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# Emphysematous Pyelonephritis

## *Disparities Observed in the Use of Percutaneous Drainage Techniques*

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**Abstract**

***Objectives:*** Emphysematous pyelonephritis (EPN) has high mortality rates reaching 50%, however later studies have reported significantly lower mortality rates ranging from 0 to 37.5%. Renal percutaneous drainage techniques have reduced the mortality and the necessity for surgery. Nevertheless, the same studies have reported a wide diversity in the usage of percutaneous drainage (PCD) and percutaneous nephrostomy (PCN) techniques. ***Methods:*** A retrospective study of 17 patients was conducted over a 10year period, from January 2008 to December 2017. All patients had undergone abdominal computerized tomography, these were reviewed and categorized according to Huang and Tseng's classification. ***Results:*** 13 patients (76%) were categorized as class I and II, 3 (17%) as class IIIA**,** and 1 (6%) as class IIIB**.** Five patients from the class I & II categories underwent drainage of the pelvicalyceal system, 4 by PCN and 1 by Double J Stent (DJS) insertion. All the class IIIA and IIIB patients had PCN inserted. One class IIIB patient required PCD for localized gas and fluid collection but later underwent emergency nephrectomy. There were no mortalities**.** ***Conclusion:*** The favourable outcome of this study is in keeping with the more recent studies. However, despite the present classifications and guidelines, wide variations are reported in the use of percutaneous drains with

PCD ranging from 2.5 – 91%. The lack of precise guidelines may be a cause of these disparities in the clinical management.
***Keywords:*** emphysematous, pyelonephritis, drainage, percutaneous, nephrostomy.

**Advances in Knowledge:**

- Recent trends have demonstrated a significant decrease in the nephrectomy and mortality rates of this rare and fatal disease. The favourable outcome of this 10year study which has no mortality is in keeping with the recent trends.
- The use of percutaneous drains is well established as an essential part of the management of EPN, however guidelines do not provide precise details for the deployment of "parenchymal" drains (PCD) or percutaneous nephrostomy drains (PCN).

**Application to Patient Care:**

- Numerous studies have reported diverse and inconsistent use of PCD and PCN. Specific details on the extent of collected parenchymal gas and/or fluid requiring drainage and the appropriate number of drains to use are not defined in guidelines and left to the discretion of the clinician.
- The lack of precise guidelines leads to variations in the management of care and uncertainty in the clinical and radiological assessments. Furthermore, these diverse and inconsistent practices may negatively impact the morbidity and mortality rates.

**Introduction**

Emphysematous pyelonephritis (EPN) is a serious, often necrotizing infection of the kidneys associated with the presence of gas in the renal parenchyma, collecting system or perinephric tissue. Earlier studies reported high rates of nephrectomy and mortality reaching 50%,[1] however recent studies have highlighted changing trends in the clinical spectrum and have reported significantly lower mortality rates ranging from 0 to 37.5%.[2-6] The outcome of our series of 17 patients over a 10 year period in a tertiary hospital had no deaths and only 2 nephrectomies. Percutaneous drainage techniques of the kidney have played a major role in reducing the need for surgery and the mortality rates. However, at the same time studies have reported a wide diversity in clinical management particularly in the use of the 2 different percutaneous

techniques, i.e. percutaneous nephrostomy (PCN) and percutaneous drainage, (PCD) of the kidney. A distinction in terms of the objective of the 2 techniques is often overlooked. This study aims to highlight the inconsistencies in the use of the 2 techniques which to our knowledge has not been documented before. We believe this may lead to suboptimal treatment affecting the clinical outcomes.

**Methods**

A retrospective review of the electronic database from January 2008 to December 2017 was conducted. All patients' records who were admitted with a diagnosis of EPN were retrieved and data analysed. It included the patients' demographics such as age, gender, BMI and the laboratory results, i.e. full blood count, renal function tests, glycosylated Hb, random blood sugar, blood and urine cultures. All patients routinely had abdominal Non-Contrast Computerised Tomography (NCCT) performed and Contrast Enhanced Computerised Tomography (CECT) when not contra-indicated. The images were retrospectively reviewed and categorized according to Huang and Tseng's classification.[7] The treatment given was recorded including the initial medical management and the type of drainage procedures performed. PCN or DJS were inserted for the relief of obstruction of the pelvicalyceal system (PCS) whereas PCD was deployed for drainage of parenchymal or perinephric gas with or without fluid collections. Any other surgical interventions performed were also noted, i.e. emergency nephrectomy, open drainage or elective operations. The initial medical management consisted of adequate intravenous hydration, broad-spectrum antibiotics and glycemic control. Haemodynamically unstable patients were managed in high dependency (HD) or intensive care units (ICU). The period of outpatient follow-up ranged from 12 to 18 months. The ethical permission for the study was granted by the Scientific Research Committee of the institution.

