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Original Research Article

Judging the Risk Factors of Catheter Induced UTI (Urinary Tract Infection) in Pediatric Subjects Admitted to ICU (Intensive Care Unit)

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Abstract:

Background: Catheter-induced urinary tract infections are among the most common causes of nosocomial infections. These contribute to nearly 30% of infections associated with the healthcare sector. The most vital predictor in Catheter induced urinary tract infections is catheterization duration.

Aim: The present clinical study was aimed to assess the risk factors, microbiology, and occurrence of Catheter induced urinary tract infection in pediatric subjects admitted to the ICU (intensive care unit).

Methods: The study assessed 31 child subjects with urinary tract infections admitted to the pediatric intensive care unit of the institute. The risk factors, microbiology, and occurrence were assessed in the study, and the results were formed.

Results: Among 31 subjects with Catheter induced urinary tract infection, 48% (n=) were male subjects, and the rate of occurrence was found to be 7.2/1000 catheter days. The most common organism seen associated with Catheter induced urinary tract infections was E. coli, seen in 33% (n=) cases, followed by E. faecalis, seen in 31% (n=) cases. The risk factors seen significantly associated with the Catheter induced urinary tract infections were hospital stay (p=0.01), PICU stay (p=<0.001), and duration of catheter drainage (p=0.008).

Conclusion: The present study concludes that Catheter induced urinary tract infections are common nosocomial infections seen in subjects admitted to pediatric ICU. The risk of these infections increases with the duration of PICU stay, hospital stay, and duration of catheter drainage.

Keywords: Catheter, Catheter induced UTI, catheterization, PICU, UTI.

Introduction

Urinary tract infection (UTI) signifies infection in any part of the urinary system, including the urethrae, bladder, ureter, and/or kidney. UTI depicts the microorganisms in the urine of the affected subjects. Urinary infections are divided into three classifications, namely UTI-A, UTI-B, and UTI-C, depicting symptomatic UTI with microbiologic confirmation, symptomatic UTI with no microbiologic confirmation, and asymptomatic bacteriuria UTI, respectively.[1]

The CDC (Centers for disease control) further simplified these classifications depending on the mycobacterium growth in the urine culture. UTIs are considered if urine culture had ≥105 CFU (colony forming units) showing a minimum of one/two microorganism species with or without the clinical features. UTI in hospitalized subjects is nearly seen in 96% of subjects with a positive history of catheter use. Long-term use of Catheters is considered a major risk-factors in the development of UTIs as nosocomial infections.[2]

CAUTI (Catheter induced urinary tract infection) is an infection in subjects using the urine catheter for a minimum of three days. In long-duration use of urine catheters, it is considered a predisposing factor for Catheter induced UTI. It has been reported that a higher number of urinary tract infections in child subjects are seen in critically ill subjects owing to the use of invasive tools, including the endotracheal tube, artery, and vein Catheter, and urine catheter.[3]

Urine catheter use hampers the system of an innate immune defense mechanism by affecting the mucous barrier having the function of preventing the attachment of uro-pathogen and their migration to vesica urinary. Catheter invokes inflammatory responses and leads to trauma in the bladder, neck, and urethra mucous. Mechanical and inflammatory damages in the epithelium of the urinary tract not

only increase the UTI risk but also affect the immune responses to the causative pathogens.[4]

The main risk factor for CAUTI is the duration of catheter use, along with bacteriuria. Other risk factors are immunocompromised state, illness severity, fecal incontinence, poor nutrition, pregnancy, and/or female gender. Various uropathogens associated with CAUTI are Enterobacter spp., Klebsiella pneumonia, pseudomonas aeruginosa, Enterococcus spp., Candida spp., and/or Escherichia coli. The emergence of resistance in these microorganisms has increased rapidly in the past few years, which can be attributed to treatment without indication, long-term catheter use, and excessive use of antibiotics.[5]

Despite extensive literature research on UTI and Catheter induced UTI in adult subjects, the literature data is scarce on child subjects, especially in the Indian context. Hence, the present clinical study was aimed to assess the risk factors, microbiology, and occurrence of Catheter induced urinary tract infection in pediatric subjects admitted to the ICU (intensive care unit).

Materials and Methods

The present clinical study was aimed to assess the risk factors, microbiology, and occurrence of Catheter induced urinary tract infection in pediatric subjects admitted to the ICU (intensive care unit). Before study participation informed consent was taken from Parents of all the subjects before study participation. The data of the study subjects were taken from the electronic records of the hospital, the register of the hospital infection committee, and the clinical database from the PICU.

For the present study, Catheter-associated UTI was considered as NHSN (National Healthcare Safety Network) and CDC (Centers for Disease Control and Prevention).[6]

The inclusion criteria for the study were subjects with urinary Catheters placed for a minimum of two days with a fever of $>38^0$C and a culture with significant growth of a minimum of 105 CFUs (colony-forming units) with one/two microorganisms present.

