DOI: 10.7860/JCDR/2024/69057.19400

Case Series

Microbiology Section

Presence of Enteric Fever with Unusual Clinical Scenarios: A Case Series

VRUSHALI THAKAR[1], MAHADEVAN KUMAR[2], NEETU MEHROTRA[3], PRAJAKTA JADHAV[4], SUNITA BHATAWADEKAR[5]

ABSTRACT

Salmonella species are associated with bacteraemia, diarrhoea, as well as focal infections. *Salmonella* Typhi is the most pathogenic species. *Salmonella* Paratyphi B commonly affects immunocompromised hosts. The present case series showcases six cases of infection caused by typhoidal *Salmonellae* with unusual clinical scenarios. The first case report explains a case of neonatal meningitis where the causative agent was *S.* Paratyphi B. A case of lumbar spondylodiscitis is also reported where the aetiology was found to be *Salmonella* Typhi. Case three reports *S.* Typhi infection in a patient with Pre-B cell Acute Lymphoblastic Leukemia (ALL). *S.* Paratyphi B was isolated from a blood culture of a patient on haemodialysis and also from ascitic fluid from a case of Chronic Liver Disease (CLD). *S.* Typhi was isolated from the pleural fluid of a patient with carcinoma of the prostate.

Keywords: Meningitis, *Salmonella* Paratyphi B, Spondylodiscitis

INTRODUCTION

A total of 14.3 million cases of enteric fever caused by *Salmonella enterica* serovar Typhi and Paratyphi were reported globally in 2017. *S.* Typhi was responsible for 11 million cases of typhoid fever and 120,000 deaths [1]. *Salmonella* are enteric pathogens. However, dissemination of bacilli occurs throughout the body, which occasionally causes focal infections [2]. There are few case reports of spondylodiscitis caused by *S.* Typhi. However, it is a rare clinical condition often misdiagnosed as Tuberculosis of the spine [3,4]. There are very few case reports of meningitis caused by *S.* Paratyphi B from India [5,6]. Here, authors report a few unusual cases of Typhoidal *Salmonella* infections. The strains were identified along with Antimicrobial Susceptibility Testing (AST) by an automated method (Vitek 2, Biomerieux). Biochemical testing along with serotyping was carried out by conventional methods. Additional AST for chloramphenicol and azithromycin was done by the disc diffusion method (Kirby Bauer) as per the Clinical Laboratory Standard Institute guidelines [7]. Present series is of six cases which were reported from November 2022 to July 2023.

CASE SERIES

Case 1

Meningitis in a newborn: A two-month-old male baby, full-term vaginal delivery, presented with a moderate-grade fever for eight days. The baby was exclusively breastfed in the first month of life, after which diluted unpasteurised cow milk was given to him. He had received Bacillus Calmette-Guerin (BCG) and Oral Polio Vaccine (OPV) at birth. The baby was treated by a local practitioner with oral amoxicillin-clavulanic acid syrup and paracetamol syrup thrice a day for five days, but his condition worsened. He was admitted to our hospital for excessive irritability, refusal to feed, and an episode of seizure. A provisional diagnosis of meningitis was made based on the above symptoms, and the patient was initiated on Intravenous (iv) vancomycin 15 mg/kg/12 hourly (hrly) and ceftriaxone 50 mg/kg 12 hrly empirically. Cerebrospinal Fluid (CSF) analysis was suggestive of bacterial meningitis [Table/Fig-1]. Blood and CSF on culture grew Salmonella enterica subsp enterica serovar Paratyphi B susceptible to ceftriaxone [Table/Fig-2]. Radiological images [Table/Fig-3,4] showed features suggestive of meningitis, ventriculitis (lateral, 3rd, and 4th), and small lacunar vasculitic infarcts in the right frontal region along with intraventricular exudates. Vancomycin was discontinued, and iv ceftriaxone 50 mg/kg 12 hourly along with i.v. Levetiracetam 60 mg/kg/day, i.v. Fosphenytoin 5PE/Kg were administered. The baby was started on iv fluids. He was also transfused with Packed Cell Volume (PCV) 15 mL/kg due to low haemoglobin (7.9 gm/dL). Treatment was continued for three weeks. Repeat CSF analysis after one week showed improvement (Proteins- 131 mg/dL, glucose <5 mg/dL, nucleated cells-350/cumm, Neutrophils-80%). The baby showed clinical improvement after one week of antibiotic treatment and was started on oral feeds, which were well tolerated. Blood and stool culture of the infant's mother were also done to ascertain the source

