

Case Series

Gram negative grimness: unveiling prognostic peril of septic pulmonary embolism in a case series

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ABSTRACT

Septic pulmonary embolism (SPE) is a complex condition characterized by the embolization of fibrin-thrombi containing pathogens from an infectious site to pulmonary vasculature, leading to secondary infection. The commonly reported causes are right sided infective endocarditis, septic thrombophlebitis, purulent infections in the skin and soft tissues, pelvic thrombophlebitis, intravascular catheters and liver abscess and the leading organisms implicated are *Staphylococcus* and *Klebsiella*. This case series describes three elderly patients with comorbid illnesses and having gram-negative septicemia secondary to *Klebsiella*, each with sub segmental septic pulmonary emboli and tries to explore the possibility of association of sub segmental SPE as prognostication marker in gram negative sepsis.

Keywords: Gram negative sepsis, Subsegmental septic pulmonary embolism, *Klebsiella*

INTRODUCTION

Septic pulmonary embolism (SPE) is an uncommon diagnosis which is characterized by mixture of fibrin and thrombi containing pathogens from an infected site and its embolization to pulmonary vasculature with secondary infection.¹ Insidious onset of fever, respiratory symptoms, and lung infiltrates are commonly the presenting features of SPE, clinical and radiologic features are usually nonspecific, and therefore the diagnosis is often delayed. Over the past two to three decades, there has been a shift in the epidemiology of SPE attributed to the rising prevalence of extrapulmonary infection sources. *Klebsiella pneumoniae* is emerging as the primary causative pathogen among gram-negative bacteria, ranking second only to *Staphylococcus aureus*, which remains overall the most prevalent pathogenic bacterium associated with SPE.²

In this case series we are describing three cases of gram negative septicemia secondary to *Klebsiella* with segmental and subsegmental SPE having poor outcomes.

CASE SERIES

Case 1

An 86 years old female patient known case of systemic hypertension, diabetes and hyperthyroidism on regular treatment presented with chief complaints of cough with expectoration since last 5 days, high grade fever since last 5 days and breathlessness since 3 days. There was no history of chest pain or lower limb swelling. At the time of presentation GCS of the patient was E3V2M5, pulse rate of 112/minute, regular, blood pressure (BP) was 140/90 mm Hg, respiratory rate (RR) was 26/minute with the use of accessory muscles and oxygen saturation of 88 % on 10 liters oxygen. Respiratory system examination showed a central trachea with diffuse wheeze in all lung fields and bilateral mammary, infra-axillary, infrascapular and interscapular inspiratory coarse crepitations, cardiovascular system (CVS) examination showed loud first heart sound, in neurological examination pupils were normal size and normally reactive, plantars were flexors, no FND of any limb, per abdomen examination was within normal limits. Chest X-ray was done which showed

bilateral heterogeneous infiltrates, patient was managed on the lines of community acquired pneumonia with oxygen support, IV antibiotics and other measures. Investigations neutrophilic leukocytosis, raised procalcitonin, C-reactive protein (CRP) and D dimers and *Klebsiella* was isolated from sputum, bed sore swab pus and urine culture. Antibiotics were changed according to sensitivity but the patient showed minimal response and continued to deteriorate and was subsequently intubated and put on mechanical ventilation, later Endotracheal tube aspirate culture also came out positive for *Klebsiella*. Contrast computed tomography (CT) of chest plus CTPA was planned for the patient which showed segmental and subsegmental thromboembolism shown in Figure 1 and Table 1. Despite of all possible treatment and supportive measures patient succumbed to her illness after 58 days of hospitalization.

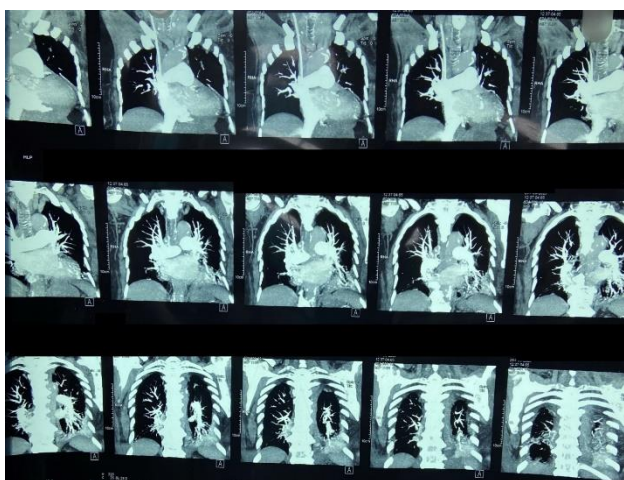


Figure 1: CT pulmonary angiogram showing filling defects apical segmental and subsegmental branches of right upper lobe and superior segmental and posterior basal segmental branch of right lower lobe pulmonary artery.

