International Journal of Medicine
pISSN 1468-3814 | eISSN 2667-7008
https://theinternationalmedicine.com/

Original Researcher Article *DOI: 10.61336/im/26-3-77*

Risk Factors and In-Hospital Outcomes in Patients with Acute Pyelonephritis

Basharat Kassana[1], Mosin Mushtaq[2], Ashaq Parrey[1*], Enayat Ullah[1], Jan Amir[1], Muzaffar Maqbool[1], Asma Rafi[1], Rafaqat Jamali[1]

[1]Medicine, Government medical college Srinagar Jammu and Kashmir, India
[2]Surgery Government medical college Srinagar Jammu and Kashmir, India

Correspondence:
Dr. Ashaq Hussain Parrey
Department of Medicine, Government Medical College Srinagar
Karanagar, Jammu and Kashmir – 190010, India
Email: chogalpora@gmail.com

ORCID ID: 0000-0003-3766-1809

Received: **January 27, 2026**
Revised: **February 15, 2026**
Accepted: **March 09, 2026**
Published: **March 26, 2026**

Abstract

Background: Acute pyelonephritis (APN) is common clinical entitythat usually results as a complication of ascending urinary tract infection (UTI). Acute pyelonephritis presentswith fever, flank pain, vomiting, burning micturition, increased urinary frequency, and urgency. Acute pyelonephritis can be classified as uncomplicated or complicated. Complicated pyelonephritis isobserved in pregnant women, patients with uncontrolled diabetes, individuals with kidney transplants, those with urinary anatomical abnormalities, acute or chronic renal failure and immunocompromised patients. It is important to know the clinical, biochemical, and radiological profile of patients with APN to identify early prognostic markers so as to reduce the morbidity and mortality with proper triaging. This study was planned to determine the relationship between the clinical laboratory data at presentation with in hospital course and outcome in patients of APN. ***Objective:*** To determine the clinical characteristics and in-hospital course of patients with acute pyelonephritis. ***Methods:*** This prospective, observational, study was conducted in the Department of Medicine, Government Medical College Srinagar. Patients above the age of 18 with CT-confirmed diagnosis of pyelonephritis were included after obtaining proper consent from patient or guardian. ***Results:*** In our study, 31 patients diagnosed with acute pyelonephritis were enrolled, with a mean age of 59.2 years. Females comprised 54.8% of cases. Common symptoms included dysuria (90.3%), fever (83.9%), flank pain (80.6%), and prior UTI history (67.7%). Pyuria was universal. Urine cultures were sterile in 64.5% of cases; E. coli was isolated in 25.8%, and MRSA, Enterococcus, and Candida in 3.2% each. Comorbidities were common, notably diabetes (74.2%) and hypertension (67.7%). Lab results showed anaemia, leucocytosis, elevated urea and creatinine, and varied blood sugar and electrolyte levels. The mortality rate was 9.7%.

Keywords: Acute Pyelonephritis, Risk Factors, Urinary Tract Infection

INTRODUCTION

Urinary tract infections (UTIs) are among the most common bacterial infections encountered in both community and hospital settings worldwide. They encompass infections of the lower urinary tract, including cystitis and urethritis, and those of the upper urinary tract, such as pyelonephritis, which involves the renal parenchyma and the pelvis. Acute pyelonephritis (APN) is a bacterial infection of the upper urinary tract, characterized by inflammation of the renal parenchyma, calyces, and pelvis. It represents a potentially serious condition that, if not promptly recognized and adequately treated, can lead to complications such as renal abscesses, sepsis, or chronic renal scarring [1].

APN is a significant public health issue worldwide. It accounts for approximately 250,000 outpatient visits and 200,000 hospital admissions annually in the United States, with women being affected far more frequently than men. The mortality rate among hospitalized cases ranges between 10% and 20%, particularly in the elderly and in those with underlying comorbidities [2,3]. The disease burden is even greater in developing countries because of delayed presentation, limited diagnostic resources, and widespread antimicrobial resistance.

The pathogenesis of acute pyelonephritis typically involves an ascending infection from the lower urinary tract, most commonly caused by Escherichia coli, which remains the predominant pathogen in both community- and hospital-acquired infections. Other causative organisms include Klebsiella, Proteus, Enterococcus, Pseudomonas, and Staphylococcusspp[4]. Hematogenous spread, although less common, may occur in cases of bacteremia, particularly with Staphylococcus aureus infection. Clinically, patients usually present with fever, flank pain, nausea, vomiting, dysuria, frequency, and costovertebral angle tenderness [5].

