A Cross Sectional Study on Risk Factors, Clinical Profile and Aetiology of Acute Pyelonephritis in a Tertiary Teaching Hospital in Kerala

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ABSTRACT

BACKGROUND

Acute pyelonephritis (APN) is one of the most severe forms of urinary tract infections (UTI) with a higher incidence among females compared to males. *Escherichia coli* is the commonest causative organism isolated in 80 % of the cases in Kerala. Risk factors like structural or functional abnormalities of urogenital system, immunosuppression, comorbidities and virulence & resistance of microorganism play vital roles in predicting the prognosis. Our aim was to study the prevalence of various risk factors of acute pyelonephritis in adult patients, the clinical profile, aetiological agents and their sensitivity to antibiotics, and related complications on their usage.

METHODS

In a cross-sectional observational study, 100 adult patients with acute pyelonephritis admitted in a tertiary teaching hospital in Kerala were studied between January 2016 and January 2017. Detailed history and clinical examination were carried out. Complete haemogram, random blood sugar, renal function test, urine culture and sensitivity, and ultrasonogram of abdomen and pelvis were done.

RESULTS

The most common age group was 40 - 49 years with a male to female ratio of 2:3. Dysuria was observed in 82 % of patients followed by increased frequency of micturition in 65 % and vomiting in 42 %. Diabetes mellitus was observed in 55 % of patients and recurrent UTI in 44 %. *Escherichia coli* was found in 66 % of patients followed by *Klebsiella* in 23 %. Culture showed that 85 % of the bacteria were sensitive to piperacillin-tazobactam. 44 % of the patients did not respond to the empirical antibiotic, and the failure rate was higher among those empirically treated with ciprofloxacin. 41 % of the patients developed acute kidney injury, which necessitated haemodialysis in 23 %. 14 % of the patients developed septic shock and the mortality was 10 %.

CONCLUSIONS

Certain risk factors such as diabetes, hypertension, chronic kidney disease and indwelling catheters were associated with increased incidence of complications. Hence, in presence of such risk factors appropriate treatment and preventive measures should be initiated promptly. Among the pathogens, 85 % of the organisms were sensitive to piperacillin–tazobactam. Hence, piperacillin-tazobactam can be recommended as the first line empirical antibiotic.

KEYWORDS

Acute Pyelonephritis, Urinary Tract Infection, Acute Kidney Injury (AKI), and *E. coli*

BACKGROUND

Acute Pyelonephritis (APN) is the inflammation of renal pelvis and renal parenchyma. It is considered one of the most severe forms of urinary tract infection (UTI) and is associated with significant morbidity and mortality. Its incidence is higher among females compared to males.[1,2,3] The commonest bacteria causing it is s *Escherichia coli* constituting 80 % of the cases.[4] The estimated overall mortality of APN was 6.1 %.[5] The prognosis of APN is based on risk factors like structural or functional abnormalities of urogenital system, immuno suppression, co-morbidities and virulence of microorganisms & their resistance to antibiotics.[6] Ultrasonogram (USG) and computed tomography (CT) scan usually are used in its diagnosis. Irrational prescription of antibiotics and poor patient compliance results in emergence of bacterial antibiotic resistance among UTI patients [7,8]. Studies related to risk factors are very few from South India, especially, Kerala.[9]

Past History of UTI during childhood due to obstruction at the ureterovesical junction, vesicoureteral reflux (VUR) and urinary incontinence, oestrogen deficiency (menopausal), diabetes mellitus (DM), resistant pathogens causing UTI, urolithiasis, urinary indwelling catheter or urological instrumentation and behavioural factors: like sexual intercourse, use of spermicides and / or diaphragm as contraceptive and irrational use of certain antibiotics are some of the risk factors of APN.[10, 11]

The microbial spectrum of complicated UTI includes *Pseudomonas, E. coli, Serratia*, and *Providencia species*, in addition to enterococci, staphylococci, and fungi.[12] The routes of spread of bacteria are through the bloodstream or from the lower urinary tract.[13]

