

Original Research Article

Case series to study the clinical features, risk factors, prognostic factors, and to assess the different management modalities of EPN and its outcomes

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ABSTRACT

Background: Emphysematous pyelonephritis is an acute necrotising infection of the kidney, often associated with high rate of renal loss and mortality. EPN mostly present with triad of fever, flank pain and nausea. The diagnostic tool of choice is CT KUB. *E. coli* is the most common pathogen.

Methods: It was prospective study done on 52 patients who were diagnosed to have EPN from department of nephrology and urology in Narayana Medical College, Nellore from March 2022 to January 2024. The diagnosis of EPN was confirmed by plain CT KUB scan.

Results: Among 52 patients 48 patients had diabetes mellitus (DM). left kidney involved in 28 patients and right kidney involved in 16 patients and bilateral kidney involvement in 8. Fever (92%), flank pain (88%) are the most common presentation in patients. Shock during initial presentation was seen in 19.5% of patients. *E. coli* growth was seen in 26.9% cases. 8 patients were treated conservatively with antibiotics according to culture and sensitivity. 32 patients required double J stenting, 7 patients required percutaneous nephrostomy. Nephrectomy was done in 5 patients. Mortality rate in our study was zero.

Conclusions: Nephrectomy should be promptly attempted for patients not responding to conservative methods. Pre-existing CKD status, shock at presentation and altered sensorium are the factors determining the prognosis and management.

Keywords: Double J stenting, Emphysematous pyelonephritis, Nephrectomy, PCN

INTRODUCTION

Emphysematous pyelonephritis (EPN) is an acute necrotizing renal parenchymal and peri renal tissue Infection resulting in formation of gas within the collecting system, perinephric tissue or renal parenchyma.¹⁻³ Most commonly diabetics and women are at increased risk of infection, Other risk factors associated are renal stone disease, structural abnormalities of the urinary tract, and immunosuppression.⁴ Most common presenting complaints include fever, loin pain, vomiting, altered consciousness and shock.^{5,6} In this study, we analyzed the

characteristics of 52 patients with EPN with respect to patient demographics, clinical presentation, diagnostic investigations, microbiological findings, treatment modality and outcome, and the influence of prognostic factors on the outcome.

METHODS

This prospective interventional study included patients diagnosed with EPN who were managed in the Department of urology at Narayana medical college and hospital, Nellore from March 2022 to January 2024. The diagnosis of EPN was done based on documentation of

gas within the renal parenchyma, collecting system, or perinephric tissue on computed tomography (CT) scan. The clinical, laboratory, radiological, and microbiological findings, treatment modality, and outcome of these patients were documented. The treatment modalities included either antibiotics alone, DJ stenting in addition to antibiotics or percutaneous nephrostomy or interval nephrectomy. According to Huang and Tseng classification based on computed tomography (CT) scan, patients with EPN were classified as follows class I: gas in collecting system only; class II: parenchymal gas only; class IIIA: extension of gas into perinephric space; class IIIB: extension of gas into para renal space; class IV: EPN in solitary kidney, or bilateral disease. Clinical, biochemical, and microbiological data were recorded in a tabular form. Data were analyzed using SPSS version 20.0 for Windows (IBM, Armonk, New York). Quantitative variables were expressed as mean SD, whereas qualitative data were presented as the number of observations with percentages. Continuous data were compared by using Student's t-test. Paired data were analyzed by an independent sample t test. Univariate analysis was performed to identify risk factors of morbidity. A p value <0.05 was considered significant.

RESULTS

A total of 52 cases were diagnosed to have Emphysematous pyelonephritis. All the patients in our study were started on well renally adjusted doses of third-generation cephalosporin and amino glycoside (amikacin) per institutional antibiotic protocol. Blood and urine cultures were taken before initiating antimicrobials for all our patients and antibiotic therapy changed depending on the microbiological culture reports. All patients were treated with standard protocols which included control of hyperglycemia, intravenous antibiotics, strict intake and output monitoring, and use of inotropes if required. Drain placement was performed when patients did not respond to initial measures. A nephrectomy was performed in those patients who did not improve after drain placement. We further followed up patients with non-contrast CT to document any residual EPN, and radionuclide study for differential renal function. Patients with renal function <10% underwent nephrectomy on follow-up. Patients who had a functional kidney with stones underwent percutaneous nephrolithotomy, uretero-renaloscopic stone removal and/or retrograde intrarenal surgery as per stone characteristics and stone clearance was achieved.