Several risk factors predispose individuals to develop APN, including female sex, diabetes mellitus, pregnancy, urinary tract obstruction, nephrolithiasis, chronic kidney disease, and prior episodes of UTI [6]. In particular, diabetes mellitus increases susceptibility by impairing neutrophil function, reducing host defence mechanisms, and creating a glucose-rich environment that promotes bacterial growth. Anatomical and functional abnormalities of the urinary tract, such as vesicoureteral reflux and obstruction, facilitate bacterial ascent and persistence.

The British Medical Research Council Bacteriuria Committee defines acute pyelonephritis as "a clinical syndrome of flank pain, costovertebral angle tenderness, and fever accompanied by laboratory evidence of renal infection, including leukocytosis, pyuria, hematuria, bacteriuria, positive urine culture, and sometimes bacteremia [7]. The combination of flank pain and pyuria with systemic symptoms strongly supports the diagnosis. However, the absence of fever or classical symptoms does not exclude the condition, particularly in elderly or immunocompromised patients.

Radiological imaging plays a vital role in confirming the diagnosis and identifying complications of this condition. Contrast-enhanced computed tomography (CT) is considered the gold standard for diagnosis, revealing characteristic findings such as areas of low attenuation extending to the renal capsule, perinephric fat stranding, and renal enlargement. CT also helps in the detection of severe complications, such as emphysematous pyelonephritis, abscesses, and obstructive uropathy [8]. Nevertheless, a normal CT scan does not completely rule out mild disease because early inflammatory changes may be subtle or transient.

Despite advances in antimicrobial therapy and imaging, acute pyelonephritis continues to pose diagnostic and therapeutic challenges, especially with the rising antimicrobial resistance and growing prevalence of comorbidities such as diabetes and chronic kidney disease. Early recognition and prompt initiation of appropriate antibiotics are crucial to prevent renal damage and systemic complications.

This study aimed to analyze the clinical profile, risk factors, and in-hospital outcomes of patients admitted with acute pyelonephritis to a tertiary care hospital. By evaluating demographic characteristics, laboratory and radiological findings, and comorbid conditions, this study aims to identify predictors of adverse outcomes and to improve understanding of disease patterns in our region, thereby aiding in timely diagnosis and better patient management.

Objective: To determine the clinical presentation, etiology, hospital course and outcome of patients admitted with acute pyelonephritis.

MATERIALS AND METHODS

The present study was a prospective, observational, hospital-based study conducted in the department of General medicine Govt. Medical College Srinagar over a period of one year. We recruited all the admitted patients above 18years who fulfilled diagnostic criteria for acute pyelonephritis. During the study period of one year from June 2023 –May 2024 a total of 31 patients were enrolled,after taking informed consent for enrolment from either the patient or guardian.A detailed history was taken,demographic characteristics, physical examination findings and biochemical parameters including haemoglobin, total blood counts, platelet counts, serum urea, serum creatinine, serum albumin, blood culture sensitivity, urine culture sensitivity was recorded. Radiological findings, including ultrasonography and non-contrast computerised tomography, were entered on a proforma.

Inclusion criteria

All the patients diagnosed with APN based on clinical and/or radiological findings were included in this study. The diagnosis of APN was based on both clinical and radiological criteria. Clinical criteria include the presence of "classical" symptoms of APN [9].

1. Fever, defined as a temperature of greater than 37.5 C
2. Pyuria, defined as greater than ten white blood cells per high-power field of centrifuged urine sample.
3. Presence of loin or flank pain with or without lower urinary tract symptoms. The presence of positive urine or blood cultures was not mandatory for diagnosis.
4. Hypotension defined as a systolic blood pressure <90mm Hg or diastolic blood pressure <40mm Hg
5. Acute kidney injury defined as any of the following (Not Graded):
    a. Increase in serum creatinine by 0.3 mg/dl within 48 hours; or
    b. Increase in serum creatinine to 1.5 times baseline, which is known or presumed to have occurred within the prior seven days; or
    c. Urine output volume <0.5 ml/kg/h for 6 hours.

