CASE REPORT

Salmonella houtenae-induced Empyema Complicated with Chronic Tuberculous Empyema

Yuichi Mukai, Toshihiko Agatsuma and Gen Ideura

Abstract:
Salmonella spp. are food-borne pathogens that usually cause gastroenteritis, although bacteremia and subsequent focal metastatic infection can also occasionally occur. Of the known Salmonella spp., Salmonella houtenae is a rare subspecies, comprising less than 1% of all Salmonella strains. We herein report the first case of S. houtenae-induced empyema complicated with chronic tuberculous empyema, which was successfully treated by antibacterial agents alone. We wish to highlight the importance of being aware that Salmonella spp. can cause empyema in cases suffering from chronic tuberculous empyema; moreover, despite the successful completion of treatment with antibacterial agents, periodical follow-up is mandatory in such cases.

Key words: Salmonella, Salmonella houtenae, chronic tuberculous empyema, empyema

(Intern Med Advance Publication)
(DOI: 10.2169/internalmedicine.9169-17)

Introduction

Salmonella spp. are food-borne pathogens that usually cause gastroenteritis, although bacteremia and subsequent focal metastatic infection may also occasionally occur (1). More than 2,500 Salmonella serotypes have been identified to date, all of which belong to either of 2 main species: Salmonella bongori and Salmonella enterica. The latter serotype comprises 6 subspecies, including S. enterica (I), S. salamae (II), S. arizonae (IIIa), S. diarizonae (IIIb), S. houtenae (IV), and S. indica (VI). Although S. enterica subsp. enterica strains represent the vast majority of Salmonella strains isolated from warm-blooded animals including humans, the other subspecies and S. bongori are typically isolated from the intestinal tracts of cold-blooded animals (2).

S. houtenae (IV) is a rare subspecies, comprising less than 1% of all Salmonella strains (3). Although several reports on empyema due to Salmonella species have been documented (1, 4-6), few have so far been reported in association with Salmonella species-induced empyema, especially that of S. houtenae, resulting as a complication of chronic tuberculous empyema. Moreover, no clear treatments for empyema due to Salmonella species have yet been established.

We report the first known case of S. houtenae-induced empyema complicated with chronic tuberculous empyema, which was successfully treated by antibacterial agents alone.

Case Report

A 76-year-old man with a history of left chronic tuberculous empyema was admitted to our hospital with symptoms of bloody sputum and fever. Four days prior to admission, he experienced a productive cough and was treated with oral cefditoren pivoxil, a third-generation cephalosporin, by a general practitioner. Of note, he had been diagnosed with pulmonary tuberculosis 23 years prior to this presentation and suffered from left chronic tuberculous empyema with a reduction of his total lung volume after chemotherapy. His other underlying conditions included chronic heart failure, atrial fibrillation, and mitral valve regurgitation. He was a retired mechanic and did not smoke or consume alcohol. He had no recent history of gastroenteritis or any contact with animals.

On physical examination, the patient was alert, but had a mild fever of 37.9°C. His blood pressure and heart rate were normal, but arrhythmic. His respiratory rate was normal. The respiratory sounds on his left side were diminished. A chest
daily. A blood culture yielded no growth after 7 days of in-
time. Based on the antibacterial sensitivity, the antibacterial
natives were performed to evaluate the bronchial pathways; in
spects were identified as *Salmonella enterica* subspecies *houtenae* (*Salmonella* IV O40 : z4, z23 : -).

Although surgical treatments including extrapleural pneu-
monectomy were considered, we gave priority to conserva-
tive treatment with antibacterial agents. The estimated risk
of perioperative complications was high considering the pa-
tient’s history of cardiovascular disease. His fever subsided
on day 10 of hospitalization, and subsequent sputum culture
samples were negative for *Salmonella* species. Levofloxacin
500 mg was continued orally. He was discharged on day 35
of hospitalization, after completing 6 weeks of levofloxacin
therapy. Four months post-discharge, the patient remained
afebrile and healthy. Repeat chest CT showed a remission of
pneumonia and a slight reduction in the size of the em-
pyema (Fig. 2D).

