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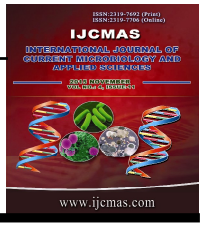

Original Research Article

Aerobic Bacteriological Study with their Antibiogram in Children with Acute Diarrhoea in North East Karnataka, India

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Keywords

Escherichia coli, *Vibrio cholerae*, *Shigella species*, Antibiogram in Children with Acute Diarrhoea

A B S T R A C T

Diarrhoea is endemic in India and accounts for morbidity and mortality among children aged 1-5 yrs, particularly in India due to the unprotected water supply, contamination of food and milk, improper disposal of human excreta, poor standards of personal hygiene, adverse climatic conditions and rampant malnutrition especially in rural areas. 100 cases of diarrhoea were enrolled in the study. Brief history and examination were done in a predesigned format. All were subjected for both macroscopic and microscopic examination, later hanging drop and gram's staining was done. Suspected pathogens were identified by standard methods and antibiotic sensitivity was done using Kirby Bauer disc diffusion method. Totally, 100 samples processed, the isolation rate of enteric pathogens were 84%. The common pathogens isolated was Entero Pathogenic *Escherichia coli* 32(33.68%), *Shigella* species 22(23.15%), *Vibrio cholerae* 19(20%). Entero Pathogenic *Escherichia coli* showed high prevalence in 13-24 months age group, *Shigella* in 25-36 months and *Vibrio* in 36-60 months age group. All the 3 species showed sensitivity to Ciprofloxacin, Gentamicin, Cephalosporins and Norfloxacin respectively. The most common etiology of acute diarrhoea in 1-5 year age group is Enteropathogenic *Escherichia coli*, *Shigella* species and *Vibrio cholerae* respectively.

Introduction

Diarrhoea is endemic in India and accounts for a high morbidity and mortality among children, particularly in developing countries like India due to the unprotected water supply, contamination of food and milk, improper disposal of human excreta, poor standards of personal hygiene, adverse climatic conditions and rampant malnutrition especially in rural areas.

Diarrhoea in children can be acute or persistent / invasive or secretory due to various causes like bacterial, viral, parasitic, fungal or combination of these. Among these causes, bacterial infection is the most common cause of acute diarrhea. The organisms causing bacterial infection are *E. coli*, *Vibrio cholerae*, *Salmonella*, *Shigella* and *Campylobacter*, etc.

It was observed that *E. coli* was found in 100% of cases, 23% were pathogenic followed by *Vibrio cholerae*, *Klebsiella pneumoniae*, *Proteus morgani*, *Pseudomonas aeruginosa*, *Campylobacter* and *Proteus mirabilis* in less than 5 yrs age group. The prevalence of *Vibrio cholerae* was31.7% and 23.4% occurred in the age group of less than two years, 41.4% in 2–5 years and 31.5% in more than 5–12 years (Aggarwal *et al.*, 1989).

Shigella was isolated from 56/634 diarrhoeal samples (8.8%) of which *S. sonnei* was the predominant species (55%). Occurrence of *Shigella* was highest in the 2–5 years age group (70.9%) and highest in summer (73.2%) with the most frequent clinical manifestation being abdominal pain (67.8%) Ezzat Ollah Ghaemi *et al.* (2007).

Hence the need for knowing the prevalence of pathogens in children was took up. The study was conducted to find out the prevalence of acute diarrhoeal diseases due to aerobic bacteria in children aged between 1-5yrs by isolation and identification of pathogenic bacteria from stool samples and to study the antibiotic sensitivity pattern of the isolates.

Materials and Method

The study was conducted at Basaveshwara Hospital, attached to M.R. Medical College, Gulbarga from Jan 2011 to Dec 2011.A total of 100 cases of acute diarrhoea, who came for the treatment to the above mentioned hospital were taken up for the study. Children with acute diarrhoea of less than 72hours duration were included in the study. Patients on antibiotic therapy during preceding three days and complicated illness were excluded. Children aged between 1 and 5 years were included in the study. The stool samples were examined macroscopically for consistency, colour, presence of mucus, blood. Grams stain and hanging drop were done and all the stools samples were subjected for plating in Mac Conkey agar, xylose lysine deoxycholate agar and thiosulphate citrate bile sucrose agar. Enrichment media's like selenite F broth and alkaline peptone water were used for *Salmonella*, *Shigella* and Vibrio and after 6hrs of incubation it was subcultured into selective media. The colonies were subjected to Gram's stain, hanging drop, biochemical reactions. Special tests were done for *Vibrio*, *Salmonella* and *Shigella*. Procedures were followed according to standard methods given in practical manual of medical microbiology (Mackie and McCartney). Serotyping was done for all the species isolated with specific antisera. The sensitivity was performed over Mueller Hinton agar plates by disc diffusion method recommended by Kirby – Bauer. Sensitivity was performed using control strains of *Staphylococcus aureus* ATCC25923, *E. coli* ATCC25922, and *Pseudomonas* ATCC 27853.

Results and Discussion

A total of 100 stool samples were processed during the study period of one year for bacterial pathogens.

Table 1 shows that the highest number of cases was encountered between 13-24 months of age group. Male preponderance was noted. Of 100 cases, 59 were males and 41 females. Male: female ratio-1.43:1.

Table 2 shows out of 100 samples received, culture was positive in 95 cases and no growth was present in 5 cases. Out of the total 95 organisms, 36(37.89%) strains of *Escherichia coli*, 23(24.2%) strains of *Shigella*, 19(20%) strains of *Vibrio* and

other organisms like *Klebsiella, Enterobacter, Proteus, Pseudomonas* were also isolated.

Table 3 shows out of the 95 culture positive samples, 80 organisms were identified as possible etiological agents. The prevalence rate of the isolated organisms was 84%.The EPEC strains was 32(33.68%), *Shigella* sp's was 22(23.15%), *Vibrio cholera* was 19(20%) and others like *Klebsiella, Enterobacter*, *Proteus* and *Pseudomonas* were isolated.

Table 4 shows enteropathogens isolated from 95 culture positive showed highest incidence of EPEC in 13–24 months of age and the incidence showing lower in higher age group, followed by *Shigella* sp's in 25–36 months age group and *Vibrio* in 36–60 months age group respectively.

Table 5 reveals the antibiotic sensitivity pattern of EPEC, *Shigella* and *Vibrio* in the 80 pathogens isolated. It was observed EPEC strains are sensitive to ciprofloxacin, cefotaxime, gentamicin and tetracycline. Also *Shigella* was sensitive to ciprofloxacin, cefotaxime, gentamicin and nalidixic acid. Lastly *Vibrio* strains were sensitive to cefotaxime, gentamycin, tetracycline, ciprofloxacin, co-trimoxazole and furazolidine respectively.

Diarrhoea in children is important in leading countries since it is associated with both mortality and morbidity due to the changing pattern of organisms and their antibiotic sensitivity. Hence it is important to study the etiology and their isolation followed by antibiogram.

In the present series the isolation rate of enteric bacteria was 84%. These results are consistent with the studies shown by Mubashir (1988) and Ogbonnaya Ogbup *et al.* (2008) respectively.

Prevalence of *Shigella* in our study was 23.15%.These results are more as compared to reports by Mamatha Ballal *et al.* (1992) and Ezzat Ollah Ghaemi *et al.* (2007).

The isolation rate of *Vibrio cholerae* in our study was 20%, with highest attack rate of cholera in children above 2 years of age. The age -wise distribution of *Vibrio cholerae* correlates with that stated by WHO group.

All strains in our study showed biotype ElTor and serotype Ogawa. Seasonal variations were seen with maximum occurrence of cases in early monsoon period. These findings are slightly higher with reports like Khatua *et al.* (1984), Anand *et al.* (1996), Mamatha Ballal and Shivananda (2002). Other organisms like *Pseudomonas aeruginosa*, *Enterobacter, Proteus*, *Klebsiella* were isolated in 8.06% of cases. These organisms may be normal inhabitants of the intestine but it was present as predominant growth hence considered as pathogens.

