Care of the Post-Hibernation Tortoise

Study Notes

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Many chelonian species hibernate and these may commonly present after hibernation with anorexia. It is important to firstly correctly identify is the species presenting is in fact a species that should have been hibernated. Then evaluating the husbandry generally and specifically, regarding preparation for hibernation, the hibernation process and the immediate post hibernation period prior to presentation is important. After this a physical examination can be performed and a diagnostic and therapeutic plan instigated.

The most commonly seen tortoises presenting after hibernation will be of the genus *Testudo*. These are the Mediterranean tortoises and broadly fall into four species. The most commonly presented species will be the spur thighed and horsfield tortoises.

Testudo horsfieldi Horsfield's tortoise. Also known as the Russian, Steppe, Afghan or Four toed tortoise. When fully grown the will weigh up to 2kg and can be identified by the following features:

- Spurs on the back of their hind legs.
- Tubercle on the end of their tail.
- Lightly coloured pale brown shell.
- Pale skin colouration.
- Four toes on the front limbs.

Testudo graeca Spur thighed tortoise. Also known as the Greek or common tortoise. These have a great variation in size and can be identified by the following features: -

- Spurs on the back of their hind legs.
- No tubercle on the end of their tail.
- Flexible plastron hinge.
- Variably coloured shell ranging from black to pale brown depending on origin. There are many recognised subtypes.
- Variable skin colouration.

Testudo hermanni Hermann's tortoise. When fully grown the will weigh up to 2kg and can be identified by the following features: -

- No spurs on the back of their hind legs.
- A prominent tubercle on the end of their tail.
- Brightly coloured yellow and black shell with a black H underneath. There are two variations on the intensity of colouration (eastern and western sub species).
- Dark skin colouration.

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Testudo marginata Marginated tortoise. When fully grown they will weigh up to 3kg and can be identified by the following features: -

- No spurs on the back of their hind legs.
- No tubercle on the end of their tail.
- Brightly coloured yellow and black shell with a distinctive flare of the posterior marginal scutes of the carapace.
- Variable skin colouration.

All of the above species come from more temperate regions and as a result their husbandry is similar. It is important to note that there are types of Spur thighed tortoises that will need a reduced hibernation period or indeed may not hibernate. Examples of the non-hibernating spur thighs are the Libyan's and the 'Golden Greeks'. Their light colour is an adaptation to reflect excessive heat in their natural environment and they may even aestivate (hide away from the heat) in peak summer. In contrast some of the black Spur thighed tortoises are designed to absorb as much heat as possible, they will hibernate and are likely to be far hardier and easier to keep.

There are some southern species previously classified as *Testudo* that do not hibernate. Tunisian spur thighed tortoises (*Furculachelys nabeulensis*) are such an example. These are small tortoises that are highly coloured with a black and pale brown shell and skin. They are more sensitive than other Mediterranean tortoises.

Gender determination is important as some of the differentials for anorexia are related to reproductive disease.

MALE	FEMALE
Longer tail with a caudally placed vent (termination of cloaca), usually beyond the edge of the carapace.	Shorter tail with a more proximally located vent, before the edge of the carapace.
Concave plastron (for balance when mating).	Flatter plastron with a more flexible hinge if present (for egg passage).
Phallus – prominent hemipenis situated in the ventral midline of the cloaca.	Small cloacal organ occasionally present.

Tortoises are ectothermic and as a result rely on an external heat source to govern their metabolic rate. There are a number of terms used to describe the range of temperatures they should be exposed to. Essentially they require a basking site with a temperature towards the top end (or exceeding it) of their activity temperature range. They do need to have the capacity to escape this heat and should have a cold end at the bottom end of this range. Ensuring the overnight temperature does not drop too low (at least 13 degrees centigrade) is important. This can be hard to achieve for those 'garden tortoises' or those in a tortoise table in a colder room.

Providing the correct thermal environment will allow the tortoise to thermoregulate and select its body temperature, optimising physiologic function.

Tortoises presenting may well be animals housed in a vivarium or tortoise table all summer with some degree of control of temperature or they may be 'garden tortoises' subjected to our colder climate and left to fend for themselves. Many people combine these two options which allows a tortoise to venture outside under natural solar radiation when it is available (and warm enough) but with the option of venturing inside to an artificial heat and UV source. It is important to remember these species are a basking species and require heat from above from either the sun or a basking site.

