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**Peribacillus simplex and Klebsiella pneumoniae responsible for Pyonephrosis with
Secondary Psoas Abscess: A Case Report**

--Manuscript Draft--

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1 *Peribacillus simplex* and *Klebsiella pneumoniae* Responsible for
2 Pyonephrosis with Secondary Psoas Abscess: A Case Report

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8 **Keywords:** Pyonephrosis, Psoas Abscess, *Peribacillus simplex*

9 **Abstract**

10 Bacterial urinary tract infections (UTIs) are common, ranging from benign cystitis to complicated
11 pyelonephritis, which can lead to severe complications such as pyonephrosis and sepsis. Pyonephrosis,
12 characterized by the presence of pus in the renal cavities, often requires urgent urological intervention.
13 We report a unique case of pyonephrosis with a psoas abscess caused by *Klebsiella pneumoniae* (*K.*
14 *pneumoniae*) and *Peribacillus simplex* (*P. simplex*) in a 64-year-old diabetic female patient. This is the
15 first case of pyonephrosis caused by *P. simplex*. The patient presented with acute right lumbar pain,
16 fever, and altered consciousness. Imaging revealed severe right hydronephrosis, pyonephrosis, and a
17 perirenal phlegmon infiltrating the psoas with abscesses. Surgical drainage and nephrectomy were
18 performed. Microbiological and proteomic analysis identified *K. pneumoniae* and *P. simplex*. This case
19 highlights the importance of considering environmental bacteria like *P. simplex* in severe infections and
20 ensuring rigorous protocols to avoid contamination. Successful management of pyonephrosis relies on
prompt surgical drainage and appropriate antibiotic therapy based on culture results.

21 **Data Summary**

22 No data were reused or generated in this study

23 **Introduction**

24 Bacterial urinary tract infections (UTIs) are a frequent cause of community and healthcare-associated
25 infections. These heterogeneous conditions can range from simple benign acute cystitis or pyelonephritis
26 to complicated acute pyelonephritis facilitated by underlying conditions. Complications can include
27 abscess formation progressing to pyonephrosis, hematogenous or contiguous dissemination potentially
28 leading to sepsis with secondary foci, or even septic shock, threatening the patient's life.

29 Pyonephrosis is defined as the presence of a purulent collection in the renal cavities with partial or total
30 destruction of the renal parenchyma associated with significant perinephritis (1). It is a rare urological
31 emergency in adults, where the variability of clinical signs makes diagnosis even more challenging (2).
32 The etiology is primarily bacterial, with the most commonly implicated pathogens being enterobacteria,
33 mainly *Escherichia coli* and *Klebsiella pneumoniae* (3).

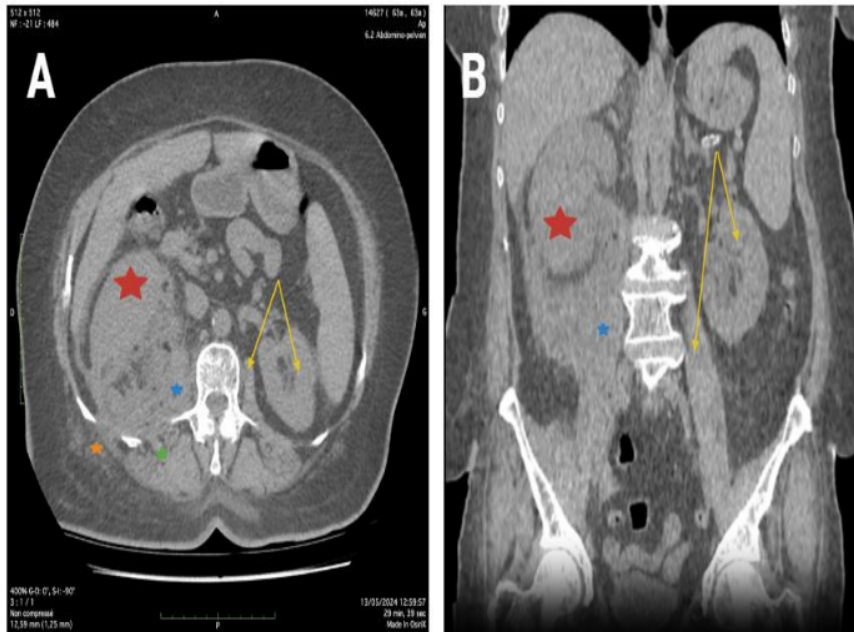
34 We report a unique case of pyonephrosis with a secondary psoas abscess due to a strain of *Klebsiella*
35 *pneumoniae* associated with a strain of *Peribacillus simplex* in a 64-year-old diabetic female patient. To
36 our knowledge, this is the first published case of pyonephrosis due to *P. simplex* and the third case of *P.*
37 *simplex* infection in the world.