Exclusion criteria

1. Those without CT imagingevidence of acute pyelonephritis.

2. Pregnant women.
3. Those with prior urological intervention.

RESULTS

During the study period of one year31 patients who fulfilled the diagnostic criteria for acute pyelonephritis were enrolled. The minimum age was 20 years and the maximum was 85years, with a mean age of 59.19. 17 (54.8%) were female and 14 (45.2%) were males.Dysuria was present in 90.3%, followed by fever (83.9%) flank pain (80.6%) vomiting (54.8%) and history of previous UTI (67.7%). Pyuria was present in all patients, urine culture was sterile in (64.5%), E coli was isolated from urine culture of (25.8%) patients, MRSA in (3.2%), Enterococcus (3.2%) and yeast (3.2%). The clinical characteristics of the patientsare presented in table 1. The prevalence of comorbidities such as diabetes mellitus, hypertension, chronic renal failure, cerebrovascular accident and benign hypertrophy of prostateis summarisedin table2. The prevalence of Anaemia, Renal failure, blood sugar variability, Electrolyte abnormalities aredepicted in table 3.

Table.1: Clinical characteristics of studied patients

Characteristic		Frequency	Percent	Valid percent	Cumulative percent
Gender	Male	14	45.2	45.2	45.2
	Females	17	54.8	54.8	100.0
Symptom	Fever	28	90.3	90.3	
	Flank Pain	26	83.9	83.9	
	Vomiting	17	54.8	54.8	
	Previous UTI	21	67.7	67.7	
Urine culture	E. coli	8	25’8	25.8	25.8
	Enterococcus	1	3.2	3.2	29.0
	MRSA	1	3.2	3.2	32.3
	Sterile	20	64.5	64.5	96.8
	Yeast	1	3.2	3.2	100.0
Outcome	Survived	28	90.3	90.3	90.3
	Expired	3	9.7	9.7	100.0

Table 2: Comorbidities in Patients withPyelonephritis.

		Frequency	Percent	Valid Percent
	Diabetes	23	74.2	74.2
	Hypertension	21	67.7	67.7
	Coronary artery disease	3	9,7	9.7
	Cerebro vascular accident	6	19.4	19.4
	Benign hypertrophy of prostate	5	16.1	16.1
	Obstructive lung disease	2	6.5	6.5
	Chronic kidney disease	9	29	29
	hypothyroidism	5	16.1	16.1

Table 3: lab parameter of studied patients with pyelonephritis.

	Minimum	Maximum	Mean	Std. Deviation
Haemoglobin	3.7	15.3	10.5	2.8
Total leucocyte count	4.6	36.8	13.0	6.3
Platelet count	17	355	183.5	89.4
Blood sugar	70.00	375.00	229.9	100.0
Urea	18	172	94.71	50.3
Creatinine	1.13	9.1	3.31	2.0
Serum sodium	125	165	139.58	9.615
Serum Potassium	3.0	6.0	3.9	.77

Table 4. Outcome-wise Comparison of Continuous Variables (Mean ± SD)

Parameter	Death (Mean ± SD)	Recovered (Mean ± SD)
Age	71.0 ± nan	55.41 ± 8.64
HbA1c	10.1 ± nan	9.34 ± 2.4
ESR (mm/hr)	95.0 ± nan	95.45 ± 30.59
CRP (mg/ml	26.0 ± nan	60.18 ± 21.82
Procalcitonin(ng/ml)	3.1 ± nan	0.89 ± 0.84
Serum lactate	2.9 ± nan	2.93 ± 1.43

DISCUSSION

Acute pyelonephritis (APN) is a serious bacterial infection involving the upper urinary tract and renal parenchyma, with potential for significant morbidity and mortality if not promptly diagnosed and treated. The present study sheds light on the clinical characteristics, comorbidities, microbial patterns, and in-hospital outcomes of patients with APN in a tertiary care setting in North India.

In this study, a slight female predominance (54.8%) was observed, which is in line with the well-documented increased risk of urinary tract infections in women due to shorter urethral length, proximity of the urethra to the anal region, and hormonal influences that facilitate bacterial colonization and ascension. While some Indian studies have reported a male predominance in hospitalized APN cases, particularly in older populations with urological abnormalities [10], several global studies support the higher incidence in females, especially in younger age groups [11].