According to the Huang and Tseng classification, three patients (15%) had class 3B, one (5%) had class 3A, and 16 (80%) had class 2 mean age was 61.75±4.3 years. 5 (62.5%) out of 8 were female, 3 (37.5%) had left EPN and 1 (12.5%) had right EPN 4 (50%) patients had bilateral EPN, 6 (75%) were diabetic and 3 (37.5%) were having nephrolithiasis.³ Urine culture was positive in 7 (87.5%) patients. *E. coli* was the most common isolate

seen in 6 (85.7%) patients out of 7 culture positive samples.

Table 1: Incidence of clinical symptoms in emphysematous pyelonephritis.

Symptoms	Affected N (52) (%)
Abdominal pain	46 (88.5)
Fever	48(92.3)
Dysuria	26 (50)
Vomiting	26 (50)
Oliguria	12 (23.07)
Generalized weakness	26 (50)
Shortness of breath	12 (23.07)
Depressed level of consciousness	10 (19.23)
Shock	10 (19.23)
Pneumaturia	2 (3.8)
Renal angle tenderness: left	28 (53.8)
Renal angle tenderness: bilateral	8 (15.3)
Renal angle tenderness: right	16 (30.7)

Table 2: Clinical and epidemiological characteristics of patients with emphysematous pyelonephritis.

Variables	N (%)
Mean age, years	58
Women	38 (73.07)
Median age of women, years	56
Men	14 (26.9)
Median age of men, years	62
Diabetics	48 (92.3)
Uncontrolled diabetes, (mean HbA1c)	8.2%
Patients with renal calculi	14 (26.92)
Depressed level of consciousness	10 (19.23)
Shock	10 (19.23)
Anemia	38 (73.07)
Median leucocyte count, cells/mm	14607
Median platelet count, lakhs/mm ³	2.52
Thrombocytopenia	10 (19.2)
Hematuria	8 (15.38)
Mean serum creatinine, mg/dl	2.7
Mean albumin, gm/dl	3.1
Hypoalbuminemia	14 (26.92)
Hyponatremia	10 (19.23)
Hemodialysis needed	14 (26.92)
Hydronephrosis	12 (23.07)

The common clinical features were fever (100%), loin pain and/or renal-angle tenderness (18 patients; 90%), vomiting (17 patients; 85%), dysuria (9 patients; 45%), increased urinary frequency (4 patients; 20%) and dehydration (6 patients; 30%). One patient (5%) presented with altered sensorium. The patients had experienced these symptoms for 3-14 days before presenting at our hospital. Neutrophilic leukocytosis was common and four patients had thrombocytopenia. All had

high erythrocyte sedimentation rates (ESR) and C-reactive protein (CRP) levels. Overall, glycemic status was poor (Table 1). Other features were pyuria (17 patients; 85%), glycosuria (19 patients; 95%) and microscopic hematuria (7 patients; 35%). Fourteen cases (70%) were complicated by acute kidney injury (AKI), 8 mostly at stage 1 (11/14; 78.6%) and 11 (55%) had hyponatremia. The laboratory characteristics are shown in Table 1.

Table 3: Causative organisms from blood, urine cultures.

Urine culture	N (%)
No growth	26 (50)
<i>E coli</i>	14 (26.9)
<i>Enterococcus</i>	2 (3.8)
<i>Klebsiella</i>	8 (15.38)
<i>Proteus</i>	2 (3.8)

The final treatment of EPN in our study mainly included antibiotics alone or antibiotics with DJ stenting or antibiotics with DJ stenting with PCN and/or nephrectomy when the previous treatment measures failed to show any favorable clinical, laboratory and radiological response. We observed that antibiotics alone were successful in treating EPN in 23 patients (45.10%). Twenty-seven (52.94%) of the patients in our study also required DJ stenting after initiating the appropriate

antibiotic. Two patients underwent a few sessions of hemodialysis. Four (20%) required surgical interventions (nephrectomy in 3; 15%) and open drainage (1; 5%). The requirement for nephrectomy was associated with a higher radiological class of EPN (p=0.034) and AKI (p=0.032). Biopsies of nephrectomised tissues revealed evidence of acute-on-chronic nephritis with micro-abscess formation. Conservative treatment of grade 1/2 was associated with a good recovery, with a mean hospital stay of 9.2 days as compared to 19 days for non-conservative. AKI resolved in 8 patients before discharge. All patients improved at discharge and had improved renal function after 1 month of follow-up. DJ stent was removed after 1 month in all cases. There was no immediate mortality.

