

Emphysematous pyelonephritis: outcomes with conservative management in a tertiary care center: A cross-sectional observational study.

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Abstract

Background:

Emphysematous pyelonephritis is a severe necrotizing infection of the kidney characterized by gas formation within the renal parenchyma, collecting system, or perinephric tissues. Early recognition and renal-preserving treatment have changed the management approach from routine nephrectomy to conservative strategies in selected patients.

Objectives:

To evaluate the clinical profile, radiological severity, treatment pattern, and short-term outcomes of patients with emphysematous pyelonephritis managed initially with conservative therapy in a tertiary care center.

Methods:

This hospital-based observational study was conducted at A C Subba Reddy Government Medical College & Hospital, Dargamitta, Nellore, Andhra Pradesh, India, from April 01, 2026, to April 30, 2026. Thirty-five patients diagnosed with emphysematous pyelonephritis and managed initially with antibiotics, supportive care, glycaemic control, and minimally invasive drainage where indicated were included. Clinical variables, CT classification, management modality, and outcomes were analysed descriptively.

Results:

The mean age was 55.1 ± 10.9 years, and females constituted 62.9% of patients. Diabetes mellitus was present in 85.7%, obstructive uropathy in 40.0%, and hypertension in 37.1%. Fever and flank pain were the commonest symptoms. Class 2 disease was the most frequent CT category. Conservative management was successful in 29 patients, giving a renal salvage rate of 82.9%. Delayed nephrectomy and mortality occurred in three patients each.

Conclusion:

Conservative management achieved favourable outcomes in most patients when combined with early antibiotics, metabolic correction, and timely drainage.

Recommendations:

Early CT-based risk stratification, prompt glycaemic control, urine culture-directed antibiotics, and low-threshold minimally invasive drainage are recommended to improve renal salvage.

Keywords: *Emphysematous pyelonephritis; Conservative management; Percutaneous nephrostomy; Diabetes mellitus; Computed tomography; Renal salvage; Urosepsis*

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Introduction

Emphysematous pyelonephritis (EPN) is an uncommon but potentially fatal necrotizing infection of the renal

parenchyma and surrounding tissues, distinguished by gas formation within the kidney, collecting system, or perinephric space. It represents the severe end of

complicated upper urinary tract infection and often presents as a urological emergency. The clinical picture overlaps with acute pyelonephritis, but the presence of gas-forming infection, sepsis, metabolic instability, and renal dysfunction gives EPN a distinctly higher risk profile [1].

Diabetes mellitus is the most consistent predisposing factor, largely because hyperglycaemia, impaired host defence, tissue hypoperfusion, and microvascular disease support bacterial proliferation and gas production. Obstructive uropathy, renal calculi, chronic kidney disease, and immunosuppression further increase susceptibility and can worsen clinical progression. *Escherichia coli* and *Klebsiella pneumoniae* are the organisms most often isolated, although polymicrobial infection and less common pathogens have also been described [2,3].

Computed tomography (CT) remains central to diagnosis because it defines the presence, amount, and anatomical extension of gas more accurately than ultrasound or plain radiography. The clinicoradiological classification proposed by Huang and Tseng is widely used to stratify disease extent from gas limited to the collecting system to bilateral disease or infection in a solitary kidney [2]. CT staging also supports treatment decisions, particularly the need for drainage, escalation of care, and consideration of nephrectomy in non-responders [4].

The management of EPN has changed substantially over recent decades. Earlier practice favoured early nephrectomy because of high mortality reported in historical series. More recent evidence supports renal-preserving treatment using broad-spectrum antibiotics, aggressive resuscitation, correction of metabolic derangements, and image-guided or endoscopic drainage when required [5,6]. This approach is especially relevant in resource-limited and high-volume tertiary centers, where renal salvage and avoidance of major surgery are clinically meaningful goals.

Despite improved outcomes, conservative treatment does not succeed uniformly. Shock, altered sensorium, thrombocytopenia, acute kidney injury, need for dialysis, hypoalbuminaemia, polymicrobial infection, and advanced CT class are repeatedly associated with treatment failure or mortality [7,8]. Local data remain important because patient profiles, referral delays, microbiological spectrum, availability of interventional radiology, and institutional management protocols differ across centers. Such data also support pragmatic protocols for triage and drainage in centers managing severe urinary infection. They additionally help audit renal-salvage practice in short-window hospital cohorts. The present study was conducted with the objective of evaluating the demographic and clinical profile, radiological severity, conservative management strategies, and treatment outcomes among

patients with emphysematous pyelonephritis managed at a tertiary care center.

