

Febrile illness after a beach day: a case of salmonella bacteremia from oral exposure to a sand dollar

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ABSTRACT

This case report discusses a rare presentation of salmonella bacteremia after an oral exposure to a sand dollar in a pediatric patient. A 2-year-old Hispanic male presented to the emergency department with a chief complaint of diarrhea and fever for 8 days after a family trip to Destin beach, Florida, during the sea turtle nesting season. The symptoms began a day after the patient took a bite on a sand dollar found on the beach that caused a small wound inside his cheek. The laboratory testing done in the emergency department was remarkable for blood and stool culture testing positive for non-typhoid salmonella. The sand dollar is a type of a sea urchin commonly found on sandy beaches and consists of an anatomical filtration system to consume sandy water. It could be inferred that the increased presence of sea turtles during the time of the patient's visit to Destin beach could have led to higher levels of salmonella in the seawater and consequently in the sand dollar, possibly leading to the inoculation of salmonella in this patient. To the best of our knowledge, this is a first case report that links oral exposure of the sand dollar to invasive salmonellosis.

Key words | bacteremia, pediatric fever, salmonella, salmonellosis, sand dollar, sea turtles

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BACKGROUND

Salmonella bacteremia is a rare condition associated with immunosuppressed state and contaminated food. For every 100,000 cases of salmonella worldwide, 49 progress to bacteremia and, of these, 65% occur in pediatric patients less than 5 years of age (Ao *et al.* 2015). Salmonella infection is commonly acquired through contaminated foods (seafood, peanut butter, poultry, eggs, meat, dairy and fresh produce) but has also been associated with exposure to pets of which reptiles are well documented in the literature (Faulder *et al.* 2017). If undiagnosed, salmonella bacteremia can progress to meningitis, osteomyelitis and endocarditic or endovascular conditions like mycotic aneurysms. This case report discusses a rare presentation of non-typhoid salmonella bacteremia after oral exposure to a sand dollar in a pediatric patient.

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CASE REPORT

A previously healthy 2-year-old Hispanic male presented to the emergency department with 8 days of fever and diarrheal illness after a family trip to Destin beach, Florida, in late June. The child's mother reported that the symptoms started the day after the patient took a bite on a sand dollar found on the beach after mistaking it for a cookie. He suffered a small wound inside his cheek which bled initially and since had persisted as a small ulcer. Per mother, immunizations were up to date at the time of presentation, and the patient had no relevant past medical history, allergies, past surgeries or relevant family history. The patient's mother denied any exposure to uncooked or new foods that could have been considered as an alternate cause of the patient's symptoms. The child was reported to

have mild intermittent abdominal cramps, maroon-colored stools and diarrhea along with fever for 8 days at the time of presentation.

On the physical examination, the patient was afebrile, and the vital signs were within normal limits for the patient's age. The physical examination was only remarkable for mild rhinorrhea and bilateral small oral ulcers on the buccal mucosa. The reported lesion that bled after biting at the sand dollar was seen over the left buccal mucosa with mildly indurated margins and was approximately 5 mm in diameter.

The initial workup consisted of the following tests: complete blood count, complete metabolic panel, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), urinalysis, stool occult blood, stool culture, respiratory viral panel (RVP), stool analysis for ova and parasites (O&P), blood culture and urine culture. Any possible venomous exposure to the sand dollar was ruled out after a discussion with the toxicology service in a consulting role in the emergency department. Pertinent positive findings on the laboratory tests were: aspartate transaminase (75 units/L), alanine transaminase (54 units/L) and mild elevation in inflammatory markers with an ESR at 22 mg/dL and CRP at 1.04 mg/dL. The results of the stool occult blood, RVP and stool analysis for O&P were negative. Given that the patient was hemodynamically stable, he was discharged with a close follow-up arranged with the pediatrician. Forty-eight hours later, the blood cultures were positive for Gram-negative rods that were later characterized as non-typhoid salmonella species. Patient's stool cultures were also positive for non-typhoid salmonella. The microorganism was found to be sensitive to all the common antimicrobials. The patient's mother was called back to the emergency department, and the patient was then admitted to the general pediatric service where he was given IV antibiotics for 24 h and discharged the next day on oral antibiotics.

