

Sea Turtle Medicine

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Abstract

Introduction

In the United States, there are many state and federal regulations which govern sea turtle rehabilitation and practitioners are encouraged to consult with these entities, where appropriate, prior to undertaking any interventions in wild or captive animals. In most cases, special licensure is necessary, even for veterinarians. There are seven species of sea turtles, most of which are listed as threatened or endangered under the Endangered Species Act. Anthropogenic threats are common and many conservation efforts are aimed at reducing these threats, in addition to providing individual patient care.

Anatomy

The dorsal part of the shell is called the [carapace](#) and the ventral portion the plastron with the inter-connection between these two being known as the bridge. The shell is comprised of dermal bone covered with either a leathery skin or a tough keratin layer of individual scutes. The scute patterns are particular for a species, but do not correspond with the underlying bony sutures of the shell. Scutes do shed intermittently. Scutes can be named and numbered, and injuries should be described by proper placement terminology. The dermal bone of the shell consists of approximately 60 bones derived from modified pectoral and pelvic limb bones, vertebrae, sacral and costal bones. The internal surface layer of the shell is pleurocoelomic membrane, and it is from here that new bone growth occurs.

Diagnostics

A complete [physical examination](#) is the most important diagnostic tool of any clinician dealing with any species. Knowing what constitutes “normal” for the species under examination is important. Measuring [core body temperature](#) within 1 hour of rescue, along with obtaining a thorough history, may help to appreciate if the patient has gotten extremely hypo- or hyperthermic and assist in designing a treatment course. Generally, the minimum database should include [diagnostic imaging](#) (which may include, ultrasounds, radiographs, endoscopy, or computed tomography), [complete blood count, iSTAT +/- chemistry profile](#), and eventually fecal examination. The preferred blood collection site in most sea turtle species is the external [jugular vein](#) (also known as the dorsal cervical sinus). Lithium heparin is the preferred [anticoagulant](#) over ethylenediamine tetra-acetic acid (EDTA) in sea turtles, as EDTA markedly lyses their red blood cells. However, any diagnostic testing should not compound the stress or trauma to the

patient. Therefore, some tests may have to wait until the patient is more stable. Assess severity of the presenting complaint and prognosis for return to the wild. Reptiles are amazingly resilient creatures and can survive things that would easily kill any other animal. Nonetheless, some presentations carry a grave prognosis for return to normal function and thus return to the ocean. In these cases, [euthanasia](#) may be the best choice. Euthanasia and assessing life in reptiles can be challenging as the heart may continue to beat long past the time of clinical brain death.

When performing a gastrointestinal contrast study, the author has had the most success with giving the following: 8 ml/kg total volume given by gavage of 2 ml/kg iohexol + 2 ml/kg water + 4 ml/kg barium (concentration 2.38 g/ml). Take first radiograph and then q24h until study is complete. GI transit time is long and so expect it to take at least several days.

If a sea turtle has pneumonia, as is often the case with hypothermia or “cold-stunning”, the author prefers to get a bronchoalveolar lavage (BAL) as soon as possible to guide therapy.

Critical care

[Fluid support](#) and [analgesia](#) are a critical part of early intervention in many cases. If the patient is dehydrated or hypothermic, it is important to take a day or more to rehydrate and warm the patient prior to giving any food or medications or metabolism of these substances may be impaired and make the animal worse. Crystalloids, such as Plasmalyte, Normasol-R, LRS or ½ strength LRS + 2.5% dextrose are all acceptable empiric choices prior to obtaining bloodwork, but the author prefers to have iSTAT results prior to initiating fluid therapy. Shock doses of fluids can be as high as 3 ml/kg/hr for up to 3 hrs. Maintenance fluid rate is generally 1-3% of body weight per day, not to exceed 25-35 ml/kg/day for most species. Fluids may be given orally to more stable patients. Parenteral fluids may be given intravenously, intraosseously, subcutaneously, epicoelomically, or intracoelomically (least preferred route), depending on whether colloidal or crystalloid fluids are being utilized. Hypertonic saline may be indicated in head trauma or hypovolemia. Indwelling IV catheters are rarely used. Whole blood transfusions are indicated in cases of acute hemorrhage and life-threatening anemia (5% or less). While blood types in sea turtles have not been determined, transfusion reactions do occur, so cross matching is important. Cold patients should not be warmed too rapidly but should be gradually brought up to preferred body temperature (PBT) over several days. Fluids may help in this regard. Antibiotic selection is often empiric and generally starts with parenteral choices, but oral medications should be used once gastrointestinal motility has been re-established to minimize repeated tissue trauma.

