Clin. Lab. 2026;72:XXX-XXX
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CASE REPORT

Salmonella Enteritidis: a Rare Cause of Meningitis in an Infant

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ABSTRACT

Background: **Meningitis due to non-typhoidal Salmonella in young children is rare but can be life-threatening in the absence of appropriate treatment and may reveal an underlying immune deficiency.**
Methods: **We report the case of a one-year-old male infant hospitalized in pediatrics for febrile meningeal syndrome, associated with episodes of postprandial vomiting and greenish diarrhea. The cerebrospinal fluid (CSF) cytobacteriological study showed: cloudy appearance, leukocytes 2,500/mm^3 (70% neutrophils, 30% lymphocytes).**
Results: **Culture was positive after 24 hours with isolation of Salmonella enterica serotype Enteritidis, which was fully susceptible to all tested antibiotics. HIV1+2 serology and stool culture were negative. Sequencing of 429 genes involved in primary immunodeficiencies revealed a homozygous mutation in the PLVAP gene. The evolution was favorable after initiation of third-generation cephalosporin therapy.**
Conclusions: **Salmonella enteritidis, the species isolated in our patient, belongs to the so-called "minor" Salmonellae, ubiquitous bacteria usually transmitted via the digestive route and typically responsible for gastroenteritis. Some individuals remain healthy carriers of Salmonella in their intestinal tract and may disseminate the organism under certain circumstances. In neonates, young children, the elderly, or immunocompromised patients (AIDS), minor Salmonella species can cross the intestinal barrier and cause systemic dissemination with positive blood cultures.**
(Clin. Lab. 2026;72:xx-xx. DOI: 10.7754/Clin.Lab.2025.251149)

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Case Report accepted December 9, 2025

KEYWORDS

salmonella enteritidis, meningitis, infant

INTRODUCTION

Non-typhoidal Salmonella species are usually responsible for gastroenteritis. Meningitis caused by Salmonella spp. is exceptional and mainly affects malnourished, immunocompromised, or sickle cell-diseased children. Despite their rarity, such infections represent a diagnostic and therapeutic challenge in both developed and developing countries due to their high mortality and severe sequelae [1].
In recent years, antibiotic therapy has been further complicated by the emergence of strains resistant to conventional antibiotics [2]. We report a case of meningitis

caused by Salmonella enterica serotype Enteritidis in a one-year-old infant.

CASE PRESENTATION

We present a one-year-old male infant from Mohammedia, admitted to the pediatric department for febrile meningeal syndrome. The child was not from a consanguineous marriage. The pregnancy was well monitored and reached full term, with vaginal delivery. Birth weight was 2,500 g, and the child was fully vaccinated according to the national immunization program. He was exclusively breastfed and had normal psychomotor and growth development, with no history of recurrent infections.

Symptoms began ten days prior to admission with the onset of a nonproductive cough, postprandial food vomiting, and greenish diarrhea (eight stools per day), accompanied by unquantified fever. Clinical examination revealed a conscious infant, without convulsive episodes, with hypotonia, neck stiffness, and head retraction. Respiratory rate was 54/minute, oxygen saturation 96%, heart rate 163 bpm, with mild signs of respiratory distress.

Lumbar puncture yielded turbid CSF with 2,500 leukocytes/mm^3 (70% neutrophils, 30% lymphocytes). Culture was positive after 24 hours, isolating Salmonella spp. CSF chemistry showed elevated proteins (4.09 g/L), hypoglycorrhachia (< 0.05 g/L), and hypochlororrhachia (107 mEq/L). C-reactive protein was 167.4 mg/L.

Blood tests showed hypochromic microcytic anemia, neutrophilic leukocytosis, and thrombocytopenia. Hemostasis assessment revealed hyperfibrinogenemia. The osmotic fragility test was normal. Bone marrow aspiration indicated peripheral thrombocytopenia. Hemoglobin electrophoresis was normal.

HIV1+2 serology was negative. Stool parasitology revealed Candida albicans/Candida dubliniensis. Stool culture was negative for Salmonella and Shigella.

