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Comparison of Catheter Care Practices and Catheter Infection Rates of Turkish and Dutch Intensive Care Units in Two University Hospitals: A Prospective Study

Türkiye'de ve Hollanda'da İki Üniversite Hastanesinde Yoğun Bakım Ünitelerinde Kateter Bakımı ve Kateter İnfeksiyon Oranlarının Karşılaştırılması: Bir Prospektif Çalışma

Emine ALP[1], Frans LOEFFLEN[2], Mehmet DOĞANAY[1], Andreas VOSS[2,3]

[1] Department of Infectious Diseases and Clinical Microbiology, Faculty of Medicine, University of Erciyes, Kayseri, Turkey
[2] Department of Medical Microbiology, Radboud University Medical Centre, Nijmegen, The Netherlands
[3] Department of Medical Microbiology and Infectious Diseases, Canisius-Wilhelmina Hospital, Nijmegen, The Netherlands

SUMMARY

Introduction: *The aim of this study was to compare catheter care practices before and after an educational intervention and also catheter infection rates after intervention in the intensive care units (ICUs) of two university hospitals, in Turkey and Holland.*

Materials and Methods: *The study was prospectively conducted in the ICUs of two university hospitals (1 Turkish, 1 Dutch). We compared catheter-related infection (CRI) rates and catheter care practices (hand hygiene practice, hub disinfection, skin antisepsis) before and after educational interventions. The study consisted of three periods: pre-interventional period, interventional period (feedback, educational program) and re-observations of the nurses, at one and six month(s) after the intervention.*

Results: *Skin antisepsis and dressing practices differed between the two hospitals, while both settings employed bedside alcoholic rubs. The overall compliance with hand disinfection prior to the intervention was significantly different between the two ICUs (65% versus 18% in the Dutch and Turkish ICUs, respectively). In both settings, the interventions led to an immediate increase in hand hygiene compliance. However, six months after the intervention, compliance dropped in the Turkish ICUs, whereas it further increased in the Dutch setting. Comparably, hub disinfection rates were lower in the Turkish ICUs before and after the intervention. Most likely as a result of the lower compliance with catheter-care practices, CRI rates were two-fold higher among Turkish ICU patients.*

Conclusion: *Catheter-related bloodstream infection (CR-BSI) can be significantly reduced by applying multifaceted interventions that help to ensure adherence with simple, evidence-based infection control measures. Educational programs and feedback are part of these interventions but, as shown in the present study, will not achieve persistent behavioral changes unless they are repeatedly applied.*

Key Words: *Catheter-related infections, Infection control, Hand, Hygiene*

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ÖZET

Türkiye'de ve Hollanda'da İki Üniversite Hastanesinde Yoğun Bakım Ünitelerinde Kateter Bakımı ve Kateter İnfeksiyon Oranlarının Karşılaştırılması: Bir Prospektif Çalışma

Emine ALP[1], Frans LOEFFLEN[2], Mehmet DOĞANAY[1], Andreas VOSS[2,3]

[1] Erciyes Üniversitesi Tıp Fakültesi, İnfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Anabilim Dalı, Kayseri, Türkiye

[2] Radboud Üniversitesi Tıp Merkezi, Tıbbi Mikrobiyoloji Bölümü, Nijmegen, Hollanda

[3] Canisius-Wilhelmina Hastanesi, Tıbbi Mikrobiyoloji ve İnfeksiyon Hastalıkları Bölümü, Nijmegen, Hollanda

Giriş: *Bu çalışmanın amacı, Türkiye ve Hollanda'daki iki üniversite hastanesi yoğun bakım üniteleri (YBÜ)'nde kateter bakımını eğitim öncesi ve sonrasında karşılaştırmak ve müdahale sonrası dönemde kateter infeksiyon oranlarını karşılaştırmaktır.*

Materyal ve Metod: *Çalışma Türkiye ve Hollanda'daki iki üniversite hastanesi YBÜ'lerinde prospektif olarak yapıldı. Kateter ilişkili infeksiyon oranları ve kateter bakım uygulamaları (el hijyeni, hub dezenfeksiyonu, deri antisepsisi) eğitim öncesi ve sonrası karşılaştırıldı. Çalışma üç dönem içeriyordu; müdahale öncesi dönem, müdahale dönemi (geri bildirim, eğitim programı) ve hemşirelerin müdahaleden bir ve altı ay sonra tekrar gözlem dönemi.*