The isolation rates in other studies vary from 10–33% as mentioned by Khanna (1977) and Naresh Gupta *et al.* (1985). Pathogenicity of these organisms in causation of diarrhoea is controversial. However, these suspected pathogens when isolated either in pure culture or in significant number and in the absence of other definitive pathogens their presence cannot be ignored.

In the present study, EPEC showed maximum resistance to ampicillin (91%), furazolidine (91%) and nalidixic acid (71%) and maximum sensitivity was observed to cefotaxime (100%), ciprofloxacin (69%) and norfloxacin (79%).

Table.1 Age distribution of cases

Age in months	Males		Females		Total		M:F
	No.	%	No.	%	No.	%	
13-24	26	26.0	22	22.0	48	48.0	1.18:1
25-36	17	17.0	11	11.0	28	28.0	1.54:1
36-60	16	16.0	8	8.0	24	24.0	2:1
Total	59	59.0	41	41.0	100	100.0	1.43:1

Table.2 Showing various organisms isolated in 95 cases

Organism	Number of organisms isolated	Percentage (%)
Escherichia coli	36	37.89
Shigella	23	24.21
Vibrio	19	20.0
Klebsiella	2	2.10
Enterobacter	6	6.31
Proteus	6	6.31
Pseudomonas	3	3.15
Total	**95**	**100**

Table.3 Pathogens isolated in 95 cases of stool samples

Pathogen	No. isolated	Percentage (%)
EPEC	32	33.68
Shigella sp	22	23.15
Vibrio cholera O1	19	20.0
Klebsiella pneumoniae	2	2.10
Enterobacter aerogenes	2	2.10
Proteus mirabilis	2	2.10
Pseudomonas aeruginosa	1	1.05
Total	**80**	**84**

Table.4 Isolation rate of enteropathogens in different age groups

Pathogens	Age in months						Total	
	13-24		25-36		37-60			
	No	%	No.	%	No.	%	No.	%
EPEC	26	27.36	5	5.26	1	1.05	32	33.68
Shigella sp	4	4.21	15	15.78	3	3.15	22	23.15
Vibrio cholerae O1	0	0	8	8.42	11	11.57	19	20
Klebsiella pneumoniae	0	0	2	2.10	0	0	2	2.10
Enterobacter aerogenes	2	2.10	0	0	0	0	2	2.10
Proteus mirabilis	2	0	0	0	0	0	2	2.10
Pseudomonas aeruginosa	1	1.05	0	0	0	0	1	1.05

Table.5 Table showing susceptibility pattern of isolates

Antibiotics	**EPEC(32) (No./%)**	***Shigella*(22) (No./%)**	**Vibrio(19) (No./%)**
Ampicillin	3(9.37)	0(0)	11(57.89)
Chloramphenicol	9(28.12)	7(21.87)	13(68.42)
Co-Trimoxazole	16(50)	5(15.62)	15(78.94)
Ciprofloxacin	22(68.75)	21(95.45)	16(84.21)
Furazolidine	3(9.37)	14(63.63)	16(84.21)
Tetracycline	19(59.37)	0(0)	14(73.68)
Gentamycin	19(59.37)	22(100)	14(73.68)
Cefotaxime	32(100)	22(100)	16(84.21)
Nalidixic acid	9(28.12)	21(95.45)	0(0)
Norfloxacin	25(78.12)	10(45.45)	14(73.68)

Similar susceptibility pattern were observed by Lankeshwar Tewari and Surendra (1982) and Usha P. Kamlakar (1995) *Shigella* strains are particularly noted for their multidrug resistance which may result from the selection of resistant mutants because of wide spread use of antimicrobials. In the present study, *Shigella* species were found to be resistant to ampicillin (100%), tetracycline (100%), co-trimoxazole (15%), and norfloxacin (45.45%). Multidrug resistant *Shigella* has been reported from different parts of India (Pal, 1984; Panigrahi *et al.*, 1984). A significantly low resistance to Nalidixic acid (4.5%), third generation cephalosporins (0%) and gentamicin (0%) was noted. Continuing monitoring of the susceptibility pattern of *Shigella* species is important to notice the emergence of drug resistance.

In the present series *Vibrio cholerae* showed resistance to nalidixic acid (100%), ampicillin (57%) and sensitive to cephalosporins (84.21%), tetracycline (73.61%) and ciprofloxacin (84.21%). This was comparable with study done by Mamatha Ballal and Shivananda (2002). Multidrug resistance with ElTor strains of *Vibrio cholerae* was reported as early as 1977–1978 from Tanzania by Mhalu *et al.* (1979).

In the present study, it is important to state that our inability to screen for the other potential enteric pathogens particularly (viruses, parasites, anaerobes), the low population size of cases and the limited number of antibiotics used in the study were among the limitations of this study.

Hence we conclude that many organisms other that EPEC are also the causative agents of acute diarrhoea in children above 1 yr, possible methods have to be made to isolate them and antibiotics should be used judiciously to control the emergence of resistant strains and limit the acquisition of additional antibiotic resistant genes in the existing strains.

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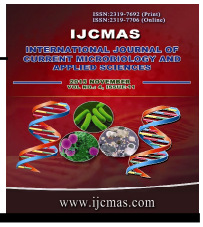

Original Research Article

Aerobic Bacteriological Study with their Antibiogram in Infants with Acute Diarrhoea in North East Karnataka, India

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Keywords

Entero-pathogenic *E coli*, Diarrhea

A B S T R A C T

The high incidence of diarrhoea in less than 1 year of age necessitates the periodic assessment of the spectrum of the enteric pathogens and their microbiological susceptibility, which aids in the rational use of the antibiotics. Two hundred cases of diarrhoea were enrolled in the study. A detailed clinical history was recorded in the predesigned proforma. Samples were subjected to both macroscopic and microscopic examination, later hanging drop and gram's staining was done. Suspected pathogens were identified by standard methods and antibiotic sensitivity was done using Kirby Bauer disc diffusion method. Most cases were frequently observed in 7 to 12 months age group (73.13%) and with male children getting affected more. The causative enteric pathogens were isolated in 31.05% of cases. *Escherichia coli* was isolated in 98.42% (Entero Pathogenic *E. coli* was 29.47%) of cases. Antibiotic susceptibility pattern of Entero Pathogenic *E. coli* was ampicillin (16.07%), ciprofloxacin (85.71%), cotrimoxazole (37.5%), furazolidine (37.5%), chloramphenicol (46.42%), tetracycline (37.5%), gentamycin (85.71%), cefotaxime (94.64%), nalidixic acid (26.78%) and norfloxacin (87.5%). The most common etiology of acute diarrhoea in less than 1 year in infants is *Escherichia coli* of which enteropathogenic *E. coli* is the commonest.

Introduction

Diarrhoea may be defined as deviation from established bowel rhythm, characterized by an increase in frequency and fluidity of stools. In others words, if passage of stools occur 3 or more times a day. In the health institutions, up to one third of total paediatric admissions are due to diarrhoeal diseases and up to 17% of all deaths in indoor paediatric patients are diarrhoeal related. According to WHO, children alone constitute 3.5 to 8 million diarrhoeal deaths per year, worldwide.

In the study carried out in rural and urban areas of 11 states of India (1991), it was noticed that the diarrhoeal episodes occurred

at 1.5 episodes per child per year in urban area and 4.57 episodes per child per year in rural areas. *Escherichia coli, Vibrio cholera, Shigella, Salmonella, Rotavirus* and parasites are the major postulated causes of acute diarrhoea throughout the world.

Diarrhoea is a major public health problem in the developing countries. An estimated 1.8 billion episodes of diarrhoea occur each year and 3 million children under the age of 5 years die of diarrhoea, 80% of these deaths affect children under the age of 2 years.

The maximum number of patients was below the age of 12 months with maximum incidence in between 7 and 12 months followed by age group of 0–6 months. It was also observed that EPEC was more predominant isolate among the 29% of bacterial enteropathogens and common serotypes were 086, 0119, 0126, 0127 and 0128. The other organisms were *Pseudomonas aeruginosa, Proteus* species and *Klebsiella* (Khanna *et al.,* 1996).

The study was conducted to find out the prevalence of acute diarrhoeal diseases due to aerobic bacteria in infants by isolation and identification of pathogenic bacteria from stool samples and to study the antibiotic sensitivity pattern of the isolates.