Case 2

65 years old female patient with systemic HTN and poorly controlled diabetes with history of CVA 2 months back, since then patient is bedridden and had Ryle's tube and Foley's catheter in situ presented to ED with complaints of high-grade fever with chills since last 7 days, decreased urine output since 3 days and altered sensorium in the form of decreased verbal response, decreased oral intake and drowsiness since 2 days. On examination GCS of the patient was E3V3M4, BP of 106/72 mm Hg PR: 110/minutes regular, RR: 26/minute and room air saturation of 88%, axillary temperature was 101 F, grade 3 bed sore was present on sacrum and pus was visible in Foley's catheter. Systemic examination was evident of B/L coarse crepitations in mammary and infra-axillary areas and reduced breath sounds in bases of the lungs, Patient was initially managed conservatively on the lines of sepsis secondary to UTI and LRTI and septic encephalopathy with broad spectrum antibiotics. Blood investigations

showed Hb=9.2 gm/dl, TLC=19200 (80% polymorphs), pre renal AKI and transaminitis. Serum procalcitonin levels were positive (>10 ng/ml) and CRP was 25mg/dL. Brain imaging excluded any acute CVA. Urine microscopy showed full field pus cells and 200 RBCs/hpf. Urine culture and bed sore swab had growth of *Klebsiella spp.*, for which antibiotics were changed according to sensitivity, but the patient had persistent tachycardia and tachypnea with type 1 respiratory failure. D Dimers levels came out to be 910 ng/ml. With a Wells score of 3, CECT chest plus CTPA was done which showed thrombus in Right upper lobe pulmonary artery partially occluding the lumen (Figure 2) and pneumonia in lower lobe of both the lungs. DVT was ruled out by venous Doppler. Despite the all the treatment measures, patient went into shock which was non responsive to fluid and required inotropic support. Patient had minimal response to treatment and had cardiac arrest, from which she could not be revived.

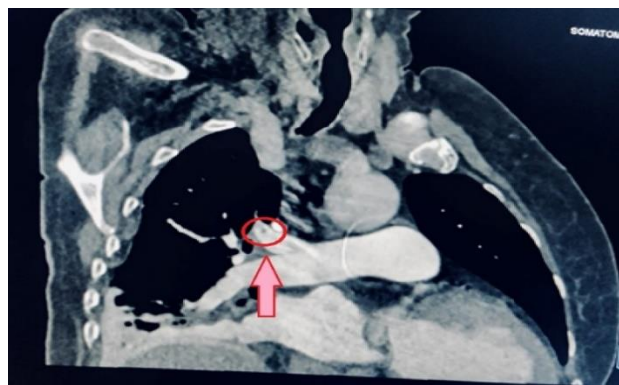


Figure 2: CT pulmonary angiography showing small hypodense filling defect in right upper lobar pulmonary artery which is partially occluding the lumen (red arrow).

Case 3

82 years old male patient with systemic hypertension and type 2 diabetes mellitus presented with history of fall followed by inability to bear weight on left lower limb, X-ray revealed left sided neck of femur fracture and patient was managed in orthopedics department where underwent left bipolar hemiarthroplasty after a normal pre-operative assessment. Immediate post-operative period was uneventful, patient was given adequate analgesia, antibiotic coverage and prophylactic anticoagulation along with other supportive treatment. Patient then started having fever with dip in sensorium in the form of inability to recognize relatives and decreased movement of limbs. On examination patient had tachycardia, tachypnea and diffuse coarse crepitations in bilateral lung fields likely due to aspiration. Non contrast CT of head, serum electrolytes, blood sugars were done to evaluate altered mentation which were normal, ABG suggestive of type 1 respiratory failure. Antibiotics were changes but patient deteriorated further and was subsequently intubated and put on mechanical ventilation. Investigations showed TLC of 13200 (87% polymorphs), CRP=21.8 mg/dl, S.

procalcitonin=8.37 ng/ml, D dimers=1729 mg/dl. Sputum culture showed growth of *Klebsiella spp.* sensitive to Colistin and Tigecycline, and blood culture from central line also showed *Klebsiella* with similar sensitivity. Contrast CT scan of chest along with CTPA was done which showed ground glass opacities in upper lobes of both lungs, consolidation in middle zone, bilateral pleural effusion with adjacent atelectasis of lungs, and thrombus occluding sub segmental branches of Right upper lobe pulmonary artery in CTPA. There was no evidence of any DVT in lower limb Doppler. Patient developed HAP along with CLABSI due to *Klebsiella* for which sensitive antibiotics were started, but there was little response and patient's general condition further declined and patient expired due to septic shock after around two months of hospitalization.

