

Steriled and Nonsteriled Urinary Catheters and the Urinary Tract Infection in Hospitalized Patients

Masoumeh Kaboli¹; Hossein Gholami^{1,*}; Mehrdad Jor gholami²; Hasti Masiha Akbar¹; Hengame Kheyrkhah¹; Koosha Ramezani¹; Talaye Mirkarimi¹; Maryam Ghavam¹

¹Faculty of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran

²Iran University of Medical Sciences, Tehran, IR Iran

*Corresponding author: Hossein Gholami, Faculty of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran. Tel: +98-9122281319, Fax: +98-2166267816, E-mail: dr.m_kaboli@yahoo.com

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Background: Urinary tract infection (UTI) is one of the most common types of infection which can occur in all age groups. The use of catheters is one of the most important underlying factors, especially when they are left in place for a long time.

Objectives: This study aimed to investigate the effect of sterile catheter fixation on bacteriuria and urinary tract infections.

Patients and Methods: The present research is a clinical trial study. The patients who had urinary catheters based on the existing indications in 2012, hospitalized in Imam Hussein (AS) Hospital, Tehran enrolled in the study. Patients were divided into two groups. The first group consisted of patients whom the catheters were installed by a medical intern in the emergency department. The second group consisted of patients whom the catheters were installed in the same department by two medical interns using a completely sterile method especially at fixation and lubrication steps. The information contained in the patients' check list including the background information, age, hospitalization days, history of urinary catheters, history of infection and results of urine culture and analysis.

Results: A total of one hundred and eighty-eight individuals with the mean age of 39.1 ± 19 years (age range between 18 - 77 years old) enrolled in this study. There was no significant difference in the number of hospitalization days between the two groups ($P > 0.05$). The number of hospitalization days and incidence of infection were significantly correlated ($P < 0.05$). The results showed a total OR of 1.5 indicating that the risk of infection is higher in the first group. Overall, the rate of urinary tract infection in this study was 16.4% while this rate was 19.1% and 13.8% in the first and second groups, respectively. The statistical tests showed significant difference between two groups in the incidence of urinary tract infection ($P < 0.05$), and also positive urine cultures were reported for twelve patients in the first group and nine patients in the second group. *Escherichia coli* (*E. coli*) was the most common infective microorganism in both groups, which was observed in 66.6% of the first and 88.8% of the second groups. The frequency of Gram-negative bacteria was 10 cases (83.3%) in the first group and 8 cases (88.8%) in the second group.

Conclusions: According to this study, employing the principles of sterile techniques during the catheterization and sterilization of instruments, as well as skills and experiments of individuals in this process, are the most important factors that can significantly reduce the number of infections after catheterization.

Keywords: Catheterization; Infertility; Urinary Tract Infections; Bacteriuria

1. Background

Urinary tract infection is the most common reason for patient referrals to the medical centers that sometimes the person requires hospitalization because of critical or medical incapacitating conditions. Urinary tract infection is the most common type of nosocomial infections and the second leading cause of death (1). Urinary tract infection (UTI) is caused by various microorganisms in the urinary tract (2) that infects people of all ages. In the United States of America, an average of seven million patients referred to the medical centers due to UTI. High-cost treatments are needed to treat this disease (3). In addition, UTI leads to higher mortality rate and increased

hospitalization time (4). The risk of UTI in women (3), people with diabetes (5), the elderly (6), infants (7) and patients with complete spinal cord injury is higher (8).

Urinary catheterization is one of the main measures used for the treatment and care of patients. It is associated with the emergence of bacteria in the urine, unpleasant symptoms, complications which can cause reduced quality of health care services. Any safe and affordable action plays an important role in reducing or preventing the UTI; the use of antiseptic solutions is one of those approaches. It seems that by employing sterile methods and conditions the risk would be eliminated,

Implication for health policy/practice/research/medical education:

To reduce the prevalence of urinary tract infection, employing the sterilized conditions and methods during the catheterization is recommended.

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and it is preferred to use water rather than disinfectant solutions because it is inexpensive, easy access and has no adverse effects (2). The widespread use of urinary catheters as therapeutic aid in different hospital departments to drain urine of patients undergoing major abdominal surgeries such as abdominal hysterectomy, patients undergoing cesarean delivery and prostatectomy or for urine control in people with urinary incontinence, can cause increased urinary tract infections (3).

