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BIOFILM FORMING PROPERTY & ANTIMICROBIAL SUSCEPTIBILITY PATTERN OF UROPATHOGENS CAUSING CATHETER ASSOCIATED URINARY TRACT INFECTION (CAUTI)

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ABSTRACT

Introduction: Catheter Associated Urinary Tract Infection (CAUTI), a common healthcare-associated infection, is difficult to manage for biofilm producing microorganisms and this property is also predisposing by nature of devise material. Moreover, multi-drugs resistance uropathogens are one of the challenging problem in healthcare facility.

Aims and Objectives: Evaluation of biofilm forming properties and antimicrobial susceptibility of uropathogenic microorganisms isolated from cases of CAUTI in Latex rubber Foley's catheters and Silicone-coated Foley's catheter.

Materials and Methods: Aseptically collected Urine samples of 116 individuals qualified as CAUTI were investigated to obtain uropathogenic bacteria. Their biofilm forming properties & antimicrobial resistance patterns were also evaluated. The different biofilm forming properties of uropathogens in Latex rubber Foley's catheter and Silicone-coated rubber Foley's catheter was also analysed.

Results: During study period, 116 patients were labelled as CAUTIs and total CAUTI rate per thousand urinary catheter days was 5.7. A total of 116 bacteria were isolated from the CAUTI patients with *Escherichia coli* being the most frequent isolate 35%, followed by *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, *Enterococcus faecalis* and other Gram negative organisms. Out of 116 isolates, 56% of bacteria were found to produce biofilms. Of these, 43% were strong biofilm producers and 13% observed as moderate biofilm producers. Majority of uropathogens were found to be resistance to most of the antibiotics had been tested.

Conclusion: *Enterobacteriaceae* were the most common isolates and the biofilm producing isolates were observed more resistant to antimicrobials agents. Most of the Gram negative isolates were multi-drugs resistant organisms (MDRO). Using Silicone-coated Foley's catheter can not only delay the onset of Catheter Associated Urinary Tract Infection but also have lesser proportion of biofilm producing bacteria with lower chance of multi-drugs resistant organisms (MDRO) thereby ensuring better curative treatment for the patient.

KEYWORDS: CAUTI, Biofilm, Uroparhogens, Antimicrobial resistance.

INTRODUCTION

Urinary tract infection is one of the leading causes of morbidity and also most common Health Care Associated Infection world over. It was estimated as 25-40% of Health Care Associated Infections and were associated with urinary catheter and labeled as Catheter Associated Urinary Tract Infections (CAUTIs)[1]. The daily risk of infection associated with indwelling catheter is 3-5%.[1] The highest percentage of CAUTIs is caused by Gram-negative bacteria 48%. Biofilm matrix ensures better protection for uropathogens from antimicrobial agents and host defense. Therefore, the patients with indwelling catheter are difficult to treat. There is sparse literature in India on this subject of biofilm producing capabilities of organisms causing CAUTIs. This study aims to compare the biofilm forming property in the uropathogens isolated from case of CAUTI in patient catheterized with natural rubber latex catheter and silicone-coated catheter and also compares differences in antimicrobial susceptibility pattern if any.

MATERIALS AND METHODS

This cross sectional analytic study was carried out at Department of Microbiology and urine samples were collected from tertiary care centre, over a period of eighteen months with the aim to compare biofilm forming property and antimicrobial susceptibility pattern of uropathogens causing catheter associated urinary tract infection in two different types of catheter as per definition given below.[2]

Criteria for Catheter Associated Urinary Tract Infection (CAUTI)

1. Adult patients with an indwelling urinary catheter in place for more than 48 hours
2. And at least one of signs and symptoms : new onset of fever (>38ºC) or suprapubic tenderness or costovertebral angle pain or tenderness
3. And bedside test and microscopy (at least one): positive nitrate test, pyuria (urine specimen with ≥10 white blood cells/mm^3 unspun urine or >5 WBC/high power field spun urine)
4. And positive urine culture of $\geq 10^3$ CFU/ml with no more than 2 species of microorganisms

