Original Article

# Emphysematous pyelonephritis: Is nephrectomy warranted?

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## Abstract

**Introduction:** Emphysematous pyelonephritis (EPN) is associated with high mortality rate, up to 25%. There is still conflicting reports regarding the most appropriate management, conservative versus nephrectomy. Objective: To describe the outcome of patients with EPN.

**Methods:** We retrospectively reviewed the medical records of patients diagnosed with EPN by computed tomography from three tertiary institutes in Jeddah, Saudi Arabia. Type of management was classified as conservative and surgical. The conservative includes medical and minimally invasive procedures, such as percutaneous drainage and nephrostomy. The surgical which is nephrectomy. The outcome observed was preservation of the kidney function or patient's life.

**Results:** A total of 10 patients were included (9 females and 1 male), median age was 55 years and 63% were diabetic. The most common presentation was flank pain (100%), fever (75%), and vomiting (63%). The most common organism isolated was *Escherichia coli*. Nephrectomy was not associated with increased survival rate, while conservative management was associated with a good outcome, less morbidity (not dialysis-dependent).

**Conclusion:** Nephrectomy was not associated with high survival rate. Patients managed conservatively had a better overall performance and better survival. This study will add to other studies, which are encouraging conservative management.

**Key Words:** Diabetes mellitus, emphysematous pyelonephritis, nephrectomy, percutaneous drainage

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## INTRODUCTION

Emphysematous pyelonephritis (EPN) is an uncommon acute suppurative infection of the kidney.[1] Characterized by presence of gas in the renal system, which might extend to perinephric tissue.[2] As shown in Figures 1 and 2. Seventy to ninety percent of cases occur in diabetic females.[3] Furthermore, it is commonly seen in patients with obstructive uropathy, polycystic kidney, and end-stage renal disease.[4] With a mortality rate of 25%;[5] it is considered life-threatening, which, necessitates early and aggressive management.[6] The management can be classified into: Conservative which includes medical and minimally invasive procedures, such as percutaneous drainage (PCD) (nephrostomy) or double J (DJ) stent, and surgical which is nephrectomy.

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Despite the morbidity and mortality of EPN[5,7,8] there is still conflicting reports regarding the most appropriate management.[1,3,4,6,9-18] Early interference with nephrectomy was almost a mandatory approach due to increased mortality

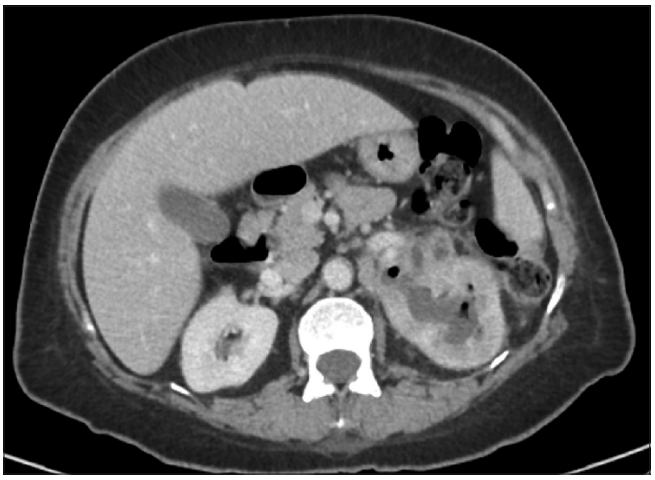

**Figure 1:** Abdominal computed tomography showing multiple air bubble foci within the collecting system of the left kidney

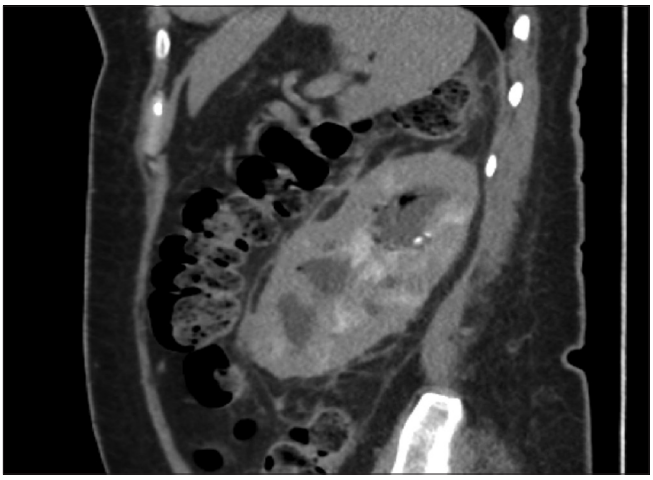

**Figure 2:** Abdominal computed tomography, findings are consistent with complicated left pyelonephritis and emphysematous pyelonephritis

