

# A Rare Case of Pneumoureter: Emphysematous Pyelitis versus Emphysematous Pyelonephritis

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## ABSTRACT

Emphysematous pyelitis is a rare benign entity which is defined as isolated gas production in the pelvicalyceal system, ureters or in the urinary bladder as a consequence of acute bacterial renal infection. In this case report we present a case with no prior medical history of diabetes or urinary obstruction who presented with uncontrolled hyperglycaemia for the first time associated with emphysematous pyelonephritis. Further, the imaging differences between emphysematous pyelonephritis (EPN) and emphysematous pyelitis (EP) has been discussed along with the approach and their management.

**Keywords:** CT, Diabetes, USG

## CASE REPORT

A 49-year-old male with no prior medical history presented to the surgical outpatient department with complaints of intermittent fever, radiating pain in the right loin region, dysuria and haematuria since 1 month. On examination, he was stable, afebrile and his vital signs were normal. Per abdomen examination revealed right renal angle tenderness. Examination of other systems was within normal limits. Clinical diagnosis of right ureteric colic with secondary renal infection was made and the patient was referred to the department of radio diagnosis for the purpose of ultrasound abdomen and radiograph Kidney Ureter Bladder.

Urine analysis revealed-Pus cells (5-8/hpf), RBCs (7-8cells/hpf) with presence of amorphous phosphate crystals and epithelial cells. Urine culture yielded growth of *Escherichia coli* (*E coli*). Renal functional parameters were within normal limits. Fasting blood sugar level was 410 mg/dl and post prandial blood sugar level was 607 mg/dl with high levels of glycosylated Hb (13%). Urine sample was negative for ketone bodies. Leucocytosis was noted in the blood counts.

Ultrasound (USG) abdomen and pelvis showed fatty infiltration of liver & features of cystitis. Right kidney was mildly enlarged with moderate to gross hydronephrosis. Multiple hyper echoic foci were noted in the mid and lower poles of the right kidney with mixture of clear and dirty after shadowing-suggestive of presence of both calculus and air in the collecting system [Table/Fig-1].

KUB radiograph revealed presence of a fragmented right staghorn calculus with multiple foci of air in the region of right kidney. A well defined tubular curved air filled structure was noted in the right paravertebral region suggestive of right pneumoureter [Table/Fig-2].

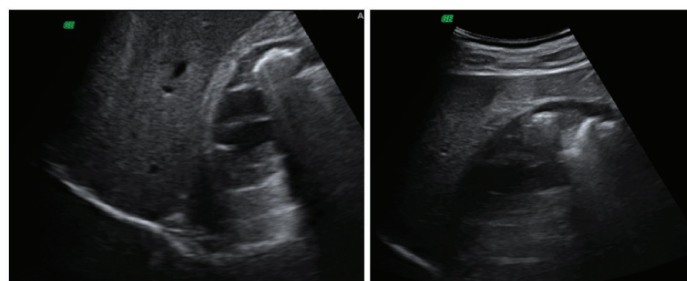
In view of above findings, the patient was immediately shifted for spiral Computed Tomography (CT) KUB plain with 16 slice CT using Siemens Somatom emotion. CT revealed large fragmented staghorn calculus in the right renal pelvis causing gross hydropneumopelvis with thinning of renal parenchyma. Multiple foci of air with large air-fluid level were noted in the dilated right pelvis. Right upper and mid ureter was mildly dilated and was filled with air. Perinephric fat stranding was noted. Focus of air with air-urine level was also noted in the urinary bladder [Table/Fig-3]. However, there were no air pockets in the right renal parenchyma or perinephric region.

With above findings, diagnosis of right emphysematous pyelitis

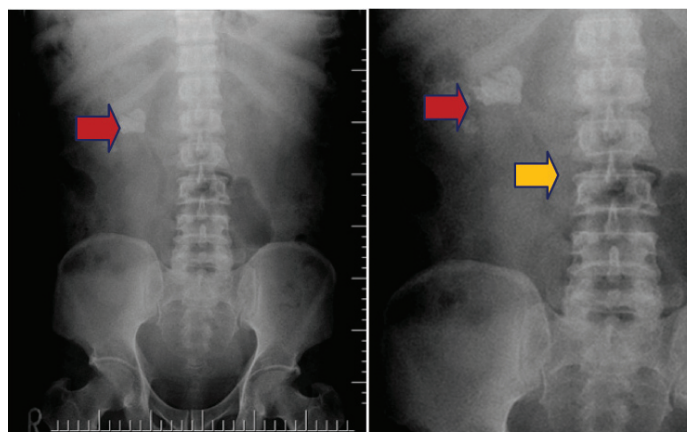
with pneumoureter and pneumobladder was made. Patient was treated with i.v. Ceftriaxone 2 g BD. The patient responded well to the treatment and achieved recovery from his symptoms with antibiotics alone [Table/Fig-4].

