DOI: 10.7860/JCDR/2023/66075.18843

Case Series

Microbiology Section

Extraintestinal *Salmonella* Infections-An Underdiagnosed Clinical Entity: A Case Series

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ABSTRACT

Extraintestinal salmonellosis can occur as a complication of enteric fever. In this case series, five clinically suspected cases of pyogenic meningitis and arthritis, a case of pyelonephritis suspected to be pyogenic or tubercular, a case of vertebral osteomyelitis suspected to be tuberculosis or malignancy, and a case of pyomyositis that clinically presented as a tumour were discussed. Although none of these cases were clinically suspected to be due to *Salmonella*, all were confirmed as extraintestinal salmonellosis based on microbiological evaluation. *Salmonella* should be suspected in acute inflammatory lesions that are unresponsive to empirical treatment. Instead of empirical antibiotics, culture and sensitivity-based antibiotics for the recommended duration are the only way to cure extraintestinal salmonellosis and prevent morbidity. Effective communication and correlation between the laboratory, clinician, and radiologist are essential for a definitive diagnosis. Histopathological and microbiological investigations should be done simultaneously to identify the definitive aetiology in all localised lesions presenting with necrosis/inflammatory response. This case series presents five cases of extraintestinal salmonellosis with serious complications, including meningitis, pyelonephritis, osteomyelitis, septic arthritis, and pyomyositis, each with varied clinical presentations.

Keywords: Enteric, Meningitis, Osteomyelitis, Pyelonephritis, Pyomyositis

INTRODUCTION

Salmonellae are ubiquitous human and animal pathogens that primarily infect the enteric tract. Infections with *Salmonella* in humans commonly manifest as enteric fever, food poisoning, and septicaemia, though extraintestinal salmonellosis can rarely occur as complications of enteric fever and gastroenteritis. *Salmonella* is transmitted through ingestion of contaminated food and water. Lower gastric acidity, previous gastrointestinal surgery, and oral antibiotic therapy that suppress normal intestinal flora are risk factors for *Salmonella* infection. Salmonellae enter through the epithelial cells in the intestinal mucosa, leading to alterations in the actin cytoskeleton and enclosing themselves inside vesicles through a process called bacteria-mediated endocytosis. *Salmonella* inside the vesicles are phagocytosed by macrophages. Salmonellae have the ability to survive inside macrophages by inducing certain alterations on the bacterial surface. Salmonellae inside macrophages enter the bloodstream via lymphatics (transient primary bacteraemia), then spread to the reticuloendothelial tissues and other organs, resulting in the onset of clinical disease [1]. Both typhoidal and non typhoidal *Salmonella* can cause extraintestinal salmonellosis [1]. *Salmonella* infection can present with extraintestinal manifestations such as meningitis, osteomyelitis, bacteriuria, septic arthritis, pyomyositis, and cardiovascular infections [2,3].

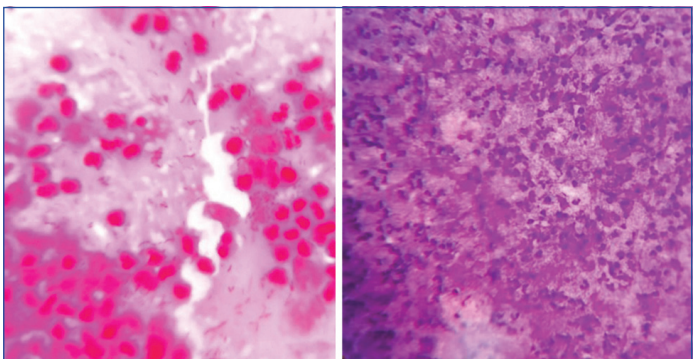
Many cases of extraintestinal salmonellosis do not come to light primarily because they are not suspected. Blind treatment with antibiotics, without performing microbial culture to identify the causative organism, leads to underreporting or no reporting of the exact cause of the extraintestinal lesions. A high level of clinical suspicion is necessary for the diagnosis of extraintestinal salmonellosis. Prompt treatment for a longer duration is essential for the cure of extraintestinal infections due to *Salmonella* [2]. There are very few reported cases of extraintestinal salmonellosis. A case series of five extraintestinal salmonellosis cases with various clinical manifestations and risk factors, which were reported over the past two years, has been presented here to emphasise the importance of appropriate diagnosis of lesions based on microbiological examinations.

Case 1

An 18-month-old girl was brought to the paediatric department with a complaint of a seizure episode. The mother reported that the seizure was generalised, and the child became drowsy afterward. There were histories of fever and vomiting for the past two days. However, there was no history of coughing, breathlessness, or passing dark-coloured urine.

During the physical examination, a drowsy child with a temperature of 38°C was observed. Neurological examination revealed neck stiffness. A provisional diagnosis of bacterial meningitis was made. Blood and Cerebrospinal Fluid (CSF) samples were collected for culture, and the CSF sample was sent for biochemical tests. The baby was started on intravenous ceftriaxone and amikacin.