Failure to provide the correct thermal environment can lead to anorexia and inactivity. In many cases this occurs in tortoises, which were not intended to be hibernated by their owners. In the hibernating tortoises this can occur after hibernation due to low environmental temperatures. If the tortoise cannot reach its optimal temperature for digestion it will not eat.

Although many will present with anorexia it is important to remember that reptiles use about 2 – 5% of the energy of a comparably sized mammal. Energy conservation is what it is all about and a tortoises life is geared towards getting metabolically active (which costs energy) but then is able to forage and obtain food (which provides an energy source). This food source will be scarce and the cost of obtaining it against the benefits (energetically speaking) need to be considered. Thus anorexia is not really a problem in the short term.

Preparation for hibernation is important and 'garden tortoises' run the risk of being exposed to a cold thermal environment and hibernating themselves. It is very easy to misplace a tortoise in these circumstances and some do not emerge until the following year, if they have survived. So the general recommendation is for these tortoises to be housed in a safe outdoor enclosure where more active management is possible.

Water is essential for life and the tortoises have a number of unique physiological adaptations to survive harsh environments and hibernation. Knowledge of how these work is vital. Tortoises usually drink by submerging their entire head underwater and can take water in via their nose or mouth or even suck fluid into the cloaca/bladder/colon and from there it can be absorbed. In a sense bathing allows dialysis of the tortoise via the bladder. Water should be presented in a shallow bowl with easy access into it. Twice a week the tortoise should be bathed in a cat litter tray of warm water. There should be sufficient water for the tortoise to be able to lower its head and suck up the water via its nose. This water should be 25^0C temperature. Warm water bathing also serves as a stimulus for voiding urates and faecal material. The passing of urine is a sign that the tortoise has rehydrated itself. Weighing the tortoise both before and after a bath is a good way of assessing the degree of rehydration that has occurred. Bladder volume can comprise up to 25% of the bodyweight. Protein breakdown and excretion of nitrogenous waste is one of the major factors influencing the amount of water lost. As a result tortoises are able to modify the protein breakdown products they utilise. Ammonia and Urea require a lot of fluid and this if fine where fresh water is plentiful. However species where fresh water is limited (such as terrestrial species) use uric acid. This forms insoluble urate salts in the bladder which exert no osmotic effect. The bladder amongst other sites is used as a water storage facility. As the tortoise dehydrates it uses water from the bladder to maintain its circulatory volume. In order to draw water into the circulation the tortoise must maintain an osmotic gradient. To achieve this it increases the osmolarity of its blood. As a result terrestrial species have a wide range of normal blood osmolarity depending on the availability of water. This can range between 250 – 450mOsm. Most commercially available fluids for rehydration therapy in mammals have values around 320mOsm.

Plasma osmolarity can be an indication of the hydration status of the tortoise. The tortoise elevates this by increasing sodium, chloride, urea and glucose in the circulation. Thus a simple equation can be used to estimate blood osmolarity: -

$2(Na^+ + K^+)$ + glucose + urea = osmolarity.

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Urea is a rapidly diffusible solute that can be excreted when water is available again. Blood electrolytes and urea can be used to detect subclinical blood concentration in a tortoise. Bear in mind parameters such as PCV, TP or uric acid will be unaltered at this stage as blood volume is maintained.

The effects of this were observed by Darwin noting the bladder contents of the giant tortoises on their voyages (used as a water source for sailors) became less pure as they continued on their journey. The specific gravity of the urine, its pH and its rate of production also allow an assessment of the tortoise's water balance and is easy to check in a consultation. It is only once the bladder osmolarity exceeds the capacity of the tortoise to elevate blood osmolarity that clinical dehydration is seen. Body weight is also a good guide to the hydration status given the sheer size of a full bladder versus and empty one.

Evaluating the heath of a tortoise prior to hibernation is important and many owners rely on previous weight records or charts such as the 'Jacksons ratio'. Whilst these can help many were derived from specific subtypes of wild caught animals and do not relate to captive raised animals. Equally a tortoise full of follicles, eggs or coelomic acites will appear healthy based on these charts. These are no substitute for a detailed physical examination and husbandry evaluation. My advice is not to hibernate a tortoise unless the husbandry provided in the preceding summer was optimal, combined with a detailed clinical examination in which no signs of disease was identified.

Hibernation for Mediterranean species should be of no longer than three months (maybe four or five for horsfield). In order for this to occur an indoor facility (or heated outside accommodation) will be needed to enable early activity in the spring. Thus hibernation can occur during October to February. A tortoise must be allowed to drink prior to hibernation and daily bathing as described previously is essential to encourage water intake and voiding of faecal material. Tortoises should be fasted prior to hibernation to prevent decomposition of gut contents and avoid subsequent bloat or septicaemia which can happen upon awakening from hibernation. Fasting should occur for one month prior to hibernation.

