



ANESTHESIA IN THE GREEN SEA TURTLE, (*Chelonia mydas*)

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SUMMARY

Surgical anesthesia for green sea turtles weighing between 6 and 195 kg was achieved with the injectable anesthetics sodium pentobarbital, ketamine hydrochloride, and sodium thiopental. Induction of, duration of, and recovery from anesthesia varied among individual turtles.

Limited data are available regarding dosages and responses for injectable anesthetics among reptiles. In a review report, Maxwell (1) summarized the varied results using different dosage levels and routes of administration for sodium pentobarbital in turtles. Ketamine hydrochloride has been suggested as a suitable anesthetic for aquatic turtles when administered subcutaneously or IM at the dosage rate of 20 to 40 mg/kg of body weight. (2,3) Sodium thiopental has been used in snakes to induce light anesthesia when administered at 0.016 to 0.025 mg/g of body weight intraperitoneally (IP)(4) Other injectable anesthetics and alternative methods of anesthesia have been used with reptiles. (1,5,6,7.)

The purpose of the present study was to report anesthetic dosages and responses for green sea turtles ranging in size from 6 to 195 kg.

MATERIALS AND METHODS

Turtles used in these studies were part of the stock of Cayman Turtle Farm LTD, Grand Cayman, British West Indies, a sea turtle farm raising the green sea turtle, *Chelonia mydas*. The turtles were maintained in concrete tanks or excavated ponds supplied with constantly flowing, unfiltered sea water. Surgical procedure were conducted in a covered, open-air building (ambient temperature ranging from 21 to 26 C) or in an air-conditioned laboratory (maintained at approx. 25 C). After surgical procedures, the turtles were allowed to recover fully in screen-covered tanks with water flowing into the tank, but without water depth being maintained. The 45 turtles used ranged in size from 6 to 195 kg and were 2 to 13 years old. A few mature turtles of unknown age were wild caught, and are part of the breeding colony on the farm. The turtles were anesthetized to determine the sex via laparoscopy or to assess the state of ovarian development during the animal's re-productive period.

Sodium pentobarbital (64.8 mg/ml) (a) was administered iv through the dorsal cervical sinus to 8 turtles (weighing 91 to 170 kg).(8) A small amount of blood was drawn into the syringe to mix with the anesthetic to ensure that the anesthetic was being injected IV. The drug was then administered slowly with repetitive checks to verify that the drug was being introduced into the sinus. Administration time was 30 to 40 s for an approximate 10-ml injection.

Ketamine hydrochloride (100 mg/ml)(b) was administered to 11 turtles (weighing 6 to 151 kg) IM into the cranial muscle of the fore flipper shoulder, IP in the region of the rear flipper, or IV into the dorsal cervical sinus. Unlike IV injections of sodium pentobarbital, ketamine hydrochloride was administered rapidly into the sinus.

Sodium thiopental (c,d) was administered IV to 26 turtles (weighing 28 to 195 kg). After initial mixing with the blood, the drug was introduced rapidly, within 2 to 10 s into the sinus. The drug was dissolved in sterile distilled water to amounts of 50 mg/ml or 200 mg/ml.

The induction time, the length of surgical anesthesia, and recovery time was measured in all turtles. The term induction time refers to the time between administration of the anesthetic and deep anesthesia. Deep or surgical anesthesia refers to the state in which the turtle has no voluntary muscular response to surgical procedures. Total recovery of the turtle from anesthesia is assumed when the turtle can lift its head to breathe and swims easily.

RESULTS

The 8 turtles given sodium pentobarbital were anesthetized at the rate of 10 to 26 mg/kg of body weight, IV. Induction time varied from 14 to 120 minutes. In 4 of the 8 turtles approximately 10 mg/kg was initially given, with additional pentobarbital given within 30 to 85 minutes to induce deep anesthesia. In the 4 other turtles, initial dosages varied from 10 to 18 mg/kg, IV. There was no apparent

correlation between total anesthetic administered and time of induction for those turtles in which dosages varied. Surgical anesthesia lasted 40 to 240 minutes. Total recovery occurred within 4 to 24 hours. One turtle (weighing 95 kg), given a single dose of 18 mg of sodium pentobarbital/kg, showed slight loss of muscular control but deep anesthesia was not achieved.

