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DIAGNOSIS AND MANAGEMENT OF INTESTINAL PARTIAL OBSTRUCTION IN A LOGGERHEAD TURTLE (*CARETTA CARETTA*)

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Abstract: A loggerhead sea turtle (*Caretta caretta*) was suspected of ingesting rubber suction cups during rehabilitation following a cold-stun event. Survey radiographs were inconclusive. Computed tomography (CT) was performed to determine whether the objects had been ingested after traditional radiographs failed to resolve the material. The items were identified, and a partial obstruction was diagnosed. The case was managed with medical therapy using white petrolatum and light mineral oil administered to the turtle in fish for 3 wk. The CT exam was repeated 2 wk into the therapy. A persistent partial obstruction was identified; however, progression of the foreign objects through the intestinal tract was evident and continued medical mangement was deemed appropriate. The foreign bodies were passed with feces 26 days after ingestion.
Key words: Sea turtle, foreign objects, medical management, diagnostic imaging.

BRIEF COMMUNICATION

A 23.5-kg subadult Atlantic loggerhead sea turtle (*Caretta caretta*) stranded on Cape Cod, Massachusetts, on 11 November 2008 during a seasonal mass-stranding cold-stun event. The straight carapace length was 53.6 cm, and initial core body temperature was 44.4°F (6.9°C). The turtle was transported to the New England Aquarium for critical care and gradual rewarming. A common constellation of metabolic disturbances associated with cold-stunning—hypothermia, acidosis, and hyperglycemia—were identified, but the animal stabilized quickly with standard treatment.[18] After 6 days of therapy, the turtle was transferred to the National Marine Life Center (NMLC). The animal presented in good condition with no external lesions and was swimming normally in 76°F (24.4°C) water. Melena was observed and treated with carafate (Sucralfate, Nostrum Laboratories Inc., Kansas City, Missouri 64120, USA) at an oral dosage of 1 g once a day for 7 days. Necrotizing, ulcerative, heterophilic enteritis has been reported in postmortem examinations of cold-stunned sea turtles.[5] Normal feces were observed within 1 wk of admission. Ceftazidime (Fortaz, Glaxo Wellcome, Research Triangle Park, North Carolina 27709, USA) was administered by intramuscular injection at a dosage of 22 mg/kg every 3 days for 3 weeks[14] as prophylactic antibiotic therapy. The turtle ate voluntarily 5 days into rehabilitation and initially consumed 1% to 1.5% of its body weight with an offered diet of herring (*Clupea* sp.), squid (*Loligo* sp.), Atlantic mackerel (*Scomber scombrus*), and green crabs (*Carcinus maenas*). Maximum food intake was 3.5% of body weight, or approximately 700–2,000 kCal/day. The diet was supplemented with a vitamin B complex tablet (B-Complex, Nature Made, Mission Hills, California 91346, USA), 500 mg calcium, and half a multivitamin (Sea Tabs for Birds, Turtles, Fish, and Sharks, Pacific Research Laboratories, San Diego, California 92101, USA) with each meal.

Blood was collected weekly for 3 wk then monthly throughout the entire period of captivity from the dorsal cervical sinus. Initial blood work showed elevated tissue enzymes (aspartate aminotransferase [AST] = 808 U/L, 75–150 U/L mean ± SD;[19] creatine kinase [CK] = 181,407 U/L, 0–3,291 U/L; lactate dehydrogenase [LDH] = 3,713 U/L, 45–172 U/L), mild hyperglycemia (glucose = 258 mg/dl, 121–142 mg/dl), hyponatremia (Na = 151 mEq/L, 156–158 mEq/L), hypokalemia (K = 2.2 mEq/L, 4.2–5.0 mEq/L), and hyperuricemia (uric acid = 2 mg/dl, 0.42–0.50 mg/dl[7]). The glucose, sodium, and uric acid levels were normal within 1 wk, and the CK and LDH were normal within 1 mo. The AST was still slightly increased (AST = 382 U/L) at the time of release; however, a twofold reduction was noted during rehabilitation, and this degree of elevation was not considered significant. The potassium level remained low but increased before release (K = 3.5 mEq/L), with a

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value within one standard deviation of the mean according to a report of loggerhead serum electrolytes.[6] The initial white blood cell count (WBC) was low (WBC = 4,000 cells/μl; 8,870–20,470 cells/μl[19]) but improved within 1 wk (WBC = 12,000 cells/μl). The hematocrit (HCT) was normal to elevated (HCT = 42%, average = 44%) depending on the reference range used (28%–48%[8] or 17%–27%[19]).