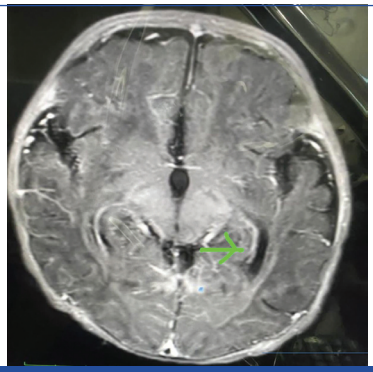
Case no.	Age	Sex	Diagnosis	Co-morbidities	Hb (gm/dL)	TLC/ cumm	Platelet/ cumm	Sample/ culture	Other investigations
1	2 months	M	Meningitis	Nil	7.9	6200	2.2 L	Blood and CSF/ *Salmonella* Paratyphi B	**CSF biochemical analysis-** Glucose- <5 mg/dL Proteins- 214 mg/dL Nucleated cells- 1754/cumm Neutrophils- 95% **Repeat CSF analysis** Glucose- < 5 mg/dL Proteins- 131 mg/dL Nucleated cells- 350/cumm Neuterophils- 80% C Reactive Protein (CRP)- 79 mg/L MRI- signs of meningitis, vasculitic infarct
2	59 years	M	Spondylodiscitis	Nil Patient on steroids	8.1	10300	3.6 L	Intraoperative pus sample/ *Salmonella* Typhi	Repeat Haemogram- Drop in TLC 6400/cumm MRI spine-L2L3 spondylodiscitis L3 vertebral body collapse

3	10 years	M	Pre-B cell ALL with enteric fever	ALL onchemotherapy	6.1	5500	1 L	Blood/ *Salmonella* Typhi	Haemogram Hb-6.1 g/dL Total Leucocyte Count (TLC)- 5500/cumm Platelet- 18000/cumm RBC Morphology-Marked anisopoikilocytosis. Macrocytes+few tear drop cells Repeat haemogram (After one week) Hb-8.5 g/dL Total Leucocyte Count (TLC)- 100/cumm Platelet- 16000/cumm RBC Morphology-Marked anisopoikilocytosis. Macrocytes+ few pencil cells, tear drop cells and polychromatic cells seen. Ultrasonography of abdomen and pelvis- Hepatosplenomegaly
4	52 years	M	CKD with sepsis	DM/HTN/ IHD/CKD on haemodialysis	10.2	9300	1.6 L	Blood/ *Salmonella* Paratyphi B	Random blood sugar- 164 mg/dL Creatinine- 14.7 mg/dL USG abdomen and pelvis-Renal parenchymal disease
5	57 years	M	SBP in c/o CLD with decompensated liver cirrhosis	CLD	9.1	5000	1.8 L	Ascitic fluid/ *Salmonella* Paratyphi B	**Ascitic fluid cytological analysis-** Nucleated cells- 670/cu mm Polymorphs- 60% **Liver function test** Total proteins- 4 g/dL Albumin- 2 g/dL Total bil- 1 mg/dL Direct bilirubin- 0.5 mg/dL Indirect bilirubin- 0.5 mg/dL Serum glutamic-oxaloacetic transaminase/Serum glutamic-pyruvic transaminase- 80/60 lu/L
6	72 years	M	Pleural effusion in a known case of carcinoma prostate with metastasis.	Carcinoma prostate with metastasis, DM, HTN, AKI, sepsis	7.6	17600	3.3 L	Blood and urine culture- no growth Pleural fluid/ *Salmonella* Typhi	Chest X-ray- left pleural effusion Procalcitonin- 1.78 ng/mL CRP- 323 mg/L Prostate specific antigen- 830 ng/mL USG abdomen pelvis-left hydronephrosis Enlarged mesenteric lymph nodes in right lumbar region CT abdomen and pelvis- suggestive of left hydronephrosis and metastasis Serum creatinine- 9.4 mg/dL Serum urea- 228 mg/dL Pleural fluid- LDH- 307u/L ADA- 9.5 u/L Nucleated cells- 2000/cumm Polymorphs- 40%

