

**COMPARATIVE STUDY OF
TWO METHODS OF PROTECTING
THE THREE-WAY STOPCOCK
IN ARTERIAL CATHETERS**

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INTRODUCTION

When plastic catheters started being used in 1945, it signified an important advancement in patient treatment and care. However, we must not forget that catheters are foreign objects that facilitate infectious complications: phlebitis, suppurative, thrombophlebitis, Bacteremias...

The incidence of catheter-related sepsis depends on the type of catheterization, the patient being treated, diagnostic aggressiveness and the skill of the person in charge of using and maintaining it. Intensive Care Units account for one-third of all cases of Bacteremia.¹

Insertion of peripheral arterial catheters makes it possible to have complete control over a critical patient's monitoring of their hemodynamic and blood gas analysis status; however, the catheters are not free from complications and present a potential risk of infection. The incidence of arterial catheter infection ranges between 0 and 22%, with Bacteremia representing between 0 and 7%.²

Frequent handling of the arterial catheter(s) to collect blood samples is a risk factor for infection in this type of catheter.

The use of devices that improve and guarantee the highest standards of arterial catheter asepsis should contribute to the reduction in the incidence of infections.

The objective of our study was to compare the rate of arterial catheter infection using two kinds of three-way stopcock protection devices: one, using a closed system device (CSD) with a swabbable luer, according to protocol A (fig. 1), and the other, using a dead end cap (DEC), according to protocol B (fig. 2).

MATERIALS AND METHODS

The study was conducted at the Red Cross Hospital of Barcelona, which is a level two, 245-bed hospital. The intensive care unit (ICU) has 6 polyvalent beds with individualized boxes for each patient.

1. Patient selection and sample size.

A prospective study was conducted including 55 patients who had been admitted to our unit during the period ranging from April 1999 to March 2000.

The criteria for inclusion included that the arterial catheter had to be inserted and subsequently maintained at the unit.

Patients were randomly allocated into two groups. In the first group (control), a conventional DEC was used to close the three way stopcock of the arterial catheter. Blood samples were collected according to protocol A (Fig. 1). In the second group (case), a CSD was put into place, and blood samples were collected according to protocol B (Fig. 2).

2. Descriptive variables, infection criteria.

A data collection sheet was designed to record the different variables. Some were patient-related (such as age, sex, reason for being admitted to the unit, mechanical ventilation and the APACHE II prognostic index) and others were catheter-related (place of insertion, number of punctures, days of catheterization, signs of local infection, and total number of times handled).

We defined two main criteria in order to organize the data collected. The criteria were: an evaluation of the condition of the puncture site and a definition for the number of times handled.

To evaluate the condition of the puncture site, we used the definitions of healthy skin and local signs of infection found in the recommendations for the Prevention of Infection in Health Centers, published by the Departament de Sanitat i Seguretat Social de la Generalitat de Catalunya (The Department of Health and Social Security of Catalunya).

- > "Healthy skin: normal appearance around the puncture site."
- > "Local signs of infection: presence of erythema, pain, induration or purulent secretion, limited to a 2 cm diameter around the catheter puncture site."

The concept of catheter handling was defined as any direct manipulation of the catheter, whether for blood sample collection and/or catheter maintenance.

A catheter infection was defined as the isolation of + 15 colonies by semiquantitative culture, in accordance with the Maki catheter tip technique.

3. Statistical Analysis

A statistical analysis was done using the SPSS program. Quantitative variable results were expressed as mean \pm standard deviation, while the qualitative variables were expressed as %.

Mean comparison between the two groups was conducted using the Student's T Test, and proportion comparison using the chi-squared test. Statistical significance was set at $p < 0.05$.

RESULTS

A total of 55 patients were included in the trial period, with 24 of them (16 men and 8 women) we used a CSD, and with 31 (19 men and 12 women), the conventional DEC.

The absolute and relative frequencies with respect to the different risk factors were similar in both groups. No statistically significant differences were found, as shown in Table 1.

