



Research Article

Emphysematous pyelonephritis – A case series from a single centre in Southern India

Phanisri Alaparathi¹, Shobhana Nayak Rao^{2*} and Pradeep Shenoy M³¹Postgraduate Student in General Medicine K.S Hegde Medical Academy, Derlakatte, Mangalore 575013, India²Associate Professor and Head, Department of Nephrology, K.S Hegde Medical Academy, Mangalore, India³Assistant Professor Nephrology, K.S Hegde Medical Academy, Mangalore, India

***Address for Correspondence:** Shobhana Nayak Rao, Associate Professor and Head, Department of Nephrology, K.S Hegde Medical Academy, Mangalore, India, Tel: +91-824-2204471-76; Fax: 0824-2204016; Email: nayak_shobhana@rediffmail.com

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Abstract

Emphysematous pyelonephritis (EPN) is a rare but potentially life-threatening necrotizing renal parenchymal infection characterised by the production of intra-parenchymal gas. The approach and the management of emphysematous has changed dramatically over the last two decades with the advent of computed tomography (CT)-based diagnosis and advances in antibiotic therapy as well as multidisciplinary intensive care of sepsis leading to an overall decline in mortality rates to 20-25%. The previously standard treatment for EPN which included nephrectomy of the affected kidney has been replaced by minimally invasive and nephron sparing surgery with better patient outcomes. We present our case series of 12 patients with EPN over a short period of two years treated at our tertiary care centre in South Western India.

Introduction

Emphysematous pyelonephritis (EPN) is a rare but potentially life-threatening necrotizing renal parenchymal infection characterized by the production of intra-parenchymal gas. The reported prevalence in Western countries is still low at 1-2 cases /year in urology practices. However the prevalence may be higher in the Indian subcontinent possibly due to a higher rates of untreated diabetes mellitus, a definite predisposing risk factor. Till about two decades ago, the standard treatment for EPN was nephrectomy of the affected kidney because efforts at preserving the kidney by non-surgical treatment led to mortality of 60-80% [1]. The situation has however improved dramatically since the last two decades with the advent of computed tomography (CT)-based diagnosis and advances in antibiotic therapy as well as multidisciplinary intensive care of sepsis leading to an overall decline in mortality rates to 20-25% [2]. We present our case series of 12 patients with EPN treated at our tertiary care centre in South Western India.

Materials and Methods

We retrospectively analysed the medical records of 12 consecutive cases of emphysematous pyelonephritis admitted between Jan 2014-May 2016 at the KS. Hegde Medical Academy, a tertiary care medical college hospital in Mangalore. Demographic data, clinical and laboratory profile and patient outcomes were documented. The presence and duration of diabetes mellitus (DM) as well as other predisposing factors such as urinary tract obstruction were noted. Renal function, hemodynamic status and level of consciousness at initial presentation as well relevant biochemical

parameters were recorded. Initial diagnosis was recorded as acute pyelonephritis (APN), urosepsis or multi-organ dysfunction (MODS). APN was diagnosed by the triad of fever, loin pain and dysuria. Urosepsis was defined as pyuria with markers of sepsis syndrome and positive urinary/blood culture. MODS was defined as clinical or biochemical markers of dysfunction of two or more organ systems in the presence of sepsis. Acute kidney injury was defined as fall in GFR by 50% compared to baseline or elevation of serum creatinine level by more than 0.3mg/dl compared to previously documented report or first value after adequate fluid resuscitation. Diagnosis of EPN was based on either initial ultrasound evidence of gas in renal parenchyma, confirmed by CT scan of abdomen in all patients. Cases were classified into four classes based on CT findings as described by Huang and Tseng [3]. We analyzed the difference in clinical features, management and outcome among the different clinic-radiological classes of EPN. All patients were treated by the multidisciplinary team comprising of the nephrology, urology and intensive care team if the patient was in the ICU. Standard treatment protocols for fluid resuscitation, insulin therapy as well as antibiotic therapy were followed. Empirical antibiotic treatment was with use of third generation cephalosporin and or piperacillin/tazobactam with adequate dosage modification for renal failure. Combination of antibiotics was used in all patients as first line therapy and then changed depending on the microbiological culture reports of blood/urine. The need for renal replacement therapy (RRT) was based on clinical and biochemical indication. Continuous variables are stated as mean±standard deviation comparison of means analyzed by student t-test and categorical variables by Fischer's exact test. Predefined risk factors for mortality as well as renal failure namely: age (<60 or > 60 yrs), gender (male vs female), duration of diabetes mellitus (<10 yrs or >10 yrs), CT grading, serum creatinine at presentation, altered sensorium septic shock, thrombocytopenia and mode of treatment (medical therapy alone vs intervention). Two sided p value of <0.05 was considered significant. Statistical analysis was done using STATA version 14.0 (Stata Tex, USA).

