



**ORIGINAL RESEARCH PAPER**

**UROLOGY**

**EMPHYSEMATOUS PYELONEPHRITIS : NO LONGER A RARE ENTITY !**

**KEY WORDS:** Emphysematous, pyelonephritis, urosepsis, stenting

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<b>ABSTRACT</b>	<b>EMPHYSEMATOUS</b> pyelonephritis (EPN) has been defined as a necrotizing infection of the renal parenchyma and its surrounding areas that results in the presence of gas in the renal parenchyma, collecting system, or perinephric tissue.
	<b>MATERIAL AND METHOD :</b> 19 patients were treated between January 2014 and May 2016. According to the radiological findings on computed tomography scanning patients were classified as grade 1 to grade 4 EPN. The clinical manifestations, management and outcomes were compared.
	<b>RESULTS :</b> Most of the patients with grade 1 and 2 EPN were managed well with antibiotic and ureteric stenting . In grade 3 AND 4 EPN, nephrectomy was done for patients having risk factors like thrombocytopenia / shock / renal failure/ altered consciousness.
	<b>CONCLUSION :</b> EPN is an life threatening disease but with early aggressive medical and surgical management , has a favorable outcome. With modern imaging techniques, it can be picked up easily when suspicion of this condition is kept while evaluating patients with loin pain and fever, especially in diabetics.

**INTRODUCTION**

EMPHYSEMATOUS PYELONEPHRITIS (EPN) has been defined as a fulminant , potentially life threatening necrotizing infection of the kidney and its surrounding areas that results in the presence of gas in the renal collecting system , parenchyma or perinephric tissue. In the present era, with wide availability of Computed tomography, more number of cases are being diagnosed early. Most of these cases are reported in radiology and urology journals. Today, EPN should not be considered a rare entity. In the last two to three decades, the management of this potentially fatal disease has changed drastically due to early diagnosis, multi-disciplinary intensive care and aggressive surgical management. The overall mortality was estimated to be up to 20 % [1]. We present our experience of 19 cases treated between January 2014 and may 2016.

**MATERIALS AND METHODS**

19 patients treated between January 2014 and May 2016 were analyzed both retrospectively and prospectively for clinical features, presentation, radiological classification and prognostic factors. The various modalities of management and outcome among the various radiological classes of EPN were compared. According to the radiological findings on computed tomography scanning , patients were classified as grade 1 to grade 4 . Any recent history of instrumentation or fistulae between the urinary and gastro intestinal tract were ruled out.

The presence and duration of diabetes and glycemic control over the last three months (HbA1C) were compared. The clinical presentation at the time of admission, the presence of thrombocytopenia, leukocytosis , altered consciousness , shock / urosepsis / MODS (multi organ dysfunction syndrome) were analysed and compared . Routine urine and blood cultures were sent at the time of admission . The referring department was noted . Renal function at the time of admission and through out the treatment course was observed. An initial diagnosis was made by ultrasonography and confirmed in all cases with a computed tomography scanning. Acute pyelonephritis was diagnosed with loin pain , dysuria and fever . Acute renal functional impairment was defined as persistent elevation of serum creatinine level of more than 0.3 mg/dl from baseline or first serum level from the time of admission after resuscitation. Urosepsis was considered as

bacteriological evidence of urinary tract infection with pyuria . The patients were classified based on CT (computed tomography ) findings as described by Huang and Tseng [2]. Class I – gas in ureter/pelviccalyceal system; Class II – gas in renal parenchyma; Class III – gas in renal parenchyma extending beyond the fascia to perinephric (IIIa/pararenal spaces IIIb); and Class IV – bilateral EPN or EPN in solitary kidney. All the patients were treated with an multi-disciplinary approach involving the urologist , nephrologist , endocrinologist , intensivist and a hematologist whenever needed. An aggressive medical and surgical approach was used. All patients were started empirically on piperacillin tazobactam and changed as per the culture sensitivity pattern. Surgical procedures included ureteric stenting , percutaneous drainage and nephrectomy whenever required. A nephrology consultation was taken for all patients who presented with acute renal impairment .