Methodology

Study design and setting

This was a hospital-based cross-sectional observational study conducted in the Department of Urology and allied emergency care units at A C Subba Reddy Government Medical College & Hospital, Dargamitta, Nellore, Andhra Pradesh, India. The institution is a government tertiary-care teaching hospital providing specialist urological outpatient, emergency, inpatient, diagnostic, and operative services to patients from Nellore and surrounding regions. The Department of Urology manages patients requiring endoscopic and surgical treatment for urinary tract obstruction, urolithiasis, retained ureteral stents, and other complex urological conditions. Patients included in the study were evaluated through the urology outpatient department, emergency services, or inpatient referral system and were treated using the available endourological and operative facilities. The study was designed to assess the clinical profile, radiological severity, conservative management approach, and short-term outcomes of patients diagnosed with emphysematous pyelonephritis. The protocol followed the principles of observational clinical reporting and outcome assessment in acute urological infections [9,10].

Study period and data collection

The retrospective study period covered five years, from **April 01, 2021, to March 31, 2026**. Case records of eligible patients diagnosed and treated during this period were reviewed. Data extraction and compilation were carried out between **April 01, 2026, and April 30, 2026**, after obtaining Institutional Ethics Committee approval. A total of **35 consecutive patients** diagnosed with emphysematous pyelonephritis and managed initially with conservative treatment were included in the final analysis. The sample size was based on complete case inclusion during the defined retrospective study period.

Eligibility criteria

Patients with clinical suspicion of severe upper urinary tract infection and radiological confirmation of emphysematous pyelonephritis on computed tomography were eligible. Patients were included when initial management was conservative, consisting of antibiotics and supportive care with or without minimally invasive drainage. Patients with incomplete essential clinical or radiological data, those referred after definitive nephrectomy elsewhere, and patients in whom gas in the renal region was attributable to

recent instrumentation or trauma rather than infection were excluded.

Clinical assessment and investigations

Demographic variables, comorbid conditions, presenting symptoms, haemodynamic status, and relevant laboratory parameters were recorded. Laboratory evaluation included complete blood count, renal function tests, blood glucose estimation, urine microscopy, urine culture, and blood culture, where clinically indicated. Leukocytosis, thrombocytopenia, and acute kidney injury were documented using institutional laboratory thresholds and clinical judgment. CT findings were classified according to the Huang and Tseng system, which stratifies EPN based on the anatomical extent of gas and abscess formation [2].

Treatment protocol

Conservative management was defined as initial renal-preserving treatment without upfront nephrectomy. All patients received intravenous broad-spectrum antibiotics, fluid resuscitation, glycaemic control, analgesia, correction of electrolyte imbalance, and organ-supportive measures as required. Antibiotic therapy was modified after culture and sensitivity results. Double-J stenting, percutaneous nephrostomy, percutaneous catheter drainage, or combined drainage was performed in patients with obstruction, significant collection, poor early clinical response, or advanced CT class. Delayed nephrectomy was reserved for persistent sepsis, non-resolving infection, or failure of conservative therapy despite adequate supportive and drainage measures [5,11,12].

Bias

To reduce selection bias, all consecutive patients who met the predefined eligibility criteria during the five-year study period were included. Information and misclassification bias were minimized by extracting data using uniform definitions, confirming emphysematous pyelonephritis through computed tomography, applying the Huang and Tseng classification consistently, and defining treatment success and unfavourable outcomes before analysis. Patients with incomplete essential clinical or radiological information were excluded. Clinical, laboratory, radiological, treatment, and outcome data were obtained from the same institutional records to maintain consistency. Nevertheless, residual information bias and unmeasured confounding could not be eliminated because of the retrospective, single-centre design.

Outcome measures and statistical analysis

The primary outcome was successful conservative management, defined as clinical recovery with renal salvage and no requirement for nephrectomy during the hospital stay. Secondary outcomes included clinical improvement within 72 hours, improvement in renal function, intensive care unit admission, delayed nephrectomy, mortality, and outcome according to CT severity. Data were entered in a spreadsheet and analysed descriptively. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as numbers and percentages.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee, A C Subba Reddy Government Medical College & Hospital, Nellore (EC Ref No.: ECR/961/Inst/AP/2017/RR-25/97-04/28-03-26; dated 28-Mar-2026). Written informed consent was obtained, confidentiality was maintained, and the study followed ICMR and GCP principles.

Results

A total of 35 patients diagnosed with emphysematous pyelonephritis and managed initially with conservative treatment were included in the final analysis. The mean age of the study population was 55.1 ± 10.9 years. The majority of patients were females, and diabetes mellitus was the most common associated comorbidity. Obstructive uropathy and hypertension were also frequently observed among the study population (Table 1).

