IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A Study On Catheter-Associated Urinary Tract Infections In Anaesthesia Intensive Care Units In A Tertiary Care Hospital.

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ABSTRACT

Background: UTIs are prevalent around the world and represent approximately 40% of hospital-acquired infection. Catheter acquired urinary tract infection is one of the most common health care acquired infections reported to the National Healthcare Safety Network (NHSN). CAUTI can range from asymptomatic bacteraemia urinary tract infection to symptomatic urinary tract infection.

Material and methods:

***Study design*:** A prospective hospital-based study was carried out in the Department of Microbiology in collaboration with Department of Anaesthesia at Dr. Rajendra Prasad Government Medical College, Kangra at Tanda (H.P.)

Study duration: The study was conducted for a period of 12 months with effect from September 2021 to August 2022.

Results: **Distribution of pathogens and contaminants on culture of urine samples:** Out of all the 100 samples of urine, 52 samples were sterile and 41 yielded pathogenic growth. In 7 samples, contaminants were obtained. Out of the 41 urine samples which yielded pathogenic organisms, a total of 48 organisms were isolated. Out of these 48 organisms, 33 (68.75%) were Gram negative bacteria and 11 (22.9%) were Gram positive bacteria and 4 (8.3%) samples yielded yeast. Most common Gram-negative isolate obtained from urine samples was *Klebsiella pneumoniae* which was isolated in 9 (27.27%) samples followed by *Acinetobacter baumannii* which was isolated in 9 (27.27%) samples and *Escherichia coli* was isolated from 6 (18.18%) samples.

Conclusion: Early detection of the bacterial isolates leading to catheter-associated Urinary Tract infections along with their antimicrobial susceptibility pattern will help in framing policies.

INTRODUCTION

Catheter acquired urinary tract infection is one of the most common health care acquired infections reported to the National Healthcare Safety Network (NHSN). Urinary tract infections (UTI) affects about 150 million individuals annually worldwide.[1]UTIs are prevalent around the world and represent approximately 40% of hospital-acquired infections.[2,3]

Catheter-associated urinary tract infections (CAUTI) has been defined as an Urinary Tract Infection (UTI) where an indwelling urinary catheter was in place for >2 calendar days on the date of the event, with the day of device placement being Day 1, and an indwelling urinary catheter was in place on the date of an event or the day before.[4]

Approximately 12%-16% of adult hospital in patients will have an indwelling urinary catheter (IUC) at some time during their hospitalization, and each day the indwelling urinary catheter remains, a patient has a 3% - 7% increased risk of acquiring a catheter-associated urinary tract infection (CAUTI).[5] Risk factors for CAUTI include age, female gender, diabetes, and prolonged catheterization time.[6]

The study of device associated healthcare associated infections (DA-HAI) in the intensive care units (ICU) forms an important aspect in the prevention of healthcare-associated infections.

Device associated healthcare associated infections (DA-HAI) can easily be tackled with the right knowledge and proper preventive measures. By identifying the cause, the rates of infections, their microbiological profile and antibiotic sensitivity, an almost accurate picture and overall analysis of these infections can be obtained. Infection control practitioners can utilize this data and devise effective strategies to prevent the spread of device associated infections in hospitals. Thereby, reducing the burden on patients and improving the health standards in general.[7]

MATERIAL AND METHODS

***Study design*:**

A prospective hospital-based study was carried out in the Department of Microbiology in collaboration with Department of Anaesthesia at Dr. Rajendra Prasad Government Medical College, Kangra at Tanda (H.P.)

Study duration:

The study was conducted for a period of 12 months with effect from September 2021 to August 2022. A total of 100 participants were included in study who were clinically suspected cases of device associated hospital acquired infections, admitted in Anaesthesia Intensive care units

***Inclusion criteria*:**

1. Patient admitted to Anaesthesia ICU for more than 48 hours.
2. Age above 18 years.
3. Patients who were willing to give consent.