Routes and rates of administration for ketamine hydrochloride varied among the 11 turtles. For 9 of the 11 turtles in which deep anesthesia was achieved, induction occurred within 2 to 10 minutes after final injection; duration of deep anesthesia was 2 to 10 minutes; and total recovery occurred within 4 hours. Single or multiple injections (administered within 25 minutes of each other) totalling 50 to 71 mg/kg, IP resulted in deep anesthesia for 4 turtles weighing 10 to 50 kg. Intramuscular injection of 50 mg/kg was unsuccessful in inducing anesthesia in 2 turtles weighing (3 to 8 kg, but subsequent injections of 12.5 mg/kg, IV or 34.4 mg/kg, IP resulted in anesthesia. Attempts to decrease dosages required for deep anesthesia by IV injection of ketamine hydrochloride were unsuccessful at dosage levels from 19 to 36 mg/kg for 5 turtles weighing 30 to 151 kg. Subsequent IP injections induced anesthesia in 3 of the 5 turtles with total dosages of 38 to 67 mg/kg.

TABLE 1 - Summary of anesthetic parameters for drugs used to anesthetize green sea turtles

No.of turtles	Drug	Dosage (mg/kg)	Route	Induction Time (min.)	Duration of anesthesia	Recovery time(hr.)
8	Sodium pentobarbital	10.0 -25.0	IV	14 - 120	40 -240	4 -24
11	Ketamine hydrochloride	38.0 - 71.0	IP	2 - 10	2 - 10	<4
26	Sodium thiopental	18.8 - 31.4	IP	5 - 10	5 - 120	<6

In the 26 turtles anesthetized with a single IV injection of sodium thiopental, the normal rate of administration was 20 mg/kg, but ranged from 18.8 to 29.9 mg/kg. Induction time was within 5 to 10 minutes and duration of deep anesthesia was 5 to 120 minutes. Total recovery occurred within 6 hours. One of the turtles given 20.0 mg/kg died from an apparent overdose of anesthesia. Nine turtles weighing 17 to 168 kg were given an initial dosage of 18.8 to 21.2 mg of sodium thiopental/kg and then subsequent injections within 5 to 70 minutes after the initial dosage, to bring the total dosage administered to 23.8 to 31.4 mg/kg. Of these 9, 3 failed to achieve deep anesthesia (total dosage levels of 24.1, 30.0, and 30.0 mg/kg); 2 died from an apparent overdose of anesthesia (dosage levels of 25.2 and 23.8 mg/kg); and the remaining 4 turtles achieved deep anesthesia with duration and recovery similar to turtles given a single injection: All, but 3, of the turtles were given sodium thiopental at a concentration of 50 mg/ml. For 3 turtles in which 200 mg of thiopental/ml was used to reduce the volume of anesthetic to be injected, 1 failed to achieve deep anesthesia, and deep anesthesia did not appear to last as long as for turtles anesthetized with the lower concentration.

Discussion

Results (Table 1) indicated that sodium pentobarbital can be used as an effective anesthesia in large turtle species as in the smaller species. (1,9) An initial dosage of 10 mg/kg iv is suggested, with subsequent injections of 5 mg/kg at 15- to 30-minute intervals, up to a total dosage level of 25 mg/kg, if anesthesia is not achieved. Sodium pentobarbital has the disadvantages that the turtle may need to be kept out of water for 24 hours until recovery is complete, and induction time may be extended up to 2 hours. After deep anesthesia is achieved, however, it generally lasts longer than for ketamine hydrochloride or sodium thiopental.

Ketamine hydrochloride has a rapid induction time, short duration and rapid recovery. It appears most effective when administered IP, which is often easier than IV injection. However, the dosage levels required (up to 71 mg/kg) make the quantity and cost of the anesthesia a major practical consideration when anesthetizing the larger turtles. Ketamine hydrochloride would not be suitable for lengthy surgical techniques.

Sodium thiopental has the advantages of rapid induction and quicker recovery time than pentobarbital. At the administered dosage levels, the anesthesia was ineffective in inducing deep anesthesia 10% of the time, similar to sodium pentobarbital. An administration rate of 20 mg/kg is suggested; if the animal fails to achieve deep anesthesia, further administration is not recommended, because of the risk involved in losing the animal to an overdose of anesthetic. The variability in the duration of deep anesthesia would restrict surgical techniques with sodium thiopental.

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