DISCUSSION

SPE is the embolism of blood clot mixed with a pathogenic organism to the pulmonary vasculature. Infective foci break into smaller particles, traverse through bloodstream and obstruct the vessel in newly invaded area, resulting in a dual injury: ischemic damage and an inflammatory or infectious insult and at tissue level fibrinoid necrosis is seen in the intima layer and in area adjoining the vessel wall.³ Primary source for SPE are liver abscess, skin and soft tissues purulent infections, pelvic or septic thrombophlebitis, intravascular catheters, pneumonia, periodontal abscess, and right sided IE.⁴ Overall most common organism associated with SPE is *Staphylococcus* and *Kebsiella* is leading cause amongst gram negative bacteria.² And it has been shown the prevalence of SPE with *Klebsiella* pneumonia liver abscess (KPLA) at around 4-6 % in China due to hypervirulent K1 serotype of the organism.^{2,5,6} There are few reports of *Klebsiella* isolated

from urinary tract that led to SPE.^{7,8} In the study conducted by Jiang et al, describing CT findings of SPE multiple peripheral nodules were the most followed by pleural effusion, cavitation, feeding vessel sign, lobar consolidation.⁹ The estimated hospital mortality rate for patients with septic pulmonary emboli falls within the range of 12% to 19.4% and in a systemic review of clinical characteristics of patients with SPE, septic shock and MODS have been found to be the leading causes of mortality.¹⁰⁻¹²

All three of our patients were elderly with comorbidities and were admitted in ICU, initial investigations were suggestive of neutrophilic leukocytosis with raised serum procalcitonin and CRP and were started on empirical antibiotics, as *Klebsiella* was isolated from the cultures, drugs were changed as per the sensitivity. In the first case, primary infective focus was LRTI which led to the septicaemia. UTI appears to be the primary source of infection in the second case as patient was catheterized for about 2 months whereas third case was a post-operative case who developed hospital acquired pneumonia and central line associated blood stream infection (CLABSI) secondary to *Klebsiella*. All three cases had a guarded course with worsening respiratory symptoms requiring mechanical ventilation and ionotropic support during the last days of hospitalization. In all three cases D Dimers were increased and DVT was ruled out. Case 1 and 3 had thrombus in segmental and sub segmental branches of right pulmonary artery whereas case 2 had a single thrombus partially occluding the right upper lobar artery. All three patients succumbed to their illness and had septic shock as the terminal event. Clinical, laboratory and radiological findings of all 3 patients are shown in the Table 1.

Table 1: Clinical, laboratory and radiological characteristics of cases.

Characteristics	Case 1	Case 2	Case 3
Age (years), sex	86, Female	65, Female	82, Male
Comorbidities	Hypertension, diabetes mellitus, hyperthyroidism	Hypertension, diabetes mellitus, CVA	Hypertension, diabetes mellitus
TLC (cu. mm)	21900	19200	13200
D Dimers (mg/dl)	4793	910	1729
S. Procalcitonin (ng/ml)	>10	>10	8.37
Cultures from <i>Klebsiella</i> isolated	Sputum, ET aspirate, urine, bed sore pus swab	Urine, bed sore pus swab	Sputum, blood
Hospitalization duration and final outcome	Presented as case of pneumonia, admitted for 58 days, intubated in mid-course; expired	Presented with sepsis and septic encephalopathy, intubated in view of poor GCS and respiratory failure admitted for total 40 days; expired	Post operatively developed HAP and CLABSI, leading to sepsis and septic shock, intubated and expired after 62 days
CT pulmonary angiography	Thrombus in apical segmental and subsegmental branch of right upper lobe and superior and posterior basal segmental branch of right lower lobe pulmonary artery	Partially occluding thrombus in right upper lobar pulmonary artery	Thrombus in sub segmental branch of right upper lobe pulmonary artery

Treatment outcomes is dependent acuity of illness at the presentation, it was shown by Goswami et al that 8 patients out of 13 patients, those who had acutely ill presentation and required ICU stay did not survive the hospitalization either due to refractory shock and resultant multi system organ failure or due to grave pulmonary complications including hemorrhage and hemoptysis.¹² They attributed these poor outcomes might be due to the late presentation or the concomitant presence of severe comorbidities such as end stage renal disease, diabetes and/or immunosuppression. All three of our patients were admitted in the ICU and had comorbidities, none of them could survive their illness.

