

**Author's Affiliation:**

<sup>1</sup>Additional Professor,  
<sup>2</sup>Senior Resident, Department of Nephrology  
Government TD Medical College,  
Alappuzha 688005, Kerala, India.

**Corresponding Author:**

**Ghasni Pasil R**, Senior Resident,  
Department of Nephrology Government TD  
Medical College, Alappuzha 688005, Kerala,  
India.

**Email:** [gaznipasil1988@gmail.com](mailto:gaznipasil1988@gmail.com)

## Management & Mortality of Emphysematous Pyelonephritis in Type 2 Diabetes Mellitus a Single Centre Experience

Mohandas M K<sup>1</sup>, Ghasni Pasil<sup>2</sup>

**Abstract**

Emphysematous pyelonephritis (EPN) is a life threatening necrotizing infection of the kidney. It is commonly seen in diabetic patients and continuous to be a major cause for morbidity Treatment options were limited in the past and most patients were managed surgically. With newer antibiotic protocols medical management is effective in most of the cases.

**Aims and Objectives:** To study about the mortality with conservative medical management of Emphysematous Pyelonephritis in type 2 Diabetes Mellitus patients.

**Methods:** Study population included type 2 Diabetes Mellitus patients with urinary tract infection (UTI) (proven by culture) and radiological evidence of Gas in the collecting system, renal parenchyma or perirenal tissue. 50 patients with EPN who were admitted in our hospital from 1 October, 2010 to March 31, 2021 were included in this prospective observational study. The clinical presentation, comorbidities, baseline laboratories data and abdominal CT scan were taken. Patients were classified into four stages based on CT imaging. All the patients were started on medical management with antibiotics. Those patients not responded to medical therapy were offered surgical treatment and the outcome of management was assessed.

**Results:** Mean age of the study group was 59.24 years. Fever was the most common presenting symptom (100%). E.Coli was the most common organism isolated from urine (75%). Patients were divided into different classes based on CT imaging and most of them belonged to class II (50%). Most of the patients managed successfully with antibiotics. Multiple factors found to influence the mortality such as shock, altered sensorium and advanced classes in CT scan.

**Conclusions:** Medical therapy is the corner stone of management of class I and class II EPN.

**Keywords:** Emphysematous Pyelonephritis; Type 2 Diabetes Mellitus.

**How to cite this article:**

Mohandas MK, Ghasni Pasil/Management & Mortality of Emphysematous Pyelonephritis in Type 2 Diabetes Mellitus a Single Centre Experience/Urology, Nephrology and Andrology International./2021;6(2):47-52.

## Background

Type 2 Diabetes mellitus patients constitute around 15% of Kerala's population. Of them, about 30-40% develop diabetic nephropathy. About 60-70% of end stage renal disease patients in Kerala are diabetic. Acute worsening of renal

function occur in Type 2 Diabetic mellitus patients due to infections like acute pyelonephritis. We have to suspect Emphysematous pyelonephritis when type 2 diabetes mellitus patients present with fever, rigor and chills, lower abdominal pain, dysuria and pyuria. Gas in the urine is also present in some cases. Longstanding uncontrolled diabetes mellitus leads to EPN. It is a severe form

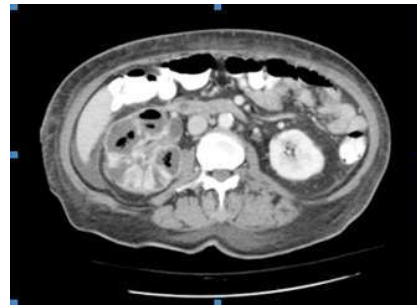
of upper UTI. EPN is a fulminant life threatening necrotizing infection of the kidney. Symptoms of EPN are characterized by gas formation within the collecting system, renal parenchyma or perirenal tissues. Most common predisposing factor for EPN is type 2 diabetes mellitus with lesser contributions from immunosuppressive conditions and urinary tract obstruction.<sup>3,4</sup> The presence of gas forming bacteria, impaired tissue perfusion (e.g. diabetic vasculopathy), and high levels of glucose predispose to EPN and explain the marked preponderance of diabetes in this condition. (Huang and Tseng, 2000) as well as asymptomatic bacteriuria being significantly more common in diabetics (Stapleton, 2002).