Two months into the rehabilitation, it was noted that a submersible water heater protected by a polyvinyl chloride (PVC) grating had become dislodged from the side of the tank overnight. The two rubber suctions cups that secured the heater to the inside of the PVC sleeve were missing. Radiographic evaluation of the turtle included whole-body dorsal–ventral (DV) projection and horizonal beam lateral and cranial–caudal projections. The horizonal beam projections were accomplished by resting the turtle in sternal recumbancy on a styrofoam support (under the plastron) so that the legs did not touch the table. Radiographic findings were inconclusive; although adequate for evaluation of the skeleton, gastrointestinal segments and ingesta were not defined. Because of a concern for the probable ingestion of the objects and being aware of the difficulty to ascertain rubber material via standard radiographs through the shell of a live turtle, computed tomography (CT) was performed at the Woods Hole Oceanographic Institution Computerized Scanning and Imaging Facility (WHOI-CSI). The turtle was placed in sternal recumbancy in a plastic container on the scanner table with its head covered by a towel. It was not anesthetized and remained still for the period of the two rapid helical scan data acquisitions. Scans were aquired with a helical CT (Volume Zoom, Siemens, Munich, Germany 80333) using 120-KV and 200-mAS with 3-mm slice acquisition and a table pitch of 3, throughout the entire animal, and 1-mm slice acquisition with a table pitch of 2 for the midbody region. Transverse images were reconstructed in both bone and soft-tissue algorithms. Three-dimensional (3D) images were obtained using Siemens propriety SSD and VRT software. Image reconstructions were completed after the turtle was returned to its transport container. Typical table times were less than 5 min.

The two rubber stoppers were immediately identifable by their size and shape and were discovered in close proximity to each other in the left upper quadrant within the lumen of the small intestine (Fig. 1). The intestines aboral to the objects contained less ingesta and subjectively were normal in appearance and diameter. Ingesta had accumulated orad to the foreign objects, and a short region of intestines was distended to a diameter of 2.4 cm compared with the intestines distal to the foreign bodies that had diameters between 1.6 and 2.1 cm. These findings were consistent with partial obstruction. There was no evidence of coelomic effusion or free gas and no evidence of intestinal mural gas. All other body systems were considered normal.

Medical management of nonobstructive foreign object ingestion in sea turtles with fluid therapy followed by metoclopramide has been described.[11] In this case, white petrolatum USP, light mineral oil NF, corn syrup, malt syrup, soybean oil, cane molasses, and water (Lataone, Vetoquinol Prolab, Princeville, Quebec, Lavaltrie, QCJ5T355, Canada) were adminstered as a single daily dose of 0.2 ml/kg in fish for 3 wk. The turtle accepted the medicated fish. Shortly after beginning therapy, an oil film developed in the tank, and the protein skimmer required intensive daily maintenance to remove the oil from the water. Feces were collected daily and examined for the objects and parasites. Trematode ova measuring 47 μm × 38 μm were present in small numbers. Intestinal trematodiasis is not uncommon in sea turtles, with more than 40 species inhabiting the loggerhead.[3] The infection was considered mild, and no treatment was instituted. After 2 wk, the foreign material had not been observed to pass. Concern for a possible complete obstruction or complications secondary to the presence of the material in the intestines prompted a second CT exam. The foreign objects were still evident but had changed position (now within a loop 6 cm cranial to the pelvic girdle compared with 9 cm initially, but still within the left midabdomen) and were more widely separated (initially touching, now 5 cm apart). Gaseous pockets had developed within the fluid filling the small intestinal tract oral to the foreign objects and distension had increased moderately to a maximal diameter of 3 cm. The remainder of the anatomy was within normal limits and unchanged from the previous scans on this animal. Persistent partial obstruction was diagnosed. Given some evidence of intestinal transit, no significant progression of distension, and no evidence of intestinal perforation, continued medical management was considered most appropriate. Six days later the passage of the first object was confirmed, followed by the second object after another 4 days. The total transit time for both foreign bodies was 26 days.