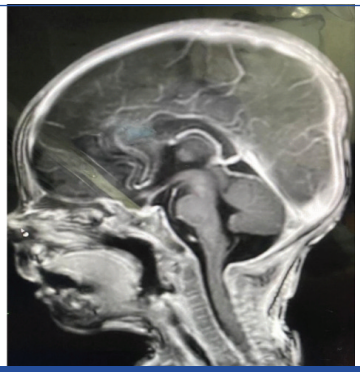
[Table/Fig-1]: Laboratory investigations.
ALL: Acute lymphoblastic leukaemia; CKD: Chronic kidney disease; DM: Diabetes mellitius; HTN: Hypertension; IHD: Ischaemic heart disease; SBP: Spontaneous bacterial peritonitis, CLD: Chronic liver disease; AKI: Acute kidney injury

Case no.	Diagnosis	Sample processed	Isolate	Disc diffusion					Treatment
				Ceftriaxone (µg/mL)	Ciprofloxacin (µg/mL)	Cotrimoxazole (µg/mL)	Chloramphenicol (mm)	Azithromycin (mm)	
1	Meningitis	CSF	*Salmonella* Paratyphi B	S (<=1)	I (0.5)	S (<=20)	S (20)	S (20)	Ceftriaxone
2	Spondylodiscitis	Intraoperative tissue	*Salmonella* Typhi	S (1)	S (<=0.06)	S (<=20)	S (20)	S (22)	Ceftriaxone
3	Enteric fever in Pre B cell ALL	Blood	*Salmonella* Typhi	S (<=0.25)	S (<=0.06)	S (<=20)	S (25)	S (26)	Ceftriaxone
4	CKD on haemodialysis	Blood	*Salmonella* Paratyphi B	S (<=0.25)	S (<=0.06)	S (<=20)	S (22)	NA	Ceftriaxone and azithromycin
5	SBP in CLD	Ascitic fluid	*Salmonella* Paratyphi B	S (<=0.25)	R (2)	S (<=20)	S (22)	NA	Ceftriaxone
6	Pleural effusion in a K/C/O CA prostate with metastasis	Pleural fluid	*Salmonella* Typhi	S (<=0.25)	I (0.25)	S (<=20)	S (21)	S (22)	Meropenem (Empirical)

[Table/Fig-2]: Antibiotic susceptibility pattern of *Salmonella* isolates (MIC in µg/mL).
S: Susceptible; R: Resistant; NA: Not applicable; ALL: Acute lymphoblastic leukaemia; CKD: Chronic kidney disease; SBP: Spontaneous bacterial peritonitis; CLD: Chronic liver disease; CA: Carcinoma



[Table/Fig-3]: MRI brain- Ventriculitis.



[Table/Fig-4]: MRI brain showing meningeal enhancement.

of infection. Her blood culture showed no growth, and no pathogen was isolated from stool. So, the probable source of infection was likely unpasteurised milk or water used for its dilution. The baby was discharged after three weeks of treatment.

