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Bladder Irrigation with 1% Povidone-Iodine Reduces Catheter Associated Urinary Tract Infections in ICU Patients

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Abstract:

Objective: *Urinary tract infections (UTI) are commonly acquired in hospitals, within an estimated prevalence of 1% -10% representing 30%-40% of all nosocomial infections. The most important risk factor for the development of nosocomial UTI, especially in the ICU is the presence of urinary catheter. Catheter related urinary tract infection occurs because urethral catheters inoculate organisms into the bladder and promote colonization by providing surface for bacterial adhesion and causing mucosal irritation. This study was performed to determine the effectiveness of 1% povidone-iodine bladder wash in the prevention of catheter-associated urinary tract infection (CAUTI) in ICU patients.*

Methodology: *This experimental study was carried out during a period of two years. A total of 80 admitted patients who need Foley's catheter in ICU during this study period at the study place were included in the study. Patients were enrolled in two groups by purposive sampling. Group-A; received 1% povidone-iodine bladder wash, Group-B: received standard catheter care. Tri-channel Foley's catheter was introduced with standard aseptic protocol and patient who received Bi-channel Foley's catheter at operation theater on same ICU admission day, the catheter was replaced by a Tri-channel Foley's catheter in ICU setup. For both groups, 1st sample of urine were collected just after insertion of catheter and was analyzed in the microbiology laboratory to see any growth of microorganisms (Culture) and their sensitivity pattern of antibiotics (C/S). After getting 1st sample report the subsequent urine sample for C/S was collected on day 3 , 7 , and then weekly till removal of catheter or up to 28th post catheter insertion day, which one come first. CAUTI was diagnosed when the urine culture shows growth of microorganism > 10^5 CFU/ml of urine.*

Data was collected according to preformed data collection sheet. The whole data were computed, and statistical analyses were carried out by using the SPSS. The mean values were calculated for continuous variables. The qualitative observations were expressed by frequencies and percentages. Chi-Square test was used to analyze the categorical variables. Unpaired t-test was used for continuous variables. P value <0.05 was considered as statistically significant.

Result: *Growth of microorganism was significantly higher (42.5%) in Group-B in comparison to Group-A (17.5 %). E. coli, Klebsiella and Pseudomonas was frequently isolated organism in both groups. Patients without 1% povidone-iodine bladder wash had 2.42 times the risk of CAUTI compared to patients who received 1% povidone-iodine bladder wash with a 95% confidence interval ranging from 1.13 to 5.21*

Conclusion: *Patients who had the 1% Povidone-Iodine bladder wash were at low risk of catheter associated urinary tract infection.*

Key Words: *Urinary Bladder, Povidone-Iodine, Infection, Urinary Catheter, ICU*

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Introduction

Urinary tract infections (UTIs) are commonly acquired in hospitals, with an estimated prevalence of 1%-10%, representing 30-40% of all nosocomial infections[1]. The most important risk factor for the development of nosocomial UTIs, especially in the intensive care setting is the presence of a urinary catheter[2]. Approximately quarter of patients who are admitted to a hospital will have an indwelling catheter at some point during their stay and 7% of nursing home residents are managed by

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long term catheterization[2]. Though the indwelling urinary catheter is an essential part of modern medical care, and a variety of different indwelling urinary catheters are used for various purposes. Unfortunately, when poorly managed, the indwelling catheter may present hazard to each and every patient[3]. UTI account for at least 35% of all hospital-acquired infections[4], with 80% of those being attributed to the use of indwelling catheters[5].

