Case report

Salmonella stanley ovarian abscess with endometrioma in a pregnant woman in the third trimester

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ABSTRACT

Ovarian abscesses infected with Salmonella species are a rare clinical occurrence. A 26-year-old woman at 36 weeks gestation presented with high fever, left lower abdominal pain, and diarrhea; she was referred to our hospital 5 days after a vaginal delivery. She was diagnosed with a left ovarian abscess and underwent abscess enucleation. According to the stool findings, we speculated that the abscess was infected with Salmonella species; appropriate antibiotics were administered after the positive identification of Salmonella stanley. This case highlights the importance of treating infections in pelvic abscesses appropriately to limit the effects on fertility.

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Introduction

A tubo-ovarian abscess is commonly associated with pelvic inflammatory disease (PID) and is one of the major complications of acute PID. It occurs in 10–15% of hospitalized women with PID [1]. Generally, tubo-ovarian abscess occurs secondary to salpingo-oophoritis. However, isolated ovarian abscesses without tubal involvement can occur as metastatic infections, especially as superinfected ovarian cysts [2]. We report a case of Salmonella stanley ovarian abscess without fallopian tube abscesses in a pregnant woman with endometrioma. Additionally, we reviewed previous reports of non-pregnant and pregnant women with Salmonella ovarian abscesses with superinfected endometriomas. Furthermore, we evaluated the relationships between Salmonella infections, preexisting endometriomas, and pregnancy. This report emphasizes the potential of ovarian cysts and endometriomas to become superinfected with Salmonella, especially in pregnant women, and underscores the importance of well-timed clinical and microbiological diagnoses to prevent later infertility.

Case

A 26-year-old Japanese woman, gravida 1, para 0, at 36 weeks gestation with an unremarkable prenatal course presented with high fever, shaking chills, left lower abdominal pain, and diarrhea; therefore, she was referred to our hospital 5 days after a vaginal delivery. She had been treated with cefmetazole 1 g every 12 h for 5 days at another hospital. She presented with nausea, greenish diarrhea (Fig. 1A), and one vomiting episode along with the abovementioned symptoms at our hospital. She had no history of traveling abroad or contact with improperly handled foods or animals during pregnancy and fertility treatments. She had no known allergies and had not been prescribed any recent medications.

She was alert, and her vital signs were: body temperature, 39.3°C; blood pressure, 123/73 mmHg; heart rate, 94 beats/minute; respiratory rate, 20 breaths/minute; and percutaneous oxygen saturation, 98% on room air. Physical examination showed hypoactive bowel sounds on auscultation and abdominal tenderness mainly in the lower abdomen. Other examinations were unremarkable. Laboratory findings were: total protein, 5.5 g/dL; albumin, 1.8 g/dL; alanine aminotransferase, 5 IU/L; aspartate aminotransferase, 10 IU/L; lactate dehydrogenase, 122 IU/L; blood urea nitrogen, 7 mg/dL; creatinine, 0.51 mg/dL; C-reactive protein, 18.88 mg/dL; white blood cell count, 10,700/μL with 88.8% neutrophils; hemoglobin, 9.5 g/dL; and platelet count, 30.1 × 10^3/μL.

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Sonographic examination showed a left multicystic adnexal mass measuring 8 × 7.5 cm. Computed tomography (CT) and magnetic resonance imaging (MRI) showed a fluid collection in the pelvis and wall thickness and fluid collection in the small intestine (Fig. 1B, C). She was diagnosed with a left ovarian abscess with pelvic peritonitis and inflammation of the small intestine. Blood and stool cultures were taken, and intravenous ceftriaxone 1 g every 24 h and a single 2-g oral dose of azithromycin were administered. Subsequently, she underwent abdominal enucleation of the abscess with removal of the pelvic abscesses on day 4 post-admission. We found pelvic peritonitis with several abscesses; the bilateral fallopian tubes were intact. Cultures of the abscesses were positive for Salmonella species susceptible to ampicillin (minimum inhibitory concentration [MIC] ≤2 μg/mL), ceftriaxone (MIC ≤ 1 μg/mL), ciprofloxacin (MIC ≤ 0.06 μg/mL; susceptibility defined as MIC ≤ 0.06 μg/mL), and levofloxacin (MIC ≤ 0.06 μg/mL; susceptibility defined as MIC ≤ 0.12 μg/mL) according to E-tests (bioMérieux, Marcy l’Etoile, France) (Table 1). The VITEK II system (bioMérieux) indicated the Salmonella group, while S. enterica subsp. enterica was identified by 16S rRNA gene sequencing. Isolate serotyping was performed by latex agglutination using mono- and poly-valent anti-sera for O and H antigens according to the Kauffman-White scheme. The serovar was determined to be S. stanley (O4:d:1,2). Blood and stool cultures were negative. Pathology of the left ovary revealed endometrioma with acute inflammation and abscess. She was treated with ceftriaxone for 7 days followed by oral levofloxacin 500 mg daily for 3 weeks postoperatively according to the susceptibility test (Fig. 2). Consequently, the abscess was no longer visible on CT, and the patient has remained well.

