilation rates can be used to deepen anaesthesia. Pressure cycling ventilators can be acquired fairly cheaply now. The Vetronics SAV03/SAV04 ventilators are ideal for reptile patients.Low flow rates will be required for animals requiring small endotracheal tubes. Moderm vapourisers can cope will flow rates as low as 300ml/minute. Sevoflurane is the preferred gaseous agent. Initially 6 – 8% is used until the patient is at an appropriate plane. If there is no voluntary movement then the percentage can be reduced to 4 - 5%.

Monitoring temperature is vital to reduce recovery time. Digital probes can be placed into the cloaca or oesophagus.

Anaesthesia is best monitored using a Doppler probe. Heart rate can be predicted by metabolic scaling, HBR = $34w^{-0.25}$. Practically most conscious tortoises at their T_o have a heart rate of approximately 70 BPM. Anaesthetised tortoises have a rate of 30 – 40 BPM. All staff tune into the melody and can easily identify changes in the rate and rhythm. The probe is best placed at the thoracic inlet or over the carotid vessels. In juvenile tortoises it can be placed over the plastron at the junction of the abdominal and pectoral scutes.

Reflexes such as the toe pinch, tail pinch, head withdrawl, palpebral reflex and jaw tone can be used to assess the depth of anaesthesia.

Pulse oximetry and capnography are not to be trusted in reptilian anaesthesia.

Recovery can be protracted. Plan to perform reptile anaesthetics early in the day. Many cases can be given an intravenous bolus for a short procedure to be performed and allowed to recover without any gaseous anaesthesia.

Hypoxia elevates the respiration rate and hypercapnia elevates both rate and depth of ventilation. During diving this reflex is overridden. Reducing oxygenation and allowing hypercapnia to occur should increase recovery rates. Keep the tortoise at an even temperature of monitor it closely under a spot bulb, as it will be unable to thermo regulate at this stage. Only when mobile can a hot spot be used. Extubate when jaw tone increases and voluntary respiration occurs.

Common medical and surgical conditions.

Anorexia

Most likely presenting clinical sign. Most of these individuals will have had poor husbandry. Hospitalising these patients and providing supportive care will markedly improve their condition. This stabilises the patient and if required prepares it for diagnostic investigation.

Blood and urine analysis are generally performed to assess the metabolic state as the chelonian. Faecal analysis can be performed if the opportunity arises. Radiography is a key step to identify likely underlying diseases such as bladder stones, egg binding, foreign bodies.

Upper respiratory tract disease

Runny nose syndrome (RNS) and stomatitis (mouth rot) are historic diseases of tortoises. These were attributed to poor husbandry. Many pathogens can be involved and will occur in both good and bad husbandry. Clinical signs include conjunctivitis, rhinitis, stomatitis, dyspnoea, respiratory stridor and noise. Caseous discharges can accumulate. Secondary infections with bacterial and fungal agents are common.

Mycoplasma agassizzi is a common pathogen in tortoises. Quarantine is an important factor for limiting exposure and disease outbreaks. It is endemic in the U.K. population. Transmission is via oculo-nasal discharges. Testing is possible by PCR on conjunctival or choanal swabs. A positive test means an animal is positive for the rest of it's life. Recrudescence of clinical disease is possible despite clinical cure. Topical and systemic therapy using antibiotics effective against Mycoplasma should be used. Antibiotics to consider include enrofloxacin, doxycycline, chloramphenicol or azithromycin. Supportive therapy with an oesophagostomy tube may be required.

Herpes viruses are also common pathogens and can be found concurrently with Mycoplasma. Multiple genotypes are possible and are host adapted. PCR testing is available and sampling technique is similar to the above. Stomatitis is generally a feature of Herpes viruses. Tongue scrapings can be taken for cytology or histopathology to check for intraneuclear eosinophillic inclusion bodies. Secondary fungal and/or bacterial infections are common. Latency is a common feature and recrudescence after a number of years is possible. Mixing naive individuals is a common predisposing factor. Treatment is supportive and involves oesophagostomy tube placement for anorexic animals. Covering antibiotic therapy and topical treatment (silver sulphasalazine cream is fine) should be used with topical debridement to reduce the risk of invasion by secondary pathogens.

Upper respiratory tract disease can progress to lower respiratory tract disease and lead to pneumonia. This can be focal, unilateral or bilateral. Bacterial, fungal and viral agents can be involved. Horizontal beam radiography or CT should be performed alongside haematology and tracheal washes. PCR testing, and pneumonoscopy should be considered depending on initial results. Histopathology, cytology or culture of endoscopic biopsy samples can be performed to confirm diagnoses as required.

Treatment can include nebulisation with F10 disinfectant at 1:250 dilution, intrapneumonic therapy via the pre femoral fossa or via a hole drilled in the carapace. Treatment may be required for 4 – 6 weeks. Repeat testing to confirm that the infection has resolved is recommended.