Catheter-related urinary tract infection occurs because urethral catheters inoculate organisms into the bladder and promote colonization by providing a surface for bacterial adhesion and causing mucosal irritation[6]. In 2011, CAUTI rates from intensive care units (ICUs) that reported to National Healthcare Safety Network (NHSN) ranged from 1.2 to 45 per 1,000 urinary catheter-days in adult ICUs[7]. Although representing only 5 - 15% of hospital beds, ICUs account for 10 - 25% of healthcare costs, corresponding to 1 - 2% of the gross national product of the United States. No data were available for Bangladesh. Most of the patient admitted in ICU needs catheter care, CAUTI increases morbidity, mortality as well as cost of treatment in critically ill patients[8]. Interventions such as topical mental antimicrobials, disinfectants added to the urinary drainage bag, and antimicrobials coatings for catheter have not been shown to decrease the incidence of UTI[9]. An effective measure to prevent the CAUTI has not yet been developed. The standard catheter care like daily cleaning of meatus and perineal care are usually followed in all ICUs in Bangladesh.

The most common organisms responsible for CAUTI are Bacteria (Escherichia coli, Proteus mirabilis, Klebsiella, Pseudomonas aeruginosa, Serratia, Enterobacter, Staphylococcus aureus) Viruses (Cytomegalovirus, Adenovirus) Fungi (Candida albicans, Histoplasma capsulatum) and some Protozoa (Trichomonas vaginalis, Schistosoma haematobium).[10]

Iodine has been recognized as an effective broad - spectrum bactericide, and it is also effective against yeasts, molds, fungi, viruses, and protozoans [11-12]. In addition, it has been demonstrated that bacteria do not develop resistance to povidone - iodine [13]. Since there is no significant systemic absorption of povidone - iodine used for bladder irrigation, prophylactic irrigations are considered safe[14].

The present study was designed to evaluate the effectiveness of 1% povidone-iodine bladder wash in terms of prevention of CAUTI. As one bottle of 100 ml 10% povidone- iodine which was used for 2 days costs only BDT 35 (approx. USD 0.4). Therefore, it became very cost effective. Maximum people of our country lives below the standard level economical parameter. So, we should be more sincere about the usefulness of 1% povidone-iodine in prevention of urinary-tract infections associated with urethral catheterization in ICU patients for the sake of the wellbeing of our critically ill patients. As it is seen that even with standard catheter care the rate of UTI is high. We wanted to see the effect of daily povidone-iodine wash of the bladder to see any changes in the UTI rate.

The knowledge of this study would enable the physician to make a right choice to prevent CAUTI. This would not only reduce the mortality and morbidity but also contribute to reduction of cost of treatment, in fact which is definitely a major concern for a developing country like Bangladesh, with limited facility allocated for health care.

Materials and Methods

This study was undertaken in the department of Anaesthesia, Pain, Palliative and ICU of Dhaka Medical College & Hospital (DMCH), Dhaka. This was an experimental study. This study was carried out during the period of July 2013 to June 2015. All adult admitted patients in the ICU of DMCH, who needed catheterization were considered for inclusion. Purposive sampling and strictly considering the inclusion and exclusion criteria.

Sample size:[15]

To determine the sample size the following formula was followed.

n =

n= the desired sample size

z= is standard normal deviate (at 5% type I error (P<0.05) it is 1.96 and at 1% type I error (P<0.01) it is 2.58). As in majority of studies P values are considered significant below 0.05 hence 1.96 is used in formula. p= is expected proportion in the population; based on previous studies, it is regarded as 0.5 (50.0%) q = 1-p

d = is degree of accuracy which is considered as 0.05

According to this formula the targeted sample was 384.

Most of patient who shifted from different ward to ICU. or transferred from other hospitals to DMCH for ICU support are catheterized. Scarcity of newly admitted non-catheterized patient, time limitation of this study period and previous unpublished data of DMCH, ICU showed that, it was difficult to get more than 80 patients for this study during the time frame. Therefore, 80 patients were enrolled in this study.

Inclusion criteria:

- Informed consent.
- ICU admitted patient who needed urinary catheterization.
- Age above 18 years.

Exclusion criteria:

- Patient with 1 sample positive urine culture.[16]
- Catheter removed before third day.
- Past history of recurrent UTI (3 or more UTIs in 12 months).[17]
- Immunocompromised patients (AIDS, chemotherapy).

