



CLINICO-MICROBIOLOGICAL SPECTRUM OF EMPHYSEMATOUS PYELONEPHRITIS: A TERTIARY CARE STUDY IN NORTH INDIA

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ABSTRACT

Emphysematous pyelonephritis (EPN) is a severe, gas-forming infection of the kidney involving the renal parenchyma, collecting system, or surrounding tissues. It occurs predominantly in patients with Diabetes Mellitus. Early aggressive medical treatment may help avoid surgical removal of the kidney (nephrectomy). **Aim:** To evaluate Clinical presentation, Diagnostic findings, Microbiological profile, treatment approaches. Patient outcomes and Prognostic factors influencing treatment success. **Materials and Methods:** Retrospective review of 40 patients with EPN was done. Analysis included: Clinical, laboratory, radiological, and microbiological data, treatment modalities and outcomes. Disease severity classified using the Huang classification system. **Results:** Diabetes Mellitus present in most patients. Majority were female (30 out of 40). Most common pathogen: Escherichia coli (30%). 24 patients (60%) improved with conservative management. 16 patients required ureteral stenting. No deaths reported with conservative treatment. About one-third had bilateral disease. **Conclusions:** EPN is strongly associated with diabetes and more common in women. Escherichia coli is the leading causative organism, Conservative treatment (antibiotics ± drainage) is effective in most cases. Nephrectomy should be reserved for: Patients who deteriorate Patients not responding to medical management.

Keywords: Diabetes Melitus, Emphysematous Pyelonephritis, Gas Forming Infection, Necrotizing Pyelonephritis.

INTRODUCTION

Emphysematous pyelonephritis (EPN) is a severe, life-threatening kidney infection characterized by acute necrosis of the renal parenchyma and surrounding tissues. A defining feature of this condition is the presence of gas, which may accumulate in the renal parenchyma, collecting system, or perinephric fat ^[1,2]. The most significant risk factor for EPN is Diabetes Mellitus, present in over 90% of affected patients ^[3,4]. Historically, EPN was first described in 1898 by Kelly and MacCallum ^[5] and later termed “emphysematous pyelonephritis” by Schultz and Klorfein ^[6] due to its gas-forming nature. EPN carries a high mortality rate, reported between 40% and 90% ^[7,8]. Management strategies for EPN have changed significantly over time ranging from aggressive surgical management (e.g., nephrectomy) to more conservative management, including Broad-spectrum antibiotics Percutaneous or internal drainage ^[9].

MATERIALS AND METHODS

The study was carried out at SMHS hospital, Govt. medical college srinagar. The study included 40 diagnosed cases of EPN admitted during the period from March 2021 to July 2023. The diagnosis of EPN was done based on clinical features and 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 reviewed retrospectively.

RESULTS

A Total of 40 cases of Emphysematous pyelonephritis were analysed. The mean age was 65+4 years. 30(75%) out of 40 were female, 30 (75%) patients were diabetic and 10 (25%) were having nephrolithiasis. Urine culture was positive in 14 (87.5%) patients. E. coli was the most common organism seen in 12 (30%) patients out of all culture positive samples. 18 (45%) patients had left EPN, 14 (35%) had right EPN and 8 (20%) had bilateral EPN. All patients received intravenous antibiotics according to the culture sensitivities or with empirical antibiotics in culture negative cases. All patients were given appropriate supportive care. 16 patients under-went DJ stenting. All patients improved at discharge and had improved renal



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function after 1 month of follow-up. DJ stent was removed after 1 month in all cases. There was no immediate mortality.

Following are The clinical details of each case along with the hemato-logical & metabolic panel, urine analysis, culture report, interventions, and outcome of each of the patients in the study.

Table 1: Clinical data

Variable	No. Of Patients
Fever	32
Flank pain	26
Vomiting	18
Dysurea	20
Renal angle tenderness	28

Table 2: Lab data

Variable	No. of patients
Leucocytosis	30
Pyurea	40
Hematuria	14
Serum creatnine	22
Raised Blood glucose	28
Raised procal	26
Raised CRP	16
Thrombocytopenia	14
Hypoalbuminemia	23

Table 3: Radiological data

Variable	No. of patients
Left sided	18
Right sided	14
Bilateral	08

Table 4: Microbiologic data

Organism present	No. of patients
E.coli	12
Proteus	08
Klebsela	04
Pseudomonas	00
Polymicrobial	04
Sterile	12

Table 5: Treatment

Medical management	24
Dj stenting	16
Nephrectomy	00

Table 6: Outcome

Outcome	No. of patients
Survived	40
Death	00

DISCUSSION

The symptoms of EPN infection can be non-specific, but the clinical triad of fever, flank pain, and nausea represent the most common presentations. Patients may also present with renal colic or hematuria. In cases of severe sepsis, patients may present with conscious disturbance. A history of urolithiasis or urinary tract malignancy may also be associated

with the occurrence of EPN^[10,11]. Costo vertebral angle tenderness is often present in cases of severe infection, and if the gas reaches the subcutaneous layer, subcutaneous crepitus may be noticeable during the physical examinations. Blood test abnormalities include leukocytosis, thrombocytopenia, elevated creatinine levels, high C-reactive protein levels, high procalcitonin levels

or hypoalbuminemia. Pyuria and hematuria can also be detected by urinalysis. The collection of the urine and blood cultures should always be performed prior to antibiotic administration. Patients may present variable symptoms and depends on the extent of renal involvement. And the disease may have an insidious onset and may rapidly progress to severe sepsis or septic shock.