Bulgular: *Her iki merkezde yatakbaşı alkol bazlı el dezenfektanı kullanılmakla beraber, cilt antisepsisi ve kateter örtüsü uygulamalarında farklılıklar vardı. Müdahale öncesi dönemde her iki merkezin YBÜ'lerinde el dezenfeksiyonuna uyum oranları anlamlı ölçüde farklı (Hollanda YBÜ'lerinde %65, Türkiye YBÜ'lerinde %18) idi. Her iki merkezde de müdahaleden hemen sonra hemşirelerin el hijyenine uyumunda artış izlendi. Ancak müdahaleden altı ay sonra, uyum Türkiye'deki merkezin YBÜ'lerinde düşerken, Hollanda'daki merkezin YBÜ'lerinde arttı. Benzer olarak, Türkiye'de bulunan merkezdeki YBÜ'lerde hub dezenfeksiyonu müdahale öncesi ve sonrası dönemde düşüktü. Türkiye'de bulunan merkezdeki YBÜ'lerde katetere bağlı infeksiyon oranlarının iki kat fazla görülmesi muhtemelen, kateter bakımındaki infeksiyon kontrol önlemlerine uyumsuzlukla ilişkiliydi.*

Sonuç: *Kateter ilişkili kan dolaşımı infeksiyonu oranları, basit, kanıta dayalı infeksiyon kontrol önlemlerine uyumu artıracak pek çok müdahale ile azaltılabilir. Eğitim programları ve geri bildirim bu müdahalelerin bir kısmıdır, ancak bu çalışmada da gösterildiği gibi kalıcı davranış değişiklikleri ancak tekrarlanan müdahalelerle sağlanabilir.*

Anahtar Kelimeler: *Kateter ilişkili infeksiyonlar, İnfeksiyon kontrolü, El, Hijyen*

INTRODUCTION

Current medical practices could not ensue without a wide use of vascular catheters for therapeutic and diagnostic applications. In intensive care units (ICUs), the use of catheters has become an essential part of daily care in order to administer medications, fluids, parenteral nutrition, and blood products or to monitor cardiac functions. Catheters for venous access are inserted into more than 60% of all hospitalized patients, and 48% of ICU patients have indwelling central venous catheter (CVC) in situ[1]. Unfortunately, this intense use of vascular catheters is inherently combined with complications such as catheter-related infections (CRIs). Data from the National Nosocomial Infection Surveillance (NNIS) system have revealed that blood stream infections (BSI) are the third most common nosocomial infection (14%) in ICU patients and that 87% of primary BSIs were associated with a central line[2]. While CRIs are a major cause of morbidity, mortality and increased costs of care, they are preventable by simple infection control measures such as hand hygiene, adequate skin preparation and full-barrier precautions during insertion[3-6].

In this study, we compared CRI rates and catheter care practices (hand hygiene practice, hub disinfection, skin antisepsis) applied to ICU patients in two university hospitals (1 Turkish, 1 Dutch), before and after educational interventions.

MATERIALS and METHODS

The study was prospectively conducted in ICUs of a Turkish (T-ICUs, 38 beds) and Dutch (D-ICUs, 40 beds) university hospital and consisted of three periods: in the pre-interventional period, we observed 40 Dutch and 50 Turkish nurses during catheter

care and intravenous (IV) drug administration. Their compliance with hand disinfection, hub disinfection and correct skin antisepsis was registered. The second period was an interventional period consisting of the feedback of the results of the first period and application of an educational program regarding catheter care. The educational program was based on the intravascular therapy guidelines of the Dutch Infection Prevention Working Party[7]. The third study period included re-observations of the nurses, at one and six month(s) after the intervention. During the study period, there was no change among the nurses in the ICUs. CRI rates were recorded after the interventions in the two university hospitals. Furthermore, all CRIs were determined using the Centers for Disease Control and Prevention (CDC) definitions[8]. In the T-ICUs, the bed-to-bed space is minimal (< 1 m) and there are an insufficient number of healthcare workers (HCWs) (nurse/patient ratio: 1/3-5). In the D-ICUs, the bed-to-bed distance is at least 150 cm and the nurse/patient ratio is 1/1. The chi-square test was used for statistical analysis, and a p-value of < 0.05 was accepted as indicating statistical significance.

