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Non-Purulent Empyema Salmonellosis in an Elderly Patient with Heart Failure: A Case Report and Literature Review

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1. Abstract

1.1. Background

Salmonella is a genus of bacteria that is primarily recognized for causing foodborne illnesses and gastrointestinal infections. However, cases involving empyema attributed to Salmonella remain quite rare, with only a handful of cases reported in the medical literature.

1.2. Case Presentation

This article details the intriguing case of an elderly female patient who was admitted to the hospital with complaints of cough and dyspnea. Further investigation, including a chest X-ray, CT scan, and diagnostic pleural tap, revealed a substantial accumulation of fluid in the pleural space, indicative of non-purulent empyema, on top of heart failure, complicating her clinical picture. Extensive laboratory analysis confirmed the presence of Salmonella in the pleural fluid, linking it directly to the empyema.

1.3. Conclusion

The case findings suggest that empyema can present with a non-purulent appearance. It also highlights the unusual manifestations of Salmonella, even when gastrointestinal symptoms are absent, particularly in elderly patients with existing health issues.

2. Introduction

Salmonella is a genus of gram-negative, flagellated, facultatively anaerobic bacilli belonging to the Enterobacteriaceae family. It is a significant global pathogen responsible for a wide spectrum of clinical diseases, ranging from self-limiting gastroenteritis to systemic infections such as enteric fever and bacteremia [1-3]. Humans typically contract the infection by consuming contaminated food or water, coming into direct contact with infected animals, or through person-to-person transmission (Acheson & Hohmann, n.d.; Foley & Lynne, n.d.). While Salmonella typically affects the gastrointestinal (GI) tract, it has the potential to spread into a systemic disease. Bacteremia, particularly with non-typhoidal Salmonella (NTS), can lead to metastatic infections such as endocarditis, osteomyelitis, mycotic aneurysms, and soft tissue abscesses [4,5]. Among these, pleural involvement is infrequent, with Salmonella empyema being an unusual and often underrecognized manifestation [6,7]. Pleural effusions, defined as an abnormal accumulation of fluid in the pleural space, are broadly classified based on their underlying pathophysiology into transudates and exudates [8-10]. Exudative effusions, typically resulting from infection, malignancy, or inflammatory conditions, can progress further to empyema—a condition characterized by the accumulation of pus in the pleural cavity [11]. Empyema is frequently associated with pyogenic bacterial infections, most commonly caused by Streptococcus pneumoniae, Staphylococcus aureus, and anaerobes. Salmonella empyema is an uncommon purulent infection of the pleural space that can arise through multiple seeding routes [12,13]. Here, we present what we believe to be the first documented case of non-purulent Salmonella empyema, highlighting an atypical presentation of an already exceedingly rare entity.

3. Case Presentation

An 80-year-old woman known to have hypertension, dyslipidemia, diabetes mellitus, coronary artery disease, and heart failure with reduced ejection fraction (HFrEF with an EF 35%) presented to the emergency department with a one-week history of progressively increasing fatigue, generalized weakness, dyspnea on exertion, and severe, sharp nocturnal chest pain. On examination, she was afebrile but tachycardic with a heart rate of 117, blood pressure of 85/54, an oxygen saturation of 84%, and in significant respiratory distress. There was a notable decrease in air entry on the right side of the chest, with unremarkable cardiac auscultation. No gastrointestinal symptoms were noted. The patient was started on fluid resuscitation and oxygen supplementation, with a delivery rate of 4L/min via nasal cannula. Initial lab results revealed a leukocytosis of 13.66 x $10^3/\mu L$, with neutrophilic shift (89.7%), an elevated C-reactive protein (CRP) of 117 mg/dL, an elevated creatinine level of 1.2mg/dL, and a positive lactic acid level of 3.1 mmol/L. Her pro-BNP level was alarmingly high (>35,000 pg/mL). EKG showed sinus tachycardia without acute changes. A chest X-ray showed a large right-sided pleural effusion with basal consolidation and bilateral vascular congestion, pointing toward a severe infectious process. A follow-up chest CT scan without contrast revealed cardiomegaly, ground-glass opacities involving the right lung with a considerable right-sided pleural effusion indicative of early alveolar edema. The left lung showed subsegmental consolidation in the posterior base, suggesting pneumonia or atelectasis (chest radiographs are shown in Figures 1 and 2). Given the severity of the pleural effusion and her respiratory distress, a therapeutic pleural tap was performed, draining 1200 mL of yellowish-clear to slightly cloudy pleural fluid, which provided immediate relief and significantly improved her breathing. She was started on a combination of Levofloxacin and Piperacillin-Tazobactam for broad-spectrum antibiotic coverage and diuretics to manage her fluid overload. Within hours, the patient's condition worsened, with persistent hypotension despite fluid resuscitation, requiring initiation of vasopressors (Levophed, 5cc push syringe) and central venous access with a right-sided jugular line. A chest tube was inserted for 5 days to further drain the pleural space. Pleural fluid studies were exudative, with an LDH ratio of 4.35 (pleural LDH of 1437, serum LDH of 330) and a protein ratio of 0.55 (pleural protein of 3.0, serum protein of 5.5). Pleural white count was 1084 with 69% neutrophils, a pH of 7, and a glucose of 195. Additionally, the culture identified Salmonella spp., a gram-negative rod that was resistant to ceftazidime. Blood cultures were negative after 7 days of inoculation. The patient's clinical course showed significant improvement, with stabilized blood pressure and cessation of vasopressors, and she was subsequently transferred to the floor for continued antibiotic therapy. Two weeks later, a follow-up chest CT revealed mild bilateral pleural effusion and consolidative changes in the anterior lung fields. Upon minimal drainage, the chest tube was removed, and the patient was discharged to continue a total of a 6-week antibiotic regimen at home.

