

Maintenance of hemodialysis catheters in the intensive care unit

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Abstract— Renal failure is a common complication of the acute conditions. One in five patients of the ICU (Intensive Care Unit) develop acute renal failure and 17% of them need the renal replacement therapy. Studies have shown that the use of hemofiltration in the development of acute renal failure improves patient survival. The early start of hemofiltration and the careful maintenance of hemodialysis catheters are associated with better results. Nurses face the complications in caring the hemodialysis catheters, that prologs treatment and patient care, length of stay and critically ill patients often die from the developed infections.

The aim of the study was to investigate the maintenance of hemodialysis catheters in the intensive care unit: to identify the most common complications and analyze the actions of nurses aimed to reduce the risk of complications.

Investigation method. Quantitative research, questionnaire. Statistical analysis of data was performed using IBM SPSS Statistics 20.0 and Excel 2010 programs. Descriptive statistical methods were used, the sample characteristics were calculated: average, percentage.

Conclusions. When working with the hemofiltration patients who has the hemodialysis catheters, nurses focus on prevention of infections, completing documentation related to hemofiltration and monitoring the status of the catheter and the patient's condition.

Keywords— *hemodialysis catheter, complications, infection.*

I. INTRODUCTION

Vascular catheters are increasingly used all over the world not only for the administration of fluids or drugs, but also for blood transfusion, intravenous nutrition and procedures for patients with severe diseases requiring hemodialysis [1]. Central venous catheterization has changed the lives of the patients requiring hemodialysis in recent decades. Despite the advantages of vascular catheters, the more they are manipulated, the higher is the risk of complications and infection. It not only prolongs the patient's treatment, but also increases the cost of the treatment itself [2]. According to statistics, patients of ICU have the highest risk of developing the hospital infections. These wards treat the most severe,

usually immunosuppressed patients, or those with various traumas, invasive measures are used to monitor, treat or diagnose them: mechanical ventilation, central venous and catheterization of the bladder. All this leads to the hospital infections that are harder to treat and control [3]. Not only in Europe, but also in the United States, more than 500,000 cases of infection associated with hemodialysis catheters are recorded annually, 80,000 of which are registered in the ICU [4]. It is important to note that catheterization of the central veins can even cause death in seriously ill patients. Proper catheter placement and aseptic and antiseptic maintenance are necessary to prevent infection and other complications [5]. The number of hemodialysis patients is growing rapidly in Lithuania as in the rest of the word, the frequency of hospitalizations and nursing volumes are increasing [6]. The maintenance of the hemodialysis catheter completely depends on the deep theoretical and practical knowledge of ICU nursing staff. Unfortunately, many research results are fragmentary in Lithuania [7], usually only aspects of peripheral and central venous catheters are assessed. Researchers say that a nurse is exactly the kind of person who works primarily with vascular catheters. Therefore, it is very important to mention that they should not only know the main indications and contraindications of hemodialysis catheters, but also distinguish complications, actively participate in their elimination and be able to properly care for catheters [8, 9]. The main problem of this study is the maintenance of hemodialysis catheters in the ICU. The aim of the study was to investigate the maintenance of hemodialysis catheters in the intensive care unit, paying special attention to the late complications, where the most frequent and dangerous is infection, and to reveal the actions of nurses aimed to reduce the risk of those complications.

II. METHODS

The ICU nurses of one of Vilnius city university hospitals participated in a two-months study. Quantitative type research and questionnaire were used. The study involved 40 nurses. The questionnaire consists of two parts: the general part (professional work experience, education), the special part, in

which the basic questions of the hemodialysis catheters care are examined. Answers to the questions were evaluated by choosing the right answer. When assessing professional work experience, the subjects were divided into five groups according to the duration of work experience: from less than one year, 1 to 5 years, 6-10 years, 11-15 years and having more than 15 years of experience in ICU. Statistical analysis of data was performed using IBM SPSS Statistics 20.0 and Excel 2010 programs. Descriptive statistical methods were used, the sample characteristics were calculated: average, percentage. Calculated sample characteristics: absolute number (n), percentage (per cent). Differences between risk factors were assessed using the Pearson chi-square criterion (χ^2). The statistical reliability index was assessed when the value of p did not exceed 0.05 ($p \leq 0.05$) and it was concluded that the differences were statistically significant.

III. RESULTS

The study involved 40 nurses of the anesthesia and intensive care unit, the average age of which was $36,34 \pm 15,83$ years, and the average work experience in the ICU was $29,17 \pm 8,18$ years. Nurses were asked to give their opinion on the reasons why they thought the risk of complications was increasing (Fig.1). The answers were distributed as follows: the vast majority (93%, $n=37$) believe that the risk of complications increases due to aseptic and antiseptic non-compliance, just over half (55%, $n=22$) claim that it depends on the patient's health, slightly more than two quarters (45%, $n=18$) indicated that this could be due to anatomical obstructions that occur during catheter insertion, more than a third (33%, $n=13$) believe that complications increase due to lack of knowledge and skills of the nurse, and exactly two-quarters (40%, $n=16$) believe that the risk of complications may be influenced by the skills of the person performing the venipuncture.