Metabolic bone diseases and their complications

NSHP or metabolic bone disease is a common finding in juvenile tortoises. Problems are caused by dietary calcium deficiency, imbalances in the calcium to phosphorus ratio, or hypovitaminosis D. A lack of vitamin D (cholecalciferol) can be due to either dietary deficiency or failure to provide adequate UV-b radiation (naturally or artificially). A critical review of heating, lighting and diet is therefore mandatory in every case that is seen. Clinical signs include a soft compressible carapace and a lack of truncal lifting. In males hemipenile prolapse is a common finding. Thickening of the plastrocarapcial bridge and ventral deviation of the carapace often occur. Deviation and fractures of the limbs are possible in severe cases. Flaccid paralysis is possible if there is a decreased blood ionised calcium. Diagnosis is fairly self evident based on clinical history and examination. Radiography can

demonstrate gastrointestinal stasis, poor bone mineralization and in cases with concurrent renal disease, articular gout can be seen. A blood profile should be taken to assist with the long term prognosis. Treatment includes placement of an oesophagostomy tube, UV-b light, phosphate binders such as aluminium hydroxide and oral or systemic calcium therapy. Calcium gluconate at 100 – 200 mg/kg every six hours is recommended if the ionised calcium is reduced.

Growth abnormalities.

Pyramidal carapace growth is a common finding in captive bred tortoises. Over feeding high protein sources and a low humidity environment are predisposing factors. Existing pyramiding will never go away but with correction of husbandry can instigate more normal growth. A higher humidity environment can be created by providing a box with a small entrance hole. Foam stuck into the roof can be sprayed repeatedly with water to keep the relative humidity high.

Hepatic lipidosis.

Fatty liver is a common finding in sick chelonians. It is a physiological response to hibernation and reproductive activity where fat storage is required. However in captivity it can reach pathological levels due to repeated breeding cycles, obesity, lack of hibernation amongst others. In these cases signs of liver disease can be seen. It can be seen at any time of the year. The main sign is anorexia, but coelomic ascites and yellow urates can be seen in extreme disease. Diagnosis requires imaging and biopsy of the liver. Bile acids and other biochemistry may give an idea of hepatic function. Treatment includes supportive care, carnitine, choline and methionine. Anabolic steroids and thyroid hormones can also be given.

Reproductive diseases.

Many female tortoises will try to breed in captivity. Radiography can identify if shelled eggs are present. It can be difficult differentiating between normal gravidity and egg retention. Many females may just lack the appropriate physiological and behavioural cues to lay eggs. Middle aged females are most at risk. Egg stasis can occur pre ovulation (Pre ovulatory ova stasis) or post ovulation (Post ovulation egg stasis). Isolated females may require social cues from males (pheromones or physical interaction) to induce ovulation. Females that have eggs to lay are quite fickle about where they lay their eggs. A familiar environment, the correct temperature and humidity and a suitable area to lay eggs are required. Nutrition is important, producing eggs requires high levels of protein and calcium and marginal husbandry can have a greater effect on reproductively active females.

If normal looking shelled eggs are present in the expected location on the radiographs and the tortoise is healthy, then providing the correct environment for oviposition at home is an option, but medical induction is preferred. Premedication with oral atenolol at 7mg/kg followed by oxytocin at 1 – 10 IU/kg IM is generally recommended. This is better to be by infusion, but chelonians usually respond well to IM dosing. Incrementally increase the dose based on effectiveness. Aim for a minimum of one egg per day. As the female is induced to lay a nesting site is generally ignored. The right cases often lay all their eggs after a single dose. Providing parenteral calcium is often advocated, but generally is not needed, unless there is a genuine hypocalcaemia evident.

Assisting egg laying is often needed. In some cases per cloacal manipulation can get a large egg to pass. However in some cases anaesthesia, decompression and even cloacal endoscopy can be used for retrieval of egg material.

Pre follicular ova stasis generally occurs in middle aged isolated females. This is often linked with hepatic lipidosis. There is usually a prolonged history of anorexia and non specific illness. Cloacal endoscopy can be performed under anaesthesia to visualise follicles in a non invasive way. Otherwise CT or ultrasound can be utilised. Medical treatment is unlikely to be successful and surgical intervention via a plastronotomy is usually required.

You will need some equipment to do this as it involves cutting through the plastron. Most tortoise vets use diamond discs to cut through the shell attached to electric dental motors. The use of a saggital saw (used for orthopaedics) is suitable should you have access.

There are many vital structures underneath the shell (heart, thick bony bridge, and pelvis). This limits access to the coelomic cavity. Hinges should be avoided. A bevel edged incision is made in the abdominal scutes. The incision has bevelled edges to prevent the flap from falling into the tortoise and keeping skeletal muscle attachments maintains some blood flow to the surgical site. It is likely some of the flap will still die. Care has to be taken not to go too deep when cutting the shell. Checking the depth by using a scalpel blade can help. The flap can be gently lifted using retractors, screwdrivers or periosteal elevators. Now the coelomic membrane will be identified. Tortoises have two abdominal veins running caudo-cranially. These should be avoided if possible but if they are cut accidentally then just ligate them. A cranio-caudal incision can be made in the membrane to get access to the coelomic cavity.