**Discussion**

We identified two interesting clinical issues in relation to
the present case.

First, *S. houtenae*, a rare *Salmonella* subspecies, can
cause empyema in a patient with underlying chronic tuber-
culous empyema. A review of pleuropulmonary complica-
tions due to *Salmonella* species by Crum revealed only 39
such cases reported until 2005, with *Salmonella typhi-
murium* as the most common non-typhi species associ-
ated with empyema (4). Our search of the pertinent English
literature based on relevant keywords through the PubMed
database yielded no reports on pleuropulmonary manifesta-
tions due to *S. houtenae*. Moreover, no reports of *S.
houtenae*-induced empyema as a complication of chronic tu-
berculous empyema were found. Therefore, to the best of
our knowledge, this is the first case of its kind.

Second, conservative treatment with antibacterial agents
alone was effective in this case. Our patient had a long his-
tory of chronic tuberculous empyema, leading to chronic in-
flammation that had progressed through the phases of exu-
dative effusion, fibrinopurulent empyema thoracis, and or-
ganizing fibrothorax. Pleural drainage is ineffective in such

---

**Figure 1.** Chest radiograph on day of admission. Chest radiograph showing volume reduction of the left lung and decreased permeability in the left upper lung field with a tracheal shift to the left; there is no permeability in the lower lung field.

---

**Table 1. Laboratory Data on Day of Admission.**

<table>
<thead>
<tr>
<th>TP</th>
<th>7.4 g/dL</th>
<th>WBC</th>
<th>10,100 /μL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alb</td>
<td>3.4 g/dL</td>
<td>neutrophil</td>
<td>88%</td>
</tr>
<tr>
<td>Tbil</td>
<td>1.9 mg/dL</td>
<td>lymphocyte</td>
<td>4%</td>
</tr>
<tr>
<td>AST</td>
<td>21 IU/L</td>
<td>eosinophil</td>
<td>0%</td>
</tr>
<tr>
<td>ALT</td>
<td>5 IU/L</td>
<td>basophil</td>
<td>0%</td>
</tr>
<tr>
<td>LDH</td>
<td>205 IU/L</td>
<td>monocyte</td>
<td>8%</td>
</tr>
<tr>
<td>ALP</td>
<td>575 IU/L</td>
<td>RBC</td>
<td>435 x 10^6/μL</td>
</tr>
<tr>
<td>CK</td>
<td>96 IU/L</td>
<td>Hb</td>
<td>13 g/dL</td>
</tr>
<tr>
<td>BUN</td>
<td>17.8 mg/dL</td>
<td>Ht</td>
<td>40%</td>
</tr>
<tr>
<td>Cre</td>
<td>1.0 mg/dL</td>
<td>Pht</td>
<td>14.7 x 10^6/μL</td>
</tr>
<tr>
<td>Na</td>
<td>130 mEq/L</td>
<td>NT-proBNP</td>
<td>3767 pg/mL</td>
</tr>
<tr>
<td>K</td>
<td>3.5 mEq/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cl</td>
<td>94 mEq/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRP</td>
<td>20.5 mg/dL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 2. Chest computed tomography (CT) findings. A, B: Day of admission. A CT image showing volume reduction due to fibrous change in the left upper lobe and encysted empyema in the left lower thoracic cavity. Consolidation (arrowhead) in the left lower lobe indicates pneumonia. C: Day 5 of hospitalization. A contrast-enhanced CT image showing encysted empyema penetrating into the parenchyma of the left lower lobe (arrow). D: Four months after discharge. A CT image showing remission of pneumonia and a slight decrease in the size of the empyema.

Table 2. Antibacterial Minimum Inhibitory Concentration Results for S. Houtenae (Susceptibility Testing and Isolate Identification Performed by Walk Away 40 Plus Automated Microbiology System; Beckman Coulter, Inc, Brea CA, USA).