The pathogenesis shows patchy interstitial suppurative inflammation, intratubular aggregates of neutrophils, neutrophilic tubulitis and tubular necrosis.[2] Fever is the main feature and gross haematuria (haemorrhagic cystitis) is present in 30 - 40 % of APN especially in females; most often young women. Gross haematuria is unusual in males and should prompt consideration of a more serious cause.[14] Supra pubic tenderness ranging from mild to moderate degree without rebound tenderness; unilateral flank or costovertebral angle (CVA) tenderness may be present. On pelvic examination tenderness of the cervix, uterus, and adnexa should be absent.[15] Complications include renal failure, sepsis, and renal abscess formation.[16]

Preliminary ultrasonogram usually clinches the diagnosis, but in a few patients CT scan is necessary.[17] Empirical usage of trimethoprim-sulfamethoxazole resistance (TMP-SMX), fluoroquinolones as the first-line therapy for acute uncomplicated pyelonephritis or a 7-day course of therapy with oral ciprofloxacin (500 mg twice daily, with or without an initial IV 400 - mg dose) was highly effective for the initial management of APN.[18,19,20] Recently, vaginal probiotics / lactobacilli, immuno-stimulation / vaccines, inhibitors of bacterial adhesion, inhibitors of bacterial bio films, stimulation of cyclic adenosine / forskolin, hormone therapy and instillation of attenuated bacteria into the urinary bladder are being tried. [21,22,23]

Objectives

To study the prevalence of various risk factors, clinical profile and aetiology of acute pyelonephritis in a tertiary teaching hospital in Kerala in adult patients.

METHODS

A cross sectional, observational study was conducted over a period of 12 months, from January 2016 and January 2017 at the Department of General Medicine, Govt. Medical College, Kottayam.

Ethics committee clearance was obtained, and the study was conducted among patients admitted in wards under the Department of General Medicine. Detail history and clinical examination were carried out on all patients. Investigations included were complete haemogram, random blood sugar, renal function test, and urine microscopy and ultrasonogram of abdomen and pelvis was carried out. Urine culture and sensitivity tests were done.

Sample Size

Sample size calculated by the formula.

$$\frac{Z^2 \text{ x (p) x } (1-p)}{C^2}$$

Where,

Z = Z value (e.g., 1.96 for 95 % confidence level)

p = percentage picking a choice, expressed as decimal (.5 used for sample size needed)

c = confidence interval, expressed as decimal (e.g. 04 = ± 4)

n = 1.96² X 0. 5 X (1-0.5) / (20 X 0.5/100)²

  = 96

Hence, sample size was approximately taken as 100.

Inclusion Criteria

1. Patients aged above 16 years with clinical features of fever with chills / rigors and flank pain at renal angle & tenderness were included.
2. Patients with or without dysuria were included.
3. Patients with laboratory evidence of leukocytosis and pyuria were included.
4. Patients with ultrasound evidence of APN were included.

Exclusion Criteria

Patients not willing to be a part of the study were excluded.

Statistical Analysis

SPSS version 20.0 was used for data analysis. Continuous variables were analysed by mean, SD, median, minimum and maximum. Qualitative variables were described by percentage distribution among groups. Comparison of

quantitative variables was done by 'student 't" test and qualitative variables compared by chi square test. 'p' value at less than 0.05 was taken as significant statistically.

RESULTS

Age distribution showed that the maximum number of patients were clustered in the age groups of 40 - 49 & 50 - 59 years; with the mean age of 52.16 ± 17.81 years. Of the 100 patients, 40 were males and 60 were females.

Dysuria was the most common symptom, observed in 82 % of the patients, increased frequency of micturition in 65 %, vomiting in 42 % and 21 % patients had oliguria. 18 % of the patients with APN presented with altered sensorium.