Urine samples from catheterized patients were collected in universal sterile containers from catheters under aseptic condition. If the catheter had been removed, the early morning clean-catch midstream urine samples were collected after briefing individuals about collection procedure. All specimens received were processed within one hour of receiving the sample as per standard protocol for urine sample processing. Identification of organism and detection of their antimicrobial susceptibility pattern were identified as per Standard microbiology procedure. Zone size of inhibition for each antibiotic was interpreted according to CLSI: M100S Performance Standards for Antimicrobial Susceptibility Testing: Twenty Eighth Edition and the organisms were reported as susceptible, intermediate, or resistant to the agents tested.[3]

Modified Tissue Culture Plate Method (Modified Christensen's) was used to detect biofilms and optical density value interpretations of biofilm producing properties of microorganisms were as shown in table-1.[4] Quality control strains were also used in every test run: *Escherichia coli* (ATCC 35218) and *Pseudomonas aeruginosa* (ATCC 27853) as positive control (Biofilm producer) and *Staphylococcus epidermidis* (ATCC 12228) as negative control (Biofilm non-producer).

The values for various statistical parameters like mean, standard deviation and coefficient of correlation were calculated using SPSS version 20.2 software. Analytical data was analysed using Chi-square & student't' test for various parametric variables and coefficient of correlation was calculated by applying Person's formula.

RESULTS

During eighteen months study period, (116) patients were labelled as CAUTIs. Fifty-eight individuals were participated in each group of catheters with the mean age of Latex rubber Foley's catheter group was (43.98) years and Silicone-coated Foley's catheter group was (59.53) years. Almost (63%) of study population were male and (37%) were female patients. Total CAUTI rate per thousand urinary catheter days was (5.7) with (7.9) in Latex catheter group and (4.4) in Silicone-coated catheter group (Table – 2). The mean duration of catheterization in Silicone-coated catheter group was (9.33 days) and that of Latex catheter group (4.98 days) (Table – 3). A total of (116) bacteria were isolated from the CAUTI patients with *Escherichia coli* being most frequently isolate (35%), followed by *Klebsiella pneumonia* (16%), *Pseudomonas aeruginosa* (15%), *Enterococcus faecalis* (12%) and *Proteus mirabilis* (8%). The others were *Citrobacter freundii*, *Acinetobacter baumannii*, *Chryseobacterium indologenes* and *Enterococcus faecium* (3%) each, and *Citrobacter koseri* and *Enterobacter cloacae* (1%) each (Figure – 1/3/4). Out of (116) isolates, (56%) of bacteria were found to produce biofilms. Of these, (43%) were strong biofilm producers and (13%) observed as moderate biofilm producers (Figure – 2). The (64%) of isolates were biofilm producers in Latex catheter group and (49%) of isolates produced biofilms in Silicone-coated catheter group. The difference though was not statistically significant. However, when inpatients with urinary catheterization of less than 7 days were studied; the proportion of CAUTI in latex group was much higher than Silicone-coated catheter group (67% vs 7%). Majority of uropathogens were found to be resistance to most of the antibiotics had been tested (Table – 4/5/6).

TABLES & FIGURES

Table 1: Interpretation of biofilm producing properties of microorganisms.

Sr. No.	Optical Density (OD) Value at 570nm	Interpretation
1	< 2.63	Weak or no biofilm formation
2	2.63-5.32	Biofilm moderate producer
3	> 5.32	Biofilm strong producer

Table 2: CAUTI rate per 1000 urinary catheter days.

Group	Total catheter days	CAUTI days	CAUTI rate*
Latex Rubber Foley's catheter	7333	58	7.9
Silicone-coated Foley's catheter	12961	58	4.4
Total	20294	116	5.7

*CAUTI rate/1000 urinary catheter days = Number of CAUTI patients/Number of urinary catheter days x 1000

Table 3: Duration of onset of CAUTIs.

