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Urology

EMPHYSEMATOUS PYELONEPHRITIS - ITS CLINICAL PROFILE & OUTCOMES: OUR INSTITUTIONAL EXPERIENCE

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ABSTRACT **Introduction & Objectives:** Emphysematous pyelonephritis (EPN) is a necrotizing infection which results in gas within the renal parenchyma, collecting system, or perinephric tissue. Objectives of this study is to analyze the characteristics of patients with EPN with respect to patient demographics, clinical presentation, diagnostic investigations, microbiological findings, treatment modalities and outcomes. **METHODS:** The study involved 50 consecutive cases of EPN admitted in Department of Urology, Govt. Kilpauk Medical college during the period- Sep 2018 to Sep 2022. The diagnosis of EPN was based on clinical features and documentation of gas within the renal parenchyma, collecting system, or perinephric tissue on computed tomography (CT) abdomen. We retrospectively reviewed the clinical, laboratory, radiological, and microbiological findings, treatment modality, and outcome of these patients. **Results:** Mean age was 55yrs. 38(76%) were Females. 43(86%) were Diabetics, 6 patients had ipsilateral obstructive Ureteric calculus, 1 was having End stage renal disease. Most patients 32(64%) had extensive EPN (class 3 & 4). Most common Isolated Organism: Escherichia coli 29(58%).48 (96%) patients were managed with conservative treatment. PCD/PCN was done in 21(42%), DJS in 9(18%) and both PCD/PCN and DJS in 6(12%) cases. 12 (24%) cases were managed medically. Two required nephrectomy and one expired on conservative treatment. **Conclusion:** The treatment of EPN has evolved over the years from invasive surgery to more conservative approaches in the form of DJ stenting, percutaneous drainage. We recommend early aggressive medical treatment and suggest that nephrectomy be considered only if patients deteriorate or do not improve on conservative treatment.

KEYWORDS : Emphysematous pyelonephritis (EPN), Percutaneous Drainage/Nephrostomy (PCD/PCN), Double J Stenting (DJS)

INTRODUCTION

Emphysematous Pyelonephritis (EPN) is an acute necrotizing infection of the renal parenchyma and surrounding tissues. Gas may present in the renal parenchyma or collecting system or in the perinephric fat [1,2]. EPN was first reported in 1898 by Kelly and MacCallum [3] and was named by Schultz and Klorfein [4] more than 60 years later due to gas accumulation characteristics. It is more common in patients with diabetes mellitus (DM) or patients who are immunocompromised, with a female: male predominance of 4:1 and a mean (range) age of 57 (24–83) years [5,6]. A history of urolithiasis or urinary tract malignancy may also be associated with the occurrence of EPN [7,8]. An imaging-based classification system was first described in 1996 by Wan et al. [9], who distinguished EPN into two groups based on the detection of fluid and gas patterns in the CT findings. Class I refer to those cases that present with parenchymal destruction, with either the absence of fluid collection or the presence of streaky or mottled gas. Class II refers to those cases with either the renal or perinephric collection of bubbly or localized gas or gas in the renal collecting system. Class I is typically associated with poor prognosis and a higher mortality rate than Class II [9]. Huang and Tseng [7] reported another classification system bases on CT findings, which is currently widely used in clinical assessments. Huang and Tseng focused primarily on the gas distribution: In Class 1, the gas is present only in the renal collecting system; in Class 2, the gas is present in the renal parenchyma, without extension to the extrarenal area; in Class 3A, gas or abscess are present in the perinephric space; in Class 3B, gas or abscess are present in the pararenal space; and in Class 4 bilateral involvement can be observed. Although it is a life-threatening illness with a mortality rate of up to 50% there is no consensus on the best management of these patients [3]. EPN treatment options have evolved over time, ranging from aggressive operations to more conservative therapy approaches consisting primarily of drainage and medication [10]. The focus of treatment is an emergency nephrectomy (EN), percutaneous drainage (PCD), percutaneous nephrostomy (PCN) or medical management (MM), with or with no Double J (DJ) stenting of the urinary tract. Some reports recommend that EN should be the mainstay of treatment and not be delayed [1,2], but others recommended a more conservative approach with PCD [11-13], and a purely conservative approach with MM alone has also been advocated [14-16], which further increases the management conundrum.

AIMS AND OBJECTIVES

The aim of this study is to analyze the characteristics of patients with EPN with respect to patient demographics, clinical presentation, diagnostic investigations, microbiological findings, treatment modalities and outcomes.