Supportive care

Dehydrated turtles and those covered with excess epibionts (e.g., leeches, barnacles) should initially be placed in fresh water for the first 12-24 hours, which will allow for rehydration and will eventually kill the epibionts. For patients that are not eating, assisted alimentation is often a vital element of supportive care. In most cases, chelonians that are medically stable and have good pain control should begin eating within 1 week of admission. If they do not, consider [gavage feeding](#) or placing an indwelling [esophagostomy tube](#). If they have been NPO for a long time, beware of refeeding syndrome. One study in turtles showed a five-times increase in insulin

levels after a 30 day fast, increasing the potential for hypokalemia & hypophosphatemia with force feeding. Start at 50% of calculated energy needs. Place patient at upright angle to prevent regurgitation if very debilitated. Indwelling tubes must be placed under general anesthesia. Tubes may be left in place for months and are easily removed at any time. If a stoma is persisting weeks after tube removal, then debridement and primary closure may be performed but the author has rarely found this necessary. Additionally, total parenteral nutrition (TPN) may also be easily utilized in sea turtles. The author uses TPN compounded by [Infuserve America](#) (St. Petersburg, FL) at a rate of 2.5-3 ml/kg/h (although the author has given more rapidly on occasion with no apparent ill effects) IV twice daily.

Therapeutics

Anesthesia and analgesia

The author's preference for [sedation](#) in most sea turtles is to pre-medicate with atropine (0.05 mg/kg IM), followed by induction with dexmedetomidine (prefer combination with vatinoxan, like Zenalpha; 0.03-0.05 mg/kg), hydromorphone (0.3-0.8 mg/kg), midazolam (0.3-0.5 mg/kg) +/- ketamine (3 mg/kg) all given IV. Reversal is typically with atipamezole (0.2-0.5mg/kg IM; if given IV nausea and arrhythmias may occur), naloxone (0.04-0.08 mg/kg IV) and flumazenil (0.05-0.08mg/kg IV). In the author's experience, the hydromorphone generally needs to be reversed in order to have a good complete recovery that allows the patient to go back into a tank the same day. Thus, multimodal analgesia is important. Pharmacokinetic studies indicate that meloxicam is not useful in loggerheads, but a dose of 1 mg/kg SQ every 12 hours in Kemp's ridleys and every 48 hours in greens maintains appropriate plasma levels to potentially reduce pain and provide anti-inflammatory effects. Ketoprofen (2 mg/kg once daily, maximum 5 days consecutively, with 5 days off before resuming if needed) is preferred in loggerheads. The author has also had good success with pregabalin (Lyrica; 4 mg/kg PO q24h), or gabapentin (10-15 mg/kg PO q24h) especially for neurogenic pain (i.e. post-amputation).

Antimicrobials

The author's preference for empiric antibiotic choice includes: amikacin (5mg/kg q72h IM) usually with ampicillin (20 mg/kg IM q24h), ceftazidime (22 mg/kg IM q72h), azithromycin (5 mg/kg PO q48h), enrofloxacin (20 mg/kg PO or SQ in fluid bolus q72h), oxytetracycline (biomycin; 44 mg/kg q6 days x4 injections, then decrease to 22 mg/kg SQ), piperacillin-tazobactam (50-100 mg/kg IM q24h), metronidazole (25 mg/kg PO q24h), and trimethoprim-sulfamethoxazole (22-48 mg/kg PO q24h). The author has used itraconazole (5 mg/kg PO q25h), voriconazole (10 mg/kg PO or SQ q24h), and other antifungals as indicated. While nebulization has been utilized in cases of respiratory disease, the efficacy is questioned by the author and certainly warrants further study. When doing regional limb perfusion, the author uses the systemic dose of the NSAID, antifungal, and/or antibiotic locally into the regional vein and then removes the tourniquet in 10-15m.

