



Brief Report

Assessment of the invisible blood contamination on nurses' gloved hands during vascular access procedures in a hemodialysis unit



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A prospective study was conducted to assess potential invisible blood contamination on nurses' gloved hands during vascular access procedures using the occult blood detection method in a hemodialysis unit. 60.13% (273/454) of samples tested positive for hemoglobin. These results highlighted the importance of hand hygiene and glove change during hemodialysis access care.

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Hemodialysis settings are considered high-risk environments for contamination by blood-borne pathogens, including hepatitis C virus (HCV).¹ Many outbreaks of HCV among hemodialysis patients have been reported all over the world, with an estimated 20,000 new cases annually.² The low adherence to infection control practices by health-care workers remains a major cause of the nosocomial transmission of HCV within hemodialysis settings.³

Nursing staff plays a key role in providing vascular access care and are responsible for maintaining dialysis equipment, and reducing access-related complications. The importance of hand hygiene and glove use during vascular access procedures is well known, however, there is a lack of real-world evidence to support the necessity of implementing these standard precautions. The aim of this study was to use the occult blood detection method to assess blood contamination on the gloved hands of nurses performing hemodialysis access care.

METHODS

This prospective survey was conducted in an 80-bed hemodialysis unit from September 2020 to January 2021. There are 390 registered patients and 38 nurse practitioners who work double shifts from 7:30 to 11:50 am, and 12:20 to 5:00 pm. At the end of the vascular access

connection and disconnection process, the nurses' gloved hands were sampled using a convenience sampling method. Trained investigators worn gloves during the sampling process and changed the gloves after each sampling to avoid cross-contamination. This research project was approved by the ethical review board of the Affiliated Hospital of Inner Mongolia Medical University (No. KY2020027).

To identify invisible blood contamination on the nurses' gloved hands, we used filter paper or cotton swabs in occult blood detection kits (BWETM, Shanghai, China). Its detection principle is based on the characteristic that the iron porphyrin in hemoglobin has catalase-like activity. It uses the catalase substrate in hydrogen peroxide, and in the presence of hemoglobin, a discoloration reaction occurs. As the concentration of hemoglobin increases, the bluish-purple will be darker (Fig 1). The test reaches the highest level of discoloration within 5 minute, and maintains for 24 hour without fading. The method can identify hemoglobin in concentrations as low as 5 μ g Hb/g. At the beginning of daily sampling survey, investigators conducted positive control and blank control tests to evaluate the quality of reagents.

Analyses were performed using SPSS version 26 (IBM, Armonk, NY). All qualitative variables were presented as percentages. Chi-square test and Wilcoxon test were used as appropriate. All statistical tests were two-sided, and a *P*-value < .05 was considered statistically significant.

RESULTS

Over the study period, a total of 454 samples were collected from the gloved hands of nursing staff. 60.13% (273/454) of samples tested

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Conflicts of interest: None to report.