The extent of involvement ranges from inconsequential lower urinary tract colonization to cystitis, pyelonephritis and renal or perirenal abscess. EPN is an uncommon life-threatening condition, precipitated mainly by poorly controlled blood sugars and urinary tract obstruction. Prevalence of diabetes in patients with EPN ranges from 53%-90%. Nephrectomy was the treatment of choice for most patients with EPN in the past.<sup>5</sup> With the advent of newer antibiotics, medical management is found to be effective. Conventional treatment of EPN is parenteral antibiotics with percutaneous or open surgical drainage and/or nephrectomy. There is no current consensus on management of EPN as to whether present day antibiotics alone good enough or is surgical intervention necessary and if surgical intervention required when should one go for nephrectomy.

Diagnosis is confirmed through radiology. Abdominal x-ray can identify tissue gas distributed in the parenchyma that appears as gaseous shadows over the compromised kidney. As the infection advances, the gas extends into the perinephric space and the retroperitoneum. Ultrasound can show strong, localized echoes that suggest the presence of intraparenchymal gas. Computed tomography is the diagnostic imaging of choice for defining the extension of the emphysematous process and can aid in treatment selection. The presence of fluid in the renal or perinephric space with gas in bubbles or between the septa in the collecting system and the presence of striated or mottled gaseous patterns are associated with low mortality. The absence of fluid in the tomographic images or the presence of striated or mottled gaseous patterns with accumulated gas bubbles or septa appear to be associated with rapid destruction of the renal parenchyma and high mortality.

Since EPN is a severe life-threatening

necrotizing infection of kidneys, early diagnosis and a proper management is mandatory to reduce mortality and morbidity. Treatment for patients with emphysematous pyelonephritis are Medical management (MM), MM+Endoscopic or percutaneous drainage or Emergency nephrectomy. Currently nephron sparing approach with PCD with or without elective nephrectomy at later stage is the main treatment of choice for EPN and the mortality rate is significantly low in this type of management. Nephrectomy should be reserved for extensive form of EPN with multi organ failure or for patients who show a failed response to conservative management. Conservative management is indicated in Class 1 and Class 2 EPN and early cases associated with gas in the collecting system alone, with the patient otherwise stable.



**Class I:** Air seen only in dilated PCS.



**Class II:** Air seen in PCS and Renal parenchyma.

Conservative management involves keeping the patient well hydrated and giving parenteral antibiotics. Control of blood glucose level is mandatory. In cases of urinary tract obstruction, percutaneous drainage or stent placement is indicated for relief of the obstruction. Nephrectomy is indicated in Patients who fail to respond conservative management, Situations where there

is no access to PCD/ stenting. In addition to above management options, patients might need renal supportive care like dialysis or other modes of renal replacement therapy which seems to reduce the mortality rate significantly.

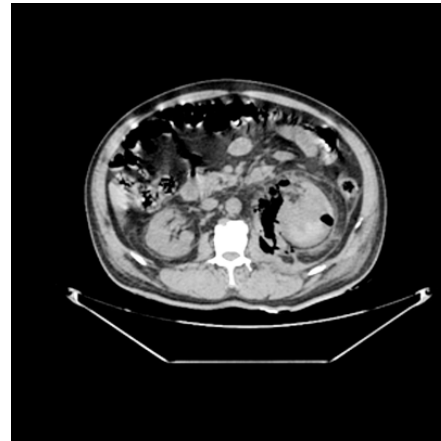
## Methodology

The present study was conducted between October 1, 2010 to March 31, 2021 at the Department of Nephrology, Government TD Medical College, Alappuzha, Kerala. The department cater to needs of patients from Alappuzha, Ernakulam, Kollam and Pathanamthitta districts of Southern Kerala. Inclusion Criteria used were: 1. Pyuria with culture positivity 2. Radiological evidence of gas in the collecting system, renal parenchyma, or perinephric or paranephric space. Patients who fulfilled the inclusion criteria were selected from nephrology Out Patient Department (OPD) and wards. The final sample size obtained was 50. Informed consent was taken from all the study participants. All the 50 study participants were having type 2 diabetes mellitus. Non emphysematous pyelonephritis and other UTIs were excluded from the study.

