Note

Use of chlorhexidine-impregnated dressings and early catheter exchange to reduce the onset of central line-associated bloodstream infections: A case-control study in a cardiac intensive care unit

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Abstract: Central line-associated bloodstream infections (CLABSIs) are important hospital-acquired infections that are related to increased mortality in cardiac intensive care units (CICUs). To determine the risk factors for CLABSIs, a case-control study was conducted in the CICU of our hospital. Emergency surgery (odds ratio: 9.6, 95% confidence interval: 1.633-56.926) was the strongest risk factor comparing the case group (n=11) to the control group (n=22). In addition, the indwelling period was significantly longer in the case group than in the control group (median 9 days versus 7 days, p=0.004). An intervention for the insertion of central lines was then started, with 1) thorough use of chlorhexidine-impregnated dressings (also known as chlorhexidine patches, CHG patches) in the insertion of central lines before emergency surgery, and 2) exchange of the central line 7 days after emergency surgery. After the intervention, the CLABSI incidence rate decreased from 6.8 to 0.8/1,000 device-days. These data suggest the usefulness of CHG patches and the importance of the early exchange of central lines in the CICU in patients following emergency surgery.

Keywords: Case-Control Study, Central Line-Associated Bloodstream Infection, Chlorhexidine Patch, Early Catheter Exchange, Emergency Operation, Intensive Care Unit

1. Note

Central line-associated bloodstream infections (CLABSIs) are associated with increased mortality and prolonged intensive care unit (ICU) stays [1, 2]. The universally accepted method for minimizing catheter-related (CR) BSIs is a bundle of care combining maximal sterile barrier precautions for insertion, an appropriate antiseptic solution for skin antisepsis and line access, preferential subclavian catheterization, and immediate removal of unnecessary catheters [1, 3]. However, these items and their bundles might not be acting according to certain accepted standards in specific situations, including emergency and severe cases, especially in the cardiac ICU (CICU).

A case-control study in the CICU of a single, but highly functional, university hospital in Japan was conducted to identify potential CLABSI risk factors, and an intervention to reduce the incidence of CLABSI was performed in the same ICU. These cases and the related study were approved as #2022-072 by the Institutional Review Board of Saitama Medical University International Medical Center on September 07, 2022 and registered as

UMIN000047992. The patients whose specimens were used provided written, informed consent to have their case details and any accompanying images published.

The cases were the catheter-inserted patients with BSIs in the CICU of our university hospital, and the controls were defined as catheter-inserted patients without BSIs who stayed in the same CICU during the same period.

In the BSI cases (n=11), emergency surgery (odds ratio: 9.6, 95% confidence interval (CI): 1.633-56.926), large vessel operation (odds ratio: 6.5, 95% CI: 0.489-10.089), incomplete maximal barrier precaution (MBP) (odds ratio: 3.6, 95% CI: 0.591-21.931), specific surgeon #1 (odds ratio: 2.2, 95% CI: 0.489-10.089), and female patient (odds ratio: 1.7, 95% CI: 0.403-7.906) appeared to be risk factors compared with the control group (n=22) (Table 1). Furthermore, the catheter-indwelling period after surgery was much longer in the cases (median 9 days, 7-13 days) than in the controls (median 7 days, 2-17 days) (Table 2).

Table 1. Risk factors for central line-associated bloodstream infections

Risk factors	Cases (n=11)		Controls (n=22)		Odds	95% CI	
	Yes	No	Yes	No	Ratio	Low	Upper
Female	5	6	7	15	1.7	0.403	7.906
Emergency operation	9	2	7	15	9.6	1.633	56.926
Large vessel operation	9	2	9	13	6.5	1.127	37.485
Surgeon 1	5	6	6	16	2.2	0.489	10.089
Surgeon 2	4	7	12	10	0.4	0.108	2.108
CVC by Anesthesiologist	6	4	19	0			
MBP imcomplete	6	2	10	12	3.6	0.591	21.932
SG→CVC	2	9	5	17	0.7	0.121	4.701

Table 2. Comparisons of the indwelling period between cases and controls

	Indwelling period (Mann-Whitney U test)					
	Min	25%	Median	75%	Max	P value
Cases (n=11)	7	8	9	10	13	0.004
Controls (n=22)	2	5	7	7	17	