Table 1. Demographic and clinical profile of patients with emphysematous pyelonephritis

Variable	Category	Number	Percentage
Age group	≤40 years	4	11.4
	41–50 years	9	25.7
	51–60 years	13	37.1
	>60 years	9	25.7
Sex	Male	13	37.1
	Female	22	62.9
Diabetes mellitus	Present	30	85.7
Hypertension	Present	13	37.1
Chronic kidney disease	Present	5	14.3
Obstructive uropathy	Present	14	40.0
Renal calculi	Present	10	28.6

Fever was the most common presenting symptom, followed by flank pain, dysuria, and vomiting. Leukocytosis was the most frequent laboratory abnormality, while acute kidney

injury was noted in nearly one-third of patients. Urine culture was positive in 26 patients, with *Escherichia coli* being the predominant organism isolated (Table 2).

Table 2. Presenting features and laboratory findings

Variable	Number	Percentage
Fever	33	94.3
Flank pain	31	88.6
Dysuria	23	65.7
Vomiting	18	51.4
Altered sensorium	5	14.3
Hypotension at admission	6	17.1
Leukocytosis	28	80.0
Thrombocytopenia	9	25.7
Acute kidney injury	12	34.3
Positive urine culture	26	74.3
Blood culture positivity	8	22.9

Computed tomography showed that Class 2 emphysematous pyelonephritis was the most common radiological category, followed by Class 3A disease. All patients received broad-spectrum intravenous antibiotics, fluid resuscitation, glycaemic control, and supportive care. Antibiotics alone

were sufficient in nine patients, while the remaining patients required minimally invasive drainage procedures such as double-J stenting, percutaneous nephrostomy, or percutaneous catheter drainage (Table 3).

Table 3. CT classification and conservative management strategy

Variable	Category	Number	Percentage
CT classification	Class 1	6	17.1
	Class 2	12	34.3
	Class 3A	9	25.7
	Class 3B	6	17.1
	Class 4	2	5.7
Management modality	Antibiotics and supportive care alone	9	25.7
	Antibiotics with double-J stenting	8	22.9
	Antibiotics with percutaneous nephrostomy	10	28.6
	Antibiotics with percutaneous catheter drainage	6	17.1
	Combined percutaneous nephrostomy and catheter drainage	2	5.7

Clinical improvement within 72 hours was observed in 25 patients. Renal function improved in 29 patients during the hospital stay. Conservative management was successful in 29 patients, giving an overall renal salvage rate of 82.9%. Three patients required delayed nephrectomy, and three

patients died despite intensive supportive care. The mean duration of hospital stay was 10.8 ± 4.6 days. Unfavourable outcomes were more frequent among patients with advanced CT class, hypotension, thrombocytopenia, and acute kidney injury at presentation (Table 4).

Table 4. Treatment outcomes and outcomes according to CT severity

Panel	Variable/CT class	Number/Total	Percentage/Outcome
Treatment outcomes	Clinical improvement within 72 hours	25	71.4
	Improvement in renal function	29	82.9
	ICU admission required	7	20.0
	Successful conservative management	29	82.9
	Delayed nephrectomy	3	8.6
	Mortality	3	8.6
	Overall unfavourable outcome	6	17.1
Outcome according to CT severity	Class 1	6	6 successful; 0 unfavourable
	Class 2	12	12 successful; 0 unfavourable
	Class 3A	9	8 successful; 1 unfavourable
	Class 3B	6	3 successful; 3 unfavourable
	Class 4	2	0 successful; 2 unfavourable
	Total	35	29 successful; 6 unfavourable

Overall, conservative management achieved favourable outcomes in most patients with emphysematous pyelonephritis. The combination of early antibiotic therapy, metabolic correction, glycaemic control, and timely minimally invasive drainage was associated with high renal salvage. Poor outcomes were mainly observed in patients with severe radiological disease and systemic complications at admission.

Discussion

The present study describes the outcomes of 35 patients with emphysematous pyelonephritis managed initially with a renal-preserving strategy at a tertiary care center. The mean age of 55.1 years and female predominance are consistent

with contemporary EPN series, where middle-aged and older diabetic patients form the principal risk group [1,7]. Diabetes mellitus was present in 85.7%, reinforcing the role of hyperglycaemia, impaired host response, and tissue hypoperfusion in gas-forming renal infection [2,6]. The clinical presentation was typical of severe upper urinary tract infection, with fever and flank pain as leading symptoms. Dysuria and vomiting were frequent, while altered sensorium and hypotension represented systemic severity. Similar observations were reported by Eswarappa et al. and Rafiq et al., where fever, renal angle tenderness, urinary symptoms, vomiting, and acute kidney injury were common [7,14]. The predominance of *Escherichia coli* also

agrees with reports identifying Gram-negative enteric organisms as the chief pathogens [1,6].

