Applied Nursing Research 32 (2016) 257–261

Contents lists available at ScienceDirect

Applied Nursing Research

journal homepage: www.elsevier.com/locate/apnr

# The effect of nursing care protocol on the prevention of central venous catheter-related infections in neurosurgery intensive care unit

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ARTICLE INFO

*Article history:*
Received 1 April 2016
Revised 15 August 2016
Accepted 18 August 2016
Available online xxxx

*Keywords:*
Central venous catheters
Infection
Nursing care
Protocols

ABSTRACT

*Purpose:* This clinical study was planned to determine the effect of Nursing Care Protocol on the prevention of central venous catheter-related infections in neurosurgery intensive care unit.
*Method:* The study was conducted between January 2012 and December 2013. The sampling consisted of 160 patients compatible with study inclusion criteria (80 protocol and 80 control patients). Routine care was applied to the control group while the protocol group received catheter care according to the protocol formed in accordance with the suggestions of the Centers for Disease Control and Prevention. The data were collected from Patient Information Form, Follow-Up Form, and APACHE II scores.
*Results:* A significant difference existed between the two groups in terms of mean APACHE II scores on discharge ($p < 0.05$) whereas no significant difference in terms of mean fever, number of leucocytes and lymphocytes, C-reactive protein, and days of catheter carriage ($p < 0.05$). Hemoculture positivity was less in protocol group, and this difference was statistically significant ($p < 0.05$).
*Conclusion:* The suggested nursing care protocol is significantly efficacious in the prevention of CVC-related infections. Training of healthcare workers on using this protocol is recommended.


## 1. Introduction

At the present time, among medical practices interventional methods such as intravenous catheters are widely used, being accepted as an integral or compulsive part of modern health services. Central venous catheters (CVCs) are widely used in critically ill patients throughout the world. Peripheral catheterization can be inadequate in cases of total parenteral nutrition, chemotherapy, trauma, major surgery, acute hemodialysis, plasmapheresis, radiologic interventions, peripheral circulation disorders, hypovolemia, pulmonary artery catheterization, pacemaker placement, coagulopathy, and long hospitalization. In such cases, central venous catheterization should be preferred (Akmal, Hasan, & Mariam, 2007; Ertürk & Akbulut, 2007; Orak, Üstündağ, Güloğlu, Aldemir, & Doğan, 2006; Ülger, 2006). For central venous catheterization jugular vein, subclavian vein, femoral vein, and arm veins can be used (Ertürk & Akbulut, 2007; Orak et al., 2006). However, the vein to be used for catheterization should be chosen according to the condition of the patient and infection risk. The subclavian vein is the most preferred one because of low infection risk, high patient comfort, and easy catheter care in long-term catheterization whereas femoral vein is preferred for short-term catheterization because of high infection risk (Orak et al., 2006).

Despite benefits, CVCs are associated with seriously complications, including infections, hemorrhage, pneumothorax, and thrombosis. Among these complications, CVC-related infections are the most studied, as they can significantly influence the length of intensive care unit (ICU) stays, hospital costs, and mortality rates. Increases of 4–37% in attributable mortality have been reported in several studies of CVC-related infections (Higuera et al., 2007). Various studies of CVC-related infections in the critical care setting have been reported, and various treatment guidelines have been developed based on their findings, including the Centers for Disease Control's (CDC) guidelines (Devrim et al., 2016; Helder, Brug, Looman, Van Goudoever, & Kornelisse, 2010; Koutzavekiaris et al., 2011).

Educating and training of healthcare providers who insert and maintain CVCs is essential for preventing catheter-related infection, improving patient outcomes, and reducing healthcare costs. Programs for training nurses in long-term catheter care were associated with a

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http://dx.doi.org/10.1016/j.apnr.2016.08.006
0897-1897/

reduction in catheter-related infections in the USA (Frasca, Dahyot-Fizelier, & Mimoz, 2010; Zingg et al., 2009).

## 2. Literature review

Primary bloodstream infections resulting from central venous catheterization are a common cause of excess morbidity, mortality, and medical care costs in the ICU setting. The rate of catheter-related infections depends on parameters of catheter material and applications such as catheter type, use of antibiotic-coated or non-antibiotic-coated catheter, number of catheter lumens, duration of catheterization, site of catheter insertion, training of the staff, and catheter care as well as upon patient's age, immunodeficiency, underlying systemic disorder, flora, and requirement for parenteral nutrition (Aygün, 2008; Orak et al., 2006).

Catheter-related infections take the second line among nosocomial infections occurring in intensive care units (Menteş et al., 2008). In the infected patients; bacteremia signs such as fever and chills and also septic shock signs such as hypotension, hyperventilation, respiratory failure, confusion, and convulsions can be present (Webster, Gillies, O'Riordan, Sherriff, & Rickard, 2011).

