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Research Article

Prospective pilot study on the incidence of infections caused by peripheral venous catheters at a general surgical ward

Prospektive Pilotstudie zur Inzidenz von Infektionen durch periphere venöse Gefäßkatheter auf einer allgemein-chirurgischen Station

Abstract

Device-associated infections comprise a significant proportion of all nosocomial infections. In this prospective, observational pilot study the incidence of infections in 89 peripheral venous catheters (PVCs) was documented on a general surgical ward employing an infection data sheet developed by the Institute of Hygiene and Environmental Medicine, Greifswald in adherence to CDC standards for infections.
16 of 20 infections were documented during a four-week time period when medical students in the first four months of their practical year performed their compulsory rotation on the general surgical ward. Insufficient knowledge of adequate hygienic measures as well as non-compliance to aseptical procedural measures prior to and following insertion of a peripheral venous catheter are the assumed instigators of these infections. In order to ensure a uniform hygienic standard in the performance of applied procedures, it is essential that medical students during this practical year receive not only theoretical, but also hands-on schooling prior to initiation of their subsequent official residency.

Keywords: peripheral venous catheters, nosocomial infections, infection control, education, training

Zusammenfassung

Device-assoziierte Infektionen machen einen erheblichen Anteil der nosokomialen Infektionen aus. Die Inzidenz von Infektionen durch periphere venöse Gefäßkatheter wurde in dieser prospektiven Beobachtungsstudie an 89 peripheren Venenkatheter auf einer allgemein-chirurgischen Station mithilfe eines Infektionserfassungsbogen, erarbeitet vom Institut für Hygiene und Umweltmedizin Greifswald, angelehnt an die Infektionskriterien der CDC, ermittelt.
16 von 20 Infektionen fielen in einen Zeitraum von vier Wochen, in dem Studenten des I. Tertials ihre Pflichtassistenz auf der Allgemeinen Chirurgie erfüllten. Unzureichende Kenntnis in den Bereichen der durchzuführenden Hygienemaßnahmen sowie des aseptischen Arbeitens vor und bei der Insertion eines peripheren venösen Gefäßkatheters sind als Einflussfaktoren anzunehmen.
Um zu gewährleisten dass ein einheitlicher Hygienestandard bei der Durchführung der auszuführenden Tätigkeiten vorausgesetzt werden kann, müssen Studenten im Praktischen Jahr vor Beginn ihrer Pflichtassistenzen nicht nur an theoretischen, sondern auch an praktischen Schulungen teilnehmen.

Schlüsselwörter: periphere venöse Gefäßkatheter, nosokomiale Infektion, Infektionsprävention, Ausbildung, Training

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Introduction

Peripheral venous catheters are used for the administration of hydration fluids, blood transfusions, nutritional supplements or the infusion of medications. In order not to burden the patient with multi-ple punctures, they often remain within the venous system for several days. Peripheral venous catheters are the most frequently used invasive medical device [1]. Up to 70% of all patients require a peripheral venous line during their hospital stay [2]. It is therefore interesting to note the high rate of post-insertion complications reportedly caused by healthcare-associated infections (HAI). Due to the complexity of health care strategies, HAI as a globally occurring problem has become more and more unmanageable. There is a transmission of pathogens not only within the ward, but also between wards where the hands of the staff are the major carriers of nosocomial pathogens [3]. On average, one in ten hospitalized patients contracts a HAI [4]. HAI are associated with an increased mortality rate, prolonged hospital stay and increased costs [5], [6], [7], [8], [9], [10], [11]. Once a contaminated patient is discharged there remains possible transmission of the pathogen to the people around him [12], [13]. The single most effective measure to fight HAI is appropriate hand hygiene [14], [15], [16], [17].
In this prospective observational study the incidence of infections in peripheral venous catheters was reviewed along and questionable sources of contamination were explored.

Materials and methods

Patient collective

A total of 89 (n=89) adult patients (51 male, 32–82 y.o.), (38 female, 27–84 y.o.) who were stationed on a general surgical ward of a university hospital between July 16th and November 17th 2012 (125 d) were included in the study. Each had undergone placement of a peripheral venous catheter by the staff of the ward.

Data collection form

Documentation was carried out employing an infection data sheet developed by the Institute of Hygiene and Environmental Medicine, Greifswald in adherence to CDC standards for infections. The forms were carefully completed with all of the required information for every patient on the general surgical ward, who had received a peripheral venous line. Data collection was continued until the line was eventually removed and date of removal recorded. If the same patient required placement of a new peripheral venous catheter, a new infection data sheet was started and completed until the date of removal. Every infection data sheet was labelled with the patients ID for identification purposes.