CT classification provided a practical clinical anchor. Class 2 disease was the most common radiological category, followed by Class 3A disease. All patients with Class 1 and Class 2 disease recovered with conservative treatment, supporting the view that localized disease responds well to antibiotics with drainage when indicated. Huang and Tseng, and later Elawdy et al., reported excellent outcomes in lower CT classes with appropriate medical therapy and selective drainage [2,8].

The overall renal salvage rate of 82.9% supports the current shift away from routine upfront nephrectomy. Antibiotics alone were sufficient in selected patients, while most required double-J stenting, percutaneous nephrostomy, catheter drainage, or combined procedures. This pattern is consistent with evidence that percutaneous or endoscopic drainage improves source control while preserving renal tissue [5,10,11]. Delayed nephrectomy was required only in three patients, confirming its role as rescue treatment for persistent sepsis or non-resolving disease.

Mortality occurred in three patients, and unfavourable outcomes clustered among Class 3B and Class 4 disease. The association between poor outcome and advanced CT class, haemodynamic instability, thrombocytopenia, and renal dysfunction is clinically plausible. Falagas et al. identified shock, thrombocytopenia, altered consciousness, renal impairment, and bilateral disease as adverse markers, while Lu et al. and Rahoui et al. reported conservative treatment failure with septic shock, dialysis requirement, hypoalbuminaemia, thrombocytopenia, and polymicrobial infection [4,12,13]. Therefore, conservative management should be active, closely monitored, and supported by early escalation when response is inadequate.

Generalizability

The findings apply to tertiary care hospitals where CT imaging, intensive care support, microbiology services, urology intervention, and image-guided drainage are available. The results are most relevant to similar Indian hospital settings managing diabetic and obstructive uropathy-related EPN. Extrapolation to centers without rapid imaging or drainage facilities requires caution because early source control strongly influences renal salvage and survival. Standardized emergency pathways strengthen transferability across comparable teaching hospitals.

Conclusion

Conservative management produced favourable short-term outcomes in most patients with emphysematous pyelonephritis in this tertiary care cohort. Early diagnosis with computed tomography, prompt broad-spectrum

antibiotics, metabolic stabilization, strict glycaemic control, and timely drainage were associated with a renal salvage rate of 82.9% during the same admission period. Lower CT classes responded particularly well to conservative therapy. Unfavourable outcomes were concentrated among patients with advanced radiological disease, hypotension, thrombocytopenia, and acute kidney injury at admission. Delayed nephrectomy remained necessary in a small proportion of patients with persistent sepsis or non-resolving infection. These findings overall support a structured renal-preserving approach with vigilant monitoring and early escalation when clinical response is inadequate.

Limitations

This study was limited by its single-center design, short study period, and modest sample size. Long-term renal function, recurrence, readmission, and quality-of-life outcomes were not assessed. Microbiological resistance patterns and antibiotic duration were not analysed in detail. Selection bias remains possible because only patients managed initially with conservative treatment were included. The absence of inferential modelling restricts the assessment of independent predictors of treatment failure.

Recommendations

Patients with suspected emphysematous pyelonephritis should undergo early CT imaging and prompt risk stratification using radiological class and systemic severity markers. Empirical broad-spectrum antibiotics, haemodynamic stabilization, renal function monitoring, and strict glycaemic control should begin immediately. Urine and blood cultures should guide antimicrobial modification. Drainage by double-J stenting, percutaneous nephrostomy, or catheter drainage should be performed early in obstructed systems, collections, or poor early responders. Patients with shock, thrombocytopenia, altered sensorium, acute kidney injury, bilateral disease, or Class 3B/Class 4 involvement require intensive monitoring and early multidisciplinary review. Nephrectomy should be reserved for persistent sepsis or failed renal-preserving therapy.

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Abbreviations

AKI: Acute kidney injury
CT: Computed tomography
DJ: Double-J
EPN: Emphysematous pyelonephritis
ICU: Intensive care unit
PCD: Percutaneous catheter drainage
PCN: Percutaneous nephrostomy
UTI: Urinary tract infection

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Conflict of interest

The authors declare no conflict of interest.

Author Contributions

Dr. Juturu Jayaraju: Conceptualization of the study, clinical case identification, patient data collection, interpretation of urological findings, and critical revision of the manuscript.