Group	n	Duration (days)				*p*-value
		Mean	SD	Minimum	Maximum	
Latex Rubber Foley's catheter	58	4.98	1.55	3	8	< 0.001
Silicone-coated Foley's catheter	58	9.33	1.85	5	15	

p-value < 0.05 (Significant) Unpaired t-test used

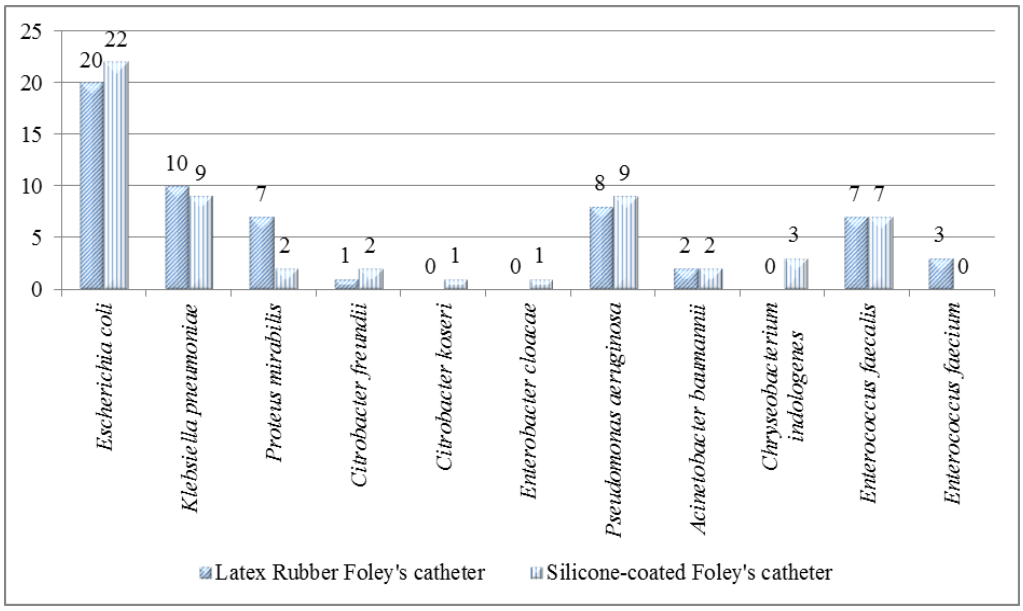

Figure 1: Frequency of bacterial isolates.

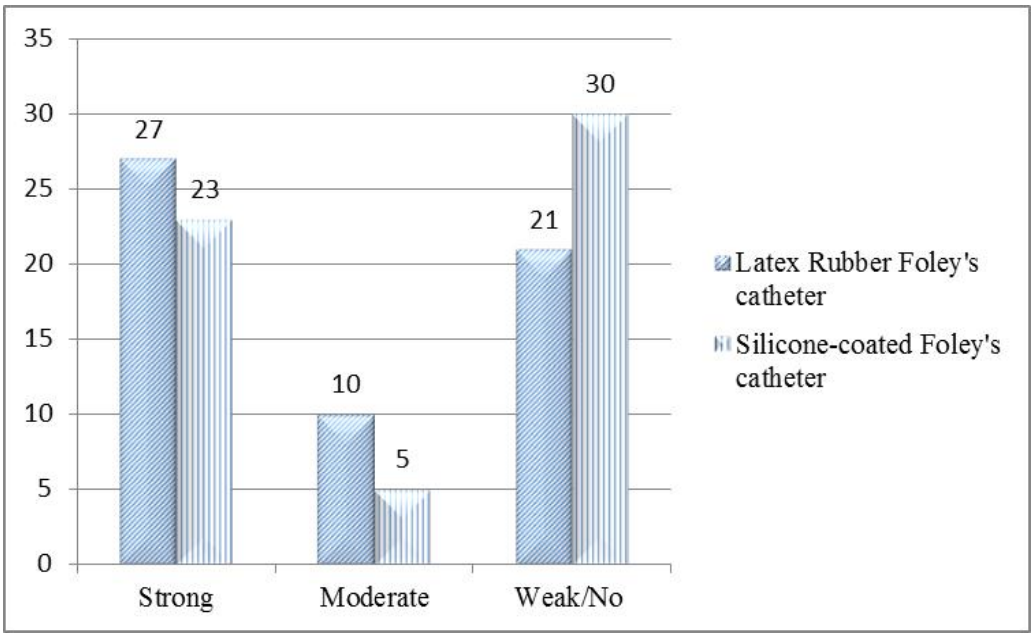

Figure 2: Comparison Biofilm forming property of Latex Foley's catheter & Silicone-coated Foley's catheter.