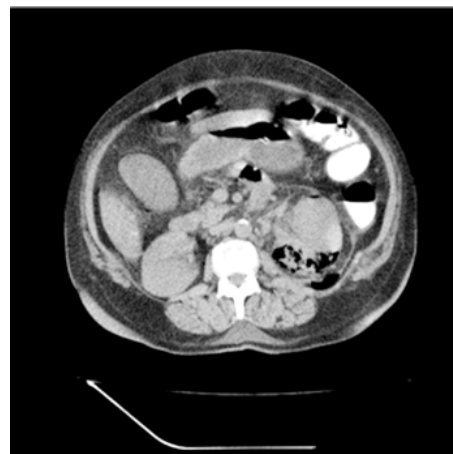
Age, sex, marital status, socioeconomic status, educational qualification and occupation were recorded. History pertaining to all co morbidities such as duration of diabetes mellitus, systemic hypertension, renal calculi, recurrent UTI, habits and additions were documented. Clinical history and physical examination were done for all patients. History of present illness such as fever, abdominal pain, dysuria, oliguria and altered sensorium were recorded.

Laboratory investigations including renal function tests, routine blood examination, platelet count, coagulation profile, serum albumin, blood glucose and urine examination was done for all patients. Azotemia was defined as serum creatinine is more than 2.5mg%, thrombocytopenia as platelet count less than 1,00,000/mm<sup>3</sup> and hypoalbuminemia as serum albumin less than 3.0gm%. Urine Culture and Sensitivity, plain X Ray abdomen, ultrasonography of kidney and urinary tract was performed at baseline. Non contrast CT was taken for all of them. Contrast enhanced computerized tomography (CECT) was performed in case of suspected renal abscess and non-recovering pyelonephritis. Staging of EPN was done using Huang et al - 2000 criteria 7- class I: gas in the collecting system only; class II: gas in the renal parenchyma without extension to the extra renal space; class III a: extension of gas or abscess

to the perinephric space; class III b: extension of gas or abscess to the para renal space; class IV: bilateral EPN or solitary kidney with EPN.<sup>1,8</sup>



**Class IIIA:** Air seen extending into perinephric space.



**Class IIIB:** Paranephric Space.



**Class IV:** Air in bilateral kidney.

All patients were initiated on standard medical management with IV antibiotics for two weeks followed by oral antibiotics for two weeks and antibiotic prophylaxis thereafter. These patients were periodically followed up in nephrology OP for recurrence/complications. The outcome of management including mortality was assessed. In statistical analysis quantitative variables were summarized by mean and standard deviation, qualitative variables were described by percentage distribution.

## Results

Mean age of the study group was 59.24 years (SD=7.8). Clinical features of our patients at presentation are discussed in Table 1.

**Table 1:** Clinical Features of Patients at Presentation.

Fever	50 (100%)
Dysuria	25 (50%)
Loin Pain	20 (40%)
LUTS	16 (32%)
Renal Stones	10 (20%)
Oliguria	25 (50%)
Altered sensorium	10 (20%)
Hematuria	25 (50%)
Shock	10 (20%)
Mortality	10 (20%)

Fever being present in all the study participants, was the most common presenting symptom followed by dysuria (50%), oliguria (50%), hematuria (50%) and altered sensorium (20%).

Regarding co-morbid illnesses while all the patients had diabetes mellitus, 30% had recurrent urinary tract infection and 20% had renal calculi. Laboratory results of patients are given in Table 2.