The CSF sample appeared turbid, with protein levels at 30 mg/dL and glucose at 42 mg/dL. Microscopic examination of the CSF sample, as well as Gram stain and cytology, showed findings suggestive of pyogenic meningitis, as presented in [Table/Fig-1a,b].



[Table/Fig-1]: a) Gram stain showing many pus cells and gram negative bacilli, under oil immersion (Giemsa, 100 x). b) CSF cytology showing plenty of neutrophils in a dirty background, under high power (Giemsa, 40x). (Images from left to right)

The sample was cultured on blood agar, MacConkey agar, and chocolate agar. Non lactose-fermenting gram negative bacilli were isolated in culture, which were identified as *Salmonella* Typhi. The identification was confirmed by positive catalase and negative

oxidase tests, negative indole test, alkaline slant with acid butt and a speck of H_2S, no gas in the triple sugar iron media, negative urease (Christensen urease) and citrate (Simmon's citrate agar) tests, fermentation and motility in mannitol motility medium. The isolate showed agglutination with the antiserum that is specific for *Salmonella* Typhi. The organism's identification was further confirmed using Vitek 2 compact as *Salmonella* Typhi. The isolate showed susceptibility to ciprofloxacin, ceftriaxone, amikacin, ceftazidime, chloramphenicol, and meropenem.

However, the blood culture showed no growth after seven days of incubation in the BacTalert rapid blood culture system.

Upon repeat history, it was revealed that the child had previously suffered from typhoid about four-month-ago. The child received treatment in the hospital for three days but did not complete the prescribed course of oral antibiotics as advised by the paediatrician. The child did not attend the recommended follow-up appointments and was only brought back to the hospital after four months following a seizure episode.

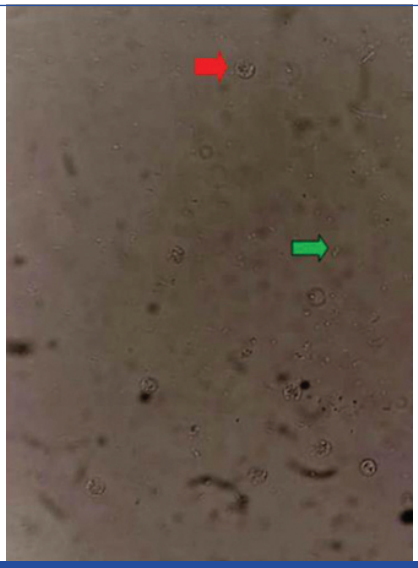
The baby was diagnosed with *Salmonella* meningitis and initially treated with ceftriaxone and amikacin for three days. However, there was no improvement despite treatment, and the baby remained unconscious. Ceftriaxone was then replaced with meropenem. Despite continued treatment, the child unfortunately passed away on the fourth day of admission.

Case 2

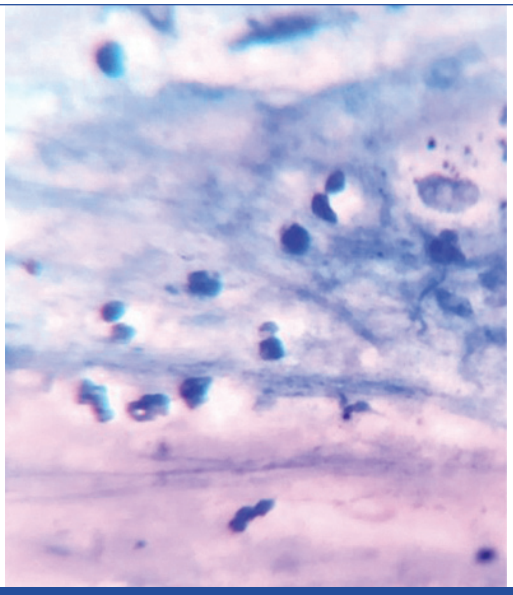
A 67-year-old man presented to the medicine Outpatient Department (OPD) with complaints of recurrent episodes of burning micturition, painful micturition, and urinary urgency over the past three months. There was no history of fever. He had a known case of type 2 diabetes mellitus for 15 years and was taking oral antidiabetic medications. He had no history of past surgeries.

During examination, his blood pressure was measured as 126/82 mmHg. He exhibited suprapubic tenderness. A urine sample was collected and sent for microbiological examination. Microscopic examination of a wet mount revealed the presence of numerous pus cells and bacilli, as shown in [Table/Fig-2]. No parasitic eggs were detected in the urine microscopy. Ziehl-Neelsen stain yielded negative results for acid-fast bacilli, as shown in [Table/Fig-3]. An ultrasound of the abdomen revealed features consistent with pyelonephritis, as shown in [Table/Fig-4].

