Surgical Repair of a Depressed Fracture in a Green Sea Turtle, *Chelonia Mydas*

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ABSTRACT. Sea turtles are considered to be endangered species. A depressed fracture of a 35 kg green sea turtle was treated surgically. Isoflurane was used for induction and maintenance of anesthesia. Slow induction of and slow recovery from anesthesia was remarkable. After the operation, there was an improvement of general status, but head tilt and weakness of the left limbs persisted. As the turtle did not eat, force feeding using stomach tube was performed. The turtle died at about 6 months after the surgery.—**KEY WORDS:** depressed fracture, green sea turtle.

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Sea turtles are considered to be endangered species. Traumatic injury to sea turtles can occur from several causes such as watercraft, fishing activity, fishermen, water controlling equipment, shark, and other turtles [1]. However, clinical reports describing anesthesia and surgery of sea turtles are rare [4]. Here, we report the case of a green sea turtle with a depressed fracture that was treated surgically.

A 35 kg green sea turtle was found on the shore in Miyazaki prefecture, Japan. The turtle was depressed and had a caving of the head. The cause of the head trauma in this case was uncertain. A small amount of white color discharge was found around the wound. The turtle had been previously kept in the Fishers Experiment Station, Miyazaki Prefecture for 14 days, before it was referred to the Veterinary Hospital of Miyazaki University. The head was tilted to the right and the left limbs were weaker than the right ones. Palpebral reflex was normal in both eyes. The radiography of the head showed fracture lines of the cranium (Fig. 1). At 31 days after the turtle was found, we carried out an operation for reduction and fixation of the bone of the head.

The turtle was positioned in the dorsal recumbency and anesthesia was induced by inhalation of 4% isoflurane in vaporizer setting with 100% oxygen by mask. The trachea was intubated with a cuffed endotracheal tube. The time for induction for enabling of intubation was 110 min. After intubation anesthesia was maintained with 2% isoflurane in vaporizer setting. Since the turtle moved when we started the operation, isoflurane was used at the concentration of 3.5 to 4.0% during the surgical procedure.

The end-tidal CO₂ partial pressure just after the intubation was 63 mmHg and was maintained at 22–46 mmHg during the surgery using artificial ventilation as required. The

cloacal temperature was kept at 28.8–29.2°C with an electrical heating pad and warmed water bottles. Electrocardiography (ECG) was also monitored. To ensure a presence of blood flow, the probe of an ultrasonic Doppler device was attached to the bottom of the left hind limb medially. Consistent heart rate measurements could not be obtained with ECG. Thus, we monitored heart rate or pulse rate with either ECG or the ultrasonic Doppler device. Heart rate or pulse rate gradually decreased from 40 to 20 beats/min during anesthesia, but it gradually regained after termination of isoflurane inhalation.

After the induction of anesthesia, ampicillin was administered intramuscularly. The surgical area of the head was scrubbed with chlorhexidine, and then povidone-iodine was applied. Two parts of the cranium near the fracture line was cut using an osteotome, a saw, and a drill so as to make the reduction easier. Using an osteotome and a periosteal elevator, the depressed fracture was reduced. There was a little hemorrhage during the surgery. Injectable gentamicin and gentamicin ointment was applied to the surgical area and the surgical area was covered with an epoxy adhesive (Quick 5, Konishi, Osaka, Japan). After the operation was completed, the turtle was covered with wet towels to prevent drying. Eighteen hr after the operation the turtle woke up and was extubated.

General status and activity of the turtle were markedly recovered after the surgery, indicating effectiveness of the surgical repair of the depressed fracture. However, the head was still tilted to the right. The turtle did not eat by himself. Force feeding with stomach tube was started on the 7th day after the surgery. The food consisted of seaweed, fish, bananas, cabbages and apples made into liquid. We fed about 200 ml each, 2 or 3 times a day. Regurgitation of the food from the mouth was often observed following the administration of about 200 ml of food. We stopped the feeding when the regurgitation was observed. The body weight at 42 days after the surgery was 32.6 kg. Decrease in body weight after the surgery could indicate insufficient food administration. Radiological examination was performed at 42 days after the surgery. One fracture line

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Fig. 1. Left: Pre operative radiography (lateral view of the head). Right: Radiography at 42 days after the surgery (lateral view of the head).

was indistinct (Fig. 1). An adhesive cover was still attached to the head at this time. At 51 days after the surgery, the turtle was sent to and then cared for in an aquarium with a much larger pool. The turtle died 6 months after the surgery. We could not carry out an autopsy.

Although causes of the death remains unknown, two reasons may be considered. Since the turtle did not eat by himself and force feeding we provided could have been insufficient during the period we observed, insufficiency of food intake may have relation to the death of the turtle. As head tilt and weakness of the left limbs lasted after the surgery, neurological damage may also be related to the death.

Several anesthetics have been used for sea turtles. Controll of the depth of anesthesia is difficult when injectable anesthetics was used and deaths from an overdose of thiopental were reported in green sea turtles [5]. In the present case we used isoflurane because isoflurane is reported to be a safe general anesthetic for sea turtles [1, 3]. Controll of the depth of anesthesia was easy. Generally, in sea turtles, fluids can be given orally, intravenously, and intraperitoneally [1]. In the present case, no fluid was administered during the perioperative period.

Slow induction of and slow recovery from anesthesia were remarkable. Since the turtle breathed every several minutes, the slow inhalation of anesthetic due to extremely infrequent breathing rate may have partly contributed to the slow induction of anesthesia. Although Moon and Stabenau completed a relatively quick induction using awake-

intubation and forced ventilation technique in Kemp's ridley sea turtles [3], this was not possible in our case. Slow recovery from anesthesia has also been reported [3, 4]. Although some reasons such as intracardiac shunting, intrapulmonary shunting, or ventilation-perfusion mismatch are considered for slow recovery in turtles [3], the underlying mechanism is still uncertain. In the present case, neurologic injury due to the head trauma may also partly contribute to the prolonged emergence as being considered in mammals [2].

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