Case 2

Lumbar spondylodiscitis: A 59-year-old male presented with complaints of lower backache radiating to the abdomen and inguinal region for the past five months. It was present at rest and on walking. He also complained of difficulty in standing up from a sitting position. He had no co-morbidities, neurogenic claudication, or bowel/bladder complaints. He gave a history of steroid use for the past six months for pain relief. At the time of presentation, he was afebrile with stable vitals and no history of gastroenteritis. On examination, tenderness was present in the lumbosacral region of the spine. The haemogram revealed Hb-8.1 g/dL, TLC- 10300/cmm, PCV-27.9/cmm. Repeat haemogram done after two days showed a drop in TLC to 6500/cmm. The radiograph of the lumbar spine showed gross destruction at L2-3 disc and end plates. These findings were consistent with spondylodiscitis. Magnetic Resonance Imaging (MRI) of the lumbosacral spine also showed L2-L3 spondylodiscitis with L3 vertebral body collapse. He was started on dexamethasone 8 mg iv 12 hourly, cefuroxime 1.5 gm iv 8 hourly, Dynapar 75 mg in 100 mL normal saline. L2-L3 wound debridement with posterior spinal instrumentation and fusion was done. The intraoperative tissue sample sent to the microbiology laboratory grew *Salmonella* Typhi susceptible to ceftriaxone [Table/Fig-2], based on which the patient was started on i.v. ceftriaxone (2 gm/12 hourly). He improved symptomatically and was discharged within seven days of treatment. He was prescribed oral cefixime 200 mg 12 hourly for 12 weeks and advised physiotherapy after discharge.

Case 3

Enteric fever in a child with Pre-B cell Acute Lymphoblastic Leukemia (ALL): A 10-year-old male child, a known case of Pre-B cell ALL diagnosed three months back and was put on chemotherapy one month back. He had a history of convulsion for one year, so was prescribed Tablet Lavera 500 mg twice a day by an outside medical practitioner. One month later, he presented with complaints of intermittent pain abdomen for two weeks. At the time of admission, he was afebrile with normal vitals and tenderness in the hypogastrium. Clinicians suspected drug-induced pancreatitis, so he was empirically started on i.v. meropenem (1 gm/8 hrly), i.v. fluids, and oral paracetamol for pain management. He had a history of convulsions so oral Lavera was also given. Laboratory investigations showed thrombocytopenia and macrocytosis [Table/Fig-1]. Other parameters were within normal limits [Table/Fig-1]. On ultrasonography of the abdomen and pelvis, hepatosplenomegaly was observed. His abdominal pain reduced after five days of treatment. As the patient tolerated oral food, his chemotherapy was restarted. On the seventh day of hospitalisation, he developed a fever, so a blood culture was sent, which grew Salmonella enterica serovar Typhi, which was susceptible to ceftriaxone [Table/Fig-2]. His antibiotic was de-escalated to ceftriaxone (1 gm/12 hourly), to which the patient responded well and was discharged after 14 days of treatment after developing a fever.

Case 4

Chronic kidney disease on haemodialysis: A 52-year-old man, a known case of diabetes mellitus and hypertension for three years, had a history of obstructive uropathy for which Double J stenting and cystoscopy had been done one year back. The stent was removed after one month of placement. After six months, the patient was diagnosed with a left eye cataract for which surgery was planned in an outside hospital. During preoperative evaluation, deranged renal function tests were noted (Serum creatinine-9.21, urea- 187). Due to this, he was referred to our hospital. At the time of admission, he had complaints of swelling on the face, arms, and legs. He also complained of shortness of breath on exertion since a month. The nephrologist's opinion was taken. Haemodialysis was initiated in view of deranged Renal Function Test (RFT). The patient developed a fever on the second day of admission, so i.v. ceftriaxone (1 gm/12 hourly) was started. A blood culture was sent. Nested multiplex Polymerase Chain Reaction (PCR) (BioFire FilmArray, Biomerieux) detected *Salmonella* species. Automated system (Vitek2) and conventional methods identified the strain as *Salmonella* ser. Paratyphi B. The strain was susceptible to ceftriaxone and chloramphenicol [Table/Fig-2]. The patient was treated with i.v. ceftriaxone (1 gm/12 hrly) and tablet azithromycin (500 mg/24 hours) for 14 days and was discharged after two weeks of hospitalisation. The patient was asymptomatic when he came for the next haemodialysis session after a month.