Informed written consent has taken from the patient or patient's guardian after duly informing the procedure, anticipated result, possible advantages, disadvantages and complications. Confidentiality was maintained both verbally and documentary by using separate locker and computer password. Prior to start of the study permission was taken from the appropriate authority of the ICU. Protocol was approved by ethical committee of the institution.

A total of first 80 admitted patients who needed Foley's catheter in ICU during this study period at the study place were enrolled in the study. Each patient and/or his/her guardian were interviewed regarding the history of the patient, followed by thorough clinical examination.

Informed written consent was taken from the patients or patients' relatives after providing appropriate information to the concerned. A total of 80 patients were selected by matching sampling & allocated them in 2 groups (Group A &B), Group-A: received 1% povidone-iodine bladder wash, Group-B: received standard catheter care.

Tri-channel Foley's catheter was introduced with standard aseptic protocol as described. Hands were cleaned with soap & water [18]. Trolley cleaned & equipment were gathered upon bottom shelf. Catheter pack opened and equipment kept onto critical aseptic field using non-touch technique (NTT).[19] Antiseptic hand wash taken (soap water followed by 2.5% Chlorhexidine Gluconate in 70% Isopropyl Alcohol) & sterilized hand gloves were worn. Genitalia & mid part of thighs scrubbed with 10% Povidone-iodine & aseptic field drapes applied[20]. Two percent (2%) Lignocaine jelly inserted through urethral orifice, 10 ml for male & 5 ml for female [21-22].

Catheter was inserted using non touch technique by touching only the plastic wrapping [23]. Balloon inflated with distilled water & collection bag attached to drainage lumen. Catheter was secured to the lower part of abdomen, waste and gloves were disposed off. In case of post operative patient who received bi-channel Foley's catheter at Operation Theater on same ICU admission day, the catheter was removed and replaced by a tri- channel Foley's catheter in ICU setup using same aseptic protocol.

Before collecting the urine specimen, drainage tube was occluded about three inches below the sampling port, which ensures to collect freshly voided sample. The sampling port was prepared with Alcohol-saturated swab (70% Isopropyl alcohol)[24]. The urine was collected by aspiration from the prepared site (sampling port) with a l0 ml disposable syringe, and then the sample quickly transferred to a sterile test tube[25]. For both groups, 1st sample of urine were collected just after insertion of catheter and send it to the microbiology laboratory for culture and sensitivity (C/S) test. For Group-A, fifty milliliter of 10% povidone-iodine was added to 500 ml normal saline and 250 ml of this solution was instilled into the bladder through a tri-channel Foleys catheter (with drainage tube clamped) using an IV set. Solution is allowed to remain in the bladder for 15 minutes and then drained. Group-A received this 1% povidone iodine bladder wash twice daily under strict aseptic precautions. The Group-B did not receive 1% povidone-iodine bladder wash; they received standard catheter care like daily cleaning of meatus and perineal care. Experimental group also received same routine catheter care [2].

After getting 1 sample report the subsequent urine sample for C/S from both groups were collected on day 3, 7, and then weekly till removal of catheter or up to 28th

post catheter insertion day, which criteria came first. CAUTI was diagnosed when it met the operational definition [26].

The diagnosis of catheter – associated urinary tract infection was made when the urine culture shows growth of microorganism > 10^5 CFU/ml of urine from a catheterize patient[27-28].

Statistical analysis:

Statistical analyses were carried out by using the Statistical Package for Social Sciences version 20.0 for Windows (SPSS Inc., Chicago, Illinois, USA). The mean values were calculated for continuous variables. The qualitative observations were expressed by frequencies and percentages. Chi-Square test was used to analyze the categorical variables. Unpaired t-test was used for continuous variables. P value <0.05 was considered as statistically significant.

