Management and Outcomes of Emphysematous Pyelonephritis – A study of 34 cases.

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ABSTRACT

Introduction: Emphysematous pyelonephritis (EPN) is a severe, necrotizing infection of the renal parenchyma; it causes gas formation within the collecting system, renal parenchyma, and/or perirenal tissues . Gas in the renal pelvis alone, without parenchymal gas, is often referred to as emphysematous pyelitis. The main objective of this study is to elucidate the clinical features,radiological classification, prognostic factors of Emphysematous pyelonephritis , to compare the modalities of management and outcomes among various radiological classes of EPN.

Materials & Methods:

The present study was conducted among the patients who were admitted between September 2013 to September 2015. 34 consecutive cases diagnosed as EPN were included in the study. The baseline characteristics , laboratory data, abdominal CT scan was taken. Based on CT scan staging , HDN/ HDUN/collection was managed with PCN/DJ stenting/ PCD/ nephrectomy and results noted.

Results: The mean age of our patients was 55 years , with a male to female ratio of 1.2:1. The most common predisposing factor was diabetes (28 cases-82%) followed by urolithiasis. Right side (50%) was more commonly affected than left (35.3%). Five patients (11.7%) had bilateral involvement and one had EPN of solitary kidney (2.9%). 2 patients (6%) received antibiotics alone , four (12%) had an early nephrectomy , 25 (73%) received PCD/PCN/DJ stenting alone and 3(9%) had delayed nephrectomy after initial PCD

Conclusion:

Traditionally EPN is associated with high mortality, but presently the mortality rates seem to be reducing because of improved staging modalities and effective antibiotics /PCD/ PCN/DJ stenting.Identification of prognostic factors may stratify patients for conservative or surgical management.In the era of effective antibiotics & interventional radiology the threshold for early nephrectomy should be high, which is associated with high mortality

Keywords: Emphysematous pyelonephritis, nephrectomy, necrotizing infection, renal parenchyma.

INTRODUCTION

Emphysematous pyelonephritis is a severe, necrotizing infection of the renal parenchyma; it causes gas formation within the collecting system, renal parenchyma, and/or perirenal tissues[1].

EPN is common in persons with diabetes, and the presentation of EPN is similar to that of acute pyelonephritis. However, the clinical course of EPN can be severe and life-threatening if not recognized and treated promptly.

Kelly and MacCullum reported the first case of gas-forming renal infection (pneumaturia) in 1898[2]. Since then, a multiplicity of terms such as "renal emphysema," "pneumonephritis," and "emphysematous pyelonephritis" have been used to describe this gas-forming infectious disease. As suggested by Schultz and Klorfein in 1962, emphysematous pyelonephritis is the preferred designation, since it stresses the relation between acute infectious process and gas formation.

EPN is a rare condition. Only 1-2 cases per year are encountered in a typical busy urological department in the United States. However, the frequency of reports from developing nations suggests that this may be a reflection of access to health care and health education. Because the condition preferentially affects persons with diabetes, the reported frequency reflects how poorly diabetes is controlled in these geographical areas. A renal calculi is another predisposing condition and therefore affects the frequency of EPN.

MATERIALS AND METHODS

The present study was conducted between June 2012 to March 2015.A total of 34 consecutive cases were diagnosed as EPN as they met all of the following criteria: (1) symptoms and signs of upper UTI, or fever with a positive urine culture or pyuria without other identified infectious foci; (2) radiological evidence (by CT scan) of gas accumulation in the collecting system, renal parenchyma, or perinephric or pararenal space; (3) absence of any fistula between the urinary tract and bowel; and (4) absence of any recent history of trauma, urinary catheter insertion, or drainage.