Table 1	Comparison of groups		
	CSD Connector (n=24)	Conventional DEC (n=31)	p
Sex (M/F)	16/8	19/12	n.s.
Age ^a	65 \pm 16	69 \pm 11	n.s.
Days of catheterization ^a	4.5 \pm 3	6 \pm 3	n.s.
Number of times handled ^a	8.2 \pm 5	9.2 \pm 5	n.s.
Apache II ^a	19.2 \pm 4.2	20.5 \pm 6.7	n.s.
Arterial Catheter (R/F) ^b	22/2	30/1	n.s.

^aMean \pm Standard deviation

^bRadial arterial catheter (R), femoral arterial catheter (F)

Upon catheter removal, the tips were cultured and the condition of the puncture site was evaluated. In the control group, which had the conventional DEC, a total of 29 catheters were cultured. Of these, 20.6% of the catheter tips had a positive culture. In the other group, which had the CSD, a total of 21 catheters were cultured, and no bacteria were isolated from the catheter tip ($P < 0.05$). (Fig. 3).

The condition of the insertion site was observed in both the CSD group and in the DEC group. Of the 21 catheters observed in the CSD group, only one puncture site showed local signs of infection. A culture of the catheter tip was negative. As for the group using the conventional DEC, 27 catheters were observed, with 6 showing local signs of infection, 50% of which were positive when cultured (Fig. 4).

The clinical criteria for arterial catheter removal are shown in Table 2. The table shows that the main reason for removal in both groups was removal of the catheter because the catheter was no longer needed and the patient was transferred to another unit.

Table 2	Reasons for arterial catheter removal	
	CSD (n=24)	DEC (n=31)
Redness at puncture site	1 (4.2%)	2 (6.5%)
Suspected catheter-related sepsis	1 (4.2%)	4 (12.9%)
Catheter-associated fever	0	4 (12.9%)
Non-functioning catheter	0	0
Catheter change	0	1 (3.2%)
Transfer to another unit	4 (16.7%)	4 (12.9%)
No longer necessary	4 (16.7%)	7 (22.6%)
Removal	12 (50%)	7 (22.6%)
Not recorded	1 (4.2%)	2 (6.5%)

DISCUSSION

Initially, colonization at the skin insertion site was considered the sole source of intravascular catheter infection. Recent studies, however, have shown that the catheter hub may be a point of entry for microorganisms.³

Colonization at the catheter hub point is primarily due to manipulations by healthcare personnel. Microorganisms can migrate from this point to the catheter tip via the catheter's internal lumen. (Fig. 5)

A review of published literature has shown that establishing which pathogen route is the most important is a controversial issue. However, several articles have confirmed that a greater risk of infection can be expected when the catheter's hub becomes contaminated^{4, 5}

From such findings, several authors have concluded that the highest level of asepsis is required in handling a catheter's hub. This is just as important in preventing catheter-related Bacteremia as those measures taken in the insertion of the catheter and maintenance of the skin insertion site.^{6, 7}

Protecting the hub through the use of devices that prevent pathogenic microorganisms from entering the system must be included in protocols for arterial catheter care and maintenance in order to reduce the incidence of catheter colonization and prevent associated complications.

The most important finding in our study was the reduction in the incidence of arterial catheter colonization when using the CSD with the three-way stopcock. This protection device sets up a mechanical barrier that prevents the migration of microorganisms into the blood stream.⁸

Now that the importance of protecting the catheter hub in the prevention of intravascular catheter-related infections has been established, further studies are needed to know the impact of such devices with other types of catheters. For now one can conclude that the application of closed system devices for manipulations at the catheter's hub can significantly favor a reduction in associated complications and can prevent infections.