Catheter-related infections increase hospital costs and length of stay. Studies have shown that in the United States of America (USA) mortality caused by these infections ranges between 12% and 35% depending on the causative agent and status of the patient and costs up to 2.3 billion dollars per year (Frasca et al., 2010). A study involving France, Germany, Italy and the UK countries estimated that there were between 8400 and 14,400 episodes of catheter-related bloodstream infections per year in these countries, with associated annual costs of between EUR 35.9 and EUR 163.9 million (Tacconelli, Smith, Hieke, Lafuma, & Bastide, 2009).

To improve patient outcome and to reduce healthcare costs, there is considerable interest by healthcare team, insurers, and patient advocates in reducing the incidence of these infections. (O'Grady et al., 2011). Catheter-related infections display patient care quality and also indicate the quality of nursing care. Nurses should have adequate knowledge and ability in catheter care. If there is an infusion team in a medical center, the nurse in the team, otherwise, infection control nurse should be responsible for catheter care.

In 2002, Centers for Disease Control and Prevention, and Hospital Infection Control Practices Advisory Committee (HICPAC) in USA developed evidence-based and practicable guidelines for the prevention of catheter-related infections which were then revised in 2011. It is suggested that healthcare workers should do catheter placement and care according to these guidelines. Prevention practices, including the use of chlorhexidine gluconate skin preparations, use of the subclavian or internal jugular vein instead of the femoral vein, hand hygiene, and daily assessment of line necessity, have been developed for preventing CVC-related infections. Based on these guidelines Devrim et al. (2016) carried out a study in our country and they found that during the prebundle period, the overall rate was 24.5 catheter-related bloodstream infections per 1000 central line days, whereas after the initiation of the central line bundle, the catheter-related bloodstream infections per 1000 central line days dropped to 14.29. Although there are a few studies dealing with use of prevention protocols, the issue has not been studied well in our country. In this context, the purpose of the present study was to determine the effect of Nursing Care Protocol formed according to the suggestions of CDC on the prevention of CVC-related infections (O'Grady et al., 2011).

## 3. Methods

### 3.1. Sample

This clinical study was planned to determine the effect of Nursing Care Protocol on the prevention of catheter-related infections in neurosurgery intensive care unit.

The studied subjects were patients with CVC hospitalized in the neurosurgery intensive care unit of a university hospital in Turkey. The study was conducted between January 2012 and December 2013. Sample size estimation was calculated using 80% power, $\alpha = 0.05$ with F tests as the statistical basis of the calculation using G*Power 3.0™. The calculated group size of 160 total patients, 80 patients in each of the two groups (80 protocol — PG and 80 control group — CG) was deemed adequate to determine significant differences between groups.

Inclusion criteria for the study were as follows:

- Catheter placed for at least 3 days
- No systemic disorder on hospitalization.

### 3.2. Data collection tools

The data were collected from Patient Information Form, CVC Follow-Up Form, and Acute Physiology and Chronic Health Evaluation II (APACHE II) scores.

*Patient Information Form:* The form includes the socio-demographic and catheter characteristics such as patient's age, gender, medical diagnosis, presence of chronic disorder, catheter type, catheter insertion site, and duration of catheter carriage.
*Central Venous Catheter Care and Follow-Up Form:* The form includes parameters of daily catheter care and follow-up.
*Acute Physiology and Chronic Health Evaluation II (APACHE II):* APACHE II has been adapted from the APACHE Scoring System by Knaus and co-workers in 1985. The APACHE II is used to evaluate the physiologic parameters during patient's critical therapy and care starting with the date of hospital admittance. It is a severity of disease classification system, predicting mortality risk.

### 3.3. Procedure

Central venous catheters are routinely placed by the anesthesiologists in the operating room or in the intensive care unit. The catheters were inserted by anesthesiologist with the following sterile-barrier precautions: use of large sterile drapes around the insertion site, surgical antiseptic hand wash, and sterile gown, gloves, mask and cap. The skin insertion site was first disinfected with chlorhexidine. The catheters were percutaneously inserted using the Seldinger technique and were fixed to the skin with 2-0 silk suture. After the line insertion, the insertion site was cleaned with chlorhexidine and covered with a dry sterile gauze occlusive dressing.

Following catheter placement in the CG, Patient Information Form was filled in, routine care was applied, and patients were evaluated using the daily APACHE II and CVC Follow-Up Form. After catheter placement in the PG, Patient Information Form was filled in, daily catheter care was given according to the CVC Protocol based on CDC suggestions, and patients were evaluated using the daily APACHE II and CVC Follow-Up Form. At the beginning of the study, healthcare workers underwent education and training for CVC care on the basis of infection control practices published by the CDC and Hospital Infection Control Practices Advisory Committee (O'Grady et al., 2011).

In both groups, the decision to remove the catheter was made by the physician. Catheters were removed when they were no longer needed or when a systemic or local complication occurred. Once catheter-related infections were suspected, all catheter sites were examined carefully. If there was any purulence or erythema, an exit-site infection was considered likely and the catheter was removed. Besides the peripheral blood sampling, all suspected catheters were removed, and the tips and blood samples sent for culture.

### 3.4. Ethical considerations

Written approval for conduction of the study was obtained from the university hospital where the study was implemented, and ethical