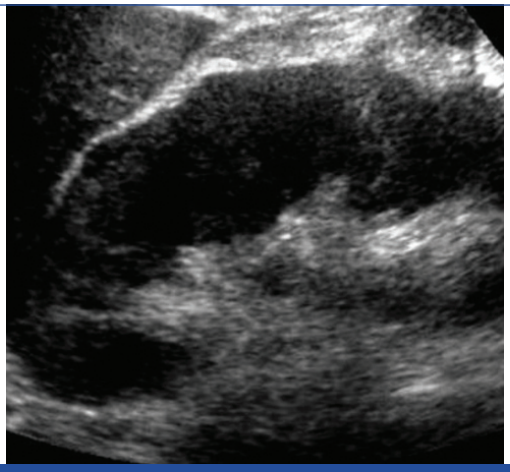
Culture on MacConkey agar showed heavy growth of non lactose fermenting colonies. Blood agar displayed grey moist colonies with haemodigestion. Vitek 2 compact identified the organism as *Salmonella*. The organism was specifically identified as *Salmonella* Typhi through biochemical tests. The test organism agglutinated with *Salmonella* polyvalent O antisera and antisera specific for *S. typhi*. The strain was found to be sensitive to ceftriaxone, cefixime, cotrimoxazole, and resistant to ampicillin, nalidixic acid, and ciprofloxacin. Subsequent abdominal imaging revealed no abnormalities in the urinary tract.



[Table/Fig-2]: Urine wet mount showing many pus cells and bacilli under high power (40x). Red arrow shows pus cell and green arrow shows bacilli.



[Table/Fig-3]: Ziehl neelsen stain showing no acid-fast bacilli under oil immersion (100x).



[Table/Fig-4]: Ultrasound abdomen showing features of pyelonephritis- Bulky and hypoechoic kidney with trace perinephric fluid. (Images from left to right)

Upon repeating the patient's history, there was no recent history of loose stools or fever. Urine microscopy showed no presence of parasitic eggs, and the sample tested negative for acid-fast bacilli. Blood and stool cultures also tested negative for *Salmonella*.

The patient was diagnosed with *Salmonella* pyelonephritis and treated with oral co-trimoxazole for 14 days, resulting in symptom resolution. Periodic urine and stool cultures were carried out for six months, all of which tested negative for *Salmonella*.

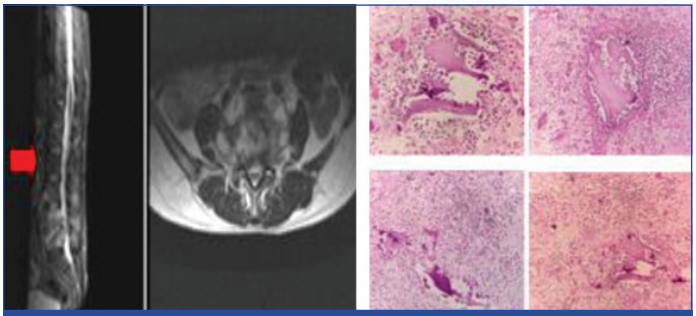
Case 3

A 34-year-old man presented to the orthopaedic OPD with a complaint of back pain persisting for one month. There was no history of trauma or any significant medical conditions associated with back pain. The patient had no history of diabetes, hypertension, or alcoholism, and had not received treatment for any unrelated diseases.

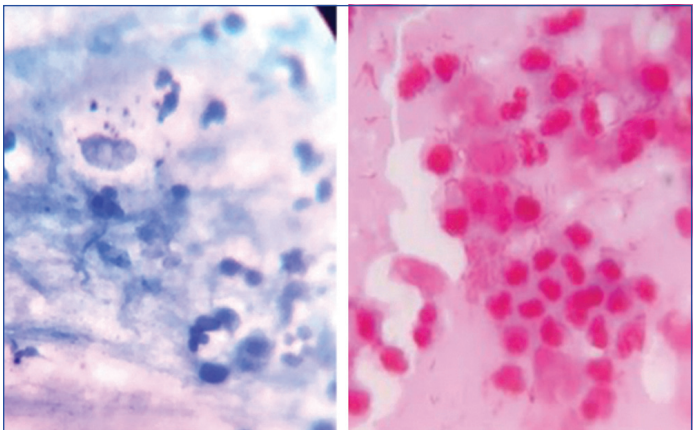
During the physical examination, the patient was afebrile with excessive paraspinal muscle spasms. Severe tenderness was observed over the L2-L4 region. Neurological examination revealed a bilateral sensory deficit below the L4 level. An Magnetic Resonance Imaging (MRI) of the spine showed spondylodiscitis of L2-L4, as depicted in [Table/Fig-5]. A presumptive diagnosis of Pott's spine

was made, leading to an open disc biopsy and decompressive laminotomy in the L2-L4 region. Pus and tissue samples were collected and sent for histopathological examination, Ziehl-Neelsen staining, and bacterial culture.