The baseline characteristics, clinical features, and laboratory data at the initial presentation, management, and outcome were studied prospectively . The baseline characteristics included age, sex, history of DM, status of glucose control (A glycosylated haemoglobin A1c level >7.5% was defined as a glucose level in poor control) . The clinical features at the initial presentation included the hemodynamic status, renal function, and the degree of consciousness. The duration from the onset of symptoms and signs to diagnosis of EPN were also checked. Shock was defined as a systolic blood pressure less than 90 mm Hg

Disturbance of consciousness included confusion, delirium, stupor, and coma. Leucocytosis was defined as a blood leucocyte count higher than 12 × 109/L. Thrombocytopenia was defined as platelet count lower than 100,000/µL. Renal impairment at presentation was defined as serum creatinine of more than 2.5 mg/dl.

Abdominal CT scan was performed for all 34 cases. According to the findings on the CT scan, they were classified into the following classes: (1) class 1: gas in the collecting system only (so-called emphysematous pyelitis); (2) class 2: gas in the renal parenchyma without extension to the extra renal space; (3) class 3A: extension of gas or abscess to the perinephric space; class 3B: extension of gas or abscess to the pararenal space; and (4) class 4: bilateral EPN or solitary kidney with EPN . The perinephric space was defined as the area between the fibrous renal capsule and renal fascia. The pararenal space was defined as the space beyond the renal fascia and/or extending to the adjacent tissues such as the psoas muscle. The differences of clinical features, management, and outcome among the 4 classes were compared and analyzed. Insertion of percutaneous catheter into the renal or extra renal lesion was performed via imaging guidance (i.e., renal CT scan).

RESULTS

The mean age group in the present study was 55 years . The male to female ratio was 1.2:1.The most common predisposing factor was diabetes (82%) , followed by urolithiasis (14.7 %). Twenty-eight (100%) of the 28 patients with DM had a glycosylated haemoglobin A1c level higher than 7.5%. Right side(50%) was more commonly affected than left(35.3%) . Five patients(11.7%) had bilateral involvement and one had EPN of solitary (2.9%) kidney . The urine culture was positive in 31 patients .Escherichia coli was the most common organism isolated (25 patients) followed by klebsiella (six).Blood cultures were positive in 9 patients which were similar to urine cultures. All were E.coli. Anaerobic organisms were not obtained in our study. The overall survival rate was 85%(29/34 patients) .Overall renal salvage rate was 73.4% (29/39 renal units).

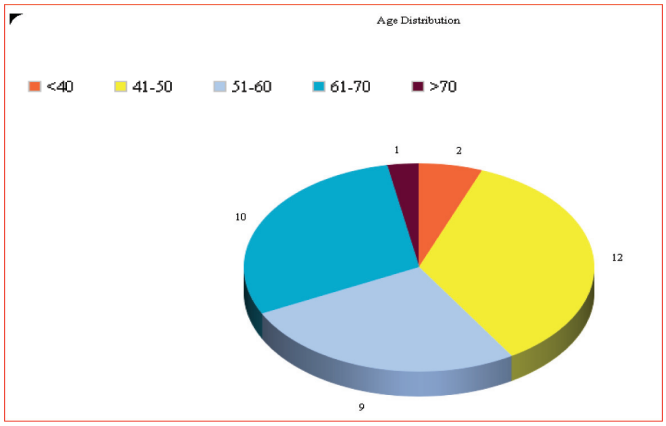

Table-1: Base line risk factors- outcome

Base line factor(mean (SD) or n (%) Variable	overall	Group A	Group B	Group C	P
Total patients	34	25	4	5	
Age, years	55(7.2)	53(8.3)	56(9.4)	59(4.8)	0.23
Male/female	19/15	11/14	4/0	4/1	0.056
Poor glycemic control (HbA1c >7.5%)	28	20	4	4	0.615
Delay in presentation	19	13	2	4	0.499
Positive blood cultures	9	3	4	2	<0.001
Initial dialysis	12	5	3	4	0.028