For treatment of *Caryospora* sp. the author has used ponazuril. (The brandname Marquis seems to work best; 100 mg/kg PO q7d x 2 doses and then recheck fecal and repeat treatment as needed).

Common selected presentations

[Fibropapillomatosis](#) (FP) is a disease associated with chelonid herpesvirus ChHV5, primarily impacting juvenile green sea turtles living in near-shore waters with predominately skin tumors. Global disease prevalence varies from 0% to 92%. External masses may be removed surgically, ideally with CO₂ laser or radiosurgery. Lidocaine, at a maximum dose of 8–10 mg/kg or bupivacaine at 2 mg/kg, is particularly helpful in reducing the level or avoiding gas anesthesia when removing FP tumors. Once surgical sites have healed (typically within 3-4 weeks post-operatively in most cases), the turtle may be released.

For post-hatchlings or “washbacks”, ingestion of plastics is the most common presentation (over 95% at the author’s institution).

Many diseases may lead to buoyancy abnormalities due to gas or air accumulation in the gastrointestinal tract, the coelomic cavity, or the lungs. Free air in the coelom may be aspirated by tilting the turtle on its side and directing the head ventrally to bring the air pocket up to the inguinal space and removing with a 3-way stopcock set up. In larger turtles a vacuum may be helpful. If air keeps refilling, then a lung tear may be responsible, and blood-patch pleurodesis has been successful in alleviating this condition in the author’s experience. In sea turtles with spinal injuries, ileus and subsequent distension and gas trapping in the large intestine may never be resolved and may warrant euthanasia.

Trauma from boat strikes, fishing line entanglements, hook ingestion, and other anthropogenic issues are frequent reasons why sea turtles strand and common enough in the literature that they won’t be addressed here.

Outline

- I. **Sea turtle emergencies**
 - A. May vary based on
 - Location around the world
 - Time of year
 - Resource allocation
 - Local, state, and federal or regional regulations/laws
 - B. Guidelines established in advance
- II. **Anatomy**
 - A. [Carapace, plastron, bridge](#)
 - B. Scute patterns species specific
 - C. Pleurocoelomic membrane: new bone growth
- III. **Diagnostics**
 - A. [Physical examination](#)
 - B. Body temperature on admit
 - C. MDB: [iSTAT, CBC, imaging, +/- chem profile](#), +/- fecal exam
 - D. [Lithium heparin](#) best anticoagulant

- E. GI contrast: long transit time
- F. CT and BAL for pneumonia
- IV. **Critical care**
 - A. Parenteral administration of [fluids](#)/medication
 - B. Fluid rate 25 ml/kg/d maintenance
 - IV or IO (marginal scute) preferred
 - Blood transfusions/crossmatching
 - C. If hypothermic, rewarm over 2-3 days
 - D. Parenteral → oral antimicrobials
 - E. Crystalloids
 - LRS, Plasmalyte, Normasol-R, ½ strength LRS + 2.5% dextrose
 - F. Colloids
 - Hypertonic saline: Head trauma, hypovolemia
 - G. Blood and plasma transfusions
- V. **Supportive care**
 - A. Fresh water bath 12-24h
 - B. Gavage feeding, [esophagostomy tubes](#)
 - C. Refeeding syndrome
 - D. Total parenteral nutrition
- VI. **Therapeutics**
 - A. [Anesthesia](#)
 - Hydromorphone, medetomidine-vatinoxan (Zenalpha, Dechra Pharmaceuticals), midazolam
 - B. [Analgesia](#)
 - NSAIDs
 - Pregabalin, gabapentin
 - C. Antimicrobials
 - Parenteral → oral
 - Regional limb perfusion
 - D. Antiparasitics
- VII. **Common selected presentations**
 - A. [Fibropapillomatosis](#)
 - B. Plastics ingestion
 - C. Buoyancy abnormalities

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