There are four approaches to hibernation:

1 – In the garden. Not advised due to the risk of frostbite, rodent or bonfire trauma. The tortoise will need to be well covered to reduce these risks with leaves or polythene. There is no ability to weigh or check the tortoise. Problems encountered may be due to incorrect hibernation temperatures; resulting in movement and weight loss. Too low a temperature may lead to blindness due to frost damage. Owners need to be aware of the risks of this method and confine their tortoise so it does not hibernate itself in the garden.

2 – In the fridge. Good in principle enabling a constant hibernation temperature of 5^0C to be kept. Easy to check the tortoise and weigh it. However 5^0C is at the limit of the temperature range offered by the fridge. Freezing of the tortoise is possible in the event of a malfunction. The inclusion of a thermal probe or max/min thermometer is required. Fridges will also tend to dry out the air inside them and the humidity will be too low. Providing a full bowl of water in the bottom of the fridge is important to counteract this. The ventilation is poor and opening the door daily for a few seconds is important to allow for air exchange.

3 – In a minibar/chiller cabinet. Advised. Has the advantages of a fridge but generally is operating within the normal limits of the appliance. Usually glass doors enabling visual inspection with no disturbance. Many are fan assisted and do not dehydrate the air. Weight checks can be performed easily. Usually if the minibar fails then it will heat up thus the tortoise just becomes mobile and wakes up from hibernation. The inclusion of a thermal probe or max/min thermometer is required.

4 – In a box in the garage/shed. This should consist of two rodent proof boxes. The tortoise is placed in the first box and padded with insulation material/bedding (hay, paper, straw). This box is then placed in another insulated box. The reason for this is the tortoise may still move to the side of the first box and thus would have minimal protection if a second box was not used. The inclusion of a thermal probe or max/min thermometer is required. The temperatures recorded

should dictate where the box is placed. Generally a garage, outbuilding or garden shed are appropriate. This is not ideal, as there is no control over the exact temperatures experienced by the tortoise. Problems due to incorrect hibernation temperatures may be encountered.

Ideally the tortoise should be exposed to a temperature range of 3 – 7 degrees centigrade. A bodyweight loss of 1% per month is anticipated during hibernation. Urination indicates the loss of the main water utilised during hibernation and the tortoise should be woken up and hydrated.

After a three-month hibernation period, the tortoise should be warmed up to its optimal temperature. This should be performed quite quickly over 24 - 48 hours. This is best achieved by the use of a floor pen in a utility room or in a purpose built building. The pen can be made out of melamine boarding with the joints sealed with mastic silicone sealant. Having rounded corners and in the case of small tortoises, a low slope on the lower section of the sides will prevent escape attempts and the tortoise from falling onto its back. Checking the tortoise's weight is also vital and this needs to be compared to previous values. Bathing should be performed daily at this stage until the tortoise voids urine. Feeding should commence within one week of awakening.

Any tortoise presenting to the vets will require a clinical examination after having taken a detailed history. Hypothermic tortoises should be warmed to their optimal temperatures prior to a physical examination.

Initially time should be taken to observe the tortoise presented to you. Assess its general demeanour, activity and respiration prior to handling or stressing the tortoise. Active animals should walk or run with their plastron raised off the floor. Respiration should be observed. There is usually a small amount of forelimb movement with no undue exertion or respiratory noise. Increased yawning, face rubbing, effort, noises such as squeaks can all indicate underlying respiratory disease.

Disposable gloves should be worn when handling any tortoise. This is to prevent the risk of disease transmission between the reptile and yourself, and to reduce the risk of you being a vector for disease between different tortoises. A full clinical examination should be systematically performed in every case seen. A healthy tortoise will have bright open eyes and be active. There should be no nasal or ocular discharges. Some may be resistant and retract into their carapace. Time must be given for these animals to relax. A closer examination of the head, limbs and shell should follow. The tortoise should give a perception of strength when extremities are being examined. Check the eyes, nares, beak and ear drums for any abnormalities. Beak overgrowths are a common presentation and can be carefully burred back. Middle ear abscesses are also common leading to distension of the ear drums. The mouth should be opened and the choana, tongue and glottis examined. If possible the glottis should be observed when the tortoise exhales to check for discharges. The heart can be assessed using a Doppler probe placed at the thoracic inlet. The skin should be examined for any wounds, burns, scarring, swellings, dysecdysis or external parasites. The shell should be examined for compressibility, loose scutes, discharges, fractures, reddening. The coelomic cavity can be palpated via the pre femoral fossa in front of the hind legs. Tipping the tortoise towards the examiner can allow eggs and bladder stones to fall onto your finger and ballottement can confirm their presence. In larger tortoises examination of the cloaca is possible.