***Exclusion criteria*:**

1. All patients with less than 48 hours stay in the intensive care unit.

2. Age 18 years.

3. Patients who were not willing to give consent.

After getting approval from institutional ethics committee, informed consent was taken from 100 patients that meet the requirements of inclusion criteria. . Patient details including demographic profile, clinical presentation, relevant past medical history with culture and antimicrobial susceptibility testing report was collected, organized, analysed and interpreted. Urine culture was done 48 hours after catheterization and when the patient had symptoms of fever, supra pubic pain, loin pain or change in colour of urine.

In suspected CAUTI cases – urine was aseptically aspirated from the sampling port of the catheter after sterilizing the port with 10% povidone iodine. Samples that were received were examined immediately and the cultures were inoculation into Mac Conkey and blood agar plates. Quantitative analysis for the growth and type of organisms were monitored at 24 – 48 hours. Cultures that showed no growth in 24 to 48 hours indicated absence of infection as sterile. Samples were processed according to the standard operative procedure. Antibiotic susceptibility testing was done using the Kirby-Bauer disk diffusion technique as per CLSI guidelines.[8]

RESULTS

1) **Distribution of patients on the basis of age: In the present study, the patient's age** ranged from 19 years to 95 years. The most common age group in which maximum patients were enrolled was more than 61 years with a count of 30 (30%) followed by 18-30 years of age with 23 (23%) patients. There were 17 (17%), 17(17%) and 13 (13%) patients of age 31-40 years, 51- 60 years and 41 – 50 years respectively. Mean age of all the participants was 48.93±18.68 years with youngest subject of age 19 years and oldest patient of age 95 years. (Table 1 and Figure 1)

Table 1: Distribution of patients on the basis of age

Age Group	Frequency (n)	Percentage (%)
18-30	23	23%
31-40	17	17%
41-50	13	13%
51-60	17	17%
More than 61	30	30%
Total	100	100%

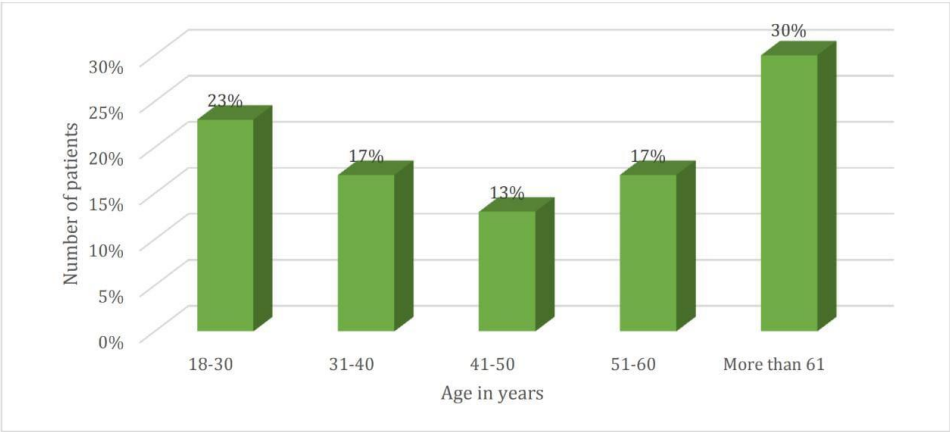

Figure 1: Distribution of patients on the basis of age

2) **Distribution of pathogens and contaminants on culture of urine samples:** Out of all the 100 samples of urine, 52 (52%) samples were sterile and 41 (41%) yielded pathogenic growth. In 7 (7%) samples, contaminants were obtained. (Table 2; Figure 2)

Table 2: Distribution of pathogens and contaminants on culture of urine samples

	Frequency (n)	Percentage (%)
Pathogens	41	41%
Sterile	52	52%
Contaminants	7	7%
Total	100	100%