Case 5

Spontaneous Bacterial Peritonitis (SBP) in Chronic Liver Disease (CLD): A 57-year-old male, a known case of decompensated CLD and liver cirrhosis for six months, presented with abdominal pain, nausea, and vomiting for the past four days. The patient was admitted due to the risk of spontaneous bacterial peritonitis. Injection Piperacillin tazobactam was started 3.375g eight hourly. On admission, laboratory investigations showed deranged liver function tests, raised creatinine, and low albumin [Table/Fig-1]. Due to abdominal pain and swelling, ascitic paracentesis was performed, and ascitic fluid was sent for culture. *Salmonella* Paratyphi B, susceptible to ceftriaxone, was isolated [Table/Fig-2]. However, the patient discharged against medical advice after five days and was lost to follow-up.

Case 6

Pleural effusion in a known case of prostate carcinoma with metastasis: A 72-year-old male, a known case of diabetes mellitus and hypertension, was diagnosed with prostate carcinoma with metastasis eight months ago. He underwent bilateral orchidectomy within a week of diagnosis and was advised 24 cycles of chemotherapy. He presented with decreased urine output, reduced appetite, generalised weakness, and incontinence over the past week. Urgent nephrology opinion was sought, and he was initiated on dialysis. Empirical treatment with meropenem (1 gm/8 hrly) was started due to leukocytosis. His chest radiograph revealed left-sided pleural effusion, for which thoracentesis was performed. *S.* Typhi was isolated from the pleural fluid, but blood culture did not show any growth. The isolate was susceptible to ceftriaxone, cotrimoxazole, and showed intermediate susceptibility to ciprofloxacin [Table/Fig-2]. The patient was hospitalised for four days and unfortunately passed away due to complications of malignancy on the day the report was released.

DISCUSSION

India contributes half of the estimated global burden of typhoid. Public vaccination efforts remain partially implemented. John J et al., studied the prevalence of typhoid fever in India and reported a high burden of typhoid fever in urban India despite improved sanitation [1]. *Salmonella* Meningitis (SM) is a rare but severe form of bacterial meningitis caused by consuming contaminated water or food. It is associated with high morbidity and mortality rates [8]. Dudhane RA et al., reported a rise in cases of non-typhoidal *Salmonella* infections in India [9]. Sudhaharan S et al., conducted a study to analyse the spectrum of extraintestinal infections caused by *Salmonella*. The predominant species were *S. typhimurium* followed by *S. enteritidis* [10].

The first case of SM was reported by Ghon in 1908, caused by *Salmonella* Paratyphi B [11]. Gunawan PI and Noviandi R reported a case of meningitis in a seven-month-old in Indonesia

due to *Salmonella* Paratyphi B in 2022 [6]. Halwani M and Batwai R reported a case in a four-month-old child from Saudi Arabia in 2016 [12]. Mahalaxmi R et al., also reported *Salmonella* Paratyphi B meningitis in a 90-day-old infant from Chennai in 2016 [5].

Paediatricians in developing countries should consider *Salmonella* infection in their differential diagnosis when treating cases of meningitis in infants. *Salmonella* Meningitis (SM) is associated with significant mortality, morbidity, and treatment failure rates [5]. Treatment with a third-generation cephalosporin for atleast four weeks is recommended to prevent relapse [13]. Timely microbiological diagnosis is essential for initiating appropriate antibiotics to avoid unnecessary empirical use of antibiotics to cover gram-positive organisms. In first case, the source of infection was either unpasteurised milk or water used for dilution. The mother was asymptomatic, and the organism was not isolated from her stool or blood culture.