**RESULT**

A total of 19 cases were treated at our institution between January 2014 and May 2016. 9 patients were referred to our institution from outside and were admitted from emergency, 6 were admitted under nephrology for acute renal impairment and then transferred to us in view of EPN , while 4 patients were referred from general surgery out patient department when they were evaluated there for abdominal pain and found to have EPN. There were 10 women and 9 men in our study . All the patients were diabetic. The mean duration of diabetes was 6.5 years , the mean HbA1C was 8 . Fourteen patients (73.6%) had a sugar level of more than 300 mg/dl at the time of admission. 3 (15%) patients had an obstructive calculus [figure 1 ] while 6 patients (31%) were found to have papillary necrosis on subsequent follow up. One patient had a polycystic kidney disease (5%). 16 patients had diabetic retinopathy (84%) out of which 12 (63%) were background and the remaining proliferative (36%). In majority of the patients – 13 cases out of 19 the left kidney was affected . Twelve patients grew E.coli in the urine (63%) , 3 grew klebsiella (15.7%) , one had a positive fungal culture and 3 showed no growth . Bacteremia occurred in 6 (31%) of our patients and grew the same organism as isolated from urine . The most common sensitivity pattern was towards meropenem . The most common presenting symptom was fever seen in 100 % of the patients followed by flank pain in 84.2%. 16 patients had acute renal injury accounting to 84.2% , most of which resolved slowly over time in

the post operative period . Thrombocytopenia was noted in 4 (21.05%) patients .

The findings on ultrasonography suggestive of emphysematous pyelonephritis were enlarged kidneys with hyperechoic shadows within the renal parenchyma and low level posterior dirty acoustic shadowing . All the patients were evaluated with a plain CT KUB and started empirically on piperacillin tazobactam. Patients were classified based on the radiological grade of EPN . There were 3 patients belonging to grade 1 (15.7%), 8 belonging to grade 2 (42.1%), 7 belonging to grade 3 (36.8) and 1 patient belonging to grade 4(5.2%) .

All the three patients belonging to grade 1 were stented bilaterally . a stent removal and relook ureteroscopy was done after 8 weeks . All the patients recovered well. There were 8 patients belonging to grade 2 – all of them were stented with a ureteroscopy done after 8 weeks . The outcome was good in all the patients . Out of the 7 patients in grade 3 , 4 were stented with a ureteroscopy done at 8 weeks and fared well like category 1 and 2 . Another patient who was stented underwent nephrectomy the following week in view of deteriorating clinical picture , persistent fever spikes and rising creatinine with features of ongoing sepsis. One patient underwent nephrectomy as the first procedure of choice in view of severe sepsis with a refractory shock( systolic BP< 90 even with fluid resuscitation , lactate > 4 mmol with signs of end organ damage )The computed tomography image of the same patient is as shown in [figure 2]. PCN was done for another patient belonging to category 3 in view of severe thrombocytopenia , however the patient eventually left against medical advice and could not be followed up . There was one patient in category 4 who had bilateral emphysematous pyelonephritis [FIGURE 3A] . In view of thrombocytopenia and unstable hemodynamic state he was managed with percutaneous drainage bilaterally [FIGURE 3B] . The patient improved over a period of time and showed significant benefit from bilateral percutaneous drainage. However in view of persistently elevated drainage from the PCN site the patient was stented bilaterally [FIGURE 3C] . The percutaneous drainage decreased eventually and the patient was discharged with bilateral stents. Bilateral stent removal was done after 8 weeks .Presently the patient is doing well .

There was complete recovery of renal function in 16 patients while 3 patients eventually developed CKD (chronic kidney disease) – all three belonging to grade 3 . 3 patients required dialysis pre operatively , however none of the patients who developed CKD are on routine dialysis at the time of this writing .

## DISCUSSION

The first case of gas-forming renal infection (pneumaturia) was reported by Kelly and MacCallum[3] in 1898. Terms such as "renal emphysema," "pneumonephritis," and "emphysematous pyelonephritis" have been used to describe this gas-forming infectious disease. However emphysematous pyelonephritis as suggested by Schultz and Klorfein in 1962[4] is most appropriate as it emphasizes the relationship between the acute infectious process and gas formation.

There are four postulated risk factors in the pathogenesis of EPN. These include gas forming bacteria , impaired tissue perfusion , high tissue glucose levels and an immunocompromised state like diabetes mellitus [5]. High blood glucose levels in diabetics creates a microenvironment favourable for growth and rapid catabolism of microbes . This leads to massive production of gas and subsequent emphysematous pyelonephritis. All our patients who developed EPN were diabetic. EPN can also be seen in an obstructed renal unit .Unrelieved urinary tract obstruction causes hydronephrosis and increased pelvi calyceal pressure which compromises renal circulation. This results in formation of a gas chamber and resultant emphysematous pyelonephritis. In 1997, Shokeir et al [6] revealed that urinary tract obstruction was evident in all of their patients without DM and in half of their patients with DM. In addition to diabetes three of our patients also had obstruction of the corresponding renal unit due to calculus disease.

EPN predominantly affected females in the other case series. However in our series the incidence of women affected were almost same as that of men . The increased susceptibility to UTI in females was one possible reason of increased incidence in women .[6] The left renal unit was more commonly affected as in other series (67 v/s 25 % ) as well due to preponderance of left sided urinary tract obstruction [7]. A computed tomography gives an overall picture of the severity and extent of the disease. A computed tomography scan was done for all our patients . Diagnosing EPN on plain x ray is difficult and only 33 % cases demonstrated gas as shown by Michaeli et el in 1984 [8].

