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Klebsiella Pneumoniae St48: A Case Of Invasive Renal Abscess And Pan Ophthalmitis In A Diabetic Patient

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Abstract

Klebsiella pneumoniae is a ubiquitous opportunistic pathogen that causes disseminated infections especially in the immunocompromised population. We present a case of a 50-year-old diabetic female who developed a severe, invasive K. pneumoniae infection, manifesting as a renal abscess complicated by pan ophthalmitis. Blood culture identified K. pneumoniae sequence type 48 (ST48), a non-hypervirulent strain based on whole-genome sequencing which revealed the absence of key siderophores such as colibactin, salmochelin, and aerobactin, despite the presence of capsular type of KL62. Despite aggressive antibiotic therapy tailored to susceptibility, the patient's condition deteriorated, ultimately leading to mortality due to cardiac complications possibly attributed to infection. This case highlights that even non-hypervirulent K. pneumoniae strains can cause severe, metastatic infections with poor outcomes in immunocompromised individuals, underscoring the need for heightened clinical suspicion and prompt management in such populations.

Keywords: Klebsiella pneumoniae, ST 48, renal abscess, pan ophthalmitis, non-hypervirulent.

Introduction

Klebsiella pneumoniae is a Gram-negative bacterium commonly found in the human gastrointestinal and respiratory microbiota. It is a well-established cause of pyogenic infections, including liver abscesses, renal abscesses, and endophthalmitis, particularly in immunocompromised hosts such as those with diabetes mellitus or chronic obstructive pulmonary disease (COPD) **[1, 2]**. The pathogenicity of K. pneumoniae is often attributed to various virulence factors, notably specific capsular serotypes that confer hypermucoviscosity **[3]**.

Klebsiella pneumoniae Invasive Syndrome (KPIS), a rare but increasingly recognized entity, is characterized by invasive, multi-organ infection **[4]**. While K. pneumoniae liver abscess with widespread metastatic spread is frequently reported, particularly in Southeast Asia, cases of renal abscess with metastatic complications are considerably less common **[5]**. Highly virulent Klebsiella pneumoniae (HVKP) strains have emerged as significant culprits in endogenous endophthalmitis, leading to severe and invasive infections **[9]**. However, published case reports detailing metastatic infections, especially endogenous endophthalmitis, caused by non-hypervirulent K. pneumoniae strains are scarce, with the existing literature primarily linking such severe disseminated infections to hypervirulent strains.

Herein, we describe a rare case of K. pneumoniae bacteraemia originating from a renal abscess and progressing to pan ophthalmitis, caused by a non-hypervirulent strain (sequence type 48) in a diabetic patient. This case contributes to the limited understanding of the clinical implications of non-hypervirulent K. pneumoniae in severe, disseminated infections.

Case History

A 50-year-old female patient with a history of variably controlled diabetes mellitus presented with a 5-day history of high-grade fever and generalized malaise, followed by a 1-day history of redness and reduced vision in her right eye. She denied any recent respiratory, gastrointestinal, or urinary symptoms and reported no neurological deficits other than the ocular manifestations. There was no history of recent travel, significant environmental exposures, or other risk factors for immunosuppression.

On admission, her vital signs were stable. Physical examination of the cardiovascular, respiratory, and abdominal systems was

unremarkable. She was conscious and alert (Glasgow Coma Score 15/15), and a neurological assessment revealed no focal deficits, except for reduced visual acuity and a relative afferent pupillary defect in the right eye. Initial laboratory investigations showed neutrophil leukocytosis, elevated C-reactive protein (CRP), and a high erythrocyte sedimentation rate (ESR). Renal and liver function tests were within normal limits.

Blood cultures obtained upon admission yielded Gram-negative bacilli, subsequently identified as Klebsiella pneumoniae. Susceptibility testing indicated sensitivity to all tested antibiotics except ampicillin. Despite the absence of reported urinary symptoms, urine culture was positive for >105 colony-forming units of coliform bacilli with an antibiotic sensitivity pattern identical to the blood isolate. Intravenous cefotaxime 1g every eight hours was initiated.

An ophthalmology consultation led to a diagnosis of right-sided endophthalmitis, which rapidly progressed to pan ophthalmitis within days. Initial ultrasound imaging revealed a left-sided perinephric abscess. Due to an unsatisfactory clinical response to treatment, a contrast-enhanced computed tomography (CT) scan of the orbit, chest, abdomen, and pelvis was performed. The CT scan identified an ill-defined, heterogeneously enhancing lesion measuring 4.7×4×4.7 cm in the superior aspect of the left kidney, without associated hydronephrosis or hydroureter. No other significant intra-abdominal pathology was noted. Transthoracic and transesophageal echocardiography did not reveal features of infective endocarditis but did show moderately reduced left ventricular function with global hypokinesia, attributed to possible infection-induced myocardial dysfunction on a background of ischemic cardiomyopathy due to her poorly controlled diabetes mellitus. Given the exclusion of other potential foci, the renal abscess was considered the primary source of infection, leading to the addition of intravenous ciprofloxacin to the antibiotic regimen for two weeks. A subsequent ophthalmological review indicated non-progression of the pan ophthalmitis, and medical management was continued without evisceration. A follow-up ultrasound examination two weeks after the initial CT scan showed an increase in the size of the left renal lesion to 6.1×11.2×5 cm; however, the collection was not amenable to aspiration. Intravenous cefotaxime was continued for a total of 25 days. Given clinical stability and a poor response with IV cefotaxime, the patient was transitioned to oral minocycline for outpatient follow-up. Unfortunately, the patient was readmitted two weeks post-discharge with an acute onset of dyspnea in the context of existing heart failure and expired secondary to severe heart failure following a myocardial infarction. Whole genome sequencing of the Klebsiella pneumoniae isolate confirmed a capsular type of KL62 and a sequence type of ST48, indicating a non-hypervirulent strain lacking colibactin, aerobactin, and salmochelin.