Identification of the bacterial genus was performed using the API 20E gallery (BioMérieux, Marcy L'Etoile), and serotyping by slide agglutination confirmed Salmonella enterica serotype Enteritidis. The strain was wild type and fully susceptible to all tested antibiotics according to CA-SFM guidelines.

Brain CT scan showed moderate triventricular dilatation without signs of transependymal resorption. Abdominal ultrasound performed to search for asplenia (as part of immune deficiency workup) was normal.

The clinical course was favorable, with resolution of fever, CSF sterilization, and normalization of the neurological exam after initiation of meningitic-dose third-generation cephalosporin therapy. Genetic sequencing of 429 genes associated with primary immunodeficiencies revealed a homozygous mutation in the PLVAP gene (c.386A>G; p. Asn129Ser), although this variant currently remains of uncertain significance.

DISCUSSION

Salmonellosis remains a global public health problem; it is an orally transmitted infection, and the risk factors contributing to the development of this gastrointestinal infection in children include contact with an infected person, consumption of infant formula or untreated water, and visits to healthcare centers. Additionally, 1 to 5.7% of patients may develop generally mild bacteremia, while secondary infections, notably meningitis, can occur. Invasive infection results from the deterioration of local enteric immunity and is particularly frequent at the extremes of age (much more common in the neonatal period) or in individuals with predisposing factors, especially immunocompromised patients [3].

The choice of antibiotic treatment is the main factor determining prognosis in Salmonella meningitis [4]. Our infant presented with a febrile meningeal syndrome associated with diarrhea; stool culture was negative, while cytobacteriological examination of the CSF identified *Salmonella enterica* serotype Enteritidis, and no source of infection could be found.

Epidemiological surveillance studies conducted by human (CNR-ESS) and veterinary (Anses) Salmonella networks have shown a worrying increase in antibiotic-resistant strains since 2002. This includes strains resistant to third-generation cephalosporins, the treatment of choice; however, resistant strains are still less frequent than in other Enterobacteriaceae. Two plasmid-mediated resistance mechanisms have been described in Salmonella: production of extended-spectrum β-lactamases (ESBL) and/or AmpC β-lactamases. Resistance to carbapenems, which are strictly hospital-use antibiotics, has also been reported, mainly through plasmid transfer from nosocomial or environmental reservoirs. Resistance to fluoroquinolones may result from mutations in the gyrA, gyrB, parC, and parE genes, altering the target sites (DNA gyrase and topoisomerase IV) [5]. In our case, the pathogen was multisensitive, particularly to third-generation cephalosporins, and the clinical course was favorable.

In a study of 7,779 Salmonella infections, Saphra and Winter reported only 77 cases of meningitis (1%). In India, Kumar et al. reported a 3% incidence, predominantly in young infants [1]. Meningitis due to Salmonella remains a rare condition, and the presence of this organism in the CSF raises questions about its origin, whether endogenous (via hematogenous spread from an unrecognized intestinal focus) or exogenous [6]. Although generally favorable under appropriate antibiotic treatment, such infections may reveal secondary or primary immunodeficiency [3].

CONCLUSION

Salmonella enteritidis, the species isolated in our infant, belongs to the so-called "minor" Salmonellae, ubiquitous bacteria usually transmitted through the digestive

route and typically responsible for gastroenteritis. Some individuals remain asymptomatic carriers and may disseminate the organism under certain circumstances. In neonates, young children, the elderly, or immunocompromised patients (HIV), these “minor” Salmonellae may cross the intestinal barrier and cause systemic dissemination with positive blood cultures.

Declaration of Generative AI in Scientific Writing:
The authors declare that they have not used generative artificial intelligence to generate, analyze, or interpret data, nor to write original scientific content. All texts, data, results, and conclusions have been reviewed and approved by the authors, who take full responsibility for them. A generative AI was used only for French-to-English translation. The authors have verified the accuracy of the text.

Declaration of Interest:
The authors declare that they have no conflict of interest.

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