Ovaries are easily identified due to the large numbers of preovulatory follicles and the vessels can simply be ligated. Oviducts can be removed ensuring secure ligation at the level of the cloaca.

Closure of the wound is routine with monofilament material. The flap is replaced. The wound edges can be packed with gel to seal the wound. The flap can be secured in place with either technovit®, Fibreglass, dental repair kits or screws, wire or plates. Many authors are turning to screws and wires as the wound edges can be closely observed for infection. This is of vital importance in traumatic as opposed to surgical wounds where the chances of infection are high.

Oviduct prolapse can occur secondary to straining to pass eggs. In these cases amputation of the prolapse may be required externally using matress sutures prior to the plastronotomy to tidy up the remnants at the urodeum/cloaca.

The cloacal organ can prolapse in males and females, but most often in males. The cloacal organ is present for reproduction only and has no urinary function. Unless the tortoise is required for breeding it can be amputated. Cloacal organ prolapse can also be seen in juvenile males with metabolic bone disease.

This procedure can be performed using an induction agent only with a local blockade. The cloacal organ is extracted using tissue forceps. A haemostat can be clamped close to the cloacal mucosa. The main blood supply is in the centre. Horizontal mattress sutures using a monofilament material can be used to compress the main part of the stump. The tissue distal to the clamp can be removed and the end over sewn in a simple continuous fashion.

Other organs that can prolapse can be the bladder, colon or cloaca itself. Causes for prolapses can vary. Anything that can cause straining or a weakening of the musculature of the tortoise can lead to prolapses. As such a full faecal examination and blood profile (including ionised calcium) is required along with radiography to check for eggs, bladder stones, intestinal foreign bodies, tumours etc. Surgical intervention is likely and can vary from replacement and a purse string suture to amputation or a plastronotomy.

Aural abscessation

Clinically the ear drum is distended beyond the side of the head. The infection is considered to be an ascending infection from the pharynx. Predisposing factors such as hypovitaminosis A have been reported. These lead to squamous metaplasia of the lining of the ear allowing infection to colonise the area.

These are surgical cases. There is only one ossicle in tortoises the columella. This attaches dorsally on the tympanum. The ear drum can be incised from three o'clock to nine o'clock direction. The bottom segment can then be removed or cut at six o'clock. The abscess should be removed in one piece. Check there is a small bobble at the back end (which is the pus within the Eustachian tube).

Flushing should be performed and the /Eustachian tube can be cannulated to ensure patency. The ear drum can be closed if you wish to, using monofilament suture material. Antibiotics should be given in the short term. Culture and sensitivity and cytology are indicated in persistent cases.

Shell trauma

Trauma can be from lawnmowers, dogs, fires, other tortoises or infections. Devitalised areas of bone and keratin can be seen forming sequestrate and fractures may also be evident. Do not be scared to treat chelonian wounds as you would a dog or cat. Wounds require aggressive debridement and flushing. Cultures can be taken and biopsy may be indicated. This must be performed under anaesthesia. Analgesics and antibiotics should be administered. Primary closure should only be attempted if there is no infection evident, otherwise wounds should be treated as open wounds and allow healing by secondary intention. Underlying damage to the thoracic and pelvic girdles and spine are possible. The coelomic cavity and lung fields may be breached. In these cases flushing with saline is contraindicated. A through examination under anaesthesia is warranted and CT may be required for a complete evaluation. Standard dressings and products used for dogs and cats are appropriate based on the wound type. Hydrogels and hydrocolloids are often used. Multiresistant gram negatives (including *Pseudomonas sp*) and fungi, which can be common opportunistic pathogens in reptiles.

Euthanasia

Humane destruction of reptiles can be difficult. They have a high tolerance of hypoxia and it is possible for a reptile euthanased with pentobarbitone to survive the hypoxia due to cardiorespiratory collapse for some time. This means the CNS is capable of receiving noxious stimuli for some time after apparent death. Because of this all tortoises that have been euthanased or are believed to be dead should have their CNS destroyed. If the decision is made that the tortoise is non recoverable then they should be euthanased.

Premedication can be performed using any agent to deeply anaesthetise the patient, pentobarbitione is suitable, ideally, via the intravenous route. This can be intracardiac in collapsed or heavily premedicated chelonia. I would check for cardiovascular collapse using the Doppler and once the heart has stopped pith the animal either via the choana (cosmetically better) or via the nose backwards or from the back of the skull.

The only occasion where pithing should be avoided is when the CNS is required for histopathology. In this case I would perform a post mortem promptly, remove the CNS and fix it.

Post Mortem Examination

A post mortem is advised in all cases, particularly if the tortoise is from a group. A post mortem not only identifies a cause of death but also is useful to screen for underlying diseases. The shell does present a problem here, but use the dremmel® and cut through the plastrocarapacial bridge on both sides. Cut through the soft tissues to expose the whole of the coelomic cavity. Look at everything. Phone the owner and advise further testing such as histopathology, cultures etc. If you are limited on funds advise histopathology alone. Collect histopathology samples of everything including the CNS. Consider collecting tongue and nasal sinus tissue as well. Freeze the body until histopathology is back as virology or toxicology can be performed.