Histopathology revealed features of suppurative osteomyelitis, as shown in [Table/Fig-6]. Ziehl-Neelsen staining yielded negative results for acid-fast bacilli, as shown in [Table/Fig-7]. BacTalert culture for tuberculosis remained negative even after 42 days of incubation. Gram staining of the pus sample revealed numerous pus cells and a few gram negative bacilli, as shown in [Table/Fig-8]. Bacterial culture was performed by inoculating the pus and tissue samples on blood agar and MacConkey agar. Both samples showed the growth of non lactose fermenting gram negative bacilli on MacConkey agar and grey, non haemolytic colonies on blood agar. Biochemical tests were conducted from isolated colonies of the pus and tissue samples. The test organism tested negative for oxidase, positive for catalase, negative for indole, citrate, and urease tests, motile and fermenting mannitol in mannitol motility medium, and displayed an alkaline slant with an acid butt and no gas production in triple sugar iron agar. The test organism showed agglutination with the antiserum that is specific for *Salmonella* Typhi, identifying it as such. Confirmation of the identification was done using Vitek 2 compact. The isolate was found to be susceptible to ampicillin, ceftriaxone, cefuroxime, amikacin, gentamicin, chloramphenicol, cotrimoxazole, and doxycycline through the Kirby-Bauer disk diffusion method. It was, however, resistant to ciprofloxacin and nalidixic acid.



[Table/Fig-5]: MRI spine showing spondylodiscitis and epidural collection at L2-L4.
[Table/Fig-6]: Histopathology showing bone with acute inflammatory infiltrate (H&E 40x). (Images from left to right)



[Table/Fig-7]: Ziehl Neelsen stain showing no acid-fast bacilli under oil immersion (100x).
[Table/Fig-8]: Gram stain showing many pus cells and gram negative bacilli, under oil immersion (100x). (Images from left to right)

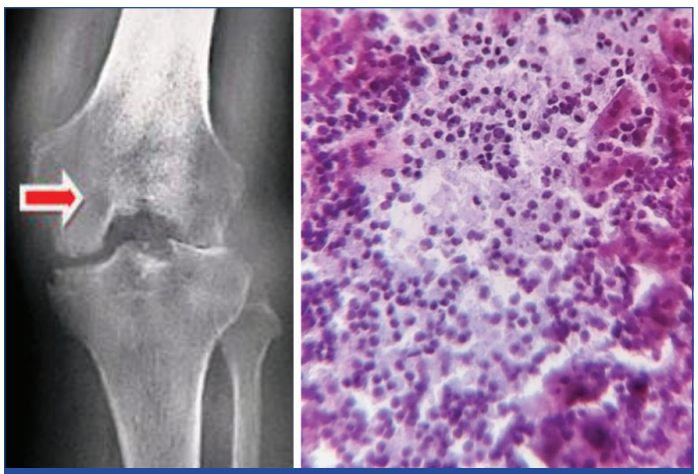
Upon further questioning, the patient recalled experiencing fever and loose stools for a week approximately three months ago. However, he did not seek medical help and instead self-medicated with paracetamol and an antidiarrhoeal drug. Blood culture was performed but yielded negative results. The sickling test was also negative.

The patient was diagnosed with *Salmonella* osteomyelitis. Treatment involved intravenous administration of ceftriaxone and amikacin for three weeks, followed by oral cefuroxime for six weeks. After completing the treatment, the patient became asymptomatic and had successful follow-up.

Case 4

A 65-year-old male patient presented to the orthopaedic department with complaints of sudden onset severe pain and restricted movements in his left knee over the past four days. There were no reported histories of fever, trauma, or other illnesses. The patient had a known history of diabetes for the past 10 years and was taking medications, though his blood sugar levels were not well controlled. There was no suggestive history of haemolytic anaemia.

Upon examination, the patient was conscious, oriented, and afebrile. His left knee exhibited medial enlargement with a swelling measuring 8×8 cm. The area was erythematous, severely tender, and firm in consistency, with restricted movements. Haemogram results showed a haemoglobin level of 13 g/dL. The peripheral smear revealed neutrophilic leukocytosis and toxic changes, with no evidence of haemolytic anaemia. Random blood sugar was measured at 280 mg/dL. X-ray of the left knee showed features consistent with infective arthritis, as shown in [Table/Fig-9]. Pus was aspirated from the left knee and sent for cytology and microbiological examination. The cytology findings were suggestive of infective arthritis, as depicted in [Table/Fig-10].