Imaging studies are necessary when diagnosing EPN. Conventional abdominal X-ray plan film can only be used to detect abnormal gas shadows (crescentic configuration) in approximately 30% of cases. Ultrasonography is a better choice than abdominal films and can usually be used to detect the presence of an enlarged kidney with hyperechoic gas accumulations in the renal parenchyma or collecting system^[12,13]. On gray-scale ultrasound, a highly echogenic area with an associated ring down artifact, commonly referred to as dirty shadowing, indicates the presence of gas bubbles. The abscess presents as a hypoechoic well-circumscribed mass with poor through transmission. There will be no internal vascular flow on Doppler. Low-level internal echoes means hemorrhage or infection debris different from gas formation^[14].

Urologic computed tomography (CT) is the most valuable examination for EPN, which can be used to identify the infected kidney and gas accumulation, and provide an accurate assessment of the extent of infection. The characteristic findings include intraparenchymal, intracalyceal, or intrapelvic gas, often extending into the subcapsular space or across Gerota's fascia. Furthermore, CT can be used to detect possible ureteral obstructions and urolithiasis, which are often associated with EPN occurrence. On CT, infected kidneys appear heterogeneous and embedded with hypodense abscesses containing fluid and gas. In An imaging-based classification system was first described in 1996 by Wan et al.^[15], 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^[8]. In 2000, Huang and Tseng^[10] reported another classification system bases on CT findings, which is currently widely used in clinical assessments. Because most current research studies use the Huang and Tseng definition, all further discussions in this review will also reference this classification system. 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. The clinical pictures were showed in Figures 1 and 2. An increase in the gas distribution reflects an increase in the infection area, which is associated with an increase in the mortality rate, with Class 4 having the worst outcomes. The pathogenesis of EPN includes gas producing bacteria, high glucose concentration and defective immune response. the high glucose level acts substrate for the microorganisms such as ecoli. they produce hydrogen and carbon dioxide by glucose fermentation. The most common organism causing EPN is Ecoli, isolated in 50_85% of patients. Other common organisms include proteus, klebsella and pseudomonas. In EPN left kidney is involved more frequently than right.

Risk Factors and Prognostic Factors

Emphysematous pyelonephritis is strongly associated with multiple predisposing factors, the most prominent being Diabetes Mellitus, which is present in approximately 75–96% of cases, followed by obstructive uropathy (29–49%) and Hypertension in nearly 39% of patients^[16,17], affected individuals often demonstrate poor glycemic control, with mean HbA1c levels around 9.2%, and the resulting glucosuria provides a nutrient-rich environment that promotes proliferation of glucose-fermenting microorganisms, leading to gas production and necrotizing infection, while concomitant urinary tract obstruction further exacerbates disease progression by reducing renal blood flow and impairing tissue perfusion, thereby facilitating bacterial growth and limiting host defense mechanisms; in non-diabetic individuals, EPN is more commonly associated with immunocompromised states such as chronic alcohol abuse, Acquired Immunodeficiency Syndrome, and Tuberculosis^[18]. Factors such as prior urological procedures, recent hospitalization, and previous antibiotic exposure do not appear to significantly contribute to disease development. Female sex remains an additional risk factor, likely reflecting the higher baseline incidence of urinary tract infections in women.

CT is the gold standard for the diagnosis of urolithiasis. Yagihashi et al.^[20]. Had reported that a delayed nephrogram or excretory phase was associated with a 6.7-fold high risk of bacteremia such patients with stone obstruction. However, contrasted CT scan was still used widely in the emergent department to get more differential diagnosis. In addition to detecting the stones, CT scan provides the degree of hydronephrosis and retroperitoneal fat stranding. Emergent decompression for infection control was usually needed prior to the stone managements. Factors associated with poor outcomes and higher

mortality rates include advanced, age, altered mental status, thrombocytopenia, severe proteinuria, acute renal failure, shock (systolic blood pressure <90 mmHg), hypoalbuminemia (serum albumin <3 g/dL), polymicrobial infections and severe hyponatremia^[21]. Other common parameters related to infection, such as glycaemia, hemodynamic instability, leukocytosis, and coagulopathy, do not appear to be associated with EPN prognosis. The presence of hydronephrosis, urolithiasis, and bacteremia do not appear to affect the outcome. CT-based classifications can also be used to indicate the degree of the infection. Among patients with more severe diseases, higher rates of both nephrectomy and mortality were noted. The destruction of >50% of the renal parenchyma (typical of Class 3), based on CT findings, was reported to be a significant predictor of nephrectomy and death^[19]. In addition, to predicting overall mortality, some laboratory data can be used to predict the response to medical management. Low hemoglobin levels, low platelet and severe proteinuria were reported as independent risk factors for the failure of conservative treatments^[22].

CONCLUSION

Emphysematous pyelonephritis is a severe, life-threatening infection characterized by gas-forming destruction of renal parenchyma, most commonly caused by *Escherichia coli*, with Diabetes Mellitus representing the common predisposing factor. Computed Tomography is the current diagnostic modality of choice as it allows accurate classification of disease severity, thereby guiding management decisions. Treatment strategies have evolved from routine emergent nephrectomy to a more conservative, kidney-preserving approach that combines aggressive medical therapy with minimally invasive interventions such as percutaneous drainage, resulting in successful outcomes in the majority of patients. Certain clinical parameters including advanced age, altered mental status, thrombocytopenia, severe proteinuria, acute renal failure, shock, hypoalbuminemia, and polymicrobial infections have been identified as independent predictors of failure of conservative management.

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