Results

As seen in table 1, a total of 12 patients with EPN were diagnosed during the study period (6 females and 6 males). 11/12 (91.6%) of patients had pre-existing diabetes mellitus or were diagnosed to have diabetes during hospitalization. 5 (41.6%) patients in addition had associated urinary tract obstruction by ureteric calculi. The mean age of our group was 59.92 yrs. The mean age in females was 58.8 and 61 yrs in males and this was not statistically different. Glycemic control was poor in all patients with 8 patients having glycosylated Hb between 7-10% while 3 patients had levels >10% reflecting very poorly controlled disease. The clinical presentation was with APN in 7 patients, urosepsis in 2 and MODS in 3 patients. 10 (83.3%) patients in our study presented with renal dysfunction at admission as defined by serum creatinine >1.5mg/dl. The mean serum creatinine was 3.19mg/dl and 8/12 (66.6%) had levels > 2.5 mg/dl signifying moderate to severe renal failure. Renal replacement therapy in the form of hemodialysis or slow low efficiency dialysis (SLED) was needed in 3 (25%) in our group. 33.3% of patients also presented with altered sensorium, though none of the patients was comatose at the time of admission. Septic shock requiring aggressive fluid resuscitation with/without inotropic support was needed in 3 (25%) of patients. Thrombocytopenia was defined as platelets <1.5 lakh/cmm was noted in only 2 (16.6%), hyponatremia (serum sodium <135meq/L) in 10 (83.3%) and hypoalbuminaemia (serum albumin <3.5g/dl) in 9 (75%) of patients.

E.coli was the predominant organism isolated on blood and/or urinary culture in 10/12 (83.4%). One patient was culture negative while one patient had double culture positive with E.coli and Klebsiella species grown on culture. Patients were classified based on CT scan grading and Grade 1 with presence of gas in renal parenchyma was the predominant CT grade with 7 patients (58.7%) presenting with this picture, grade 2

Table 1: Table depicting patient characteristics and outcomes.

Case	Age	Gender	Urinary tract obstruction (present/absent)	Diabetes (yes/no)	Duration of DM (in yrs)	Hypoalbuminemia (serum albumin<3.5mg/dl)	S.Creat at admission	S.Creat at discharge	Altered sensorium	Shock	Low platelets	Bacteriology	RRT	Treatment	CT scan Staging	Outcome
1	70	F	Absent	Yes	6	Yes	2.7	1.9	No	No	No	E. coli	No	DJ	1	Recovered
2	76	M	Present	Yes	15	Yes	4.3	3.5	No	No	No	E. coli	No	Med	1	Recovered
3	68	M	Absent	Yes	6	Yes	4.7	5.9	Yes	No	No	E.coli	Yes	Med	2	DAMA
4	53	M	Absent	Yes	10	Yes	3.4	2.6	No	No	No	E.coli	No	DJ+PC	3	Recovered
5	61	F	Present	Yes	2	No	3.0	1.7	No	Yes	No	E.coli +Klebsiella	Yes	DJ+HD	1	Recovered
6	60	F	Absent	Yes	new	Yes	2.3	1.9	No	Yes	No	E.coli	No	Med	2	Recovered
7	48	F	Absent	Yes	18	No	1.3	1.7	No	No	No	E.coli	No	DJ	1	Recovered
8	60	F	Present	Yes	6	Yes	3.8	2.5	Yes	Yes	Yes	E.coli	Yes	DJ+PC+HD	3	Recovered
9	63	M	Absent	Yes	11	Yes	5.0	7.3	Yes	No	No	E.coli	No	Med	1	DAMA
10	45	M	Present	No	-	Yes	1.3	1.3	No	No	Yes	Sterile	No	Med	1	Recovered
11	54	F	Present	Yes	New	Yes	1.7	1.1	No	No	No	E.coli	No	PC	3	Recovered
12	61	M	Absent	Yes	15	No	4.8	3.2	Yes	No	No	E.coli	Yes	DJ+HD	1	Recovered

Abbreviations: DJ -Double J stenting, PC-Percutaneous nephrostomy, HD-Hemodialysis, DAMA-Discharged against medical advice, RRT- Renal Replacement therapy.

in 16.6% (as shown in Fig 1) and grade 3 (bilateral involvement) in 25% of patients. All patients received broad spectrum antibiotics therapy with standard antibiotic regimen of piperacillin/tazobactam which was later modified to add ertapenem or meropenem based on culture sensitivity reports. 6 (50%) required DJ stenting and 3 (25%) patient required percutaneous drainage while the remaining patients improved with medical management alone. We did not have any mortality in our study, 10 patients recovered while 2 patients were discharged against medical advice and hence lost to follow-up. We did not perform prognostic risk factor analysis in our study since we had no mortality. We looked at risk factors between patients who required hemodialysis vs those who were conservatively treated. None of the conventional risk factors such as renal failure, thrombocytopenia and hypoalbuminaemia impacted patient outcome in our group. Duration of hospitalization however was longer in those (>2 weeks) with low serum albumin <3.5mg/dl (p=0.035).