Materials and method

The study was conducted at Basaveshwara Hospital, Gulbarga. A total of 200 cases of acute diarrhoea were taken up for the study during Jan 2011 to Dec 2011. Infants aged between 1 month and 12 months were included for the study. Diarrhoeal cases of 1 to 15 days of duration were included for the study. Only those samples that are taken under aseptic precautions in the hospital were included for the study. The stool samples were examined macroscopically for consistency, colour, presence of mucus, blood and parasites. Microscopic examination of each sample was done for the presence and number of faecal polymorphonuclear leucocytes/hpf, presence of red blood cells and fat globules. Samples were subjected to hanging drop and Gram's stain. Direct plating of the stool sample was done over Mac Conkey agar, xylose lysine deoxycholate agar and thiosulphate citrate bile sucrose agar. A part of the sample was inoculated into Selenite-F broth and alkaline peptone water for enrichment of *Salmonella*, Shigella and *Vibrio cholerae*.The inoculated plates were incubated aerobically at 37°C for 24-48 hours. Serotyping was done with specific antisera for *Shigella, Vibrio cholera, Salmonella* and *Escherichia* (polyvalent EPEC) antisera. The sensitivity was performed over Mueller Hinton agar plates by disc diffusion method recommended by Kirby – Bauer.

Results and Discussion

A total of 200 stool samples were processed during the study period of one year for bacterial pathogens.

Table 1 shows that the highest number of cases was encountered between 7 and 12 months of age group. Male preponderance was noted. Of the 200 cases 132 were males and 69 females. Male : female ratio – 1.9:1.

Table 2 shows out of 200 samples received, culture was positive in 190 cases and no growth was present in 10 cases. Out of the total 190 organisms, 187(98.42%) strains of *Escherichia coli* and other organism like *Klebsiella sp* were also isolated respectively.

Table 3 shows of the 190 culture positive samples 59 organisms were identified as possible etiological agents, the prevalence rate of the isolated organisms was 31.05%.

Although 187 strains of *E. coli* were isolated and submitted to serotyping with polyvalent EPEC antisera, 56(29.47%) were identified as EPEC and 3 strains of Klebsiella was isolated with a prevalence of 1.57%,

Table 4 shows enteropathogens isolated from 190 culture positive showed highest incidence of EPEC in 7–12 months of age and the incidence showing lower in higher age group, followed by *Klebsiella* sp in less than 1 year age group.

Table 5 reveals the antibiotic sensitivity of 56 enteropathogenic *E. coli* isolated, it is seen from the table that they are highly sensitive to cefotaxime 53 (94.64%) and are sensitive to ciprofloxicin 48(85.71%), gentamicin 48(85.71%), norfloxacin 49 (87.5%). The organisms showed higher resistance to ampicillin, chloramphenicol and nalidixic acid.

Table.1 Age distribution of cases

Age in months	Males		Females		Total		M:F
	No.	%	No.	%	No.	%	
0-6	35	17.41	19	9.45	54	26.86	1.8:1
7-12	97	48.25	50	24.87	147	73.13	1.9:1
Total	132	65.67	69	34.32	201	100	1.9:1

Table.2 Showing various organisms isolated in 190 cases

Organism	Number of organisms isolated	Percentage (%)
Escherichia coli	187	98.42
Klebsiella species	3	1.57
Total	**190**	**100.00**

Table.3 Pathogens isolated in 190 cases of stool samples

Pathogen	No. isolated	Percentage (%)
EPEC	56	29.47
Klebsiella sp	3	1.57
Total	**59**	**31.05**

Table.4 Isolation rate of enteropathogens in different age groups

Pathogens	Age in months				Total	
	0-6		7-12			
	No.	%	No.	%	No.	%
EPEC	25	12.43	31	15.42	56	29.47
Klebsiella sp	3	1.49	0	0	3	1.57

Table.5 Table showing susceptibility pattern of isolates

Antibiotics	**Number of isolates**	**Percentage (%)**
Ampicillin	9	16.07
Chloramphenicol	26	46.42
Co-Trimoxazole	21	37.5
Ciprofloxacin	48	85.71
Furazolidine	21	37.5
Tetracycline	21	37.5
Gentamycin	48	85.71
Cefotaxime	53	94.64
Nalidixic acid	15	26.78
Norfloxacin	49	87.5

Diarrhoea in infants and children ranks among the leading cause of morbidity and mortality. Assessment of the bacteriologic pattern of diarrhoea from time to time may be of considerable importance, not only in isolating the causative agent but also as a tool in therapeutic approach, to reduce the morbidity and mortality. Important advances have been achieved over the last few years in the field of diarrhoea research.

Diarrhoea was commonly seen in children less than 1 year of age more frequently in infants between 7 and 12 months of age accounting for 73.13% of cases. The high incidence below the age of 1 year is explainable, because at this age the child starts crawling and puts everything into mouth and is susceptible to infection. This result was consistent with the range mentioned by others like Khanna *et al.* (1996), Joshi *et al.* (1980) and Bhat *et al.* (1986) respectively.

We also observed that there was preponderance of males in cases of diarrhoea with a ratio of 1.9:1. This was consistent with the observation mentioned by Pande (1975), Khatua *et al.* (1984) and Ogunsanya *et al.* (1994).

In the present series the isolation rate of

enteric bacteria was 31.05%. These results are consistent with other studies like Khatua *et al.* (1984) and Khanna *et al.* (1996). Whereas higher isolation rate has been shown by other studies like - Ogbonnaya Ogbup *et al.* (2008) respectively.

In the present study higher proportion of EPEC were seen in 0–12 months age group, that may be due to the fact that colonization of gut with EPEC generally occurs at the time of weanling. In the present study, Prevalence of EPEC was 29.47 % (56 cases in 200 cases studied). Prevalence similar to the present study has been found in studies conducted by Khanna *et al.* (1996) and Ogbonnaya Ogbup *et al.* (2008) showed higher rate of EPEC in infants.

The antibiotic pattern of the bacterial pathogens isolated showed different patterns of sensitivity and resistance. In the present investigation, antibiotic susceptibility pattern of Entero Pathogenic *E. coli* was ampicillin (16.07%), ciprofloxacin (85.71%), cotrimoxazole (37.5%), furazolidine (37.5%), chloramphenicol (46.42%), tetracycline (37.5%), gentamycin (85.71%), cefotaxime (94.64%), nalidixic acid (26.78%) and norfloxacin (87.5%). Similar susceptibility pattern were observed by Lankeshwar Tewari and Surendra (1982) and Usha P. Kamlakar (1995).

As a public health measure to reduce the disease burden, an integrated package of immunization services and other childcare programmes need to be implemented in addition to well-focussed health education messages to improve treatment seeking behaviour for childhood diarrhoea as well as personnel and environmental hygiene. We conclude that the etiologic spectrum of acute diarrhoea vary among different age of patients. The need to etiologically define the diarrhoeal episode and establish the antimicrobial susceptible pattern for effective clinical management.

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Identification and antibiogram of gram positive cocci from catheter associated urinary tract infection (CAUTI) in intensive care units of a tertiary care hospital

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Abstract

Introduction: The study was conducted to know about the Gram positive cocci causing urinary tract infections in catheterized patients in intensive care units and to study their antimicrobial sensitivity pattern.

Materials and Methods: A sample size of 100 catheterised patients in Intensive care units were included in a period of 1 year from December 2012 to November 2013 to assess the urinary tract infections caused by indwelling catheter.

Result: Of 100 cases, 11 showed catheter associated urinary tract infections. Out of them 10 were Enterococcus spp, and 1 was Coagulase negative staphylococci. Isolates were multi drug resistant and showed sensitivity to Vancomycin, Linezolid, Teicoplanin.

Conclusion: Infections were more with male sex, prolonged catheterization, old age and diabetes. High incidence of CAUTI was found in the first 2 weeks of catheterization. It was noted by antimicrobial susceptibility, that most of the urinary isolates are resistant to the commonly used antibiotics.

Keywords: Intensive care units (ICU), Urinary tract infections (UTI), Catheter associated (CA), Multi drug resistant (MDR).

