

Case Report

Meningitis caused by *Salmonella enterica* serotype Panama in Brazil: first case reported

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Abstract

Salmonella infections usually occur as gastroenteritis that is generally self-limited. However, some serotypes of *Salmonella* can cause severe extra-intestinal infections, such as bacteremia and meningitis. Here, we report the first *Salmonella* Panama case of meningitis in 4-month-old male newborn in Brazil. The invasive strain isolated was susceptible to all antimicrobial agents tested. The genes *agfA*, *fimA*, *invA*, *sfbA*, *phoP*, and *slyA* were detected using polymerase chain reactions. These findings are relevant and physicians should be alert to the possibility of meningitis in newborns due to *S. Panama*, which can present a high rate of mortality or recurrence of infection.

Keywords: *S. Panama*. Meningitis. Newborn.

INTRODUCTION

Salmonella Panama belongs to the D1 serogroup and is frequently found in cases of nontyphoid salmonellosis in patients from different countries^{1,2}. This serotype generally causes gastroenteritis, but it is one of the many serotypes that tends to cause invasive illnesses and may be associated with bacteremia and meningitis in children¹⁻⁴. We describe here the first case of meningitis in humans caused by *S. Panama* in Brazil.

CASE REPORT

A 4-month-old male newborn weighing 5,500g with a body temperature of 39°C, diarrhea, and cough was taken to a small hospital in the town of Russas, 150km from Fortaleza, the capital of Ceará State, Northeast (NE) Brazil, where he was admitted and remained for two days with suspected virosis. Without showing any improvement, the patient underwent lumbar puncture and the cerebrospinal fluid (CSF) presented intense pleocytosis with a leucocytic count of 11.9×10^3 cells/mm³ (neutrophilic versus mononuclear cells, 93% versus 7%). The erythrocyte count in the CSF was 320 cells/mm³, concentration of proteins was 440mg/dL, and glucose level was 1 mg/dL. The blood analysis revealed a leucocytic count of 11.1×10^3 cells/mm³ (neutrophilic versus mononuclear cells, 86% versus 14%)

and the concentration of glucose was 134mg/dL. Gram staining of the CSF was positive for gram-negative bacilli. The patient showed drowsiness with a fixed upward stare, irritation, a lack of appetite to the extent of rejecting food, and uncontrolled movements in the right arm resembling convulsions or shock. The patient was then moved to a larger medical center in the City of Fortaleza, where he was diagnosed with neck rigidity and fontanel protuberant.

The CSF sample was subjected to bacteriological analysis and standard biochemical reactions yielded the presence of *Salmonella* spp., which was subsequently typed as *S. enterica* serotype Panama. Blood culture testing was not carried out. The isolate was sensitive to ampicillin, ceftazidime, ceftriaxone, ciprofloxacin, chloramphenicol, and sulfamethoxazole-trimethoprim. The patient was initiated on intravenous ceftriaxone for 21 days (80mg/kg of body weight/day). CSF analysis carried out before his discharge from the hospital revealed a cell count of 40/mm³, of which 89% were lymphocytes and 7% were neutrophils. The protein and glucose concentrations were 132mg/dL and 12mg/dL, respectively. Blood analysis revealed a leucocyte concentration of 8.6×10^3 cells/mm³, with a neutrophilic versus mononuclear cell ratio of 64% versus 34%. The platelet count was 393,000 cells/mm³. The CSF bacterioscopy and culture, and the urine cultures were negative for *S. Panama*. Stool culture was not carried out on admission or on discharge. The patient lived with his parents and his 5-year-old brother, who were all healthy, in a good-standard residence in terms of plumbing and sanitary conditions, and the family had a pet dog.

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DISCUSSION

An interesting point in our study was the susceptibility of the *S. Panama* isolate to all the antimicrobials tested. Similar results were obtained in a wider study carried out with 43 *S. Panama* isolates obtained from the same geographical region (NE Brazil), from different sources such as human, animal, and food (unpublished data). In contrast with our findings, studies carried out in other countries including Brazil have suggested that invasive strains of *S. Panama* generally present a very high resistance rate to antimicrobial agents^{3,5-7}. Our results suggest that the acquisition of antimicrobial resistance may not be the main factor of virulence that favors the colonization and posterior invasion of *S. Panama* in humans in Brazil.

Virulence markers produced by the invasive strain were analyzed using polymerase chain reaction (PCR) assays, which revealed the presence *agfA* and *fimA* (related to adherence to host cell receptors), *invA* (invasion), *sfbA* (component of the iron transport system), *phoP* (survival in macrophages), and *slyA* (resistance to oxidative stress) genes. The presence and expression of these virulence genes could play an important role and contribute to the capacity of this serotype to cause illnesses, including invasive illnesses such as meningitis, as has already been shown with other serotypes of *Salmonella* species⁸. Experiments carried out using the murine infection model showed that some serotypes of *Salmonella* could have invasive characteristics, but *S. Panama* did not show this ability⁹. However, another study suggested that *S. Panama* is more invasive than *S. Typhimurium* when tested in Hep-2 cells².

Few articles in the international scientific literature show the presence of virulence-related genes in *S. Panama* isolates⁸⁻¹¹. In strains of animals originating from Spain, it was demonstrated that *S. Panama* harbored all the virulence genes tested, such as *invE/A*, *phoP/Q*, *stn*, *iroB*, *slyA*, *hin/H2*, and *agfA*¹⁰. Another study also carried out in Spain in the Principality of Asturias with isolates from different sources showed that all the strains of *S. Panama* were negative for *spvC*, which is a virulence plasmidial gene, but were positive for *invA*, *phoP*, *stn*, and *slyA*⁸. More studies are necessary to clarify the role of virulence-related genes in the invasiveness of the *S. Panama* serotype.

Unfortunately, we were not able to determine the source and the route of transmission of the invasive *S. Panama* strain in the patient. In children with gastroenteritis from nontyphoid *Salmonella*, prolonged fever over five or more days and infection by a specific serotype of *Salmonella*, such as *S. Panama*, are strong factors associated with the development of bacteremia², and consequently, meningitis. The newborn studied in this work presented a fever of 39°C for more than five days and had diarrhea, which suggested gastroenteritis, but a stool culture was not requested by the physician that was taking care of the patient.

It is widely known that salmonellosis in humans occurs mainly due to the consumption of contaminated water and food. Due to the age of the patient (4 months), it is probable that he only fed on maternal milk or another type of milk, whether it was natural, pasteurized, or even reconstituted powdered milk. In this situation, contamination could have originated from different sources. In this study, contaminated maternal milk was

incriminated as the source of *S. Panama* in a case of meningitis in a newborn. On the other hand, rehydration of powdered milk with contaminated water could also carry infection. However, we did not find any reference of the type of food consumed in the patient's records. The fecal-oral transmission from an adult living in the same house is a possibility¹, but this hypothesis was not investigated in cultures of fecal material from the parents or the brother, even if they did not exhibit symptoms, which does not exclude the possibility of an asymptomatic infection or carrier condition. *S. Panama* has been found to colonize or cause infection in dogs¹² and the family of the patient studied considered the presence of a pet dog, but this hypothesis was not analyzed either.

Thus, we report in this paper the first case of meningitis caused by *S. Panama* in a 4-month-old baby in Brazil. This finding is relevant and Brazilian physicians should be alert to the possibility of the occurrence of meningitis in newborns under 12 months of age that have *Salmonella* detected in feces, urine, and blood, especially *S. Panama*, which can be invasive and present a high rate of mortality or recurrence of infection.

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Conflict of interest

The authors declare that there is no conflict of interest.

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