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

Session Two: Supportive care, diagnostics and clinical techniques of chelonians

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Session two – 'Supportive care, diagnostics and clinical techniques of chelonians'

Initial supportive care can simply include warming the tortoise to it's T_o. This can be by providing a thermal gradient it its mobile or a set temperature if thermoregulation is distrusted. Monitoring the tortoises temperature using a ray thermometer or dial thermometer is useful to ensure the risk of overheating is minimised.

A starting weight is important.

Oxygenation is rarely of concern but if deemed necessary then up to 40% inspired gasses.

Fluids should then be provided. Reptiles have a maintenance requirement of 30mls/kg/day. This can be via a number of routes. Most simply bathing is effective for mildly debilitated animals. Electrolytes can be added to bathing water.

More severe cases will require stomach tubing. 1% of bodyweight can be given by stomach tube. This tube can be of either giving set or a specific metal crop tube. The tube should be placed to avoid the glottis to a position between the junction of the abdominal and humeral scutes of the plastron.

Parenteral fluids can be given at the rate of 1% of bodyweight up to three times daily. Fluids used for mammalian species are acceptable. Hartmanns is the best fluid to consider for parenteral use as it has a lower sodium content and osmolarity compared to other fluids commonly available. There is no need to make up special concoctions for reptiles.

Hartmanns has an osmolarity of 280mOsmoles. This is comparable to the osmolarity of many sick chelonian. All sites should be disinfected with an iodine based scrub prior to injection.

Epicoelomic fluids can be given just above the plastron in between the head and foreleg. This fluid is delivered into the potential space between the pectoral muscles and the plastron. There is considered to be a good degree of vascularisation in this region as the pericardial fluid in chelonia can act as a fluid store during periods of drought or hibernation.

Fluids can also be given intracoelomically. The prefemoral fossa is the best site. The tortoise is tipped away from the handler and the injection delivered into the lower section to avoid injection into the lungs and bladder. The down side of this route is slow absorption, interference with subsequent diagnostics such as endoscopic examination and increased intracoelomic pressure and lung compression due to sequential overloading if repeat doses are given. Many authors recommend applying back pressure to the syringe before injecting. If fluid is aspirated there is no point injecting further fluid into the cavity.

Intraosseous techniques have been reported, but are considered difficult due to the lack of medullary bone. The most commonly reported site is in the bony bridge between the plastron and carapace. Anaesthesia is indicated as a drill is required to gain access. A spinal needle is then placed into the drilled hole. There are a number of issues and complications with this technique, including incorrect needle placement and the author would question the benefit of IO fluids versus other routes.

Intravenous fluids are also an option. The jugular vessels are the only site available and the right side is preferred as it is larger in most animals. In collapsed individuals it maybe necessary to give fluids via other routes to improve perfusion prior to catheter placement.

There has been concern over the types of fluids to administer to chelonia. Studies have shown that reptiles have a larger intracellular component of body water and so the osmolarity of replacement fluids should be lower and using mammalian fluids with the addition of 10% sterile water for injection is recommended. However, in chelonia the bladder acts as a large extracellular store and sick chelonia have blood osmolarity similar to mammalian fluids. Thus dilution of commercially available preparations is not necessary.

Plasma Urea and Sodium vary and have an influence on osmolarity. Chelonia selectively produce urea to elevate plasma osmolarity. This enables more water to be retained in the circulation. Retaining plasma sodium also allows for water to be kept in the circulation. It is only when the plasma

and the urine has reached an equilibrium and the capacity for increasing osmolarity has been exceeded that clinical dehydration follows. Thus the classical signs noted in mammals do not apply to chelonia. Instead we monitor; bodyweight, urine pH, urine specific gravity and plasma urea and sodium to assess hydration status. As a bench-mark we should see sodium below 140mmol/l and urea lower than 2.1mmol/l.

Protocols for rehydrating chelonian vary, but there are guidelines to follow. During a 24 hour period 4% of body weight can be given. 1% of body weight can be administered at one time. During the first 24 hours I would recommend using water only for stomach tubing and bathing, after that you can introduce electrolytes. Successful rehydration will result in urination.

Supportive Nutrition

Supportive nutrition is also required. A chronically anorexic animal is deficient both in fluids, electrolytes and energy. Cellular constituents are depleted in order to maintain plasma levels. This can mask the deficiencies. Providing a glucose source to any animal encourages concurrent ion transport into cells. This can lead to depletion of plasma potassium and phosphorous in particular. It is important to ensure that electrolytes are replaced prior to administering glucose. I recommend that chelonia are maintained on 4% of bodyweight fluids per day until urination in achieved. Once this occurs supportive feeding can begin. The standard metabolic rate (SMR) of a reptile is defined as the maintenance requirement at a given temperature. SMR = (Kj/day) = $10 \times \text{weight}^{0.75}$. This equates to the basal metabolic rate of endothermic animals. In general the cost of living for a reptile is 1.5 – 2 times the SMR. This is about a tenth of the cost of living for a comparable sized mammal. They do not need much to eat.