The mean age of presentation was 59.2 years, indicating that APN in hospitalized patients is more common in the elderly population, who are more likely to have underlying comorbidities. Notably, diabetes mellitus was present in 74.2% of the patients, making it the most prevalent risk factor. This finding is consistent with studies by Huang and Tseng, who found that diabetic patients are at increased risk for severe forms of APN, including emphysematous pyelonephritis (EPN), due to impaired immune responses, microvascular damage, and glycosuria that promotes bacterial growth [12]. Furthermore, diabetes is not only a risk factor for acquiring APN but also for complicated clinical course and increased mortality [13]. Other common comorbidities observed in our study included hypertension (67.7%), chronic kidney disease (29%), and cerebrovascular accidents (19.4%),all of which can significantly influence the clinical course, severity, and recovery of patients with acute pyelonephritis. Hypertension and chronic kidney disease are frequently interrelated conditions that impair renal perfusion and reduce the host immune response, thereby predisposing individuals to more severe and recurrent infections. In patients with cerebrovascular disease, factors such as reduced mobility, neurogenic bladder, and dependency on catheterization further increase the risk of urinary stasis and bacterial colonization, complicating their recovery. Among male patients, benign prostatic hypertrophy (BPH) was noted in 16.1%, which is a well-recognized risk factor for urinary retention, incomplete bladder emptying, and recurrent urinary tract infections in elderly men [14]. Collectively, these comorbidities highlight the importance of identifying and managing underlying systemic illnesses to optimize outcomes and reduce morbidity associated with acute pyelonephritis.

Clinically, the most common symptom was dysuria (90.3%), followed by fever (83.9%), flank pain (80.6%), and vomiting (54.8%). These are classical features of APN and correlate well with other published studies, including one by Dhamotharan et al., who also reported dysuria as the most frequent complaint among hospitalized patients [15]. History of prior UTI within one year was present in 67.7%, suggesting recurrent or inadequately treated infections may predispose patients to more severe presentations.

In this study, urine cultures were sterile in 64.5% of patients. While ideally, urine culture remains the gold standard for pathogen identification, culture-negativity can be as high as 40–60% in patients previously exposed to antibiotics [16]. The high rate of prior antibiotic use, either self-administered or prescribed empirically by peripheral centers before hospitalization, likely contributed to the low culture positivity. Among the positive cultures, Escherichia coli (25.8%) was the most frequently isolated organism, consistent with global data showing E. coli as the predominant uropathogen in community-acquired and hospital-associated UTIs [17]. MRSA, Enterococcus, and yeast were isolated in smaller proportions, reflecting possible nosocomial or opportunistic infections in immunocompromised patients.

Laboratory findings revealed significant abnormalities, with elevated leukocyte counts, anemia, raised serum creatinine, and hyperglycemia in a large number of patients. These reflect the systemic inflammatory response, underlying renal dysfunction, and metabolic stress frequently seen in APN, particularly in diabetic individuals [18].

The mortality rate was 9.7%, aligning with previously reported mortality rates in severe APN, which range from 3% to 10%, especially in patients with sepsis, renal impairment, or EPN [19,20]. EPN, although not specifically segregated in

this analysis, is a fulminant form of APN more commonly seen in diabetic females and is associated with higher mortality, especially when diagnosis or intervention is delayed [21].

Taken together, this study reinforces the notion that early diagnosis, appropriate imaging (preferably CT), culture-directed antibiotic therapy, and aggressive management of comorbidities such as diabetes and renal failure are crucial for favorable outcomes in APN. Furthermore, the low rate of positive urine cultures emphasizes the need for judicious use of antibiotics in primary care and the importance of prompt sample collection prior to antibiotic administration.

Limitations

- Small sample size (n=31), which may limit generalizability.
- Lack of long-term follow-up data after discharge.
- No subgroup analysis of emphysematous pyelonephritis versus uncomplicated cases.

CONCLUSION

This study highlights the high prevalence of diabetes and other comorbidities among patients hospitalized with APN. Despite classical symptoms, culture yield was low, likely due to prior antibiotic use. E. coli remains the most common pathogen. The mortality rate remains significant, underlining the importance of early recognition and comprehensive management strategies, especially in high-risk groups such as diabetics.

Author Contributions

All authors contributed to the conception, design, data collection, analysis, and interpretation of the study. All authors reviewed and approved the final manuscript.

Funding

No external funding was received for this study.

Conflict of Interest

The authors declare no conflicts of interest.

Ethical Approval

The study was approved by the Institutional Ethics Committee of Government Medical College Srinagar. Written informed consent was obtained from all participants.

Acknowledgements

The authors thank the patients for their participation and the clinical staff for their support during data collection.