Results:

Table I shows demographic and clinical variable of the study patients, it was observed that more than one third (35.0%) patients belonged to age 51-60 years in group A and 12(30.0%) in group B. The mean age was found 43.5+12.3 years in group A and 42.7+13.3 years in group B. Twenty-one (52.5%) patients were female in group A

Table-I

Distribution of the study patients by demographic and clinical variable (n = 80)

	Group A (n = 40)		Group B (n =40)		P value
	n	(%)	n	(%)	
Demographic variable					
Age (Years)					
11 - 20	1	2.5	1	2.5	
21 - 30	5	12.5	7	17.5	
31 - 40	8	20.0	7	17.5	
41 - 50	9	22.5	10	25.0	
51 - 60	14	35.0	12	30.0	
61 - 70	3	7.5	3	7.5	
Mean±SD	43.5±12.3		42.7±13.3		[a]0.781[ns]
Range (min-max)	18 - 63		19 - 65		
Sex					
Male	19	47.5	22	55.0	[b]0.502[ns]
Female	21	52.5	18	45.0	
Clinical variable					
Diabetic mellitus					
Yes	9	47.4	10	52.6	[b]0.792[ns]
No	31	50.8	30	49.2	
Re - catheterization					
Yes	9	47.4	10	52.6	[b]0.792[ns]
No	31	50.8	30	49.2	
	Mean±SD		Mean±SD		
Duration of catheter (in day)	15.2±4.9		16.2±6.3		[b]0.431[ns]
Range (min- max)	7 - 21		6 - 28		

ns = not significant
cc P value reached from unpaired t - test
[b]P value reached from chi square test
Group A = Received 1% Povidone - iodine bladder wash.
Group B = Received standard catheter care.

and 18(45.0%) patients in group B. Diabetes mellitus (DM) were 9(47.4%) patients in group A and 10(52.6%) in group B. DM did not show any significance in producing CAUTI. Re-catheterization were done 9(47.4%) patients in group A and 10(52.6%) in group B. The mean duration of catheter was found 15.2±4.9 days in group A and 16.2±6.3 days in group B. The difference was not statistically significant (p>0.05) between two groups.

Table II shows distribution of the study patients by systemic antibiotic agents, it was observed that half of the total study patients get ceftriaxone 12 & 19 in group-A & Group-B respectively. Nine (22.5 %) patients received linezolid in group A and 10(25.0%) in group B. Regarding tigecycline nine (22.5%) were received in group A and 7(17.5%) in group B. Other results are depicted in this table. None of the differences were statistically significant (p>0.05) between two groups. All the patients were on antibiotics as the treatment of their primary diseases. The different antibiotics showed no difference in CAUTI.

Table III shows urine culture of the study patients, it was observed that 7 (17.5%) patients shown growth of microorganism in group A and 17(42.5%) in group B. Patients without 1% povidone - iodine bladder wash had 2.42 times the risk of catheter associated urinary tract infections (CAUTI) compared to patients who received 1% povidone - iodine bladder wash with a 95% confidence interval ranging from 1.13 to 5.21. The difference was statistically significant (p>0.05) between two groups.

Table IV shows organisms isolated from urine of the study patients, it was observed that E. coli was the commonest organism i.e. 4(57.1%) in group A and 7(41.2%) in group B. Klebsiella also frequently noticed organism in both group, which was two and three in Group - A & B respectively. The difference was not statistically significant (p>0.05) between two groups.

Table-II

Distribution of the study patients by systemic antibiotic agent (n=80)

Systemic antibiotic agent	Group A (n = 40)		Group B (n =40)		P value
	n	(%)	n	(%)	
Cetriaxone	21	52.5	19	47.5	0.655^{ns}
Meropenem	18	45.0	16	40.0	0.651^{ns}
Metronidazole	19	47.5	18	45.0	0.823^{ns}
Linezolid	9	22.5	10	25.0	0.793^{ns}
Tigecycline	9	22.5	7	17.5	0.576^{ns}
Piperacillin + Tazobactum	7	17.5	6	15.0	0.762^{ns}
Clarithromycin	7	17.5	8	20.0	0.775^{ns}
Levofloxacin	6	15.0	8	20.0	0.556^{ns}
Polymixin	5	12.5	4	10.0	0.500^{ns}
Vancomycin	3	7.5	4	10.0	0.500^{ns}
Ceftazidime	3	7.5	4	10.0	0.500^{ns}
Flucloxacilin	3	7.5	4	10.0	0.500^{ns}
Azithromycin	2	5.0	3	7.5	0.500^{ns}

ns = not significant
P value reached from chi square test

Table-III

Distribution of the study patients by post catheter day of microorganism growth (n=80)