DISCUSSION OF IMPLICATION

The incubation period for non-typhoidal salmonella is 6–12 h, and gastroenteritis is the most frequent presentation. Nausea, vomiting and non-bloody diarrhea are common symptoms. Myalgias, arthralgias and headaches are also

reported. Bacteremia is reported more commonly among infants with gastroenteritis, and up to 40% of patients have persistent bacteremia (Christenson 2013).

This patient visited Destin, Florida beaches during the sea turtle nesting season, which extends from May through the end of October (Florida Fish and Wildlife Conservation Commission). Salmonella outbreaks in the USA from turtle transmission have been well documented. In 2007, there were 103 cases of salmonellosis reported secondary to pet turtle exposure in 33 states (Harris *et al.* 2009). This was confirmed by a case-control series done from 15 November 2007 to 5 December 2007 with 70 confirmed cases of salmonellosis. From the 70 confirmed cases, 63% of the patients interviewed reported exposure to a pet turtle within 7 days of symptoms onset vs. 4% in the control group (Harris *et al.* 2009). To date, no data exist of sea turtles causing salmonella outbreaks; however, salmonella has been isolated from sea turtle cloacas and sand from the nesting sites (Ives *et al.* 2017). In the Caribbean island of St. Kitts, a group of investigators isolated salmonella from leatherback and hawksbill turtle cloacas and from the sand near their nesting sites (Ives *et al.* 2017). In conclusion, sand exposure from sea turtle's nesting site could contribute toward salmonella outbreaks. The leatherback turtle is one of the three species of sea turtles (the other two being the Loggerhead and the green turtle), which nests on the Destin, Florida coastline. This supports the hypothesis that the beach sand that the patient was exposed to could have been inoculated with salmonella from local sea turtles. The sand dollar, therefore, may have served as a vector for the transmission of salmonella in this case (Figure 1).

Salmonella has also been isolated from other beach sand samples. A California study sampled beach sand from 53 different locations and analyzed the samples for a variety of pathogens (Yamahara *et al.* 2012). Salmonella was found to be the second most common isolated pathogen and considered to originate from a non-human source, most likely marine birds and mammals. In the UK, salmonella was isolated in 10/182 (6%) sand samples from the beaches, concluding that sand was a reservoir for bacteria and that monitoring was required to ensure public safety (Bolton *et al.* 1999). The first outbreak of salmonella secondary to sand exposure was reported in Australia in 2007–2009 (Staff *et al.* 2012). The case-control study concluded that