with medical therapy favoring interventional approach, leaving PCD for inoperable cases.[1,6,9,10,17,18] This approach has been changed recently due to early detection of patients with EPN with the aid of advanced radiological modalities, alongside early management with potent antibiotics, reserving nephrectomy for patients refractory to conservative measures.[19] Nephrectomy might not be problematic in unilateral EPN cases as it is in those with bilateral EPN, thus conservative treatment is often attempted, to avoid the increased risk of mortality and morbidity associated with bilateral nephrectomy.[5] Emergency nephrectomy might not be the first line of treatment even in severe cases because it is associated with higher mortality than conservative management.[20] Thus, combining minimally invasive procedures for drainage along with medical treatment might be effective and sufficient as a management of EPN, in order to preserve good-functioning kidneys and promote good life quality. Therefore, in this study, the aim was to describe the outcome of patients with EPN.

## METHODS

The data were collected retrospectively by reviewing medical records of patients diagnosed with EPN by computed tomography (CT) scan. From three tertiary institutes in Jeddah, Saudi Arabia, between November 1, 2012 and July 1, 2014. Patients' demographics, presence of underlying diseases, clinical features at presentation, kidney involvement, laboratory data, cultured organism, radiological classification, complications, Intensive Care Unit (ICU) admission, dialysis requirement, type of management, antibiotics used, and outcome were compared among these patients. The laboratory data included: Random blood glucose, serum creatinine, hemoglobin, white blood cells, platelets count, and proteinuria. The radiological data included the performance of abdominal CT and staging of disease based on radiological findings on the CT, patients were classified according to Huang and Tseng staging system as shown in Table 1.[16] Simple descriptive statistics were produced using statistical package used for statistical analysis (SPSS Inc. Released 2009. PASW Statistics for Windows, Version 18.0. Chicago: SPSS Inc.), frequencies and percentages were used for qualitative variables, median and interquartile range (IQR) were used for quantitative variables.

## RESULTS

We collected data of total of 8 patients with EPN. Two of the eight had a recurrence within a month and were managed differently in each episode, thus the recurrence and the line of management was considered as a new and different case in order to draw conclusion of each type of management.

The median age was 55 years and IQR of 22.3. Four patients required ICU admission, while the rest were managed in the wards. On the total, 87.5% were females and 12.5% were males of which 62.5% had diabetes mellitus, 50% had hypertension (HTN), and 37.5% had ischemic heart disease (IHD). One patient did not have any associated co-morbidities.

The laboratory data and clinical presentation of all patients is shown in Tables 2 and 3. Flank pain was present in all patients, 75% had fever and 62.5% had vomiting. *Escherichia coli* was the most common organism isolated from urine in this pathology (62%) followed by *Klebsiella* and *Pseudomonas* both constituting 15%. Three patients out of eight belonged to class II, two patients belonged to class IV, one patient belonged to class IIIA, and one patient belonged to class I. Furthermore, three patients had unilateral involvement of the right kidney and three patients had left kidney involvement, whereas bilateral involvement was encountered in two patients. More than

half of the patients had high serum creatinine levels (63%) and proteinuria, while the remainder had normal creatinine. Seventy-five percent of the patients were anemic, 25% of them having thrombocytopenia. Two patients only required dialysis. Three patients developed complications varying from septic shock to non-ST elevation myocardial infarction. Fifty percent had abnormally high random blood glucose levels. The most commonly used antibiotics were ciprofloxacin (37%), piperacillin and tazobactam (37%), meropenem (25%). Six patients were managed conservatively and two underwent nephrectomy.

The most commonly performed conservative procedure was PCD constituting 62.5% of all procedures, followed by DJ stent insertion and nephrectomy both constituted 25%. The success rate of the conservative management was 70%. The overall mortality rate was 30%, which was associated with those who had undergone nephrectomy.