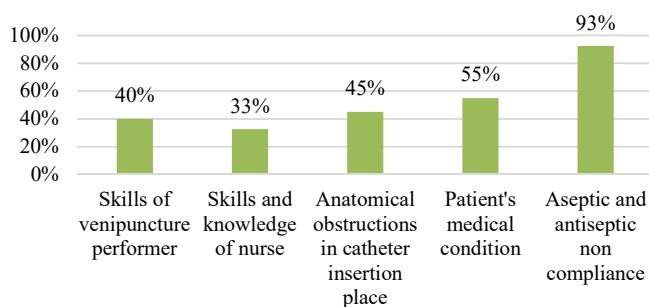


Fig. 1. Reasons that may increase the risk of complications in hemodialysis catheter maintenance

According to scientific sources, proper personal protective equipment, so as aseptic and antiseptic requirements are obligatory for vascular catheterization, as studies have shown it reduces the skin microbial colonization and minimizes the risk of infections [10]. Other authors assert that the number of complications increases due to mechanical lung ventilation, the elderly patient's age, health conditions and the use of immunosuppressant [11], also anatomical barriers [12]. Scientific sources mention, that complications increase due to the lack of knowledge and skills of nursing personal and of the

person performing venipuncture [13]. Respondents answers to the question of what complications they face when maintaining hemodialysis catheters: just over four fifths (83%, $n=33$) reported complications such as bleeding and hematomas, almost one tenth (8%, $n=3$) – tissue infiltration, half (50%, $n=20$) – catheter displacement, four fifths (80%, $n=32$) marked infections, slightly more than two fifths (45%, $n=18$) faced the occlusion, only a few percent (5%, $n=2$) reported cardiac arrhythmias, (5%, $n=2$) air embolism and (3%, $n=1$) pneumothorax. None of the nurses faced such complications as hemothorax, thrombosis, nerve damage (Fig. 2). According to the literature, common complications following the intravenous hemodialysis catheterization in patients include bleeding and hematoma, tissue infiltration, catheter displacement and occlusion [12, 14, 15, 16].

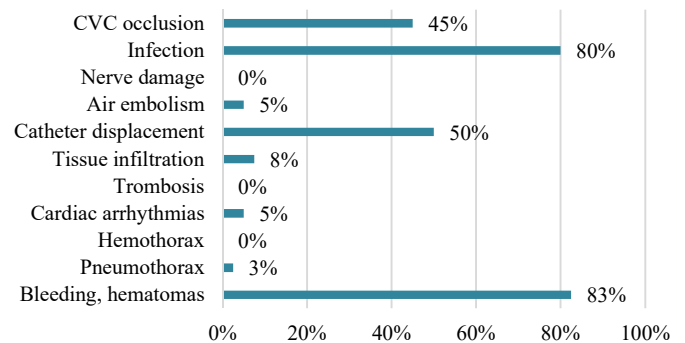


Fig. 2. Complications that nurses face when maintaining hemodialysis catheters

After analyzing the obtained data (Fig. 3), it can be observed, that it's especially important for nurses to prevent the spread of hospital infections, since all respondents (100%, $n=40$) marked this answer. The majority of respondents (93%, $n=37$) pay close attention to bandages. Just over four fifths of nurses (85%, $n=34$) noted that it was important for them to record the data related to the HC (hemodialysis catheter) care. Slightly more than three quarters (78%, $n=31$) pay attention to the condition of the catheter, slightly less than three quarters (70%, $n=28$) noted that they pay attention to vital activity, and slightly more than two-thirds (63%, $n=25$) strive to ensure the comfort of patient with HC.

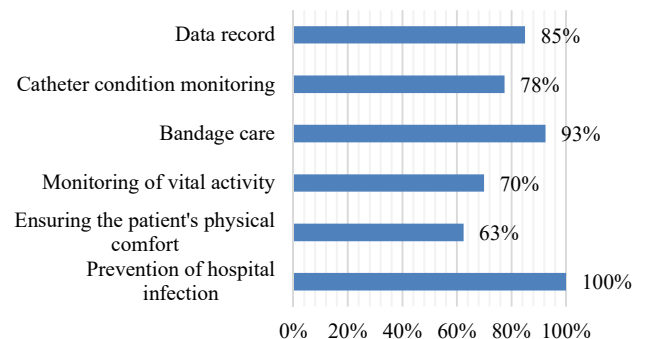


Fig. 3. The most common nursing procedures for the patients with HC

There is no consensus in the literature on the solutions used before invasive procedures. Some authors prove that an alcoholic solution of chlorhexidine is most suitable for disinfecting the skin before central venous catheter administration, while iodine-based antiseptics are considered less effective [17]. Meanwhile, other authors in their studies found no statistically significant difference between chlorhexidine or iodine-based solutions used before surgery [18]. Clinical studies have also been conducted to show that isopropyl alcohol disinfectants are as effective as chlorhexidine solutions and can be used to disinfect skin prior to invasive procedures [19].

IV. CONCLUSIONS

The analysis of the data has shown that the most common complications were: bleeding and hematoma, infection, catheter displacement and HC occlusion. In order to reduce the risk of complications nurses perform the following actions: act in compliance with aseptic and antiseptic requirements, wear protective equipment, ensure proper disinfection of the patient's skin before the invasive procedure and monitor vital signs during the procedure. All nurses immediately change bandages after they have been smeared, soaked in blood or body fluids or detached; gloves are always changed after the removal of old bandages; most nurses choose sterile absorbent bandages and change them daily after proper disinfection of the patient's skin. The majority of nurses change the drip and connection systems as recommended and when they become contaminated. The greatest attention has been paid to the prevention of nosocomial infections, the care of bandages and the monitoring of vital activities. To improve the situation, we suggest to optimize currently used HC care form the following way: include such important for nursing care points as catheter insertion date and location, the condition of the bandage and the date of its replacement, assessment of the skin around the HC, the appearance of signs of infection. This would help to ensure the continuity of nursing and improve the quality of care.

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