Introduction

Catheter associated urinary tract infection is a leading cause of morbidity and mortality in hospitalized patients. When left in place for too long or used inappropriately, it is a hazard to the very patient that it is designed to protect.[21,18]

CAUTI is defined by the presence of symptoms or signs compatible with UTI with no other identified source of infection along with $\geq 10^3$ colony forming units (cfu/ml) of $\geq$ 1 bacterial species in a single catheter urine specimen or in a mid stream voided urine specimen from a patient whose urethral, suprapubic or condom catheter has been removed within the previous 48 hours.[12]

Patients in the Intensive care units are at high risk of device associated infection due to underlying conditions and impaired host defenses, surgery and invasive medical procedures.[8] Indwelling urinary and central venous catheters are used commonly in the care of critically ill patients. Though important clinical benefits are provided by both types of devices, they are also the leading causes of nosocomial infection in the intensive care units.[17]

UTI's are the third most common type of infection which occurs in ICU'S after pneumonia and lower respiratory tract infections and comprises 8% to 21% of all nosocomial infections. Because patients in ICU's require frequent and careful monitoring of intake and output and many of them use urinary catheter, the risk of UTI is significantly higher than in other patient populations.[6] Approximately 97% of UTI's in the ICU are associated with an indwelling urinary catheter.

CA-UTI are caused by a variety of pathogens, which includes Gram positive organisms like *Enterococcus spp, CONS, Staphylococcus aureus.*

Up to 25% of patients who require a urinary catheter $\geq$ 7 days develop Nosocomial bacteriuria with a daily risk of 5%.[18] Bacteriuria develops at an average rate of 3% to 10% per day of catheterization.[4] Microorganisms are from patient's endogenous bowel, or from other patients, hospital personnel by cross-contamination, non-sterile equipment.[14]

CAUTIs are a cause of concern because catheter-associated bacteriuria comprises a huge reservoir of resistant pathogens in the hospital environment.[3] The epidemiology, frequency, microbiological spectrum and antimicrobial resistance patterns of microorganisms causing Device-Associated Infections vary among institutions and can change yearly. Multidrug resistant pathogen infection are on the rise, which further complicates the management of these infections.[8] Documented phenomena include the emergence of beta lactam and vancomycin resistance of *Enterococci* and *Coagulase Negative Staphylococci.*[4]

In healthy patients CA-UTI is often asymptomatic and is likely to resolve spontaneously with removal of the catheter. Occasionally may lead to complications and bacteremia.[14] CA-UTI is the second most common cause of nosocomial blood stream infection.[16]

The vast majority of nosocomial UTI's occur in patients whose urinary tracts are currently or recently catheterized. The development of CA-bacteriuria depends on duration of catheterization, colonization, improper care of catheter, underlying illness, older age, diabetes.[11,18]

Patients in the intensive care unit are at a higher risk of device-associated infection.[8] CAUTIs comprises a huge reservoir of resistant pathogens in the hospital environment.[2]

Most episodes of bacteriuria in short term catheterized patients are caused by single organisms, mostly *Enterococci* and coagulase negative staphylococci. *Enterococcus* spp cause most of the infections.

Enterococcal species are among the predominant organisms responsible for causing CAUTI's. Fifteen to thirty percent of CAUTI's are caused by the *Enterococcus* species, especially *Enterococcus faecalis* and *Enterococcus faecium* and is therefore now considered as the third leading cause of

hospital-acquired UTIs. During CAUTIs, *E.faecalis* due to presence of a foreign body produce biofilms and results in persistent urinary tract infections. Biofilm formation by many enterococcal isolates and increasing resistance to antibiotics, including vancomycin pose significant challenges in treating enterococcal infections.[10,5]

The risk of UTI increase with duration of catheterization and the Acute Nosocomial UTI is usually asymptomatic.[7]

Although recommendations have been made to treat CAUTI's only when they are symptomatic (fever, rigors, pain, haematuria, dysuria), symptoms have not been clearly defined and unrelated to CAUTI, the presence of an indwelling urinary catheter alone can cause dysuria or urgency.[20]

Materials and Methods

100 in-patients of Intensive care units were included in the study. Study was done from December 2012 to November 2013 in Microbiology department at Sree Gokulam Medical College and Research Foundation.

The sample included admitted Patients with indwelling catheter of either sex and above 19 years of age of all intensive care units of Sree Gokulam Medical College and Research Foundation. The samples of Patients with confirmed urinary tract infection before catheterization, patients whose lab culture reported as mixed flora, Urinary catheter tips Urine from catheter bags were excluded.

Urine samples were collected aseptically within 2 hours of catheterisation for baseline urine cultures and microscopic examination. Thereafter samples were analysed on 3rd day, 5th day, 7th day until Catheter is removed or, Significant bacteriuria occurred on two consecutive cultures or patient is discharged, whichever comes early. Minimum three samples were collected from each individual. Urine samples were collected by aspirating urine from the Foley's catheter with sterile syringe with gauge 26 needle after disinfecting the catheter with 70% alcohol.

The samples were transported to the Microbiology laboratory immediately. If there was a delay of >2 hours, sample was refrigerated at 4^{o}C.[9] Wet film microscopy and urine cultures were done.[8]

A colony count of $\geq 10^3$ CFU/ml was considered positive. Standard procedures, biochemical tests and antimicrobial susceptibility test (by Kirby-Bauer disc diffusion technique) were followed for identification of isolates.

The antibiotic discs used were from Himedia and the discs used were Ampicillin (10µg) Amoxyclav (20/30µg), Cephalexin (30µg), Cotrimoxazole (1.24/23.75µg) Nitrofurantoin (300µg), Tetracycline (30µg), Linezolid (30µg), Teicoplanin (30µg), Vancomycin (30µg), Novobiocin (30µg). The antibiotic susceptibility was interpreted as sensitive, intermediate or resistant by comparing the observed zone of inhibition of the test organisms to the required zone size for the Standard strains as per CLSI Guidelines.

Results

The results obtained are as follows:

Table 1: Number of samples obtained from the various Intensive care unit (ICU)

Intensive care units	Number of Samples
Medical Intensive care unit	56
Surgical Intensive care unit	24
Neuro surgical Intensive care unit	12
Post operative Intensive care unit	7
Cardiac care unit	1
Total	100

Out of 100 samples collected, 56 samples were collected from Medical Intensive care unit, 24 from Surgical Intensive care unit, 12 from Neuro surgical Intensive care unit, 7 from Post operative Intensive care unit and 1 from Cardiac care unit respectively.

Table 2: Association between the duration of catheterization and catheter- associated urinary tract infection

Duration of Catheterization	Total no: of patients catheterized	Growth seen
1 week	43	1(2.3%)
2 week	36	4(11.1%)
3 week	15	3(20%)
4 week	4	2(50%)
More than 4 weeks	2	1(50%)

Pearson Chi Square value: 32.47, p value< 0.001

Total number of patients catheterized for one week were 43, and the growth observed among this 43 was 1(2.3%), Total number of patients who were catheterized upto two weeks was 36, among the 36 growth observed was 4 (11.1%). Out of the 15 patients catheterized for upto 3 weeks growth observed was 3 (20%)., and 4 patients catheterized for 4 weeks and 2 patients catheterized for more than 4 weeks, half of them developed Catheter associated Urinary tract infection, that is 2 and 1 respectively.

Table 3: Catheter-associated urinary tract infections in the various Intensive care unit

Intensive care unit	Culture Positive [%]
Medical Intensive care unit	5(45.5%)
Surgical Intensive care unit	3(27%)
Neuro surgical Intensive care unit	2(18%)
Post operative Intensive care unit	1(9%)
Cardiac care unit	0(0%)
Total	11

Out of the 11 culture positive samples, 5 (45.5%) were from Medical Intensive care unit, 3 (27%) were from Surgical Intensive care unit, 2 (18%) were from Neuro surgical Intensive Care unit, 1 (9%) was from Post operative Intensive care unit. The highest percentage of growth was found in Medical Intensive care unit.

Table 4: Sex wise distribution of positive cultures

Sex	Culture negative	Culture positive
	No: (%)	No: (%)
Males	37 (28.9)	8 (17.7)
Females	52 (49.1)	3 (5.5)

Pearson Chi Square value: 4.209, $p < 0.05$

Out of 45 samples collected from males 8(17.7%) were culture positive. Out of the 55 samples collected from females 3(5.5%) were culture positive.