**Table 1: Class of disease defined on the basis of CT scan by Huang and Tseng**

| Class | Description |
|---|---|
| Class I | Gas in the collecting system only |
| Class II | Gas in the renal parenchyma without extension to extra renal space |
| Class III A | Extension of gas or abscess to perinephric space |
| Class III B | Extension of gas or abscess to pararenal space |
| Class IV | Bilateral EPN or solitary kidney with EPN |

## DISCUSSION

Emphysematous pyelonephritis is a severe, necrotizing parenchymal infection of the kidney characterized by the presence of gas, EPN predominately affects diabetic females.[21] In our series, six out of the eight patients were females, similarly to what was mentioned in literature.[16] *E. coli* was the culprit in 62%, followed by *Klebsiella* and *Pseudomonas* both constituting 15%, which is in accordance with our results.[6,14,20] However, we had one case due to *Pseudomonas aeruginosa*. Moreover, we found that flank pain is the most common complaint, followed by fever and vomiting. In contrast to other study, which showed that dysuria is the most common complaint.[2] Although EPN involves the left kidney more frequently than the right,[11] in our study, it involved the right and left kidney equally, with two cases showing bilateral involvement.

**Table 2: Demonstrates the clinical and laboratory features, the management and outcome of patients with emphysematous pyelonephritis classified by Huang and Tseng computed tomography staging system for mild to moderate classes. Case (A) patients with recurrence in their first episode, Case (B) patients with recurrence in their second episode, H and T: Huang and Tseng, CT: Computed tomography, ICU: Intensive care unit, DM: Diabetes mellitus, HTN: Hypertension, BPH: Benign prostatic hyperplasia, IHD: Ischemic heart disease, CKD: Chronic kidney disease, P: Flank pain, F: Fever, N: Nausea, V: Vomiting, D: Dysuria, O: Obstructive symptoms, *E. coli*: *Escherichia coli*, MI: Myocardial Infarction**

| | Case 1 | Case 1 (B) | Case 2 | Case 3(A) | Case 3 (B) | Case 4 |
|---|---|---|---|---|---|---|
| Gender | Female | Female | Female | Female | Female | Female |
| Age | 52 | 52 | 55 | 76 | 76 | 72 |
| Known illness | DM | DM | DM, HTN | HTN, IHD, Renal impairment Liver cirrhosis, hypothyroidism | HTN, IHD, Renal impairment Liver cirrhosis, hypothyroidism | DM, HTN, IHD |
| Kidney involved | Left | Left | Right | Right | Right | Left |
| Symptoms | P, N, V | P, F, N, V, D | P, F, N, V | P | P | P |
| H and T classification (CT staging) | Class I | Class I | Class II | Class II | Class II | Class II |
| Creatinine (mg) | 91 | 100 | 264 | 212 | 220 | 114 |
| Random blood glucose (mg) | 315 | 383 | 491 | 93 | 59 | 248 |
| Proteinuria | + | + | + | - | - | +/- |
| Culture | *E. Coli* | *E. Coli* | *E. Coli* | *E. Coli* | *E. Coli* | Mixed |
| Hemoglobin (G/DL) | 9.8 | 11.2 | 13.1 | 12.1 | 7.4 | 7.1 |
| Platelets (×10^9/L) | 224 | 226 | 125 | 116 | 62 | 388 |
| ICU admission | No | No | Yes | No | Yes | Yes |
| Complication | No | No | Septic shock. Non-ST elevation MI | No | Septic shock | No |
| Dialysis | No | No | No | No | No | No |
| Antibiotics | Gentamicin, Pipracillin, Tazobactam | Ciprofloxacin, Pipracillin, Tazobactam | Meropenum | Pipracillin, Tazobactam | Pipracillin, Tazobactam | Ciprofloxacin Cefuroxime |
| Procedure type | Nephrostomy | DJ stent insertion | Nephrostomy | Nephrostomy | Nephrectomy | Immediate Nephrectomy |
| Outcome | Improvement | Improvement | Improvement | Improvement | Death | Death |

