

Emphysematous Pyelonephritis: A Single Centre Retrospective Study**Ketan Rajyaguru^{1*}, Rupesh Shah², Vatsal Patel³, Urvish Khatri⁴, Krunal Pradhan⁵**¹Associate Professor, Department of Urology, SVP Hospital, Smt NHL Municipal Medical College, Ahmedabad, Gujarat, India²Assistant Professor, Department of Urology, SVP Hospital, Smt NHL Municipal Medical College, Ahmedabad, Gujarat, India.³2nd Year Resident, Department of Surgery, Shardaben Hospital, Smt NHL Municipal Medical College, Ahmedabad, Gujarat, India.⁴2nd Year Resident, Department of Surgery, SVP Hospital, Smt NHL Municipal Medical College, Ahmedabad, Gujarat, India.⁵1st Year Resident, Department of Surgery, SVP Hospital, Smt NHL Municipal Medical College, Ahmedabad, Gujarat, India

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Abstract:

We present total 40 cases of Emphysematous Pyelonephritis (EPN) managed between 2018 & 2022. All the cases were analysed retrospectively. EPN was diagnosed by clinical presentation, X-ray, ultrasound and confirmed by CT scan. Total 40 cases (28 females and 12 males) of EPN were diagnosed. Out of 40 cases, 24 were acute pyelonephritis (APN), 12 were urosepsis and 4 were Multi-organ dysfunction syndrome (MODS). All patients were initially managed conservatively with antibiotics and IV fluids. Later patients were managed with either DJ stenting or percutaneous nephrostomy(PCN). Four patients directly underwent emergency nephrectomy. We conclude that we can manage patients of EPN more conservatively with drainage rather than emergency nephrectomy.

Keywords: Emphysematous Pyelonephritis, DJ stenting, Diabetes Mellitus, Percutaneous nephrostomy, Urosepsis.

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Introduction

Emphysematous pyelonephritis (EPN) is characterised by the production of intra parenchymal gas, which is a characteristic feature of a rare, but potentially life-threatening necrotising renal disease [1]. Diabetes and ureteric obstruction are the main predisposing factors. The most common isolated organism is *Escherichia coli* [2]. The symptoms of EPN can be nonspecific, but the clinical triad of fever, flank pain and nausea represent the most common presentation. The diagnosis and classification are performed with help of computer tomography (CT). The commonest organisms are *E. Coli*, *K. Pneumoniae* or *P. Mirabilis*. Use of broad spectrum antibiotics like third/fourth generation cephalosporins and imipenams are recommended treatment initially [3]. Though Kelley and McCullum reported initial case of EPN in 1898, no major change was found in the management for a century. In the last century, nephrectomy or open surgical drainage was the only option available to treat EPN. Though radical, they were associated with high mortality rate of 40-50% [4].

The management of EPN has experienced a significant change in the last two decades - may be due to availability of higher antibiotics, advanced imaging technique (CT scan) and multidisciplinary team approach. Minimal invasive methods like percutaneous drainage tube or DJ stenting are new tools for management of EPN. These procedures have the advantage of sparing nephrons and also reducing mortality. A few patients may need nephrectomy later [3]. It is very difficult to predict which patients will respond to conservative measures. Here we present our 4 year experience of management of EPN with analysis of risk factors.

Objectives: a) To evaluate the management and complications of patients diagnosed with Emphysematous pyelonephritis b) To evaluate the outcome of patients with Emphysematous pyelonephritis.

Materials and Methods

Study type: The type of study was retrospective, observational single centre study.

Study site: The study was conducted at Department of Urology and Surgery at tertiary care hospital, Ahmedabad.

Study duration: The study was conducted for a total duration of 4 years.

Inclusion criteria: a) Patients admitted at the tertiary care hospital with acute pyelonephritis or urosepsis or MODS (Multi-organ dysfunction syndrome) and diagnosed with Emphysematous pyelonephritis. b) Patients diagnosed with Emphysematous pyelonephritis of any gender with or without co-morbidities.

Exclusion criteria : Patients in whom diagnosis of EPN was done by CT scan after any type of surgical intervention.

Ethical approval: This observational retrospective study was conducted at tertiary care teaching hospital, Ahmedabad. The study begins after approval of Institutional Review Board (IRB) from the institute.