MATERIALS AND METHODS

The study was carried out in the Department of Urology, Govt. Kilpauk Medical college, and Government Royapettah Hospital. The study involved 50 consecutive cases of EPN admitted during the period September 2018 to September 2022.The diagnosis of EPN was based on clinical features and documentation of gas within the renal parenchyma, collecting system, or perinephric tissue based on computed tomography (CT) abdomen. We retrospectively reviewed the clinical, laboratory, radiological, and microbiological findings, treatment modality, and outcome of these patients. Classified cases according to Huang & Tseng Classification 1- Gas in the collecting system only,2- Gas in the renal parenchyma only,3A- Extension of gas or abscess to the perinephric space,3B- Extension of gas or abscess to the pararenal space,4- EPN in bilateral kidneys or in a single functioning kidney. We defined conservative treatment of EPN as medical treatment alone or a combination of medical treatment and percutaneous catheter drainage or DJS or BOTH. The success of conservative treatment was defined as clinical resolution and disappearance/decrease in gas on follow-up imaging during hospitalization and after discharge from hospital on follow up. As per our institution protocol, the treatment included early adequate fluid resuscitation, rapid glycemic control through insulin infusion, close clinical and biochemical monitoring, initiation of higher i.v. antibiotics (third generation cephalosporin and Fluoroquinolone) at diagnosis. The antibiotics were revised if indicated by the results of susceptibility testing of the isolated organism. Patients were treated conservatively (medical management and/or DJ stenting/percutaneous drainage) OR with nephrectomy.

RESULTS

Mean patient age (range) was 55 (32-76) Yrs. Out of 50 patients, 38(76%) patients were females and 12 (24%) were males (Table-1).

Table 1: Gender Distribution Of Patients

GENDER	NUMBER OF PATIENTS[n(PERCENTAGE)]
Male	12(24%)
Female	38(76%)

At presentation 46 (92%) patients had Fever/chills, 43 (86%) had Flank pain, 26 (52%) had Dysuria, 36 (72%) had Renal angle tenderness, 10 (20%) had Altered sensorium, 14 (28%) had Hypotension (systolic Blood pressure <90 mmHg) (Table-2).

Table 2: Clinical Features At Presentation

CLINICAL FEATURES	NUMBER OF PATIENTS[n(PERCENTAGE)]
Fever/chills	46 (92%)
Flank pain	43 (86%)
Dysuria	26 (52%)
Renal angle tenderness	36 (72%)
Altered sensorium	10 (20%)
Hypotension (systolic Blood pressure <90 mmHg)	14 (28%)

43(86%) were Diabetics, 6 patients had ipsilateral obstructive Ureteric calculus, 1 was having End stage renal disease. Out of 50 patients the side of EPN on presentation was 17(34%) on right side,24(48%) on left side,9(18%) on bilateral (Table-3).

Table 3: Distribution Of Side Of EPN On Presentation

SIDE OF EPN	NUMBER OF PATIENTS[n(PERCENTAGE)]
Right	17(34%)
Left	24(48%)
Bilateral	9(18%)

According to Huang Tseng Classification of EPN 6(12%) belonged to Class1,12(24%) to Class2, 13(26%) to Class3A, 9(18%) to Class3B, 10(20%) to Class4. Most of our patients i.e., 32(64%) had extensive EPN (class 3 & 4) (Table-4).

Table 4: Distribution Of Cases According To Huang Tseng Classification Of EPN.

CLASSIFICATION	NUMBER OF PATIENTS[n(PERCENTAGE)]
1	6(12%)
2	12(24%)
3A	13(26%)
3B	9(18%)
4	10(20%)

Following are the laboratory Findings at presentation. Pyuria 47 (94%), Leukocytosis (leukocyte count >12,000/mm3) 45 (90%), Thrombocytopenia (platelet count <1 Lac/mm3) 16 (32%), Acute renal failure 38 (76%), Severe hypoalbuminemia (<3 g/dl) 31 (62%), Serum creatinine (mg/dl) * 2.14 (0.91), HbA1c %* 10.7 (2.4), Blood glucose at admission* (mg/dl) 250 (2.1) (Table-5)

Table 5: Laboratory Findings At Presentation (* Data Are Expressed As Mean (SD). SD: Standard Deviation,)

LABORATORY FINDINGS	NUMBER OF PATIENTS[n(PERCENTAGE)]
Pyuria	47 (94%)
Leukocytosis (leukocyte count >12,000/mm3)	45 (90%)
Thrombocytopenia (platelet count <1 Lac/mm3)	16 (32%)
Acute renal failure	38 (76%)
Severe hypoalbuminemia (<3 g/dl)	31 (62%)
Serum creatinine (mg/dl) *	2.14 (0.91)
HbA1c %*	10.7 (2.4)
Blood glucose at admission* (mg/dl)	250 (2.1)

On urine culture, isolated Organism are as follows: Escherichia coli 29(58%) being most common, followed by Klebsiella. pneumonia 12(24%), Pseudomonas aeruginosa 5(10%) and Growth negative 4(8%) on presentation. (Table-6)

Table 6: Organisms Isolated On Urine Culture At Presentation.

ISOLATED ORGANISM	NUMBER OF PATIENTS[n(PERCENTAGE)]
Escherichia Coli	29(58%)
Klebsiella Pneumonia	12(24%)
Pseudomonas Aeruginosa	5(10%)
Culture Negative	4(8%)

48 (96%) patients were managed with conservative treatment. PCD/PCN was done in 21(42%), DJS in 9(18%) and both PCD/PCN and DJS in 6(12%) cases. 12 (24%) cases were managed medically. Two patients required nephrectomy and one expired on conservative treatment (Table-7).