A weight should be taken at every time the tortoise is examined and should be performed twice daily while hospitalised. Most cases of post hibernation anorexia will benefit from hospitalisation.

The aim of the hospital environment is not to create a wonderful setup for captive maintenance, but to provide for the tortoise's basic needs in an easy to clean disinfectable environment with minimal risk of disease transmission. Plastic open topped vivaria serve this purpose well. A basking lamp directed from above to provide a basking area and UV- b light should be provided. Overnight the basking lamp should be turned off. The room temperature should be kept at 21^{0}C. The basking temperature can be monitored by a thermometer. There is no point in administering any therapeutics until the tortoise has reached optimal temperature. Once this temperature has been achieved initial assessment and treatment can begin.

Reptiles have a maintenance fluid requirement of 30mls/kg/day and all cases will benefit from fluid therapy. Ideally an attempt should be made to quantify the level of dehydration evident or presumptive therapy can be given. This can be via a number of routes.

Most simply bathing is effective for mildly debilitated animals. This can be achieved by placing the animal in a cat litter tray or plant propagator (with the heating element on) with sufficient depth for the animal to submerge its head. Generally this is performed with water around 28 degrees centigrade and bathing can be for 20 minutes twice a day. Plant propagators provide a heat source to keep the bathing water warm for longer. Electrolytes can be added to this water and there are a number of commercially available products.

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. Water, electrolytes and supportive nutrition can be given via this route. Initially water is sufficient. All fluids should be warmed to 28 degrees prior to administration.

Parenteral fluids can be given at the rate of 1% of bodyweight up to three times daily. Fluids used for mammalian species are acceptable. These have an osmolarity of 280 – 320 mOsmoles. This is comparable to the osmolarity of many sick chelonia. 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.

Intracystic fluids are also a useful option, particularly if the tortoise is anaesthetised or sedated. The urethra is large and a solid crop tube can be passed into the bladder for fluid administration. Given the large capacity of the bladder large volumes can be given. Care has to be taken to avoid stressing the tortoise leading to urination.

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 may be 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. Ideally fluid replacement should be geared to return the osmolarity to that expected for the species at the particular time of year. This information is not fully known and so a general approach is adopted. One such study looking into plasma osmolarity of terrestrial hibernating species is tabulated below.

Plasma osmolarity of terrestrial chelonians (mmol/L)

	Na+	K+	Ca2+	Cl-	Urea	mOsm/L
Jan	156	3.7	1.2	124	31	349
Feb	161	3.0	2.7	123	38	449
March	157	3.8	2.7	125	34	443
April	***167***	4.6	2.3	134	***103***	***467***
May	129	4.9	2.5	86	37	340
June	***105***	4.3	2.4	66	26	***258***
July	115	4.5	2.3	94	***4***	290
Aug	136	5.5	2.7	108	12	322
Sept	136	4.9	2.5	99	11	338
Oct	138	4.8	2.4	110	22	343
Nov	141	5.2	2.6	99	21	349
Dec	155	6.3	3.1	124	31	404

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

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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. Evaluation of the blood sodium and urea levels and urine specific gravity can be used prior to fluid therapy to assess the tortoises requirements and its hydration status.

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, reduced blood sodium, reduced blood urea and a reduced urine specific gravity.

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 x 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 animals 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. The following table provides a guide to the quantities of commercially available support care products required for chelonians. Oxbow Critical Care Herbivore Diet (fine grind) requires an 8 french tube to pass easily.

Volume required per day mls (% body weight)

Animal wt (g)	**Dilution with water**	**50**	**100**	**200**	**500**	**1000**	**2000**
CCF vetark	1 in 3 – 5	2 (3.8)	3 (3.1)	5 (2.6)	10 (2.1)	18 (1.8)	30 (1.5)
CC fine grind	1 in 3	2.5 (5.1)	4 (4.1)	7 (3.6)	15 (2.9)	24 (2.4)	40 (2.0)
CC herbivore	1 in 2	2.5 (5.1)	4 (4.1)	7 (3.6)	15 (2.9)	24 (2.4)	40 (2.0)

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. Care should be taken not to overload the tortoise and many can be maintained on once daily feeding .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.