Observation	Total Number	Male = 40	Female = 60
Age			
20 - 29	09	03	06
30 - 39	14	06	08
40 - 49	25	10	15
50 - 59	20	07	13
60 - 69	11	04	07
70 - 79	10	05	05
80 - 89	09	03	06
90 - 99	02	01	01
Symptoms			
Dysuria	82	40	42
Haematuria	10	05	05
Pyuria	20	06	14
Frequency	65	30	35
Oliguria	21	12	09
Vomiting	42	19	23
Diarrhoea	11	06	05
Altered Sensorium	18	08	10
Risk Factors			
Diabetes Mellitus	55	25	30
Hypertension	27	16	11
Chronic Kidney Disease	07	03	04
Childhood UTI	16	09	07
Recurrent UTI	44	20	24
Urinary incontinence	18	07	11
Urolithiasis	19	10	09
Indwelling catheter	14	08	06
Gender specific risk factors			
Males- BPH	13	13	-
Females			
Menopause	27	-	27
Carcinoma cervix	01	-	01
Pregnancy	02	-	02
Complications:			
AKI	41	20	21
Septicaemia	34	11	23
Septic shock	14	05	09
Emphysematous pyelonephritis	06	02	04
Failed empirical antibiotics	44	20	24
Haemodialysis	23	13	10

Table 1. Age, Gender Incidence, Symptoms, Risk Factors, and Complications in the Study Group (n = 100)

Diabetes mellitus was present in 54 % of patients, followed by a history of recurrent UTI in 44 %. 13 / 40 males had history of benign prostatic hyperplasia (BPH). Among the 60 female's menopause, pregnancy & Ca cervix were present in 27, 2 and 1 patients respectively.

Mean systolic & diastolic BP were 114.6 ± 20.97 mm Hg and 74.2 ± 15.3 Hg respectively. Mean pulse rate and temperature were 102.6 ± 19.07º F & 101.06 ± 0.95º F respectively. 44 patients failed to respond to treatment with empirical antibiotic ciprofloxacin. The complications observed were AKI in 41 patients, of whom 23 had to undergo haemodialysis. 34 patients developed septicaemia

and 14 developed septic shock. 6 patients had emphysematous pyelonephritis (Table 1).

The mean RBS was 201 ± 87 mg / dL. Mean serum creatinine was 2.3 ± 1.8 mg / dL & mean blood urea was 46.42 ± 1.86 mg / dL. Mean values of Hb & TC were 12.75 ± 1.78 g / dL and 15,000 ± 3580 / mm^3 respectively (Table 2).

54 patients were treated with empirical antibiotic ciprofloxacin. Piperacillin–tazobactam & cefoperazone-sulbactam were used in 35 & 11 patients respectively. *E. coli* was the most commonly isolated organism (66 %), followed by *Klebsiella, Pseudomonas, Staphylococci, Streptococci* & *Acinetobacter* respectively (Table 2).

| Observations	Mean	Median
Vital Signs		
Temperature	101.06 ± 0.95	101
Pulse rate	102.6 ± 19.07	104
Systolic Blood pressure	114.6 ± 20.97	110
Diastolic Blood Pressure	74.2 ± 15.3	70
Investigations		
Random Blood Sugar	201± 87	194
Serum Creatinine	2.3 ± 1.8	1.3
Blood urea	46.42 ± 1.86	40.0
Haemoglobin	12.75 ± 1.78	13
Total Count	15,000 ± 3580	14600
Empirical antibiotics used	**Frequency**	**Percentage**
Ciprofloxacin	54	54
Piperacillin + Tazobactam	35	35
Cefoperazone-Sulbactam	11	11
Isolated Organism		
E-coli	66	66
Klebsiella	23	23
Pseudomonas	05	05
Streptococci	03	03
Staphylococci	02	02
Acinetobacter	01	01

Table 2. Vital Signs, Investigations, Empirical Antibiotics Used, and Isolated Organisms in the Subjects (100)

68 % of organisms showed resistance to ciprofloxacin whereas only 15 % of them were resistant to piperacillin-tazobactam. 1st and 2nd generation cephalosporins were having sensitivity and resistance pattern comparable to that of piperacillin-tazobactam. Cefoperazone-sulbactam also showed better sensitivity pattern than ciprofloxacin, though not as good as the two classes of antibiotics mentioned above. Amikacin showed reasonably good sensitivity pattern, not used due to the risk renal impairment in this study (Figure 1). 54 patients were treated with empirical antibiotic ciprofloxacin. Piperacillin-tazobactam & cefoperazone-sulbactam were used in 35 & 11 patients respectively.