<table>
<thead>
<tr>
<th>Antibacterial agent</th>
<th>Minimum Inhibitory Concentration (μg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>≥8 Sensitive</td>
</tr>
<tr>
<td>Ampicillin/Sulbactam</td>
<td>≥8/4 Sensitive</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>≥4 Sensitive</td>
</tr>
<tr>
<td>Cefditren pivoxil</td>
<td>NA</td>
</tr>
<tr>
<td>Cefepime</td>
<td>≥2 Sensitive</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>≥1 Sensitive</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>NA</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>≥2 Sensitive</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>≤0.5 Sensitive</td>
</tr>
<tr>
<td>Meropenem</td>
<td>≤1 Sensitive</td>
</tr>
<tr>
<td>Piperacillin/Tazobactam</td>
<td>≤16 Sensitive</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>≤2 Sensitive</td>
</tr>
<tr>
<td>Trimetoprim/Sulfamethoxazole</td>
<td>≤2/38 Sensitive</td>
</tr>
</tbody>
</table>

NA: Not available

cases due to the presence of thick pus and fibrous septa (7). Although extrapleural pneumonectomy may be considered, it is associated with a high incidence of postoperative complications, such as bronchopleural fistula and postoperative empyema (8, 9). Extrapleural pneumonectomy is performed only when absolutely necessary, and in carefully-selected patients. Moreover, due to underlying cardiovascular disorders, there was an increased risk for complications in this case if conservative treatment proved to be ineffective.

The optimal treatment of empyema due to Salmonella species has not yet been fully established. In Cohen et al.’s review of 36 cases of Salmonella empyema, which included 5 patients with prior structural abnormalities of the lungs or pleura, over 85% of the patients who were treated with chest tube or open surgical drainage survived; in contrast, only 60% (3 out of 5 patients) who received antibacterial agents alone survived (1). Regarding empirical treatment, third-generation cephalosporins or fluoroquinolones are initially recommended before antibiotic susceptibility testing is finalized (10). Although resistance towards antibacterial agents is increasing these days (11), the isolate in this case was sensitive to most of the antibiotics tested, including levofloxacin, which has the lowest minimum inhibitory concentration and wide bioavailability. The patient experienced no relapse following the completion of treatment. Previous case reports of S. houtenae infections involving other sites have also shown a good response to antibacterial agents (12-15). We thus believe that conservative treatment with antibacterial agents alone is sufficient for the effective treatment of S. houtenae infections.

The route of transmission in the present case was considered to be hematogenous dissemination via the intestinal
mucosa and settlement in chronic tuberculosis empyema. In addition, *S. houtenae* was also identified in sputum, bronchial lavage, and pleural fluid specimens. Pleural penetration may lead to pneumonia-like symptoms, while local structural abnormalities may cause turbulence of the blood flow, obstruction, and flow stasis, favoring bacterial localization and an impairment of host defense mechanisms (1, 16). With regard to the sterile blood culture, we believe that the administration of oral cefditoren pivoxil prior to admission may have suppressed bacteremia.

In conclusion, *S. houtenae*-induced empyema may occur in patients with underlying chronic tuberculous empyema. In this case, conservative treatment with antibacterial agents alone proved to be effective. Moreover, despite the successful completion of treatment, periodical multidisciplinary follow-up is mandatory in such cases.

The authors state that they have no Conflict of Interest (COI).

Acknowledgement

We thank the Infectious Disease Surveillance Center in the National Institute of Infectious Diseases, Japan for identifying our specimens. We are also grateful to Yano Masatoshi’s helpful contributions regarding bacterial knowledge.

References

5. Afridi FI, Farooqi BJ, Hussain A. Pleural Empyema due to *Salmo-

13. Ma JS, Chen PY, Lau YJ, et al. Brain abscess caused by *Salmo-


The Internal Medicine is an Open Access article distributed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License. To view the details of this license, please visit (https://creativecommons.org/licenses/by-nc-nd/4.0/).