Tricuspid Valve Infective Endocarditis Due to *Klebsiella pneumoniae* in Intravenous Drug User

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**Abstract**
Infective endocarditis is a high morbidity-mortality condition despite advancements in supportive care and medical therapy. One of the strongest risk factors is intravenous drug use, which has high prevalence in the Hawai’i population. *Klebsiella pneumoniae* is a rare but aggressive pathogen causing infective endocarditis. There is no strong evidence to guide management. We present a rare case of isolated tricuspid valve infective endocarditis due to *Klebsiella pneumoniae* in an intravenous drug user causing septic pulmonary emboli and multiple abscesses. The patient was managed with combined 6-week ceftriaxone and 2-week gentamicin together with early tricuspid valve repair.

**Keywords**
*Klebsiella pneumoniae*, tricuspid valve infective endocarditis, intravenous drug use

**Abbreviations and Acronyms**
CRP = C-reactive protein
CT = Computed tomography
ESR = Erythrocyte sedimentation rate
HIV = Human immunodeficiency virus
hvKP = Hypervirulent *Klebsiella pneumoniae*
IE = Infective endocarditis
IV = Intravenous
IVDU = Intravenous drug use
MRI = Magnetic resonance imaging
TEE = Transesophageal echocardiogram
WBC = White blood cell

**Introduction**
Despite advancements in medicine, infective endocarditis (IE) still causes a high rate of mortality and morbidity. Right-sided IE is less common than left-sided IE accounting for only 5%-10% of cases. However, it is strongly associated with intravenous drug use (IVDU), which is responsible for 50%-65% of tricuspid valve IE cases. The mortality and morbidity of IE depends on the type of pathogen, virulence factors, systemic complications, and the valve involved. About 5%-16% of patients with right-sided IE require surgical intervention.

*Klebsiella pneumoniae* is the second most common overall cause of gram-negative bloodstream infections after *Escherichia coli*. While the most common causative pathogen of IE is *Staphylococcus aureus*, *Klebsiella* species caused only 1.2% of cases of native valve endocarditis and up to 4.1% of cases of prosthetic valve endocarditis. This low rate of IE may be related to the poor adherence of *Klebsiella* species to cardiac valves compared to gram-positive and other gram-negative organisms. There is no guideline on management of patients with right-sided IE due to *Klebsiella pneumoniae*.

We present a case of *Klebsiella pneumoniae* IE of isolated native tricuspid valve with septic pulmonary emboli together with systemic abscesses including osteomyelitis, epidural abscess and prevertebral abscess in an intravenous drug user.

**Case Presentation**
A 55-year-old woman with intravenous heroin and methamphetamine abuse presented with a 1-week history of acute back pain, fever, chills, and productive cough with blood-tinged sputum. Vital signs on admission showed heart rate of 112 beats per minute and hypotension at 79/45 mmHg, but she responded well to fluid resuscitation. Physical examination showed tachycardia with pansystolic murmur grade 2. There was diffuse midline and paraspinal tenderness over the back. She had three ulcerative lesions in her right popliteal area measuring up to 1 cm in maximal diameter with purulent drainage. The right upper arm had a punctate area with easily expressed purulent drainage, which was painful, warm, and indurated. There was a sclerosed vein in the area. There were no stigmata of endocarditis.

Completed blood count showed leukocytosis [White blood cell (WBC) 13290 /μL] with neutrophil 85.7% and lymphocyte 8.3%. There was elevated C-reactive protein (CRP) at 32.3 mg/L (reference range 0-10 mg/L) and sedimentation rate (ESR) at 61 mm/hr (reference range 0-30 mm/hr). She had normal lactate acid level and a negative HIV Antibody/Antigen test. Chest radiography showed focal consolidation in the right middle lung (Figure 1). Computed tomography (CT) of the chest revealed ground-glass opacity and consolidation in the anterior segment of the right upper and middle lobe with associated cavitation concerning for necrotizing infection (Figure 2). Blood culture grew *Klebsiella pneumoniae* (in 2 of 2 sets) that was susceptible to ceftriaxone and was string test negative. Sputum culture grew 2 strains of *Klebsiella pneumoniae*, one with negative string test and the other with positive string test. Magnetic resonance imaging (MRI) of the spine showed C6-7 developing discitis osteomyelitis and L4-5 discitis osteomyelitis with 15 x 4 x 9 mm epidural abscess and surrounding phlegmon mildly effacing the ventral thecal sac and mildly narrowing the neural foramina. There was a paraspinal abscess extending from the abnormal L4-5 disc space associated with surrounding myositis and cellulitis (Figure 3). Transesophageal echocardiogram (TEE) found large mobile echogenic vegetation mass (1.94 x 1.79 cm) on the atrial and ventricular aspect of the tricuspid valve septal leaflet and subvalvular apparatus. There was mild tricuspid regurgitation (Figure 4).