Discussion

This case highlights the importance of considering Klebsiella pneumoniae abscess in the differential diagnosis for patients presenting with multi-organ pathology suggestive of septic or embolic phenomena. While Klebsiella liver abscess with septic emboli is well-documented, reports of K. pneumoniae renal abscess with septic emboli are considerably rare **[5]**. The insidious onset of perinephric/renal abscesses often complicates timely diagnosis, potentially leading to severe consequences if treatment is delayed. Such complications can extend to the peritoneal cavity, skin, chest, and ocular structures. Consequently, in cases of diagnosed endogenous Klebsiella pneumoniae endophthalmitis (EKE), a concurrent renal or perinephric abscess should be considered a potential infectious source, and vice versa **[6]**.

In East Asian countries, Gram-negative bacilli, particularly K. pneumoniae and Escherichia coli, are frequently implicated in cases of endogenous bacterial endophthalmitis (EBE), with reported frequencies ranging from 22.2% to 77.1%. Notably, Klebsiella species emerge as the predominant causative organism, accounting for 31.7% to 87.6% of cases **[7]**. Endogenous endophthalmitis (EE) is a critical eye condition that poses a significant threat to vision and can even be life-threatening **[8]**. It occurs when an infection spreads from another part of the body through the bloodstream to the eye, traversing the blood-ocular barrier. EE accounts for only 2% to 8% of all endophthalmitis cases. Unfortunately, most individuals with EE experience poor visual outcomes, often due to delayed diagnosis or the virulence of the causative organism **[9]**.

The virulence of K. pneumoniae is partly attributed to its polysaccharide capsule. Certain serotypes, notably K1 or K2, exhibit enhanced resistance to phagocytosis by neutrophils **[10]**. K. pneumoniae serotype K1 has been strongly linked to liver abscesses and subsequent complications such as endophthalmitis and meningitis, particularly in diabetic patients. Key virulence factors, including K1 and K2 capsular serotypes, the hypermucoviscosity phenotype, and aerobactin production, are critical in the development of a distinct invasive syndrome observed in patients with K. pneumoniae bloodstream infections **[6]**. A study investigating virulence factors in hypervirulent Klebsiella pneumoniae (hvKP) identified common capsular serotypes as K1, K2, K5, K16, K20, K54, K57, and KN1, whereas for multidrug-resistant hvKP (MDR-hvKP), frequently observed capsular serotypes include K1, K2, K16, K20, K54, K62, K64, and K47. Furthermore, both hvKP and MDR-hvKP commonly produce siderophores such as enterobactin, yersiniabactin, salmochelin, and aerobactin **[11]**.

Despite its severe clinical presentation, our specific isolate, even with the presence of capsular serotype 62, demonstrated sensitivity to a broad range of tested antibiotics. While yersiniabactin production was noted, the lack of other key siderophores like colibactin, salmochelin, and aerobactin indicates a reduced pathogenic potential, suggesting

this strain is less virulent compared to traditional hypervirulent strains. Unfortunately, current literature offers limited information regarding the characteristics and clinical implications of Klebsiella pneumoniae sequence type 48.

Evidence indicates that systemic administration of a third-generation cephalosporin or a fluoroquinolone plays a major role in managing endogenous endophthalmitis due to Gram-negative organisms **[7, 12]**. For cases involving diffuse posterior infection or continued clinical worsening despite one to two days of maximal intravenous antibiotic therapy, direct intravitreal injection of antibiotics may be considered. Vitrectomy, along with potential evisceration or enucleation of the infected globe, is reserved for patients experiencing intractable ocular pain or uncontrolled infection **[12]**.

Despite receiving appropriate treatment and the Klebsiella pneumoniae isolate being less virulent than hypervirulent strains, the patient's overall clinical outcome, including improvement in vision and the size of the renal abscess, was not satisfactory.

Conclusion

This case highlights the complexities of managing Klebsiella pneumoniae infections, particularly those with metastatic potential like renal abscesses complicated by pan ophthalmitis. While Klebsiella pneumoniae invasive syndrome (KPIS) is well-documented, this case underscores the rarity of renal abscess with septic emboli. Despite our specific ST48 isolate demonstrating broad antibiotic sensitivity and a non-hypervirulent profile based on siderophore analysis, the patient's clinical outcome was unfortunately unfavorable. This suggests that even less virulent strains of K. pneumoniae can lead to severe, unfavorable outcomes, especially in immunocompromised individuals like those with diabetes. This case emphasizes the critical need for prompt diagnosis and aggressive management of K. pneumoniae infections, considering the potential for widespread metastatic complications even in the absence of traditional hypervirulence factors. Further research into the characteristics and pathogenicity of Klebsiella pneumoniae sequence type 48 is crucial to better understand its clinical implications and guide future therapeutic strategies.

Conflicts Of Interest: None to declare.

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