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Fig. 3. Incidence of infection in both groups

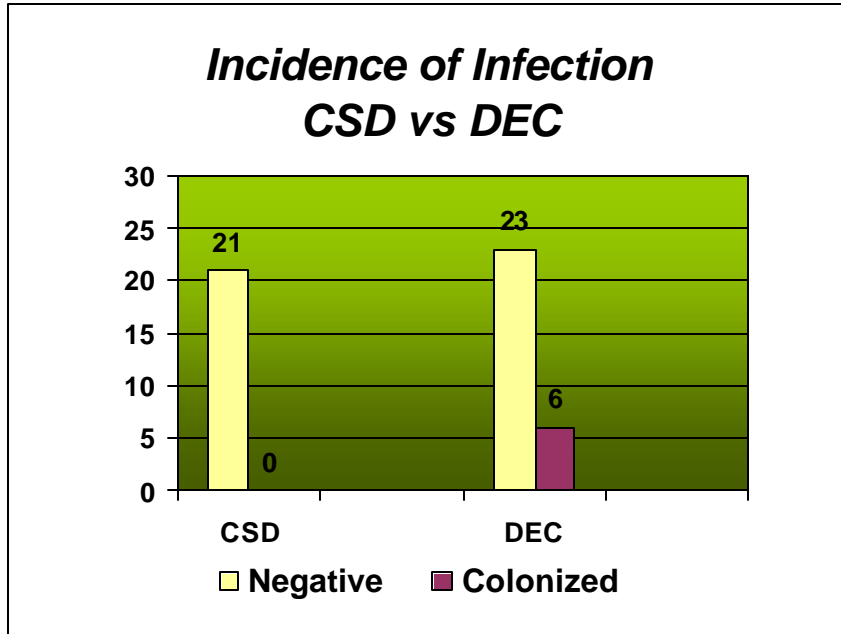


Fig. 4. Condition of puncture site in both groups

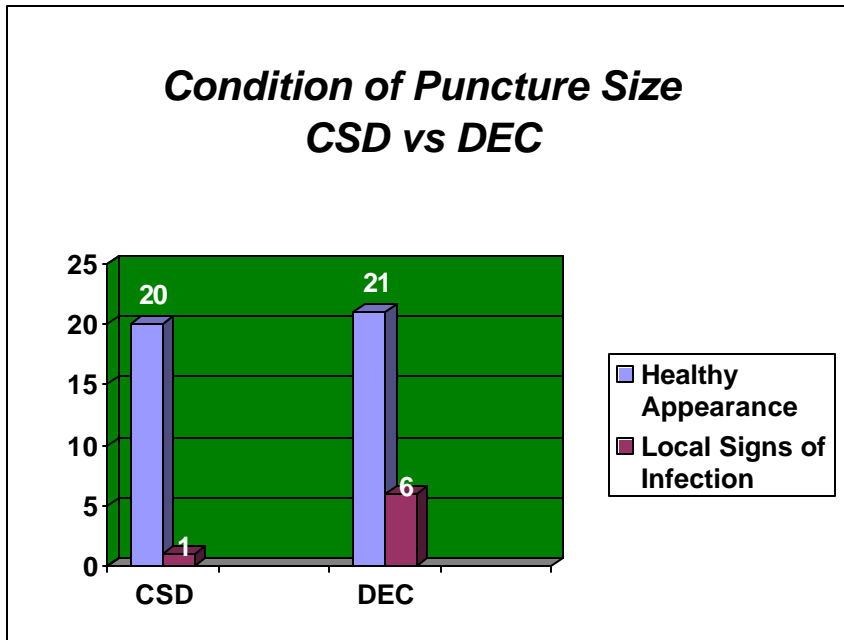


Fig. 5. Points of entry for pathogenic organisms associated with intravascular catheter infections