Urinary tract infection is one of the most common nosocomial infections that usually occur after device placement in urinary tract and generally after catheterization (4). The use of urinary catheters is considered as one of the most important underlying factors especially when it is placed for long-term. Complications of catheter application are sometimes followed by serious risks such as septicemia or deaths (3). Due to complications of catheterization (according to the important role of urinary catheters in creating UTI and its related complications such as chronic inflammation of kidney, chronic pyelonephritis, urinary stones and bladder stones production as well as the deaths caused by these complications (6)), especially in long-term cases, practices and procedures that reduce these complications including not using the catheter, condom catheter for men which drains the urine into the urine container and in general reduces the infection rate compared to catheterization inside the tract, using intermittent catheters: use of sterile or cleaned catheters to drain urine every three to six hours and immediate removal by patients or their caregivers, reduction in catheter placement time in urinary tract, use of catheter in suprapubic area, use of catheter with a closed system and the use of antimicrobial agents, have been in center of attention (5).

2. Objectives

We conducted this study to measure the effect of sterile principles application during catheterization to reduce the adverse effect of this procedure.

3. Patients and Methods

It is a clinical trial study. The hospitalized patients who had urinary catheters based on the existing indications in 2012, in Imam Hussein (AS) Hospital, Tehran enrolled in the study. The samples were collected using a simple randomized selection. Patients were divided into two groups after collecting the written informed consents. The first group consisted of patients whom the catheters were inserted by a medical intern in the emergency department where some of the steps of catheterization are typically performed under non-sterile conditions such as filling the syringe for fixation and use of lubricant gel for inserting the catheter into urethra. The second group was comprised of patients in the same department whom the catheters were installed by two Interns using completely

sterile methods and measures for instant, filling the syringe for fixation and use of lubricant gel for inserting the catheter into urethra were carefully performed under sterile condition. We did not provide any special educational program for catheterization for interns in the first group and they work as usual. The 188 selected patients were divided into two groups evenly (each group 94 patients). Background information, age, hospitalization days, history of catheterization, history of infection and results of urine culture and analysis were studied. Samples were taken on the last day of hospitalization in both groups. Inclusion criteria were to be male and over 18 years old, Foley catheter insertion and a week of hospitalization. Exclusion criteria included female patients, age less than 18 years old, catheterization by condoms, suprapubic catheter placement and suspected to have urinary tract infection at the time of catheterization. Eventually, we compared the rate of urinary tract infection and bacteriuria in the two groups, after collecting the information. We assumed pyuria (more than 5 WBC/hpf) and positive urine culture (more than 100 bacteria colony) and urinary tract infection as bacteriuria (more than 100000 bacteria in every urine milliliter).

3.1. Statistical Analysis

The results are provided as mean and standard deviation (mean \pm SD) for quantitative and percentage for qualitative variables. The analysis of the data was performed by using statistical "independent T-test" and "Fisher exact test" and SPSS13 software.

4. Results

Patients enrolled in this study consisted of 188 individuals with the mean age of 39.1 ± 19 years old (18 - 77 years old). All of the patients in this study were male. Most of the patients in this study were 25 - 35 years old 81 patients (43%), 41 patients (21.8%) were 45 - 55 years old and finally 22 patients were over 55 years old (11.7%). The average age of the patients in the first group was 38.3 ± 20.2 years old and in the second group was 40.2 ± 18.7 years old, where no significant difference was observed between the two groups in terms of age ($P > 0.05$). Average hospitalization time in the first group was 13.1 ± 9.8 days (8 - 31 days) and in the second group was 14.8 ± 10.4 days (7 - 41 days), while no significant difference was observed between the two groups in terms of the number of hospitalization days ($P > 0.05$). The number of hospitalization days and incidence of infection were significantly correlated ($P < 0.05$).

In the first group, twenty-nine patients (30.8%) and in the second group, forty-one patients (43.6 %) had previously undergone urinary catheterization. In addition, three patients (3.1 %) in the first group and five patients (5.3%) in the second group had a history of urinary tract infection after catheterization. In this study, nine patients

Table 1. Distribution of Absolute and Relative Frequency of the Studied Units^a

Variable	First Group, No. (%)	Second Group, No. (%)
Bacteriuria		
Yes	18 (19.1)	13 (13.8)
No	76 (80.8)	81 (86.2)
Bacteriuria with urinary tract infection symptoms		
Yes	7 (7.4)	5 (5.3)
No	11 (11.7)	8 (8.5)
Bacteriuria with pyuria		
Yes	15 (15.9)	11 (11.7)
No	3 (3.1)	2 (2.1)
Positive urine culture		
Yes	12 (12.7)	9 (9.5)
No	82 (87.3)	85 (90.5)

^a Abbreviation: WBC, white blood cells.

(4.7%) had prostatic hyperplasia, that four of them belonged to the first group, and five patients belonged to the second group. Overall, the rate of urinary tract infection in this study was 16.4% where this rate was 19.1% in the first group and 13.8% in the second group. The statistical test showed significant difference between the two groups in the incidence of urinary tract infection ($P < 0.05$). Results showed a total OR of 1.5 indicating that the risk of infection was higher in the first group.

