



ORIGINAL ARTICLE

Emphysematous Pyelonephritis: Demographics, Clinical Predictors, Management & Outcomes: Our Experience at a Tertiary Care Centre

Anil Kumar Nallabothula,¹ Naveen Vulia Thillainathan,^{2,*} Praveen Kumar V,² Sindhura Madugula,² Sravan Reddy Pathakunta² and Vignesh N C²

¹Professor and HOD, Department of Urology, Sri Venkateswara Institute of Medical Sciences (SVIMS), Tirupati, Andhra Pradesh, India.

²Senior Resident, Department of Urology, Sri Venkateswara Institute of Medical Sciences (SVIMS), Tirupati, Andhra Pradesh, India

Accepted: 26-February-2024 / Published Online 31-March-2024

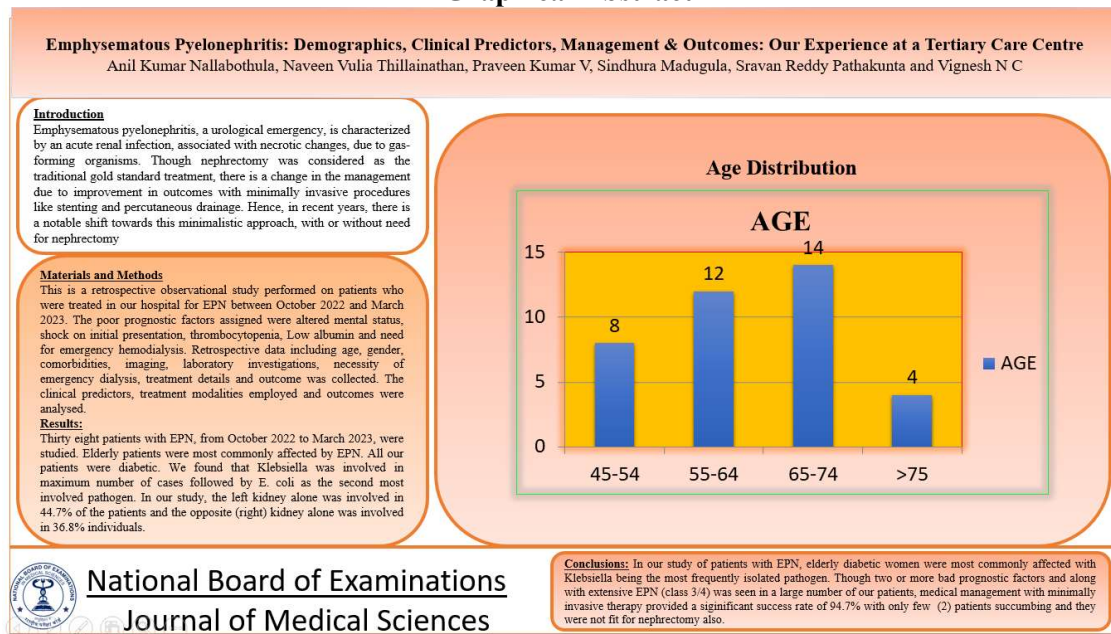
Abstract

Background: Emphysematous pyelonephritis, a urological emergency, is characterized by an acute renal infection, associated with necrotic changes, due to gas-forming organisms. Though nephrectomy was considered as the traditional gold standard treatment, there is a change in the management due to improvement in outcomes with minimally invasive procedures like stenting and percutaneous drainage. Hence, in recent years, there is a notable shift towards this minimalistic approach, with or without need for nephrectomy. **Methods:** This is a retrospective observational study performed on patients who were treated in our hospital for EPN between October 2022 and March 2023. The poor prognostic factors assigned were altered mental status, shock on initial presentation, thrombocytopenia, Low albumin and need for emergency hemodialysis. Retrospective data including age, gender, comorbidities, imaging, laboratory investigations, necessity of emergency dialysis, treatment details and outcome was collected. The clinical predictors, treatment modalities employed and outcomes were analysed. **Results:** Thirty eight patients with EPN, from October 2022 to March 2023, were studied. Elderly patients were most commonly affected by EPN. All our patients were diabetic. We found that Klebsiella was involved in maximum number of cases followed by E. coli as the second most involved pathogen. In our study, the left kidney alone was involved in 44.7% of the patients and the opposite (right) kidney alone was involved in 36.8% individuals. Of our 38 patients, 34 (89.4%) had two or more unfavourable prognostic factors. 32 patients had high grade/extensive EPN, [class 3(73.4%) and class 4(11.8%)]. **Conclusions:** In our study of patients with EPN, elderly diabetic women were most commonly affected with Klebsiella being the most frequently isolated pathogen. Though two or more bad prognostic factors and along with extensive EPN (class 3/4) was seen in a large number of our patients, medical management with minimally invasive therapy provided a significant success rate of 94.7% with only few (2) patients succumbing and they were not fit for nephrectomy also. Hence, we support early aggressive medical and minimally invasive treatment and also, we suggest that major procedures like nephrectomy should be considered in patients only if they are not improving with minimally invasive treatment.