Study procedure: Total 40 cases of EPN diagnosed at our institution (SVP Hospital, Ahmedabad) during last 4 years were studied and their case records were reviewed. Patients vitals, co-morbidities and biochemical parameters were recorded. Diagnosis of EPN was confirmed by CT scan in cases presented as Complicated Acute pyelonephritis, Urosepsis or Multi-organ dysfunction syndrome(MODS). Cases were classified based on CT findings, as per Huang and Tseng which is shown in figure 1[5].

- Class I – Gas in ureter/pelvic/lyceal system;
- Class II – Gas in renal parenchyma;
- Class IIIa– Extension of gas into perinephric space;
- Class IIIb - Extension of gas into pararenal space;
- Class IV – Bilateral EPN or EPN in solitary kidney.

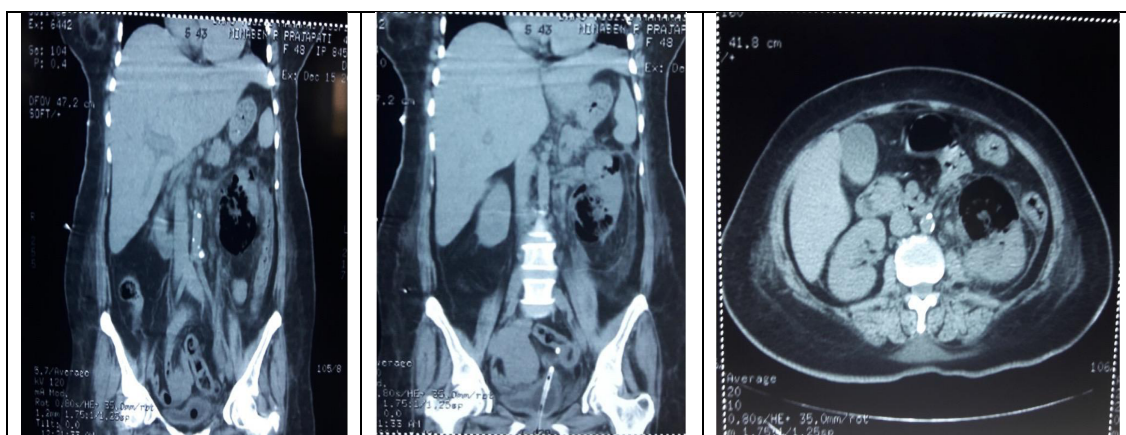


Figure 1: Class II (gas in renal parenchyma)

We analysed differences in clinical presentation, management and their outcome among the different classes of EPN. Multi-disciplinary team approach involving Nephrologist, Urologist, Endocrinologist and critical care specialist were taken as and when needed. Initial management was strict glycemic control, IV fluids with empirical antibiotic like cefoperazone and sulbactam combination or meropenem, along with or without metronidazole and hemodynamic support were given as and when required. Later antibiotics were given according to culture reports.

All patients were treated with emergency surgical approach either drainage(DJ stenting or PCN) or

nephrectomy. Risk factors for EPN like thrombocytopenia, acute renal insufficiency, altered mental status, and shock at presentation were taken into account for management of the cases[6]. Patients who did not respond well to drainage procedure were subjected to open nephrectomy. Dialysis was initiated as per nephrologist guidance. Clinical and laboratory details of these cases are provided.

Results

As shown in figure 2, out of 40 patients, 12 (30%) were males while 28 (70%) were females which suggest female predominance.

