

Ear Infections in Chelonians: A Call for Better Husbandry

by

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Over the years, I have provided post-surgical care for many box turtles with middle ear infections. Since this problem is quite common in captive chelonians, and is one that is largely avoidable through sound husbandry practices, I would like to discuss the causes, treatment, and prevention of ear infections.

Hello in there . . .

Turtles and tortoises do not have external ears. In their place is a large "tympanic membrane" located on each side of the head, well behind the eyes at the level of the corner of the mouth. (Note: The skin of the tympanum is relatively thin in the middle; care should be taken not to apply pressure to it while restraining an animal's head.)

The anatomy of the ear is well described elsewhere.¹ (See Fig. 1 for a simplified drawing.) For our purposes, the important points are: 1) the tympanic membrane protects and seals the middle ear cavity from the outside environment and 2) the middle ear connects to the oropharynx (the mouth and area of the throat at the back of the mouth) via the Eustachian tube. As we will see, this connection plays a crucial role in many ear infections. Due to the anatomy of the chelonian ear, inner ear infections are rare^{2,3} so we won't be discussing them here.

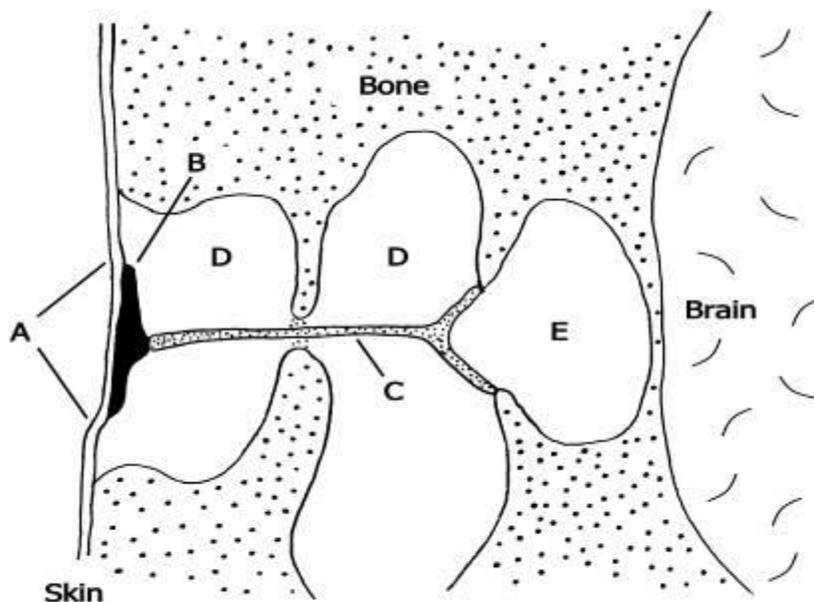


Fig 1. Dorsal (top) view of a generic turtle ear (exact anatomy differs between species). The middle ear consists of the tympanic membrane (A), the underlying cartilaginous disc known as the extra-columella (B), the ear bone or columella (C), and the multi-chambered, air-filled tympanic cavity (D). Ear infections in chelonians rarely affect the inner ear or cochlea (E). (Drawing based on McArthur et al.²)

Symptoms

Ear infections usually go unnoticed until fairly advanced, when there is usually swelling in the region of the tympanic membrane on one or both sides of the head (Fig. 2).⁴ Occasionally, the skin around the tympanic membrane will be affected by a local cellulitis (inflammation).⁴ In severe cases, the membrane may actually rupture.⁵



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Fig 2. Tympanum on the left is normal; the one on the right is swollen due to an infection of the middle ear and accumulation of purulent material under the outer membrane.

Other possible clinical signs include:^{6,7}

- Anorexia
- Difficult, seemingly painful jaw opening
- Difficult, seemingly painful swallowing
- Rubbing of the affected side of the head on objects or clawing at the area with the forefoot
- Inflammation of the eyes

Surprisingly, ear infections usually are not associated with balance problems.^{3,4} However, hearing is undoubtedly adversely affected. According to Dodd⁸, box turtles suffering from middle ear infections hear at 20-40 decibels less than healthy animals.

Most commonly, solid caseous (cheese-like) pus fills the tympanic cavity in an advanced middle-ear infection. The pus plug presses on the tympanum, causing it to bulge. Pus may also discharge down through the Eustachian tube into the back of the throat.⁶ By the time the tympanic cavity has filled with pus there often has been significant erosion of the ear bone.