**Results**

17 patients were treated for EPN over the10 year period. The median age was 55 years, ranging from 31 to 82 years, females out-numbered males by 12 to 5 and 13 patients, 76% had a history of diabetes mellitus. The patients' demographics and clinical features at presentation are shown in Table 1**.** Fever was the commonest symptom, 4 patients presented with severe sepsis associated with unstable vital signs requiring management in a HD or ICU setting. Two out of

the 4 non-diabetic patients presented with upper tract urinary calculi, one had an upper ureteric stone and a smaller non-obstructing renal calculus and the other a stone at the pelviureteric junction (PUJ)**,** both patients had significant hydronephrosis. The other 2 non-diabetic cases were elderly hypertensive females with a history of chronic renal disease**.**

Based on Huang and Tseng classification, thirteen patients (76%) were categorized as class I and II, three patients (17%) were grouped as class IIIA**,** Fig 1& 2 and one patient (6%) as class IIIB. There were no class IV patients. Five patients from the class I & II categories underwent drainage of the pelvicalyceal system, 4 by PCN and 1 by DJS insertion. All the class IIIA and IIIB patients had PCN inserted but only the one class IIIB patient underwent PCD for localized gas and fluid collection. This patient failed to respond to conservative treatment and an emergency nephrectomy was performed within 72 hours. One of the Class IIIA patients had elective nephrectomy for a non-functioning kidney with stones. Twelve patients, 71 percent attended the follow up clinic and all had been investigated by performing NCCT scans which on review showed clearance of the gas previously seen in the earlier images. There were no mortalities in this study**.**

**Discussion**

EPN has been described as a life-threatening necrotizing infection which is commonly seen in diabetics, immune compromised patients and those with obstructive urolithiasis. Characteristically gas is formed and accumulates as part of the infective process. In the present study, 13 of the 17 patients, 75% had uncontrolled diabetes mellitus. It is postulated that 4 factors are involved in the pathogenesis of EPN which include, gas forming bacteria, high tissue glucose levels, impaired tissue perfusion and a defective immune response.[8] The other 4 non-diabetic patients presented with deranged renal function of which 2 had obstructive uropathy due to a mid-ureteric calculus in one and a PUJ calculus in another. It is reported that up to 95 percent of patients with EPN have underlying uncontrolled diabetes mellitus whereas the risk of EPN secondary to obstructive uropathy is significantly less ranging from 25 to 40 %.[8]

Classification of EPN has been based on CT imaging which is considered the best radiological modality.[5] On this basis, Wan et al in1996, described EPN into Type 1, a severe form and a

milder Type 2 form of the disease. Huang and Tseng later described a more detailed CT classification with sub-categories and 4 risk factors namely, thrombocytopenia, acute renal function impairment, altered sensorium and shock. These are said to have added value as a guide to selecting the various management options and assist in predicting the prognostic value and outcomes.[5,6] The method of performing PCN differs in that the purpose is to enter and drain the PCS, however PCD is not designed to puncture the PCS but to drain parenchymal gas and/or pus. To our knowledge, after a careful search of the literature, there are no guidelines that describe the extent of gas or fluid collections which should be drained nor guidance on the number of drains to be inserted and the duration of drainage.

As stated, all class III patients in this study had PCN and only 1 case underwent a PCD procedure. The series shown in Table 2 have reported a wide variation in the type and numbers of drainage procedures performed. In the first 3 studies,[7,9,10] PCD was performed on 91% of the patients, (Total number of patients were 65). Fifty one percent of these cases were classified as Groups III and IV. In contrast only 2.5% of the 192 patients in the other 5 series[3,5,6,11] had PCD insertion despite 21.5 % of them having been documented as Groups III and IV.