In our study, the severity of the disease coincided with the radiological grade of the disease. The severity and prognosis worsened from grade 1 to grade 4 . All the patients had high blood glucose levels and though high blood sugars were a predisposing factor to EPN , it did not appear to co relate with the severity of the disease. In our study 2 patients who underwent nephrectomy , had thrombocytopenia and one was in shock . Both the patients had renal impairment . Thrombocytopenia was a part of the ongoing sepsis and DIC. Shock showed a state of cardiovascular collapse. In accordance with other studies , thrombocytopenia , shock and renal impairment – all were suggestive of high morbidity. [5] According to Huang et el , altered mentation is also a factor suggestive of poor outcome . It was also noted that the number of days from onset of symptoms to presentation to the hospital increased as the patient developed factors having a poor outcome. Hence an early diagnosis and aggressive management is the key to treating EPN.

All the patients in our series were managed both surgically and medically . In grade 1 and 2 EPN , ureteric stenting was done and a ureteroscopy was done after 8 weeks . All the patients fared well. Where ever feasible a percutaneous nephrostomy tube was placed for drainage of perinephric abscess . In all situations , attempts were made to preserve the kidney except for in one patient due to poor salvageable condition for that renal unit and hemodynamic instability. Class 3 and 4 EPN were managed by ureteric stenting / percutaneous drainage initially . However when the patient appeared to deteriorate clinically , decision for a nephrectomy was taken . Although there are no significant differences in the clinical features of all the four classes , mortality and morbidity increases from class 1 to class 4 .

## CONCLUSION

Emphysematous pyelonephritis is a life threatening gas forming infection of the renal parenchyma, collecting system and its surrounding spaces . The most common organism being Escheria coli or K Pneumoniae . Diabetes mellitus or obstruction of the reno-ureteral unit is the most common condition associated .The severity of the disease coincides with the radiological grade . For class 1 and 2 EPN , ureteric stenting / percutaneous drainage along with an aggressive medical management has a good outcome. For class 3 and 4 EPN , early surgical intervention in the form of stenting or percutaneous drainage should be attempted along with antibiotic therapy. However , in the background of a worsening clinical picture / unresponsive infection nephrectomy is the management of choice. Hence , though a life threatening disorder with an early diagnosis with an aggressive surgical and medical management Emphysematous pyelonephritis has a good outcome.

**FIGURE 1: EPN WITH OBSTRUCTIVE CALCULUS**

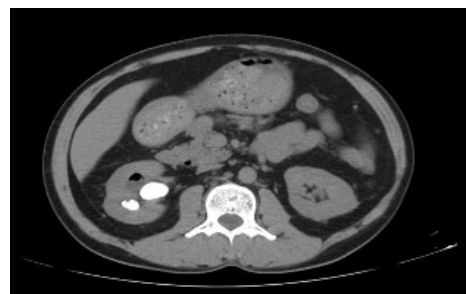




FIGURE 2 : patient who underwent nephrectomy as the surgical procedure of choice straight away.

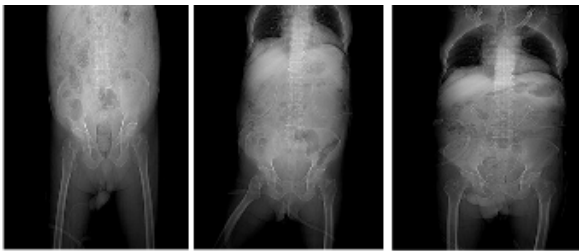


FIGURE 3A : BILATERAL EPN

FIGURE 3B : STATUS POST BILATERAL PCN FOR BILATERAL EPN

FIGURE 3C : STATUS POST BILATERAL PCN AND STENTING IN THE SAME

CATEGORY	NO OF PATIENTS	MANAGEMENT	OUTCOME
GRADE 1	3	STENTED B/L FOLLOWED BY STENT REMOVAL / URETEROSCOPY DONE AFTER 8 WEEKS	GOOD
GRADE 2	8	STENTED , STENT REMOVAL AND URETEROSCOPY AFTER 8 WEEKS	GOOD
GRADE 3	7	4 PATIENTS – STENTED AND URS AFTER 8 WEEKS 1 – DIRECT NEPHRECTOMY 1- STENTED FOLLOWED BY NEPHRECTOMY IN A WEEK 1- PCN IN VIEW OF SEVERE THROMBOCYTOPENIA – WENT AGAINST ADVICE	
GRADE 4	1	BILATERAL PCN FOLLOWED BY BILATERAL STENTING	

TABLE 1 : COMPARISON OF THE TREATMENT MODALITIES OF THE VARIOUS CLASSES OF EPN AND THEIR OUTCOME .

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