Mean duration of hospital stay was 11.64 days (range 1 to 18 days) with standard deviation 03.67. The mortality during the course of the illness was 10 %. 90 % of the patients survived in spite empirical antibiotic failure and complications. In this study risk factors like male gender, bilateral pyelonephritis, emphysematous pyelonephritis and AKI contributed to statistically significant prolongation of hospital stay ("t" test was used to calculate the p value which was 0.05) (Table 3).

Correlation between symptoms and mortality was significant ("t" test was used to know p value which was < 0.05) among patients with dysuria which was 04.8 % and without dysuria was 33.3 %. Presence of frequency of micturition with mortality (01.5 %) and absence of frequency with mortality (25.7 %) was correlated and found

that patients with absence of frequency of micturition had higher mortality; it was statistically significant (p value < 0.05). Patients with oliguria or altered sensorium had a higher mortality compared to those without them and this relationship was found to be statistically significant (p value < 0.05).

Figure 1. Showing the Antibiotics used and Their Sensitivity (n = 100)
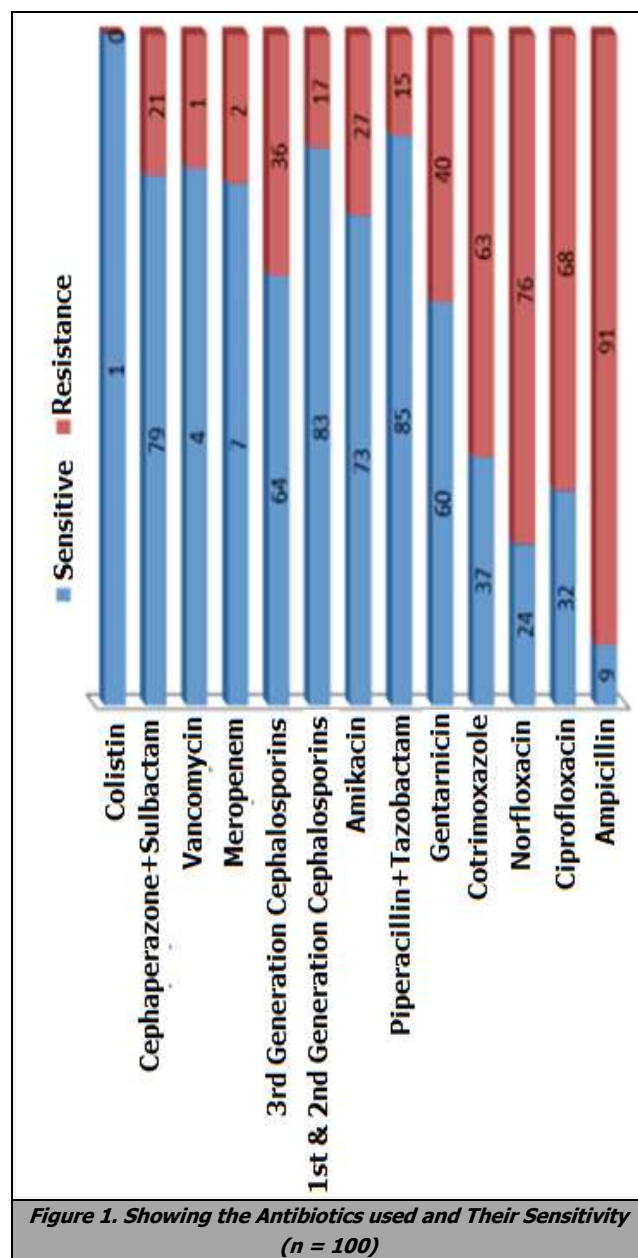
Observation		Mean Hospital Stay	T	P Value
Sex	Male	17.1 + 4.06	2.5	0.012
	Female	14.9 + 4.08		
T2DM	Absent	11.89 + 3.09	0.61	0.54
	Present	11.44 + 4.09		
Bilateral Pyelonephritis	Absent	10.92 + 2.4	- 2.58	0.011
	Present	12.82 + 4.8		
Septic shock	Absent	11.62 + 2.9	- 0.11	0.91
	Present	11.73 + 6.4		
Failed empirical therapy	Absent	12.17 + 3.04	1.50	0.13
	Present	11.06 + 4.20		
Emphysematous pyelonephritis	Absent	11.8 + 3.3	2.08	0.04
	Present	8.67 + 7.1		
AKI	Absent	11.06+2.6	- 2.1	0.035
	Present	12.67+4.9		
Haemodialysis	Not done	11.42+3.09	- 1.11	0.26
	Done	12.41+5.25		