38 **Case Report**

39 The patient is a 64-year-old woman with a medical history of poorly controlled type II diabetes under
40 oral antidiabetics. She presented to our facility with sudden onset of intense acute right lumbar pain,
41 fever, and altered consciousness. Initial clinical examination revealed tachycardia and polypnea.

42 Emergency biological workup showed a significant increase in CRP, hyperleukocytosis, and
43 inflammatory anemia. Renal assessment revealed elevated creatinine levels and decreased glomerular
44 filtration rate.

45 Imaging studies were rapidly initiated to determine the nature of the lesions and assess their extent.
46 Renal and bladder ultrasound revealed severe unilateral right uretero-hydronephrosis, pyonephrosis, and
47 bladder lithiasis. An abdominal-pelvic CT scan without and with contrast (Figure 1) showed findings
48 consistent with right pyelo-ureteritis complicated by pyonephrosis and a significant perirenal phlegmon
49 infiltrating the homolateral psoas muscle with two abscesses within the muscles of the posterior
50 abdominal wall and right paravertebral muscles.



51

10

52 *Figure 1 : Axial (A) and coronal (B) views of a CT scan showing a destroyed right kidney (red star)*
 53 *with disappearance of the pyelocaliceal cavities (pyonephrosis) and perirenal phlegmon extending to*
 54 *the psoas muscle (blue star), the paravertebral muscles (green star), and the muscles of the posterior*
 55 *abdominal wall through the intercostal spaces (orange star). For comparison, the yellow arrow*
 56 *represents the non-infiltrated contralateral left side (kidney and psoas muscle).*

57 Given this scenario of purulent retention in the pyelocaliceal cavities, surgical drainage of the renal
 58 cavities was deemed necessary before performing a nephrectomy. A 3 cm lumbar incision was made.
 59 Dissection proceeded to the abscess cavity in the retroperitoneal space, crossing the psoas muscle where
 60 the abscess was drained using a Redon drain through a counter-incision in the right flank. The pus
 61 collected was immediately sent to the laboratory for cytobacteriological analysis. In addition, one set of
 62 blood cultures in aerobic and anaerobic media was performed.

63 Direct examination of the pus with Gram staining showed altered polymorphonuclear cells associated
 64 with a polymorphic bacterial flora consisting of numerous Gram-negative and Gram-positive bacilli.
 65 The pus was inoculated into brain-heart infusion (BHI) broth, blood agar, and chocolate agar Polyvitex
 66 incubated under a CO₂-enriched atmosphere. Additionally, blood agar supplemented with inhibitors
 67 (nalidixic acid-colistin NAC) and Schaedler agar were inoculated and incubated in an anaerobic jar with
 68 an anaerobic generator system. Aerobic cultures were observed every 24 hours, while anaerobic cultures
 69 were observed every 48 hours. The BHI broth was subcultured after 24 hours of incubation onto NAC
 70 blood agar and chocolate agar incubated under the same conditions.

71 After 24 hours of incubation, a bimorphic culture of large, white, shiny, mucoid colonies and small, dry,
72 whitish colonies was observed on aerobic media. Anaerobic cultures showed a monomorphic culture of
73 large, white, shiny, mucoid colonies. The same results were found on subcultures except for the NAC
74 agar incubated aerobically, which showed a monomorphic aspect with small, dry, whitish colonies.

75 The aerobic and anaerobic blood culture bottles became positive at 8 and 12 hours, respectively. The
76 direct Gram stain examination and the culture on blood agar supplemented with ANC and chocolate
77 agar with Polyvitex showed the same results as the pus sample.

78 Identification was performed using MALDI-TOF mass spectrometry. The large, white, shiny, mucoid
79 colonies corresponded to *K. pneumoniae*, while the small, dry colonies corresponded to *P. simplex*.

80 Antibiotic susceptibility testing was performed using the disk diffusion method according to CA-SFM
81 2023 recommendations. The *K. pneumoniae* strain produced an extended-spectrum beta-lactamase
82 (ESBL) conferring resistance to aminopenicillins and cephalosporins while remaining sensitive to
83 cephamycins, penicillin-inhibitor combinations, co-trimoxazole, carbapenems, and fluoroquinolones.
84 The *P. simplex* strain was broadly sensitive to tested antibiotics, with critical diameters for *Bacillus spp.*
85 being used for result interpretation. The strain was sensitive to carbapenems, linezolid, vancomycin,
86 norfloxacin, and sensitive at high exposure to ciprofloxacin and levofloxacin, but resistant to
87 erythromycin and clindamycin.

88 After drainage, the patient was treated empirically with ceftriaxone and amikacin for 72 hours.
89 Following the antibiogram results, the patient received high-dose levofloxacin, resulting in significant
90 clinical and biological improvement, including a decrease in inflammatory parameters and resolution of
91 sepsis signs. Clinical stabilization allowed the patient to be discharged with oral antibiotics to complete
92 a 14-day treatment course.