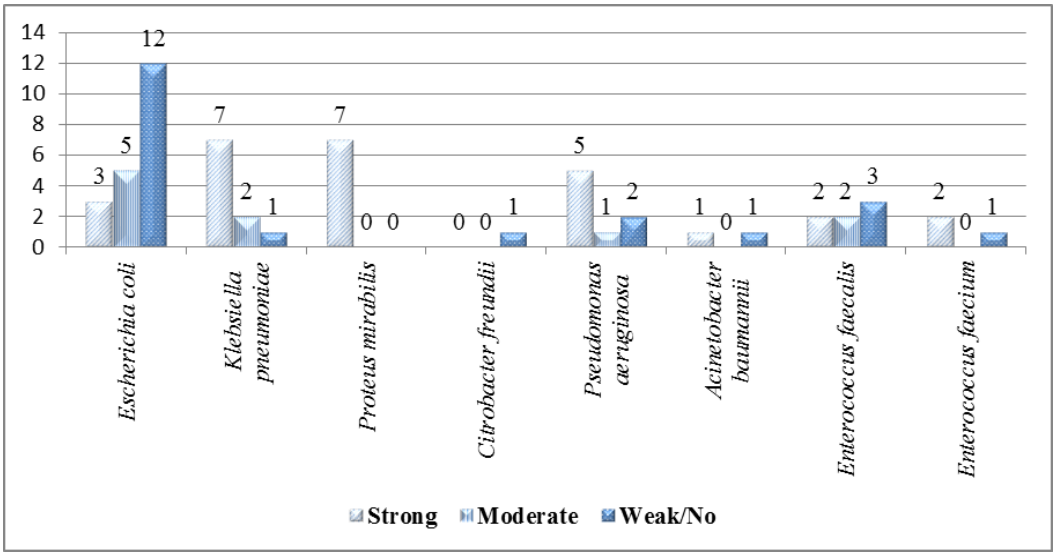

Figure 3: Frequency of Biofilm forming property of bacterial isolates (Latex Foley's catheter group)

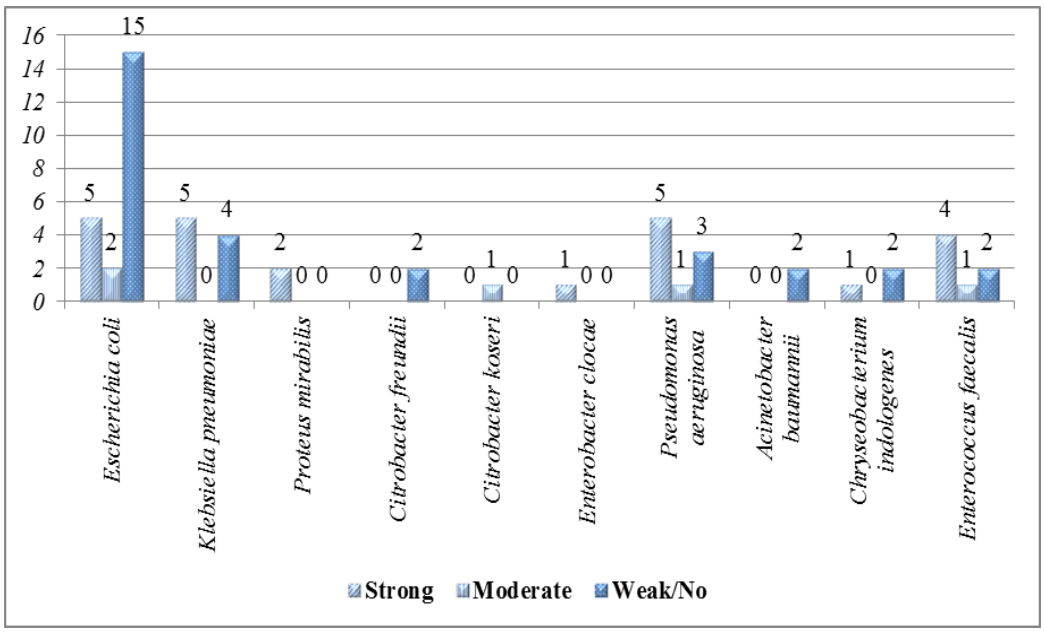

Figure 4: Frequency of Biofilm forming property of bacterial isolates. (Silicone-coated Foley's catheter group)