The patient was empirically treated with vancomycin, cefepime and metronidazole. After culture results returned, antibiotics were changed to ceftriaxone and gentamicin. Repeated blood culture which was taken 5 days after empiric antibiotics
showed no growth. She had CT-guided left paraspinal abscess
drainage at L4-5, and 12 ml of bloody purulent material was
aspirated. Given multiple septic pulmonary embolism, a
cardiothoracic surgeon suggested the patient have valvular
repair surgery. She underwent tricuspid valve repair using 28
mm Carpentier-Edwards Physio tricuspid annuloplasty ring,
removal of vegetation, and partial resection of the posterior
leaflet. TEE after the procedure showed a well-seated tricuspid
valve annuloplasty ring with trace leak posteriorly. The tricuspid
vegetation showed 4+ white blood cells (WBC) but no growth
for aerobic, anaerobic and fungus which was not unexpected
given she was on antibiotics for 2 weeks before the surgery. The
patient completed 2 weeks course of gentamicin and 6 weeks of
ceftriaxone without further complication. At 6 weeks follow-up,
she had no recurrent signs or symptoms of endocarditis.

Figure 1. Chest radiography showed focal consolidation in the right middle lung (arrow).
Figure 2. Computed tomography of the chest showed area of necrotizing infection (arrow) within the anterior segment of the right upper and middle lobe.

Figure 3. Magnetic resonance imaging of the lumbar spine showed discitis osteomyelitis with abscess (arrow) at L4-L5 disc.
**Discussion**

Our patient presented as a rare case of isolated native tricuspid valve endocarditis due to *Klebsiella pneumoniae*. The case was complicated with septic pulmonary embolism and multiple systemic emboli-like focal infections including injection site purulent drainage, osteomyelitis of L4-5, epidural and paraspinal abscess. All the culture results showed *Klebsiella pneumoniae*. These complications occurred despite no evidence of intracardiac shunt causing paradoxical embolism on TEE. The patient was successfully treated with combined 6-week ceftriaxone and 2-week gentamicin together with early tricuspid valve repair and drainage of paraspinal loculation.

*Klebsiella pneumoniae* rarely causes endocarditis likely due to its poor adherence to cardiac valves. The mechanism of infection could be due to abnormal blood flow across a previously damaged valve leading to focal deposition of platelets and fibrin, creating a site for bacterial colonization and growth. Right-sided IE most commonly involves the tricuspid valve and is usually found in IV drug users. The most common complication of right-sided IE is septic pulmonary embolism causing pulmonary infarction and acute congestive heart failure. On the other hand, systemic embolism is a rare presentation of isolated tricuspid valve infective endocarditis without co-existent left-sided vegetation. There was no left-sided involvement, no intracardiac right-to-left shunt and no evidence of intrapulmonary shunt found in our reported case. Hypervirulent *Klebsiella pneumoniae* (hvKP) has been reported since the 1980s. To determine hvKP, the organism needs to meet at least 2 indicators: a positive string test, amplification of rmpA (regulator of mucoid phenotype A), and amplification of aerobactin. According to Wu, et al, 92.9% of hvKP has a positive string test. Therefore, not all hvKP strains exhibit the hypermucoviscous phenotype. Unfortunately, bloodstream isolated *Klebsiella pneumoniae* was not tested for amplification of rmpA and aerobactin in this case. Yet, her clinical presentation with metastatic infection, as well as the presence of a string test positive strain in the sputum, raises suspicion of hypervirulent strain *Klebsiella pneumoniae* as the cause of multiple focal infections.

*Klebsiella pneumoniae* IE patients tend to worsen quickly without evidence of preceding microbiological failure, and emergent valve replacement is often necessary. The most commonly used antibiotics are aminoglycosides and cephalosporins (86% and 67% of cases, respectively) with the optimal duration of 6-week course therapy. Non-operative management of tricuspid valve IE with antibiotics alone successfully clears the bacteremia in 70%–85% of cases and is associated with 7%–11% in-hospital mortality. However, those statistics do not take hvKP into account. Expert sources disagree about indications for surgery, but common indications include large vegetation (≥20 mm), septic pulmonary embolism, failed medical therapy, infected prosthetic valves, and severe tricuspid regurgitation.

Dawood, et al., suggested that early surgical intervention could avoid on-going leaflet tissue destruction and increase the likelihood of tricuspid valve repair instead of replacement. Most importantly, valve repair with annuloplasty ring showed a significant protective effect against recurrent IE compared to valve replacement. Therefore, early tricuspid valve repair should be considered in IE when possible. As noted above, our patient who experienced septic pulmonary embolism underwent early surgical intervention, tricuspid valve repair surgery with annuloplasty ring.

In conclusion, *Klebsiella pneumoniae* is a rare but extremely dangerous cause of bacterial infective endocarditis. Systemic metastatic infection could occur in hypervirulent *Klebsiella pneumoniae* infection. Combined antibiotic and early surgical intervention are an optimal management for isolated tricuspid valve infective endocarditis.
Conflict of Interest
None of the authors identify a conflict of interest.

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