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Original Research Article

Emphysematous pyelonephritis: is conservative management effective? Our experience and review of literature

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ABSTRACT

Background: Emphysematous pyelonephritis (EPN) is a urologic emergency caused by a life-threatening necrotizing infection of the kidney leading to an accumulation of gas in the renal parenchyma and perirenal tissue. we present the clinical details and outcome of twelve patients of managed at our institute and discuss their management and outcomes.
Methods: Twelve consecutive patients with EPN were managed in our institute from July 2014 to July 2018. Data on demographic profile, clinical features, laboratory investigations, imaging studies, outcome of patients and follow up details were recorded.
Results: Out of 12 patients with EPN, nine were female and three were male. Ten patients were diabetic (83%). All the diabetic patient had raised blood sugar at the time of admission ureteric stone was present in two nondiabetic patients. All the patients had fever at the time of presentation while localized flank pain was present in 6 (50%) patients. On examination, renal angle tenderness was present in ten patients while abdominal mass found in three patients. Pyuria was found in all patients while leukocytosis found in 10 patients. Two patients had thrombocytopenia while 4 had deranged renal parameters at the time of admission. Urine culture showed *Escherichia coli* in 8 patients and *Klebsiella* in two patients. Four patients required percutaneous drainage. Interval nephrectomy was done in one patient due to non-functioning kidney.
Conclusions: Majority of patients diagnosed as emphysematous pyelonephritis were managed conservatively due to diagnosed at an early stage. Percutaneous drainage is successfully utilized in patients with more advanced disease.

Keywords: Emphysematous pyelonephritis, Renal infection, Acute necrotizing

INTRODUCTION

Emphysematous pyelonephritis (EPN) is a urologic emergency caused by a life-threatening necrotizing infection of the kidney leading to an accumulation of gas in the renal parenchyma and perirenal tissue.[1] Kelly and MacCullum reported the first case of gas forming renal infection in 1898.[2] Schultz and Klorfein coined the term emphysematous pyelonephritis in 1962.[3] EPN is common in diabetes, especially in female. Nondiabetic patients can also develop EPN, albeit rarely, with a less severe clinical course as compare to diabetes.[4] In EPN, special attention is required due to the life-threatening complications.[1] We present the clinical details and outcome of twelve patients of managed at our institute and discuss their management and outcomes.

METHODS

Twelve consecutive patients with EPN were managed in BPS Government Medical College from July 2014 to July 2018. Data on demographic profile, clinical features,

laboratory investigations, imaging studies, outcome of patients and follow up details were recorded. The baseline characteristics including age, sex, comorbid disease, and status of glucose control. The clinical features included symptoms at presentation, duration of symptoms and physical findings like mental status, hemodynamic status, palpable mass or tenderness. The laboratory variables were serum creatinine level, total leukocyte count, platelet count, coagulation profile and serum sodium level. Based on extent on gas on CT scan, patients we were grouped into four types according to classification of Huang and Tseng. After admission, all the patients were initially managed by correction and maintenance of fluid and hemodynamic status, aggressive sugar control, optimization of coagulation value, and antibiotics. Initially broad-spectrum antibiotics were used. Ceftriaxone or sulbactam were piperacillin or tazobactam were used as first line of antibiotics. Aminoglycosides were added in patients who had normal renal function tests. Antibiotics were changed in accordance with the sensitivity reports when it was available. Imaging studies percutaneous drainage (PCD) of the renal or extrarenal lesion was done using ultrasonographic guidance. In patients who improved with PCD, tubes were removed either on and inpatient or outpatient basis. At the time of discharge patients were put on either levofloxacin or oral cephalosporins for four weeks. The patients were followed up for 6 to 12 months.

SPSS software is used for data analysis. Results were presented in the form of percentage.

RESULTS

Out of 12 patients with EPN, nine were female and three were male. age range was 45 to 61 years. Ten patients were diabetic (83%). All the diabetic patient had raised blood sugar at the time of admission ureteric stone was present in two nondiabetic patients. The clinical presentation of the patients is given in Table 1 and 2. All the patients had fever at the time of presentation while localized flank pain was present in 6 (50%) patients. Four patients (33%) had vague abdominal discomfort while nausea with or without vomiting was presenting in 5 (42%) patients. Dysuria and increased urinary frequency were seen in four patients. On examination, renal angle tenderness was present in ten patients while abdominal mass found in three patients. Abdominal tenderness was present in two patients while only one had hypotension at the time of presentation.

