Research Article

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Impact of urolithiasis on the severity of emphysematous pyelonephritis.

Dr. Vishal Lodha[1], Dr. Dhaval Rasal[2], Dr. Shashank Patil[3], *Dr. Sanjay Dhangar[4], Dr. Ketan Vartak[5], Dr. D. K. Jain[6]

Department of Urology, Bharati Hospital and Research Centre, Bharati Vidyapeeth University, Pune.

***Corresponding author**

Dr. Sanjay P Dhangar,
Department of Urology, Bharati Hospital and Research Centre, Bharati Vidyapeeth University, Pune.
Phone : 9326509990
Email : drspdhangar@gmail.com

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ABSTRACT

Introduction: A severe kidney infection associated to gas production in the renal parenchyma and/or collecting system is known as emphysematous pyelonephritis. The aim of this study was to assess the effects of urolithiasis on the severity of emphysematous pyelonephritis in a modern cohort of patients and their outcomes.

Methods: From 2023 to 2024, a study was conducted for the word "emphysematous pyelonephritis" in all imaging reports at Bharati Hospital and Research Centre. Patients were considered for inclusion if they had computed tomography showing gas in the renal parenchyma or collecting system, no recent urologic instrumentation, and clinical signs of infection. The laboratory and clinical characteristics were taken from patient medical records.

Results: Twenty cases in all were identified. Sixty percent of the patients had gas that was confined to the collecting system. Gas was present in the renal parenchyma in four patients (20%) and in the perirenal tissues in four patients (20%). Twelve individuals, or 60% of the total, also had concurrent urolithiasis. DJ stenting, either bilateral or unilateral, was done for every patient. None of the patients needed a nephrectomy right away. There were no deaths. Emphysematous pyelonephritis with urolithiasis was less severe than non-urolithiasis patients.

Conclusions: Most of the study's patients had gas confined to the collecting system, and DJ stentning proved to be an effective treatment for them. No patients needed a nephrectomy on emergency basis. Patients with urolithiasis had less severe emphysematous pyelonephritis than those without urolithiasis.

Keywords: emphysematous, urolithiasis, pyelonephritis.

INTRODUCTION

Emphysematous pyelonephritis is a rare manifestation of a severe upper urinary tract infection marked by gas in the renal parenchyma and/or collecting system. The condition was first described by Kelly and Maccallum in 1898, who noted an association between glycosuria and pneumaturia in the absence of urological instrumentation (1). Further studies have confirmed >90% of patients with emphysematous pyelonephritis have diabetes mellitus (2). Historically the mortality rate has been as high as 71% with medical management alone and 33% if treated with emergent nephrectomy (3,4). Despite advances in antibiotic coverage, imaging, and treatment options, mortality rates have remained high (25% in recent series) (5). Although urolithiasis has been identified in 22% of patient with emphysematous pyelonephritis, the relationship between urolithiasis and disease severity has not been thoroughly investigated (2). In this study, we review the clinical characteristics, risk factors, treatments, and outcomes of patients diagnosed with emphysematous pyelonephritis in Bharati Hospital and Research Centre between 2023 and 2024 with emphasis on the impact of concomitant urolithiasis.

METHODS

At Bharati Hospital and Research Centre in Pune, a study of all imaging reports from 2023 to 2024 was carried out with consent from the institutional review board. All publications including the terms "emphysematous" and "pyelonephritis" were questioned regarding imaging reports. If there was evidence of a urinary fistula or recent urological manipulation, the case was excluded. Cases with a clinical diagnosis of pyelonephritis and evidence of gas in the collecting system, renal parenchyma, and/or the perinephric/paranephric space were included. Clinical data was retrieved and patient charts were examined. Clinical factors that were noted were age, gender, length of symptoms, median length of hospital

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stay, symptoms, and coexisting conditions. Evaluations were also conducted on laboratory research, microbiological data, and antibiotic therapy. Computerized tomography (CT) scans were examined; all patients had undergone CT. The imaging classification developed by Huang et al. was used to interpret the CT scan. 0Type I emphysematous pyelonephritis is limited to the collecting system, type II to the renal parenchyma, type IIIa to the perirenal spaces, and type IIIb to the pararenal space. Emphysematous pyelonephritis in one kidney or bilateral emphysematous pyelonephritis is known as type IV (6). It was also noted whether hydronephrosis and/or urolithiasis were present or absent. Prior to ureteral stent placement, all patients had fluid resuscitation and antibiotic therapy. This was done under local anesthesia, either with or without sedation, and under fluoroscopic monitoring. Every treatment modality's results were recorded. For all continuous variables, the median was used to compute descriptive statistics, and for all categorical variables, percentages were used. Using the two-tailed t-test, the difference between the means of continuous variables was examined. To evaluate categorical variables, the Fisher Exact test was used. Version 3.0.1 of the R environment was used for all statistical analysis.