Keywords: Emphysematous pyelonephritis, Gas forming uro-pathogens, Percutaneous catheter drainage, DJ stenting, Minimally invasive therapy, Emergency nephrectomy

*Corresponding author: Naveen Vulia Thillainathan
Email: naveenvt1504@gmail.com

Graphical Abstract



Introduction

Emphysematous pyelonephritis (EPN) is an emergency in urology characterized by an acute necrotizing renal parenchymal and surrounding tissues infection caused by gas-forming organisms [1]. Excess accumulated glucose in the tissues in diabetic patients, provides a favorable microenvironment for gas forming microbes. Females are more commonly affected, 6:1 [2]. This is due to the higher rate of UTIs (Urinary tract infections) in females [2].

Formation of gas is rapid, and the continued gas production denotes active infection and inadequate antibiotic treatment. Urinary tract infections which are becoming emphysematous pyelonephritis, are due to the presense of gas-forming bacteria, high tissue glucose concentration, increased proliferation of the bacteriae, vascular deficiency with ischemia/infarct [2].

EPN is a life-threatening disease. It has been noticed that the mortality rate has improved drastically with recent advances

in antibiotics, medical treatment of diabetes, resuscitation and minimally invasive therapy. The mainstay is fluid resuscitation, strict glycemic control and judicious use broad-spectrum antibiotic cover [2].

The classical teaching stated that the treatment should be aggressive, and nephrectomy was considered as first line treatment of choice. Now there is a change in the treatment aspect due to significant recent advances in non-invasive modalities like percutaneous catheter drainage (PCD) [2]. Recent protocols recommend PCD placement in patients with localized EPN and functioning parenchyma. This renders patient to retain the renal function, hence preventing ESRD and need for RRT. Since recent times, there is progressive shift towards this approach, and nephrectomy will be considered if required [3].

Aim and Objectives

The aim of our research is to emphasize the importance of early

diagnosis and minimally invasive treatment of EPN cases.

The objectives are to elucidate the outcomes of patients with EPN with relation to demographics, clinical predictors, radiological classification, treatment modalities, and the effect of bad prognostic factors on the outcome.

Material and Methods

This is a retrospective study conducted on patients who attended SVIMS with the disease between October 2022 and March 2023. A total of 38 patients with EPN admitted under urology, nephrology and medicine departments, whose complete case details were available were included. The poor prognostic factors assigned were altered mental status, shock on initial presentation (systolic BP<90), thrombocytopenia (<1.2 lakhs), low albumin (<3 gm/dl) and need for emergency HD were included in the study. The data were collected which included age, sex, comorbidities, laboratory investigations, imaging, need for emergency dialysis, management details and outcomes. The clinical predictors, treatment modalities and outcomes were studied.

Observations and Results

Thirty eight patients with EPN, from October 2022 to March 2023, were studied. Elderly patients were most commonly affected by EPN. All our patients were diabetic. We found that Klebsiella was involved in maximum number of cases followed by E. coli as the second most involved pathogen. In our study, the left kidney alone was involved in 44.7% of the patients and the opposite (right) kidney alone was involved in 36.8%

individuals. Of our 38 patients, 34 (89.4%) had two or more unfavourable prognostic factors. 32 patients had high grade/extensive EPN, [28 out of the total 38 patients come under class 3 category (73.4%) and remaining belonged to class 4(11.8%)]. All these patients had more than two bad prognostic factors. In our study, 12 patients required emergency Hemodialysis. Of these severe category patients, combined medical and minimally invasive treatment was successful in 30 patients and was not sufficient in 2 patients (expired). In our study, 12 patients required emergency Haemodialysis. 4 out of 38 patients had bilateral EPN, of whom 3 patients responded to a combined medical therapy, bilateral DJ stenting and percutaneous drainage with a catheter, while one patient succumbed.