Pyuria was found in all patients while leukocytosis found in 10 (83%) patients. Two (16%) patients had thrombocytopenia while 4 (33%) had deranged renal parameters at the time of admission. Urine culture showed *Escherichia Coli* in 8 (66%) patients and *Klebsiella* in two patients. No bacteria could be isolated from 2 patients. Urine culture was positive in ten patients with *E. coli* was the most common organism isolated (8) followed by *Klebsiella* (2) and sterile in two patients. Dyselectrolytemia was present in four patients. CT scan was performed for confirmation of diagnosis as well as for classification. The distribution of patients into various classes based on radiological investigation is given in Table 4. Six patients were managed with antibiotic therapy. Four patients required percutaneous drainage. Interval nephrectomy was done in one patient due to nonfunctioning kidney.

Table 1: Clinical symptoms at presentation.

S. no.	Symptoms	Number of patients (%)
1.	Fever	12 (100)
2.	Flank pain	6 (50)
3.	Nausea and vomiting	5 (42)
4.	Dysuria and frequency	4 (33)
5.	Abdominal discomfort	4 (33)

Table 2: Clinical signs at presentation.

S. no.	Signs	Number of patients (%)
1.	Renal angle tenderness	10 (83)
2.	Abdominal mass	3 (25)
3.	Abdominal tenderness	2 (16)
4.	Hypotension	1 (8)

Table 3: Biochemical abnormalities at presentation.

S. no.	Biochemical abnormalities	Number of patients (%)
1.	Leukocytosis	10 (83)
2.	Hyperglycemia	10 (83)
3.	Anemia	5 (42)
4.	Raised S. creatinine	4 (33)
5.	Dyselectrolytemia	4 (33)
6.	Elevated ESR	3 (25)
7.	Thrombocytopenia	2 (16)

Table 4: Radiological classification of patients.

Imaging classification (by Huang and Tseng)	No. of patients (%)
Class 1	6 (50)
Class 2	4 (33)
Class 3A	2 (16)
Class 3B	0
Class 4	0

Table 5: Management of patients.

Treatment type (initial management)	No. of patient (%)
Medical management (antibiotic therapy alone)	6 (50)
Medical management + DJ stent	2 (16)
Medical management + Percutaneous drainage	4 (33)

DISCUSSION

Emphysematous pyelonephritis is a rare, severe acute necrotizing infection of the kidney characterized by the presence of gas within the renal parenchyma, collecting system and perirenal tissue.[6] EPN occurs most commonly in women, and diabetic populations are at increased risk of infection. Renal stone disease, structural abnormality of the urinary tract, and immunosuppression are commonly associated morbidity in nondiabetic population. Although a high glucose level could provide a favorable environment for the growth of gas producing bacteria in patient with diabetes, this was not associated with increased mortality.[7] Presence of gas in the renal parenchyma is the most characteristic feature of EPN. Rapid catabolism and bacterial infection have been suggested as the cause for increased gas formation as there is vascular compromise in the pyelonephritic kidney.[8] Huang and Tseng[5] have postulated that four factors are involved in the pathogenesis of EPN, which were gas producing bacteria, impaired tissue perfusion, and a defective immune response. Gram negative facultative anaerobic microorganisms such as *E. coli* are responsible for the production of gas via the fermentation of glucose and lactate. This process results in the production of high level of carbon dioxide.[5] *E. coli* is the most common bacteria implicated in EPN, others are *Klebsiella* and *Proteus*.[4,5] Most patients present in fourth or fifth decade.[6] The presenting physical symptoms and signs are those of pyelonephritis such as dysuria, fever/rigors, nausea, vomiting, and flank pain.[7,9,10] In our study fever and flank pain are the most common symptoms. Further potential clinical manifestations include acute renal dysfunction, acid-base disturbances on blood gases, hyperglycemia, thrombocytopenia and impaired consciousness.[5] Huang and Tseng had found that thrombocytopenia (46%), acute renal functional impairment (35%), disturbance in consciousness (19%), and shock (29%) can be the initial presentation. In our study, only 16% of the patients had thrombocytopenia, 33% have deranged renal functions and only one patient had hypotension. Emphysematous pyelonephritis is a radiological diagnosis which requires imaging, since most of the clinical and the laboratory findings will only indicate sepsis of renal origin. Abdominal X-ray reveals an abnormal gas shadow in the renal region raising suspicion, whereas an ultrasonography or CT will confirm the presence of intrarenal gas which supports the diagnosis of EPN. CT is preferred as it is more sensitive, and it also defines the extent of EPN by identifying features of parenchymal destruction.[5,6,11] Ultrasonography and plain radiograph of the abdomen are only accurate in 69 and 65% of cases, respectively, so abdominal CT is necessary for early diagnosis and further management of EPN.[12]

