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ORIGINAL ARTICLE

Investigation of Nosocomial Urinary Tract Infections in Patients with Urinary Catheters

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ABSTRACT

Aim: The most significant adverse outcome of urinary catheter use is the development of a urinary tract infection (UTI). This study evaluates the role of urinary catheterization in emergencies compared to elective conditions in wards, focusing on the development of catheter-associated urinary tract infections (CA-UTI). **Methods:** Our study is a single-center retrospective case-control study between August 1 and December 30, 2021. The case group consists of patients aged 18 years and older, who underwent urinary catheterization in the emergency department (ED) and were hospitalized for at least 48 hours. The control group consisted of patients who underwent elective urinary catheterization in the wards and continued to be hospitalized for at least 48 hours. Two groups were compared in terms of development, predisposing factors of CA-UTI and reasons of using urinary catheter. **Results**: The most reason for urinary catheterization in case and control groups, each of consisted of 106 patients, is for patients' unstable medical conditions with ratios of 82.1% and 77.4%, respectively. The duration of urinary catheterization in case and control groups was 8.4 and 11.17 days, respectively ($p<0.0001$). While majority of the urinary catheter insertions were performed by intern doctors in the ED; most of them were carried out by assistant doctors in the wards ($p=0.001$). The rate of development of CA-UTI in case and control groups, was 0.078 and 0.064 per 1000 catheter days, respectively, and although the case group was higher, there was no significant difference ($p>0.005$). **Conclusion**: The process of urinary catheterization in the emergency department has not been identified as an additional risk factor for the development of CA-UTI when compared to urinary catheterization in the ward. No difference was detected in terms of catheter practitioner. This may be related to the small total number of cases, the longer catheterization duration in the control group, and the low prevalence of CA-UTI in the study.

Keywords: Emergency Department, Prevention, Urinary Catheter, Urinary Tract Infection

ÖZET

Amaç: Üriner sonda kullanımının en önemli dezavantajı, idrar yolu enfeksiyonuna (İYE) zemin hazırlamasıdır. Bu çalışma, acil ve elektif koşullarda üriner sonda uygulamalarının karşılaştırılması ve bunun sonucunda kateter ilişkili idrar yolu enfeksiyonu (Kİ-İYE) gelişiminin değerlendirilmesi amaçlanmıştır. **Yöntem:** Çalışmamız, 1 Ağustos- 30 Aralık 2021 tarihleri arasında tek merkezli retrospektif bir vaka-kontrol çalışmasıdır. Vaka grubu, acil serviste (AS) üriner kateterizasyonu yapılan ve en az 48 saat hastanede yatan 18 yaş ve üzeri hastalardan oluşmaktadır. Kontrol grubu ise serviste elektif üriner kateterizasyonu yapılan ve en az 48 saat daha hastanede kalan hastalardan oluşmaktadır. İki grup, Kİ-İYE gelişimi, predispozan faktörler ve üriner kateter kullanma nedenleri açısından karşılaştırılmıştır. **Bulgular:** Hem vaka hem de kontrol gruplarında,106 hasta bulunmaktadır. En sık üriner kateterizasyon nedeni, sırasıyla %82.1ve %77.4 oranlarıyla genel durum bozukluğu olarak belirlenmiştir. Vaka ve kontrol gruplarında üriner kateterizasyon süresi sırasıyla 8,4 ve 11,17 gün olarak bulunmuştur ($p<0.0001$). Üriner kateter takma işlemi vaka grubunda daha çok intern doktorlar, kontrol grubunda ise asistan doktorlar tarafından yapılmıştı ($p=0.001$). Kİ-İYE gelişme oranı vaka ve kontrol gruplarında sırasıyla 1000 kateter günü başına 0.078 ve 0.064 idi ve vaka grubunda daha yüksek olmasına rağmen anlamlı bir fark yoktu ($p>0.005$). **Sonuç:** Acilde üriner kateter uygulanım süreci Kİ-İYE gelişimi açısından serviste üriner kateter uygulanımına göre ek bir risk faktörü olarak saptanmamıştır. Kateter uygulayıcısı açısından da farklılık saptanmamıştır. Toplam olgu sayısının azlığı, kontrol grubunda kateterizasyon süresinin daha uzun olması ve çalışmada Kİ-İYE prevalansının düşük olması ile ilişkili olabilir.