Table 4: Antibiotic resistance pattern of *Enterobactericeae.*

Organism	n	Biofilm*		Amp		Pit		Cz		Ctx		Imp		Men		Gen		Amk		Cip		Le		Cot		Nit		Fo		Col	
		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm	
		+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
LATEX RUBBER FOLEY'S CATHETER																															
Citrobacter freundii	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	0	1	0	1	0	1	0	1	0	1	0	1	0	0	0	0
Escherichia coli	20	8	12	8	10	8	4	7	8	7	8	2	0	1	0	7	1	6	3	8	5	7	8	7	1	3	0	2	0	0	0
Klebsiella pneumoniae	10	9	1	9	1	8	1	9	1	9	1	4	1	4	1	5	1	6	1	9	1	9	1	8	1	6	0	3	0	0	0
Proteus mirabilis	7	7	0	7	0	6	0	7	0	7	0	1	0	1	0	5	0	4	0	7	0	7	0	7	0	-	-	2	0	-	-
SILICONE-COATED FOLEY'S CATHETER																															
Citrobacter freundii	2	0	2	0	2	0	2	0	2	0	2	0	1	0	0	0	1	0	1	0	2	0	2	0	1	0	1	0	0	0	0
Citrobacter koseri	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	0	0	0
Enterobacter cloacae	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	0	0	0
Escherichia coli	22	7	15	7	13	5	9	7	13	7	13	1	1	1	1	3	1	1	1	7	13	7	13	6	6	1	0	3	0	0	0
Klebsiella pneumoniae	9	5	4	5	4	5	3	5	4	5	4	2	0	1	1	4	2	3	2	5	4	5	3	5	3	4	1	4	1	0	0
Proteus mirabilis	2	2	0	2	0	2	0	2	0	2	0	1	0	1	0	1	0	1	0	2	0	1	0	2	0	-	-	0	0	-	-

(Amp=Ampicillin, Pit= Piperacillin/Tazobactam, Cz= Cefazolin, Ctx= Ceftriaxome, Imp= Imipenem, Men= Meropenem, Gen= Gentamicin, Amk= Amikacin, Cip= Ciprofloxacin, Le= Levofloxacin, Cot= Cotrimoxazole, Nit= Nitrofurantoin, Fo= Fosfomycin, Col= Colistin)

***** + (Strong & moderate biofilm producer) – (Weak or non-biofilm producer)

Table 5: Antibiotic resistance pattern of *Acinetobacter baumannii & Pseudomonas aeruginosa*

Organism	n	Biofilm*		Pit		Caz		Cpm		Imp		Men		Gen		Amk		Cip		Le		Col	
		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm	
		+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
LATEX RUBBER FOLEY'S CATHETER																							
Acinetobacter baumanii	2	1	1	1	1	1	1	1	1	1	0	1	0	1	0	1	1	1	1	1	1	0	0
Pseudomonas aeruginosa	8	6	2	4	0	5	2	5	2	3	0	2	0	6	0	6	0	6	1	6	1	0	0
SILICONE-COATED FOLEY'S CATHETER																							
Acinetobacter baumanii	2	0	2	0	2	0	2	0	2	0	1	0	1	0	2	0	2	0	1	0	1	0	0
Pseudomonas aeruginosa	9	6	3	6	0	6	3	6	3	2	0	2	0	4	1	4	1	6	3	6	3	0	0

(Pit= Piperacillin/Tazobactam, Caz= Ceftazadine, Cpm=Cefepime, Imp= Imipenem, Men= Meropenem, Gen= Gentamicin, Amk= Amikacin, Cip= Ciprofloxacin, Le= Levofloxacin, Col= Colistin)

***** + (Strong & moderate biofilm producer) – (Weak or non-biofilm producer)

Table 6: Antibiotic resistance pattern of *Enterococcus* species.