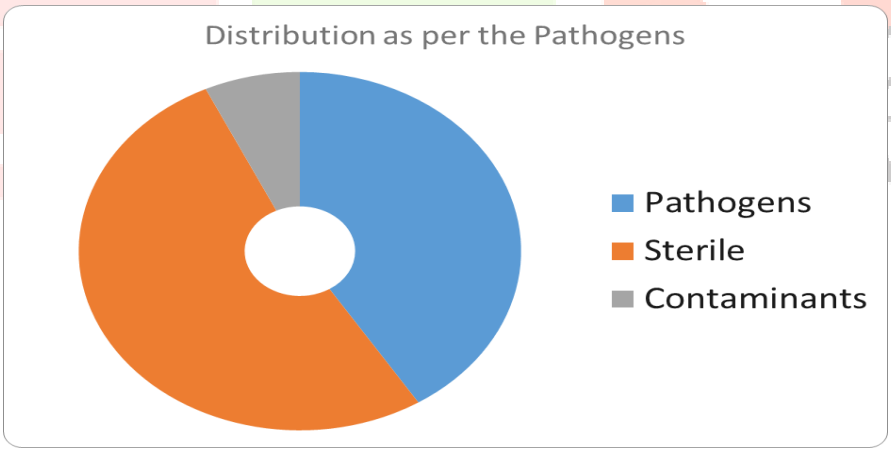

Figure 2: Distribution of pathogens and contaminants on culture of urine samples

3) Distribution of pathogens in urine samples:

Out of the 41 urine samples which yielded pathogenic organisms, a total of 48 organisms were isolated. Out of these 48 organisms, 33 (68.75%) were Gram negative bacteria and 11 (22.9%) were Gram positive bacteria and 4 (8.3%) samples yielded yeast. (Table3, Figure3)

Table 3: Distribution of pathogens in urine samples

Pathogenic organisms	Frequency (n=48)	Percentage (%)
Gram Positive	11	22.9%
Gram Negative	33	68.75%
Yeast	4	8.3%

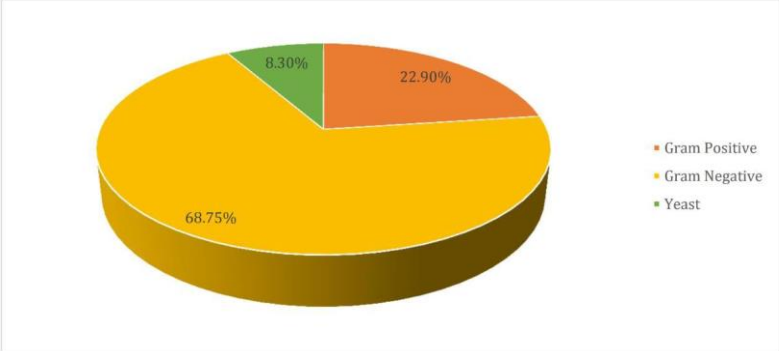

Figure 3: Distribution of pathogens in urine samples

4) Distribution of Gram-positive Isolates in suspected cases of Catheter-associated Urinary Tract Infections:

Most common Gram-positive organism isolated from urine sample was Methicillin Sensitive *Staphylococcus aureus* which was isolated in 4 (36.36%) samples followed by Coagulase negative *Staphylococcus* species in 3 (27.27%) and Methicillin Resistant *Staphylococcus aureus* in 2 (18.18%) samples. *Enterococcus faecalis* and *Enterococcus faecium* were isolated in 1 (9.09%) sample each.(Table 4; Figure 4)

Table 4: Distribution of Gram-positive Isolates in suspected cases of Catheter-associated Urinary Tract Infections

Gram Positive Isolates	Frequency (n =11)	Percentage (%)
MSSA	4	36.36%
CONS	3	27.27%
MRSA	2	18.18%
Enterococcus faecalis	1	9.09%
Enterococcus faecium	1	9.09%