Various authors have reported lumbar spondylodiscitis caused by *Salmonella* Typhi [3,4,14]. *Salmonella* spondylodiscitis is usually seen in patients with underlying conditions like leukaemia, diabetes, and patients on long-term steroids. However, spondylodiscitis caused by *Salmonella* has also been reported in immunocompetent patients without any predisposing factors [14]. These cases clinically and radiologically mimic tuberculosis, so a microbiological culture of the intraoperative pus sample is essential to rule this out. Index patient had been on steroids for the past six months but had no history of gastroenteritis. Therefore, the source of infection in this case could not be ascertained. Amsalu T et al., have reported a higher prevalence of typhoid fever (4%) compared to paratyphoid fever (1.3%) in Ethiopia [15]. *S.*Typhi was responsible for 75% of enteric fever cases, and the remaining 25% were caused by *S.*paratyphi A. All six of present series patients were immunocompromised.

Bacterial peritonitis occurs as bacteria from the gut enter mesenteric lymph nodes and then the bloodstream, followed by seeding of bacteria in ascitic fluid. It is a common and serious complication of decompensated liver cirrhosis. Enteric gram negative bacilli are common causative organisms of peritonitis. It may rarely be caused by *Salmonella* species [16]. Spontaneous Bacterial Peritonitis (SBP) due to *Salmonella* Paratyphi B has been reported by Rizwana M and Appalaraju B [17]. The same organism was isolated from the ascitic fluid in the case of liver cirrhosis in this particular case. Pleuropulmonary involvement of *Salmonella* infection is rare. Such involvement usually occurs in the elderly and those with underlying diseases such as diabetes mellitus, malignancy [18,19]. Index patient was immunocompromised due to underlying malignancy. There has been an increase in infections caused by drug-resistant *Salmonella* species worldwide [20]. This increase is mainly due to the indiscriminate use of antibiotics [21]. All six of index patients responded well to ceftriaxone. Some *Salmonella* strains were resistant to Ciprofloxacin.

CONCLUSION(S)

Unusual clinical presentations and extraintestinal manifestations are commonly associated with an immunocompromised status. Timely collection of appropriate samples before initiating empirical antibiotics is essential to obtain a positive culture. A microbiological diagnosis is imperative to avoid unnecessary use of broad-spectrum antibiotics and to prevent antimicrobial resistance.