1% of bodyweight can be given at each sitting by stomach tube. Very weakened animal will require less than this. The animal must be warm to digest and assimilate the food. If capable it will seek warmer temperatures itself. Stomach tubing is only a short term solution and some recalcitrant individuals may be impossible to stomach tube, it may therefore be necessary to fit an oesophagostomy tube.

Diets offered vary depending on the species but there are ranges of products suitable such as those provided by Oxbow, Emeraid or Vetark. Most individuals need 2% of their bodyweight daily for maintenance.

Supplementation of the assist feeding diets may be required, depending on the reason for the patient being hospitalised.

Patient Monitoring

Bodyweight change is one of the most significant parameters to measure. Initial weight increases can be dramatic as the bladder volume can account for up to 25% of the bodyweight of a chelonian. Filling the digestive tract with food will further increase weight. When the bladder and guts are full further elevations will be minor and the aim should be for a stable bodyweight (input = output). Ultimately the animal should maintain a well hydrated full bodyweight on it's own. Progressive weight loss without supportive care is an indication that the tortoise needs further nutritional and fluid support.

Monitoring urine and faecal output is helpful. Urine specific gravity and pH are a useful measure of hydration status. Herbivorous chelonia have a urine pH of 7.5 and a specific gravity of 1.003 - 1.012. In individuals with elevated osmolarity the urine specific gravity may elevate to 1.034.

If a tortoise is being belligerent then an oesophagostomy tube will need to be placed. These can be used to make supportive care easy and more economical buying time for the owners to raise funds for diagnostics for example.

Generally if a tortoise is well enough to resist tube feeding then it is well enough to withstand a brief anaesthetic for oesophagostomy tube placement.

Anaesthesia protocols vary and a variety of agents can be used. Typically propofol or alfaxalone at 10 mg/kg is used although lower doses will be required for sicker patients. As there is no concern regarding lymph dilution any vein is fine for induction (jugulars, subcarapacial, and dorsal tail vein).

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

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 approximately 70 BPM. Anaesthetised tortoises have a rate of 30 – 40 BPM. Listen to the Doppler and 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.

Oesophagostomy tube placement

Tube feeding is only a short term method for supportive care. Oesophagostomy tube placement allows for continued fluid and nutritional support and a route for oral drug therapy.

The key to keeping an O-tube in place is to situate the tube far enough back so that the tortoise is unable to hook out the tube with it's leg. The tube can be placed on the left or the right side. Many authors consider placement on the left best as the tortoise has a larger jugular on the right side and the oesophagus curves to the left. Practically it is easier to place the tubes on the right side if you are right handed. A pair of curved haemostats are introduced into the oesophagus and displaced laterally. Care should be taken to avoid the jugular vein and carotid artery. The skin tents and usually the vessels slip dorsally or ventrally. The skin is cut with a scalpel blade and the haemostats pushed through. The feeding tube is grasped and pulled through the incision and out through the mouth. It is best not to cut it to length at this stage (as it is easier to pull through the incision) but measuring and marking the tube before beginning surgery is wise. Once pulled out the mouth the tube is cut to an appropriate length and directed back down the oesophagus.

The tube can be secured using a Chinese finger trap suture or using surgical tape and sutured to the skin with horizontal mattress sutures. In aquatic species securing knots with superglue is advised. Dressing the leg can be useful as it covers the rough scales over the elbow joint further reducing the changes of the tube being pulled out.

Body weight should be monitored when an O-tube is in place. Initially weight gain can be marked due to the filling of the bladder and bowels! After this initial increase faecal and urine output will roughly equal input and the weight will stabilise. Tortoises are perfectly capable of eating voluntarily even with the tube in place. Once this has occurred and the tortoise is feeding well, supplemental feeding can be stopped. Once the tortoise is holding weight without supportive care the O-tube can be easily removed conscious.

Preliminary Diagnostics

A faecal screen should be performed on every tortoise presented to the clinician. Many parasites we see have a direct life cycle. Chelonia are messy feeders and inhabit the same box or run and parasite levels in the environment and subsequently in the tortoise can build up over time. Some can be heavily infested at the time of purchase.

Parasitic infections can be reduced by using a substrate that can be easily and completely removed. All uneaten food should be removed promptly. Any livefood that is uneaten should be removed and destroyed. Running regular faecal screens is useful to identify if any treatment is warranted. Ensuring tortoises have a negative faecal sample prior to going onto a soil based substrate or run is vital to limit pathogen build up over time.

