

A Study on Emphysematous Pyelonephritis in Relation to Diabetes Mellitus

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Abstract: Emphysematous pyelonephritis (EPN) is a severe acute necrotizing infection of the renal parenchyma and peri-renal tissue, characterized by intraparenchymal gas formation. EPN predominantly affects female diabetics, and can occur in insulin-dependent and non-insulin-dependent patients in the absence of ureteric obstruction. Nondiabetic patients can also develop EPN, but often have ureteric obstruction and do not seem to develop such extensive disease. Patients with EPN show relatively vague symptoms initially, but frequently undergo a sudden deterioration in their condition, necessitating urgent medical attention. We present four cases of EPN, two of whom were male and two were female. Of these, 3 were diabetic and one presented as EPN, and on evaluation had type 2 DM. 3 were unilateral EPN and 1 was bilateral EPN. Early detection, use of higher antibiotics, control of blood sugar levels, management of fluid and electrolyte balance and early surgical intervention when required helped to reduce the morbidity and mortality of all the patients.

Keywords: Emphysematous pyelonephritis, Hyperglycaemia, Impaired fasting glucose, Renal failure

I. Introduction

The first case of emphysematous pyelonephritis (EP) was described in 1898 by Kelly and MacCallum, and it was called 'pneumaturia'. This term was then replaced by EP in 1962 by Schultz and Klorfein¹.

Emphysematous pyelonephritis is an acute renal infection, potentially fatal, with mortality around 70–80%^{2,3}, and there are approximately 200 cases reported in literature. The disease is more frequent in women at fifth decade of life, in the proportion 5.9:1¹. The main risk factors are diabetes mellitus (80–90%) and urinary tract obstruction (40%). In most cases, a normal native kidney is involved unilaterally, but in 10% of cases, the condition is bilateral⁴.

E. coli and K. pneumoniae are the organisms most commonly isolated. High levels of glucose in the urine serve as a substrate for these bacteria, and large amounts of gas are generated through natural fermentation. In affected patients who are not diabetic, protein fermentation is a proposed source of gas formation.

The clinical manifestations are similar to an acute pyelonephritis, characterized by the triad: lumbar pain, fever and vomiting. However, a more severe evolution can be seen, mainly associated with thrombocytopenia, renal failure, sepsis and shock.

The gold-standard complimentary test for the diagnosis of EP is abdominal computed tomography (CT) scan with the finding of gas in the genitourinary tract. It is unilateral in 90% of cases. Approximately, half of the cases present with extra-renal involvement.

II. Case Presentation

Case 1

A 50 year old gentleman who is a known hypertensive on irregular treatment with beta blockers since 6 months presented with complaints of dysphagia for solids more than liquids since 1 month and was admitted in the surgery ward.

Past surgical history included a history of haemorrhoids for which he underwent haemorrhoidectomy 20 days ago.

On examination he was conscious, oriented, Pallor was present. Vitals were stable. Systemic examination was normal.

On evaluation he was found to have anaemia with Hb 7.9, acute kidney injury with urea 168mg/dl and serum creatinine 6.3 mg/dl, hyperkalemia with potassium 7.2 mmol/L and urine routine showed numerous pus cells and albumin 2+. ECG revealed Tall T waves. Patient was started on haemodialysis.

USG abdomen and CT KUB were suggestive of bilateral emphysematous pyelonephritis. Urine culture showed E.Coli and patient was treated with IV antibiotics piperacillin tazobactam and metronidazole according to sensitivity.

Patient was found to have impaired fasting glucose with HbA1C of 6.6 and random blood sugar > 500 mg/dl and was treated with insulin according to requirement. He improved symptomatically and haemodialysis

was stopped after 5 sessions and his RFT values gradually normalised with conservative treatment. He had 1 episode of passing 'meat' in urine which was revealed to be papillary necrosis on histopathological examination. Patient's condition was stable at the time of discharge. This is an example where a patient manifested with EPN and on evaluation was found to have diabetes mellitus.

Case 2

42 year old lady who is a known diabetic and hypertensive on irregular treatment with oral medications since 8 years presented with fever since 2 weeks, right sided flank pain and decreased urine output since 1 week.

On examination she was conscious, oriented, pallor was present, vitals and systemic examination were unremarkable. Investigations revealed Hb 9.8, total count 28200, urea 207, serum creatinine 6.9, RBS 308, HbA1C 12. CT abdomen showed right sided emphysematous pyelonephritis with multiple pelvic renal calculi and collection in the perinephric region. Right sided PCNL was done but in view of oliguria and increasing RFT she was initiated on haemodialysis.

Patient's GC did not improve and she was treated with multiple antibiotics including inj piperacillin tazobactam, amoxicillin clavulanate and ceftazidime. Regular haemodialysis was continued. Repeat USG KUB showed right sided perinephric abscess with tracking along the psoas muscle. She then underwent high risk right sided nephrectomy. Following nephrectomy, patient symptomatically improved and required only 3 more sessions of HD following which her urine output and RFT steadily improved. At the time of discharge her serum creatinine was 1.3 and she was dialysis free.

Case 3

A 54 year old male patient who is a known diabetic since 12 years on treatment with insulin presented with complaints of fever, decreased urine output since 5 days. He is a known case of CKD with history of left sided pyelonephritis, treated 2 years ago presently on medical management. He is also a chronic alcoholic.

On examination he was conscious, oriented, febrile, mild pedal edema was present, vitals were stable and systemic examination was within normal limits. Investigations showed Hb 13, total count 2200, platelet count of 127000, blood urea 130, serum creatinine 8, RBS 393, hbA1c 11.2, urine routine showed 10-15 pus cells.