**Table 2:** Laboratory Characteristic and CT Imaging.

<b>(HEMOGLOBIN &lt;11 GM%)</b>	<b>10(20%)</b>
(White cell count > 10000/mm <sup>3</sup> )	40(80%)
Thrombocytopenia	8(16%)
<b>Urine culture</b>	
Culture positive	90%
E. Coli	50%
K. Pneumonia	10%
Pseudomonas	10
Polymicrobial	10%
Fungal	5%
Culture negative	10%

Blood culture positive	25%
DM duration	10.7 ±5.60
<b>HbA1C</b>	
<7%	20%
7-8%	50%
>8%	30%
<b>CT Classification</b>	
Class I	10(20%)
Class II	25 (50%)
Class III a	10 (20%)
Class III b	3 (6%)
Class IV	2 (4 %)
<b>Treatment</b>	
IV antibiotics alone	74%
Antifungals+antibiotics	6%
IV antibiotics+PCD	20%
Nephrectomy	0%
RRT requirement	34%

Of the study participants, 20% were anemic and 80% had leucocytosis. A total of 25 patients had azotemia (50%) and out of which two patients required dialysis. On CT imaging 20% of patients belonged to class I, 50% were in class II, 20% were in class III a, 6% were in class III b and 4% belonged to class IV. Around 20% patients required surgical interventions in the form of percutaneous Nephrostomy and DJ stenting. It was done in addition to medical therapy and all of them belonged to either Class III or Class IV.

E Coli was the most common bacteria isolated from urine (75%) of the patients. Klebsiella was present in 16.7 % patients and 8.3% of patients had mixed growth on culture. All patients received I V antibiotics for two weeks followed by oral antibiotics for two weeks. One patient each in class IIIa, class IIIb, class IV underwent surgical management due to unresponsiveness with medical therapy.

One patient in class IIIa presented with shock and succumbed to death before any surgical intervention could be planned, hence the overall mortality in our study was 10%. On analysing the risk factors for mortality, we found that presence of shock, altered sensorium and class IIIb / class IV in CT scan were associated with increased mortality.

## Discussion

EPN is a very rare yet life threatening medical emergency. Many factors have been implicated but most importantly high level of glucose with in the

tissue, gas forming organisms, impaired vascular supply and presence of obstruction are the culprits.<sup>8</sup> Vascular compromise with high glucose levels is unique to diabetic population and it explains why the condition is more common in diabetic patients. Mixed acid fermentation of glucose to produce Hydrogen (H<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) is the mechanism implicated.<sup>7,9</sup> In our study all of the patients were diabetic further underlining the association. From literature there is preponderance of EPN in females<sup>10</sup> and in our study the ratio was 4:1, mostly due to their increased susceptibility to urinary tract infection.<sup>1</sup> Clinical symptoms of EPN include fever, dysuria, hematuria, abdominal pain, vomiting depressed levels of consciousness and shock.<sup>5,7,11</sup> Similar to the published series, fever and dysuria were the most common symptoms in our study. Leucocytosis, and renal dysfunction were the most common laboratory findings in our study which is consistent with the reported literature.<sup>5,8</sup> In our study group most common organism isolated from urine was E Coli (75%) followed by Klebsiella (16.7%) similar to previous studies.<sup>12</sup>

Definitive diagnosis of EPN is done by CT scan and in 2000 Huang et al and Tseng put forward four radiological classifications of EPN based on the extent of gas seen on CT.<sup>9</sup> In our study most patients belonged to class II(50%) followed by class I and IIIa (20%). In an Indian study by Kapoor et al. altered mental status thrombocytopenia, renal failure and severe hyponatremia were predictors of higher mortality.<sup>13</sup> In our study, shock, altered sensorium, and class IIIb /class IV in CT scan were associated with increased mortality.

The treatment of EPN differs in the degree of urgency and that immediate nephrectomy historically has been the treatment of choice (Dutton *et al*, 2007; Wong *et al*, 2007) The mortality of this condition has improved from 78% in the late 1970, to 13.5% (Somani *et al*, 2008). This may be the result of earlier diagnosis with increasing use of CT scan and lesser degrees of EPN being identified earlier. It is clear that majority of patients can be treated successfully with supportive management and percutaneous drainage.<sup>14</sup>

EPN is often the dramatic climax to chronic subclinical UTI and as such, many patients may have received many courses of antibiotics with series risk of resistance to standard antibiotics (Soo park *et al*, 2006). The choice of treatment for EPN still continues to be a matter of debate. Most of the earlier investigations were in favour of aggressive surgical treatment.<sup>5,14</sup> In contrast to earlier reports recent series have voted in favour of

initial conservative management with antibiotics and resorting to surgical therapy only when medical management fails.<sup>15,16</sup> All our patients initially managed medically with intravenous antibiotics Overall mortality in our study was 10%.