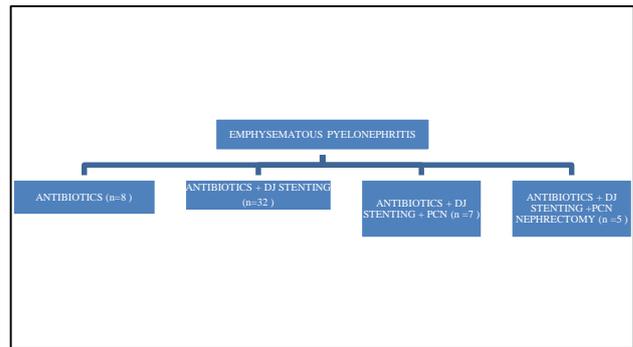


Figure 1: Various treatment modalities.

Table 4: Treatment according to EPN classification.

Class of EPN	Total no. of patients (n=8)	DJ stenting (n=32)	PCN (n=7)	Nephrectomy (n=5)
Class I	5	2	0	0
Class II	3	16	1	0
Class III	0	8	2	1
Class IV	0	6	4	4

Table 5: Pre and post-op lab values.

	Mean±SD	Min-Max
Creatinine (mg/dl)		
On admission	2.7	0.72-7.65
On discharge	1.4	0.56-2.31
Total leukocyte count (10⁹/L)		
On admission	14607	5600-32000
On discharge	9806	5300-12500
Platelet count		
On admission	1.68	34908-345000
On discharge	2.52	154000-434000

DISCUSSION

The factors associated with increased risk in mortality in EPN include altered sensorium thrombocytopenia, and/or shock at initial presentation along with polymicrobial

infections.^{7,8} We observed that patients in shock, low platelet count and/or a serum creatinine greater than 2.3 mg/dl subsequently required non-conservative treatment. This is consistent with Letal’s observations that patients with higher creatinine levels (>1.4 mg/dl) and thrombocytopenia (<60,000/mm³) were at high risk for complications.⁹ We observed 80% of our urine cultures had *E. coli* most common organism, which has been seen as trend in many studies where *E. coli* was the most commonly identified organism in urine cultures.^{10,11} Our study showed female preponderance, this is consistent with almost all studies.¹⁰⁻¹² In their study, Huang and Tseng encountered fever in 92% of their patients, abdominal or back pain in 88.5%.¹⁴ In our study, we found that fever was the most common symptom, followed by pain abdomen dysuria. A meta-analysis reported that 53.8% of patients had left-sided EPN, 30.7% had right-sided EPN, and 7.6% had bilateral EPN.¹⁴ In their study, Lu et al, showed no prognostic

significance with glycemic control.¹² In similar results were seen in our study glycemic control had no prognostic significance as all but one of our patients despite having poor glycemic control as reflected by their high mean HbA1c of 8.2±2.4% recovered. In a study by, Kapoor et al showed that higher rates of mortality were observed when presenting symptoms were altered mental status, thrombocytopenia, renal failure, and severe hyponatremia at the time of presentation.⁸ In their study, Khaira et al showed independent poor prognostic factors associated are shock at time of admission, serum creatinine >5.0 mg/dl, and disseminated intravascular coagulation were.⁴ Lu et al reported that poor prognostic factors for patients with EPN are need for hemodialysis, hypoalbuminemia <3 gm/dl, and polymicrobial infections.¹²

Previously early nephrectomy has been considered the treatment of choice in EPN with few reports suggesting increased mortality with medical therapy as compared to surgery.^{16,17} The mortality rate in a series by Ahlering et al advocating emergency nephrectomy was 42%.¹⁸ Kapoor et al have also reported that early nephrectomy is associated with higher mortality rates than an initial conservative approach.¹⁹ The meta-analysis by Aboumarzouk et al showed a significantly lower mortality rate in patients treated with percutaneous drainage and medical management compared to emergency nephrectomy.¹⁵ Falagas et al conducted a meta-analysis and concluded that conservative treatment alone, bilateral EPN, thrombocytopenia, systolic blood pressure <90 mmHg, serum creatinine >2.5 mg/dl and altered sensorium were associated with high mortality rates.¹⁴

CONCLUSION

EPN is a potentially life-threatening condition which is most commonly associated with poorly controlled diabetes. It requires a high index of suspicion in patients not responding to the routine management of pyelonephritis. It is a radiological diagnosis and CT is the best investigation. Aggressive resuscitation should be given and the condition is currently treated by medical management along with percutaneous drainage. Some patients may not respond and nephrectomy may be required.

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