Anorexic chelonians may require a specific diagnosis to be made. Initially urine and blood analysis can be used to determine hydration and catabolic status, but can also rule out some common underlying diseases.

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Tortoise veins are hard to find. The primary 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. I have seen a tortoise bleed out from a carotid vessel into its oesophagus. Skin disinfection should be thorough prior to venipuncture. 25 gauge needles will be required in most cases.

Other sites include the subcarapacial sinus which is my preferred second option. 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. In one study the PCV of tortoises was reduced by only a small percentage compared to jugular vessels. This can be accessed with the head in or out and a longer 1" or 1.5" needle required in larger tortoises. Caution is to be advised as spinal cord damage can occur with poor technique.

The dorsal tail vein should not be used for blood sampling as lymph dilution is commonplace. It is however useful in aggressive or strong specimens, but in an ideal world should be used to administer a sedative to allow for safe jugular sampling.

Once a sample is obtained it is best to place it all into heparin (as EDTA lyses chelonian red cells) and use the small amount left in the hub for glucose analysis and a blood smear.

Reptilian haematology is a specialised field and films should be examined by a haematologist with a special knowledge of reptiles. It is always worthwhile looking yourself and comparing these to any external laboratory findings. The film interpretation is important as in many cases the total white cell count may be normal or reduced even in the face of a severe challenge. Toxic activity, degranulation, bacteria and phagocytosis can all be evident on films.

Selecting the correct biochemical profile is important. 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 although it can also raise with catabolism. Uric acid is elevated only when two thirds of renal function has been compromised. Mild elevations can reflect folliculogenesis or high protein meals.

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 either in house with an istat or within 48 hours by an external laboratory. 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.

ALKP can be elevated when there is increased bone remodelling such as reproductive activity or NSHP. Trauma may also elevate values.

Glucose can be performed on a heparin sample or a glucometer. There is marked physiological variation. High levels can reflect diabetes or pancreatic disease but have been poorly quantified in reptiles. Hypoglycaemia can occur in liver disease, starvation, malnutrition and septicaemia.

AST and CK are useful in combination. AST is found in liver and muscle tissue. CK is only present in muscles. Thus an AST elevation alone can reflect hepatic damage. If in concert with CK it can be disregarded. LDH and ALT have wide tissue distribution in chelonia and there is no point measuring them! GLDH has been studied in the U.K. and was found to be below 20IU in healthy chelonia. The Americans don't use this enzyme! Bile acids are highly species specific throughout the animal kingdom. Assays developed are for mammalian bile acids and the usefulness of this test has not been conclusively confirmed in reptiles. Many clinicians consider values lower than 60µmol/L to be acceptable. Total cholesterol has also been measured in reptiles but is yet to be quantified.

Betahydroxybutyrate is the major ketone produced in chelonian blood and is elevated in post hibernation or in drought.

The opportunity to evaluate the faeces should not be missed but it is important to remember that parasites are unlikely to be the cause of the anorexia unless in very large numbers. Parasites such as oxyurids are seen in up to 50% of tortoises. Balantidium and Nyctotherus are also very common. Hexamita and cryptosporidium are much less frequently found.

Radiography may also be considered a useful screening tool of the PHA tortoise. Subclinical disease may not be obvious clinically and common examples include pneumonia or retained eggs, both of which are easily apparent on radiography.

There are three standard views for chelonia. The dorso-ventral vertical beam 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.

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 and to rule out follicular stasis.

More advanced diagnostics (such as endoscopy or CT) or specific diagnostics (e.g. nasal washes or culture) are indicated on a case by case basis.

Antibiotic therapy is often considered as part of a therapeutic regime for sick reptiles, primarily driven by a low white cell count and immunocompromise. I do not administer antibiotics without some supportive evidence of their need. First line choices should be broad spectrum, account for gram negative resistance and cover anaerobic bacteria. As such ceftazidime or ticarcillin should be the first line choice. These have no activity against Mycoplasma should this be on the list of possible pathogens. They are available as injections only. Once reconstituted they maintain potency for 24 hours at room temperature. Refrigerated injections are reported as lasting for 7 days. Frozen injections remain potent for 3 – 4 months. Only one pharmacokinetic study in a chelonian has been performed with ceftazidime. A dose of 20mg/kg IM every three days was effective. For ticarcillin 100mg/kg IM every two days was effective.

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. An O-tube can easily be placed using a propofol or alfaxalone bolus given intravenously.

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.