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PREVALENCE OF THE USE OF CENTRAL VENOUS ACCESS DEVICES WITHIN AND OUTSIDE OF THE INTENSIVE CARE UNIT: RESULTS OF A SURVEY AMONG HOSPITALS IN THE PREVENTION EPICENTER PROGRAM OF THE CENTERS FOR DISEASE CONTROL AND PREVENTION

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ABSTRACT

OBJECTIVE: To determine the prevalence of central venous catheter (CVC) use among patients both within and outside the ICU setting.

DESIGN: A 1-day prevalence survey of CVC use among adult inpatients at six medical centers participating in the Prevention Epicenter Program of the CDC. Using a standardized form, observers at each Epicenter performed a hospital-wide survey, collecting data on CVC use.

SETTING: Inpatient wards and ICUs of six large urban teaching hospitals.

RESULTS: At the six medical centers, 2,459 patients were surveyed; 29% had CVCs. Among the hospitals, from 43% to 80% (mean, 59.3%) of ICU patients and from 7% to 39% (mean, 23.7%) of non-ICU patients had CVCs. Despite the lower rate of CVC use on non-ICU wards, the actual number of CVCs outside the ICUs

exceeded that of the ICUs. Most catheters were inserted in the subclavian (55%) or jugular (22%) site, with femoral (6%) and peripheral (15%) sites less commonly used. The jugular (33.0% vs 16.6%; $P < .001$) and femoral (13.8% vs 2.7%; $P < .001$) sites were more frequently used in ICU patients, whereas peripherally inserted (19.9% vs 5.9%; $P < .001$) and subclavian (60.7% vs 47.3%; $P < .001$) catheters were more commonly used in non-ICU patients.

CONCLUSIONS: Current surveillance and infection control efforts to reduce morbidity and mortality associated with bloodstream infections concentrate on the high-risk ICU patients with CVCs. Our survey demonstrated that two-thirds of identified CVCs were not in ICU patients and suggests that more efforts should be directed to patients with CVCs who are outside the ICU (*Infect Control Hosp Epidemiol* 2003;24:942-945).

Central venous catheters (CVCs) are essential in today's healthcare environment. CVCs are extremely prevalent in intensive care units (ICUs), with mean utilization rates ranging between 32% and 80% among adult ICU patients.¹ CVC use has increased in frequency in ICU settings during the past decade with a concomitant rise in complications associated with such use.^{1,5} Bloodstream infections (BSIs) are the most serious complication of CVC use. Primary catheter-associated BSIs are the third leading cause of nosocomial infections and comprise 19% of all such infections.^{1,3} Approximately 80% to 90% of all primary BSIs are catheter related and most are due to CVC use. Among different types of ICUs, the rates of catheter-associated BSIs reported to the National Nosocomial Infections Surveillance System range from 2.9 to 8.8 per 1,000 catheter-days.¹ Risk factors for catheter-associated BSI include the duration of catheteri-

zation, type of catheter, number of lumens, type of infusate, insertion technique, site of insertion, site preparation, and certain host factors.⁶⁻¹¹

The identification of these specific risk factors has led to various strategies to prevent catheter-associated BSI among ICU patients. Improvements in catheter insertion techniques and care, maximal barriers use during CVC insertion, and choice of catheter types have been employed among ICU patient populations with success.¹²⁻¹⁸ Because of the increasing acuity of the conditions of hospitalized patients, patients on the wards and not just in the ICU are increasingly requiring CVCs. However, little is known about the epidemiology of CVC use outside of ICUs. We therefore conducted a survey of CVC use among adult inpatients at six medical centers participating in the Prevention Epicenter Program of the Centers for Disease Control and Prevention (CDC).