Discussion

Elderly diabetic females had been maximum affected [3]. In this study of ours, the female predominance was more glaring (F:M = 12:1) as compared to other available research articles. In women the increased occurrence of EPN is probably because of more pronounced susceptibility and frequency of infections of the urinary tract in them [4].

Our patients had bad glycemic control as contemplated by way of high average HbA1c. Other than DM (Diabetes mellitus), our patients had no significant or bothersome predisposing elements such as obstructive uropathy that usually lead to the development of EPN. In our observation of the, renal stones were present only in two patients, inflicting obstructive uropathy in one patient. Similar findings had been reported by RA Misgar et al. [5] (Figures 1 to 6).

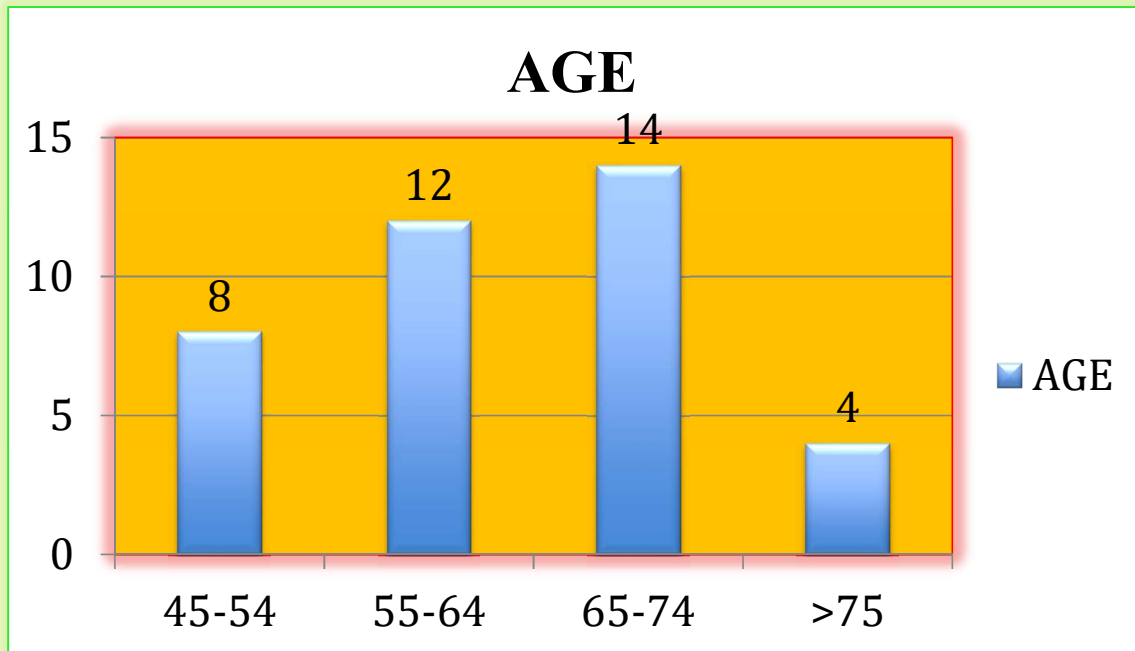


Figure 1. Age distribution

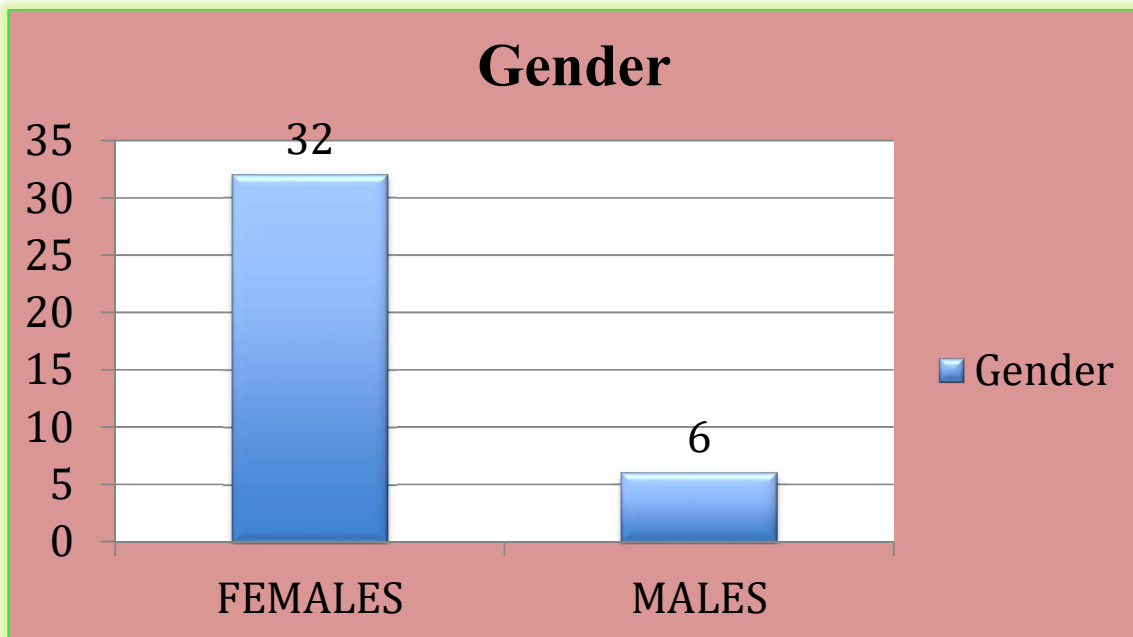