Table 3. Showing the Role of Risk Factors and Complications Determining Hospital Stay (n = 100)

Risk Factors	Death	χ^2	P Value
Diabetes	9	5.49	0.019
Hypertension	3	0.051	0.82
CKD	1	0.154	0.695
Recurrent UTI	6	1.154	0.28
History of Nephrolithiasis	1	0.585	0.734
Indwelling catheter	2	0.33	0.56
Urinary incontinence	6	13.279	0.001
Childhood UTI	1	0.298	0.585

Table 4. Showing the Relation between Risk Factors and Mortality (n = 100)

Comparing the presence of various risk factors versus mortality, patients with urinary incontinence and DM had significantly higher mortality compared to those without them. The chi square test was used to calculate the significance and found that it was statistically significant with p values 0.019 for diabetes mellitus and 0.001 for urinary incontinence (Table 4).

Type 2 diabetes mellitus: 12 / 55 (21.81 %) of diabetic patients developed septic shock whereas only 03 / 45 (06.66 %) nondiabetic patients developed it. All the 06 patients in the study who developed emphysematous pyelonephritis were diabetics. Only 04 / 55 (07.27 %) diabetics had hydronephrosis on USG whereas 12 / 45 (26.66 %) nondiabetic patients had hydronephrosis (Table 5).

09 / 27 (33.33 %) hypertensive had hydronephrosis on USG while only 07 / 73 (09.58 %) non hypertensive patients had hydronephrosis on USG. 16 / 27 (59.25 %) hypertensive patients developed AKI which was considerably higher than non-hypertensive 20 / 73 (27.39 %) patients (Table 5). 57.14 % patients with CKD had to undergo haemodialysis (HD) while only 19.35 % patients without CKD required it. 06 / 07 (85.71 %) CKD patients developed AKI which was higher compared to patients without CKD (32.2 %). 05 / 07 (14.28 %) patients with CKD had hydronephrosis whereas 82 / 93 (88.17 %) patients without CKD had hydronephrosis (Table 5). Haemodialysis was done in more patients with indwelling catheter (50 %) than the rest (17.4 %). 10 / 14 (71.4 %) patients with indwelling catheter developed bilateral pyelonephritis while only 28 / 86 (32.55 %) patients without indwelling catheter developed bilateral pyelonephritis. 50 % developed septic shock with indwelling catheter while only 09.3 % developed septic shock without it.

Hydronephrosis was found to be higher among patients with indwelling catheter. 06 / 14 (42.8 %) patients with an indwelling catheter showed hydronephrosis on USG, while 10 / 86 (11.62 %) patients showed it without an indwelling catheter. Thus, an indwelling catheter was an independent risk factor for various complications of APN (Table 5).

Patients with urinary incontinence (UI) showed greater need for dialysis (61 %), tendency to develop bilateral pyelonephritis (88.8 %), septic shock (50 %) and AKI (27.7 %). Whereas 13.4 % patients without UI had dialysis, 26.8 % developed bilateral pyelonephritis, 07 % developed septic shock and AKI in 28 % of patients (Table 5). 42.1 % of renal calculi patients had hydronephrosis while 09.8 % developed hydronephrosis in absence of renal calculi (Table 5).