Organism growth (culture positive)	Group A (n = 40)	Group B (n =40)
2nd sample (3rd day)	0	1
3rd sample (7th day)	1	4
4th sample (14th day)	3	7
5th sample (21st day)	3	4
6th sample (28th day)	0	1
Total	7	17

p>0.05

Table-IV

Distribution of the study patients by microorganism isolated (n = 24).

Organism isolated	Group A (n = 7)		Group A (n = 17)		P value
	n	%	n	%	
E. coli	4	57.1	7	41.2	0.395ns
Klebsiella	2	28.6	3	17.6	0.462ns
Pseudomonas	1	14.3	3	17.6	0.672ns
Proteus	0	0.0	1	5.9	0.708ns
Enterococcus	0	0.0	1	5.9	0.708ns
Candida albicans	0	0.0	2	11.8	0.493ns

ns = not significant
P value reached from chi square test

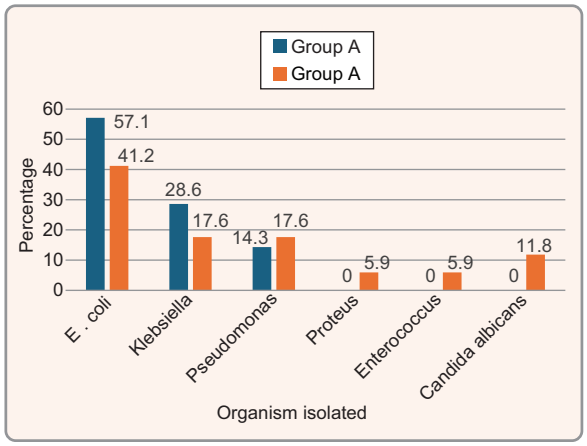

Figure 1: *Bar diagram showing organism isolated of the study patients*

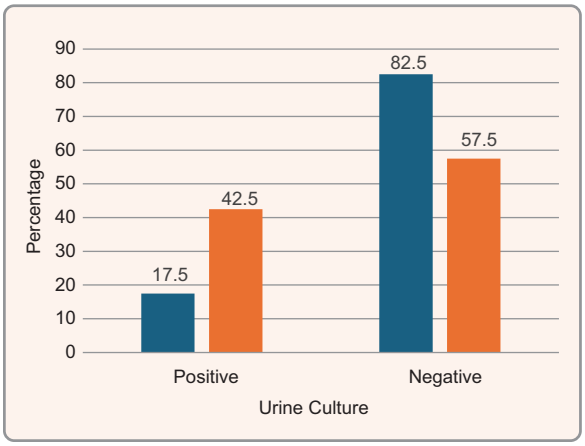

Figure 2: *Bar diagram showing urine culture of the study patients.*

Discussion

This experimental study was carried out to see the effectiveness of bladder wash with 1% povidone-iodine in the prevention of CAUTI in ICæ patients. Mojtahedzadeh M et al. [29] observed the patients with a UTI (bacteriuric patients, the mean age was 58.71±19.45 years. The mean age difference was not statistically significant ($p>0.05$) between two groups,[30] also found the higher mean age (61.2 ±17.4) years. Which all are higher than the current study. The higher mean age may be due to increased life expectancy, geographical and racial influences in their study patients.

Gender was not a risk factor for catheter-associated bacteriuria in septic patients and the male to female ratio showed no significant difference between the bacteriuric and non- bacteriuric patients[29]. Merle et al.[31] and Tissot et al.[32] have shown that nosocomial UTIs in ICU are more common in women, in another study[30]found that 61.0% were male patients.