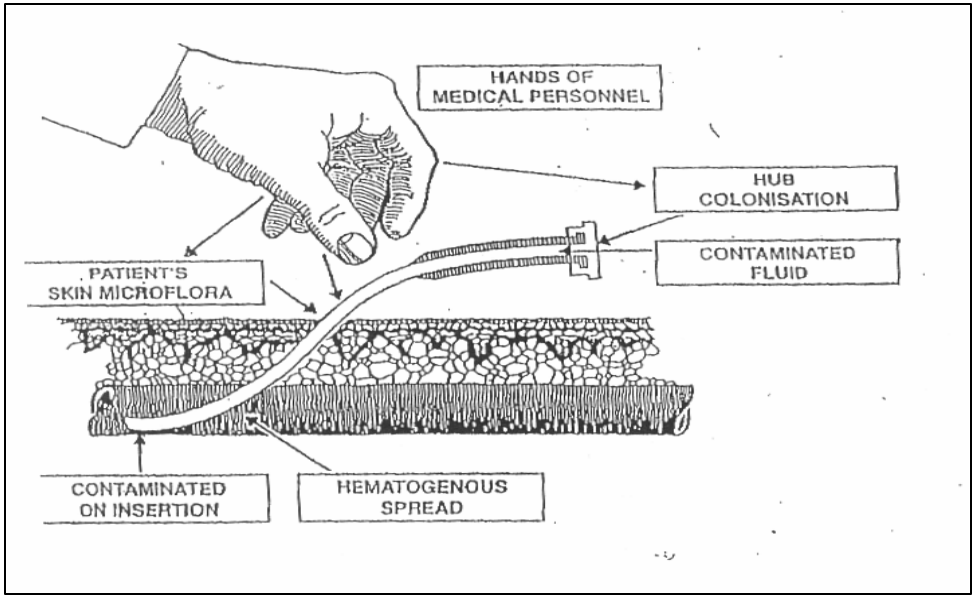


Fig.1. Protocol A - Sample blood drawing

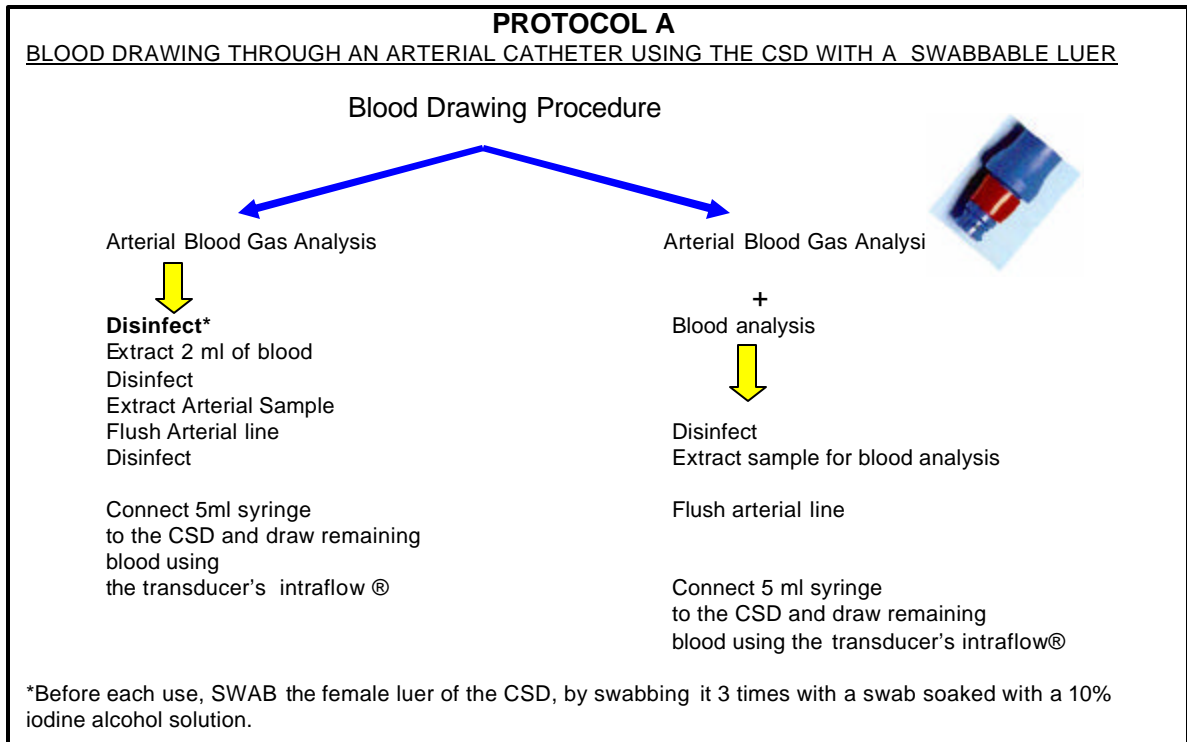


Fig. 2. Protocol B sample extraction