## DISCUSSION

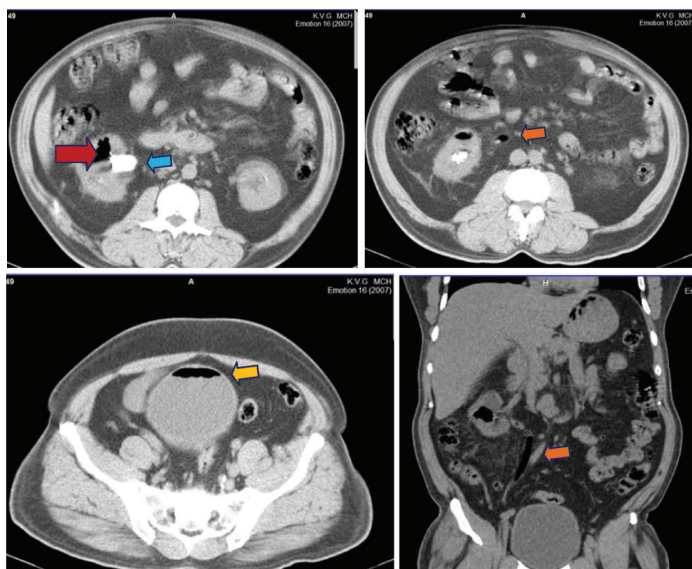
Emphysematous pyelitis is defined as isolated gas production in the pelvicalyceal system, ureters or in the urinary bladder as a consequence of acute bacterial renal infection [1].



**[Table/Fig-1]:** Transabdominal ultrasonography of right kidney depicting moderate to gross right hydronephrosis with multiple foci of hyperlucencies with mixed clear and dirty after shadowing suggestive of air and calculi in the right pelvicalyceal system



**[Table/Fig-2]:** Radiograph kidney ureter bladder demonstrating the fragmented right staghorn calculus (Red calculi) with a well defined tubular curved air filled structure in the right paravertebral region suggestive of right pneumoureter (Yellow arrow)



**[Table/Fig-3]:** Serial axial (first three images) sections & coronal reformation of CT abdomen and pelvis plain study showing right hydronephrosis with staghorn calculus (blue arrow), air fluid level in the dilated right pelvicalyceal system (red arrow), right pneumoureter (orange arrow) and air in the urinary bladder with air urine level (yellow arrow)



**[Table/Fig-4]:** Post treatment ultrasonography of right kidney with stag horn calculus and clear after shadowing indicating complete resolution of emphysematous pyelitis

Gas in the renal system is a rare occurrence and usually is associated with serious urinary tract infections by gas forming organisms. Kelly and Mac Cullum described the first case of EPN in a patient who presented with complaints of pneumaturia [2]. EPN is a progressive and potentially fatal necrotizing suppurative infection of kidneys and its surroundings with a mortality rate of 50%. EP on other hand is a benign condition as compared to EPN and is defined as a gas forming acute urinary tract infection with air collection localized to the collecting system [3]. It is important to differentiate between these two gas forming infections as their prognosis and management are different [4].

EPN is most commonly seen in diabetics and in patients with urinary tract obstruction [4]. Patients with EPN present with non specific symptoms like fever, vomiting, abdominal pain, confusion, pyuria, renal impairment or shock.

EPN is divided into two types by Wan et al., [5]. Type I presents with parenchymal destruction with streaky or mottled gas collection within renal parenchyma but with no fluid collection. Type II EPN presents with gas collection within the renal parenchyma or collecting

system with renal or perirenal fluid collection. The fluid collection in type II EPN is due to better immune response compared to type I and hence is associated with lesser morbidity and mortality. EP falls under type II category EPN in the classification proposed by Wan et al., [5]. The mortality rate in type I EPN is 69% as compared to 18% in type II EPN.

Huang and Tseng et al., defined four classes of EPN. In class 1, gas was limited in the collecting system. In class 2, gas was in the renal parenchyma without extension to the extrarenal space. In class 3A, gas extended to the perinephric space, in class 3B, to the paranephric space. Class 4, was referred to bilateral emphysematous pyelonephritis or a solitary kidney with emphysematous pyelonephritis [6].

EP has a mortality rate of 20% which is much lower than that of EPN [4,7]. Similar to EPN, EP is also associated with uncontrolled Diabetes Mellitus (DM) and urinary tract obstruction. Around 90% of patients with EPN usually have uncontrolled DM, where as only 50% patients with EP will be diagnosed with DM. In the present case both risk factors were associated with EP. Clinical features of EP are fever with chills, haematuria, dysuria, vomiting and renal angle tenderness. Clinical manifestations of EPN are more serious than EP. Patients with EP are more stable, where as in EPN patients may be in shock.

*E.coli*, *Klebsiella pneumonia* and *aerobacter* are the most common bacteria causing EP [4,7]. In the present case, the causative agent was *E coli*.

On KUB radiograph, patients with EP may reveal gas outlining the pelvicalyceal system and in rare cases, gas within the ureter or even in urinary bladder. Detection rate of EP or EPN on KUB radiograph is only 33% as it is difficult to differentiate them from overlying bowel gas [4].