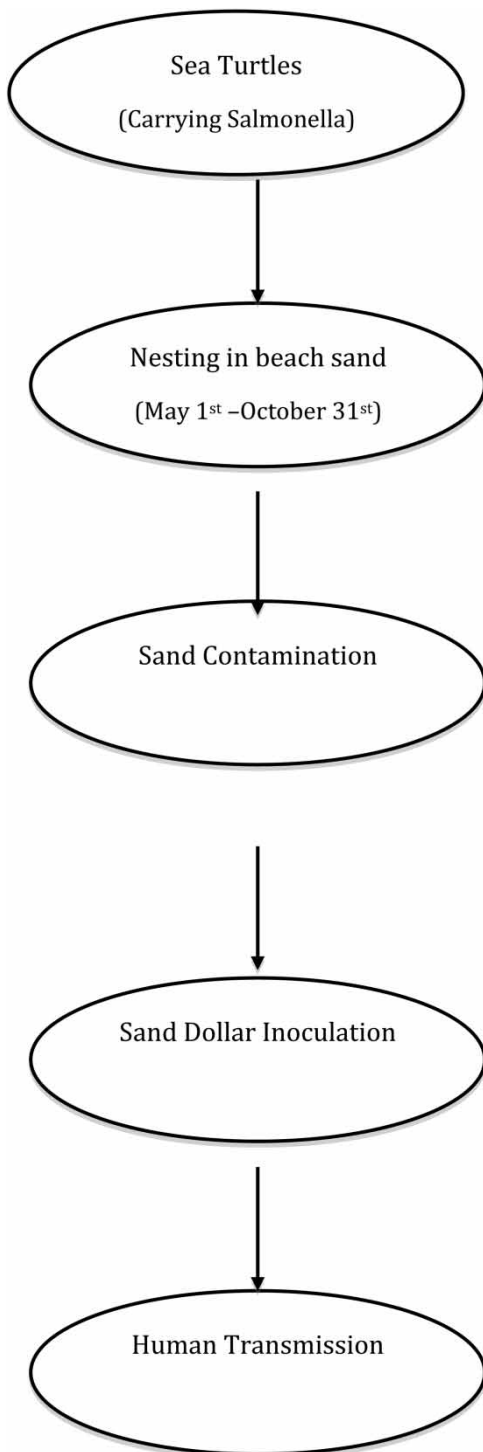


Figure 1 | Proposed cycle of *Salmonella* transmission. This figure illustrates the proposed cycle of the transmission of *Salmonella* described in our case report of salmonellosis in a pediatric patient after exposure to a sand dollar.

the salmonella outbreak was linked to the sand exposure from public sandboxes inoculated with salmonella bacteria

by the local wildlife. The long nose bandicoot, a unique marsupial to this area, was thought to be the likely source for salmonella sand inoculation during this outbreak. This study further supports the role of sand as a potential reservoir and a medium for salmonella transmission.

Accounting for the available evidence, contaminated sand was the likely source for the patient's salmonellosis, but it is impossible to discard the sand dollar as another possible cause. Sand dollars are a part of the sea urchin class Echinodea commonly found in sandy bottoms of shallow waters from where they obtain their nutrition by extracting micro-algae and microorganism via a filtering system straining through sand and water (Staff *et al.* 2012). The patient's mother reported that when he introduced the sand dollar into his mouth, he accidentally caused two small mucosal lacerations along the inside of both cheeks. These lacerations could have served as an entry point for the salmonella bacteria found in the sand within the sand dollar or a site of direct inoculation from the sand dollar itself. Unlike their cousin the sea urchin, which is considered a delicacy in Japan and other parts of the world, humans do not commonly consume sand dollars. There is very limited literature on food poisoning from sea urchin consumption; a Japanese study in 2007 isolated various food poisoning-related bacteria (*Bacillus cereus*, *Bacillus weihenstephanensis* and *Staphylococcus aureus*) from sea urchin's samples, but salmonella was not identified among the isolated bacterium (Kajikazawa *et al.* 2007).

There is extensive documentation of seafood, causing salmonella outbreaks in many parts of the world. In Thailand in 2011, salmonella was isolated from raw shrimp, sea bass, oysters and blood cockles (Woodring *et al.* 2012). In Singapore, salmonella was isolated from shellfish that resembles the sand dollar in the manner in which they procure food via the sand and water filtering process: further supporting the idea that the sand dollar was the likely vector for salmonella transmission in the patient here (Huang *et al.* 2012). In the USA, salmonella is the most common cause of foodborne outbreaks related to seafood consumption (National Advisory Committee on Microbiological Criteria for Foods 2008).

This is the first case report of non-typhoid salmonella bacteremia in a pediatric patient from oral exposure to a sand dollar. Our patient most likely consumed salmonella contaminated sand from or within the sand dollar, causing