RESULTS

A total of 20 cases were identified from Bharati Hospital and Research Centre. Table A summarizes clinical and demographic information. Twelve (60%) of the patients were female, and the median age was 49. The proportion of right and left sided instances was equal. The average number of days that symptoms persisted before presenting was seven. Hypertension (45%) and diabetes mellitus (65) were the most prevalent comorbidities. Abdominal pain (50%) was the most prevalent presenting symptom, followed by fever (35%) and flank pain (20%). Twelve individuals, or 60% of the total, also had concurrent urolithiasis. Six days was the median length of hospital stay. The majority of patients' imaging results (60%) were in line with Huang Class 1 (gas contained within the collecting system). Gas was present in the renal parenchyma in four individuals (Huang class II) and beyond the renal parenchyma in four patients (Huang class III). Table B provides a summary of the laboratory data. WBC count was 16284 on average. The creatinine increase during hospitalization was 0.5, while the median baseline creatinine was 2.5. Table C summarizes the information about microbiology. A single organism produced a positive urine culture in 13 individuals (65%); the other patients had mixed urine cultures. The most often found organism (54%) was E. Coli, which was followed by Candida (15%) and Klebsiella (31%). Third-generation cephalosporins were the most often prescribed class of antibiotics, followed by extended-spectrum penicillin. Fifty percent of the patients had at least two changes in their antibiotic coverage. DJ stent insertion was used to manage every patient (Table D). Only two patients needed a nephrectomy on an interval. None of the individuals needed a nephrectomy right away. Within our group, there were no deaths. Emphysematous pyelonephritis with gas confined to the collecting system (Huang class 1) was significantly more common in patients with stones than in patients without stones (P=<0.05), according to a comparison of patient outcomes (Figure 1A) and patient outcomes (Figure 1B) (Table E).

Figure 1

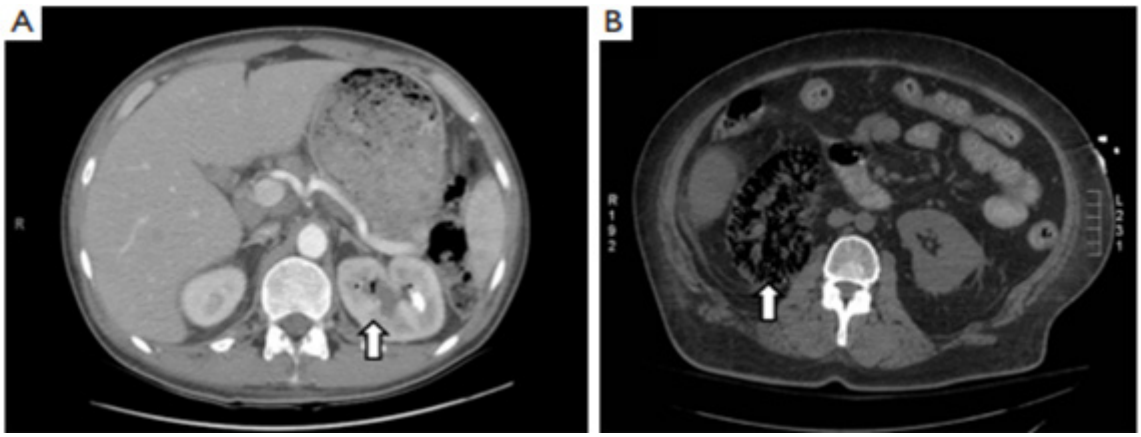


Figure 1: Compared to patients without urolithiasis (B), those with emphysematous pyelonephritis and concurrent urolithiasis (A) exhibited less widespread disease on computerized tomography (CT) scans.

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Table A: Clinical data

Variable	Number
Age	49
Female	12
Median duration of symptoms (days)	10
Median length of hospitalisation (days)	6
Medical Comorbidities	
Diabetes	13
Hypertention	9
CKD	1
Hyperthyroidism	1
Symptoms on admission	
Abdominal Pain	10
Flank Pain	4
Fever	7
Dysuria	2
Imaging Classification	
Class I	12
Class II	4
Class IIIa	4
Class IIIb	0
Class IV	0

Table B: Laboratory Investigation

Platelets(109/L)	
Mean±SD	200±60
Min-Max	60-334
Creatine (mg/dL)	
Median(IQR)	2.5 (1.9-3.8)
Min-Max	0.6-8.6
Hemoglobin (g/dL)	
Median(IQR)	10.6 (9.6-11.4)
Min-Max	1.8-12.4
Total leukocyte count (cells/cumm)	
Mean±SD	16284 ±6190.8
Min-Max	4400 -32400
Na2+ (meq/L)	
Mean±SD	135.9±6.2
Min-Max	6.2-145
K+ (meq/L)	
Mean±SD	4.5±0.5
Min-Max	0.5-5.2