Therefore, an intervention that involved 1) thorough use of chlorhexidine-impregnated dressings (also known as chlorhexidine patches, CHG patches) in the insertion of the central lines before emergency surgery, and 2) exchange of the central line within 7 days after emergency surgery was started. With this intervention, the CLABSI incidence rate decreased from 6.8 to 0.8/1,000 device-days (Figure 1). From these data, the usefulness of CHG patches and the importance of early exchange of the central lines in the CICU of patients following emergency surgery might be suggested.
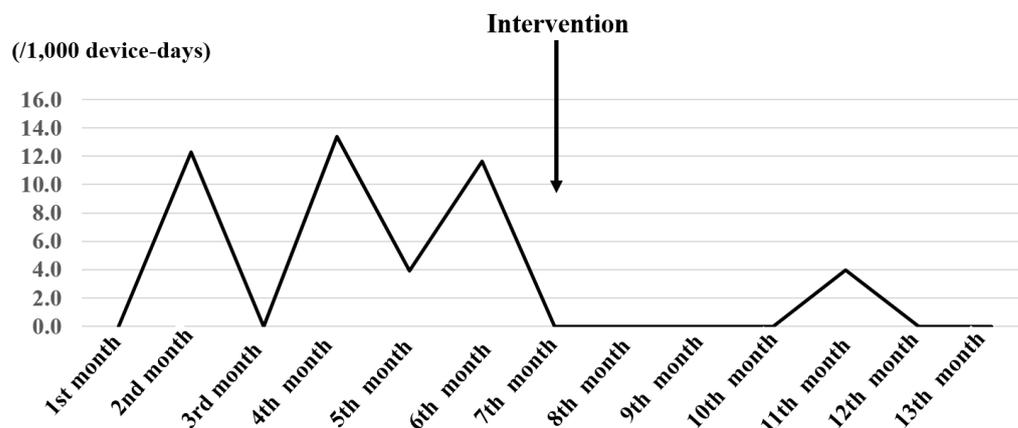
Figure 1. Changes in the incidence of catheter-associated blood stream infections before and after the intervention (1000 device-days). The incidence is seen to decrease after the intervention. Solid line: incidence rate.

A large randomized trial demonstrated that chlorhexidine gel-impregnated dressings decreased the CRI rate in ICU patients with intravascular catheters [1]. Highly adhesive dressings decreased dressing detachment, but increased skin and catheter colonization. A meta-analysis reported that the median CLABSI incidence rate was

5.7 per 1000 catheter-days in adult ICUs, and after implementation of central-line bundles, the incidence of infections in all types of ICUs decreased significantly, from a median 6.4 per 1000 catheter-days (IQR 3.8–10.9 per 1000 catheter-days) to 2.5 per 1000 catheter-days (1.4–4.8 per 1000 catheter-days) after implementation of the bundles (IRR 0.44, 95% CI 0.39–0.50, p<0.0001) [4].

In addition, it was reported that both univariate and multivariate analyses showed that duration of antibiotic treatment > 7 days was not associated with 30-day mortality [HR 0.41 (95% CI, 0.13–1.24), $p = 0.12$], even after propensity score adjustment [HR 0.47 (95% CI 0.17–1.26), $p = 0.13$] in the case of CLABSIs caused by *Enterococci* [5]. Characteristics of patients receiving more or less than 7 days of treatment were similar, and the central line was removed in 82% of cases within a median of 3 days (1–8 days). The authors suggested that a 7-day treatment course appears to be safe in non-complicated enterococcal CLABSIs. These data were similar to the present results. The current study has the limitation that it was a case-control study performed in a single center, but we should take care of central lines, especially by inserting the catheters with CHG patches and removing and/or exchanging the catheters as soon as possible.

2. Conclusions

To investigate the risk factors for CLABSIs, a case-control study was performed, and it was found that emergency surgery, large vessel operation, incomplete MBP, specific surgeon #1, and female patient were the risk factors. In addition, the catheter-indwelling period after surgery was much longer, such as more than 7 days, in the cases than in control cases. CLABSIs were reduced by thorough use of CHG patches and exchange of the central line within 7 days after emergency surgery, and their usefulness in the management of patients in the CICU was suggested.

References

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