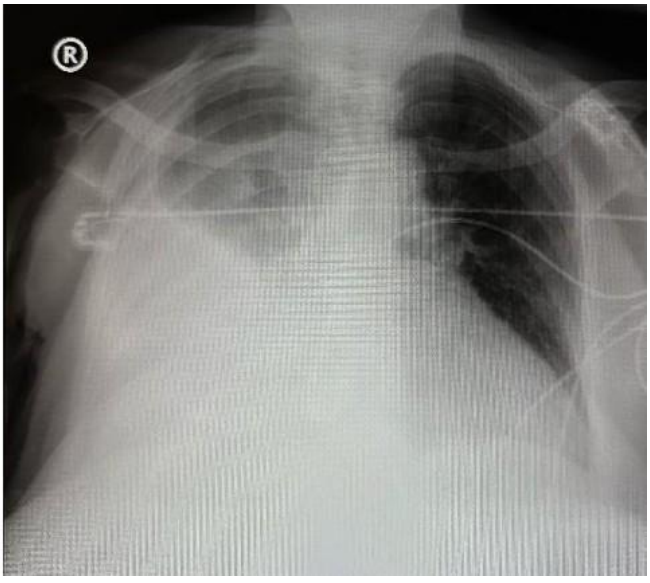

Figure 1: Chest X-RAY on admission.

Figure 2A: CT chest mediastinal view on admission.

Figure 2B: CT chest mediastinal view after 2 weeks.

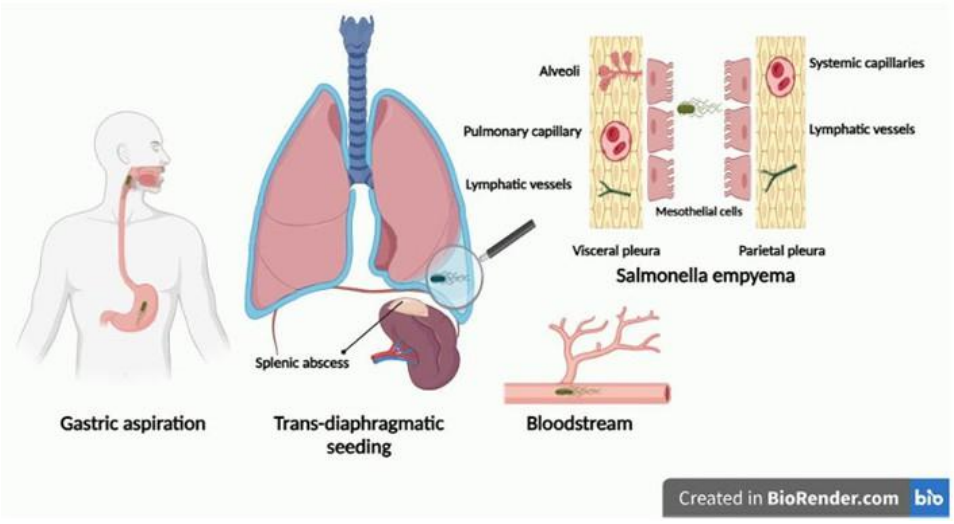

Figure 3: Pathways behind pleural empyema salmonellosis.