Maki and Tambyah[33]; Loeb et al. [34] obtained that diabetes mellitus associated with catheter-associated bacteriuria at the time of catheterization, but in our cases the DM patients did not show any significant increase in CAUTI. As 9 patients who had DM did not show any difference in CUTI. In this current study the mean duration of catheter almost similar between two groups. One of the risk factors for catheter-associated urinary tract infection (CAUT) identified in previous studies is prolonged catheterization reported by Tissot et al.[32]

The growth of microorganism was significantly ($p<0.05$) higher in group B (42,5%) in comparison to group A (17.5%) in this study. Based on the sensitivity of the assay of 86% it is expected that a 10-15% reduction in the rate of culture positivity would occur with povidone-iodine implementation mentioned by Laupland et al. [30]. In another study Rosser et al[35] demonstrated the occurrence rate was reported 15.8% of cases. The lower frequency (6.0%) observed in Mojtahedzadeh et al[29] study may be due in part to the difference in the evaluation of the patients for urosepsis where they did not include patients with positive urine culture. In the Laupland et al[30] study, 1.37% of ICU-acquired UTIs demonstrated association with a positive blood culture with the same organism. This small difference in results may be due in part to the difference in the study population.

Regarding the organism isolated, Mukosai et al[36] observed in their study that E. coli by 35.0% was the most predominant organism, other organisms was streptococcus (18.9%), Citrobacter koseri (13.5%), Klebsiella sp (10.8%). Almost similar findings also observed by Khattak et al[37], which are consistent with the current study. The second most common species of bacterial cultured was Streptococcus. This may be attributed to the nature of these pathogens commonly colonising the urinary system. All the results are comparable with this present study.

A study published in Current Reviews in Musculoskeletal Medicine (2024) investigated the use of intravesical gentamicin irrigation in trauma patients with prolonged catheterization. Patients receiving twice-daily gentamicin bladder irrigation exhibited a significant reduction in CAUTI incidence compared to a retrospective control group. However, the study emphasized the need for further research to determine optimal irrigation protocols, including frequency, solution concentration, and duration[38]. An article in the BJU International (2024) evaluated the efficacy of bladder irrigation with tap water in patients experiencing recurrent UTIs. The findings indicated that this method significantly reduced both antibiotic usage and UTI incidence, suggesting it as a safe and patient-friendly alternative. Nonetheless, the study called for additional research to confirm these results in broader ICU populations[39]. The 2022 update of the "Strategies to Prevent Catheter-Associated Urinary Tract Infections in Acute Care Hospitals" advises against the routine use of continuous antimicrobial bladder irrigation for infection prevention. The guidelines highlight that such practices may increase the risk of antibiotic-associated complications without providing significant benefits in preventing symptomatic CAUTIs[40]. We tried to avoid antimicrobials for bladder irrigation and wanted to see the efficacy of povidone-iodine as a cheap alternative.

Conclusion

This study was undertaken to see the efficacy of 1% povidone-iodine bladder wash in the prevention of CAUTI in ICU patients in comparison to the standard care that is routinely done in most of the ICU. Most of the patients were in 5th decade in both groups and male to female ratio was almost equal. Growth of microorganism was significantly higher in group B

(42.5%) in comparison to group A (17.5%). Highest number of culture positive was found in 4th sample on 14 days (3 and 7 in umber of group A and B respectively). E. coli was the most common isolated organism in both groups, Klebsiella and Pseudomonas were also frequently observed among two groups.

Patients without 1% povidone-iodine bladder wash had 2.42 times the risk of CAUTI compared to patients who received povidone-iodine bladder wash with a 95% confidence interval ranging from 1.13 to 5.21.

Our study points that the use of povidone-iodine for bladder wash can be used to prevent CAUTI. The limitation of this study is that it's a single centre study and the population size is small. A multi centre study with higher sample size will be ideal to have a definite conclusion.

Conflict of interest: None

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