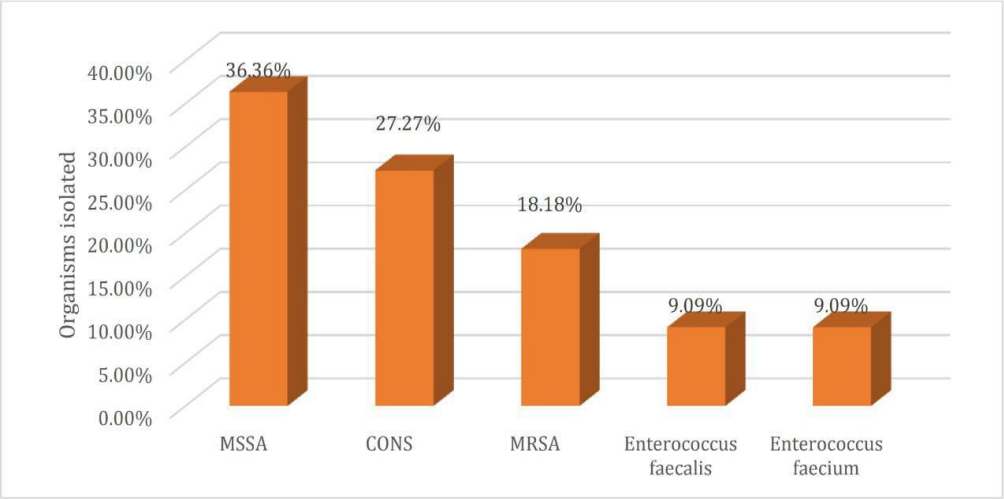

Figure 4: Distribution of Gram-positive Isolates in suspected cases of Catheter-associated Urinary Tract Infections

5) **Antimicrobial Susceptibility pattern of Gram positive organisms**: (Table 5)

Table 5: Gram positive bacteria

	PN	CD	ERY	CX	COT	NITRO	VAN	LIN
MSSA	25%	75%	75%	100%	100%	75%	100%	100%
MRSA	100%	0%	0%	0%	0%	0%	100%	100%
CONS	33%	66%	66%	66%	66%	100%	100%	100%

Among the 4 isolates of Methicillin Sensitive *Staphylococcus aureus* high resistance was seen for penicillin (PN) and good susceptibility was observed for other drugs. In comparison, Methicillin Resistant *Staphylococcus aureus* isolates showed high resistance to penicillin, clindamycin (CD), erythromycin (ERY), cephoxitin (CX), cotrimoxazole (COT) and nitrofurantoin (NITRO). All isolates of *Staphylococcus* spp. were sensitive for vancomycin (VAN) and linezolid (LIN).

Enterococcus faecalis was sensitive to nitrofurantoin, fosfomycin while *Enterococcus faecium* was sensitive to all drugs.

6) **Distribution of Gram-Negative Isolates in suspected cases of Catheter-associated Urinary Tract Infections**:

Most common Gram-negative isolate obtained from urine samples was *Klebsiella pneumoniae* which was isolated in 9 (27.27%) samples followed by *Acinetobacter baumannii* which was isolated in 9 (27.27%) samples and *Escherichia coli* was isolated from 6 (18.18%) samples. *Pseudomonas aeruginosa* were isolated from 4 (12.12%) samples while *Citrobacter freundii* were isolated from 2 samples. (Table 6; Figure 5)

Table 6: Distribution of Gram-Negative Isolates in suspected cases of Catheter-associated Urinary Tract Infections

Gram Negative Isolates	Frequency (n =33)	Percentage (%)
Klebsiella pneumoniae	9	27.27%
Escherichia coli	6	18.18%
Citrobacter freundii	2	6.06%
Proteus mirabilis	1	3.03%
Enterobacter aerogenes	1	3.03%
Enterobacter cloacae	1	3.03%
Acinetobacter baumannii	9	27.27%
Pseudomonas aeruginosa	4	12.12%