CONCLUSION

SPE refers to a pulmonary infection caused by the presence of bacteria in the bloodstream, which originates from a different primary source of infection. The studied prevalence of septic PE in *Klebsiella pneumoniae* liver abscess ranges from 4.5 to 6%.^{5,14} There should be high suspicion for SPE in high-risk patients who are in sepsis as the clinical features can be nonspecific, which warrants the importance of early CT scan with pulmonary angiography. Testing blood culture before the antibiotics use and identification of primary infection foci are crucial to make early diagnosis of SPE. Since there is a shift in epidemiology of organism causing SPE from traditional gram positive to gram negative organisms, empirical antibiotic should be given to cover both the groups. Through this case series, it is being emphasized that presence of segmental and/or subsegmental SPE in patients of gram-negative sepsis represents poor outcomes and more studies should be done to assess the prognostic significance of development of sub segmental thrombi with morbidity and mortality in such patients.

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Ethical approval: Not required

REFERENCES

- Brenes JA, Goswami U, Williams DN. The association of septic thrombophlebitis with septic pulmonary embolism in adults. *Open Resp Med J.* 2012;6:14.
- Zhang X, Yang Q, Gao B, Wang J, Tian L, Hua J, et al. *Klebsiella pneumoniae* infection associated septic pulmonary embolism in an emergency department from east China. *Ann Palliat Med.* 2021;10(2):1521-9.
- Elsaghir H, Al Khalili Y. *Septic Emboli.* In: StatPearls. Treasure Island (FL): StatPearls Publishing. 2023.
- MacMillan JC, Milstein SH, Samson PC. Clinical spectrum of septic pulmonary embolism and infarction. *J Thorac Cardiovasc Surg.* 1978;75:670-9.
- Chou DW, Wu SL, Chung KM, Han SC. Septic pulmonary embolism caused by a *Klebsiella pneumoniae* liver abscess: clinical characteristics, imaging findings, and clinical courses. *Clinics.* 2015;70:400-7.
- Chang Z, Gong Z, Zheng J, Ma Y, Liu Z. Computed tomography features of septic pulmonary embolism caused by *Klebsiella pneumoniae* liver abscess associated with extrapulmonary metastatic infection. *J Computer Assisted Tomography.* 2016;40(3):364-9.
- Costanzo L, Karki B, Chaddha S, Soto B, Fiksman A. A case of septic pulmonary emboli caused by a perinephric abscess growing *klebsiella pneumoniae*. *Chest.* 2022;162(4):A1788-9.
- Lee HY. A case of septic pulmonary embolism due to pyelonephritis. *Korean J Med.* 2009;76(1):105-9.
- Jiang J, Liang QL, Liu LH, Cai SQ, Du ZY, Kong JL, Chen YQ. Septic pulmonary embolism in China: clinical features and analysis of prognostic factors for mortality in 98 cases. *BMC Infect Dis.* 2019;19(1):1-2.
- Oh HG, Cha SI, Shin KM, Lim JK, Kim HJ, Yoo SS, et al. Risk factors for mortality in patients with septic pulmonary embolism. *J Infect Chemother.* 2016;22(8):553-8.
- Jiang J, Liang QL, Liu LH, Cai SQ, Du ZY, Kong JL, et al. Septic pulmonary embolism in China: clinical features and analysis of prognostic factors for mortality in 98 cases. *BMC Infect Dis.* 2019;19(1):1082.
- Ye R, Zhao L, Wang C, Wu X, Yan H. Clinical characteristics of septic pulmonary embolism in adults: a systematic review. *Resp Med.* 2014;108(1):1-8.
- Goswami U, Brenes JA, Punjabi GV, LeClaire MM, Williams DN. Associations and outcomes of septic pulmonary embolism. *Open Respir Med J.* 2014;8:28-33.
- Lee SS, Chen YS, Tsai HC, Wann SR, Lin HH, Huang CK, et al. Predictors of septic metastatic infection and mortality among patients with *Klebsiella pneumoniae* liver abscess. *Clin Infect Dis.* 2008;47(5):642-50.

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