**Discussion**

This report highlights the potential of ovarian cysts and endometriomas to become superinfected with Salmonella in pregnant women and the importance of timely clinical and microbiological diagnoses to prevent later infertility.

Salmonella-infected ovarian abscesses are rare. However, Salmonella species can cause extraintestinal infections that may not be suspected in the setting of mild primary infection. Extraintestinal infections include orthopedic infections, endovascular infections, visceral abscesses of any organ, and ovarian endometriomas superinfection (as in our case). Nine English-language reports including pathologically diagnosed superinfected ovarian endometriomas caused by Salmonella infection have been published since 1963 [2–10]. These reports, plus this case, are summarized in Table 2. Blood cultures were positive in only

**Table 1**

Antimicrobial susceptibility test results.

| Salmonella stanley | Antimicrobial agents | MIC (μg/mL) | Interpretation of susceptibility |
|---------------------|----------------------|-------------|----------------------------------|
| Ampicillin          | ≤2                   | S           |
| Sulbactam/ampicillin| ≤2                   | S           |
| Cefazolin           | ≤4                   | R           |
| Cefotiam            | ≤8                   | R           |
| Cefmetazole         | ≤1                   | R           |
| Cefotaxime          | ≤1                   | S           |
| Ceftriaxone         | ≤1                   | S           |
| Cefadizime          | ≤1                   | S           |
| Cefepime            | ≤1                   | S           |
| Imipenem/cilastatin| ≤0.25                | S           |
| Meropenem           | ≤0.25                | S           |
| Gentamicin          | ≤1                   | R           |
| Amikamycin          | ≤2                   | R           |
| Sulfamethoxazole/trimethoprim | ≤1/19 | S |
| Nalidixic acid*     | ≤0.06                | S           |
| Ciprofloxacin       | ≤0.06                | S           |
| Levofloxacin        | ≤0.06                | S           |

*Interpreted according to the disk method. MIC, minimum inhibitory concentration; S, susceptible; R, resistant.
3 (30 \%) of 10 patients. Generally, *Salmonella* infections can cause isolated ovarian abscesses without tubal involvement as metastatic infections. Therefore, we cannot exclude *Salmonella* extraintestinal infections based on negative blood cultures. Furthermore, *Salmonella* ovarian abscesses are presumed to result in hematogenous spread to endometriomas or ovarian cysts, including dermoid cysts and teratomas [11]. However, only 2 (20 \%) of 10 patients were diagnosed with endometriomas before admission. Thus, diagnostic imaging (e.g., ultrasonography, CT, and MRI) is needed to diagnose superinfected ovarian cysts, including endometriomas. Here, it was probable that the patient had an undiagnosed preexisting ovarian endometrioma that predisposed her to *S. stenley* multiplication via the bloodstream following transient and undetected bacteremia.

*Salmonella* gastroenteritis can cause greenish diarrhea and usually results from contact with improperly handled food. It can also be acquired via the fecal-oral route between humans and animals. However, few cases of *Salmonella* infections associated with improperly handled foods or close contact with animals have been reported. Only the cases of one patient with a history of consuming a takeaway meal [4] and another with a history of exposure to camels [2] have been published. Hence, we cannot exclude *Salmonella* infections based on a history that does not include improperly handled foods or close contact with animals. Here, we speculated that the patient had *Salmonella* superinfection of the left endometrioma according to the presentation of greenish diarrhea and preoperative CT findings, despite negative blood and stool cultures and no history of contact with improperly handled foods or animals. Additionally, we surmised that the preceding cefmetazole administration at another hospital partially accounted for the negative blood and stool culture results. Although cephemycins, including cefmetazole, may be microbiologically active (MIC ≤ 1 μg/mL here), they are not clinically effective according to the Clinical and Laboratory Standards Institute criteria [12]. Furthermore, stool cultures were positive in only two (22 \%) of nine patients (Table 2), indicating that we cannot exclude *Salmonella* extraintestinal infections based on negative stool cultures with or without preceding antibiotic administration. Symptom frequency in the previous reports was as follows: fever (70 \%), lower abdominal pain (60 \%), diarrhea (60 \%), and nausea or vomiting episodes (20 \%) (Table 2). These symptoms may indicate adnexal infections; however, they are not specific to ovarian abscesses (e.g., pyelonephritis). Etiologies of ovarian abscesses have been reported as direct contamination by fine-needle aspiration [13], hematogenous bacterial spread from a urinary tract infection [14], and association with a gastrointestinal *Salmonella* infection [3,4]. Our patient’s symptoms started with abdominal pain, greenish diarrhea, and high fever, and CT revealed enteritis. Thus, we speculated that the small intestine was the most plausible infection source.