Anahtar Kelimeler: Acil Servis, Önleme, İdrar Kateteri, İdrar Yolu Enfeksiyonu

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INTRODUCTION

The most significant adverse outcome of urinary catheter use is the development of a urinary tract infection (UTI). Several risk factors contribute to catheter-associated urinary tract infections (CA-UTI), including age, female gender, diabetes, and prolonged catheterization time. Among these, the duration of catheterization is the most critical factor in the development of bacteriuria and UTI, with a daily risk of 3-7% for bacteriuria and 0.3% per catheter day for UTI (1, 2). One study found that physicians are often unaware (38% of the time) that their patients have indwelling urinary catheters, with unsuitable catheters being 'forgotten' more frequently than suitable ones (3).

Unnecessary urinary catheter placement is a significant issue in emergency departments. Often based on subjective judgment rather than objective criteria, many catheters are inserted without documented need. To prevent complications and reduce the risk of harm during hospitalization, it is crucial to avoid catheterization unless indicated. By strictly adhering to objective criteria for catheter placement, emergency departments can substantially decrease catheter usage. (4). When catheterization is necessary, sterile equipment and aseptic techniques should always be employed (5).

Existing knowledge on the prevention of urinary tract infections associated with urinary catheterization in the emergency department is limited. CA-UTI prevention programs have been developed with a focus on the entire hospital. Unlike programs that emphasize the continuous assessment of the necessity of the catheter and its early removal for CA-UTI prevention, in the emergency department, the focus has been on minimizing the use of urinary catheters and ensuring proper insertion techniques (13).

This study aims to evaluate the role of urinary catheterization in emergencies on the development of CA-UTI compared to the application of elective conditions in inpatient services.

MATERIAL AND METHOD

Our study is a single-center observational retrospective case-control study between August 1 and December 30, 2021, conducted in 1100-bed tertiary academic hospital.

The case group consists of patients aged 18 years and older, who underwent urinary catheterization in the ED and were hospitalized for at least 48 hours. The control group consisted of patients who underwent

elective urinary catheterization in the inpatient service and continued to be hospitalized for at least 48 hours. Patients followed in the intensive care unit have not been included. Both groups were evaluated for the development of CA-UTI until discharge or death. Hospital infection control committee follow-up data was used. CAUTIs were defined according to Centers for Disease Control and Prevention (CDC) criteria (6). The two groups were compared in terms of CA-UTI development, reasons of using urinary catheter and predisposing factors. Our study has received ethical approval from the Non-Invasive Research Ethics Committee of Eskişehir Osmangazi University Faculty of Medicine (Decision No: 2022/53, Date: 22/03/2022).

Statistical analysis

Statistical analyses were conducted using IBM SPSS 25. The Shapiro-Wilk test was utilized to assess the suitability of the data for normal distribution. Numerical values were analyzed using the Mann-Whitney U test, while categorical variables were examined through the Chi-Square test. Specifically, Fisher's Exact test was applied in 2x2 tables, and the Pearson Chi-Square test was used in other cases. The study, which included 212 patients had a power of 0.9, and a p-value of less than 0.05 was considered statistically significant. In the prior power analysis conducted to determine a significant difference between the patient and control groups, a power of 90%, a type I error of 0.05, and an effect size of 0.447 were used. The calculated sample size was a total of 212 (106 cases and 106 controls). The power analysis was performed using the G-Power 3.1.9.2 software.

RESULTS

The case and control group each consisted of 106 patients. The ratios of the reasons for using a urinary catheter in the case and control groups, respectively, are as follows; for urinary analyses (13.2% vs. 0%), for patients' unstable medical condition (82.1% vs. 77.4%) and for surgical preparation (4.7% vs. 22.6%) ($p<0.001$) (Table 1).

Table 1. Reasons for urinary catheter placement in case and control groups

Reason	Case group (n=106) %	Control group (n=106) %
Urinary analyses	13.2	0
Patients' unstable medical condition	82.1	77.4
Surgical preparation	4.7	22.6

Demographic characteristics and predisposing factors of the patients in the case and control groups were evaluated and there was no significant difference in terms of age, gender, and predisposing factors (stone, obstruction, prostatic disorders, malignity, incontinence, chronic disease) (Table 2).