Comorbid conditions like DM, hypertension, CKD, in dwelling catheter, UI and urinary calculi resulted in complications such as septic shock, emphysematous pyelonephritis, hydronephrosis, AKI, hydronephrosis and necessity for haemodialysis respectively in patients with

acute pyelonephritis; statistical significance was observed with p values below 0.05 for all these co-morbid conditions (Table 5).

Risk Factors	Complications Present	Complications Absent	x^2	P Value
T2DM Present Absent	Septic shock-12 Septic shock-42	Septic shock-43 Septic shock-03	04.45	0.03
T2DM Present Absent	Hydronephrosis-04 Hydronephrosis-12	Hydronephrosis-51 Hydronephrosis-33	06.9	0.008
T2DM Present Absent	Emphysematous Pyelonephritis-06 Emphysematous Pyelonephritis-0	Emphysematous Pyelonephritis-49 Emphysematous Pyelonephritis-45	05.22	0.02
Hypertension Present Absent	Hydronephrosis-09 Hydronephrosis-66	Hydronephrosis-18 Hydronephrosis-07	08.2	0.004
Hypertension Present Absent	AKI-16 AKI-11	AKI-53 AKI-20	08.6	0.003
CKD Present Absent Present Absent Present Absent	Haemodialysis-04 Haemodialysis-18 AKI-06 AKI-30 Hydronephrosis-05 Hydronephrosis-82	Haemodialysis-03 Haemodialysis-75 AKI-01 AKI-63 Hydronephrosis-02 Hydronephrosis- 11	05.4	0.02
Indwelling catheter Present Absent Present Absent Present Absent Present Absent	Haemodialysis-07 Haemodialysis-15 B / L Pyelonephritis-10 B / L Pyelonephritis-28 Septic shock-07 Septic shock-08 Hydro nephrosis-08 Hydro nephrosis-10	Haemodialysis-07 Haemodialysis-71 B/L Pyelonephritis-04 B/L Pyelonephritis-58 Septic shock-07 Septic shock-78 Hydro nephrosis-06 Hydro nephrosis-76	07.6 07.7 15.6 08.7	0.006 0.005 0.001 0.003
Urinary Incontinence Present Absent Present Absent Present Absent Present Absent	Haemodialysis-11 Haemodialysis-11 B/L Pyelonephritis- 16 B / L Pyelonephritis-22 Septic shock-09 Septic shock-06 AKI-13 AKI-23	Haemodialysis-07 Haemodialysis-71 B/L Pyelonephritis-02 B/L Pyelonephritis-60 Septic shock-09 Septic shock-76 AKI-05 AKI-59	19.57 24.12 21.09 12.5	0.001 0.001 0.001 0.001
Urinary Calculi Present Absent	Hydronephrosis-11 Hydronephrosis-08	Hydronephrosis-08 Hydronephrosis-73	11.89	0.001

Table 5. Showing the Multivariate Analysis of Correlation between Risk Factors and Present or Absent Complications in UTI Patients (n = 100)

Observations	Mean in Recovery	Mean Death	T	P Value
Vitals				
Pulse rate	101.4 ± 19.1	113.4 ± 15.9	- 1.9	0.06
SBP	116.8 ± 18.3	97.2 ± 33.2	2.9	0.04
DBP	75.3 ± 15.2	64.4 ± 13.6	2.2	0.03
Temp	101.1±0.9	101.1 ± 0.7	- 0.14	0.89
Investigations				
Hb	12.9 ± 1.7	10.8 ± 1.6	3.8	0.001
TC	15000 ± 3300	19500 ± 3000	- 4.0	0.001
BU	42.6±17.7	80.8 ± 43	- 5.3	0.001
Scr	1.98 ± 0.5	5.5 ± 1.0	- 6.8	0.001
RBS	188.4 ± 76	319 ± 90	- 5.0	0.001