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TABLE 1
USE OF CENTRAL VENOUS CATHETERS WITHIN AND OUTSIDE OF THE INTENSIVE CARE UNIT

Medical Center	No. of Patients With CVCs/ Total	ICU		Non-ICU	
		No. of Patients With CVCs/ Total	Device Utilization Ratio	No. of Patients With CVCs/ Total	Device Utilization Ratio
A	24/256 (9.38%)	8/16	0.500	16/240	0.066
B	144/431 (33.41%)	38/71	0.535	106/360	0.294
C	163/472 (34.53%)	84/118	0.711	79/354	0.223
D	154/554 (27.80%)	44/76	0.579	110/478	0.230
E	151/375 (40.27%)	12/15	0.800	139/360	0.386
F	82/371 (22.10%)	26/87	0.300	56/284	0.197
Total	718/2,459 (29.20%)	212/383	0.554	506/2,076	0.244

ICU = intensive care unit; CVC = central venous catheter.

METHODS

The study consisted of a 1-day point-prevalence survey at six major medical centers. Each is a large, academic-affiliated, tertiary-care referral center participating in the Prevention Epicenter Program of the CDC. The Prevention Epicenter Program is a consortium of seven academic medical centers coordinated and funded by the Division of Healthcare Quality Promotion of the CDC to study the prevention of healthcare-associated complications and promotion of patient safety. At each medical center, trained personnel visually examined all hospitalized patients for the presence of an indwelling CVC. For uniformity, the survey was conducted on a midweek day during a 3- to 12-hour period.

All rooms and beds of each hospital, including those of the ICU and the inpatient wards (non-ICU), were surveyed. Emergency departments, outpatient wards, recovery rooms, operating rooms, outpatient procedural rooms, obstetric wards, ophthalmology wards, all pediatrics units (including nursery and neonatal ICU), psychiatry wards, and dialysis units were excluded from surveillance because of the high use of specialized catheters in dialysis units and the expected low prevalence of CVC use in the other areas.

A standardized data collection form was used to note the location of the patient and whether a CVC was present. For patients with a CVC, the form included the site of catheter insertion, type of catheter, and hospital ward and service. The time and place of the original catheter insertion was not collected during this survey. For the purposes of this study, we included the following four classes of CVCs, which are based on classifications previously established by the Infectious Diseases Society of America, American College of Critical Care Medicine, and Society for Healthcare Epidemiology of America¹⁸: (1) tunneled central venous access catheters; (2) nontunneled central venous access catheters; (3) peripherally inserted central catheters (PICCs); and (4) totally implanted devices (ie, Portacath, Deltec, Inc., St. Paul, MN). Sites of insertion were defined as either subclavian,

jugular, femoral, or peripheral for PICCs. Although access devices inserted in the femoral area may not be considered to be contained within the central venous system, data on their use were collected because their higher risk of infection has been reported to exceed that of true central lines.⁷ Categorical data were analyzed using the chi-square test, with a *P* value of less than .05 considered significant.

RESULTS

Prevalence of CVCs

At the six medical centers, 2,459 patients were surveyed and overall 29% had CVCs (Table 1). Between 9.38% and 40.27% (mean, 27.91%) of the patients surveyed within the participating medical centers had CVCs. CVC utilization rates were higher among the ICUs than among the non-ICU wards. CVC utilization rates averaged 0.554 for ICU patients and only 0.244 for non-ICU patients. Among the ICU patients, 212 (55.4%) of 383 had one or more CVCs. The prevalence of CVCs was lower among patients not located within the ICUs: 506 (24.4%) of 2,076 ward patients had one or more CVCs present. Despite the lower rate of use on non-ICU wards, the actual number of patients with CVCs outside the ICUs exceeded that from the ICUs: 506 patients (70% of the total patients with CVCs) outside the ICUs had CVCs, whereas only 212 patients (30% of the total patients with CVCs) in the ICUs had CVCs (Table 2). Additionally, there were more than twice as many CVCs among ward patients compared with ICU patients (523 vs 238 CVCs, respectively).