The following data were documented on the infection data sheet:

- patient-ID
- patient sex
- patient age
- ward
- date of admission
- date of discharge
- date of insertion of the device
- localization of device (right/left and exact anatomical localization)
- date of removal of the device
- cause for removal of the device (infectious/noninfectious)
- signature/abbreviation of the person completing the infection data sheet
- serial number of the infection data sheet

A device was recorded as “infectious” if a peripheral venous catheter was in situ 48 h before the onset of symptoms/findings or if the time interval between the removal of the peripheral venous catheter and the onset of symptoms/findings was at a maximum of 48 h.

Procedures

The required data were collected by the individual who inserted the peripheral venous catheter as well as the person who had removed it. The physicians and students in their practical year were initially familiarized and subsequently further instructed with the infection data sheet via power point presentation. The nurses of the ward were instructed through one-on-one coaching. The head nurse served as multiplier, thereby establishing usage the infection data sheet on the ward so that every physician, nurse and student in their practical year was familiar with the recording of the data and could fill the sheet on their own. The infection data sheets were collected once a week at irregular intervals and the data were compared for accuracy with the medical record.

Data analysis

The incidence rate was calculated on a base of 1000 with I=N/P (Incidence = number of new cases/persons at risk).

Results

89 peripheral venous catheters were inserted between July 16th and November 17th 2012 (125 days). The age range of the patients who had received PVC insertion was 27 through 84 in women and 32 through 82 in men. 43% (n=38) of all PVCs were inserted in women, 57% (n=51) in men.
An infection following the criteria of the CDC occurred in 20 of the inserted PVCs, 7 in women (35%) and 13 in men (65%). These 20 cases of infection from the total

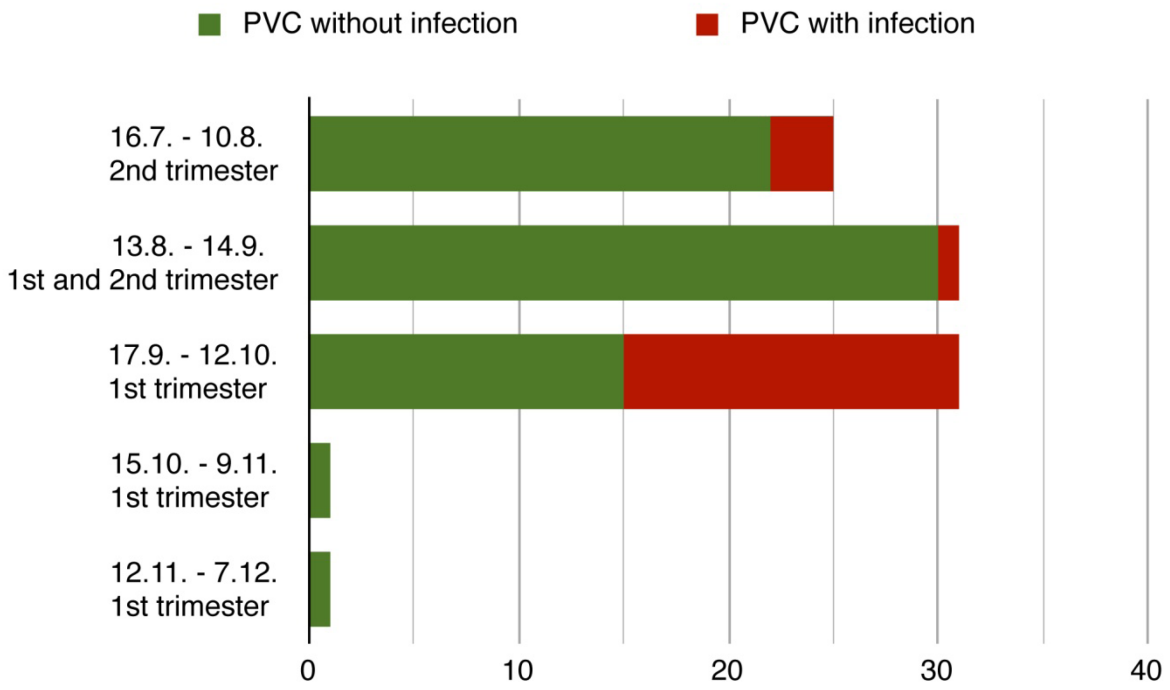

Figure 1: Distribution of PVC insertion with and without subsequent infection in the rotations of the students in their practical year

89 PVC recipients resulted in an infection rate of 22.5%. On average an infection occurred in every fourth man (25.5%) and every fifth woman (18.4%) (Table 1).