93 Discussion

94 The advent of new taxogenomic methods has led to the reclassification of many species and the
95 emergence of new genera. Previously classified within the genus *Bacillus* by Meyer and Gottheil (1901),
96 *P. simplex* has been described as an environmental organism found in soil (4,5). To date, two cases of *P.*
97 *simplex* infections have been reported: a wound infection (6) and a brain abscess (7). This study reports
98 the first case of pyonephrosis involving a strain of *P. simplex* and *K. pneumoniae*.

99 Pyonephrosis is an accumulation of pus in the renal parenchyma causing its obstruction. It is an
100 aggressive condition associated with intense and destructive renal inflammation accompanied by
101 potentially fatal septicemia. It primarily affects adults (70% of cases) with a mean age between 42 and
102 51 years, with a higher incidence in women, and most commonly affects the right kidney (3).

103 Like any abscess formation, pyonephrosis typically presents with fever, chills, and pain, notably in the
104 lumbar region or abdomen (flank) but can be asymptomatic (2). Urinary source bacteremia causes sepsis
105 signs, including hemodynamic instability, leukocytosis, inflammatory anemia, and renal failure (3).

106 The main risk factors are immunosuppression, urinary tract obstruction, and poorly controlled diabetes
107 (2,8). An obstruction cause, particularly kidney stones, is found in over 70% of cases (9).

108 The most common complication is peritonitis (2). The occurrence of a psoas abscess is rare (2). The
109 iliopsoas muscle is in close contact with the kidney, its vessels, and the ureter. This anatomical
110 relationship predisposes the iliopsoas to secondary abscesses from the extension of infection from
111 adjacent sites.

112 Radiological examinations are crucial for the immediate diagnosis and management of this pathology
113 and its complications, given that death can rapidly occur from septic shock.

114 Gram-negative bacteria are most commonly associated with this condition, particularly *Escherichia coli*
115 (30%) and *Klebsiella pneumoniae* (19%) (10).

116 *P. simplex* is a Gram-positive bacterium capable of sporulation with an aerobic metabolism (11). Some
117 *P. simplex* strains (N65.1 and N58.2) produce toxins capable of damaging immune cells by inhibiting
118 mitochondrial activity, as well as hemolytic and non-hemolytic toxins (6,12,13). Hemolysis releases
119 nutrients allowing the bacterium to survive and cause cellular damage, thus accessing deep tissues.
120 Although there is limited data in the literature describing the virulence of *P. simplex*, the cytotoxic
121 properties of these toxins must be considered in our patient's case. Currently, data on the antimicrobial
122 sensitivity of this organism are limited. Our strain showed isolated resistance to macrolides, unlike the
123 strain isolated in a wound infection that was sensitive to imipenem, clindamycin, and ciprofloxacin (6).

124 *K. pneumoniae*'s pathogenicity is due to numerous virulence factors allowing it to evade the immune
125 response (polysaccharide capsule), adhere to mucous membranes with biofilm formation (adhesins and
126 slime secretion), and induce toxic shock (LPS). A siderophore system ensures its survival in a hostile
127 environment through competitive iron capture (14). Multi-drug resistance, particularly through ESBL
128 and carbapenemase production, complicates therapeutic management.

129 The treatment of pyonephrosis involves surgery followed by targeted antibiotic therapy based on
130 antibiogram results. Surgical options include percutaneous pus drainage, retrograde ureteral drainage
131 with a double J stent, and in extreme cases, nephrectomy. In our case, right nephrectomy was necessary
132 due to irreversible loss of renal function.

133 **Conclusion**

134 The isolation of environmental bacteria in clinical samples requires rigorous evaluation to exclude
135 contamination. In our case, the sample came from a sterile site, and strict aseptic protocols during
136 collection and in the laboratory confirmed the partial responsibility of *Peribacillus simplex* in
137 pyonephrosis.

138 This case highlights the importance of considering environmental bacteria like *P. simplex* in severe
139 infections. Effective management of pyonephrosis relies on prompt surgical drainage combined with
140 targeted antibiotic therapy based on culture results.

141 **Author Contributions:** Conceptualization, Z.M. and M.C.; methodology, Z.M. and M.C.; validation,
142 Z.M. and M.C.; writing—original draft preparation, Z.M., T.A.; writing—review and editing, E.B.,
143 Y.B.L. and M.C.; supervision, M.C.; project administration, M.C. All authors have read and agreed to
144 the published version of the manuscript.”

145 **Institutional Review Board Statement:** The study was conducted in accordance with the Declara-
146 tion of Helsinki, and approved by the Ethics Committee of Mohammed V Military Teaching
147 Hospital/Faculty of Medicine and Pharmacy (protocol code 2894; date of approval : 24 June 2024).

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151 **Conflicts of Interest:** The authors declare no conflicts of interest.

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