The distribution of patients during the hospitalization period was as follows in the case and control groups, respectively; 32.1% and 23.6% in internal clinics, 34% and 44.3% in internal intensive care units, 13.2% and 11.3% in surgical clinics and 20.8% and 20.8% in surgical intensive care units (p=0.657).

The percentage of urinary analysis performed before urinary catheterization was 67.9% and 49.1% in the case and control groups, respectively (p=0.05). The rate of pyuria and nitrite positivity in the urine before urinary catheterization was 19.4% and 7%, respectively, in the case group, while it was 29.6% and 5.6%, respectively, in the control group. No statistically significant difference was found between the two groups in terms of pyuria and nitrite positivity (p=0.209 and p=1, respectively).

During the follow-up, urinary catheter changes were made in 7.5% of the case group, and 11.3% of the control group, and there was no statistical difference (p=0.384). There was no statistically significant difference between the groups in terms of catheter irrigation during the follow-up period (p=0.432) and it was 16% and 11.3% in the case and control groups, respectively. Interventions to the urinary catheter are shown in Table 3.

Table 2. Demographic characteristics and predisposing factors of case and control groups

	Case group	**Control group**	**P**
	n=106	n=106	
Age (Mean)/year	64.34	68.42	0.1*
Female/Male	52/54	47/59	0.165**
Stone	1	2	0.756***
Obstruction	2	3	0.931***
Prostatic disorders	4	0	0.26***
Malignity	7	16	0.188***
Incontinence	15	34	0.54***
Chronic Disease	47	58	0.784***

***** Mann-Whitney U test ****** Pearson Chi-Square ******* Fisher's Exact test

Table 3. Interventions to urinary catheter during the study period.

Interventions	Case group (n=106) %	Control group (n=106) %	P
Catheter replacement	7.5	11.3	0.384*
Catheter irrigation	16	11.3	0.432*

* Pearson Chi-Square

The length of stay of the urinary catheter in the case and control groups was 8.4 and 11.17 days, respectively, and there was a significant difference between the groups (p<0.0001).

Broad-spectrum antibiotic use was 64.6% and 69.5% in the case and control groups, respectively, and there was no statistically significant difference between the groups (p=0.551).

The causative agents of CA-UTI were similar in both groups, and the most common causative agent was Escherichia coli with a rate of 33% and 45% in the case and control groups, respectively. Other agents, in order of frequency, were Staphylococcus heamolyticus, Enterococcus feacalis, Acinetobacter baumanni, Candida glabrata, Enterococcus feacium and Klebsiella pneumoniae.

When the distribution of health workers who apply the urinary catheter is examined, 82% are intern doctors, 17% are assistant doctors and 1% are nurses in the ED.

In the wards, by contrast, 56% are assistant doctors and 44% are nurses. While majority of the urinary catheter insertions were performed by intern doctors in the ED; most of them were carried out by assistant doctors in the wards (p=0.001).

When the rate of development of CA-UTI is evaluated; 0.078 and 0.064 per 1000 urinary catheter days in the case and control groups, respectively. Although the case group was higher, there was no significant difference in the development of CA-UTI between the case and control groups (p>0.05).

DISCUSSION

Urinary catheters are used more frequently and with wider indications in ED. Despite the lack of comprehensive medical documentation for urinary catheters, this issue has been interpreted as inappropriate usage in several studies (7,17). A study reported that the rate of urinary catheterization in the emergency department for patients aged 65 and older was 73%. Of these, 4% were deemed inappropriate, and 8.7% developed CA-UTI. At the end of the study, it was recommended to create a list of acceptable indications for urinary catheter insertion in emergency departments (16). Fakih et al. (7) show that only 69.7% of patients undergo urinary catheterization in ED were

compliant with the institutional guidelines for catheterization. Gokula et al. (8) reported in their study that only 46% of catheter use was an appropriate indication. A study has demonstrated that educational programs for doctors and nurses, along with the mandatory implementation of a checklist containing acceptable indications, resulted in nearly an 80% reduction in catheter use in the emergency department. Additionally, the rate of 'appropriate catheter use' increased from 37% to 51% (p=0.06), while the proportion of physician order documentation rose from 43% to 63% (p<0.01) (18). A study based on long-term follow-up has shown that inpatients receiving routine monitoring of urinary catheter use, with a focus on re-evaluating indications and appropriateness during the hospitalization process and early discontinuation in the emergency department, demonstrated a trend toward a decrease in urinary catheter use across the hospital (20). In our study, in the ED, 13.2% of urinary catheters were applied only for urinary analysis. Even when inappropriately placed in the emergency department, urinary catheters are often transferred to the wards without removal. For this reason, the indication for urinary catheter application in ED should be carefully evaluated and the indication should be reviewed when the patient is transferred to the wards. Establishing an automated control or warning system can help clinicians in this regard.