Site of CVC Insertion

Most catheters were inserted in the subclavian (55%) or jugular (22%) site, with femoral (6%) and peripheral (15%) insertion being less common (Fig. 1). Also, the jugular site (33.0% vs 16.6%; *P* < .001) and the femoral site (13.8% vs 2.7%; *P* < .001) were more frequently used in ICU patients, whereas PICCs (19.9% vs 5.9%; *P* < .001) and subclavian catheters (60.7% vs 47.3%; *P* < .001) were more

TABLE 2

PREVALENCE AND RELATIVE PROPORTIONS OF CENTRAL VENOUS CATHETER USE IN INTENSIVE CARE UNIT (ICU) AND NON-ICU PATIENTS

Medical Center	No. of Patients			No. of CVCs		
	No./Total	With CVCs		No./Patients	ICU	Non-ICU
A	24/256	8 (33%)	16 (67%)	27/256	11	16
B	144/431	38 (26%)	106 (74%)	155/431	43	112
C	163/472	84 (52%)	79 (48%)	177/472	95	82
D	154/554	44 (29%)	110 (71%)	163/554	48	115
E	151/375	12 (8%)	139 (92%)	151/375	12	139
F	82/371	26 (32%)	56 (68%)	88/371	29	59
Total	718/2,459	212 (30%)	506 (70%)	761/2,459	238	523

CVC = central venous catheter; ICU = intensive care unit.

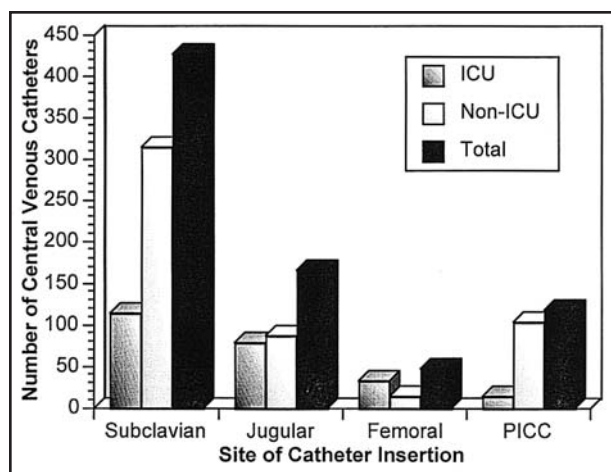


FIGURE 1. Sites of central venous catheter insertion in a 1-day point-prevalence survey among the six medical centers participating in the Prevention Epicenter Program of the Centers for Disease Control and Prevention. ICU = intensive care unit; PICC = peripherally inserted central catheter.

commonly used in non-ICU patients (Fig. 1). More than 80% of CVCs in ward patients were subclavian or PICCs.

CVC Types

The most commonly used catheters were nontunneled CVCs (349 of 756, 46%) followed by tunneled CVCs (176 of 756, 23%), totally implanted devices (120 of 756, 16%), and PICCs (111 of 756, 15%) (Fig. 2). In the ICUs, 74% of catheters used were nontunneled CVCs. The use of tunneled CVCs, totally implanted devices, and PICCs was seen more often among non-ICU patients (346 of 517, 67%).

DISCUSSION

CVCs provide much needed vascular access in critically ill patients, but their use can lead to serious complications, including BSIs. In the past, research on the prevention of complications largely focused on the population of patients with the highest use of CVCs (ie, patients in the ICU). Because of the increasing acuity of the condi-

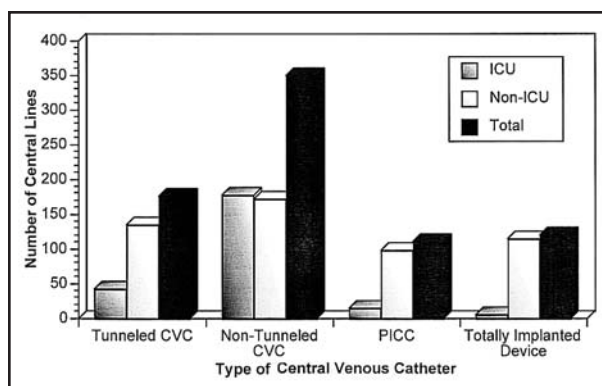


FIGURE 2. Types of central venous catheters identified during the point-prevalence survey. ICU = intensive care unit; CVC = central venous catheter; PICC = peripherally inserted central catheter.