Twelve patients in the first group had positive urine culture while nine patients in the second group showed the same results. *Escherichia coli* was the most common detected microorganism in both groups, that was detected in 66.6% of patients the first group and 88.8% of the patients in the second group. Ten Gram-negative bacteria (83.3%) isolated from the first group patients and 8 (88.8%) isolated from the patients in the second group. In patients who had a positive urine culture, clinical symptoms of urinary tract infection was observed in 50% of the first group and 44.4% of the second group, and pyuria was observed in 91.6% of the patients in the first group and 100% of patients in the second group. There was a significant relationship between the patients' age and incidence of urinary tract infections ($P < 0.05$). There was no significant relationship between history of urinary tract infection and incidence of urinary tract infection ($P > 0.05$). There was no significant relationship between prostatic hyperplasia and incidence of urinary tract infections ($P > 0.05$).

5. Discussion

Urinary catheters especially the indwelling catheters are among the most important factors for urinary tract infections of hospitalized patients which comprises about 40% of these infections in most hospitals (9,10). The

widespread use of urinary catheters as therapeutic aid in different hospital departments to drain urine of patients undergoing major abdominal surgeries such as abdominal hysterectomy, patients undergoing cesarean delivery and prostatectomy or for urine control in people with urinary incontinence, can cause increased urinary tract infections in these patients (11). According to our findings, most of the patients were 25 - 35 years old men compromised 81 of the patients (43%). Patients were divided into two groups, in the first group, some sterilization parameters did not implemented and in the second group, all cases of sterilization were completely implemented. The two study groups showed no significant difference in terms of age. Moreover, 37.2% of the individuals in this study had a history of catheterization which 4.2% of patients had a history of infection after catheterization. In this study, the incidence of infection was 19.1% in the first group and 13.8% in the second group where the statistical analysis showed significant difference between the two groups with regards to the incidence of urinary tract infection. Also the results of the study showed a total OR of 1.5 indicating higher risk of infection among patients in the first group. According to the previous studies, there is a significant relationship between age and catheter-related infections.

Furthermore, the results of this study revealed that most patients with urinary tract infection were infected with Gram-negative bacteria. *E. coli* was the most common microorganism causing urinary tract infection in both groups, which is in agreement with the results of previous research. *Candida* was not isolated from the patients with urinary tract infection which is probably because the patients did not use antibiotics. Most of the patients with positive urine culture, in both groups had pyuria while they showed slight urinary symptoms. Re-

garding the low level of urinary tract infection, clinical symptoms, presence of catheter in the urinary tract can be noted which can suppress the clinical symptoms of urinary tract infection expect fever and sometimes suprapubic sensitivity. In this study, no significant correlation was found between the incidence of catheter-associated urinary tract infection and prostatic hyperplasia. It should be explained that in patients who have a urinary catheter, obstructive effect of enlarged prostate on urine flow is resolved due to the urinary catheter which can justify the lack of relationship between urinary tract infection and prostatic hyperplasia.

Another finding of this research is the relationship between the severity of disease and urinary tract infection which is similar to the results reported by Leone et al. (12). However, these findings should be interpreted cautiously because firstly, the sample size was small and secondly, only male patients were involved in this research. Therefore, it seems that to assess the relationship between severity of the main disease and urinary tract infection, the sample size should be large enough and the patients of both genders should be involved in the studied. The significant relationship between long-term catheterization and the incidence of urinary tract infections should be mentioned in the study. According to this study, it was determined that by employing the sterilization principles during catheterization and sterilization of instruments, as well as training the staffs involved in this process are among the most important points that can significantly reduce the incidence of infections after catheterization, so by emphasizing on the need to implement this process and implementation of all issues regarding sterilization, we can considerably reduce the infectious burden of this problem.

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Authors' Contributions

Study concept and design: Masoumeh Kaboli, Hossein Gholami, Hasti Masiha Akbar. Acquisition of data: Hengame Kheyrikhah, Koosha Ramezani, Maryam Ghavam, Mehrdad Jor gholami. Analysis and interpretation of data: Masoumeh Kaboli, Hossein Gholam, Hasti Masiha Akbar, Talaye Mirkarimi. Drafting of the manuscript:

Masoumeh Kaboli, Hossein Gholami. Critical revision of the manuscript for important intellectual content: Mehrdad Jor gholami, Hengame Kheyrikhah, Koosha Ramezani. Statistical analysis: Masoumeh Kaboli, Hossein Gholam, Hasti Masiha Akbar. Administrative, technical, and material support: Masoumeh Kaboli, Hossein Gholam, Hasti Masiha Akbar, Hengame Kheyrikhah. Study supervision: Masoumeh Kaboli, Hossein Gholam, Hasti Masiha Akbar, Maryam Ghavam.

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