Table 5: Gram positive organisms isolated

Gram positive organisms	Number
Enterococcus faecalis	7 (63.6%)
Enterococcus faecium	3 (27.3%)
Coagulase negative Staphylococcus	1 (9.1%)
Total	11

Out of the 11 Gram positive cocci isolated, 7(63.6%) were *Enterococcus faecalis*, 3(27.3%) were *Enterococcus faecium*, and 1 Coagulase negative Staphylococcus was isolated (9.1%).

Table 6: Sensitivity pattern of Enterococcus species

	E.faecalis (n=7)		*E.faecium (n=3)*	
Drugs	**S**	**R**	**S**	**R**
Ampicillin	1(14.3%)	6(85.7%)	1(33.3%)	2(66.7%)
Amoxy Clav	1(14.3%)	6(85.7%)	1(33.3%)	2(66.7%)
Cephalexin	-	7(100%)	-	3(100%)
Nitrofurantoin	2(28.6%)	5(71.4%)	-	3(100%)
Cotrimoxazole	0(0%)	7(100%)	-	3(100%)
Tetracycline	4(57.1%)	3(42.9%)	2(66.7%)	-
Linezolid	7(100%)	-	3(100%)	-
Vancomycin	7(100%)	-	3(100%)	-
Teicoplanin	7(100%)	-	3(100%)	-

Both *E.faecalis* and *E. faecium* showed 100% resistance to Cephalexin and Cotrimoxazole. *E.faecalis* showed 57.1% and *E. Faecium* showed 66.7% sensitive to Tetracycline. Low percentage of sensitivity was shown by *E.faecalis* as well as *E.Faecium* to Ampicillin (14.3% and 33.3% respectively). All *E.faecium* was resistant to Nitrofurantoin whereas *E faecalis* (71.4%) was resistant to Nitrofurantoin.

Both *E.faecalis* and *E. faecium* showed complete sensitivity to Vancomycin, Teicoplanin and Linezolid.

Discussion

Urinary tract infections (UTIs) as a nosocomial infection, has a prevalence of 1% to 10%.[9,22] Catheter-associated urinary tract infections is common and accounts for bacteremia in 2 to 4% of patients and has a case fatality three times higher than nonbacteriuric patients.[23] Among catheterized patients the reported incidence of CAUTI ranges from as low as 5% to as high as 73%.[4] In the present study, out of 100 cases studied, 11% developed CAUTI and high incidence of CAUTI was found in the first two weeks of catheterization. This result is comparable with Danchaivijitr et al[15] study which showed a incidence 73.3% of CAUTI with high incidence in the first two weeks of catheterization. Prolonged catheterization was identified as a risk factor in the present study also and there was no CAUTI induced bacteremia.[15]

In our study *Enterococcus spp*, (10 in numbers – 90.9%) were predominant. 7(70%) were *Enteroccus faecalis* and 3 (30%) were *Enterococcus faecium*. Studies done by Ho Lee et al[6] who evaluated 1,315 patients at medical and surgical ICUs, out of which 61 people developed CAUTI and *Enterococcus spp* was seen in 30.6% patients.[6] Similarly in a prospective study in a medical intensive care unit including 137 consecutive catheterised patients by Tissot et al[19] 17% of the pathogens that caused CAUTI was *Enterococcus spp*.

Only 1 Coagulase negative staphylococcus was isolated in our study, whereas a study done by Thombare et al[1] isolated 6.06% of CONS responsible for causing CAUTI. The CONS isolated in our study showed sensitivity to Nitrofurantoin, Cephalexin, Amoxycillin-Clavalunic acid, Clindamycin, Vancomycin, Linezolid, Teicoplanin and Rifamycin, a zone of more than 25 mm was observed to Cefoxitin, hence it was not Methicillin resistant CONS. In the study by Thombare et al[4] sensitivity to the drugs were Ampicillin (25%), Gentamicin (50%), Cefoxitin (100%), Vancomycin (100%), and Nitrofurantoin (50%).

Conclusion

All health care associated UTI are caused by instrumentation of the urinary tract. The incidence was more in males and risk factors identified were prolonged catheterisation, old age and diabetes mellitus. High incidence of CAUTI was found in the first 2 weeks of catheterisation.

Longer duration of catheterization increases the chances of CAUTI. The antibiogram pattern gives a clue that most of the isolates are resistant to the commonly used antibiotics. Hospital acquired CAUTI is often due to multi drug resistant strains which require higher antibiotics and these strains may spread to other patients.

Conflict of Interest: None.

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Microbiological Profile and Antibiogram of Gram Negative Bacilli Isolated from Catheter Associated Urinary Tract Infection (CAUTI) in Intensive Care Units of a Tertiary Care Hospital

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Intensive care units (ICU), Urinary tract infections (UTI), Catheter associated (CA), Multi drug resistant (MDR)

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A B S T R A C T

Aim of the study was to isolate and characterize Gram negative bacilli causing urinary tract infections in catheterized patients of either sex and above 19 years of age in intensive care units and to study the antimicrobial sensitivity pattern of the urinary isolates. Total of 100 catheterised patients in Intensive care units were analysed retrospectively and prospectively in a period of 1 year from December 2012 to November 2013 to assess the urinary tract infections caused by indwelling catheter. Of 100 cases, 26 showed catheter associated urinary tract infections. Out of them 11 were *E. coli*, 5 each for *Klebsiella* spp and *Pseudomonas aeruginosa*, 2 were *Citrobacter* spp, and one case each for *Enterobacter* spp, *Acinetobacter* spp, *Schwanella* spp. Isolates were multi drug resistant and showed sensitivity to Cefoperazone-Sulbactam, Piperacillin-Tazobactam, Carbapenems and Colistin. Infections were more with male sex, prolonged catheterization, old age and diabetes. High incidence of CAUTI was found in the first 2 weeks of catheterization. The antimicrobial susceptibility pattern confirmed that most of the urinary isolates in our environment are resistant to the commonly used antibiotics.

Introduction

Catheter associated urinary tract infection is a leading cause of morbidity and mortality in hospitalized patients. When left in place for too long or used inappropriately, it is a hazard to the very patient that it is designed to protect.[17, 15]

According to 2009 International practice guidelines of Infectious Diseases Society of America, CA-UTI in patients with indwelling urethral, indwelling suprapubic, or intermittent catheterization is defined by the presence of symptoms or signs compatible with UTI with no other identified source of infection along with $\geq 10^3$ colony forming units (cfu/ml) of ≥ 1 bacterial species in a single catheter urine specimen or in a mid stream voided urine specimen from a patient whose urethral, suprapubic or condom catheter has been removed within the previous 48 hours.[10]

Patients in the Intensive care units are at high risk of device associated infection due to underlying conditions and impaired host defenses, surgery and invasive medical procedures[6].Indwelling urinary and central venous catheters are used commonly in the care of critically ill patients. Though important clinical benefits are provided by both types of devices, they are also the leading causes of nosocomial infection in the intensive care units[14]

UTI's were the third most common type of infection which occurs in ICU'S after pneumonia and lower respiratory tract infections. UTI's occurring in ICU's comprises 8% to 21% of all nosocomial infections. Because patients in ICU's require frequent and careful monitoring of intake and output and many of them use urinary catheter, the risk of UTI is significantly higher than in other patient populations[5]

Approximately 97% of UTI's in the ICU are associated with an indwelling urinary catheter. Because most patients admitted to ICU's have complications that are significant and are sicker than other patients, the effects of CA-UTI are more critical [5]

Patients in the intensive care unit are at a higher risk of device-associated infection, due to their impaired host defences, underlying conditions, surgery, and invasive medical procedures.[7] Central role in the pathogenesis of CAUTI is played by presence of a biofilm.[6] CAUTIs are cause for concern because catheter-associated bacteriuria comprises a huge reservoir of resistant pathogens in the hospital environment [6] and an important goal of health- care infection prevention programmes is prevention of infections attributable to these devices.[14]