**Table 3: Demonstrates the clinical and laboratory features, the management and outcome of patients with emphysematous pyelonephritis classified by Huang and Tseng computed tomography staging system for severe classes, *Missing data**

| | Case 5 | Case 6 | Case 7 | Case 8 |
|---|---|---|---|---|
| Gender | Female | Female | Male | Female |
| Age | 55 | 56 | 77 | 48 |
| Known illness | DM, HTN, Retrocaval ureter | TB | DM, BPH, IHD, CKD | No |
| Kidney involved | Right | Right & Left | Right & Left | Left |
| Symptoms | P, F, V | P, F, D, V | P, F, D, O | P, F, V |
| H ansd T classification (CT staging) | Class III A | Class IV | Class IV | * |
| Creatinine (mg) | 56 | 510 | 618 | 60 |
| Random blood glucose (mg) | 171 | 106 | 83 | 84 |
| Proteinuria | Trace | + | + | - |
| Culture | *E. Coli* | *Klebsiella* | *E. Coli* | *Pseudomonas aeruginosa* |
| Hemoglobin (G/DL) | 10.9 | 9.4 | 9.1 | 12.6 |
| Platelets (×10^9/L) | 436 | 483 | 156 | 297 |
| ICU admission | No | Yes | No | No |
| Complication | No | Septic shock | No | No |
| Dialysis | No | No | Yes | No |
| Antibiotics | Ceftriaxone | Pipracillin Metronidazole | Meropenum | Ciprofloxacin |
| Procedure type | Nephrostomy | Nephrostomy | RT Nephrostomy LT DJ stent | Nephrostomy |
| Outcome | Improvement | Death | Improvement | Improvement |

In our series, 80% of patients were initially managed conservatively with either PCD or DJ stent insertion along with medical treatment. Most of the patients were stable, discharged in a good condition. Eight out of ten patients were treated conservatively with a good outcome, the eighth patient was managed using DJ stent instead of PCD with a poor outcome, this patient who was known to have pulmonary tuberculosis on isoniazid, she was managed initially by DJ stent insertion with poor response and persistent fever deteriorated over a couple of weeks, developed septic shock and died, even though PCD was performed at a very late stage. Even though, patient number 2 was complicated by septic shock and non-ST elevation myocardial infarction yet, she was managed with PCD and had a good outcome. In addition, patient number 5 belonged to class IV, correspondingly managed with PCD and discharged in a good condition.

Two patients were managed with nephrectomy, patient number 7 who was known to have diabetes, HTN, IHD, renal impairment, and hypothyroidism, she had a first episode of EPN which was managed by PCD and improved and discharged home.

A couple of weeks later, she was re-admitted with a recurrent EPN, required ICU admission and nephrectomy, which was complicated by septic shock and died few days postoperatively.

As for patient number 3 she was known to have diabetes, HTN, and IHD, she presented with left EPN and was managed initially by immediate nephrectomy, died within a week post operation.

Some studies recommend aggressive therapy due to the potentially life-threatening nature of the disease, favoring nephrectomy.[1,6,7,9,10,17,18] Recent articles revealed that nephrectomy is associated with higher morbidity and mortality one of which was a systematic review that demonstrated 13.5% mortality in patients treated with PCD compared with 50% mortality for emergency nephrectomy.[3,5,7,8,16,22] In our series, the mortality was definitely higher with those who underwent nephrectomy. The overall mortality was 37.5% which was associated with those who had undergone nephrectomy, while those who were treated conservatively had a good outcome compared to those who had undergone nephrectomy.

In contrast, other studies suggested that PCD is a quite effective and adequate approach with a high success rate even in extensive EPN.[3,4,11-16,22,23] which is in accordance with our study where patients managed conservatively had a good outcome and survived. Furthermore, two patients with class I and class IV treated primarily with DJ stent showed improvement similar to those treated with nephrostomy. This may be an indicator that DJ stenting has a place in the management of EPN.[24] Conservative management can be carried out in all patient with EPN irrespective of the class of the disease or the severity of the disease.[23]

With this evidence of higher mortality and morbidity associated with nephrectomy,[3,5,7,8,16,22] we need to reconsider and direct our management toward kidney preservation and improvement of the quality of patients' life, not rendering them dialysis-dependent when they could have the chance to retain their kidney, PCD is the best preferred initial management, and stents can be used when indicated. There is no place for immediate nephrectomy keeping nephrectomy for those refractory to conservative management. Based on the evidence we have and other studies', conservative management

might be the first line of treatment in the future.[3,4,11-16,22,23] In order to determine if kidney-preserving procedures were the gold standard in the management of EPN, we need further comparative studies and a larger sample.

## CONCLUSION

Nephrectomy was not associated with high survival rate. Patients managed conservatively had a better overall performance and better survival. Therefore, we recommend conservative management as a first-line therapy for patients with EPN. We need to direct our management toward kidney preservation and improvement of the quality of patients' life, not rendering them dialysis-dependent when they could have the chance to retain their kidney, keeping nephrectomy the last resort for those refractory to conservative management.

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