Cultures with contaminants and duplicate cultures were not included in the analysis. Contamination was taken in cases where >2 types of microorganisms were isolated. Along with the demographic data, the susceptibility of microorganisms to common antibiotics and details of causative agents were recorded from the microbiology reports.

The rate of Catheter induced UTI per 1000 catheter days was assessed by dividing the number of catheter-induced UTI episodes by the catheter days number and multiplying by 1000. For identification of the risk factors that can lead to infection, catheter-induced UTI subjects were matched by age (±2) and gender to subjects with urinary Catheters and no incidence of catheter-induced UTI. To match the severity of the illness, PRISM-III scores were used.[7]

The data gathered were analyzed statistically using SPSS software version 21.0. A comparison of all parameters was made in the control group and catheter-induced UTI groups using the Mann-Whitney test and t-test. The p-value of <0.05 was taken as statistically significant.

Results

The present clinical study was aimed to assess the risk factors, microbiology, and occurrence of Catheter induced urinary tract infection in pediatric subjects admitted to the ICU (intensive care unit). The study assessed 31 child subjects with CA-UTO and 60 child subjects with Non-C-UTI. The mean age of study subjects in the CA-UTI and Non-CA-UTI groups was 36.1±1.4 and 42.3±2.2 months, respectively. There were 48.38% (n=15) and 48.33% (n=29) subjects in CA-UTI and Non-CA-UTI groups, respectively. Mean Prism II scores in CA-UTI and Non-CA-UTI groups, respectively, were 7.4±5.3 and 7.2±4.4. The mean duration of hospital stay was 15.1±2.5 and 10.4±2.4 days, respectively, in CA-UTI and Non-CA-UTI groups. The mean duration of PICU stay was 7.4±2.4and 4.6±2.2 days, respectively, in CA-UTI and Non-CA-UTI groups, as shown in Table 1.

Mean catheter days were 5.2±4.27 and 3.1±2.6, respectively, in CA-UTI and Non-CA-UTI groups. Mean platelet, WBC, and hemoglobin counts in the CA-UTI group were 220.4±3.11 $X10^9$/L, 13.57±2.44 $X10^9$/L, and 9.5±2.45 g/dL respectively in CA-UTI group, whereas, in non-CA-UTI groups, they were 274±4.01 $X10^9$/L, 15.72±2.12$X10^9$/L, and 10.3±1.41g/dL respectively. Surgical intervention was done in 9.67% (n=3) and 8.33% (n=5) subjects from CA-UTI and Non-CA-UTI groups, respectively. Among potential risk factors, a history of the neurogenic bladder was positive in 6.45% (n=2), and congenital anomalies of the urinary tract were seen in 12.90% (n=4) subjects with CA-UTI. Mortality rates were 19.35% (n=6) and 8.33% (n=5) subjects from CA-UTI and Non-CA-UTI groups, respectively (Table 1).

In the multivariate and univariate analysis, it was seen that no associated potential risk factor could increase the risk of influence of UTI on the rate of Catheter-associated UTI when compared to the control subjects. With the multivariate logistic regression analysis, the three factors seen associated with getting the CA-UTI were hospital stay duration (p=0.01) OR=1.01 (1.03, 1.04), PICU stay (p=<0.001) OR=1.11 (1.03, 1.23), and duration of catheter drainage (p=0.008) and OR=1.12 (1.01, 1.25) as shown in Table 2. With additional of each

day of the catheter use, the odds of CA-UTI are seen to be increased by 14%.

On identifying the organisms isolated from the culture of affected subjects, non-albicans were seen in 12% (n=3) subjects, candida, pseudomonas, and other microorganisms were all seen in 4% (n=1) study subjects. The most common organism was E. coli, seen in 36% (n=9) study subjects, E. faecalis in 32% (n=8) study subjects, and Klebsiella were seen in 8% (n=2) study subjects, respectively, as depicted in Table 3.

Table 1: Demographic and disease characteristics in the study subjects admitted to PICU

Characteristics	CA-UTI		Non-CA-UTI	
	n=31	%	n=60	%
Mean age (months)	36.1±1.4		42.3±2.2	
Male gender	15	48.38	29	48.33
Mean PRISM III scores	7.4±5.3		7.2±4.4	
Hospital stay duration (days)	15.1±2.5		10.4±2.4	
PICU stay duration (days)	7.4±2.4		4.6±2.2	
Catheter days	5.2±4.27		3.1±2.6	
Platelets ($X10^9$/L)	220.4±3.11		274±4.01	
WBC ($X10^9$/L)	13.57±2.44		15.72±2.12	
Hemoglobin (g/dL)	9.5±2.45		10.3±1.41	
Surgical intervention	3	9.67	5	8.33
Potential risk factors				
Neurogenic bladder history	2	6.45	1	1.66
CAKUT	4	12.90	2	3.33
Mortality	6	19.35	5	8.33