Table-2 : Prognostic factors – outcome

Prognostic factor	Overall (34)	Group A (25)	Group B (4)	Group C (5)	p
Mental status Confusion.delirium.stupor. coma	4	0	1	3	< 0.001
Shock at presentation SBP<90mm /Hg	17	10	2	5	0.050
Renal failure at presentation (Scr >2.5mg/dl)	23	15	3	5	0.2062
Thrombocytopenia (< 100,000/micro L)	12	5	2	5	< 0.001
Leukocytosis (>12000/ micr L)	32	23	4	5	0.682

Table -3 :CT Classification-Final outcome

Haung & Tseng Classification	Overall	Group A	Group B	Group C	P value
Class 1	3	3	0	0	0.5531
Class 2	12	9	1	2	0.851
Class 3	15	10	3	2	0.4161
Class 4	4	3	0	1	0.6501
Parenchymal destruction> 50%	10	2	3	5	<0.001

Table -4 :Management-Final outcome

Management	overall	Group A	Group B	Group C	p
Antibiotics alone(6%)	2	2	0	0	0.6822
DJS/PCD/PCN alone(73%)	25	23	0	2	<0.001
Early nephrectomy(12%)	4	0	1	3	<0.001
Delayed nephrectomy(9%)	3	0	3	0	<0.001

Figure -1: Investigations showing damage to renal parenchyma and mild hydronephrosis.

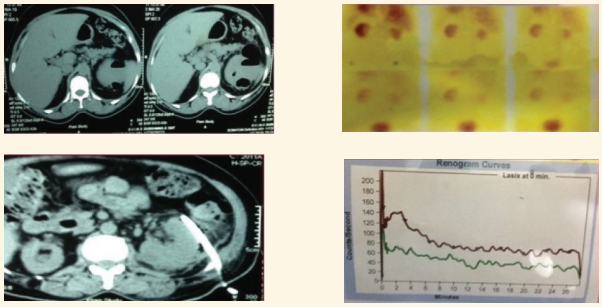

Figure 2: 50 years old female with left class- 3 EPN (Managed conservatively

DISCUSSION

Emphysematous pyelonephritis has been defined as a necrotizing infection of the renal parenchyma and its surrounding areas that results in the presence of gas in the renal parenchyma, collecting system or perinephric tissue[3]. More than 90% of cases occur in diabetics with poor glycemic control. Other predisposing factors include urinary tract obstruction, polycystic kidneys, end stage renal disease and immunosupression[3,4].

In 2000, Huang and Tseng modified the staging proposed by Michaeli et al, as follows:

- Class 1 - Gas confined to the collecting system
- Class 2 - Gas confined to the renal parenchyma alone
- Class 3A - Perinephric extension of gas or abscess
- Class 3B - Extension of gas beyond the Gerota's fascia
- Class 4 - Bilateral EPN or EPN in a solitary kidney

The pathogenesis of EPN remains unclear. However, four factors have been implicated, including gas-forming bacteria, high tissue glucose level (favoring rapid bacterial growth), impaired tissue perfusion (diabetic nephropathy leads to further compromise regional oxygen delivery in the kidney resulting in tissue ischemia and necrosis; nitrogen released during tissue necrosis) and a defective immune response due to impaired vascular supply. Intrarenal thrombi and renal infarctions have been claimed to be predisposing factors in non-diabetic patients[3,4].

The main bacteria causing emphysematous pyelonephritis are the classical germs of urinary tract infection. The most common is Escherichia coli. Other bacteria include Klebsiella pneumoniae, Proteus mirabilis and Pseudomonas aeruginosa[4-6]. Anaerobic infection is extremely uncommon[7].

The mean patient age was 55 years old. Women outnumbered men probably due to their increased susceptibility to urinary tract infections. The left kidney was more frequently involved than the right one[8]. The clinical manifestations of EPN appear to be similar to those encountered in classical cases of upper urinary tract infections.

Earlier investigators recommended that early aggressive surgical intervention, along with medical treatment, could decrease the mortality rate in patients with EPN.

Others concluded that vigorous resuscitation an appropriate medical treatment should be attempted, but immediate nephrectomy should not be delayed, for the successful management of EPN.