The salmonellosis rate in pregnant women is the same as that in the general population (i.e., 0.2 \%) [15]. However, *Salmonella* species can cause more severe infections in older people, infants, those with human immunodeficiency virus infection, those undergoing treatment with immunosuppressive agents, patients with malignancy, organ transplant recipients, or pregnant women [15]. During pregnancy, the immune system must protect itself without rejecting foreign paternal antigens. The immune system resolves this dilemma by altering the Th1/Th2 cytokine level to Th2 cytokine dominance [16], which protects the fetus from the Th1-mediated immune system at the fetal-maternal interface. Nevertheless, this also makes pregnant women susceptible to *Salmonella* infections because it is an intracellular pathogen and its immunity is Th1 dependent [16].

Three reports of *Salmonella* ovarian abscesses in pregnant women [17–19] plus this case are summarized in Table 3. All patients had ovarian abscesses in the third trimester, and two patients had been diagnosed with dermoid cysts before admission. It is unclear why all the patients had *Salmonella* ovarian abscesses in the third trimester. Generally, immune system modulation during pregnancy contributes to differential responses that depend on both microorganisms and the pregnancy stage. These findings indicate the tendency of *Salmonella* spp. to cause ovarian abscesses in pregnant women in the third trimester (as with *Listeria monocytogenes*) [20]. The symptom frequency in the patients with *Salmonella* ovarian abscess was fever (75 \%), lower abdominal pain (75 \%), diarrhea (75 \%), and nausea or vomiting episodes (50 \%). Blood cultures were positive in one (25 \%) of four patients. In this review, the percentage of positive blood cultures in pregnant women with *Salmonella* ovarian abscesses was low, similar to that in patients with *Salmonella* ovarian abscesses with preexisting endometriomas (25 \% vs. 30 \%). Regarding serotypes,
Table 2
Superinfection of endometriomas.

| Authors           | Age (years) | Comorbidity | Location | Preceding symptoms                                      | Positive blood cultures | Positive stool cultures | Pathogens                  | Tubal involvement | Pregnancy | Size (cm) | Antibiotic used | Antibiotic duration (days) | Outcome |
|-------------------|-------------|-------------|----------|----------------------------------------------------------|--------------------------|-------------------------|--------------------------|------------------|-----------|-----------|----------------|-----------------------------|---------|
| Adelman et al. [2] | 28          | None        | USA      | Diarrhea, abdominal pain, fever, anorexia                | Positive                 | Positive                | S. schwarzengrund          | None             | No        | 12        | Ciprofloxacin               | 14               | A       |
| Magliulo et al. [3] | 30          | None        | Italy    | Abdominal pain, fever                                   | Negative                 | Negative                | S. brandenburg             | None             | No        | 11        | Chloramphenicol             | 10               | A       |
| Ghose et al. [4]  | 28          | None        | UK       | Bloody diarrhea, abdominal pain, vaginal bleeding       | Negative (positive after surgery) | Negative                  | Salmonella spp.               | None             | No        | 10 × 8 × 3 | Amoxicillin Metronidazole | 19               | A       |
| Kemmann et al. [5] | 26          | Endometrioma | Canada   | None                                                     | Negative                 | Negative                | S. enteritidis (blood, stool)/S. typhimurium (pus) | Yes              | No        | 7         | Ciprofloxacin               | 14               | A       |
| Li and Cohen [6]  | 31          | SLE         | Hong Kong | None                                                     | Positive                 | Positive                | S. enteritidis             | None             | No        | 8.5 × 7.8  | Ofloxacin                   | 11               | A       |
| Burgmans et al. [7] | 16          | None        | Netherlands | Abdominal pain, fever, headache, fatigue, productive cough | Negative                 | Negative                | S. enteritidis             | None             | No        | 25 × 20    | Amoxicillin Ceftriaxone     | 35               | A       |
| Wang et al. [8]    | 43          | None        | Taiwan   | Abdominal fullness, nausea, vomiting, diarrhea, fever, fever | Positive                | NA                      | S. enteritidis             | None             | No        | 8 × 4      | Cefuroxime Metronidazole Ceftriaxone | 7        | A       |
| Thaneemalai et al. [9] | 38      | Endometrioma | Kuala Lumpur | Fever, diarrhea, vaginal discharge, Fever, abdominal pain, bloody diarrhea | Negative                 | Negative                | S. enteritidis             | Yes              | No        | 15        | Ceftriaxone Metronidazole Ceftriaxone | 42        | A       |
| Sharma et al. [10] | 19          | None        | Nepal    | Diarrhea, abdominal pain, fever, anorexia                | Positive                 | Positive                | S. schwarzengrund          | Yes              | No        | 12        | Ciprofloxacin Metronidazole Ceftriaxone Azithromycin | 14        | A       |
| This case         | 26          | None        | Japan    | Diarrhea, abdominal pain, fever, anorexia                | Negative                 | Negative                | S. stanley                 | No               | 36        | 8         | Ceftriaxone Azithromycin    | 32               | A       |

SLE, systemic lupus erythematosus; NA, not applicable; A, alive; UK, United Kingdom; USA, United States of America.