Discussion

EPN has been defined as a necrotizing infection of the renal parenchyma and its surrounding areas resulting in the presence of gas in the renal parenchyma, collecting system or perinephric tissue. The term EPN was first used by Schultz and Klorfein [4], although it was first reported as pneumaturia in 1898. EPN is reported to be more common in females with various studies reporting a ratio ranging from 3:1 to 43:3 [5,6]. This has been attributed to the fact that asymptomatic bacteriuria is more common in women. In our study too, 50% of our patients were females. EPN is also common in patients with diabetes mellitus and upto 90% of them are poorly controlled diabetics [5]. All patients in our case series were diabetics and all were poorly controlled with glycosylated hemoglobin >7%. The factors that predispose persons with diabetes to EPN may include uncontrolled diabetes, high levels of glycosylated hemoglobin and impaired host immune mechanisms. Alcoholic fermentation of glucose with carbon dioxide production by organisms has been identified as a source of gas in the tissues. Analysis of gas content in EPN has demonstrated nitrogen (60%), hydrogen (15%), CO₂ (5%) and oxygen (8%) [7]. Unilateral or bilateral urinary tract obstruction is also a documented risk factor, however the disease has been reported to be less extensive in them. 6 (50%) of our patients had hydronephrosis secondary to ureteric calculi necessitating DJ stent placement. This incidence has been higher than previously reported studies and is worth noting. Most patients also presented with less extensive

disease (CT grading) thereby accounting for good clinical outcomes in our group. Even in patients with no obstruction, placement of a urinary stent has been previously used to facilitate drainage of purulent material and hasten recovery. Placement of a urinary drainage may facilitate recovery by drainage of pus and necrotic papillary material. The association of two documented risk factors namely diabetes mellitus and urinary tract obstruction has also been rarely reported in previous studies so far. Since we had only no mortality in our group we did not analyse the prognostic risk factors predicting bad outcome proposed by Huang and Tseng [3], including thrombocytopenia, renal failure and shock. Previously reported Indian series of patients with EPN have also reported a female preponderance with mortality rates of 13-14% [8-12]. Certain factors have been associated with poor outcomes in EPN, these bad prognostic factors include thrombocytopenia, azotemia, hematuria, altered sensorium, shock (systolic BP<90mm of Hg) at initial presentation, need for emergency hemodialysis, severe hypoalbuminemia (serum albumin<3.0mg/dl), extension into the perinephric space and polymicrobial infection [10,11].

The clinical approach to treating patients with EPN has changed over the years. Due to advances in medical imaging, interventional radiology, newer more effective antibiotics and better supportive intensive care including dialysis, patients with EPN have better outcomes. Managing EPN more conservatively has thus become the standard of care [13]. A systematic review of 10 retrospective studies including 210 patients with emphysematous pyelonephritis regarding the timing and nature of interventions noted that mortality associated with medical management plus percutaneous drainage was significantly lower than medical management plus emergency nephrectomy (13.5%vs 25% respectively) [14]. A more recent meta-analysis has also associated nephrectomy with increased patient mortality and has reemphasized the relevance of conservative and minimally invasive procedures [15].

Early intervention by placement of intraureteric stenting with or without percutaneous nephrostomy drainage could account for the lower mortality rate in our study. A meta-analysis of seven retrospective cohort studies in 175 patients with emphysematous pyelonephritis [2], looked at 23 risk factors with an overall mortality of 25%. Four major risk factors significantly associated with an increased risk of mortality were: class 4 EPN, renal parenchymal necrosis with either gas/fluid content, conservative therapy defined as fluid resuscitation and antimicrobials without PCD and thrombocytopenia.

Our study is limited by its retrospective design and small size which limits statistical inference. However EPN is still a relatively rare condition in medical practice either nephrology or urological practices. Most studies have also reported fewer or similar patient numbers [9-11,13]. In our study, early and aggressive fluid therapy, blood sugar control and antibiotic therapy along with judicious use of stenting procedures was helpful in successful management of our patients with EPN. Though more than one risk factor was identified in 45% of patients, prompt intervention coupled with antibiotic therapy and good supportive care improved patient outcomes. Thus minimally invasive modalities were successful.

Conclusion

The clinical scenario of EPN has changed over the course of time as reflected in our study. EPN in previous decade was associated with poor patient survival. However with increasing awareness, increasing availability and decreased threshold of imaging modalities like CT scan in patients with severe urinary tract infection and sepsis, more number of patients are now diagnosed with EPN at an earlier stage leading to better patient outcome. There has also been a distinct trend towards managing EPN more conservatively with minimal intervention and this has become the standard of care.



With the limitation of our study design and small sample size, we can conclude that patients with CT grade of lesions (2 and below) can be managed successfully with a conservative plan. Renal failure at presentation should not hinder percutaneous intervention and a good recovery can be expected in this group.

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