Equally there is a wide disparity in the numbers of PCN and DJS insertions with some studies reporting no drainage of the pelvicalyceal system.[9] This contrasts with one of the largest series in Table 2 which reported DJS insertions in a third of all their patients without performing PCN in any patient and inserting only 1 PCD.[11] Despite the present classifications and guidelines, there is a great diversity in the use of PCD and PCN. This may be due to surgeons who are less conversant with the management of this rare disease, uncertainty in the interpretation of the radiological images and the lack of clarity regarding percutaneous drainage in the existing guidelines. Furthermore, interventional radiologists may be more familiar and less hesitant to perform PCN as opposed to PCD. Complications of PCD which include bleeding, septic shock and injury to adjacent organs have been documented and are not insignificant.[12] The combined mortality rates of the 5 studies with only a 2.5% PCD insertion rate was 4 percent. This is in contrast to a 20% mortality rate for the 3 studies with a 91% PCD insertion rate.

Most of these studies are retrospective and portray heterogeneity with some unavailable data, e.g.

the extent of the gas / pus drained, number of PCDs used per patient and duration of the drainage which may be as long as 12 weeks.[13] These limitations do not allow for valid comparisons and statistical analyses. Although it is not possible to draw conclusions, it is apparent there is a lack of consistency and standardization which may affect the morbidity and mortality.

**Conclusion**

The favourable outcome of this study is in keeping with the recent studies. However, despite the available classifications and guidelines, wide variations are reported in the usage of the two percutaneous drainage techniques with use of PCD ranging from 2.5 – 91%. The lack of more precise guidelines may be a cause for these disparities in the clinical management.

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**Table 1: Patients' demographics and clinical features**

| | |
|---|---|
| Age Mean | 55y (Range 31 -82) |
| Gender M:F | 05:12 |
| BMI Mean | 26.5 (Range 18.5 - 41) |
| | |
| **Clinical features:** | **No of patients** |
| Loin pain | 12 |
| Fever | 14 |
| Septic shock | 4 |
| Diabetes Mellitus | 13 |
| Urinary Obstruction | 2 |

**Table 2: Comparison of results of various studies.**

| Series | No of Patients | Class 1 & 2 | Class 3 & 4 | No of DJS | No of PCN | No of PCD | No of Emerg Nephrectomies | No of Deaths (%) |
|---|---|---|---|---|---|---|---|---|
| Huang[7] | 46 | 16 | 30(65%) | N/A | N/A | 41(14 failed) | 9 | 9(18) |
| Kangjam [9] | 8 | 5 | 3(37.5%) | 0 | 0 | 7* | 3 | 3(37.5) |
| Narlawar[10] | 11 | 11 | 0 | N/A | N/A | 11(4 failed) | 3 | 1(9) |
| Sokhal[3] | 74 | 45 | 29(39%) | 18 | | 0 | 4 (2 Op Drainage) | 6 (8.1) |
| Das[5] | 15 | 10 | 5(33%) | 7 | 4 | 0 | 0 | 0 |
| Sharma[6] | 14 | 9 | 5(35.7%) | 3 | 0 | 3(1 failed) | 0 (1 Op Drainage) | 0 |
| Sandeep[11] | 72 | N/A | N/A | 25 | 0 | 1 | 1 | 2(2) |
| Present Study | 17 | 13 | 4(23.5%) | 1 | 8 | 1 | 1 | 0 |

** 5 pts had 1 PCD and 2 had multiple PCD*

**Figure 1:** Patient with Class IIIA EPN of the left kidney with one stone in the upper ureter and another in the kidney.

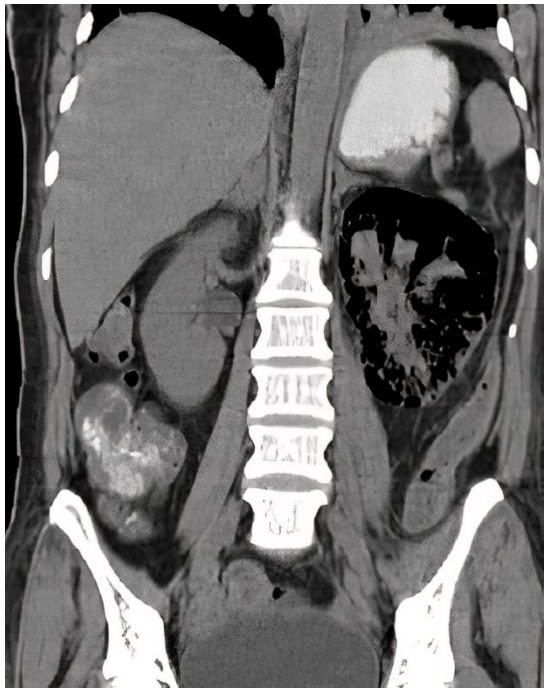

**Figure 2:** Patient with Class IIIA EPN of the left kidney with one stone in the upper ureter and another in the kidney.