Florida Statewide Nesting Beaches

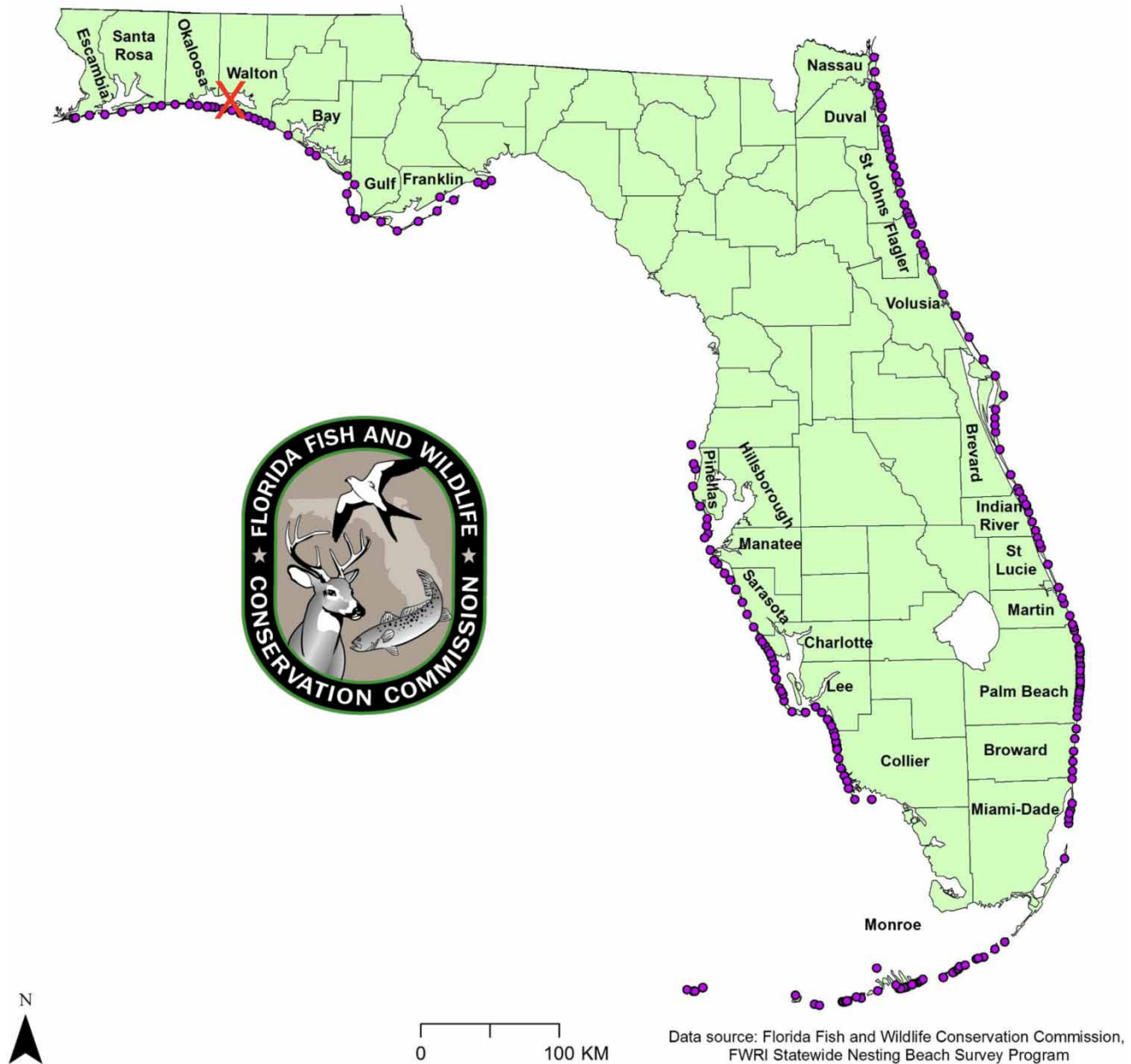


Figure 2 | This figure shows a map of sea turtles nesting beaches in the state of Florida, and marked with a red 'X' is the location where our patient had the oral exposure to a sand dollar. Please refer to the online version of this paper to see this figure in color: <http://dx.doi.org/10.2166/wh.2020.201>.

salmonella bacteremia. The specific beach location and the time of the year coincided with the sea turtle nesting season and likely lead to the salmonella contamination of the beach sand (Figure 2). The mucosal laceration caused by the sand dollar in our patient most likely served as a site of direct inoculation for the bacterium. Sand dollars feed using a

sand and water filtering system, and the abundance of turtles during the nesting season translates to a greater salmonella content in the seawater and the sand, which increases the likelihood of sand dollar inoculation with this bacterium. This case implicates the sand dollar as the other possible reservoir for salmonella when placed in these unique

conditions pertaining to the time and the location. However, further definitive testing on sand dollar samples is necessary to delineate if they could serve as primary vectors by hosting the microorganisms.

In conclusion, the general public should be educated to exercise vigilance when visiting beaches during the sea turtle nesting season. Parents need to be informed of the risk of salmonella infection from sand–oral exposure when visiting beaches during the sea turtle nesting season. Physicians should consider salmonella bacteremia as a differential in pediatric patients with prolonged fever, history of diarrhea and a travel history to the turtle nesting beaches.

AUTHOR CONTRIBUTIONS

Study concept: C.E.T. and F.P.; drafting the manuscript: C.T. and F.P.; critical revision of the manuscript: C.E.T. and F.P.; approval of the final manuscript: F.P.

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