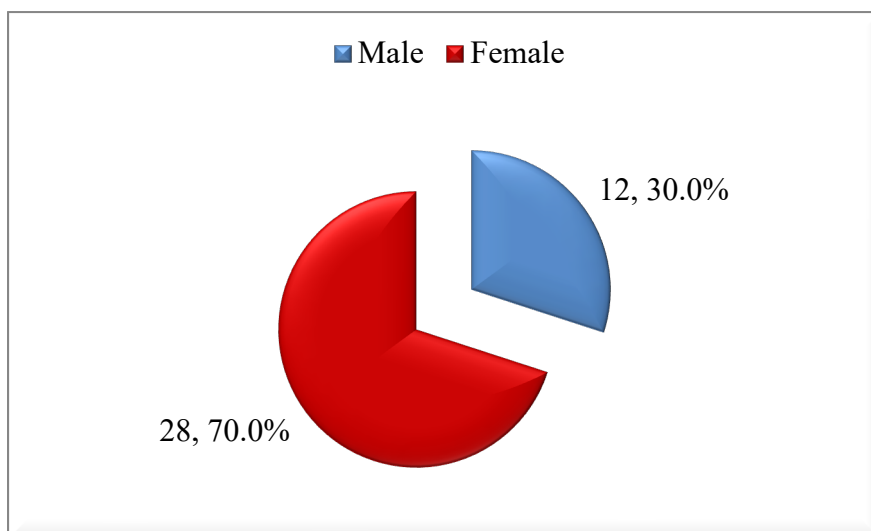


Figure 2: Genderwise distribution of patients

As shown in figure 3, various co-morbidities were also recorded. Out of 40 patients in the study, all had diabetes mellitus. Total 12 patients had hypertension while 8 patients had Ischemic Heart Disease (IHD). Total 5 patients had hyperlipidaemia.

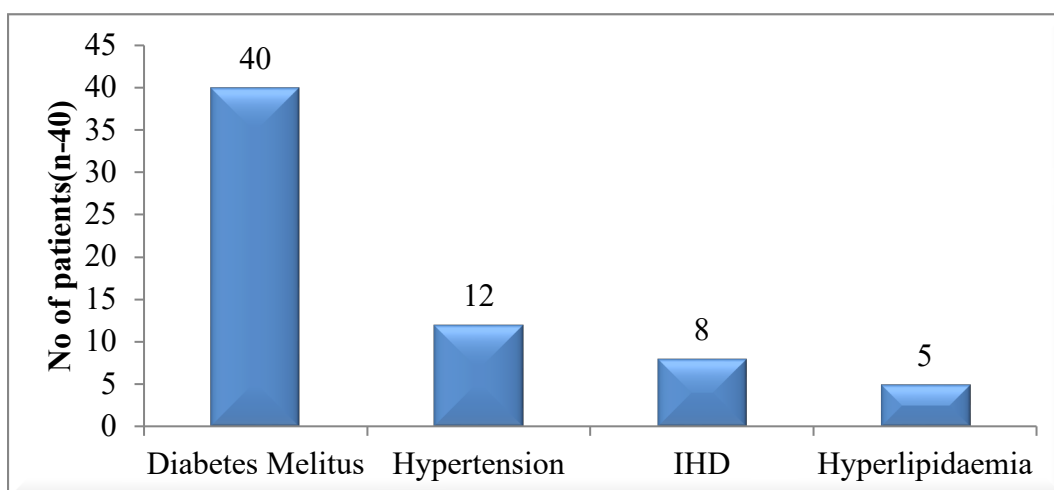


Figure 3: Distribution of Comorbidities among patients

The mean age of the patients were 60 ± 3.4 years. As shown in fig.1 the mean age in the survivals was 59 ± 1.2 years. While in patients who died, the mean age was 66 ± 2.9 years. As gender distribution, most of the females 24 survived with no significant p value (0.02). Out of 12 males, 9 survived while 3 died with no statistically significant p value (0.02).

Various co-morbidities were recorded. Out of which 33 patients survived with diabetes mellitus, with statistically significant values (0.012, OR 2.2).

Out of 12 patients of hypertension, 8 survived while 4 died. While 8 patients of Ischemic Heart Disease (IHD), 4 survived while 4 died with no statistical significant.

Out of 4 patients of shock, 1 survived while 3 died (p value-0.042). Most of the patients having leucocytosis were survived with p value 0.023. About 5 patients having altered mental status died while 1 survived with statistically significant value (0.0091). It is seen that polymicrobial infection leads to mortality in 4 patients (p value: 0.032).

Table 1 Demographic data and clinical characteristics of the patients with emphysematous pyelonephritis

Variable (Total 40)	Surviving (33)	Died (7)	p-value	Odd ratio (OR)
Mean age (years)	59 ± 1.2	66 ± 2.9	0.42	0.9 (0.8 -1.2)
Female (28)	24	04	0.02	0.8 (0.5 -1.4)
Male (12)	09	03	1.23	1.1 (0.04-1.4)
Co-morbidities				

