Section: Medicine

Original Research Article

A STUDY ON CLINICAL AND MICROBIAL PROFILE OF ACUTE PYELONEPHRITIS

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ABSTRACT

Background: Acute pyelonephritis is a potential organ and life-threatening infection that often results in renal scarring. This study is conducted to asses clinical features, microbial profile and various clinical and biochemical factors determining prognosis of acute pyelonephritis.

Materials and Methods: A hospital based single centre, observational study was carried out among 100 patients with acute pyelonephritis admitted in the wards of the Department of Medicine, Assam Medical College and Hospital with duration of one year. Clinical features, laboratory results and outcomes were analysed.

Results: Most common symptom was fever with chills and rigor (82%) and increased temperature(85%) as the most common sign. Diabetes mellitus(74%) is the common associated comorbidity with acute kidney injury(48%) is the most common complication. E coli(39%) as the commonly isolated organism in the urine. Most sensitive antibiotic against gram negative bacilli was piperacillin tazobactam and most sensitive antibiotic against gram positive cocci was linezolid. poor prognostic factors were age greater than 65, shock, presence of altered sensorium, presence of diabetes mellitus, increased total leukocyte count, thrombocytopenia, increased urea, increased creatinine, hyperkalaemia and increased HbA1C $\geq$ 7.5.

Conclusion: This study highlights the importance of early recognition and management of acute pyelonephritis. The findings can help to guide treatment decisions and improve patient outcome.

Keywords: Acute pyelonephritis, risk factors, microbial profile.

INTRODUCTION

Acute pyelonephritis is a potential organ and life-threatening infection that often results in renal scarring. Acute pyelonephritis mostly caused by bacteria and sometimes fungus also may cause.[1] Bacteria usually ascends from the lower urogenitary tract and, rarely reaches the kidney through blood stream.[2] Commonest organism causing pyelonephritis is E coli and patients come with chief complaints of fever with chills and rigor, nausea, dysuria, and flank pain.[3] Diabetes, a history of UTI, anatomical abnormalities of the urogenital tract, sexual activity, and spermicide use are risk factors associated with the disease.[4]

According to a recent community-based assessment, infections among elderly diabetics, UTI ranks second after LRTI. The degree of involvement varies, ranging from a minor colonization of the urinary tract to cystitis, pyelonephritis and perirenal abscess.[5]

Due to the high prevalence of diabetes in our society, the incidence of UTIs is increasing well.[6] Emphysematous pyelonephritis is most commonly observed in patients of diabetes.[7]

Aims and objectives

1. To assess clinical features of acute pyelonephritis
2. To assess microbial profile of acute pyelonephritis
3. To assess clinical and biochemical factors determining prognosis of patients with acute pyelonephritis

MATERIALS AND METHODS

Place of Study: Assam Medical College and Hospital, Medicine Department.

Duration of Study: 1 year from March 2023 to February 2024

Study Design: Hospital based observational study

Inclusion Criteria

- All patients of admitted in the department of medicine with diagnosis of acute pyelonephritis
- Age ≥13 years
- Patient willing to give consent

Exclusion Criteria

- Patient not willing to give consent.
- Age < 13 years.

Sample Size: considering 95 % confidence interval with absolute error 10%, sample size for present study is calculated 93 and rounded off to 100.

Sample size is calculated using the formula

$n = 4pq/d2$

Where n = sample size,

p = prevalence (from previous studies)

q = 100-p

d = allowable error (5-20% of p)

Ethical Clearance: Ethical clearance was obtained from the Institutional Ethics Committee of Assam Medical College and Hospital, Dibrugarh (no AMC/EC/PG/5217) prior to the onset of study. Informed written consent was taken from the patients or their attendants after explaining about the purpose of the study.

Case Definition: A patient of acute pyelonephritis was taken who had the following

Clinical symptoms of acute pyelonephritis

- Fever with chills and rigor
- Burning micturition
- Loin pain

Clinical signs of acute pyelonephritis

- Renal angle tenderness

Findings on USG abdomen and KUB

- Enlarged kidney
- Presence of collection and perinephric fat stranding

Method of data collection: Data was taken from patients of acute pyelonephritis admitted in department of medicine of Assam Medical College and Hospital. Patients were selected according to inclusion and exclusion criteria. Demographic and clinical data was collected from each patient.

Methodology

- A detailed history was taken of the patients including present illness, past history and comorbid conditions. Thorough general and systemic examination, vitals measurement was done. Data was collected regarding patient clinical features, vital parameters, laboratory test, complication and outcome on a predesigned data extraction form and recorded in predesigned and pretested proforma.
- Sample for Urine routine examination and culture and sensitivity sent before starting antibiotics.