Table 2: Risk factors of Catheter-associated urinary tract infection

Variable	OR (95% CI)	p-value	Length of stay OR (95% CI)	p-value
Hospital stays	1.01 (1.03, 1.04)	**0.01**	1.01 (1.03, 1.04)	**0.01**
PICU stay	1.3 (1.02, 1.15)	**<0.001**	1.11 (1.03, 1.23)	**<0.001**
Catheter days	1.11 (1.04, 1.15)	**0.01**	1.12 (1.01, 1.25)	**0.008**
CAUKT	6.4 (1.51, 25.12)	**0.003**	0.64 (0.06, 5.21)	0.674

Table 3: Pathogens isolated from the culture of subjects having CA-UTI

Isolated organism	n=25	%
Non albicans	3	12
Candida	1	4
Pseudomonas	1	4
Klebsiella	2	8
E. faecalis	8	32
E. coli	9	36
Others	1	4

Discussion

The study assessed 31 child subjects with CA-UTO and 60 child subjects with Non-C-UTI. The mean age of study subjects in the CA-UTI and Non-CA-UTI groups was 36.1±1.4 and 42.3±2.2 months, respectively. There were 48.38% (n=15) and 48.33% (n=29) subjects in CA-UTI and Non-CA-UTI groups, respectively. Mean Prism II scores in CA-UTI and Non-CA-UTI groups, respectively, were 7.4±5.3 and 7.2±4.4. The mean duration of hospital stay was 15.1±2.5 and 10.4±2.4 days, respectively, in CA-UTI and Non-CA-UTI groups. The mean duration of PIC8U stay was 7.4±2.4and 4.6±2.2 days, respectively, in CA-UTI and Non-CA-UTI groups. These results were consistent with the studies of Lo E et al.[8] in 2013 and Temiz E et al.[9] in 2012, where authors assessed subjects with demographic data comparable to the present study.

The study results showed that the mean catheter days were 5.2±4.27 and 3.1±2.6, respectively, in CA-UTI

and Non-CA-UTI groups. Mean platelet, WBC, and hemoglobin counts in the CA-UTI group were 220.4±3.11 $X10^9$/L, 13.57±2.44 $X10^9$/L, and 9.5±2.45 g/dL respectively in CA-UTI group, whereas, in non-CA-UTI groups, they were 274±4.01 $X10^9$/L, 15.72±2.12$X10^9$/L, and 10.3±1.41g/dL respectively. Surgical intervention was done in 9.67% (n=3) and 8.33% (n=5) subjects from CA-UTI and Non-CA-UTI groups, respectively. Among potential risk factors, a history of the neurogenic bladder was positive in 6.45% (n=2), and congenital anomalies of the urinary tract were seen in 12.90% (n=4) subjects with CA-UTI. Mortality rates were 19.35% (n=6) and 8.33% (n=5) subjects from CA-UTI and Non-CA-UTI groups, respectively. These results were in agreement with the studies of Letica Kriegel AS et al. [10] in 2019 and Samraj R et al. [11] in 2015, where authors reported similar catheter parameters as seen in the present study.

It was also seen that in the multivariate and univariate analysis, it was seen that no associated potential risk factor could increase the risk of influence of UTI on the rate of Catheter-associated UTI when compared to the control subjects. With the multivariate logistic regression analysis, the three factors seen associated with getting the CA-UTI were hospital stay duration (p=0.01) OR=1.01 (1.03, 1.04), PICU stay (p=<0.001) OR=1.11 (1.03, 1.23), and duration of catheter drainage (p=0.008) and OR=1.12 (1.01, 1.25). With additional of each day of the catheter use, the odds of CA-UTI are seen to be increased by 14%. These results were comparable to the findings of Fernando MM et al. [12] in 2017 and Goudie A et al. [13] in 2015, where authors reported similar risk factors with CA-UTI as in the present study.

The study results showed that on identifying the organisms isolated from the culture of affected subjects, non-albicans were seen in 12% (n=3) subjects, candida, pseudomonas, and other microorganisms were all seen in 4% (n=1) study subjects. The most common organism was E. coli, seen in 36% (n=9) study subjects, E. faecalis in 32% (n=8) study subjects, and Klebsiella was seen in 8% (n=2) study subjects, respectively. These findings were similar to the studies of Rinke ML et al. [14] in 2020 and Ramayani OR et al. [15] in 2017, where authors reported E. coli to be the most commonly isolated microorganism in CA-UTI as in the present study.

Conclusion

Considering its limitations, the present study concludes that Catheter induced urinary tract infections are common nosocomial infections seen in subjects admitted to pediatric ICU. The risk of these infections increases with the duration of PICU stay, hospital stay, and duration of catheter drainage.

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