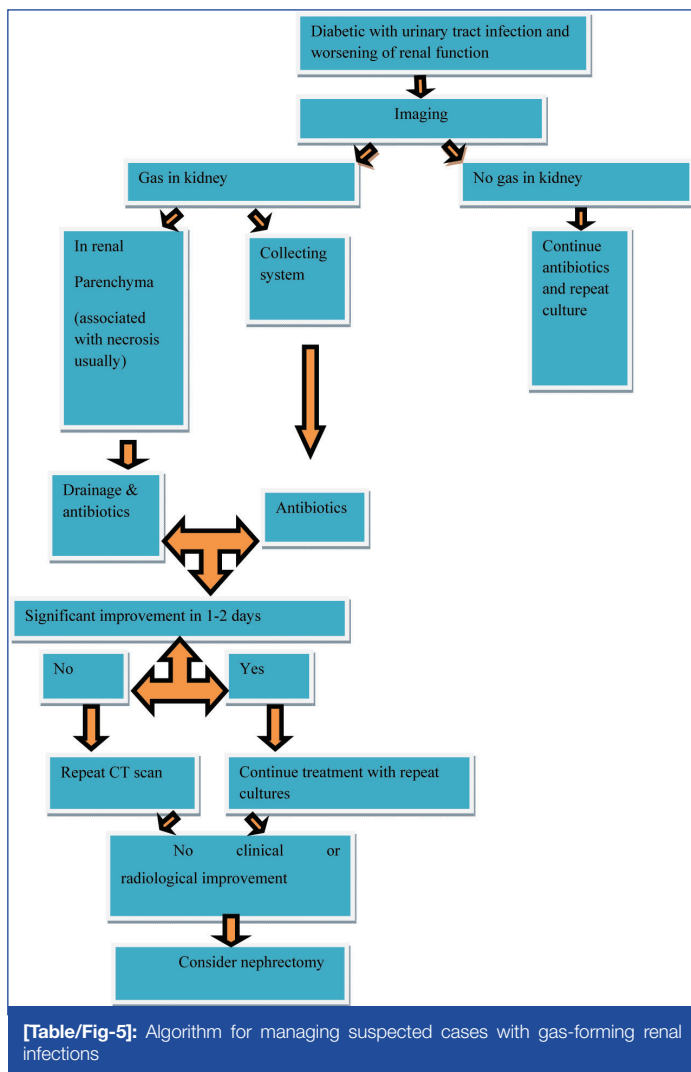
On USG, flat anterior margin echoes with dirty shadowing with low level internal echoes and reverberations are seen [7]. According to Alexander et al., ultrasound is insensitive for the diagnosis of renal gas, but useful in diagnosing urinary tract obstruction [6]. But in this case we demonstrated that renal calculi will result in clean acoustic shadowing and this may help to differentiate it from the dirty after shadow of the gas collection. This finding is also supported by the work of Kua et al., and Goncalves et al., [3,8].

CT is the most sensitive and specific imaging modality for diagnosis of emphysematous urinary tract infections [8]. CT is reliable in demonstrating the presence and location of gas in the collecting system, renal parenchyma and perinephric spaces. Hence it is the best modality for differentiating EPN from EP [8]. Furthermore, CT may define the presence and site of obstruction [9].

In addition to the demonstration of gas foci in the renal pelvic calices like in our case, Chiang et al., also reported a delay in the concentration and elimination of the contrast medium, determining the finding of striated nephrogram [9].

Pneumoureter or gas in upper urinary tract may also be visualized in patients with urinary diversions, fistulous connections with bowel or sometimes post procedure. Sometimes the gas may reflux from the urinary bladder back into the ureter.

Management of EP and EPN are different. EPN may require percutaneous drainage, surgical nephrectomy with intravenous broad spectrum antibiotics [4]. However literature based on recent studies shows that broad spectrum antibiotics with or without percutaneous drainage is sufficient and successful in treatment. The clinical management of EP is mainly by broad spectrum antibiotics [4]. Removal of the obstructing calculus is important in both entities. The present case recovered completely with intravenous Cephalosporins alone.



A suggested algorithm for managing suspected cases with gas-forming renal infections is shown in [Table/Fig-5].

EP and EPN are acute bacterial infections of kidneys by gas forming uropathogens with similar risk factors but both are on either ends of the spectrum. The former has a benign course and low mortality whereas the latter is a potentially fatal disease. CT is the method of choice in detecting emphysematous urinary tract infections and helps in differentiating between EP and EPN [9,10].

## CONCLUSION

This report emphasizes the fact that both the clinician and the radiologist must be alert to the possibility of EPN/EP in a patient with diabetes, thought to have uncomplicated pyelonephritis and is not responding to routine treatment. It also stresses on the differences in imaging findings between EP and EPN as it has a bearing on the clinical management and prognosis. Our experience agrees with previous studies in regard to achieving a successful outcome with early diagnosis, a combination of medical and timely surgical interventions when needed along with meticulous monitoring of progress.

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