Dr. Chenna Sai Krishna: Study design, supervision of data collection, radiological and clinical outcome assessment, manuscript drafting, correspondence, and final coordination of the article submission.

Dr. V. Mary Snygdha: Clinical input in allied emergency and multidisciplinary care, review of patient records, interpretation of associated clinical variables, literature review, and critical editing of the manuscript.

All authors contributed to the intellectual content of the manuscript, reviewed the final version, and approved it for submission.

Data availability

Data available on request

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References

1. Ubee SS, McGlynn L, Fordham M. Emphysematous pyelonephritis. *BJU Int*. 2011;107(9):1474-1478. <https://doi.org/10.1111/j.1464-410X.2010.09660.x>
2. Huang JJ, Tseng CC. Emphysematous pyelonephritis: clinicoradiological classification, management, prognosis, and pathogenesis. *Arch Intern Med*. 2000;160(6):797-805. <https://doi.org/10.1001/archinte.160.6.797>
3. Wan YL, Lo SK, Bullard MJ, Chang PL, Lee TY. Predictors of outcome in emphysematous pyelonephritis. *J Urol*. 1998;159(2):369-373. [https://doi.org/10.1016/S0022-5347\(01\)63919-3](https://doi.org/10.1016/S0022-5347(01)63919-3)
4. Falagas ME, Alexiou VG, Giannopoulou KP, Siempos II. Risk factors for mortality in patients with emphysematous pyelonephritis: a meta-analysis. *J Urol*. 2007;178(3 Pt 1):880-885; quiz 1129. <https://doi.org/10.1016/j.juro.2007.05.017>
5. Somani BK, Nabi G, Thorpe P, Hussey J, Cook J, N'Dow J; ABACUS Research Group. Is percutaneous drainage the new gold standard in the management of emphysematous pyelonephritis? Evidence from a systematic review. *J Urol*. 2008;179(5):1844-1849. <https://doi.org/10.1016/j.juro.2008.01.019>
6. Wu SY, Yang SSD, Chang SJ, Hsu CK, Chen HW, Chang CH. Emphysematous pyelonephritis: classification, management, and prognosis. *Tzu Chi Med J*. 2022;34(3):297-302. https://doi.org/10.4103/tcmj.tcmj_257_21
7. Eswarappa M, Suryadevara S, John MM, Kumar M, Reddy SB, Suhail M. Emphysematous pyelonephritis case series from South India.

- Kidney Int Rep. 2018;3(4):950-955. <https://doi.org/10.1016/j.ekir.2017.12.003>
8. Elawdy MM, Osman Y, Abouelkheir RT, El-Halwagy S, Awad B, El-Mekresh M. Emphysematous pyelonephritis treatment strategies in correlation to the CT classification: have the current experience and prognosis changed? Int Urol Nephrol. 2019;51(10):1709-1713. <https://doi.org/10.1007/s11255-019-02220-3>
 9. Tsu JHL, Chan CK, Chu RWH, Law IC, Kong CK, Liu PL, et al. Emphysematous pyelonephritis: an 8-year retrospective review across four acute hospitals. Asian J Surg. 2013;36(3):121-125. <https://doi.org/10.1016/j.asjsur.2013.01.003>
 10. Bhat RA, Khan I, Khan I, Palla N, Mir T. Emphysematous pyelonephritis: outcome with conservative management. Indian J Nephrol. 2013;23(6):444-447. <https://doi.org/10.4103/0971-4065.120343>
 11. Jain A, Manikandan R, Dorairajan LN, Sreenivasan SK, Bokka S. Emphysematous pyelonephritis: does a standard management algorithm and a prognostic scoring model optimize patient outcomes? Urol Ann. 2019;11(4):414-420. https://doi.org/10.4103/UA.UA_17_19
 12. Lu YC, Chiang BJ, Pong YH, Huang KH, Hsueh PR, Huang CY, et al. Predictors of failure of conservative treatment among patients with emphysematous pyelonephritis. BMC Infect Dis. 2014;14:418. <https://doi.org/10.1186/1471-2334-14-418>
 13. Rahoui M, Ouanes Y, Chaker K, Bibi M, Dali KM, Sellami A, et al. Predictive factors for failure of conservative management in patients with emphysematous pyelonephritis. Ann Med Surg (Lond). 2022;78:103930. <https://doi.org/10.1016/j.amsu.2022.103930>
 14. Rafiq N, Nabi T, Rasool S, Sheikh RY. A prospective study of emphysematous pyelonephritis in patients with type 2 diabetes. Indian J Nephrol. 2021;31(6):536-543. https://doi.org/10.4103/ijn.IJN_411_19

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