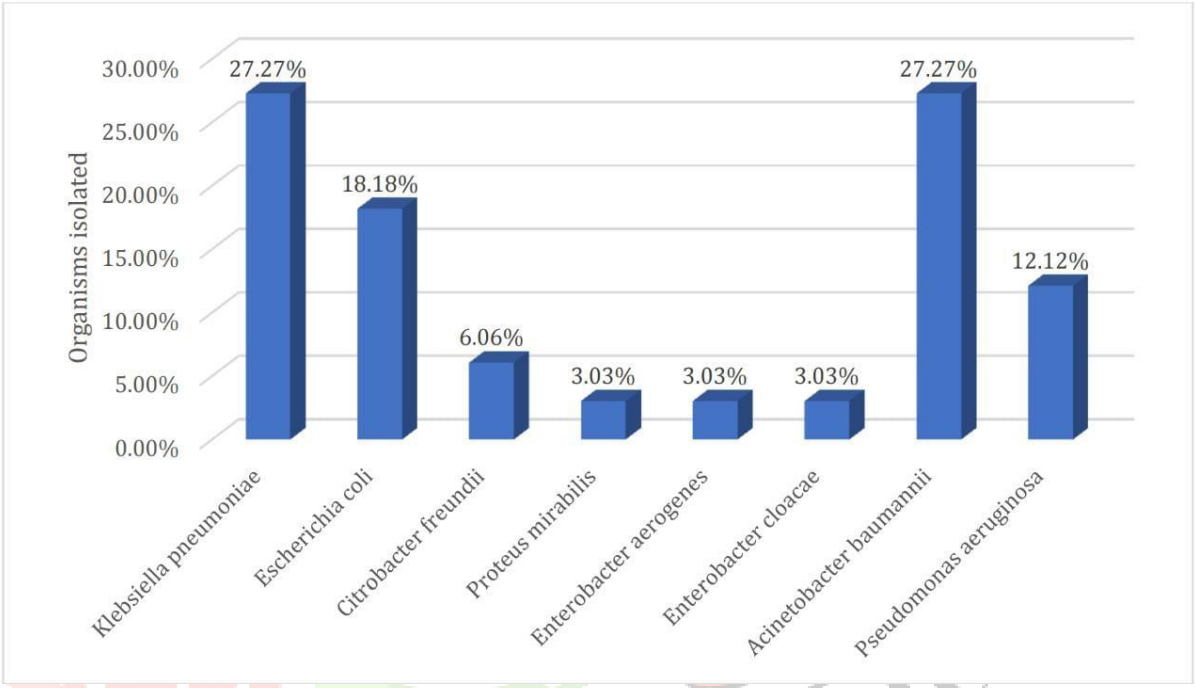

Figure 5: Distribution of Gram-Negative Isolates in suspected cases of Catheter-associated Urinary Tract Infections

7) Antimicrobial Susceptibility pattern of Gram Negative bacteria:

Among *Enterobacterales*, nine isolates of *Klebsiella pneumoniae* showed maximum sensitivity for ceftazidime (CAZ) and piperacillin / tazobactam (PIPTAZ). Out of 6 isolates of *Escherichia coli*, high sensitivity was seen for gentamicin (GEN). Most sensitive drugs were for nitrofurantoin (NITRO) and colistin (COL).

Among non-fermenters, *Acinetobacter baumannii* maximum sensitivity was for piptaz and imipenem (IMI). Among Pseudomonas aeruginosa isolates, maximum sensitivity was seen for doxycycline (DOXY), gentamicin, piperacillin / tazobactam. All isolates were sensitive to colistin.

(Table7)

Table 7: Antimicrobial Susceptibility pattern of Gram Negative bacteria

	CAZ	GEN	DOXY	PIPTAZ	IMI	COL
Citrobacter ferundii	100%	0%	100%	100%	50%	100%
Enterobacter	50%	50%	100%	50%	50%	100%
Escherichia coli	66%	100%	83%	83%	83%	100%
Klebsiella pneumonia	55%	44%	44%	55%	44%	100%
Proteus	0%	100%	100%	100%	100%	100%
Pseudomonas aeruginosa	75%	100%	75%	100%	75%	100%
Acinetobacter baumannii	11%	22%	44%	100%	75%	100%