In many cases, an ear infection remains localized for a long period—reptiles are good at walling off abscesses. However, the infection may eventually spread resulting in osteomyelitis (inflammation and infection) of the jaw and skull, possibly involving eye structures. In rare cases, an ear infection may spread and lead to life-threatening septicemia (“blood poisoning”).^{4,7}

Causes

Chelonians normally have some bacteria living in their mouth. These bacteria can proliferate to an unhealthy level when an animal’s immune system is compromised, resulting in stomatitis (mouth infection) and migration of the bacteria up the Eustachian tube(s) into the middle ear(s).

Compromised immune function can potentially result from any type of improper husbandry that chronically stresses an animal (e.g. suboptimal temperature and humidity, excessive heat,

malnutrition). Thus poor husbandry can ultimately lead to mouth and ear infections.^{3,4,9}

Hypovitaminosis A (Vitamin A deficiency) is a predisposing factor for middle ear infections (as well as other serious health problems). It causes changes in the cells lining the Eustachian tubes and middle ear that make the tissue more susceptible to colonization and infection by bacteria. Also, sloughing cells tend to accumulate in the tympanic cavity, contributing to the pus plug.^{10,11}

Hypovitaminosis A is most common in omnivorous or carnivorous chelonians, especially juveniles, which are maintained on a diet of unsupplemented greens (especially iceberg lettuce), muscle meat, and poorly formulated commercial diets. Herbivorous chelonians less commonly suffer from Vitamin A deficiency, as they often receive a diet high in dark leafy greens and/or forage that is rich in β -carotene, the plant precursor to Vitamin A.¹¹

Poor sanitary conditions commonly lead to ear infections, especially in aquatic and semi-aquatic chelonians. Animals that ingest fecal-contaminated water over an extended period can fall victim to colonization of their oropharynx with pathogenic bacteria, which in turn may ascend the Eustachian tube(s) and enter the middle ear(s).^{3,4}

Trauma is sometimes the cause of ear infections. The tympanic membrane may be punctured accidentally on enclosure furnishings or by getting hooked on the claw of an enclosure mate. Even the family cat may be the culprit! Left untreated, the wound could become infected.

Ear abscesses are frequently seen in wild eastern box turtles (*Terrapene carolina*), particularly in early spring. Many of these turtles also suffer from stomatitis. It is likely that many of the affected animals entered their last hibernation in suboptimal health, and could not mount an adequate defense against an overgrowth of mouth bacteria when the turtles first emerged in the spring (S. Boylan, pers. comm).

Finally, there is some evidence linking exposure to immuno-suppressing organochlorine pesticides to ear abscesses in wild eastern box turtles. However, the data to support this claim are limited.¹²

Treatment

When a turtle or tortoise is taken to a vet for treatment, it is important that the animal receive a thorough physical examination (including careful examination of the oral cavity, blood work and head radiograph to assess bony involvement), and a review of its care and diet. Whatever situation predisposed the animal to an ear infection could have also predisposed it to other, sometimes more serious, health issues that need to be addressed. Moreover, unless the underlying cause of the infection is identified, recurrence is likely.

Surgery

Treatment is usually surgical, as most ear abscesses encapsulate and drugs do not readily penetrate the center. Although there may be short-term improvement with antibiotics alone, there often remains a reservoir of infection that can result in recurrence.⁶

Surgery (performed under general anesthesia) involves cutting across or around the base of the tympanic membrane and carefully lifting or scooping out the inflammatory debris. The tympanic cavity and Eustachian tube are then gently but thoroughly flushed with sterile saline to completely remove all debris. Some veterinarians also flushed with an antimicrobial agent such as dilute chlorhexidine. (A small irrigating tube may be passed through the Eustachian tube to help clear it.) Cotton swabs or applicators are usually placed inside the oral cavity during surgery and flushing to prevent the animal from inadvertently ingesting or aspirating (inhaling) debris that may be forced through the Eustachian tubes into the oropharynx.