Many tortoises will be presented twice a year for deworming. I do not recommend this. By all means test for faecal parasites twice a year instead. Fenbendazole toxicity is now well recognised. It causes radiomimetic lesions (gastrointestinal ulceration, bleeding, immune suppression and secondary infections). The effective kill is increased by using a lower dose over a few days, eliminating the need

for high one off doses. **Ivermectins should not be used in chelonians as it can enter the central nervous system and cause paralysis by activation of GABA receptors.**

Initially a fresh wet preparation examined under the microscope will give an indication of parasite numbers and any motility can be noted. Only a tiny amount of faecal material is needed and this can be diluted with warmed saline and examined immediately. A common mistake is to have a thick preparation. A floatation is the next useful preparation to make. A saturated saline solution is fine and a coverslip is used to collect any parasites or ova that float. A common mistake is to be impatient and not give sufficient time for adequate floatation. In most cases I would advise the treatment of any worm burden in tortoises given the likelihood of autoinfection and severe burdens developing.

There are three types of parasites commonly seen in chelonia.

Ascarids are very commonly identified in chelonia and in one study had an incidence of 30%. The adults can be up to 10cm long and can lead to intestinal impaction, vomiting and death. They have direct and indirect life cycles. The most common species identified is *Angusticaecum sp*. The eggs are thick walled with scalloped edges. Fenbendazole is an effective treatment. Lower doses given over a few days are safer than one off higher dosing. Treatment with 20mg/kg sid for three days by stomach tube is my preferred protocol.

Oxyurids can be found in up to 75% of faecal samples and large burdens can develop due to their direct life cycle. They are small worms up to 1cm in length. Clinical signs reported include anorexia, obstruction and rectal prolapse. The eggs are D shaped with thin walls. Fenbendazole is a suitable treatment.

Ciliates are also commonly identified in faecal smears and many of these can be evident in high numbers in sick chelonia. The difficulty is attaching any significance to their presence. They may be secondary overgrowth with digestive disturbances. Many are commensals such as *Balantidium sp* or *Nytcotherus sp*. It is difficult to identify individual species without special training and stains. I am of the opinion if the chelonian is sick and high numbers are identified then treatment should be given. Metronidazole at 50mg/kg EOD PO is my preferred regime for three to four doses.

Cytology, PCR and cultures

Cytology and culture samples can be taken from any site (eye, nose, mouth, skin lesion, faecal sample etc). The cultures should be placed into charcoal medium and held at room temperature for one hour (to allow the bacteria to colonise the medium) and then be kept cool or posted immediately (to reduce the chances of overgrowing the medium). This is fine for aerobic bacteria. Cooling swabs will kill off the more fastidious anaerobes. Samples should be submitted for aerobic, anaerobic (up to 50% of reptile infections include anaerobes) and fungal culture. Most of these cultures will grow gram negative bacteria with multiple resistance patterns. They will likely be potential pathogens and their significance in a culture is always questioned.

Cytology is a useful tool in clinical practice and samples can be taken from any lesions, nares, tongue, eyes, colon, stomach or trachea, either on swabs or as a wash. These samples can be used for culture, but the cytology is not to be underestimated. Cytology can confirm the presence of an organism but also an inflammatory response to the organism confirming its pathogenicity.

PCR analysis is now available for two common pathogens in chelonia (Herpesvirus and Mycoplasma) and ocular, nasal or oral swabs and flushes are acceptable samples to send. Starving the tortoise and using saline moistened swabs will help to improve isolation of the DNA.

Pressing under the jaw can lead to discharges being produced from the nares. For nasal flushing a syringe with a needle hub on the end can be used to blast material form the nares out the mouth. Occasionally discharges will be so thick that a nasal discharge is absent despite having upper respiratory disease.

Blood Sampling

Tortoise veins are hard to find. Skin disinfection should be thorough prior to venipuncture. 25 gauge needles will be required in most cases.

The first site to consider is the jugular vein. This runs on either side of the neck (the right is larger) from the tympanum coursing dorsally. The carotid artery can also be sampled and runs more ventrally. They are both superficial vessels. Care has to be taken as haematomas are common particularly if the carotid vessels are inadvertently punctured.

Other sites include the subcarapacial sinus. This sinus is a confluence of the common intercostals veins and the dorsal branch of the jugular veins. Lymph dilution is possible at this site but usually has minimal effect on results with careful technique. The lymph vessels lie directly over the sinus site and so some contamination is inevitable. A longer 1" or 1.5" needle required in larger tortoises.