The number of studies investigating the role of emergency and elective intervention in the development of CA-UTI is not high in the literature. While some studies have determined that urinary catheterization in the ED is a risk factor for bacterial colonization of catheters and CA-UTI (9, 10, 19), there is also a study in the literature that was not detected as a risk factor (11).Bhatia et al. (9) found that urinary catheter colonization and CA-UTI were more common in patients who underwent urinary catheterization in the ED, compared to patients with urinary catheterization in the wards. They attributed this to inadequate sterile precautions taken during catheter insertion in the ED, citing time constraints as a factor. Our study did not reveal a significant difference in CA-UTI rates between the case and control groups. This could be attributed to the small control group size, minimization of catheterization duration or the overall low CA-UTI prevalence.

Contamination of sterile catheters during urinary catheter insertion is unfortunately common. In a study where patients who had urinary catheters placed by nurses in the emergency department were prospectively observed for 6 months, a significant breach in aseptic technique was found in 59% of cases. The characteristics of the emergency department environment, where life-threatening conditions are prioritized, inconsistent or inappropriate placement of hand sanitizers, and limited space to create sterile moments, have been identified as contributing factors (15). The same study found no association between the catheter inserter or patient characteristics and variations in technique. In our study, urinary catheter insertion was more frequently performed by

intern doctors in the emergency clinic, while in the elective urinary catheter insertion group, it was performed by resident doctors. However, no difference was found in terms of CA-UTI development, and therefore, it was not defined as a risk factor.

The duration of catheterization is the most significant modifiable risk factor associated with the development of infection (14). Oumer et al. (12) stated that prolonged catheterization (7 days) is an independent risk factor for CA-UTIs. Conversely, Bhatia et al. (9) reported higher urinary catheter colonization and CA-UTI rates in ED patients despite shorter catheterization (4.3 days) compared to ward patients (6.2 days), attributing this to inadequate ED sterile precautions due to time constraints. Our case group exhibited shorter catheterization (8.4 days) than the control group (11.17 days, $p<0.0001$), possibly due to earlier catheter removal in the wards. However, despite this shorter duration, we observed no significant difference in CA-UTI rates between groups. This suggests that factors beyond catheterization time, such as inadequate ED sterile precautions, may contribute to CA-UTI development. Further research is needed to elucidate these factors.

A study has shown that obtaining a urine culture when urinary catheterization is performed in the emergency department helps reduce unnecessary tests and treatments in the subsequent process (7). Another study found that among cases where both urine analysis and culture were performed along with urinary catheter insertion in the emergency clinic, 26% exhibited evidence of UTI (10). In our study, urine analysis was performed prior to catheterization, and no significant difference was found in terms of CA-UTI development.

Limitations

There are some limitations in our study. The team applied the urinary catheter was not followed up. Therefore, data on inappropriate use of the urinary catheter could not be obtained. There are no medical records regarding the criteria for the clinical appropriateness of urinary catheters or the adherence to aseptic techniques. In addition, the small number of patients weakened our results.

CONCLUSIONS

Urinary catheterization in the emergency department was not found to be an additional risk factor for CA-UTI development compared to urinary catheterization in the inpatient setting. This may be related to the small total sample size, the longer catheterization duration in the control group, and the generally low prevalence of CA-UTI. No significant difference was found regarding urinary catheter practitioners in the emergency department. The fact that the study was conducted in a tertiary care hospital emergency department, where practitioners undergo regular and standardized training and aseptic techniques are monitored, may explain this finding. Further evaluation is warranted through large-scale studies with a larger sample size to provide more robust evidence.

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Conflict of interest: The authors declare no conflicts of interest.

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