Figure 2. Gender distribution

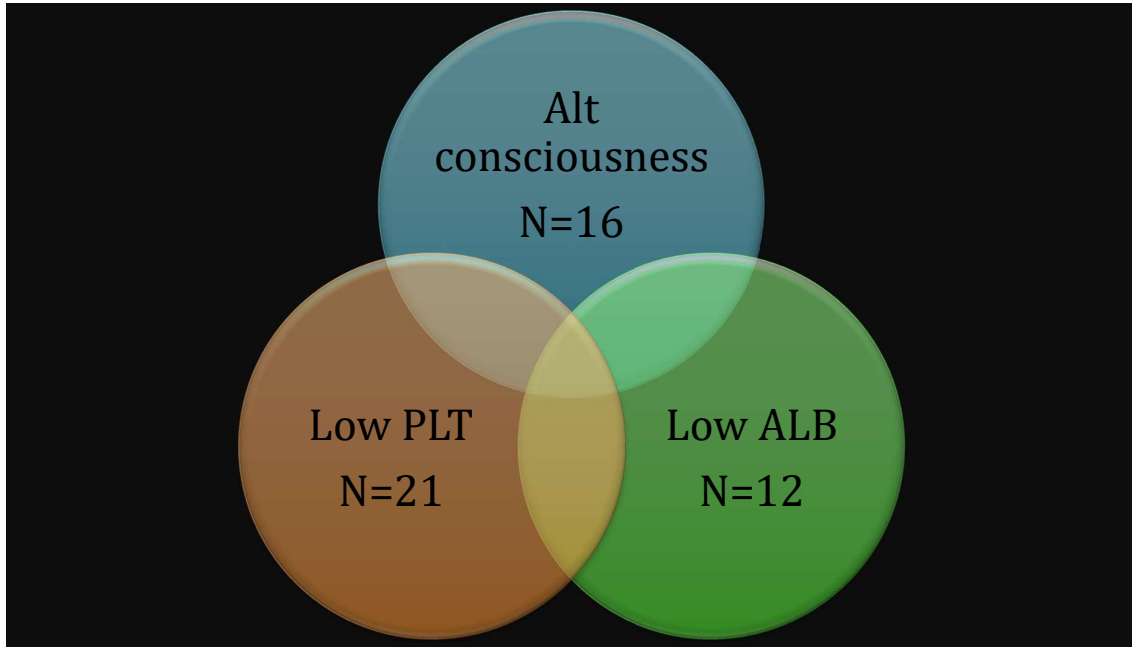


Figure 3. Poor prognostic factors

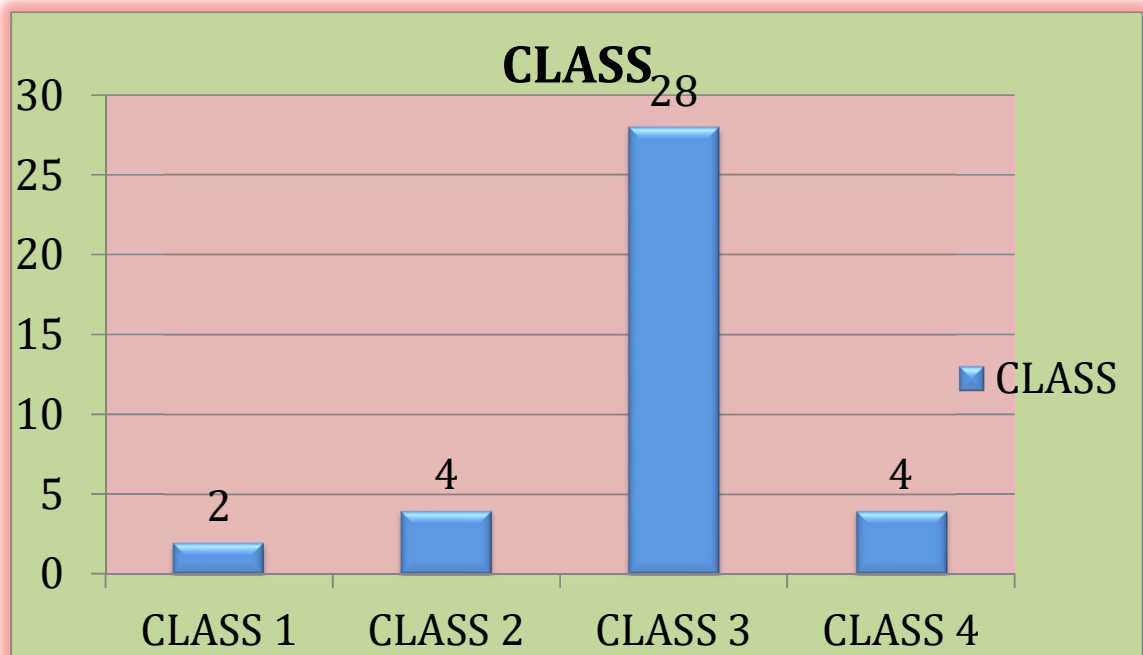


Figure 4. CT Classification: (Huang-Tseng)

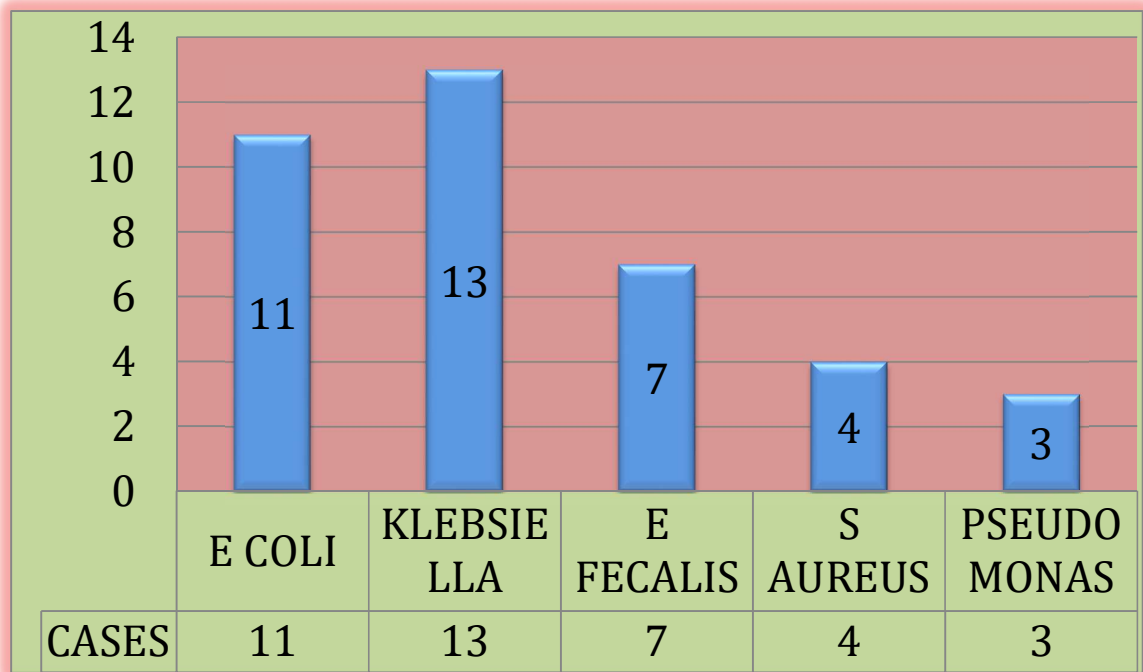


Figure 5. Causative organisms

CT CLASS	BAD PROGNOSTIC FACTORS	TREATMENT			OUTCOME	
		MEDICAL AND DJS	MEDICAL DJS & PCD	NEPHRECTOMY	SURVIVED	DEAD
1&2 (N=6)	<2(N=4)	4	0	0	4	0
	≥2(N=2)	2	0	0	2	0
3&4 (N=32)	<2(N=0)	0	0	0	0	0
	≥2(N=32)	26	6	0	30	2