Table 7: Modality Of Treatment

MODE OF MANAGEMENT	NUMBER OF PATIENTS[n(PERCENTAGE)]
PCD/PCN	44
DJ Stenting	20
Both PCD/PCN and DJ Stenting	12
Medical Management	24
Nephrectomy	4

Figure 1 to 4 represent the CT images of different cases managed accordingly as explained in description.

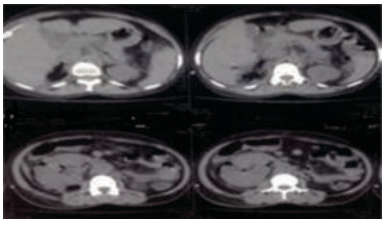

Figure 1. Case 1- 48 Years Old Female Had Emphysematous Pyelonephritis Class 2, Managed With DJ Stenting And Antibiotics.

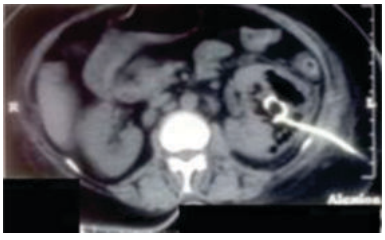

Figure 2: Case 2- 52 Years Old Female With Diabetes Had Emphysematous Pyelonephritis Class 3A, Managed With Percutaneous Drainage.

Figure 3:56 Years Old Male With Class 3B EPN, Managed With Right Percutaneous Drainage & Antibiotics.

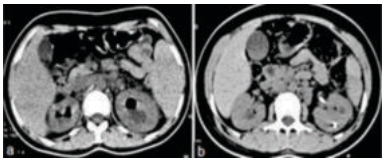

Figure 4: Case 4- 42 Years Old Female Had Class 4 EPN, Managed With Antibiotics And B/L DJ Stenting

DISCUSSION

EPN is an uncommon necrotizing infection predominantly seen in patients with diabetes mellitus (DM) or patients who are immunocompromised, with a female: male predominance of 4:1 and a mean (range) age of 57 (24–83) years [5,6]. In our study, Mean patient age was 55yrs. female: male ratio was 3:1 comparable to other studies. The increased occurrence in women is presumably because of their increased susceptibility to urinary tract infections. The most common clinical features in our series and reported by others include fever/chills, flank pain, renal angle tenderness, vomiting and dysuria. The factors believed to underlie the pathogenesis of EPN include gas-forming bacteria, high tissue glucose concentrations, impaired tissue perfusion and defective immune response which occurs in DM [17]. The high tissue glucose level acts as a substrate for the microorganisms such as Enterobacteriaceae to produce hydrogen (H_2) and carbon dioxide (CO_2) by mixed acid fermentation of glucose. In a study by Huang et al., five of the six gas samples contained H_2 and all the gas samples contained CO_2. E. coli is by far the most common causative organism for EPN isolated in 47–90% of the patients; the other commonly involved organisms include P. mirabilis, K. pneumoniae, Enterococcus species, and P. aeruginosa. [2, 15,18]. Escherichia coli was the most common causative organism involved in 29 (58%) in our study, second being Klebsiella pneumonia. In our study, 4 patients (8%) were Urine culture-negative. A recent meta-analysis has reported that 52% of patients had left-sided, 37.7% right-sided, and 10.2% bilateral EPN [18], In our study 34% of patients had EPN on right side,48% on left side,18% on bilateral. A recent meta-analysis has reported that in patients with EPN, shock is associated with high mortality rate [18]. Traditionally, early nephrectomy has been considered the treatment of choice in EPN with few reports suggesting increased mortality with medical therapy as compared to surgery [19,20]. However, surgery is often poorly tolerated in EPN due to poor hemodynamic status; the mortality rate in a series by Ahlering et al. advocating emergency nephrectomy was 42% [21]. Kapoor et al. have also reported that early nephrectomy is associated with higher mortality rates than an initial conservative approach [22]. In 1996, Chen et al. reported that antibiotic therapy combined with CT-guided percutaneous drainage was an acceptable alternative to nephrectomy. Our study consistent with other studies showed conservative management an acceptable management. A recent meta-analysis has shown that compared to emergency nephrectomy, percutaneous drainage and medical management alone are associated with a significantly lower mortality rate [18]. Our results also reflect the evolving trends in the management of EPN as the success rate of conservative treatment in our study was 96%.

CONCLUSION

The treatment of EPN has evolved over the years from invasive surgery to more conservative approaches due to the availability of better imaging modalities, potent antibiotics, and early intervention in the form of DJ stenting, percutaneous drainage, percutaneous nephrostomy; and nephrectomy done in rare cases. We recommend early aggressive medical treatment and suggest that nephrectomy be considered only if patients deteriorate or do not improve on conservative treatment.

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