[Table/Fig-9]: X-ray of the left knee showing soft tissue swelling, oedema, and capsular distension.
[Table/Fig-10]: Cytology showing acute inflammatory cell infiltrate with neutrophilic preponderance in a dirty background (H&E 40x). (Images from left to right)

Gram staining of the pus sample revealed the presence of numerous pus cells and gram negative bacilli. Bacterial culture was conducted by inoculating the sample on blood agar and MacConkey agar. The growth of non lactose fermenting gram negative bacilli was observed on MacConkey agar, while grey, moist, and non haemolytic colonies were seen on blood agar. Biochemical tests were performed from isolated colonies, which indicated that the test organism was negative for oxidase and positive for catalase. It also tested negative for indole, citrate, and urease, but was found to be motile and capable of fermenting mannitol in mannitol motility medium. In triple sugar iron agar, the organism displayed an alkaline slant with an acid butt and no gas production. Additionally, the test organism agglutinated with specific antiserum for *Salmonella* Typhi. As a result, the bacterium was identified as *Salmonella* Typhi, with confirmation from Vitek 2 compact. Susceptibility testing using the Kirby-Bauer disk diffusion method indicated that the isolate was susceptible to ampicillin, ceftriaxone, cefuroxime, amikacin, gentamycin, chloramphenicol, cotrimoxazole, and doxycycline. However, it exhibited resistance to ciprofloxacin and nalidixic acid.

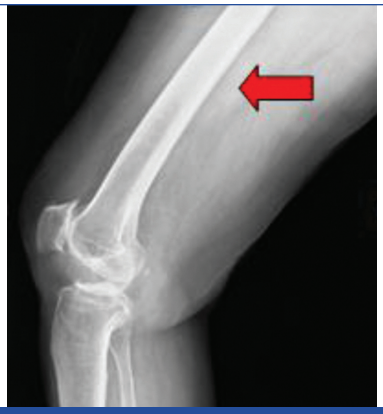
Upon further questioning, the patient stated that he could not recall experiencing any episodes of fever or loose stools in the past few months. Blood culture, stool culture, and Widal tests were performed, all of which yielded negative results.

The patient was diagnosed with *Salmonella* arthritis and received treatment consisting of joint debridement, along with one week of intravenous ceftriaxone and amikacin, followed by three weeks of oral cotrimoxazole. The affected knee was subjected to repeat aspiration. After completing the treatment, the patient became asymptomatic and remained disease-free during the six-month follow-up period.

Case 5

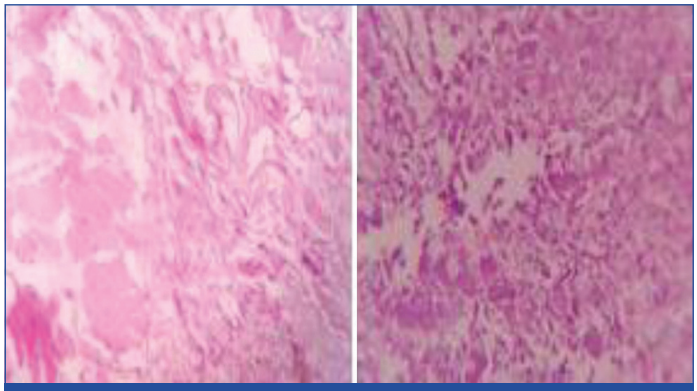
A 40-year-old male presented to the orthopaedic OPD with complaints of pain in his left thigh over the past three days. The patient reported that the pain had started suddenly and he noticed some swelling upon touch. There was no history of fever, and the patient did not have a known history of diabetes or hypertension.

During the examination, the patient's oral temperature was found to be within the normal range. His pulse rate was 84/min, and his blood pressure was measured at 124/80 mmHg. Examination of the left thigh revealed a warm, tender, and fluctuant swelling measuring approximately 4×3×2 cm upon palpation of the upper lateral aspect. An X-ray was performed, which showed the presence of an intramuscular lesion in the upper and lateral aspect of the left thigh, as depicted in [Table/Fig-11].



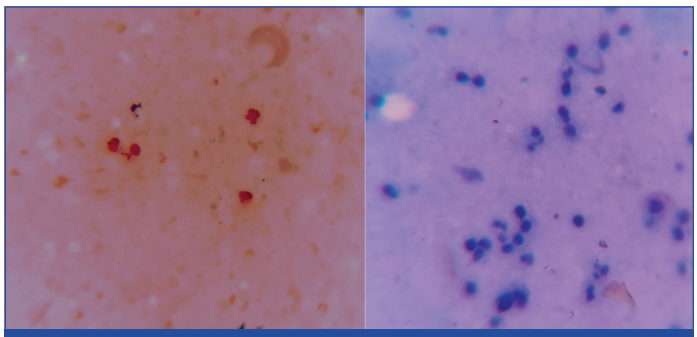
[Table/Fig-11]: X-ray showing a soft-tissue swelling in the upper thigh predominantly invoking the muscular compartment.

Ultrasound-guided Fine Needle Aspiration Cytology (FNAC) was performed, resulting in the drainage of pus, and the sample was sent for microbiological examination. The patient was empirically started on i.v. vancomycin. Histopathological examination findings were consistent with acute pyomyositis, as shown in [Table/Fig-12].