Figure 6. The CT class, prognostic factors, TX and outcome:

E. coli is usually considered as the most frequent culprit causing EPN and has been isolated in about 47–90% of the cases.^[5] The other commonly involved organisms included Proteus mirabilis, Klebsiella pneumoniae, Enterococcus species, and Pseudomonas aeruginosa. In

contrast to the available literature, we, in our study, found that Klebsiella species was involved in maximum number of cases and E. coli was noted as the second most frequently grown pathogen in the cultures of our study [5].

In EPN, as per existing literature, left kidney was more commonly involved (cause unknown) than the right [6]. One of the meta-analysis done recently reported that 52% of all the EPN patients had left-sided disease, 37.7% suffered right-sided kidney involvement and 10.2% had bilateral pathology. Huang et al., in their study, reported that, out of the 48 patients with EPN they evaluated 67%, 25%, and 8% of the patients had left alone, right alone and bilateral involvement, respectively [7]. In our study of EPN, the left kidney alone was involved in 44.7% patients and the right sided pathology was observed in 36.8% patients. Bilateral occurrence was noted in 10.5% of patients.

Huang et al. also commented that initial presentation with severe proteinuria, thrombocytopenia, shock (defined by systolic BP <90 mmHg), altered sensorium and spread of the infection beyond the kidney, i.e., to the perinephric area were considerably linked with mortality and morbidity [7]. One more recent meta-analysis reported that patients suffering with EPN had a significantly high mortality rate when in association with shock. One more study done recently reported that severe hypoalbuminemia (with serum albumin <3 g/dl), necessity to start emergency hemodialysis and infections of polymicrobial origin are poor prognostic factors in patients affected by EPN.^[5] Of our 38 patients, 34 (89.4%) had two or more poor prognostic factors. In our series, 32 patients had extensive EPN (class 3 or 4) and all these patients had ≥ 2 bad prognostic factors, of whom, conservative minimally invasive therapy successfully improved 30 patients but was, for reasons unknown, unsuccessful in 2 patients who later expired.

Huang et al., in their study of 48 patients, finalized that nephrectomy presents the best possible management option and should be executed early for extensive form of EPN with a likely fulminant course (like those with ≥ 2 poor prognostic factors) [7]. Our data challenges this ideology, which is quite radical, as 30 out of the 32 patients, in our study, with severe and extensive (class 3/4) EPN improved with conservative management. Results, quite comparable to this, have been presented by Lu et al. [8].

Controversial and debatable is the treatment of EPN as such. Traditionally and historically, early nephrectomy was believed as the treatment of choice in those suffering from EPN with few reports even indicating that there was likely an increased mortality rate with medical and minimally invasive management when compared to surgical management. But surgery is frequently poorly tolerated in cases of EPN because of their poor hemodynamic condition. In an article by Ahlering et al., the mortality rate in those who underwent emergency nephrectomy was a staggering 42% [9]. A study by Kapoor et al. reported that an early nephrectomy, when performed, was linked with a higher mortality rate as compared to immediate conservative approach [10]. Chen et al., in 1996, presented an article, which stated that a proper antibiotic therapy in conjunction with CT (Image)-guided percutaneous aspiration or drainage was a reasonably good and acceptable alternative to upfront nephrectomy [11].

One more meta-analysis of recent times emphasized that in comparison to emergency nephrectomy, drainage by percutaneous route along with medical management was associated with an arguably lower mortality rate. Our findings

do positively reflect the ongoing trend in the treatment of EPN, because, in our analysis, the successful resolution of EPN with conservative treatment alone is 89.4%. Performing nephrectomy in these patients would have increased the probability of lifelong need for renal replacement therapy. Success of non-surgical treatment of EPN afflicting both the kidneys has already been previously reported by some authors. The probable reasons, for the encouragingly low mortality (<5.2%) in the present case series, are quick and adequate glycemic control, early and appropriate fluid resuscitation, combined use of potent antibiotics, and, in the majority of them, absence of any extra risk factors or bothersome elements other than DM for the development of EPN.