Organism	n	Biofilm*		Amp		Van		Tei		Cip		Lev		Nit		Tet		Lnz		HLG		HLS		Fos	
				Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm		Biofilm	
		+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
LATEX RUBBER FOLEY'S CATHETER																									
Enterococcus faecalis	7	4	3	1	0	0	0	0	0	4	1	4	1	3	1	4	3	0	0	2	2	3	3	0	0
Enterococcus faecium	3	2	1	2	1	1	1	1	1	2	1	2	1	0	1	2	1	0	0	2	1	2	1	2	0
SILICONE-COATED FOLEY'S CATHETER																									
Enterococcus faecalis	7	5	2	2	0	2	0	1	0	5	2	5	2	3	0	4	2	0	0	3	1	4	2	2	0

Amp= Ampicillin, Van= Vancomycin, Tei= Teicoplanin, Cip= Ciprofloxacin, Lev= Levofloxacin, Nit= Nitrofurantoin, Tet= Tetracycline, Lnz= Linezolic, HLG= High level Gentamicin, HLS= High level Streptomycin, Fos= Fosfomycin

***** + (Strong & moderate biofilm producer) – (Weak or non-biofilm producer)

DISCUSSION

According to the aim and objectives, the present study evaluated biofilm forming properties and antimicrobial susceptibility of uropathogenic microorganisms isolated from cases of CAUTI in Latex rubber Foley's catheters and Silicone-coated Foley's catheter. Fifty-eight individuals were participated in each group of catheters with the mean age of Latex rubber Foley's catheter group was 43.98 years and the mean age of Silicone-coated Foley's catheter group was 59.53 years.

Almost 63% of study population were male and 37% were female patients. Generally uncomplicated UTI is more common in female population with male & female ratio as high as 8:1.[5] In complicated UTIs the ratio is not as high. In this study there was predominance of CAUTI in males as most of the patients in Latex catheter group were from urology ward which is a male ward.

In the present study, CAUTI rate per thousand urinary catheter days was 5.7. The CAUTI rate of Latex catheter group 7.9 was higher than Silicone-coated catheter group 4.4 (Table-2). This demonstrates the benefits of using Silicone coated catheter over standard Latex rubber catheter. The CAUTI rate of present study was higher than some Indian studies which found the rates between 1.78 and 3.65 cases per 1000 catheter days.[6,7] However, the CAUTI rate was lower than some other Indian studies such as that of 7.53/1000 catheter days in Tomar *et al* study.[8] According to the systematic review and meta-analysis study, the CAUTI rate was observed variable from 4.4 to 14.7 per 1000 catheter days according to different WHO regions.[9] CAUTI rate was also as high as 14.71/1000 catheter days in Southeast Asia Region.[9] Verma *et al* compared the CAUTI rate of the two different urinary catheters and they observed that in Pure-Silicone catheter, CAUTI rate significantly lower than Silicone-coated latex catheter.[10] Sabir *et al*'s study showed that CAUTI rate was higher in Latex rubber catheter group than Silicone catheter group within 05 days of insertion of catheter (70% vs 30%).[11]

The duration of catheterization remains the most remarkable risk factors for urinary tract infection and biofilm formation. Catheterized individual were observed susceptible to get urinary tract infection than others with 3-7% everyday risk and almost 100% after continuous catheterization for one month.[12] In this study, the mean duration of onset of CAUTIs was significantly shorter in the Latex group (mean ≈ 5 days) than Silicone-coated group (mean ≈ 9 days) (Table-3). Yakov Shalom *et al* study revealed that CAUTI was observed by 4 days after insertion of Latex catheter in *in-vitro* study. However, the CAUTI was delay and not detected until 7 days or more in coated catheter.[13]

During the study period, a total of 116 bacteria were isolated from the CAUTI patients with *Escherichia coli* being most frequently isolate (35%), followed by *Klebsiella pneumonia* (16%), *Pseudomonas aeruginosa* (15%), *Enterococcus faecalis* (12%) and *Proteus mirabilis* (8%). The others were *Citrobacter freundii*, *Acinetobacter baumannii*, *Chryseobacterium indologenes* and *Enterococcus faecium* (3% each), and *Citrobacter koseri* and *Enterobacter cloacae* 1% each (Fig-1). The isolate pattern was similar to most of the studies on CAUTI. Systematic review and meta-analysis study revealed that the highest percentage of CAUTIs was caused by Gram negative bacteria with 47.5%, followed by fungi 27.8% and Gram positive bacteria 19%.[9] However, in the present study no fungus was isolated and a total of 85% Gram negative and 15% Gram positive bacteria were isolated. A study conducted in Pondicherry, India, also revealed that there was no fungus isolated from CAUTI patients.[15] In their study, Gram negative organisms (92%) were more frequently isolated than the present study, with *E. coli* being the most commonly isolated organisms.[16] Another Indian study from Tamilnadu also did not find any fungal isolates from CAUTI patients.[17]