8) Distribution of yeast isolates in suspected cases of Catheter-associated Urinary Tract Infections There were 4 yeasts isolated from the urine samples and out of them there were 2 samples each of Candida albicans and Non-albicans Candida. Candida albicans (two) isolates, both were sensitive to voriconazole and fluconazole while Non albicans Candida (two) isolates were both resistant to these drugs.(Table 8)

Table 8: Yeast isolates

Yeast isolates	Frequency (n=4)	Percentage(%)
Candida albicans	2	50%
Non albicans Candida	2	50%

9) DEVICE ASSOCIATED RATES:

Among 100 ICU admitted patients, at 1st 6 months of study. The CA-UTI rates were 16.83/1000 catheter days which reduced to 14.77 CA-UTI days after 6 months with awareness and training sessions with clinicians. Mean catheter associated urinary tract infection rate was 15.8 per 1000 catheter days. (Figure 6)

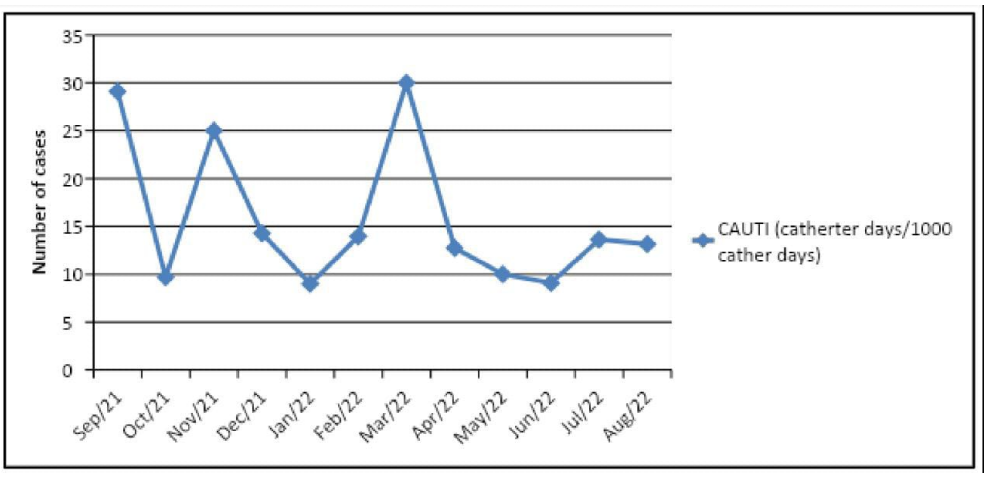

Figure 6: Monthly trend of CAUTI (catheter days/1000 catheter days)

DISCUSSION:

This is a prospective hospital-based study where, active DA-HAI surveillance study was conducted in the Anaesthesia Intensive Care Unit of a tertiary care hospital. The study was conducted in order to determine the rates of DA-HAIs and thus provide an outline for the infection control teams to identify the causes and come up with strategic measures to cut down the rates of infection in critical care units

We observed that there were 65 males and 35 females among the enrolled subjects with male to female ratio of 1.85:1. Similar results were observed by Iwuafor AA et al[11] and Sarvepalli A et al [12].

In our study, 68.75% of organisms causing CAUTI were Gram negative followed by 22.9% Gram positive organisms and 8.3% yeast.

In our study, most common Gram-negative isolate obtained from urine samples was *Klebsiella pneumoniae* which was isolated in 9 (27.27%) samples followed by *Acinetobacter baumannii* which was isolated in 8 (24.24%) samples. *Escherichia coli* was isolated from 6 (18.18%) samples and *Pseudomonas aeruginosa* was isolated from 4 (12.12%) samples. *Citrobacter freundii* were isolated from 2 (6.06%) samples. Guneysel OA[13] and Bagchi I[14] have also reported that Gram-negative bacteria such as *Escherichia coli, Klebsiella* spp., *Proteus mirabilis, Pseudomonas aeruginosa*, and *Citrobacter* spp. are the predominant isolates in urinary tract infections and among Gram positive bacteria, *Staphylococcus aureus* and *Enterococcus* species are the most common.