[Table/Fig-12]: Histopathology showing normal and necrotic muscle fibres under high power (H&E 40x).

Gram staining revealed the presence of numerous pus cells and a moderate number of gram negative bacilli [Table/Fig-13]. Ziehl-Neelsen staining showed no acid-fast bacilli, as depicted in [Table/Fig-14]. Bacterial culture was conducted by inoculating the sample on blood agar and MacConkey agar. MacConkey agar showed the growth of non lactose fermenting gram negative bacilli, while blood agar exhibited the growth of grey and moist non haemolytic colonies. The test organism tested negative for oxidase and positive for catalase. It was also negative for indole, citrate, and urease tests, but displayed motility and fermentation of mannitol in mannitol motility medium. In triple sugar iron agar, the organism showed an alkaline slant with an acid butt and no gas production, as illustrated in [Table/Fig-15]. Additionally, the test organism agglutinated with the specific antiserum for *Salmonella* Typhi. Hence, the bacterium was identified as *Salmonella* Typhi, with confirmation from Vitek 2 compact. Susceptibility testing using the Kirby-Bauer disk diffusion method indicated that the isolate was susceptible to ampicillin, ciprofloxacin, ceftriaxone, cefuroxime, amikacin, gentamicin, chloramphenicol, cotrimoxazole, and doxycycline. A final diagnosis of *Salmonella* pyomyositis was established.



[Table/Fig-13]: Gram stain showing pus cells and gram negative bacilli, under oil immersion (100x). **[Table/Fig-14]:** Ziehl Neelsen stain showing no acid-fast bacilli under oil immersion (100x). (Images from left to right)

[Table/Fig-15]: Biochemical tests of *Salmonella* typhi. (From left to right-Indole, citrate, urease, Triple sugar iron, mannitol motility medium).

The patient denied experiencing any episodes of fever or loose stools in the past year. Treatment involved a two-week course of intravenous ceftriaxone and amikacin, followed by a two-week course of oral ciprofloxacin. After completing the treatment, the patient became asymptomatic. Regular follow-up was conducted for six months, during which the patient remained asymptomatic.

A summarised overview of the clinical findings, investigational results, treatment, and follow-up for the discussed cases in the series has been presented in [Table/Fig-16].

DISCUSSION

Salmonellae are gram negative bacilli and facultative anaerobes belonging to the family Enterobacteriaceae. They commonly cause intestinal manifestations but can also lead to extraintestinal infections [3]. However, extraintestinal Salmonellosis is often under reported and underdiagnosed. The primary mode of transmission for *Salmonella* is fecal-oral. Sudhaharan S et al., reported *Salmonella* osteomyelitis as the most common extraintestinal manifestation of *Salmonella* [2]. Among the *Salmonella* species, *Salmonella* Typhi is the most frequent cause of extraintestinal infections, according to Sudhaharan S et al., [2]. In the present case series, all the patients experienced extraintestinal infections caused by *Salmonella* Typhi.

S. No.	Clinical diagnosis	Salient clinical findings	History of fever/ loose stools	Investigational results	Treatment received	Follow-up
1	*Salmonella* meningitis	Seizures, fever, vomiting, neck stiffness	Typhoid illness 4 months ago. Incompletely treated. Mother not investigated.	Turbid CSF, increased protein and reduced glucose levels. Gram stain- many pus cells, gram negative *bacilli*. Culture- Non lactose fermenting colony-identified as *Salmonella* typhi by vitek and confirmed by antisera. Negative blood cultures.	Ceftriaxone and amikacin for three days. Meropenem and amikacin for one day.	Child died on the fourth day of admission despite treatment.
2	*Salmonella* pyelonephritis	Recurrent episodes of burning micturition, painful micturition, and urinary urgency	No history in the recent past.	Urine wet mount-many pus cells and bacilli. Zeihl Neelsen stain-negative for acid fast bacilli. Culture- Non lactose fermenting colony-identified as *Salmonella* typhi by vitek and confirmed by antisera. Negative blood and stool cultures. Normal ultrasound abdomen.	Oral cotrimoxazole for 14 days.	Asymptomatic after six months.
3	*Salmonella* osteomyelitis	Back pain Paraspinal muscle spasm. Tenderness-L2-L4 region Bilateral sensory deficit below the L4 level	History of fever and loose stools three months ago. Self-medicated with paracetamol and loperide.	MRI spine showed spondylodiscitis and epidural collection at L2-L4. Gram stain of aspirated pus-many pus cells and gram negative bacilli. Zeihl Neelsen stain-negative for acid fast bacilli. Culture- Non lactose fermenting colony-identified as *Salmonella* typhi by vitek and confirmed by antisera. Negative blood culture.	Ceftriaxone and amikacin intravenously for three weeks and cefuroxime orally for six weeks.	Asymptomatic upto two months.
4	*Salmonella* septic arthritis	Severe pain, swelling and restricted movements of the knee for four days	Could not recollect any.	Hb- 13 g/dL Peripheral smear-neutrophilic leucocytosis and toxic changes. X-ray left knee- features of infective arthritis. Gram stain of aspirated pus-many pus cells and gram negative bacilli. Culture- Non lactose fermenting colony-identified as *Salmonella* typhi by vitek and confirmed by antisera. Negative blood culture, stool culture and widal tests.	Joint debridement along with intravenous ceftriaxone and amikacin for a week and oral cotrimoxazole for the next three weeks.	Asymptomatic and disease-free upto six months.
5	*Salmonella* pyomyositis	Pain and swelling- left thigh. Warm, tender, and fluctuant swelling- left thigh	No history.	X-ray showed intramuscular lesion- thigh. Gram stain of aspirated pus-many pus cells and gram negative bacilli. Culture- Non lactose fermenting colony-identified as *Salmonella* typhi by vitek and confirmed by antisera.	Ceftriaxone and amikacin intravenously for two weeks followed by ciprofloxacin orally for two weeks.	Asymptomatic and disease-free upto six months.