4. Discussion

Salmonella empyema is a rare clinical entity, with only 100 reported cases between 1949 and the present, and 52 cases in the last 25 years, as determined by a PubMed database search. This case is the first reported case in Lebanon. The table below shows the detected Salmonella serotypes in empyema salmonellosis over the previous 10 years. It typically occurs in immunocompromised individuals or those with underlying comorbidities such as diabetes mellitus, malignancies, structural lung disease, chronic liver disease, or HIV/AIDS [15,16]. The mechanisms by which Salmonella causes empyema are not entirely elucidated, but several plausible pathways have been proposed. One such mechanism is through hematogenous dissemination, as Salmonella species are facultative intracellular pathogens capable of surviving and replicating within macrophages [17,18]. In systemic infections, facilitated by a compromised immune system, Salmonella can evade host immune defenses, allowing for prolonged bacteremia and subsequent seeding of distant sites, including the pleura. In patients with Salmonella gastrointestinal infection or colonization, aspiration of gastric contents could also serve as a potential route for infection. Direct extension from an intra-abdominal or intra-thoracic focus is another potential route of pleural involvement, such as subphrenic abscesses or diaphragmatic translocation from peritonitis. A fourth route is through direct inoculation, through trauma, surgery, or thoracic procedures, which may introduce Salmonella into the pleural cavity, although such cases are exceedingly rare. The pathway of empyema salmonellosis is mentioned in Figure 3. A key component of pleural infection is fibrin deposition and loculation. Inflammatory cytokines, particularly tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6), drive the exudative phase of empyema, leading to increased vascular permeability and fibrinogen leakage into the pleural fluid. Salmonella can further exacerbate this process by activating the coagulation cascade, promoting the formation of fibrin septations that compartmentalize the pleural space. This fibrinous network may impair bacterial clearance and create microenvironments that shield bacteria from immune-mediated destruction, facilitating chronic infection and treatment resistance. Several unusual cases of Salmonella empyema have been documented in the literature. Pui et al. highlighted a case occurring in a previously healthy individual, suggesting that even immunocompetent hosts may be susceptible under certain conditions. An 8-year retrospective study conducted by Chan KP et al. between 2013 and 2020 classified pleural empyema in 212 patients into four categories based on macroscopic appearance and culture results, intending to provide a more nuanced understanding of empyema, which can have implications on diagnosis and management. The two major categories were either culture-positive empyema (CPE) or culture-negative empyema (CNE). Additionally, each of these categories is subdivided as pus-appearing empyema (PAE) or non-pus-appearing empyema (non-PAE). In our case, we can classify the empyema as a non-pus-appearing, culture-positive (non-PAE CPE), displaying an uncommon presentation on top of an already exceedingly rare diagnosis. Treatment of Salmonella empyema typically involves a combination of antimicrobial therapy and pleural drainage. Fluoroquinolones and third-generation cephalosporins are commonly used due to their efficacy against Salmonella and their ability to achieve adequate tissue penetration. In cases of persistent or loculated effusions, chest tube drainage, fibrinolytic therapy, or surgical intervention (e.g., video-assisted thoracoscopic surgery [VATS] or decortication) may be required. Our case stands out from previously reported instances of Salmonella empyema due to its non-purulent nature. While traditional empyema is characterized by the presence of thick, purulent pleural fluid, our patient's pleural fluid lacked the typical purulence despite a confirmed Salmonella infection. This raises intriguing questions regarding the host-pathogen interaction and immune response in pleural infections caused by Salmonella. Further research is needed to determine whether specific virulence factors, immune evasion strategies, or host immune responses contribute to this atypical presentation.

Table 1: Summary of empyema salmonellosis reported cases on PubMed in the last 10 years.

Author	Year	Organism detected
Chao et.al	2014	(S*. enterica (Enteritidis
Pathmanathan et.al	2015	S. enterica
Woo et.al	2015	S. enterica
Kojić et.al	2016	(S. enterica (Enteritidis
Xaplanteri et.al	2016	(S. enterica (Enteritidis
Saeed et.al	2016	(S. enterica (Enteritidis
Papaioannou et.al	2017	(S. enterica (Enteritidis
Duhil de Bénazé et.al	2018	S. typhi
Mukai et.al	2018	(S. enterica (houtenae
Johari et.al	2019	Unknown
Shima et.al	2020	(S. enterica (arizonae
Rôlo Silvestre et.al	2021	(S. enterica (Enteritidis
Sullivan et.al	2022	S. group D
Wu et.al	2023	S. group D
S*: Salmonella		

5. Conclusion

Salmonella empyema is a rare but significant manifestation of the Salmonella bacterium that requires prompt diagnosis. Key diagnostic methods include pleural fluid analysis through pleural taps and imaging studies such as chest X-rays and CT scans. The primary treatment involves antibiotics, diuretics, and supportive care. Unlike typical empyema, which usually has purulent fluid, Salmonella empyema can present with serous or clear fluid, complicating diagnosis and increasing the risk of misdiagnosis. Healthcare professionals should be vigilant, even without gastrointestinal symptoms, to ensure effective management and protect patient health.

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