Laboratory investigations: The investigations were done in every patients includes Complete blood count. ESR, Fasting Blood sugar, HBA1c, Blood urea, Serum Creatinine, serum sodium, serum potassium and Urine Culture and Sensitivity.

USG abdomen: Ultrasound abdomen and KUB done in radiology department of Assam Medical College. Finding suggestive of acute pyelonephritis is noted and looked for any complications.

CT KUB: CT abdomen was done at CT (Radiology department, Assam Medical College and Hospital).

The patients who were successfully treated with 'antibiotics alone' or with 'percutaneous nephrostomy' were assigned to "good" outcome group. Those who had 'nephrectomy' or 'expired' were classified as "poor" outcome group

Statistical analysis: A master chart was created using the data entered on pre-tested and pre-designed proforma. 'Microsoft Excel 2010' and the statistical package for 'social sciences (SPSS for Windows, version 20.0. Chicago, SPSS Inc.)' were used to perform the data's statistical analysis. The mean ± standard deviation is used to present results for continuous measurements. where a significant p value ($p<0.05$) was discovered. The 'Chi Square test' was used to analyse the discrete data, which were condensed into numbers and percentages. The relationship between continuous variables was measured using Pearson's correlation coefficient (r). For every analysis, the statistical significance was evaluated at the 5% level.

RESULTS

Out of 100 study subjects in our study 40 were male (40%) and 60 were female (60%). male; female ratio was 0.67:1 among study subjects.

Mean age in our study was 50.92±13.11. Around 59% (n=59) of study population were among age group of 41-60.

Table 1: Showing Symptoms of Acute Pyelonephritis

Signs and Symptoms	Number (n)	Percentage (%)
Fever with Chills	82	82.00
Dysuria	55	55.00
Loin Pain	61	61.00
Vomiting	23	23.00
Altered Sensorium	10	10.00
Decreased Urine Output	21	21.00

Table 2. Signs of acute pyelonephritis

Signs	Number (n)	Percentage (%)
Toxic Appearance	20	20.00
Fever (°F)	85	85.00
99–99.9	10	10.00
100–103	60	60.00
104–106	15	15.00
Renal Angle Tenderness	61	61.00
(a)Unilateral	40	40.00
(b)Bilateral	21	21.00
Suprapubic Tenderness	16	16.00

Table 3: Risk Factors of Acute Pyelonephritis

Risk Factors	Number (n)	Percentage (%)
Diabetes mellitus	74	74.00
BPH	12	12.00
CKD	8	8.00
Urolithiasis	11	11.00
Pregnancy	2	2.00
HIV	1	1.00
Urinary Anomalies	9	9.00
Renal Transplantation	1	1.00
Malignancy	1	1.00
Multiple Comorbidities	18	18.00
No Comorbidities	15	15.00

Table 4: Complications of Acute Pyelonephritis in Study Subjects

Complications	Number (n)	Percentage (%)
Sepsis	34	34.00
Acute Kidney Injury	48	48.00
Renal Abscess	16	16.00
Perinephric Abscess	6	6.00
Emphysematous Pyelonephritis	16	16.00
Renal Vein Thrombosis	1	1.00

Table 5: Organisms Encountered in Urine Culture of Study Patients

Organism Isolated	Number (n)	Percentage (%)
E. coli	39	39.00
Klebsiella	6	6.00
Pseudomonas	3	3.00
Proteus	2	2.00
Enterobacter	20	20.00
No Growth	30	30.00
TOTAL	100	100.00

Table 6: Antibiotic Spectrum for Gram Negative Bacilli Isolated in The Study Subjects

First Line Antibiogram	Resistant		Sensitive		Intermediate	
	n	%	n	%	N	%
Amikacin	13	26.00	30	60.00	7	14.00
Levofloxacin	13	26.00	30	60.00	7	14.00
Meropenem	8	16.00	36	72.00	6	12.00
Cotrimoxazole	14	28.00	32	64.00	4	8.00
Nitrofurantoin	14	28.00	29	58.00	7	14.00
Cefotaxime	16	32.00	26	52.00	8	16.00
Piperacillin Tazobactam	9	18.00	38	76.00	3	6.00
Total gram negative bacilli	50					

Table 7: Antibiotic Spectrum for Gram Positive Cocci Isolated in The Study Subjects