Three isolates of *Chryseobacterium* species were isolated in this study. It is uncommon and emerging Gram negative pathogens and it was isolated from catheterized patient's urine and blood specimens, especially immunocompromised individual such as malignancy patient.[18,19] Cases of *C. indologenes* CAUTIs were also reported from different parts of India and these isolates were multi-drug resistant showing resistance to second and third generation cephalosporins, carbapenems, β-lactam/β-lactam inhibitor combinations and colistin. However, the microbes were mostly sensitive to trimethroprim-sulfamethoxazole (cotrimoxazole).[20] In this study too *C. indologenes were sensitive to*

Cotrimoxazole and found only in Silicone-coated catheter group.

Out of total of 116 isolates, 56% of bacteria were found to produce biofilms. Of these, 43% were strong biofilm producers and 13% observed as moderate biofilm producers (Fig-2). The rest of isolates were weak producer or showed no biofilm production. In Sabir *et al* study, biofilm formation was detected in 73.4% isolates, whereas 26.6% were non-biofilm producer.[11] The frequency of biofilm producers is lesser in present study compared with their study. The comparison of biofilm producers between the two study groups showed that 64% of isolates were biofilm producers in Latex catheter group and 49% in Silicone-coated catheter group. The difference though was not statistically significant. However, when inpatients with urinary catheterization of less than 7 days were studied; the proportion of CAUTI in latex group was much higher than Silicone-coated catheter group (67% vs 7%). Verma *et al* also had similar findings wherein they found that after 5 days duration of catheterization, the pure-silicone catheter had significantly less colonization and biofilm formation than Silicone-coated Latex rubber catheter group (20% vs 80%).[10]

In this study, amongst the isolates, most of the urease enzyme producing bacteria such as *Proteus mirabilis*, *Klebsiella pneumonia* and *Pseudomonas aeruginosa* were either strong or moderate biofilm producers (100%, 88% and 71% respectively). However, only 35.7% of total *Escherichia coli* produced biofilms either strongly or moderately. In Enterococcus species 64.7% were detected as biofilm producers (Fig-3–4). Tajbakhsh *et al* study revealed 43% of *Escherichia coli* were strong and moderate biofilm producers.[21] Sabir *et al* found that 68% of *E. coli* detected as biofilm producers. In their study, *Klebsiella pneumoniae*, *Pseudomonas areuginosa* and *Enterococcus* species produced biofilms with 87%, 72% and 79% respectively.[11] A study from Nepal revealed 50% of total isolates were biofilm producers with the frequency distribution of *E. coli* (33%), followed *by K. pneumoniae* and *P. aeruginosa.*[22]

Enterobacteriaceae family, the most frequently isolated organisms of present study, showed highly level of antimicrobial resistant pattern. These isolates were resistant to ampicillin (95%), cefazolin and cefotaxime (91% each). The lowest resistant group of antibiotics were carbapenems with imipenem (23%), ertapenem (27%) and meropenem (19%). The organisms were also resistant to cotrimoxazole (67%), nitrofurantoin (32%) and fosfomycin (20%) (Table-4). When comparing resistant patterns (*Enterobacteriaceae*) between the biofilm forming isolates and weak/no-biofilm producers of the present study, higher proportion of resistant pattern was observed in biofilm forming isolates.

According to systematic review and meta-analysis of CAUTIs from China, *Enterobacteriaceae* (most frequent isolate) were found to be resistant to β-lactams antibiotics (ampicillin 87%, ampi-sabactam 55%, cefazolin 55%, ceftazidine 52% and carbapenem for only 6%), cotrimoxazole 67%, nitrofurantoin 20% and gentamicin 60%.[9] A study from Tamil Nadu, India, found that uropathogenic *Escherichia coli* were resistant to amoxyclave 100%, piperacillin/tazobactam 83%, cotrimoxazole 83%, and gentamicin 86%. The resistant pattern was higher in biofilm producer. But, all isolates were sensitive to imipenem.[23] However, study from Haryana, India, detected that 27% of Gram negative bacteria other than non-fermenters were resistant to meropenem.[24] The *Enterobacteriaceae* of the present study have similar resistant pattern especially in β-lactams including carbapenem antibiotics.