Following surgery, the turtle is commonly prescribed a course of injectable antibiotic therapy (e.g.,

Baytril (10mg/kg) given IM every 48 hrs for 7 treatments). Until drug therapy ends, I recommend cleaning the ear hole daily with a cotton swab soaked in sterile saline. After the hole is swabbed out, it should be packed with antibiotic ointment (e.g, triple antibiotic ointment). During this time, it is very important that the turtle stay well hydrated to reduce the stress of the medication on its kidneys.

Special postsurgical housing is necessary until the ear hole closes over (several weeks). The goal is to keep debris out of the wound site while still providing the turtle with a sense of security, and proper warmth and humidity.

When I deal with box turtles recovering from surgery, I put down a layer of moistened newspaper in a large (90-110 quart) Rubbermaid® tub provide a pile of 3-4 moist washcloths for the turtle to nestle into (to reduce stress). The washcloths are changed daily; the newspaper on alternate days or any time the substrate is soiled. Using 2-inch binder clamps, I attached bunches of crumpled strips of newspaper to the tub walls that hang nearly to the floor. Most paper clumps are hung near the back of the tub, under which the moistened towels are located. The turtle seem to like to hide beneath them, as if they were plants. I keep a warm 25 watt reflector spot light near a clump of hanging newspaper near one end of the tub in the daytime. It allows the turtle to bask and raise its body temperature to help fight any infection but still feel hidden and secure. The daytime ambient temperature in the room is 78- 80 ° F; at night is fall no more than five degrees. No lights are kept on at night, but the room is heated with a small oil-filled heater if necessary. A warm air humidifier runs continuously except during the summer months when the ambient level is naturally high in my home.

In the case of semi-aquatic and aquatic turtles, the animals may be kept post-operatively in water that is 3 parts per thousand salt (3 mg salt per liter water, or 3/4 tsp salt per quart water), changed daily, until the ear wound heals over. The salt will inhibit bacterial growth in the water and wound site. The water temperature should be maintained at whatever is optimal for the species, as should the temperature of a diurnal basking area.

In many instances, a surgery where debris in the middle ear cavity is removed and the tympanic membrane is resected does not appear to affect the animal's behavior or balance.² Wever and Vernon¹³ showed that opening the tympanic cavity and removing part of the lateral wall had no effect on response to low tones and produced only slight variations for high tones. This may be because the small-sized tympanic cavity in chelonians doesn't appear to play a major role in sound resonance.

Correction of Dietary Deficiency

If an animal has a middle ear infection associated with hypovitaminosis A, a veterinarian may treat the chelonian post-operatively with injectable Vitamin A. However, hypervitaminosis A, a potentially fatal condition, is readily induced with injectable preparations, particularly aqueous solutions, if the dose is not carefully calculated, and if there is no actual deficiency. In many situations, a simple improvement in diet will prevent recurrence of an ear infection associated with a Vitamin A deficient diet (see Prevention).

Prevention

Prevention is generally straightforward, involving willingness to practice good hygiene, and following through on good husbandry practices once the needs of a pet have been determined through a little literature research and talking to other hobbyists who have been successful.

- **Good hygiene:** Make sure the enclosure and water supply are kept scrupulously clean. Water and food bowls should be changed frequently, and disinfected regularly. (Wash off all

organic debris, then soak the bowls for at least 20 minutes in a solution of one teaspoon household bleach per quart of cool water.) We all know that chelonians are renowned for dragging their substrate into their water and food, so it is important to keep all surfaces that the animals contact clean and free of fecal build-up. (For helpful information on maintaining water quality for aquatic turtles, see Highfield⁹ and Gurley¹⁴.)

- **Proper climate control:** Highfield⁹ and Gurley¹⁴ are good starting points for investigating the heat and humidity requirements of your turtle or tortoise. The Tortoise Trust website (tortoisetrust.org) has insightful articles covering climate control as well as many other relevant husbandry topics.
- **Proper nutrition:** Donoghue and Langenberg¹⁵, Highfield^{9,16}, Gurley¹⁴ and McArthur¹¹, provide excellent advice on chelonian nutrition, as does the Tortoise Trust website. With regard to turtle chows, I recommend two: Mazuri Freshwater Turtle Diet (sold in many regular and online stores), and Nasco's "Turtle Brittle" (available at enasco.com as well as through various online herp supply companies and the New York Turtle & Tortoise Society).

By practicing these simple but sound rules of husbandry, you can avoid most ear infections in your pet chelonians and save costly trips to the veterinarian.

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