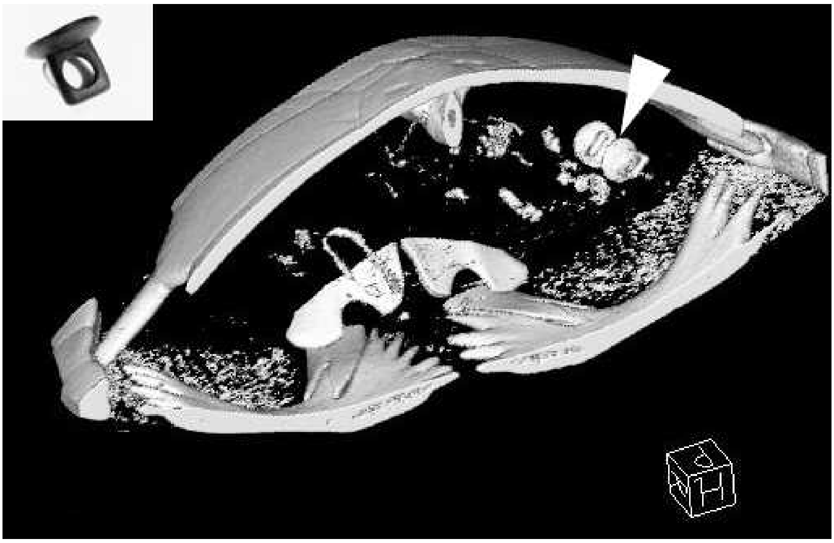

Figure 1. Three-dimensional maximum intensity projection slab reconstruction from the first computed tomography scan. The image shows the rubber objects in close proximity in the left cranial quadrant. The insert shows an image of one of the rubber suction cups taken after recovery.

The remaining rehabilitation was uneventful. The turtle was transferred first to a Virginia facility then onward to North Carolina, where it was released and monitored via satellite telemetry (Wildlife Computers, SPOT 5, Redmond, Washington 98052, USA) and documented on SeaTurtle.org.[1] The turtle was tracked in the coastal waters (<25 miles) off the North Carolina shore for 71 days. The animal's movements following return to the wild were considered normal for the species, and the rehabilitation proved successful.

Loggerhead sea turtles are facultative carnivores that utilize a wide range of food sources, predominantly benthic invertebrates and coelenterates,[3] and may investigate and ingest novel objects in their environment. Foreign material has been identified within the gastrointestinal (GI) tract of turtles during postmortem examination, and GI obstruction is a source of morbidity[11,15] and mortality.[2] Complete intestinal tract obstruction and chronic partial obstruction without evidence of transit of the foreign material require surgical intervention to relieve the obstruction and prevent development of mural necrosis, respectively. Such surgical techniques have been published for sea turtles but are not without risk.[2] Given the invasive nature of such techniques, evidence that surgery is required is desirable, and is usually best achieved via diagnostic imaging.

Radiography can be challenging and limited in its usefulness in chelonians because of difficulties in interpretation caused by the superimposition of the carapace and plastron and the low volume of intracoelomic fat that together limit subject contrast. Furthermore, plastic and rubber foreign materials can be radiolucent or of an opacity that silhouettes with ingesta, fluid, or soft tissue, which adds additional challenges to the task of foreign body identification. Contrast radiography has historically been used in small-animal medicine when obstructive disorders are suspected; however, prolonged GI transit time in loggerhead turtles reduces the clinical usefullness of this type of study. Valente et al.[17] examined ingesta passage in loggerehead turtles with small foam dishes and barium-impregnated polyethylene spheres. They found the transit time of 85% of the dishes to be more than 13 days, whereas spheres took even longer. Some dishes and small spheres were retained even after the 23-day study was completed. Contrast enemas were not preformed but could be considered in such a case. Contrast radiography has recently been augmented in veterinary medicine by greater access to ultrasound, which has been shown to be particullarly useful in many presentations of acute abdomen, including obstructive disorders.[13,16] Ultrasound in chelonians is fraught with difficulty because of the small windows available to evaluate the coelom, and published studies have concentrated on the reproductive tract.[10,12]

CT overcomes many of the limitations of radiography, as it removes superimposition of structures and improves distinction of soft tissue structures by superior contrast resolution. Helical CT studies are considered the gold standard imaging modality in human medicine when patients present with signs of acute abdomen. They are particularly useful for determining or ruling out the presence of mural pneumotosis or abdominal free gas.[4,9] Information gained from the CT studies in this loggerhead turtle confirmed the presence of foreign material, allowed diagnosis of a partial obstruction, and determined that, although present, intestinal distension was not severe. The serial studies permitted monitoring of the distension and the ability to record intestinal measurements accurately for comparison over time. Most importantly, there was no evidence in either study of intestinal necrosis or perforation that would have required immediate surgical intervention, and the foreign objects were documented to be moving, albeit slowly, along the tract. These data allowed pursuit of a more conservative approach until the objects, considered at high risk for complete obstruction, exited. Passage of these objects was slightly prolonged compared with transit times of other materials published for the species,[17] further supporting the diagnosis of a partial intestinal obstruction.

The use of CT allowed a proactive approach and provided valuable information that contributed to case management that could not have otherwise been acquired. If clinical signs alone had been used to monitor the turtle, and complete obstruction or mural necrosis had developed, the patient might have progressed into a critical state by the time of intervention, thus reducing chances of a successful outcome.

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