RESULTS

Hand disinfection prior to intravenous catheter care is regarded as one of the most important infection control measures to prevent CRIs. While alcohol-based hand-rubs were located at the bedside in the Dutch as well the T-ICUs, the nurse/patient staffing ratio was 1/1 versus 1/4, respectively. Maximal sterile barrier precautions were already used in both ICUs.

The compliance with hand disinfection prior to catheter care before and after the intervention is shown in Figure 1. The overall compliance with hand disinfection in the D-ICUs was 65%, ranging from 47% before CVC care to 91% before peripheral vascular catheter (PVC) care. About two-thirds of the nurses (66.7%) disinfected their hands before taking care of an arterial line. In general, the compliance rates in the T-ICUs was lower than in the D-ICUs (p< 0.001). The overall rate of compliance with hand disinfection was 18%, ranging from 0% and 5% to 31%, before arterial line, CVC, and PVC care, respectively. In both settings, the interventions led to an

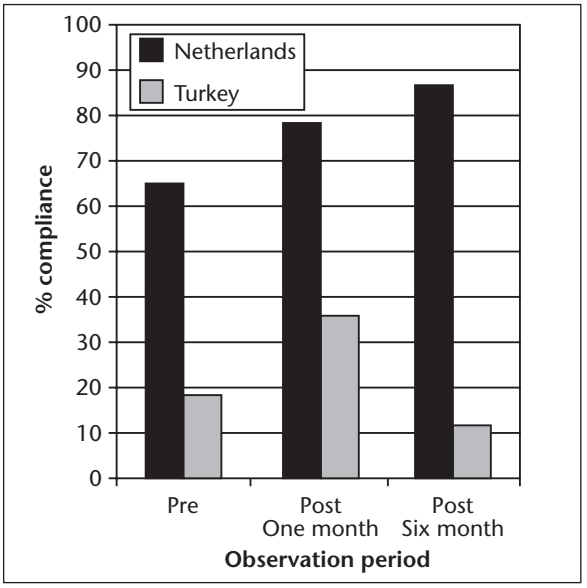

Figure 1. Compliance with hand disinfection among nurses in the Dutch and Turkish intensive care units before and after an educational intervention.

immediate increase in hand hygiene compliance (p= 0.03 for D-ICUs, p= 0.004 for T-ICUs). However, six months after the intervention, compliance dropped in the T-ICUs, whereas it further increased in the D-ICUs.

Hubs were disinfected prior to IV administration in 42% of the cases in the D- ICUs, versus 17% in the T-ICUs (p= 0.02). In both settings, the compliance dropped after the intervention. While in the T-ICUs, disinfection of hubs was completely omitted (0% compliance), the rates in the D-ICUs dropped to 22% and 21%, one and six months after the intervention, respectively.

In D-ICUs, 0.5% chlorhexidine gluconate in 80% alcohol was used for skin antisepsis whereas 10% povidone iodine was used in the T-ICUs. Transparent dressing was used in the D-ICUs for both PVCs and CVCs, whereas the T-ICUs initially used plaster for PVCs and a sterile non-woven adhesive wound dressing for CVCs. After the intervention, the sterile non-woven adhesive wound dressing was used for both PVCs and CVCs.

For the month following the intervention, the CRI rates were 7/1000 versus 3.5/1000 catheter days in the Turkish and Dutch ICUs, respectively.

DISCUSSION

The presence of a vascular catheter in an ICU patient is an important risk factor for acquiring nosocomial infections. Bacterial colonization at the catheter insertion site, contamination of the catheter hub, and transmission of microorganisms from the HCWs hands are the three major sources of CRI. Microorganisms, especially in close proximity of the insertion site, move along the catheter surface and gain access to cause infections. Progression of these invading microorganisms along the catheter tract can result in BSI with or without obvious involvement of local CRIs, such as insertion site or tunnel infections[9]. Appropriate skin disinfection before the catheter insertion is an important preventive measure to reduce the bacterial colonization. While earlier studies and guidelines favored the use of aqueous chlorhexidine gluconate over povidone-iodine or alcohol, recent reports have indicated the superiority of alcoholic solutions of povidone-iodine and chlorhexidine in preventing microbial CVC colonization and consequent infections[10-16]. The choice of an alcoholic solution of 0.5% chlorhexidine gluconate in the D-ICUs, therefore, might be preferable over the 10% povidone iodine used in the T-ICUs.