Table C : Microbioogical and antibiotic therapy data

Microbiology	Number
Positive Urine Culture	18
Single organism	13
Mixed culture	5
Organisms	
E.coli	7
Klebsiella	4
Candida	2
Initial Antibiotic therapy	
3rd generation cephalosporin	9
Piperacillin/tazobactum	5
Meropenem	4
Colistin	1
Ceftazidime/azetronam	1

Table D : Treatment

Treatment Type	Number
Initial Management	
Bilateral DJ stentning	20
Delayed Treatment	
Nephrectomy	02

Table E: Comparison of patients with/without kidney stones

Variable	Without stones	Stones	P value
Age	58	40	
Female	3	5	
Median duration of Symtoms (days)	1	2	
Median Length of hospitalisation	8	5	
Fever	4	3	
Medical Comorbidities			
Diabetes	7	6	
Hypertention	5	4	
CKD	1	0	
Hyperthyroidism	1	0	
Imaging Classification			<0.05
Class 1	3	9	
Class 2+3	5	3	
Management			
DJ stent Placement	8	12	
Delayed Treatment Interval Nephrectomy	2	0	<0.05

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DISCUSSION

A rare and serious kidney infection called emphysematous pyelonephritis causes gas production in the renal collecting system and/or parenchyma. Numerous case reports and over 20 series with a total of over 400 patients have been published since the original description (7–10). When gas is seen inside or around the kidney during imaging examinations, emphysematous pyelonephritis is diagnosed. While abdominal X-ray, ultrasonography, or CT can all be used to diagnose emphysematous pyelonephritis, CT is currently regarded as the gold standard due to the 30% non-detection rate on plain abdominal X-ray and ultrasonography. There are several categories for imaging that have been created. Tsu et al.'s study (2011) found that the imaging categorization utilized in this investigation, which was created by Huang et al. based on CT scan results, was predictive of mortality.Only four patients (20%) in this series found gas spreading past the kidney (Huang class 3), while majority of patients (60%) had emphysematous pyelonephritis limited to the collecting system. Our cohort contains a greater proportion of patients with gas restricted to the collecting system than prior studies (11, 12). The culture results are in line with previous research on emphysematous pyelonephritis, and the most often isolated microorganisms were Klebsiella and E. coli. Contrary to earlier research, third-generation cephalosporins were the most often prescribed antibiotics for the first time. That being said, it should be highlighted that 70% of patients had at least one antibiotic change and 50% had two more drug changes. There were times when switching to a different intravenous antibiotic was necessary after the urine culture and sensitivity data were received. Once the patient was hemodynamically stable and afebrile, oral antibiotics were started. With a few notable differences, the comorbid illnesses and presenting symptoms most frequently linked to emphysematous pyelonephritis are comparable to those described in other series (11). While most large datasets indicate rates of >90%, our series reports a substantially lower related rate of diabetes mellitus (65%) (5). Our related urolithiasis rate of 60% was more than the 22% documented in the literature (2). Comparing patients with and without stones, it was shown that patients with stones had far lower first imaging-based illness classifications. Compared to patients without stones, those with stones often experienced lower increases in creatinine while in the hospital. A less aggressive type of the disease, emphysematous pyelonephritis associated with urolithiasis, is probably caused by microorganism activity in or related to the stones rather than within the renal parenchyma. Emphysematous pyelonephritis treatment has long been a contentious issue. From 1898 to 1978, Spangola et al. examined all cases that were reported from various parts of the globe (total 31 patients). He discovered that the death rate for patients who had an urgent nephrectomy was 33% as opposed to 71% for patients who just received medical care (3). Hudson invented percutaneous drainage in 1986 for emphysematous pyelonephritis, and it was later proved to be a successful first line of treatment (10,15). Other study authors have pushed for aggressive medical care and early diagnosis (12, 16). For all stable patients, DJ stent insertion alone seems to be the optimal first approach, based on the outcomes of our recent series. All patients in this study were managed without immediate nephrectomy and only two patient required subsequent nephrectomy due to a minimally functional kidney and a potential for subsequent infection. The small sample size and retrospective nature of this study present limitations. Additionally, the study used radiology report inquiries to identify instances of emphysematous pyelonephritis; cases might have gone unnoticed if radiology reports lacked the proper nomenclature.

CONCLUSION

The severe infection known as emphysematous pyelonephritis has a high mortality rate. The lack of mortality in this study is associated with relatively less disease severity in our cohort. The majority of patients were successfully treated with DJ stent placement alone. No patients needed a nephrectomy on emergency basis. Concomitant urolithiasis and emphysematous pyelonephritis have been linked to less severe disease, indicating that these people might have a different mechanism for producing gas that contributes to a less aggressive version of the illness.

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