CA-UTI are caused by a variety of pathogens, which includes Gram negative bacilli like *E. coli, Klebsiella spp, Pseudomonas aeruginosa.*

Up to 25% of patients who require a urinary catheter ≥ 7 days develop Nosocomial bacteriuria with a daily risk of 5%[15]. Bacteriuria develops at an average rate of 3% to 10% per day of catheterization.[4]Many of these microorganisms belong to the patient's endogenous bowel flora but they can also be acquired from other patients or hospital personnel by cross-contamination or by exposure to contaminated solutions or non-sterile equipment.[12]

CAUTIs are a cause of concern because catheter- associated bacteriuria comprises a huge reservoir of resistant pathogens in the hospital environment.[7] The epidemiology, frequency, microbiological spectrum and antimicrobial resistance patterns of microorganisms causing Device-Associated Infections vary among institutions and can change yearly. Multidrug resistant pathogen infection are on the rise, which further complicates the management of these infections.[6] Documented phenomena include the emergence of extended spectrum beta lactamase producing *E. coli.*[4]

In healthy patients CA-UTI is often asymptomatic and is likely to resolve spontaneously with removal of the catheter. Infection persists occasionally and leads to complications such as prostatitis, epididymitis, cystitis, pyelonephritis and gram negative bacteremia particularly in high risk patients. The last complication is serious since it is associated with a significant mortality but fortunately occurs in less than 1% of catheterized patient's.[12]CA-UTI is the second most common cause of nosocomial blood stream infection.[13]

The vast majority of nosocomial UTIs occur in patients whose urinary tracts are currently

or recently catheterized. The duration of catheterization is the most important risk factor for the development of CA-bacteriuria. Other risk factors for CA-bacteriuria include the lack of systemic antimicrobial therapy, female sex, meatal colonization with uropathogens, microbial colonization of the drainage bag, catheter insertion outside the operating room, catheter care violations like improper position of the drainage tube (above the level of the bladder or sagging below the level of collection bag), absence of use of a drip chamber, rapidly fatal underlying illness, older age, diabetes and elevated serum creatinine at the time of catheterization.[9, 15]

Most episodes of bacteriuria in short term catheterized patients are caused by single organisms, mostly *E. coli* and *Klebsiella* spp. *E coli* cause most of the infections

Biofilm formation by uropathogens like *Klebsilla pneumoniae* is favoured by presence of indwelling urinary catheters by providing an inert surface for the attachment of bacterial adhesins, which enhances colonization by microbes and helps in the development of biofilm. Attachment of biofilms to catheters is initiated by adhesins, for example, fimbriae, located on the bacterial surface. The best understood *K. pneumoniae* fimbrial types that are also the most frequently encoded are fimbriae type 1 fimbriae and type 3 fimbriae. Type 1 fimbriae are encoded by the majority of *Enterobactericeae* and it was established that type 1 fimbriae are essential for the ability of *K. pneumoniae* to cause urinary tract infections.[8]

The virulence of *Pseudomonas aeruginosa* is multifactorial and the cell associated factors responsible for its virulence are alginate, lipopolysaccharide, flagellum, pilus, non-pilus adhesions, exoenzymes and secretory virulence factors like elastase, protease, phospolipase, pyocyanin, exozyme S, exotoxin A, hemolysins and siderophores. *Pseudomonas* also shows tendency to form biofilms on the surface of urinary catheters in addition to these virulence factors.[13]

The risk of UTI increase with duration of catheterization and the Acute Nosocomial UTI is usually asymptomatic[7]

CA-UTI induced signs and symptoms include new onset of worsening of fever, rigors, malaise or lethargy, with no other identified cause, altered mental status, flank pain, tenderness of the costo- vertebral angle, acute hematuria, pelvic discomfort, and dysuria, urgent or frequent urination, or suprapubic pain or tenderness in those whose catheters have been removed.[10] In patients with spinal cord injury (SCI), increased spasticity, autonomic dysreflexia or sense of unease are also compatible with CA-UTI.[9]

Although recommendations have been made to treat CAUTI's only when they are symptomatic. The CAUTI associated symptoms have not been clearly defined and unrelated to CAUTI, the presence of an indwelling urinary catheter alone can cause dysuria or urgency.[16]

Materials and Methods

On approval from ethical committee, in our study 100 in-patients of Intensive care units were analysed for a period of 1 year from December 2012 to November 2013 in Microbiology department at Sree Gokulam Medical College and Research Foundation.

The sample included admitted Patients with indwelling catheter of either sex and above 19 years of age of all intensive care units of Sree Gokulam Medical College and Research Foundation. The samples of Patients with confirmed urinary tract infection before catheterization, patients whose lab culture

reported as mixed flora' Urinary catheter tips' Urine from catheter bags were excluded.

Samples of urine after insertion of catheters will be collected aseptically within 2 hours from the time of insertion for baseline urine cultures and microscopic examination. Thereafter urine cultures and urine analysis will be done on the 3rd day, 5th day, 7th, until Catheter is removed or significant bacteriuria occurred on two consecutive cultures or patient is discharged, whichever comes early. Minimum three samples will be collected from each individual. Urine samples will be collected by aspirating urine from the Foley's catheter with sterile syringe with gauge 26 needle after disinfecting the catheter with 70% alcohol.

The samples are transported to the Microbiology laboratory immediately. If there is a delay of >2 hours, sample is refrigerated at $4^{o}C$[9]. Wet film microscopy and urine cultures will be done.

A colony count of $\geq 10^3$ CFU/ml is considered positive. All the isolates were identified by standard procedures and biochemical tests and antimicrobial susceptibility test was done for pathogens isolated, by Kirby-Bauer disc diffusion technique.

The antibiotic discs used were from Himedia and the discs used were Ampicillin (10µg) Amoxyclav (20/30µg), Cephalexin (30µg), Cefuroxime (30µg), Ceftazidime (30µg), Cefotaxime (30µg), Cefipime (30µg), Gentamicin 10µg), Netilmicin (30µg), Amikacin (30µg), Cotrimoxazole (1.24/23.75µg) Nitrofurantoin (300µg), Ciprofloxacin (5µg), Norfloxacin (10µg), Ofloxacin (10µg), Tetracycline (30µg), Piperacillin (100µg), Aztreonam (30µg), Cefoperazone Sulbactam, Piperacillin Tazobactam (100/10µg), Imipemen (10µg), Meropenem (10µg) Colistin (10µg), Cefoxitin. The antibiotic susceptibility was interpreted as sensitive, intermediate or resistant by comparing the observed zone of inhibition of the test organisms to the required zone size for the Standard strains as per CLSI Guidelines.

Results and Discussion

The results obtained are as follows:

Out of 100 samples collected, 56 samples were collected from MICU, 24 from SICU, 12 from NSICU, 7 from POICU and 1 from CCU respectively.

Total numbers of samples collected in the study were 100. Among them 45 samples were from male patients and 55 samples were from female patients.

Among 100 samples collected 26 samples were culture positive showing growth, 74 samples were culture negative showing no growth.

Total number of patients catheterized for one week were 43, and the growth observed among this 43 was 3.Total number of patients who were catheterized for upto two weeks was 36, among the 36 growth observed was 6. Out of the 15 patients catheterized for up to 3 weeks growth observed was 11 and 6 patients catheterized for ≥ 4 weeks all of them developed CA-UTI.

Out of the 26 culture positive samples, 15(57%) were from MICU, 4(15%) were from SICU, 3 (11%) were from NSICU, 2 (7%) were from POICU and CCU. The highest percentage of growth was found in Medical ICU.

Out of 45 samples collected from males 18 (40%) were culture positive. Out of the 55 samples collected from females 8 (14.5%) were culture positive.

Out of the 26 gram negative bacilli isolated, 11 (42.3%) were *E. coli*, 5 (19.2%) were *Klebsiella pneumoniae*, 5 (19.2%) were *Pseudomonas aeruginosa*, 2 (7.7%) were *Citrobacter freundi* and 1 (3.8%) each of *Enterobacter cloacae, Acinetobacter spp, Schewanella algae* respectively.