During their work, HCWs' hands are commonly colonized with nosocomial bacteria. These pathogens may be transmitted from patient to patient when the compliance with hand hygiene is poor. Consequently, hand hygiene is the gold standard for the prevention of cross-infection among patients. However, many studies have shown that hand hygiene compliance of HCWs is poor, particularly among those in ICUs[17-20]. The poor compliance of ICU HCWs can best be explained by their heavy workload, leaving insufficient time for hand hygiene. Alcohol-based solutions can (in part) solve this problem and improve hand disinfection compliance, because of the less time required for hand rub[21]. Since handwashing is less efficacious than hygienic hand disinfection with alcoholic rub, in general a system change (point-of-care use of alcoholic rubs) is needed. Hirschmann et al.[22] showed that washing hands was no better in preventing CRIs than disregarding hand hygiene altogether.

While both the Turkish and Dutch ICUs went through a system change and offered point-of-care use of alcoholic rubs, the hand hygiene compliance before catheter care was significantly worse among T-ICUs nurses. The major reasons for non-compliance are the heavy workload, inadequate structure (lack of sinks, difficult access to hygiene products), and behavioral aspects. All of the above factors are amplified by the combination of overcrowding and insufficient numbers of HCWs. In the Netherlands, on average, the nurse/patient ratio in ICUs is 1/1, whereas in Turkey this is usually 1/3-5.

Educational programs and feedback are part of the multi-modal strategy to improve hand hygiene compliance[23,24]. During the intervention phase, feedback was given to the ICU nurses with regard to the results of the first observation. Furthermore, all nurses were instructed on how to implement the catheter-care guideline. While the compliance progressively increased among the Dutch nurses, the hand hygiene compliance before catheter-care in Turkish nurses actually dropped six months after the intervention. Despite the fact that knowledge is only a weak motivator for behavioral change, the outcome in the T-ICUs is surprising. As mentioned above, the significant higher workload may in part explain the differences, but in addition, behavioral differences may affect the compliance in different countries.

The pathogenesis of vascular catheter infections is often related to the colonization of the hub and the lumen originated from the skin. Microorganisms, contaminating the catheter hub, can be infused during the administration of the medications or fluids[25]. Therefore, hub disinfection is another important infection control measure for CRIs. It was low in both ICUs and decreased after intervention.

Within the two settings, a different type of dressing was used to protect the catheter insertion site. While the best choice of dressing for this indication may be discussed, it is important to notice that the type of dressing remained unchanged in the Dutch ICU (according to the guideline), whereas an attempt to improve the choice of dressing was followed immediately after the intervention in the Turkish setting, but HCWs unintentionally reverted back to the old type of dressing within the following months. Cotton gauze dressings are preferred to transparent dressings because of low colonization rates[26].

All of the above cannot explain how it was possible that in both settings the disinfection of the hubs decreased after the intervention, and within the Turkish setting even to the point of total disregard, despite the fact that hub disinfection was a part of the educational program. Obviously, hub disinfection was not perceived as important in comparison to, for example, hand hygiene compliance.

Nevertheless, we can not strictly compare the CRI infection rate in the two settings, since the two patient populations are not fully described, the two-fold higher CRI rate in the T-ICUs may be seen as a result of the lower compliance with catheter-care practices and because of the unfavorable nurse/patient ratio.

Catheter-related blood stream infections can be significantly reduced by applying multifaceted interventions that help to ensure adherence with simple, evidence-based infection control measures[27]. Educational programs and feedback are part of these interventions but, as shown in the present study, will not achieve persistent behavioral changes unless they are repeatedly applied. The different effects on the Turkish and Dutch ICU nurses observed in the present study may be explained by several parameters, such as lack of education/experience, being overworked, lack of knowledge, and possibly cultural differences that may influence the general compliance to work according to guidelines versus enjoying professional freedom.

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Yazışma Adresi/Address for Correspondence

Doç. Dr. Emine ALP

Erciyes Üniversitesi Tıp Fakültesi
İnfeksiyon Hastalıkları ve
Klinik Mikrobiyoloji Anabilim Dalı
38039 Kayseri-Türkiye

E-posta: ealp@erciyes.edu.tr