Table 1: Gender and infection distribution with PVC

	Women	Men
Gender distribution with PVC	38	51
Infection by gender	7	13
Average incidence of infection by sex	18.4%	25.5%

Table 2 shows the rate of incidence (I) for all of study months. One in 11 patients developed an infection post PVC insertion in July. This corresponds to an incidence rate of 0.09. In August 3 from 37 patients (I=0.08) and in September 5 from 23 (I=0.22) developed an infection. In October 11 from 16 patients developed an infection, which corresponds to an infection rate of 0.69. There were no infections in November.

Table 2: Incidence rate of infections during the study months

Month	No infection	Infection	Incidence rate
July	10	1	0.09
August	34	3	0.08
September	18	5	0.22
October	5	11	0.69
November	2	0	0

Due to the fact that it was solely the duty of the medical students in their practical year to insert PVCs on the general surgical ward, we decided to scrutinize their rotations. Between July 16th and August 10th 2012 students in their 2nd trimester performed their compulsory rotation on the general surgical ward. During this time interval three infections (15%) were reported post PVC insertion. Students in their first and 2nd trimester fulfilled their compulsory rotation between August 13th and September 14th 2012. One infection (5%) occurred during this period. Students in the first part of their trimester were scheduled for their rotation on the ward between September 17th and October 12th. A total of 16 infections (80%) were recorded during this interval. Only one PVC was inserted between October 15th and November 9th as well as during the rotation from November 12th to December 7th. Interestingly, both intervals were covered by students in their first trimester (Figure 1).

Discussion

Due to a significant increase in infections between September 17th and October 12th, our study revealed that there appears to be a lack of infection control skills/knowledge present in students at the beginning of their practical year. Students in the first part of their practical year seem to have insufficient skills in performing adequate hygienic measures and working aseptically before and while inserting a peripheral venous catheter in comparison to students in the 2nd part of their practical year. The infection rate decreased when students in the first part of their trimester worked together with students

in the 2nd part of their trimester who already gained experience in their previous rotation.

Although lectures on hygiene are held in the course of medical studies and all students receive hygienic instructions before beginning their practical year, working aseptically before and while inserting a peripheral venous catheter isn't trained in real terms. We hypothesize that the increase in infections is the result of a lack of remaining knowledge from lectures held in the course of medical studies, which subsequently resulted in contamination during insertion of PVCs that caused the infection. In order to remind medical personnel of possible ways of transmission and possible preventive measures, it is vital that all personnel on the ward are trained and educated in hygienic measures on a regular basis as they have proven to have the greatest positive effect in the prevention of HAI [18]. Roberto et al. [19] have recently demonstrated that compliance in medical students decreases from the first to sixth year and ascribed this result to a change in social and moral norms. To counteract the lack of compliance Scheithauer et al. [20] suggest implementing training early on during medical studies on a regular basis throughout the medical studies.

During a mandatory seminar on January 15th, 2013 guidelines for hygienic measure and working aseptically in preparation, during insertion, care and removal of the PVC were introduced in a presentation. The subsequent discussion revealed that it falls to the students if they seek advice or ask for a demonstration if they're unsure about a procedure or the precautions or simply act as one sees fit. Particularly inefficient students lack appropriate insight into the quality of their performance and the ability to self-assess and judge what they know and what they do not know [21]. The overestimation of the student's own capabilities, a lack of experience and ignorance of how to insert a PVC aseptically following all hygienic precautions could have played a decisive role in the outcome of our study.

Limitations

The numbers of reported peripheral venous catheters in the months following the introduction of the infection data sheet have been low. Further instruction of hygienic precautions on a regular basis could have resulted in a higher number of reported PVCs through better compliance of the students in their practical year. No subsequent intervention study could be carried out in order to clarify of our findings.

Conclusions

This study concluded that in order to maintain high hygiene standards and maintain control over infection rates, it is vital that all personnel on the ward be continuously trained and educated in hygienic measures on a regular basis. In particular students, before being given permission to begin their practical year, must attend compulsory theoretical and practical training on a regular basis in order to ensure standardized hygienic measures in every aspect of their work. This has been initiated at our institution in 2013 following the evaluation of this study. Further interventional studies are required in order to verify our findings.

Notes

Competing interests

The authors declare that they have no competing interests.

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