Diabetes Mellitus – (40)	33	07	0.012	2.2 (0.1-3.3)
Hypertension –(12)	08	04	0.91	4.1 (1.3-6.7)
History of IHD – (08)	04	04	2.019	1.5 (0.9-3.2)
Laboratory Findings				
Leucocytosis (>11000) – (36)	32	04	0.0023	0.9 (0.2-2.8)
Thrombocytopenia (<100000) – (16)	09	07	2.091	5.3 (3.4-7.5)
HBA1C (>8.0) – (40)	33	07	0.041	1.0 (0.5-4.7)
Others				
Radiological Classification (IV) – (12)	05	07	0.103	0.2 (0.03-2.1)
Need of Hemodialysis – (05)	01	04	0.032	1.2 (0.2-4.7)
Shock –(04)	01	03	0.042	1.9 (0.9-2.6)
Altered Mental status –(06)	01	05	0.0091	2.9 (1.1-5.2)
Polymicrobial Infection –(05)	01	04	0.0032	0.9 (0.5-2.1)

All the cases had poor glycemic control (HbA1c >8%), with EPN being unilateral in 28 patients and bilateral in 12. Total 24 individuals were diagnosed with acute pyelonephritis (APN), 12 with urosepsis and 4 with MODS. To present with, 12 patients had impaired renal function. MODS was present in 4 patients who required hemodialysis during treatment. All patients had history of temperature

>101°F. Out of 40, 32 patients had tachycardia (pulse>100). 36 patient had leucocytosis, 16 had altered coagulation profile and 4 had hypotension (<90/60 mm hg). Patients were classified according to CT scan findings. Total 16 patients presented with EPN class 2 (40%). In class 4 EPN there were 12 (30%) patients. Number of patients in class 1 and 3 were four and eight respectively.

Table 2: Causative organisms from blood, urine and wound/pus.

Urine culture (28 cases, 70.0%)	Wound/Pus culture (08 cases, 20.0%)	Blood culture (04 cases, 10.0%)
E. Coli (16)	E. coli (04)	E. coli (02)
K. Pneumoniae(08)	K. Pneumoniae(02)	K. Pneumoniae(01)
Polymicrobial (04)	P. mirabilis (01)	P. mirabilis (01)
	Polymicrobial (01)	Polymicrobial (00)

As shown in the table 2, all the patients underwent urine culture report, Of them 28 (70%) were positive. Total 16 (57.2%) patient had E.Coli infection. Second commonest (8 in number) infection was by K. Pneumoniae (28.6%). Polymicrobial infection by both organism was present in 04 patients (14.3%). Eight out of 40 patients pus culture/wound culture was done, 04(50%) patient had E.Coli in

pus/wound culture, 02 (25%) patient had K. Pneumoniae and 01 (12.5%) patient had P. Mirabilis. One (12.5%) patient had polymicrobial infection. In 4 patients blood culture was done, of which 02 (50%) patients had E.Coli in blood culture, 01 (25%) patient had K. Pneumoniae and 01 (25%) patient had P. Mirabilis.

Table 3: Susceptibility rate of causative organisms to antibiotics

ANTIBIOTIC	E. coli-27	K. pneumoniae-16	P. mirabilis-3
Cefoperazone/ Sulbactam	15	10	2
Meropenem	13	6	2
Amikacin	9	4	2
Levofloxacin	4	4	3
Piperacillin/ Tazobactam	5	3	2
Linezolid	3	4	1

As shown in table 3, Out of all different cultures, Ecoli was present in 27 reports, K.pneumoniae was present in 16 reports and P.mirabilis was present in 3 reports.