Table 6. Showing the Relation between the Vitals & Investigations and Mean Values of Recovery & Death (n = 100)

Failure rate of empirical treatment was considerably higher among the patients who were started on ciprofloxacin (70.37 %) compared to piperacillin-tazobactam (22.8 %) and cefoperazone-sulbactam (18.18 %). This fact was statistically significant with p value 0.001 (p significant at < 0.05). Analysis of USG features showed significant association between presence of abscess & emphysematous pyelonephritis and mortality. The complications observed were AKI in 36 % patients, hydronephrosis in 16 %, emphysematous pyelonephritis in 06 %, bilateral pyelonephritis in 38 %, septic shock in 14 %, failure to respond to antibiotic therapy in 48 % and the requirement of haemodialysis in 22 %. All of the complications, except for hydronephrosis had significant attributable mortality (p value > 0.05), (Table 7).

Observations	Total	Death	Recovery	x^2	P Value
USG					
Nephrolithiasis	34	3	31	0.08	0.77
Abscess	08	05	03	07.30	0.007
EPN	06	03	03	11.34	0.001
Anomalies	02	00	02	0.22	0.63
Complications					
AKI	36	10	26	19.75	0.001
Hydro nephrosis	16	03	13	01.62	0.20
Septic shock	14	09	06	49.02	0.001
B/L Pyelonephritis	38	10	28	18.12	0.001
Failed empirical therapy	68	28	40	04.55	0.03

Table 7. Showing the Relation between USG Findings & Complications with Death and Recovery of UTI Patients (n = 100)

DISCUSSION

Out of 100 patients, 25 % belonged to the age groups of 40-49 years and 20 % belonged to 50 - 59 years. V M Dhamotharan et al.[24] reported 23 % and 35 % frequency among the ages of 41 - 50 and 51 - 60 years respectively. Nicholleet et al.[16] reported APN highest among the patients aged above 59 years followed by 20 to 29 years. As in this study inclusion of only inpatients and excluding patients < 16 years has resulted presentation of higher incidence of APN in among the younger age groups. There were 60 females and 40 males in this study with male to female ratio of 3:2 which was similar to the global reports by population based epidemiological study by Czaja et al.[25] Dysuria was present in 82 % of the patients followed by frequency of micturition in 35 %, pyuria in 20 % of the patients & haematuria in 10 %. Vomiting & diarrhoea was present in 42 % and 11 % of patients respectively. 18 % of the patients presented with altered sensorium. V M Dhamotharan et al., observed similarly; dysuria in 52 % of the patients.[24] Higher incidence of dysuria may be due to inclusion of fever and flank pain as inclusion criteria, excluding atypical cases of pyelonephritis, where dysuria could be absent. M. Eshwarappa et al.[8] observed oliguria / anuria in 12.8 % of their patients with APN unlike 21 % observed in this study. Huang J Jet al.[26] observed that haematuria, oliguria, and altered consciousness were having attributable risk of mortality. But Buonaiutoet al.[27] in an urban hospital in Spain, observed absence of fever and absence of costo vertebral angle tenderness were found to have attributable risk to mortality. Diabetes mellitus was present in 55 % of the patients in this study. M. Eshwarappa et al.[8] reported DM in 42.6 % patients which was a common risk factor in patients with APN. The incidences of urinary incontinence, urinary stones and benign prostatic hyperplasia (BPH) in this study were 18 %, 19 % & 13 % respectively. It was similar to the study by Buonaiutoet al.[27] the incidences were 16, 25 & 15 respectively. The prevalence of indwelling catheter

was 14 % in this present study similar to Veronica et al.[28] The present study showed a prognostic significance in the presence of risk factors such as DM and urinary incontinence. There was a statistically significantt correlation between DM and UI with mortality in this study (Table 5). Risk factors observed in the study by Buonaiutoet et al.[27] was indwelling bladder catheterization and chronic kidney disease (CKD). But the present study could not find any significant relationship with mortality for either indwelling catheter or CKD. Vera Y Chung et al.[29] reported no significant prognostic implications for any of the above-mentioned risk factors such as DM, CKD or renal stones. Nitzan et al.[30] observed from their study that the percentage of mortality in APN to be 5 times that of the general population in patients with DM.