Hamishekar et al conducted a retrospective study in 2010- 2012, where Staphylococcus aureus was the most frequent pathogen among the Gram-positive organisms (39.7%).[15] Another study conducted by H. Guanche Garcell et al in Cuba reported *Klebsiella* spp (17.2%) as the most common pathogen isolated among ICU patients.[16]

In our study, 100% of isolates of MSSA isolated were sensitive to clindamycin, erythromycin, cefoxitin, cotrimoxazole, vancomycin, linezolid. However, 75% were resistant to penicillin and 75% were sensitive to nitrofurantoin. Regarding MRSA, 100% were resistant to penicillin, clindamycin, erythromycin, cefoxitin, cotrimoxazole and nitrofurantoin while 100% were sensitive to vancomycin and linezolid.

Al-Zoubi MS et al[17] observed that the MRSA strains showed high rates of susceptibility (>80%) to chloramphenicol, linezolid, nitrofurantoin, rifampicin and teicoplanin, but high resistance to erythromycin and penicillin. Brown DF also observed that MRSA was resistant to antibiotics such as methicillin, oxacillin, penicillin and amoxicillin[18].

In our study, 100% of Coagulase negative Staphylococcus species were sensitive to nitrofurantoin, vancomycin, linezolid while 66% were sensitive to clindamycin, erythromycin, cefoxitin and cotrimoxazole. Similarly, Al Tayyar IA et al[19] observed that CONS species showed high sensitivity to vancomycin (100%), linezolid (98.2%).

We observed that among Enterobacterales, in Klebsiella species, sensitivity for imipenem and gentamicin was 44%. All isolates were sensitive to colistin. Tunyong W et al[20] observed results with Enterobacterales being resistant to carbapenems (imipenem 82%) .

Escherichia Coli was least sensitive to ceftazidime (66%). A study by Eezzeldin HM observed that 71% of Escherichia Coli in urine samples were resistant to ceftazidime.[21]

Among non-fermenters, maximum resistance was seen in ceftazidime and gentamicin. All isolates were sensitive to colistin. Similar results have been reported by Gajdács M et al[22] where all the non-fermenters were sensitive to colistin while increased resistance was seen towards gentamicin (42%).

Resistance in these pathogens may arise due to intrinsic non-susceptibility mechanisms, they may be acquired (mutations or through plasmids) or they may develop during prolonged Discussion 107 therapy, which was initially effective[23-29]. Prolonged hospital stay facilitates cross transmission of multi drug resistant organisms. It is suggestive seeing their susceptibility rates that the least prescribed antibiotics are still good but need attention when introducing these drugs as we are running out of effective antibiotics to cure the most vulnerable patients. Colistin should be used as a reserved drug.

In our study, Catheter associated urinary tract infection rate was (CA-UTI) 15.8 per 1000 catheter days. It was comparable to study done by Ravi PR et al from Karnataka, which reported CA-UTI rate 18.95 per 1000 catheter days[30].

CONCLUSION:

The present study has given us knowledge about catheter-associated urinary tract infections and its rates in Anaesthesia intensive care unit. No such study has been previously conducted in our hospital. Study on catheter-associated Urinary Tract infections in Anaesthesia intensive care unit reflects the frequency of Hospital Acquired Infections present in the critical areas of our hospital. Early detection of the bacterial isolates leading to catheter-associated Urinary Tract infections along with their antimicrobial susceptibility pattern will help in framing policies. So, increased rates of hospital acquired infections in our hospital demands a careful and continuous microbiological surveillance. Also, regular continuing medical education with strengthened infection control practices will help to reduce different types of hospital acquired infections.

***Funding**: No funding sources*

***Conflict of interest**: None declared.*

***Ethical approval**: The study was approved by the institutional ethics committee*.

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