First Line Antibiogram	Resistant		Sensitive		Intermediate	
	n	%	n	%	N	%
Gentamicin	17	85	2	10	1	5
Ampicillin	16	80	4	20	0	0
Doxycycline	5	25	5	25	10	50
Levofloxacin	16	80	4	20	0	0
Nitrofurantoin	15	75	3	15	2	10
Vancomycin	3	15	16	80	1	5
Linezolid	2	10	18	90	0	0
Total gram positive cocci	20					

According to our study 83% (n=83) study subjects were treated with antibiotics alone and 5% (n=5) of the study subjects underwent percutaneous nephrostomy (PCN). 9% (n=9) of the study subjects expired and 3% (n=3) underwent nephrectomy. Total number of patients with good outcome includes 88% (n=88) and poor outcome includes 12% (n=12). Mortality was 9% among study subjects.

Poor prognostic factors which associated with poor outcome includes age greater than 65 (p value<0.001), shock (p value<0.001), altered sensorium (p value<0.001), presence of diabetes mellitus (p value 0.005), increased total leukocyte count>11000 (p value<0.001), platelet count less than 1.5 lakhs (p value<0.001), increased urea greater than 40 (p value<0.001), increased creatinine greater than 1.5 (p value 0.003), increased potassium ≥5 (p value0.006), increased HBA1C ≥ 7.5 (p value0.007). Haemoglobin less than 12 didn't show any association with poor outcome with (p value 0.588) and sodium less than 135 didn't show any association with poor outcome (p value0.427).

DISCUSSION

Out of 100 patients in our study 40 were male and remaining 60 were female. According to Rakesh kumar koul et al,[8] the study conducted among 200 patients 59 % were female and 41% were male. According to Muhammed shafi et al,[9] the study conducted among 100 patients, 60% were female and 40% were male.

Mean age in our study is 50.92±13.11. Around 59% of study population were among age group of 41-60. According to Senthil kumar et al,[10] 34% patients belongs to age group of 51-60 and 30% of patients include 41-50. According to Muhammed Shafi,[9] most of the patients belonged to age groups of 40 to 60 years and mean age of the study was 52.16. According to Ramachandran et al,[11] mean age of study was 57.4 ± 8.5 years. According to Umesha et al,[12] Mean age of their study subjects was 53.85 ± 9.78 years.

In our study, fever with chills was most common symptom. 82(82%) patient had fever with chills, Followed by loin pain 61 (61%), dysuria 55(55%), vomiting 23(23%), reduced urine output 21(21%) and altered sensorium10 (10%). According to Senthil kumar et al,[10] fever (82%) was most common symptom, followed by loin pain (64%) and dysuria (56%). pedal edema was seen in (6%) patients and altered sensorium seen in 12% of the patients. According to veronica et al,[13] most common symptom was fever (87%) and 59.4% had flank pain. According to Muhammed shafi et al.[9] The most prevalent symptom was dysuria (82%). Other symptoms were increased micturition frequency (65%), vomiting (42%), and oliguria (21%). Altered sensorium was observed in 18% of the individuals with acute pyelonephritis.

In our study showed that 20(20%) patients had toxic look. 85 (85%) of study subjects had fever and number of patients with low grade, moderate grade and high grade temperature were 10(10%), 60(60%), 15(15%) respectively. Number of patients with renal angle tenderness were 61(61%) and among these 40(40%) had unilateral renal angle tenderness and 21(21%) had bilateral renal angle tenderness. Number of patients with suprapubic tenderness were 16 (16%).

According to Veronica A Buonaiuto et al,[13] 87.2 % patients had fever and renal angle tenderness were present among 56.7% patients.

Distribution of comorbidities of the study population: In our study most common associated comorbidity was diabetes mellitus in 74 (74%) patients, followed by BPH 12(12%), urolithiasis 11(11%), urinary anomalies 9(9%), chronic kidney disease (8%), pregnancy (2%), renal transplantation (1%) and malignancy (1%). Multiple co- morbidities were observed among 18(18%) patients and no comorbidities seen in 15(15%) patients. According to Senthil Kumar et al,[10] diabetes mellitus was most common risk factor (74%), followed by renal stones(8%). According to Muhammed Shafi et al,[9] Diabetes mellitus was most common comorbidity present in 54 % of patients followed by urolithiasis (19%) and 7% had chronic kidney disease. Out of 40 male patients 13 had history of BPH. Acute pyelonephritis was seen among 2 patients out of 60 female patients. According to Umesh et al,[12] Diabetes mellitus (54.4%) was the most common comorbidity followed by nephrolithiasis (14.4%), BPH (6.7%), and immune deficient state (3.3%). According to Venkateshwara Murali Dhamotharan et al,[14] 76 % 0f patients were diabetic .12% of patients had BPH and 7% had nephrolithiasis