Percentage of *E. coli* isolated in our study was18.3%. *E. coli* showed highest rate of sensitivity to Imipenem (100%), lowest rate of sensitivity to Cephalosporins (27.3%) and Ampicillin (27.3%), and moderate rate of sensitivity to Aminoglycosides [Ak (63.6%), Gen (45.5%), Net (45.5%) respectively] and Fluoroquinolones (36.4%). About 54.5% were sensitive to Tetracycline and 72.7% were sensitive to Cefoperazone –Sulbactam and Piperacillin –Tazobactam.

Klebsiella Spp showed 100% sensitivity to Imipenem, Meropenem, Cefoperazone Sulbactam, and Piperacillin- Tazobactam. None were sensitive to Ampicillin (0%). It showed 40% sensitivity to Piperacillin, Amoxycillin-Clavalunic acid, Cephlexin, Cefuroxime, Ceftazidime, Cefotaxime, Cefipime, Aztreonam and Nitrofurantoin. Sensitivity to Tetracycline and Cotrimoxazole were 60%. Only 20% were sensitive to Fluoroquinolones.

The next predominant pathogen *Citrobacter freundi* isolated were 2 in number (3.3%), *Citrobacter freundii* isolated showed 100% resistance to Ampicillin, Amoxycillin-Clavalunic acid, Cephalexin and Cefuroxime. 50 % sensitivity was observed towards Cefotaxim, Ceftazidime and Cefipime, Aztreonam, Aminoglycosides and Fluoroquinolones and Tetracycline. No resistance was shown to Cefoxitine, and it was found to be 100% sensitive to Nitrofurantoin, Cotrimoxazole, Cefoperazone-Sulbactam, Piperacillin-Tazobactam, Imipenem, Meropenem.

Pseudomonas isolated showed 100% resistance to Piperacillin, Ceftazidime and Cefipime. It also showed 100% resistance to Fluoroquinolones and Aminoglycosides like Netilmycin and Amikacin, 40% of Pseudomonas was sensitive to Tobramycin and Piperacillin-Tazobactam (40%). 100% sensitive to Aztreonam, Imipenem, Meropenem and Colistin.

Only one *Acinetobacter* was isolated, It was a multidrug resistant strain, It showed complete resistance to all tested antibiotics except to Aztreonam, Imipenem, Meropenem and Colistin.

Among the 26 uropathogens only one *Enterobacter cloacae* was isolated. The isolate was sensitive to Nitrofurantoin, Cotrimoxazole, Tetracycline, Fluoroquinolones, Aminoglycosides, Piperacillin-Tazobactam, Cefoperazone-Sulbactam, and Carbapenems.

Lastly among the Gram negative bacilli one rare uropathogen *Schewanella algae* (1) was isolated. It was found to be sensitive to Nitrofurantoin, Cotrimoxazole, Ceftazadime, Tetracycline, Fluoroquinolones, Aminoglycosides, Piperacillin. Piperacillin-Tazobactam, Cefoperazone-Sulbactam, and Carbapenems.

In our study the percentage of ESBL among the *E. coli* was 36.4% and in *Klebsiella, Citrobacter* and they were 75%, and 50% respectively. No ESBL production was observed in *Enterobacter* Amp C production for *E. coli*, was 18.2%, whereas there was no Amp C production in *Klebsiella* and *Citrobacter.*

Urinary tract infections (UTIs) are commonly acquired in hospitals, representing 30% -40% of all nosocomial infections with an estimated prevalence of 1% to 10%.[12].Catheter-

associated urinary tract infections is the most common nosocomial infection and accounts for bacteremia in 2 to 4% of patients and the case fatality associated with it is three times as high as nonbacteriuric patients.[15] All age groups are affected by UTI and are diagnosed in both outpatients and hospitalized patients. It causes a serious burden on the socio economic life of individuals and leads to consumption of large population of all antibacterial drugs used in the world[6]. Among catheterized patients the reported incidence of CAUTI ranges from as low as 5% to as high as 73%.[4] In the present study, out of 100 cases studied, 26 % developed CAUTI and high incidence of CAUTI was found in the first two weeks of catheterization. This result is comparable with that of a study by Danchaivijitr *et al.,* [7]where one hundred and one patients met the inclusion criteria and the incidence of CAUTI was 73.3% and high incidence of CAUTI was found in the first two weeks of catheterization. None of the episodes of CAUTI in our study was associated with nosocomial bacteremia and prolonged catheterization was identified as a risk factor in the present study, also similar to the study by Danchaivijitr *et al.,*[7]

In most of the Indian studies and studies from abroad the most common organism was *E. coli*. [10, 11, 3] The major uropathogen isolated in our study was *E. coli* [18.3%]. This is in agreement with study by Danchaivijitr *et al.,* [3] in 101 catheterized patients where *E. coli* (15.1%) isolated. Whereas in an Indian study conducted by Manish *et al.,* [10] in 100 adult patients with an indwelling Foleys catheter the most common organism colonizing and causing catheter associated urinary tract infection was found to be *E. coli* (57%).

The percentage of *Pseudomonas aeruginosa* isolated in the present study was 8.3%. Other studies isolated *Pseudomonas aeruginosa* in the range of 2% [16] to 20.6%[11], whereas in a study by Dutta *et al.,* the commonest organism causing CAUTI was identified as *Pseudomonas aeruginosa*.

Klebsiella pneumoniae (8.3%), *Citrobacter freundii* (3.3%), *Acinetobacter* (1.7%) spp, *Enterobacter cloacae* (1.7%), *Shewanella algae* (1.7%) were the other uropathogens isolated in that order in our study.

Contrary to other studies in which CAUTI was prevalent in females in our study CAUTI was more prevalent in men. Out of 45 samples collected from males 18(40%) were culture positive. Out of the 55 samples collected from females 8 (14.5%) were culture positive.

Bacteria, which exist as a biofilm inside catheters, show higher antimicrobial resistance when compared to non-CAUTI pathogens[6]. In the present study *E. coli* showed highest rate of sensitivity to Imipenem (100%), lowest rate of sensitivity to Cephalosporins(27.3%) and Ampicillin(27.3%), and moderate rate of sensitivity to Aminoglycosides [Ak (63.6%), Gen (45.5%), Net (45.5%) respectively] and Fluoroquinolones (36.4%). About 54.5% were sensitive to Tetracycline and 72.7% were sensitive to Cefoperazone–Sulbactam and Piperacillin–Tazobactam.

Klebsiella pneumoniae isolated in our study is 8.3%. The other less predominant pathogens isolated in our study were *Citrobacter freundi* (3.3%), *Acinetobacter* spp (1.7%), *Enterobacter cloacae* (1.7%) and *Shewanella alga* (1.7%).

In our study out of the lesser common pathogens isolated *Citrobacter freundii* was 3.3% that is out of the 60 uropathogens only 2 were *Citrobacter freundii*. A similar observation was found in a study by Aravind *et al.,* [66] regarding device associated infections in which 1 *Citobacter freundii* was isolated among the five uropathogens causing CAUTI.[19] In our study *C. freundii* showed

100% resistance to Amoicillin, Amoxycillin-Clavalunic acid, Cephalosporins and 100% sensitivity to Nitrofurantoin, Cotrimoxazole, Cefoperazone-Sulbactam, Piperacillin-Tazobactam, Imipenem and Meropenem, We could not compare the sensitivity pattern with as other studies which reported their sensitivity pattern were rare. In our study out of the sixty uropathogens isolated only one *Acinetobacter* was isolated, It was a multidrug resistant strain and it showed resistance to Cephalosporins, Fluoroquinolones, Aminoglycosides, Piperacillin, Aztreonam and Piperacillin-Tazobactam whereas it showed sensitivity to Imipenem, Meropenem and Colistin. Similar to our study only 1% *Acinetobacter* was isolated in a study by Chaudhary *et al.,* and it was a strain sensitive to Amikacin alone.[10]

The rare pathogen isolated in our study i.e. *Shewanella alage,* which was a sensitive strain showing sensitivity to all the antibiotics used in the study. In our study among Gram negative fermenters the highest number of ESBL and Amp C producers belonged to *E. coli* (ESBL: 36.4%, AmpC: 18.2% followed by *Klebsiella* (ESBL: 75%, AmpC: 0%). Patil *et al.,* in his study observed that the percentage of ESBL production in *E. coli* causing UTI in patients with indwelling catheter was 20.68% and in *Klebsiella* it was 43.75%.[20] Several studies have reported the incidence of ESBL among pathogens causing urinary tract infections and it ranges from 34.8% to 64.2%[21, 22, 23] According to a study conducted by Talaat *et al.,* on surveillance of catheter-associated urinary tract infections in 4 intensive care units at Alexandra university hospitals in Egypt, The prevalence of ESBL producers among *K. pneumoniae* and *E. coli* isolates was 56% and 78.6% respectively (Table 1-10).