[Table/Fig-16]: Summary of the cases presented in this case series.

Salmonella meningitis typically occurs in neonates and infants. It is not as common as meningitis caused by bacteria like *Haemophilus influenzae* and *Streptococcus pneumoniae*, but some cases have been reported. In the study by Nwadike VU et al., CSF examination showed a normal cell count, while in the current case, a high neutrophil count similar to septic meningitis was observed [4]. Meningitis caused by *Salmonella* carries a high morbidity and mortality rate [4]. Risk factors for *Salmonella* infection include fecal-oral transmission from a carrier mother or caretaker, as well as ingestion of breast milk from a *Salmonella*-infected mother [5]. In the present case, the mother could not be evaluated for carrier status due to the child's death.

Contact with pet reptiles has also been reported as a risk factor for *Salmonella* meningitis, particularly due to *Salmonella* rubislaw [5]. Although previous case reports have documented rare Salmonella species such as *Salmonella* Newport and *Salmonella* enteric serotype Houtenae, the patient in present case suffered from meningitis caused by *Salmonella* Typhi [6,7]. Children who survive *Salmonella* meningitis are at a higher risk of experiencing complications such as seizures, hydrocephalus, empyemas, retardation, paresis, athetosis, and visual disturbances. When gram negative bacteria are observed in CSF, the possibility of *Salmonella* should be considered. Treatment of choice involves intravenous administration of third-generation cephalosporins and fluoroquinolones for at least three weeks [8]. In patients with cerebral abscesses, it is recommended to continue treatment for at least five weeks [8].

Salmonella osteomyelitis refers to an infection of the bone caused by *Salmonella*. The incidence of osteomyelitis is less than 1% of all *Salmonella* infections [9]. In India, *Salmonella* Typhi is the most common cause of *Salmonella* osteomyelitis. The infection typically occurs through haematogenous seeding of the bones following a bloodstream infection, which is likely the cause in present case. Rarely, it can also result from penetrating trauma or spread from a nearby site. Present case is similar to a case report by Rohilla R et al., where no predisposing factors such as sickle cell disease, diabetes, immunosuppressive states, connective tissue disorders and extremes of age were present [9,10].

Incomplete antibiotic treatment or lack of appropriate antibiotic therapy, as seen in the patient who self-medicated for fever and loose stools without medical guidance, increases the risk of *Salmonella* osteomyelitis and other extraintestinal manifestations [10]. The appropriate treatment of enteric fever with the right antibiotics for the recommended duration can help prevent *Salmonella* osteomyelitis. Treatment options for *Salmonella* osteomyelitis include cephalosporins, aminoglycosides, and quinolones, administered for a minimum of 3-6 weeks depending on the results of antibiotic susceptibility tests [9-11]. In patients with a history of previous fever and loose stools, a higher index of suspicion should be maintained for *Salmonella* as the causative agent [10]. Therefore, when evaluating suspected cases of osteomyelitis, it is important to include a history of fever and loose stools within the past 3-6 months in the checklist.

Salmonella can also cause Urinary Tract Infections (UTIs). The bacteria can enter the urinary tract through hematogenous seeding or direct spread from the urethra due to fecal contamination [12]. The symptoms of *Salmonella* UTIs are similar to those caused by other bacteria. While *Salmonella* UTIs often occur in individuals with anatomical abnormalities of the urinary tract, some cases may not have any predisposing factors. Risk factors for *Salmonella* UTIs include renal stones, nephrocalcinosis, renal cysts, urethral strictures, Schistosomiasis, renal neoplasms, renal transplantation, tuberculosis, prostatic hypertrophy, lupus nephritis, and cystoscopic procedures. However, in the cases reported by Dawar R et al., and Klosterman SA the patients had urinary tract abnormalities, whereas the patient did not [12,13].