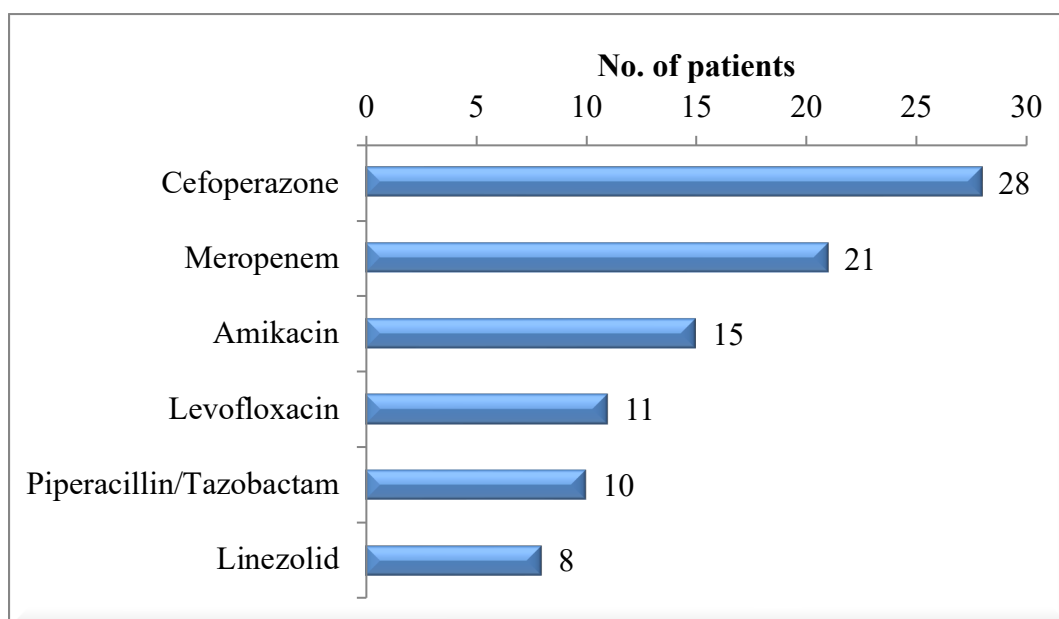


Figure 4: Sensitivity of antibiotics

As shown in figure 4, Sensitivity of antibiotics was tested and out of all culture reports Cefoperazone/sulbactam combination was sensitive in 28 reports. Meropenem, Amikacin and Levofloxacin were sensitive in 21, 15 and 11 reports respectively.

Thrombocytopenia (platelet count $<1,00,000/\mu\text{l}$) was noted in 16 cases but was life-threatening in 7 patients.

The overall survival rate in our series was 82.5% (33/40). Total 36 patients out of 40 were treated with drainage. Out of 36 patients 4 required further nephrectomy, of them 3 patients died. Remaining 4 patients with class IV EPN treated with emergency nephrectomy, who subsequently died.

Discussion

Although EPN is potentially life threatening urological emergency, early diagnostic suspicion, availability of advanced imaging techniques (CT scan) and availability of higher antibiotics allow conservative management of the disease in many patients. EPN is strongly associated with DM and urinary tract obstruction, presence of gas forming organisms and immunocompromised status [7]. In our series all patients had DM who developed EPN [5,9]. Female to Male ratio of EPN is 7:3, this is similar to other studies [9]. Female predominance to EPN could be due to increased susceptibility of UTI [10]. Those who presented late to hospital, three out of four patient required nephrectomy.

Altered Laboratory parameters are almost similar to those reported in literature like leucocytosis, thrombocytopenia and azotemia. E.coli and Klebsiella pneumonia are the most common organisms isolated from urine culture as seen in our pa-

tients. When there was polymicrobial infection mortality was high [11].

We followed classification of Huang and Tseng on basis of extension of gas in CT scan - 20 patients are in class 3-4, out of which 16 had either Urosepsis or MODS suggests severity of the disease which correlates with classification according to CT scan. Patients of class IV in Huang & Tseng classification had a very high mortality (7 out of 12 -58%). Which patient will not respond to drainage procedures or nephrectomy is difficult to predict [12].

Success rate of drainage and antibiotic was 88.8%(32/36) comparable to 66-92% other series [5,8]. All patients who underwent drainage were monitored and four patients required nephrectomy due to worsening of clinical condition out of which 3 patients died. So, though drainage procedure has a role in management of EPN, close watch is very important and timely intervention by nephrectomy can be lifesaving [13].

In our study, most patients who underwent nephrectomy could not survive. This may be due to the late presentation and very high associated comorbidities like IHD or MODS. Patients who presented early could be saved with help of drainage procedures (DJ or PCN). Inadvertent use of antibiotics or patient's negligence or physicians lack of knowledge lead to delayed presentation with resistant or polymicrobial infection causing failure to respond to proper treatment AND/OR Mortality.

Conclusion

EPN is a life threatening condition. With tools for early diagnosis and multidisciplinary team management, mortality can be decreased. CT scan is very important in diagnosis and management. Con-

servative management should be considered in patients on basis of clinical presentation and risk factors. Nephrectomy should be reserved for patients with multiple risk factors and patients who do not respond to drainage procedures. Close observation is very important during post operative course.

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