Table.1 Number of samples obtained from the various ICU's

I.C.U	NUMBER OF SAMPLES
MICU	56
SICU	24
NSICU	12
POICU	7
CCU	1
TOTAL	100

Table.2 Sex wise distribution

Number of males	45
Number of females	55
Total	100

Table.3 Samples showing growth

CULTURE POSITIVE	26
CULTURE NEGATIVE	74
TOTAL	100

Table.4 Association between the duration of catheterization and catheter- associated urinary tract infection

Duration of Catheterization	Total no: of patients catheterized	Growth seen
1 week	43	3
2 week	36	6
3 week	15	11
≥4 week	6	6

Pearson ChiSquare value: 32.47, p value< 0.001

Table.5 Percentage prevalence of catheter-associated urinary tract infections in the various ICUs of a tertiary care hospital

ICU	CULTURE POSITIVE [%]
MICU	15(57%)
SICU	4(15%)
NSICU	3(11%)
POICU	2(7%)
CCU	2(7%)
TOTAL	26

Table.6 Sex wise distribution of positive cultures

SEX	CULTURE NEGATIVE	CULTURE POSITIVE
	No: (%)	No: (%)
MALES	27(60%)	18 (40)
FEMALES	47(85.5%)	8 (14.5)

Pearson Chi Square value: 4.209, $p < 0.05$

Table.7 Gram negative bacilli isolated

GNB	Number[%]
E. coli	11(42.3%)
Klebsiella spp	5(19.2%)
Citrobacter freundi	2(7.7%)
Enterobacter cloacae	1(3.8%)
P. aeruginosa	5(19.2%)
Acinetobacter spp	1(3.8%)
Schewanella algae	1(3.8%)
TOTAL	26

Table.8 Antibiotic susceptibility pattern *of E. coli, Klebsiella pneumoniae* and *Citrobacter freundii*

	Escherichia coli (n=11)		*Klebsiella pneumoniae* (n=5)		*C.freundii* (n=2)	
Antibiotics	S	R	S	R	S	R
AMP	3(27.3%)	8(72.7%)	0 (0%)	5(100%)	0(0%)	2(100%)
PP	3(27.3%)	8(72.7%)	2 (40%)	3 (60%)	1(50%)	1(50%)
AMC	3(27.3%)	8(72.7%)	2 (40%)	3 (60%)	0(0%)	2(100%)
CEPH	3(27.3%)	8(72.7%)	2 (40%)	3 (60%)	0(0%)	2(100%)
CXM	3(27.3%)	8(72.7%)	2 (40%)	3 (60%)	0(0%)	2(100%)
CTX	3(27.3%)	8(72.7%)	2 (40%)	3 (60%)	1(50%)	1(50%)
CAZ	3(27.3%)	8(72.7%)	2 (40%)	3 (60%)	1(50%)	1(50%)
CPM	6(54.5%)	5(45.5%)	2 (40%)	3 (60%)	1(50%)	1(50%)
CX	8(72.7%)	3(27.3%)	5 (100%)	0 (0%)	0(0%)	2(100%)
AT	7(63.6%)	4(36.4%)	2 (40%)	3 (60%)	1(50%)	1(50%)
GEN	5(45.5%)	6(54.5%)	1(20%)	4(80%)	1(50%)	1(50%)
NET	5(45.5%)	6(54.5%)	3(60%)	2(40%)	1(50%)	1(50%)
AK	7(63.6%)	4(36.4%)	3(60%)	2(40%)	1(50%)	1(50%)
NX	4(36.4%)	7(63.6%)	1(20%)	4(80%)	1(50%)	1(50%)
CIP	4(36.4%)	7(63.6%)	1(20%)	4(80%)	1(50%)	1(50%)
OF	4(36.4%)	7(63.6%)	1(20%)	4(80%)	1(50%)	1(50%)
NITRO	6(54.5%)	5(45.5%)	2 (40%)	3 (60%)	2(100%)	0(0%)
COT	6(54.5%)	5(45.5%)	3(60%)	2(40%)	2(100%)	0(0%)
T	6(54.5%)	5(45.5%)	3(60%)	2(40%)	1(50%)	1(50%)
CS	8(72.7%)	3(27.3%)	5(100%)	0(0%)	2(100%)	0(0%)
PT	8(72.7%)	3(27.3%)	5(100%)	0(0%)	2(100%)	0(0%)
MRP	11(100%)	0 (0%)	5(100%)	0(0%)	2(100%)	0(0%)
IMP	11(100%)	0(0%)	5(100%)	0(0%)	2(100%)	0(0%)

Table.9 Percentage of ESBL and AMPc among Enterobactericiae in the various ICU's

GNB	No: isolated	ESBL	AmpC
		NO: (%)	NO:(%)
E. coli	11(18.3%)	4(36.4%)	2(18.2%)
Klebsiella	5(8.3%)	3(75%)	0(0%)
Citrobacter	2(3.3%)	1(50%)	0 (0%)
Enterobacter	1(1.7%)	0(0%)	0(0%)

Table.10 Antibiotic susceptibility pattern of *Pseudomonas aeruginosa* and *Acinetobacter* species isolated

	Pseudomonas aeruginosa (n=5)		*Acinetobacter spp. (n=1)*	
Antibiotics	S	R	S	R
PP	0(0%)	5(100%)	0 (0%)	1(100%)
CAZ	0(0%)	5(100%)	0(0%)	1(100%)
CPM	0(0%)	5 (100%)	0(0%)	1(100%)
GEN	0(0%)	5(100%)	0(0%)	1(100%)
TOB	2(40%)	3(60%)	0(0%)	1(100%)
NET	0(0%)	5(100%)	0(0%)	1(100%)
AK	0(0%)	5(100%)	0(0%)	1(100%)
CIP	0(0%)	5(100%)	0(0%)	1(100%)
NOR	0(0%)	5(100%)	0(0%)	1(100%)
OF	0(0%)	5(100%)	0(0%)	1(100%)
CS	____	____	1(100%)	0(0%)
PT	2(40%)	3(60%)	0(0%)	1(100%)
AT	5(100%)	0(0%)	1(100%)	0(0%)
IMP	5(100%)	0(0%)	1(100%)	0(0%)
MRP	5(100%)	0(0%)	1(100%)	0(0%)
CL	5(100%)	0(0%)	1(100%)	0(0%)
TIGE	____	____	1(100%)	0(0%)

In conclusion, all health care associated UTI are caused by instrumentation of the urinary tract. The incidence of CAUTI in the present study was 26%.The incidence was more in males and risk factors identified were prolonged catheterisation, old age and diabetes mellitus.

High incidence of CAUTI was found in the first 2 weeks of catheterisation. Longer duration of catheterization increases the chances of CAUTI.

The most common organism associated was *E. coli* [18.3%] and *Pseudomonas aeruginosa* [8.3%], *Klebsiella* spp (8.3%). Hospital acquired CAUTI is often due to multi drug resistant strains which require higher antibiotics and these strains may spread to other patients. Gram negative organism showed high degree of sensitivity to Cefoperazone-Sulbactam, Piperacillin-Tazobactam, Carbapenems, and Colistin whereas high resistance was observed for Ampicillin, Amoxycillin-Clavalunic acid, Cephalosporins, Aminoglycosides and Fluoroquinolones and moderate sensitivity was observed for Nitrofurantoin, Cotrimoxazole and Tetracyclines. The antimicrobial susceptibility pattern confirmed that most of the urinary isolates in our environment are resistant to the commonly used antibiotics including cephalosporins and fluoroquinolones. Effective infection prevention measures should be in place to reduce the prevalence of nosocomial UTIs. Better management of urinary catheter is to be explored and implemented.

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