Complications of *Salmonella* UTIs include interstitial nephritis, renal micro-abscesses, and pyelonephritis [12,13]. Various species of *Salmonella* have been isolated from cases of Salmonella bacteriuria, including *Salmonella* Typhi, *S.* paratyphi A, *S.* paratyphi B, *S.* typhimurium, *S.* virchow, *S.* chester, *S.* hedelberg, *S.* cholerasuis, *S.* eastbourne, *S. enterica* sub sp. *enterica*, *S.* enteritidis, *S.* oranienberg, *S.* manhaten, and *S.* Newport [14]. It is important to note that treating suspected UTIs without conducting a culture and sensitivity test can result in the underdiagnosis of infections caused

by uncommon pathogens like *Salmonella*. Therefore, *Salmonella* bacteriuria should be considered in patients with a history of fever and loose stools, as enteric fever can lead to urinary carriers. A high degree of clinical suspicion and avoidance of blind antimicrobial treatment without identifying the causative organisms can help prevent the underdiagnosis of UTIs caused by *Salmonella*.

Salmonella can cause septic arthritis, and the clinical symptoms are similar to those caused by other bacteria. Avascular necrosis is the most common predisposing factor, with the hip joint being the most commonly affected in cases of *Salmonella* septic arthritis. Other risk factors include immunosuppression and prolonged steroid treatment. Shanthi M et al., reported a case of *Salmonella* septic arthritis in a patient with Systemic Lupus Erythematosus (SLE) who was predisposed to immunosuppression due to steroid therapy. In the patient's case, they had diabetes, which is an immunosuppressive condition. Most cases of septic arthritis are caused by non typhoidal *Salmonella*, but there have been rare reports of typhoidal arthritis, similar to the present case [15].

Like the case described by Shanthi M et al., the patient had negative blood culture, Widal test, and stool cultures, most likely due to a long latency period [15]. Therefore, culture of pus from the infected joint is the ideal diagnostic investigation for septic arthritis caused by Salmonella. The main steps in managing septic arthritis due to Salmonella involve surgical intervention and antibiotic therapy based on drug sensitivity reports. The duration of antibiotic treatment may range from 2 to 6 weeks depending on the severity of the infection. Early diagnosis and treatment are crucial in preventing extensive joint damage [2,15].

Intramuscular abscesses can occur as extraintestinal manifestations of *Salmonella*. While pyomyositis due to *Salmonella* is rare, non typhoidal *Salmonella* are commonly associated with pyomyositis [16]. *Salmonella enterica* subspp. enterica has been found to cause neck abscesses in diabetic patients with poor glycaemic control [17]. *Salmonella* Paratyphi A has been reported as a rare cause of pyomyositis, as described in the case report by Bhosale A and Kolte S in one of the patients, *Salmonella* Typhi was isolated [18]. Thyroid abscesses have been associated with *Salmonella enterica* serotype Panama and *Salmonella* Typhimurium [19]. *Salmonella* has also been isolated from cases of gluteal abscess, ovarian abscess, liver abscess, splenic abscess, and pelvic abscesses [2]. When treating patients with abscesses, it is essential to perform a culture and sensitivity test on the pus sample obtained through incision and drainage or aspiration. Blind antibiotic therapy can lead to the overlooking of rare causes such as *Salmonella*.

Salmonella has also been isolated in cases of myelitis, cellulitis, necrotising fasciitis, empyema, pericarditis, vasculitis, and digital gangrene [2]. Accurate diagnosis of extraintestinal Salmonellosis requires the exact identification of the causative organism through culture of the appropriate clinical specimen before initiating antibiotic treatment. Early treatment for the recommended duration is necessary to prevent relapse and other irreversible complications.

CONCLUSION(S)

Salmonellosis should be considered as a possible diagnosis in any extraintestinal infection. Histopathological findings in infectious diseases are typically non specific. If empirical antibiotic therapy fails to show improvement, it should raise suspicion for tuberculosis, malignancy, and other atypical presentations of infectious diseases, including salmonellosis. What makes this case series unique is that none of the five cases were initially suspected to be caused by *Salmonella*. Meningitis, pyelonephritis, and septic arthritis were initially suspected to be caused by other common pyogenic bacteria. Osteomyelitis and pyomyositis were clinically and radiologically suspected to be tuberculosis or malignancy. The correct diagnosis was ultimately made through microbial culture. Prompt diagnosis and treatment of extraintestinal *Salmonella* infections with appropriate antibiotics, based on sensitivity reports, for the recommended duration can significantly reduce morbidity and mortality due to serious complications.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Jun 20, 2023
- Manual Googling: Aug 19, 2023
- iThenticate Software: Nov 13, 2023 (10%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? No
- For any images presented appropriate consent has been obtained from the subjects. No

Date of Submission: **Jun 19, 2023**
Date of Peer Review: **Aug 07, 2023**
Date of Acceptance: **Nov 16, 2023**
Date of Publishing: **Dec 01, 2023**