The dorsal tail vein leads to marked lymph dilution and should not be used for blood sampling. It is however useful in aggressive or strong specimens, but in an ideal world should be used to administer a sedative to allow for jugular sampling more safely! Tortoises with hinges may also need sedation. 10mg/kg propofol into the tail vein or subcarapacial sinus can greatly facilitate sampling (or other diagnostics).

EDTA lyses chelonian red cells so heparin should be used in preference. Remember to perform the haematology first prior to spinning the sample.

Tortoise red cells are larger than mammalian cells and are nucleated. They are able to regenerate from pleuripotential thrombocytes within the circulation. They last for 800 days and regenerative responses may not be obviously marked on films. Polychromasia and mitoses can indicate a regenerative response. This may be seen after hibernation. A low level of polychromasia is expected on all films. Reptiles can cope with blood loss well due to their ability to tolerate anaerobic metabolism. The PCV varies depending on hydration status.

Tortoises have both granulocytes and agranulocytes. Their morphology on a smear is more important than their numbers. Numbers can be low even in the presence of severe infections. The main granulocytes are the heterophil. This has similar functions to the mammalian neutrophil. They frequently respond to acute bacterial and parasitic diseases. Heterophils represent about 40% of the white cells. Toxic activity includes degranulation, vacuolation and bacteria may be seen within the cytoplasm. Eosinophils can be up to 20% of the cells and are influenced by seasonality (low in summer). Basophils are also present but in much lower numbers. Fresh water species can have higher numbers. Agranulocytes include monocytes and lymphocytes. Their function and morphology are as for mammals.

Selecting the correct biochemical profile is important.

The following tests are recommended:

Total protein, Albumin, Uric Acid, Urea, Sodium, Potassium, Phosphorus, Bile Acids and Ionized calcium.

Protein excretion varies depending on the habitat of the species we are considering and the season. Typically terrestrial species excrete high levels of Uric Acid. Urea also is a useful parameter to measure as terrestrial tortoises increase production of urea in order to raise blood osmolarity. Fresh water species excrete more urea. Uric acid is elevated only when two thirds of renal function has been compromised. Mild elevations can reflect folliculogenesis or high protein meals in omnivores (can be elevated two fold the day after feeding). Urea is useful in terrestrial species. Dehydration and protein catabolism can lead to elevated values. Creatinine is of no use in reptiles.

Sodium is useful to quantify the hydration status of tortoises. Low levels can be due to gastrointestinal infections or over perfusion. Potassium should be analysed immediately as it leaks from erthrocytes in aged samples. Potassium can elevate in dehydrated chelonia due to reduced renal excretion.

Total protein and albumin can elevate in dehydration and in reproductive activity. Seasonal elevations also occur in female chelonia and to a lesser extent in males. Reduced values can be due to anorexia, gastrointestinal tract disease, liver disease or blood loss.

Total calcium consists of protein bound calcium, complexed calcium and free or ionised calcium. Ionised calcium consists of 18 – 67% of the total calcium. There is no physiological control of total calcium levels and values are primarily influenced by protein binding. Hypocalcaemia and lymph dilution decrease levels. Ionised calcium can be directly measured now. This is the regulated ion and it is decreased when there is an acute demand leading to flaccid paralysis. This is most common in reproductively active females laying eggs. Many juveniles can have normal levels despite having marked NSHP.

Elevated phosphorus is the hallmark of renal secondary hyperparathyroidism. Mild elevations can occur in reproductive activity where it is liberated from the bone matrix. Haemolysis also leads to elevated values. Reductions can be due to starvation, nutritional deficiency or lymph dilution.

Imaging

There are three standard views for chelonia. Dorso-ventral vertical beam. This is useful for gastrointestinal tract disease, bladder stones, eggs and bone abnormalities. Anaesthesia may be needed to examine the extremities so that they can be pulled beyond the margin of the carapace and kept still.

Horizontal beam radiographs are required as tortoises do not have a diaphragm and coelomic contents can compress the chest. Lateral and crainio-caudal views should be taken. These are useful for assessing the lung fields.

Barium studies are useful to assess gastrointestinal transit time and 1% of bodyweight can be given by stomach tube. Transit time can be increased by using iodinated compounds in KY jelly. Pro-kinetic agents had no effect on transit time in a study in gopher tortoises. Heat and fibre have greater influences on transit time.

CT enables far greater evaluation of chelonians as there is no superimposition of the shell over soft tissue structures.

Ultrasound examination is a useful tool should the practice possess a unit with probes that have a small footprint. 7.5mHz probes are ideal for most individuals and can be used via the prefemoral fossae or between the neck and front legs to view the internal organs. They are most useful to assess the reproductive status of female chelonians.