## Conclusions

EPN a life threatening infection commonly seen in diabetic patients and is responsible for significant mortality if not managed promptly. A high index of suspicion and early imaging studies are required to diagnose EPN in diabetics presenting with features of pyelonephritis, especially if blood sugars are poorly controlled CT scan is the investigation of choice, in making the correct diagnosis. Renal preservation must be the aim of treatment, but this is often associated with significant morbidity, especially in patients with extensive EPN. With a good antibiotic policy most of the patients in class I, II and IIIa were successfully managed conservatively.

## References

1. Shokeir AA, El - Azab M, Mohsen T, El-Diasty T. Emphysematous pyelonephritis: A-15 year experience with 20 cases. *Urology* 1997; 49:343-6.
2. Smitherman KO, Peacock JE, Jr. Infectious Emergencies in patients with diabetes mellitus. *Med Clin North Am* 1995;79:53-77.
3. Michaeli J, Mogle P, Perlberg S, Heiman S, Caine M. Emphysematous pyelonephritis. *J Urol* 1984; 131:203e208.
4. Godec CJ, Cass AS, Berlcseth R, Emphysematous pyelonephritis in a solitary kidney. *J Urol* 1984; 124:119e121.
5. Alan R Pontin and Richard D. Barnes Current management Emphysematous pyelonephritis; *Nat. Rev Urol* 2009; 6:272-279.
6. Karthekeyan Aswathaman, Ganesh Gopalakrishnan Lionel Gnanraaj, Ninan K Chacko, Nithin S Kekre *et al*. Emphysematous pyelonephritis
7. Outcome of Conservative Management. *J Urology* 2008; 71:1007-1009.
8. Huang JJ, Tseng CC, Emphysematous pyelonephritis: Clinic radiological classification, management, prognosis, and pathogenesis. *Arch Intern Med* 2000; 160:797-805. .
9. Tang HJ, Li CM, Yen MY, *et al*. Clinical characteristics of Emphysematous pyelonephritis *J Microbiol Immuno Infect* 2001;34:125e130.
10. Huang JJ, Chen KW, Ruaan MK, Mixed acid

- fermentation of glucose as a mechanism of Emphysematous urinary tract infection. *J Urol* 1991; 146:148-51.
11. Wan YL, Lo SK, Bullard MJ, Chang PL, Lee TY. Predictors of outcome in Emphysematous pyelonephritis *J Urol* 1998; 169,369-73.
  12. Schultz EH, Jr. Klorfein EH, Emphysematous pyelonephritis *J Urol*. 1962; 87:762-6.
  13. Dutta P Bhansali A, Singh SK, et al. Presentation and outcome Emphysematous renal tract disease in patients with Diabetes mellitus. *Urol Int*. 2007; 78:13e22.
  14. KapoorR, Muruganandham K, Gulia AK, Singla M, Agarwal S, Mandhani A, et al. Predictive factors for mortality and need for nephrectomy in patients with Emphysematous pyelonephritis: *BJU Int* 2010; 105:986-9.
  15. Klein FA, Smith MJ, Vick 3rd CW, Schneider V, Emphysematous pyelonephritis diagnosis and treatment. *South Med J*, 1986, 79,41e46.
  16. Nagappan R, Klektcho S, Bilateral Emphysematous pyelonephritis resolving to medical therapy. *J Intern Med*. 1992;232:77-80.
  17. Dhabalia JV, Nelivigi GG, Kumar V, Gokhale A, Punia MS, Pujari N, Emphysematous pyelonephritis Tertiary care centre experience in management and review of the literature. *Urol Int* 2010;85:304-8.
  18. Huang and Tseng, "Emphysematous Pyelonephritis."
-