Staging of EPN is done radiologically based on the extent of gas in the renal parenchyma and surrounding tissues. It might be useful for decision making and prognostication. Langston and Pfister suggested a classification based on abdominal X-ray and intravenous pyelography, which was later modified by Michaeli et al.[13,14] They classified EPN into 3 classes.

In class I, gas in renal parenchyma or perinephric tissue, in class II, gas in the kidney and its surroundings. And in class III, extension of gas through fascia, or bilateral disease.

Wan et al classified the gas collection as type I or type II, based on CT scans.[6]

Type I was renal necrosis with presence of gas but no fluid in renal parenchyma, perinephric space, or collecting system.

Type II was parenchymal gas associated with fluid in renal parenchyma, perinephric space, or collecting system.

Huang and Tseng also used CT to classify patients with EPN as follows.[5]

Class 1: Gas in collecting system only.
Class 2: Parenchyma gas only.
Class 3A: Extension of gas into perinephric space.
Class3B: Extension of gas into pararenal space.
Class 4: EPN in solitary kidney, or bilateral disease.

The classification by Huang and Tseng is a superior due to the better prognostic value and is also helpful in selecting a management protocol. In their study, class 1 and 2 patients, all survived following treatment with percutaneous procedures and medical therapy. While in patients belonging to class 3 and 4, those with fewer than two risk factors (i.e. thrombocytopenia, acute renal function important, disturbance of consciousness and shock) had an 85% survival rate with percutaneous drainage and medical therapy.

Basic resuscitation measures of oxygen, intravenous fluids, acid base balance correction and appropriate antibiotic should be commenced along with good glycemic control. It is important to maintain a systolic blood pressure of more than 100 mmHg, with fluid resuscitation or inotropic support if required. Meta-analysis of the risk factors affecting the mortality rate concluded that a systolic blood pressure of 90 mmHg adversely affected the mortality rate when compared with a pressure of more than 100 mmHg.[1] Gram-negative bacteria remain the most common causative organisms so the initial antibiotic regimen should target them. Aminoglycosides, B lactamase inhibitors, cephalosporins and quinolones can be used, and this is guided by the local hospital policy. A combination of aminoglycoside with the any of the other three groups can be use in the report is available, the antibiotics can be changed according to the type and number of organisms along with their individual sensitivities.[15] Significant advances in the percutaneous catheters used made it possible to

have PCD as treatment option for EPN, which was first shown by Hudson et al.[16] Subsequent case studies have shown patients being successfully treated with PCD when used in addition to medical management, with significant reduction in the mortality rates.[7,9] PCD helps to preserve the function of the affected kidney in about 70% of cases. PCD should be performed on patients who have localized areas of gas and in whom functioning renal tissue is present.

Nephrectomy should be considered in a select group of patients who have gross destruction of renal parenchyma, have Class 3A or Class 3B gas distribution when there is simultaneous presence of 2 or more risk factors or when the involved kidney is non –functioning.[17] Dhabalia et al in their study similarly found that EPN can be successfully managed with conservative treatment modalities, and the such treatment strategies are associated with lower mortalities than emergency nephrectomies.[17]

CONCLUSION

EPN is a potentially life-threatening condition which is most 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 PCD. Some patients may not respond, and nephrectomy maybe required.

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