REFERENCES

[1] GBD 2017 Typhoid and Paratyphoid Collaborators. The global burden of typhoid and paratyphoid fevers: A systematic analysis for the Global Burden of Disease Study 2017. Lancet Infect Dis. 2019;19(4):369-81.
[2] Huang DB, DuPont HL. Problem pathogens: Extra-intestinal complications of Salmonella enterica serotype Typhi infection. Lancet Infect Dis. 2005;5(6):341-48.
[3] Das S, Bandyopadhyay R, Hansdak SG. Case report of infective spondylodiscitis due to nalidixic acid-resistant *Salmonella* paratyphi A. J Family Med Prim Care. 2021;10(1):554-57.
[4] Chang IC. *Salmonella* spondylodiscitis in patients without sickle cell disease. Clin Orthop Relat Res. 2005;(430):243-47.
[5] Mahalakshmi R, Rajeshbabu B, Mohan R, Balakumaran D, Venkataraman P, Vinoth PN. *Salmonella* paratyphi B meningitis in an infant. Australas Med J. 2013;6(7):350-53.
[6] Gunawan PI, Noviandi R. *Salmonella* Paratyphi B meningitis in an infant: The First Report in Indonesia. Medico Legal Update. 2022;22(3):63-65. Available from: https://doi.org/10.37506/mlu.v22i3.3309.
[7] Clinical and Laboratory Standard (CLSI). 2023. Performance standard for antimicrobial susceptibility testing. 33rd edition. CLSI supplement. Wayne PA.
[8] Elouali A, Ouerradi N, Ayad G, Babakhouya A, Rkain M. *Salmonella* meningitis in a young infant: A case report. Cureus. 2023;15(8):e44147.
[9] Dudhane RA, Bankar NJ, Shelke YP, Badge AK. The rise of non-typhoidal *salmonella* infections in India: Causes, symptoms, and prevention. Cureus. 2023:15(10):e46699.
[10] Sudhaharan S, Kanne P, Vemu L, Bhaskara A. Extraintestinal infections caused by nontyphoidal *Salmonella* from a tertiary care center in India. J Lab Physicians. 2018;10(4):401-05.
[11] Kim KS. Acute bacterial meningitis in infants and children. Lancet Infect Dis. 2010;10(1):32-42.
[12] Halwani M, Batwai R. A case of meningitis caused by *Salmonella* Paratyphi Type B in a four months-old infant. Clin Trials Pathol Case Stud. 2016;1(1):26-28. Available from: https://www.ommegaonline.org.
[13] American Academy of Pediatrics. Committee on Infectious Diseases. (2000). *Salmonella* infections. In Report of the Committee on Infectious Diseases, 25th edn, (Peter, G., Ed), pp. 503. American Academy of Pediatrics, Elk Grove Village, IL.
[14] Saravu K, Bhat SN, Gupta N. Spondylodiscitis due to *Salmonella* Typhi: A series of four cases. Oxf Med Case Reports. 2021;28:11-12.
[15] Amsalu T, Genet C, Adem Siraj Y. *Salmonella* Typhi and *Salmonella* Paratyphi prevalence, antimicrobial susceptibility profile and factors associated with enteric fever infection in Bahir Dar, Ethiopia. Sci Rep. 2021;11(1):7359.
[16] Bacon BR. Cirrhosis and its complications. In: Fauci AS, Braunwald E, Kasper DL, Hauser SL, Longo DL, Jameson]L, Loscalzo J editors. Harrison's principles of internal medicine. 17th edition. New York: McGraw-Hill; 2008;1971-80.
[17] Rizwana M, Appalaraju B. *Salmonella* paratyphi B- A rare cause of spontaneous bacterial peritonitis. Indian J Pathol Microbiol. 2022;65(2):513-14.
[18] Rim MS, Park CM, Ko KH, Lim SC, Park KO. Pleural empyema due to *Salmonella*: A case report. Korean J Intern Med. 2000;15(2):138-41.
[19] Samir Abdelhafiz A, Wassef M, Alorabi M. Pleural empyema due to *Salmonella* in a patient with bronchogenic carcinoma: The first case report from a cancer hospital in Egypt. Access Microbiol. 2020;2(9):acmi000151.
[20] Threlfall EJ. Antimicrobial drug resistance in *Salmonella*: Problems and perspectives in food- and water-borne infections. EMS Microbiol Rev. 2002;26(2):141-48.
[21] Wu W, Wang H, Lu J, Wu J, Chen M, Xu Y, et al. Genetic diversity of *Salmonella enteric* serovar Typhi and Paratyphi in Shenzhen, China from 2002 through 2007. BMC Microbiol. 2010;10:32.

PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Microbiology, Bharati Vidyapeeth (Deemed to be University) Medical College, Pune, Maharashtra, India.
2. Professor, Department of Microbiology, Bharati Vidyapeeth (Deemed to be University) Medical College, Pune, Maharashtra, India.
3. Fellow, Department of Microbiology, Bharati Vidyapeeth (Deemed to be University) Medical College, Pune, Maharashtra, India.
4. Postgraduate Student, Department of Microbiology, Bharati Vidyapeeth (Deemed to be University) Medical College, Pune, Maharashtra, India.
5. Professor and Head, Department of Microbiology, Bharati Vidyapeeth (Deemed to be University) Medical College, Pune, Maharashtra, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Neetu Mehrotra,
Flat No. 4, B Building, Sacred Heart Town Society, Wanwadi,
Pune City East-411040, Maharashtra, India.
E-mail: mehrotraneetu@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Dec 13, 2023
- Manual Googling: Mar 08, 2024
- iThenticate Software: Mar 11, 2024 (7%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Dec 13, 2023**
Date of Peer Review: **Jan 15, 2024**
Date of Acceptance: **Mar 14, 2024**
Date of Publishing: **May 01, 2024**