According to our study commonest complication was acute kidney injury which observed among 48 (48%) patients followed by sepsis 34 (34%) patients, emphysematous pyelonephritis16(16%), renal abscess 16(16%), perirenal abscess 6(6%) and renal vein thrombosis 1 (1%) respectively. According to Muhammed shafi et al9 most common complication was acute kidney injury 41% followed by sepsis 34% and emphysematous pyelonephritis 6%. According to Dae-Hong Jeon et al,[15] acute kidney injury observed among 62.8% patients with acute pyelonephritis. According to Rakesh Kumar et al8 acute kidney injury was observed among 46% of patients and emphysematous pyelonephritis was observed among 8%.

The most important aspect for disease treatment and preventing complications in patients with acute pyelonephritis is microbiology. No growth found in 30 (30%) number of patients and growth was observed among 70(70%) number of patients. Among culture positive organism E coli was most common organism 57%(n=39) followed by Enterobacter 28%(n=20), klebsiella 8.5%(n=6), pseudomonas 4.2%(n=3) and proteus 2.8%(n=2) respectively. Most sensitive antibiotic against gram

negative bacilli was the piperacillin tazobactam which is 76% and the most resistant antibiotic is cefotaxime with 32%. Most sensitive antibiotic against gram positive cocci was linezolid with 90% sensitivity followed by vancomycin 80% and most resistant antibiotic was gentamicin 15%. 10% (n=2) of the gram positive cocci were vancomycin resistant which were sensitive to linezolid.

According to veronica et al,[13] urine culture was positive in 67.7% of the urine sample. E coli was commonest bacteria isolated from 67% patients and Klebsiella species were grown in 7.9% patients. Proteus species were grown in 6.6% patients.

According to our study 83%(n=83) study subjects were managed with antibiotics alone and 5%(n=5) of the study subjects underwent percutaneous nephrostomy (PCN). 9%(n=9) of the study subjects expired and 3%(n=3) underwent nephrostomy. Total number of patients with good outcome includes 88%(n=88) and poor outcome includes 12%(n=12). Mortality was 9% among study subjects. Poor prognostic factors which associated with poor outcome includes age greater than 65 (p value<0.001), shock (p value<0.001), altered sensorium (p value<0.001), presence of diabetes mellitus (p value 0.005), increased total leukocyte count>11000(p value<0.001), platelet count less than 1.5 lakhs(p value<0.001), increased urea greater than 40 (p value<0.001), increased creatinine greater than 1.5(p value 0.003), increased potassium ≥5 (p value0.006), increased HBA1C ≥ 7.5(p value0.007). haemoglobin less than 12 didn't show any association with poor outcome with (p value 0.588) and sodium <135 didn't show any association with poor outcome (p value0.427).

According to Vera Y Chung et al,[16] poor prognostic factors were old age (age >65), deranged KFT tests and presence of septic shock and mortality during study period was 7.40%.

Senthil Kumar et al,[10] found that 41 patients(out of 50) cured with antibiotics alone, 3 required percutaneous nephrostomy, and 6 patients expired. The study determined that thrombocytopenia (p-value 0.007 – significant), altered sensorium (p-value 0.001), hypotension (p-value 0.001), HBA1C greater than 7.5%, and renal impairment are poor prognostic factors.

In a study conducted by Akhaira et al,[17] in 2009 on clinical profile and prognostic factors among emphysematous pyelonephritis patients creatinine > 5 mg/dl with p value=0.035 and Shock with p value=0.03 were independent poor prognostic factors. Mortality was 10.5%.

According to study conducted by Dhamotharan et al,[18] nephrectomy had done among19.2%(n=5) and mortality was12.3%. poor prognostic factors were altered sensorium and shock among emphysematous pyelonephritis patients.

Limitation of study: our study is limited due to the small sample size. Our study only included patients admitted in a tertiary care centre. So findings cannot be generalized. Higher antibiotic sensitivity may be due to prior antibiotic treatment before hospitalization.