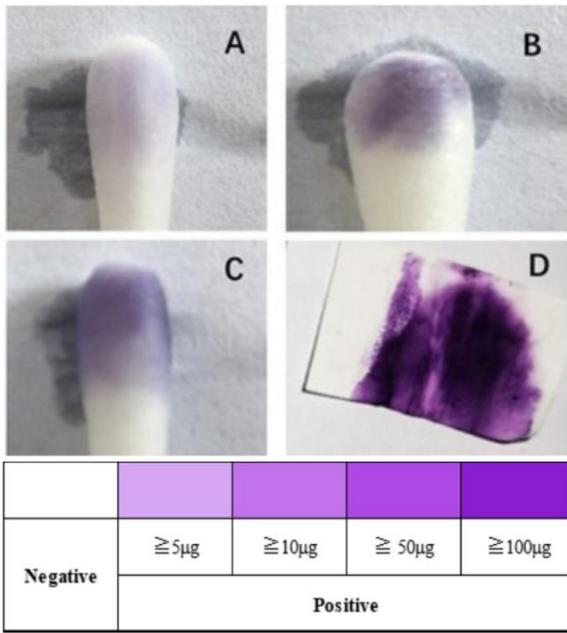


Fig 1. The color standard for hemoglobin-positive concentration (A) hemoglobin-positive concentration $\geq 5\mu\text{g}$; (B) hemoglobin-positive concentration $\geq 10\mu\text{g}$; (C) hemoglobin-positive concentration $\geq 50\mu\text{g}$; (D) hemoglobin-positive concentration $\geq 100\mu\text{g}$.

positive for hemoglobin, with 68.37% (134/196) hemoglobin-positive samples after the connection of vascular access and 53.88% (139/258) hemoglobin-positive samples after the disconnection of vascular access. There was a significant difference in the positive rate of blood contamination on gloved hands between the connection and disconnection groups ($\chi^2 = 9.757$, $P = .002$) (Table 1).

In terms of the distribution of hemoglobin-positive concentrations from samples, the highest positive rate was shown for a concentration of hemoglobin $\geq 5\mu\text{g}$ (34.4%), followed by $\geq 10\mu\text{g}$ (11.7%), $\geq 50\mu\text{g}$ (9.7%), and $\geq 100\mu\text{g}$ (4.4%). There was a significant difference in the concentrations of hemoglobin detected from samples between the connection and disconnection groups ($Z = -5.978$, $P < .001$).

DISCUSSION

This study is the first to use the occult blood detection kits to assess the blood contamination of nurses' gloved hands during vascular access procedures. Our results highlight the fact that the low adherence to hand hygiene and glove change by nursing staff may be at risk of transmitting blood-borne pathogens.

From 2008 to 2019, a total of 22 outbreaks occurred in hemodialysis settings, with 104 outbreak-associated cases of HCV in the United States.⁴ A common finding from the outbreak investigations was that newly infected patients were often found to have been treated in close proximity to a previously HCV patient. Epidemiologic studies reported that blood contamination has been detected in the hemodialysis environment.^{5, 6} In our study, 60.1% of samples tested

Table 1

The test results of blood contamination on nurses' gloved hands

Concentration	Connection operating person-time (%)	Disconnection operating person-time (%)	P-value
Negative	62 (31.63)	119 (46.12)	0.002*
$\geq 5\mu\text{g}$	54 (27.55)	102 (39.54)	<0.001†
$\geq 10\mu\text{g}$	30 (15.31)	23 (8.92)	
$\geq 50\mu\text{g}$	33 (16.84)	11 (4.26)	
$\geq 100\mu\text{g}$	17 (8.67)	3 (1.16)	
Total	196 (100.00)	258 (100.00)	

*Chi-square test for the positive rate between the two groups.

†Wilcoxon test for the concentrations of hemoglobin-positive between the two groups.

positive for hemoglobin, indicating a potential risk of blood contamination on nurses' hands during vascular access care. As the catheters are disposable, the potential blood contamination on the nurses' gloved hand during vascular access connection may mainly come from the patient, while the contamination during vascular access disconnection may come from the patient or the catheter. Considering high patient-to-staff ratio and increased baseline HCV prevalence,⁷ adherence to hand hygiene and glove use by nursing staff are critical to prevent transmission of HCV in hemodialysis settings.

Our study had some limitations. This prospective survey was conducted in a single center, and the positive rate of blood contamination can only reflect the actual situation of the hemodialysis unit that was sampled. Thus, further studies with more centers are necessary. Second, the positive rate of nurses' gloved hands in connection group was higher than that in disconnection group in our study, whether this phenomenon was caused by sampling error or other influencing factors remains to be further studied.

CONCLUSION

The described method provides a useful way of assessing invisible blood contamination on nurses' hands in hemodialysis settings. This study provides evidence of the importance of hand hygiene and glove change during vascular access procedures.

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