Study by Pallet et al.[31] concluded that outcome in patients with pyelonephritis was worse in presence of UI. The present study opines that the patients with DM were found to have higher probability of developing septic shock and emphysematous pyelonephritis when compared to APN patients without diabetes mellitus (DM), (Table 5). A study by Kalra and Raizadaet et al.[32] reported higher risk for sepsis among patients with DM and immunosuppression; hypertension and CKD were found to be risk factors causing AKI. CKD, indwelling catheter and UI were found to increase the need for haemodialysis. Hsiao et al.[33] reported risk factors like neurogenic bladder, pre-existing renal disease, instrumentation and emphysematous pyelonephritis were independent variables leading to dialysis. Hydronephrosis was found to be higher among patients with DM, hypertension, CKD, indwelling catheter and urolithiasis compared to patients without these risk factors. Mean systolic & diastolic BP were 114.6 and 74.2 respectively in this study; mean pulse rate & temperature were 110.6 and 101.06 respectively. The mean BP was lower in deceased patients compared to survived patients. This relationship was found to be statistically significant (Table 2). There was no significant relationship between rise in temperature and mortality. In this study haemoglobin levels were lower whereas blood urea, serum creatinine and total leukocyte count were above normal in deceased patients. This correlation was statistically significant (Table 6).

Anaemia, leukocytosis, DM and AKI at the time of presentation were important predictors of grave prognosis, with higher mortality. Thus, these patients warrant more aggressive management. Buonaiuto et al.[27] reported correlation between higher total leukocyte counts above 20,000, high serum creatinine with mortality. *E coli* was the most common causative organism in the present study. *Klebsiella, Pseudomonas,* staphylococci and streptococci caused the rest of the infections & *Acinetobacter* was the culprit in a single case. The mortality was maximum among *Acinetobacter* followed by streptococci and staphylococci. Buonaiuto et al.[27] reported *Escherichia coli* as the causative agent in 67 % followed by *Klebsiella* species in 07.9 %. In the present study *E coli* was isolated in urine culture sensitivity in 66 % patients and *Klebsiella* in 23 % and rest were constituted by *Pseudomonas,* staphylococci,

streptococci and *Acinetobacter*. 54 / 100 patients were treated with empirical antibiotic ciprofloxacin. Piperacillin-tazobactam & cefoperazone-sulbactam was used in 35 & 11 patients respectively. Empirical therapy failure rate was found to be considerably higher among the patients who were given ciprofloxacin compared to other antibiotics and this was found to be statistically significant (Figure 1). In an Indian study by M. Eshwarappa et al.[8] the resistance to quinolones were found to be 74 %. Buonaiutoet al.[27] reported the prevalence of renal abscess to be 09.7 % which was comparable with our study where USG showed evidence of abscess in 08 % of the patients. In this study urolithiasis was present in 37 % of the patients which was almost double in the study by Eshwarappa et al.; 17.9 %,[8] Among the USG features, abscess and evident emphysematous pyelonephritis were found to have significant mortality which is in accordance with the study by Vera Y Chung et al.[29] Among the complications, AKI, bilateral (B / L) pyelonephritis, septic shock and failure of empirical treatment had significant attributable mortality. Vera Y Chung et al.[29] reported significant attributable mortality for AKI, emphysematous pyelonephritis and septic shock, hence the results were comparable.

CONCLUSIONS

Certain risk factors such as diabetes, urinary incontinence hypertension, chronic kidney disease, hypertension and indwelling catheters were associated with increased incidence of complications. Hence, in the presence of such risk factors, appropriate treatment and preventive measures should be initiated promptly. Among the pathogens, 85 % of the organisms were sensitive to piperacillin–tazobactam. Hence, piperacillin-tazobactam can be recommended as the first line empirical antibiotic.

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