Table 3
Ovarian abscesses in pregnant women.

| Authors                        | Age (years) | Comorbidity | Location     | Preceding symptoms                                     | Positive blood cultures | Positive stool cultures | Pathogens              | Tubal involvement | Gestational weeks | Size (cm) | Antibiotic used           | Antibiotic duration (days) | Outcome |
|--------------------------------|-------------|-------------|--------------|---------------------------------------------------------|--------------------------|-------------------------|------------------------|------------------|------------------|-----------|--------------------------|-----------------------------|---------|
| Brelje and Garcia-Bunuel [17]  | 26          | Dermoid cyst (infected) | USA | Increased urinary frequency, nocturia, Weight loss, anorexia, malaise, abdominal pain, vomiting, diarrhea, fever | Negative                 | Negative                | S. montevideo          | Yes              | 33               | 16 × 12 × 12 | Penicillin Terramycin Co-trimoxazole Metronidazole | 12              | A       |
| Nuttall et al. [18]            | 23          | Dermoid cyst (infected) | India | Diarrhea, abdominal pain, fever, anorexia                | Positive                 | Positive                | S. typhi               | Yes              | 32               | 20        | Ciprofloxacin Metronidazole Ceftriaxone Azithromycin | 49              | A       |
| Sharma et al. [19]             | 19          | None        | Nepal       | Diarrhea, abdominal pain, fever, anorexia                | Positive                 | Positive                | S. schwarzengrund      | Yes              | 37               | 12        | Ciprofloxacin Metronidazole Ceftriaxone Azithromycin | 14              | A       |
| This case                      | 26          | None        | Japan       | Diarrhea, abdominal pain, fever, anorexia                | Negative                 | Negative                | S. stanley             | No               | 36               | 8         | Ceftriaxone Azithromycin    | 32              | A       |

A, alive; USA, United States of America.
the most common serovar was Enteritidis, which was identified in 4 of 10 cases (40%) of Salmonella superinfections of ovarian endometriomas (Table 2). Contrasting, there have been no reports of S. stenley ovarian abscesses in pregnant women (Table 3). This is the first report of an S. stenley ovarian abscess without fallopian tube abscesses in a pregnant woman with endometrioma.

Another clinical issue of Salmonella ovarian abscesses in reproductive-age women should be considered. Regarding superinfected endometriomas caused by Salmonella species, three cases (30%) had tubal involvement (Table 2). Furthermore, regarding Salmonella ovarian abscesses in pregnant women, three of four cases (75%) had tubal involvement (Table 3). Both oophoritis and tubal involvement may cause later infertility.

A limitation of this study is that positive blood and stool findings were not proven despite repeated blood and stool cultures. The low rate of Salmonella ovarian abscesses with endometriomas in non-pregnant and pregnant women likely correlates with the low rate of positive blood and stool cultures. However, the involvement of Salmonella species can be suspected according to the clinical setting (e.g., a history of improperly handled foods or close contact with animals, preceding enteritis with greenish diarrhea, and preexisting ovarian cyst), although Salmonella ovarian abscesses are rare. Furthermore, Salmonella identification can be performed from bacterial cultures of abscesses in addition to blood and stool cultures because of a higher positivity rate. Appropriate antibiotic therapy for Salmonella infections, considering the potential for fluoroquinolone resistance extended-spectrum beta-lactamase production, is essential to limit the effects on later fertility.

In conclusion, clinicians should pay attention to Salmonella species involvement in superinfected ovarian cysts, particularly in pregnant women. Those especially those with oophoritis or tubal involvement, should be treated appropriately to prevent later infertility, considering that Salmonella species may be resistant to antibiotics.

Ethical approval

This study was approved by the institutional review board and ethics committee of Japanese Red Cross Ise Hospital (approval number: ER2020–27).

Consent for publication

Informed consent was obtained from the patient for publication of this case report and accompanying images.

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CRediT authorship contribution statement

Hirokazu Toyoshima: Conceptualization, Methodology, Data curation, Writing - original draft, Writing - review & editing, Visualization. Miki Hagimoto: Conceptualization, Methodology. Motoaki Tanigawa: Supervision. Hiroyuki Tanaka: Methodology. Yuki Nakashii: Methodology. Shigetoshi Sakabe: Supervision.

Declaration of Competing Interest

None.

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