Traditionally EPN is associated with high mortality, but presently the mortality rates seem to be reducing because of improved staging modalities and effective antibiotics/PCD/PCN and DJS.Identification of prognostic factors may stratify patients for conservative or surgical management.In the era of effective antibiotics and interventional radiology the threshold for early nephrectomy should be high, as it is associated with high mortality. The advantages of PCD include drainage of pus, relief of gas pressure to facilitate local circulation, and a high success rate in extensive EPN.

Therefore, we suggest that for patients with extensive EPN (class 3 or 4) with the benign manifestation (less no of poor prognostic factors); PCD combined with antibiotic treatment may be attempted owing to the high success rate and to preserve the kidney function.

Based on CT staging, Hydronephrosis/ hydrourteronephrosis/ collection were managed with Percutaneous nephrostomy(PCN) / DJ stenting/PCD. Patients were routinely re-imaged after 3 days to assess the proper placement of tubes and the need for additional drainage tubes

If there is no clinical response or deterioration in spite of drainage and antibiotic therapy, these patients had an early nephrectomy.In patients who improved with PCD/PCN, the tubes were removed either on an inpatient or an outpatient basis after ensuring the complete drainage of all collection. Patients were discharged with culture specific antibiotics for 2 weeks

The function of affected kidney was assessed by DTPA renogram and CT imaging during follow-up (4-6 weeks).Patients who had Non functioning/poorly functioning kidney (<10%) had delayed nephrectomy

Patients were grouped into: Group A: Survived with salvage of renal unit , Group B: Survival after nephrectomy and Group C : Death

In the present study, no significant differences were noted in patients mean age, glycosylated hemoglobin HbA1c level and duration of symptoms among the three groups (Table-1).Positive blood cultures and need for initial hemodialysis was associated with poorer outcome (Table-1).

Although nephrectomy may be the quickest way of treating the infection source, renal function is compromised in many patients; therefore, a strategy to preserve nephrons may be very desirable. The above-mentioned series highlight such an approach, reserving nephrectomy for patients in whom conservative treatment does not elicit a response. Management is based on the clinical and laboratory findings. If the patient is stable, conservative treatment with antibiotics and drainage should be tried[7]. If the patient has gas in the renal parenchyma and perinephric tissues along with significant exudate, initial percutaneous drainage should be given a chance. Saving nephrons and the patient's life should be weighed based on the clinical situation, response to treatment, and available facilities.

The treatment of EPN remains controversial. According to some investigators[4,5] vigorous resuscitation, administration of antimicrobial agents and control of blood glucose and electrolytes should be followed by immediate nephrectomy. Huang and Tseng et al[3,9] proposed certain therapeutic modalities based upon their radiological classification system. Localized emphysematous pyelonephritis (class 1 and 2) is confronted by antibiotic treatment, combined with CT-guided percutaneous drainage. For extensive EPN (classes 3 and 4) without signs of organ dysfunction antibiotic therapy combined with percutaneous catheter placement should be attempted. However nephrectomy should be promptly attempted in patients with extensive EPN and signs of organ dysfunction.

Risk factors indicating poor prognosis include thrombocytopenia, acute renal failure, disturbance of consciousness and shock[3,10]. However Falagas et al[11] suggested that increased serum creatinine level, disturbance of consciousness and hypotension may need further research to confirm their potential use as risk factors for fatal outcome. Furthermore their meta-analysis suggest that conservative treatment alone is a risk factor for adverse outcome, although one must take into consideration the different scheme, used by the authors of the studies included, when defining terms such as conservative treatment.

In summary, in high risk groups, such as diabetics, presenting with persistent upper urinary tract infection semiology that does not resolve with proper antibiotic treatment, the presence of a severe renal infection such as EPN should be considered. CT-guided percutaneous drainage or open drainage, along with antibiotic treatment, may be a reasonable alternative to nephrectomy. However surgical intervention should not be delayed in patients with extensive disease or in those who do not substantially improve after appropriate medical treatment and drainage.

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