A case of emphysematous pyelonephritis caused by the hypermucoviscosity phenotype of *Klebsiella pneumoniae*

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A 70-year-old woman presented to our hospital with 38.2 °C fever. She was diagnosed with high-risk emphysematous pyelonephritis caused by string test-positive *Klebsiella pneumoniae* and treated with multidisciplinary therapy. The patient developed pyogenic spondylitis during the course of the disease. This is the first reported case of emphysematous pyelonephritis caused by the hypermucoviscosity phenotype of *K. pneumoniae* and the second reported case of pyogenic spondylitis. The hypermucoviscosity phenotype of *K. pneumoniae* should be considered as an etiologic agent of emphysematous pyelonephritis.

1. Introduction

The hypermucoviscosity phenotype of *Klebsiella pneumoniae* has been reported frequently in Southeast Asia as a causative agent for invasive liver abscess syndrome that is refractory to liver abscesses. Further, there have been scattered reports of invasive liver abscesses that have not led to liver abscesses.

However, the cause of emphysematous pyelonephritis has not yet been reported. Herein, we report a case of emphysematous pyelonephritis caused by the hypermucoviscosity phenotype of *K. pneumoniae*.

2. Case presentation

A 70-year-old woman with a history of hypertension and type 2 diabetes presented to our hospital with a chief complaint of fever for 5 days. Her heart rate was 110 beats/min, her respiratory rate was 35 breaths/min, and her body temperature was 38.2 °C. Physical examination revealed left lower back pain. The white blood cell count was 21.8 × 10^9/μL, platelet count was 5.1 × 10^9/μL, blood glucose was 818 mg/dL, hemoglobin A1c level was 9.4%, creatinine level was 3.21 mg/dL, and C-reactive protein level was 26.56 mg/dL. Computed tomography (CT) showed extensive air in the perirenal space, and a diagnosis of class 3A emphysematous pyelonephritis was determined (Fig. 1). The patient was admitted to the high-care unit and started on meropenem 2 g/day with strict glycemic control. On day 6 after admission, a 10-Fr Malecot catheter (Create medic Co., Ltd Kanagawa, Japan) was inserted into the left renal cortex for drainage. Blood and urine cultures submitted at admission were positive for the string test.

Genetic testing revealed magA (−) and rmpA (−). After descaling to cefmetazole sodium (2 g/day), the initially-improving inflammatory findings worsened. On the 9th day after admission, the patient was anuric, and her respiratory condition worsened, resulting in 27 days of continuous hemodiaphilization and 66 days of ventilatory management. As her symptoms worsened, she was treated with meropenem 2 g/day, levofloxacin 500 mg/day, and rifampicin 450 mg/day. Although blood sample data showed improvement, the patient complained of back pain, and on day 39 after admission, a CT scan revealed a new complication of pyogenic spondylitis at L4/5 (Fig. 2). The patient was treated conservatively; a 12-Fr Malecot catheter was inserted on day 47 after admission, replacing the existing catheter, and the Malecot catheter was removed on day 89 after admission. The patient was started on cefazolin 750 mg/day alone on day 97 after admission and was discharged for further treatment.

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**Abbreviations**
- CT, computed tomography.
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3. Discussion

We encountered a case of emphysematous pyelonephritis with string test-positive *K. pneumoniae* as the etiologic agent, which was severely complicated by pyogenic spondylitis.

On the day of admission, urine and blood cultures revealed string test-positive *K. pneumoniae*. Although *Escherichia coli* and *K. pneumoniae* are the most common causative organisms of emphysematous pyelonephritis, no case of string test-positive *K. pneumoniae* has been reported. Genetic testing showed *magA(-)* and *rmpA(-)*. The patient had thrombocytopenia, acute renal failure, impaired consciousness, and shock, all of which are high-risk factors. The patient also did not present with a liver abscess, suggesting that invasive pneumonia may be a subtype of systemic disease, as proposed by Suzuki et al.  

This is the second reported case of pyogenic spondylitis; the first was reported by Suzuki et al. *Staphylococcus aureus* is the most common cause of pyogenic spondylitis. In this case, conservative treatment may have led to a hematogenous infection of the spine. It is unclear whether early nephrectomy improves this condition. Invasive liver abscess syndrome has been observed to spread sequentially to other parts of the body, including the lungs, central nervous system, bone and cartilage tissues, and eyes, and this case seems to have followed a similar course.  

In summary, two notable points can be learned from this case. First, string test-positive *K. pneumoniae* can cause emphysematous pyelonephritis, and second, pyogenic spondylitis can also occur secondary to emphysematous pyelonephritis.

4. Conclusion

Emphysematous pyelonephritis can be caused by string test-positive *K. pneumoniae* and can also be secondary to pyogenic spondylitis. In addition to imaging and risk assessment, the organisms that cause emphysematous pyelonephritis should also be noted. We hope that more cases are reported in the future, and that a treatment method will be
Consent

Written informed consent was obtained from the patient for the publication of this case report.

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Data statement

Data are available from the corresponding author upon request.

Declaration of competing interest

None.

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