Govinda Maharjan *et al* from Nepal observed a higher antimicrobial resistant profile of *Enterobacteriaceae* in CAUTI patients especially amongst biofilm producers. They found that the *Enterobacteriaceae* were resistant to amoxyclave (96%), ceftazidime (81%), gentamicin (54%), meropenem (54%), nitrofurantoin (46%), imipenem (19%) and fosfomycin (11%).[22] This difference could be due to different case selection/ type included in the study.

Nargis Sabir *et al* from Pakistan observed the resistant pattern of biofilm producers and found that a high resistance was seen with ampicillin 100% and lowest with fosfomycin (17.2%). And, Gram negative organisms were resistant to cotrimoxazole 83%, gentamicin 72% and ciprofloxacin 92%. However, approximately 20% of isolates were resistant to carbapenems. Another study from Haryana also found that 100% of biofilm producing *Escherichia coli* were multi-drugs resistant organisms with β-lactamase production as follow; ESBL 88%, AmpC 22%, MBL 6% and ESBL+AmpC 22%.[25]

So, the antimicrobial resistant pattern of *Enterobacteriaceae* family especially biofilm forming isolates in present study was similar to the other studies and also higher than non-biofilm forming organisms.

In non-fermenter isolates (*Pseudomonas aeruginosa* and *Acinetobacter baumannii*) of present study, resistant rate was highest in cephalosporin antibiotics including Ceftazidine (95%) and cefipime (95%). The isolates were resistant to other β-lactam and β-lactam inhibitor combination antibiotic such as piperacillin/ tazobactam (67%), imipenem (33%) and meropenem (33%) (Table-5). In a study from Tamil Nadu, 47% of *Pseudomonas* species were resistant to meropenem and imipenem also, 75% of *Acinetobacter* species were resistant to carbapenems.[26] However, the resistance rate of other β-lactam and β-lactam inhibitor combination were lower than present study. The antimicrobial resistant pattern of present study was quite similar to another study with 83%-94% resistant rate for β-lactam antibiotics and 33.3% for imipenems.[27]

In present study, 14% of total isolates were *Enterococcus faecalis* (12%) and *E. faeciun* (2%). The *Enterococci* were resistant to ampicillin (35%), nitrofurantoin (41%), fosfomycin (24%), vancomycin (24%) and teicoplanin (18%) (Table-6). As comparison between biofilm producers and biofilm non-producers, the resistant rate was proportionally higher in biofilm producer. However, there was no difference between two catheter groups. Shrestha *et al*, also compared the resistant rate of *Enterococcus* species and they found that 33% of isolates were vancomycin resistant enterococci (VRE) in CAUTIs compared with 3% in community acquired UTIs. And most of the VRE in CAUTIs were biofilm producers. And they also observed 77% of isolates were multi-drugs resistant organisms.[28] Since the total number of Enterococci isolates were below 20, it would not be prudent to generalise the antimicrobial resistance pattern.

CONCLUSION

The study compared the biofilm forming property and antimicrobial resistant pattern between the two commonly used catheters, Latex rubber Foley's Catheter and Silicone-coated rubber Foley's catheter. The patients of Latex Catheter group developed CAUTIs much earlier than Silicone-coated counterpart. The overall CAUTI rate/1000 urinary catheter days were 5.7. Higher CAUTI rate (7.9/1000 catheter days) was observed in Latex catheter than Silicone-coated catheter (4.4/1000 catheter days). The spectrums of microorganisms isolated from both catheter groups were almost similar. *Escherichia coli* were detected as the most frequent isolated organism in both catheter groups. The biofilm forming properties of microorganisms causing CAUTIs in Latex catheter were higher against Silicone-coated counterpart. Most of the Gram negative isolates were multi-drugs resistant organisms (MDRO). In general, Biofilm producing *Enterobacteriaceae* were found to be more resistant to antimicrobials than weak/non-biofilm producers. We conclude that using Silicone-coated Foley's catheter can not only delay the onset of Catheter Associated Urinary Tract Infection but also have lesser proportion of biofilm producing bacteria with lower chance of multi-drugs resistant organisms (MDRO) thereby ensuring better curative treatment for the patient.

Limitation of the study

a. Relatively small sample size
b. Did not study on the other different types of catheters such as antimicrobial coated catheter.

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