tions of patients admitted to hospitals, we believe that CVCs are increasingly being used outside of the ICU. The lack of information on the frequency of such use prompted us to perform a 1-day prevalence survey among hospitals participating in the Prevention Epicenter Program.

Not surprisingly, our study found that the overall rate of CVC use was highest among patients in the ICUs (mean device utilization rate, 55.4%). However, there was considerable variation in the utilization rates among the participating medical centers, which ranged from a low of 30% to a high of 80%, even though all six were large tertiary-care referral hospitals. In contrast to the ICUs, the wards had a much lower rate of CVC use. This is not an unexpected finding. However, it is notable that, despite the lower utilization rate among non-ICU patients, the actual number of CVCs identified in patients on the wards was more than twice that for ICU patients (523 vs 238, respectively, or 2.2 times higher). In addition, most of the CVCs used outside of the ICUs were tunneled, totally implanted, or peripherally inserted, devices traditionally used for longer durations and associated with different risk factors for BSI compared with nontunneled CVCs. This may affect future prevention efforts aimed at non-ICU CVCs.

We believe that this is one of the first large-scale prospective studies to identify the high number of CVCs being used outside of the ICU. Our findings have several important implications. Because central vascular catheterization is a known risk factor for BSIs, we should expect that a significant number of infections will occur in patients on the wards who have CVCs. A study of hospital-acquired bacteremias in English hospitals between 1997 and 2000 reported that 40% of nosocomial bacteremias occurred in general surgery and general medicine patients.¹⁹ Given our results, we should actually expect the number of nosocomial BSIs coming from patients on the wards to exceed that from patients in the ICU. Indeed, Lyytikainen et al., in a study of four Finnish hospitals during 1999 to 2000, found that 74% of their BSIs were seen outside of the ICU.²⁰ Recent data from a statewide candidemia surveillance program revealed that more than half (56%) of *Candida* BSIs in a survey of Iowa hospitals occurred among patients on general wards rather than in ICUs.²¹ In another center participating in the Prevention Epicenter Program, 75% of all nosocomial BSIs within a 6-month period occurred outside of the ICU. Fifty-two percent of these were catheter associated (data not shown).

The prevention of catheter-associated BSI has been addressed by recent CDC guidelines.²² The guidelines recommend (1) educating and training healthcare providers who insert and maintain catheters; (2) using maximal sterile barrier precautions during CVC insertion; (3) using a 2% chlorhexidine preparation for skin antisepsis; (4) avoiding routine replacement of CVCs as a strategy to prevent infection; and (5) using antiseptic- or antibiotic-impregnated short-term CVCs *only* if the infection rate is high despite adherence to other strategies (ie, education and training, maximal sterile barrier precautions, and 2% chlorhexidine for skin antisepsis). These guidelines are largely based on studies performed on ICU patients with CVCs. We have shown that there are differences in the epidemiology of CVCs in patients within and outside of the ICU: femoral CVCs are found more frequently in ICU patients, and PICCs are used more frequently in ward patients. We anticipate that there will also be differences in host risk factors and how long catheters stay in place between patients in ICUs and patients in non-ICU wards, although these features were not explored in our point-prevalence survey. Are guidelines for the prevention of catheter-associated BSIs applicable to CVCs maintained on the wards, as they were developed based on the experience in the ICU? Our study suggests that additional surveillance of CVC use outside of the ICU is needed. Such data will allow healthcare workers to develop protocols that decrease the risk of CVC-associated BSIs in non-ICU patients and thereby reduce morbidity and mortality.

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