CONCLUSION

Our study shows that Poor prognostic factors associated with poor outcome were age greater than 65, shock, presence of altered sensorium, presence of diabetes mellitus, increased total leukocyte count, thrombocytopenia, increased urea, increased creatinine, hyperkalemia and increased HBA1C ≥ 7.5. This study highlights the importance of early recognition and management of acute pyelonephritis, especially in high risk patients with comorbidities and poor prognostic factors. The findings can help to guide treatment decisions and improve patient outcome.

REFERENCES

1. Colgan R, Williams M, Johnson JR. Diagnosis and treatment of acute pyelonephritis in women. American family physician. 2011;84(5):519–26 .
2. Semeraro A, Defilippi C. Acute Pyelonephritis. Imaging Non-traumatic Abdominal Emergencies in Pediatric Patients. 2016;255.
3. Johnson JR, Russo TA. Acute pyelonephritis in adults. New England Journal of Medicine. 2018;378(1):48–59.
4. Hooton TM, Scholes D, Stapleton AE, Roberts PL, Winter C, Gupta K, et al. A Prospective Study of Asymptomatic Bacteriuria in Sexually Active Young Women. N Engl J Med. 2000 Oct 5;343(14):992–7.
5. De Lastours V, Foxman B. Urinary Tract Infection in Diabetes: Epidemiologic Considerations. Curr Infect Dis Rep. 2014 Jan;16(1):389.
6. Goswami R, Bal CS, Tejaswi S, Punjabi GV, Kapil A, Kochupillai N. Prevalence of urinary tract infection and renal scars in patients with diabetes mellitus. Diabetes research and clinical practice. 2001;53(3):181–6.
7. Abdul-Halim H, Kehinde EO, Abdeen S, Lashin I, Al-Hunayan AA, Al-Awadi KA. Severe emphysematous pyelonephritis in diabetic patients. Urologia internationalis. 2005;75(2):123–8.
8. Wani AR, Koul RK, Dar MA, Farooq S. Study of Clinical, Laboratory Profile, and Outcome of Patients with Acute Pyelonephritis in a Tertiary Care Hospital. Matrix Science Medica. 2023;7(2):43–50.
9. PK MS, Rosh P. A Cross Sectional Study on Risk Factors, Clinical Profile and Aetiology of Acute Pyelonephritis in a Tertiary Teaching Hospital in Kerala. 2020 [cited 2024 Jun 3];
10. Senthilkumar PK, Bhaba VK, Bharathi G, Ramasubramanian V, Anandan H. Factors affecting the Prognosis of Patients with Pyelonephritis. IJCMR [Internet]. 2019 Jul [cited 2024 Jun 3];6(7).
11. Kumar S, Ramachandran R, Mete U, Mittal T, Dutta P, Kumar V, et al. Acute pyelonephritis in diabetes mellitus: Single center experience. Indian journal of nephrology. 2014;24(6):367–71.
12. Umesha L, Shivaprasad SM, Rajiv EN, Kumar MMS, Leelavathy V, Sreedhara CG, et al. Acute Pyelonephritis: A Single-center Experience. Indian J Nephrol. 2018;28(6):454–61.
13. Buonaiuto VA, De Toro I, Joya C, Ruiz-Mesa JD, Seara R, Plata A, et al. Clinical and epidemiological features and prognosis of complicated pyelonephritis: a prospective observational single hospital-based study. BMC Infect Dis. 2014 Dec;14(1):639.
14. Damodharan. Study of The Clinical Profile of Patients with CT Proven Acute Pyelonephritis in A Tertiary Care Hospital | Medico Research Chronicles [Internet]. [cited 2024 Jun 9].
15. Jeon DH, Jang HN, Cho HS, Lee TW, Bae E, Chang SH, et al. Incidence, risk factors, and clinical outcomes of acute kidney

injury associated with acute pyelonephritis in patients attending a tertiary care referral center. Renal Failure. 2019 Jan 1;41(1):204–10.
16. Division of Urology, Department of Surgery, Pamela Youde Nethersole Eastern Hospital, Chai Wan, Hong Kong, Chung VY, Tai C, Fan C, Tang C. Severe acute pyelonephritis: a review of clinical outcome and risk factors for mortality.
17. Khaira A, Gupta A, Rana DS, Gupta A, Bhalla A, Khullar D. Retrospective analysis of clinical profile prognostic factors and outcomes of 19 patients of emphysematous pyelonephritis. Int Urol Nephrol. 2009 Dec 1;41(4):959–66.
18. Dhamotharan VM, Ramadurai S, Gopalan S, Arthur P. Study of the clinical profile of patients with CT proven acute pyelonephritis in a tertiary care hospital. Medico Research Chronicles. 2016;3(1):64–8.