Limitations

Ours is a single centre study with a small number of patients.

Conclusion

In this series of patients with EPN, elderly diabetic women were most commonly affected and klebsiella was the most frequently isolated pathogen. Though two or more poor prognostic factors along with extensive EPN (class 4 or 3) was seen in a major part of our study group, medical management with minimally invasive therapy afforded a successful resolution rate of 94.7% with only two patients succumbed and they were not fit for nephrectomy also.

Hence, we support early aggressive medical and minimally invasive treatment and also, we suggest that major procedures like nephrectomy should be considered in patients only if they are not improving with minimally invasive treatment.

Statements and Declarations

Ethics approval and consent to participate–

This study was approved by the ethics committee of Sri Venkateswara Institute of medical sciences (SVIMS), Tirupati, Andhra Pradesh, India. The patient provided written consent on the condition that his personal details are not revealed anywhere.

Consent for publication

Obtained from the patient and approved by Institutional Ethics Committee (IEC).

Availability of data and material

Approval of competent authority taken for retrieval and usage of data/privacy concerns addressed.

Competing interests

None.

Authors' contributions

Conceptualization: AKN.
Methodology: NVT. Software: NVT.
Validation: AKN. Formal analysis: NVT.
Investigation: AKN. Resources: All authors. Data Curation: All authors.
Writing - Original Draft: NVT. Writing - Review & Editing: AKN. Visualization: NVT. Supervision: AKN. Project administration: All authors. Funding acquisition:

Acknowledgements

I thank and express my heartfelt gratitude to Dr. N. Anirudh Suseel, Assistant Professor, Department of Urology for providing me the necessary guidance and inputs.

References

1. Shokeir AA, El-Azab M, Mohsen T, El-Diasty T. Emphysematous pyelonephritis: A 15-year experience with 20 cases. *Urology*. 1997;49:343–6.
2. Kuchay M., Laway B., Bhat M., Mir S. Medical therapy alone can be sufficient for bilateral emphysematous pyelonephritis: report of a new case and review of previous experiences. *Int Urol Nephrol*. 2014;46(1):223–227.
3. Ubee S., McGlynn L., Fordham M. Emphysematous pyelonephritis. *Br J Urol Int*. 2011;107(9):1474–1478.
4. Schultz EH, Jr, Klorfein EH. Emphysematous pyelonephritis. *J Urol*. 1962;87:762–6.
5. Misgar RA, Mubarik I, Wani AI, Bashir MI, Ramzan M, Laway BA. Emphysematous pyelonephritis: A 10-year experience with 26 cases. *Indian J Endocrinol Metab*. 2016 Jul-Aug;20(4):475-80. doi: 10.4103/2230-8210.183475. PMID: 27366713; PMCID: PMC4911836.
6. Aboumarzouk OM, Hughes O, Narahari K, Coulthard R, Kynaston H, Chlosta P, et al. Emphysematous pyelonephritis: Time for a management plan with an evidence-based approach. *Arab J Urol*. 2014;12:106–15.
7. Huang J., Tseng C. Emphysematous pyelonephritis: Clinicoradiological classification, management, prognosis, and pathogenesis. *Arch Intern Med*. 2000;160(6):797–805.
8. Lu Y.C., Chiang B.J., Pong Y.H. Emphysematous pyelonephritis: clinical characteristics and prognostic factors. *Int J Urol*. 2014;21:277–282.
9. Ahlering TE, Boyd SD, Hamilton CL, Bragin SD, Chandrasoma PT, Lieskovsky G, et al. Emphysematous pyelonephritis: A 5-year experience with 13 patients. *J Urol*. 1985;134:1086–8.
10. Kapoor R, Muruganandham K, Gulia AK, Singla M, Agrawal S, Mandhani A, et al. Predictive factors for mortality and need for nephrectomy in patients with emphysematous pyelonephritis. *BJU Int*. 2010;105:986–9.
11. Chen M., Huang C., Chou Y., Huang C., Chiang C., Liu G. Percutaneous drainage in the treatment of emphysematous pyelonephritis: 10-year experience. *J Urol*. 1997;157(5):1569.