CT abdomen showed right sided emphysematous pyelonephritis and left sided pyelonephritis. Urine culture showed no growth and he was treated with antibiotics meropenem and metronidazole, insulin and other supportive measures. Patient clinically improved and was discharged with oral antibiotics. At the time of discharge his creatinine value was 5 which was his baseline creatinine value even prior to infection.

Case 4

A 55 year old lady who is a known diabetic since 10 years on regular treatment with metformin 500 mg twice daily and also a known hypertensive on treatment with telmisartan 40mg once daily presented with complaints of fever, pain over the left flank and paraumbilical region and dysuria since 20 days. She was admitted at a local hospital and treated with IV antibiotics for 3 days prior to admission in our institution.

On examination, she was conscious, oriented, bilateral pedal edema was present and there was wound over the dorsum of the left foot. Vitals were stable, systemic examination revealed bilateral crepitations over the lung fields and pain on palpation over the left lumbar region and left renal angle tenderness.

On evaluation she had Hb 10.3, total count 13200 with neutrophilic predominance, ESR 91mm/hr. RBS was 741 at the time of admission and urine for ketone bodies was negative. She also had acute kidney injury with blood urea 58 and serum creatinine 1.9. ABG was suggestive of metabolic acidosis. Urine routine showed 8-10 pus cells. HbA1C was 13.2.

CT abdomen done was suggestive of left sided emphysematous pyelonephritis type 1. Urine culture did not reveal any organisms and she was treated with IV piperacillin tazobactam and meropenem, insulin and other supportive measures.

Patient improved symptomatically and fever and pain subsided. Her RFT values normalised and blood sugars were under control with insulin at the time of discharge.

III. Discussion

Emphysematous pyelonephritis (EPN) is a severe acute necrotizing infection of the renal parenchyma and peri-renal tissue, characterized by intraparenchymal gas formation. Affected patients usually have diabetes with poor glucose control. Obstruction is another common predisposing factor for emphysematous pyelonephritis. It is believed that high levels of glucose, in association with inadequate perfusion, lead to a favourable environment for the growth of anaerobic organisms. This disease affects individuals of all ages, but women are six times more likely to be affected^{5,6}.

Emphysematous pyelonephritis is commonly seen in patients with uncontrolled diabetes mellitus. Our first case was not a previously known diabetic and had only impaired fasting glucose requiring insulin administration. He also did not have any evidence of obstructive uropathy. He had a urinary tract infection on investigation but was asymptomatic. Ultrasound and CT abdomen showed bilateral bulky kidneys with altered echotexture and air pockets in bilateral renal collecting system with perinephric fat stranding which was suggestive of emphysematous pyelonephritis.

The second patient presented here was a known diabetic and hypertensive with elevated blood sugar levels who presented with sepsis, right sided pyelonephritis, renal calculi and perinephric abscess in acute renal failure.

The third case presented was a known case of CKD with diabetes and with a previous history of pyelonephritis who presented with acute right sided EPN and left sided pyelonephritis, UTI in sepsis with acute on chronic renal failure.

Our fourth patient was a diabetic and hypertensive who presented with hyperglycaemia, acute renal failure and symptomatic urinary tract infection. CT abdomen showed air in the pelvicalyceal system which was suggestive of left sided emphysematous pyelonephritis.

Huang and Tseng⁷ proposed a radiological classification for emphysematous pyelonephritis in four classes:

- (1) gas in the collecting system only,
- (2) gas in the renal parenchyma without extension to extrarenal space,
- (3A) extension of gas or abscess to perinephric space,
- (3B) extension of gas or abscess to pararenal space, and
- (4) bilateral EPN or solitary kidney with emphysematous pyelonephritis

According to the classification, the first case presented here falls under class 4 with fewer than 2 risk factors (ie, thrombocytopenia, acute renal function impairment, disturbance of consciousness, or shock), which improved drastically with IV antibiotics and haemodialysis. The second case presented is of Class 3b type of EPN and presented in sepsis with renal failure and recovered with haemodialysis and right nephrectomy. The third case falls under class 1 with complications in view of thrombocytopenia and recovered with conservative management. Whereas the fourth case presented falls under class 1 despite having hyperglycaemia which is the characteristic etiopathogenesis of EPN in all studies, she had a much milder presentation of the disease and responded to treatment with IV antibiotics and insulin and her renal failure also resolved with conservative management not requiring haemodialysis.

As per most of the cases published, there is no consensus regarding whether the best treatment is conservative management, with intravenous antibiotics and percutaneous drainage, or surgery, with nephrectomy of the involved kidney and treatment should be chosen according to each case. Early nephrectomy (<1 week) is reported to be associated with increased mortality in comparison to conservative treatment.

IV. Conclusion

In summary, we presented a case of newly diagnosed diabetes mellitus which presented as UTI with emphysematous pyelonephritis class 4 (Radiological classification) and impaired fasting glucose without any evidence of obstructive uropathy which improved with conservative treatment with IV antibiotics and haemodialysis, a case of unilateral EPN with abscess which extended to pararenal space which responded to early nephrectomy, haemodialysis, antibiotics, insulin and other supportive measures. A case of CKD with unilateral EPN and pyelonephritis who responded to early diagnosis and treatment with antibiotics and insulin. And lastly, a case of uncontrolled diabetes mellitus with UTI and sepsis with emphysematous pyelonephritis class 1 who despite having renal failure in a setting of hyperglycaemia which according to all published data is the most life threatening form of the disease associated with high mortality and morbidity, had a milder disease and disease progression requiring only glycemic control and high antibiotics following which she made a speedy recovery.

In conclusion we must keep in mind that diabetes and obstructive uropathy may not be the only main pathologies associated with EPN. Hyperglycaemia despite being one of the main complicating factors associated with the disease may not have a direct effect on the mortality, morbidity and severity of the disease.

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