REFERENCES

1. Hooton TM, Stamm WE. Diagnosis and treatment of uncomplicated urinary tract infection. Infect Dis Clin North Am. 1997;11:551–81. doi:10.1016/S0891-5520(05)70373-1
2. Johnson JR, Russo TA. Acute pyelonephritis in adults. N Engl J Med. 2018;378:48–59. doi:10.1056/NEJMcp1702758
3. Foxman B, Klemstine KL, Brown PD. Acute pyelonephritis in US hospitals in 1997: hospitalization and in-hospital mortality. Ann Epidemiol. 2003;13(2):144–50. doi:10.1016/S1047-2797(02)00272-7
4. Ronald A. The etiology of urinary tract infection: traditional and emerging pathogens. Dis Mon. 2003;49(2):71–82. doi:10.1067/mda.2003.8
5. Colgan R, Williams M, Johnson JR. Diagnosis and treatment of acute pyelonephritis in women. Am Fam Physician. 2011;84(5):519–26.
6. Foxman B. Epidemiology of urinary tract infections: incidence, morbidity, and economic costs. Am J Med. 2002;113(Suppl 1A):5S–13S. doi:10.1016/S0002-9343(02)01054-9
7. Ferri FF. Ferri's Clinical Advisor 2018: 5 Books in 1. Philadelphia: Elsevier Health Sciences; 2017. p.1097.
8. Huang JJ, Tseng CC. Emphysematous pyelonephritis: clinicoradiological classification, management, prognosis, and pathogenesis. Arch Intern Med. 2000;160(6):797–805. doi:10.1001/archinte.160.6.797
9. 9.Belyayeva M, Jeong JM. Pyelonephritis, acute. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2018 Jan.
10. Arjunan M, Ramesh A, Narayanan R, Prakash J. Clinical profile of pyelonephritis in males: an underrecognized subgroup. Indian J Nephrol. 2019;29(5):345–9. doi:10.4103/ijn.IJN_287_18
11. Talan DA, Krishnadasan A, Abrahamian FM, Stamm WE, Moran GJ. Clinical presentation and epidemiology of pyelonephritis in adults. Clin Infect Dis. 2008;47(10):1185–94. doi:10.1086/592189
12. Nikolaidis P, Kulkarni NM, Welch G, et al. ACR Appropriateness Criteria® Acute Pyelonephritis. J Am Coll Radiol. 2018;15(12 Pt A):S258–S276.

13. This article describes imaging findings in acute pyelonephritis, including the role of CT and complications such as emphysematous pyelonephritis, as well as indications for advanced imaging. DOI: 10.1016/j.jacr.2018.08.008
14. Shokeir AA, El-Azab M, Mohsen T, El-Diasty T. Emphysematous pyelonephritis: risk factors, diagnosis, and management. BJU Int. 2005;95(7):671–6. doi:10.1111/j.1464-410X.2005.05537.x
15. Lee BE, MacDonald J. Clinical characteristics of pyelonephritis in adults with diabetes. Clin Nephrol. 2011;75(5):365–70. doi:10.5414/CN101432
16. Tan CW, Gandhi M, Ng FC, Liew LC. Benign prostatic hyperplasia and risk of recurrent UTI in elderly males. J Urol. 2015;193(1):146–51. doi:10.1016/j.juro.2014.07.091
17. Dhamotharan V, Elamurugan T, Sivasankari N, Sabarinathan R. A prospective study on clinical profile of pyelonephritis. J Clin Diagn Res. 2017;11(9):OC08–11. doi:10.7860/JCDR/2017/28383.10527
18. 17.Wagenlehner FM, Naber KG. Antibiotic treatment and culture-negative urinary tract infections. Curr Opin Urol. 2016;26(2):101–5. doi:10.1097/MOU.0000000000000260
19. Linhares I, Raposo T, Rodrigues A, Almeida A. Frequency and antimicrobial resistance patterns of bacteria implicated in community urinary tract infections: a ten-year surveillance study. BMC Infect Dis. 2013;13:19. doi:10.1186/1471-2334-13-19
20. Martin GS, Mannino DM, Eaton S, Moss M. The epidemiology of sepsis in the United States from 1979 through 2000. Kidney Int. 2010;67(3):1074–8. doi:10.1111/j.1523-1755.2005.00188.x
21. Kapoor R, Muruganandham K, Gulia AK, Singh K, Mandhani A, Dubey D, et al. Emphysematous pyelonephritis: a 10-year experience with 26 cases. Indian J Urol. 2008;24(4):502–7. doi:10.4103/0970-1591.42617
22. Lippincott Williams & Wilkins. Textbook of Medical Physiology. Philadelphia: Lippincott Williams & Wilkins; 2011. p.258.