Bacterial persistence on blood donors' arms after phlebotomy site preparation: analysis of risk factors

We assessed determinants associated with the persistence of bacteria on the arms of blood donors prepared for phlebotomy. Bacterial persistence occurred in 42 (35%) cases. Significant determinants were a high number of previous donations (p=0.045), male sex (p=0.037), outdoor work (p=0.008) and collection during the summer (p=0.035).

haematologica 2003; 88:839-840
(*http://www.www.haematologica.org/839.htm*)

Bacterial contamination of blood products (BCBP) was one of the earliest recognized complications of blood transfusion.[1] The source of contamination is rarely found, but that most frequently reported is the blood donor's skin.[2] Despite well-conducted antisepsis, high concentrations of bacteria may remain on the surface of the skin.[3-6] The aim of our study was to assess determinants associated with persistence of bacteria on blood donors' arms after preparation of the phlebotomy site.

Consecutive donors were included if they had been accepted for donation after a medical selection complying with our current legal regulations and had given their informed consent to participation in this study. The phlebotomy site was the antecubital fossa and was prepared according to our current two-stage procedure with povidone-iodine 7.5% scrub (Betadine-Scrub®, Munipharma AG, Switzerland) followed by application of 1% PVP-iodine (Orsan®, B. Braun-Dexon, SA, Barcelona, Spain).

We recorded demographic variables related to the donors, such as sex, age, arm of phlebotomy and number of previous donations. We also asked them about their place of work (outdoors or indoors). Other variables recorded were related to the collection site (blood bank or mobile sessions) and collection time (winter or summer). We also recorded the number of donors attending each collection session. Finally, we performed the cultures after the 1% PVP-iodine had dried (30 seconds vs. 60 seconds).

After disinfection, cultures were taken using a 6×2-cm flexible tongue following the manufacturer's instructions (Microcheck®, Biomedics, SL, Madrid, Spain). Bacteria were identified according to standard microbiological methods.

Culture results were recorded on a separate form at the laboratory and transferred to the corresponding donation form. Unpaired t-tests or Mann-Whitney U analysis according to Levene, were used to compare the means of the quantitative variables between bacterial and non-bacterial persistence on blood donors' arms after preparation of the phlebotomy site. The association between a qualitative variable and bacterial persistence on the donors' skin was estimated by the odds ratio (OR). A p value less than 0.05 was considered statistically significant. Statistical analysis was performed with SPSS for Windows 11.0 statistical software (SPSS inc., Chicago, IL, USA).

Our study comprised 120 blood donors. Persistent bacterial contamination was found in 42 cases (35%). The most commonly isolated bacterial species were coagulase negative staphylococci (36 cases; 85,7%). Other bacterial species isolated were Bacillus sp. (3 cases; 7.1%), Acinetobacter lwoffi (2 cases; 4.8%) and Micrococcus sp. (1 case, 2.4%). The analyses of quantitative and qualitative variables are shown in Tables 1 and 2, respectively.

In this study, we found bacterial persistence at 42 (35%) out of 120 skin sites prepared for blood donation. These results agree with Goldman's and McDonald's studies.[5,6] The authors reported bacteria persistence on blood donors' arms after disinfection with all evaluated techniques. The chosen method, which was considered a validated, optimal best practice disinfection technique, produced zero counts on 70% of arms.

Table 1. Univariate analysis of associations between quantitative variables and bacterial persistence on blood donors' skin after phlebotomy site preparation.

Variables	*Bacterial persistence n=42 Mean (SD[1])*	*No bacterial persistence n=78 Mean (SD)*	*p value*
Age	38.9 (13)	35.2 (14)	0.165[2]
Number of previous donations	7.7 (10.3)	4.3 (7.6)	0.045[3]
Number of donors during collection	30 (16.7)	28.9 (17.3)	0.744[2]

[1]Standard deviation; [2]Unpaired t-test; [3]Mann-Whitney U test.

Table 2. Analysis of associations between qualitative variables and bacterial persistence on blood donors' skin after phlebotomy site preparation.

Variables	*n*	*Bacterial persistence rate (%)*	*OR (95% CI)[1]*	*p value[2]*
Sex				
Male	63	44.4	1.81 (1.06-3.08)[3]	0.037
Female	57	24.6	Ref.[3]	
Arm				
Left	61	39.3	1.29 (0.79-2.12)[3]	0.410
Right	59	30.5	Ref.[3]	
Place of work of donors				
Outdoor	40	52.5	3.10 (1.40-6.88)[3]	0.008
Indoor	80	26.3	Ref.[3]	
Collection site				
Blood bank	40	30	Ref.[3]	
Mobile session	80	37.5	1.40 (0.62-3.16)[3]	0.543
Collection time				
Winter	60	25	Ref.[3]	
Summer	60	45	2.45 (1.13-5.32)[3]	0.035
PVP-iodine dry				
30 seconds	60	36.7	1.1 (0.67-1.79)[3]	0.848
60 seconds	60	33.3	Ref.[3]	

[1]Odds ratio and 95% confidence interval of odds ratio; [2]χ^2 analysis; [3]reference category for OR estimation.

Thus, our results extend these findings and confirm that it may be almost impossible to decontaminate human skin.[7]

We found three reports on factors contributing to bacterial contamination at the collection stage; the available data are scarce and contradictory. First, McDonald et al. reported no correlation between age, gender, occupation, donor appearance or amount of hair on the donor's arm and the bacterial load pre- or post-disinfection.[8] Second, Perez et al. revealed an association between transfusion-associated bacterial contamination and the number of previous donations in the univariate analysis and also in the final multivariate analysis.[9] Third, a multivariate analysis of determinants of bacterial contamination of whole-blood donations performed by Perez et al. showed a donor age >35 years, the participant blood bank and lack of repetition of the scrubbing to be significantly asso-

ciated with positive cultures in the whole-blood donations.[4]

In our study, we found that male sex, outdoor place of work, collection time in the summer and a high number of previous donations were associated with bacterial persistence on the blood donors' arms after preparation of the phlebotomy sites. Two hypotheses may explain these findings. First, disinfection could be more difficult to obtain in male donors because they have more hair[10] and the needle may touch hair follicles, rich in bacteria. Second, outdoor work is associated with a thick, cornified layer of epidermis and poor skin hygiene, and a high ambient temperature leads to sweating. All these factors make it unlikely that correct disinfection is achieved. In summary, we must reiterate that phlebotomy site preparation is an important step in preventing BCBP although the independent contribution of each factor facilitating or hindering correct disinfection remains to be determined.

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Acknowledgments: the authors acknowledge the excellent care of donors by all the blood-collection nursing staff and the expertise of the microbiology laboratory staff . We would also like to thank Ms. E. Mallafré for providing epidemiological information on selected blood donors.

Key words: blood transfusion, blood donors, bacterial infections, risk factors.

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Manuscript processing

This manuscript was peer-reviewed by two external referees and by Professor Mario Cazzola, Editor-in-Chief. The final decision to accept this paper for publication was taken jointly by Professor Cazzola and the Editors. Manuscript received March 12, 2003; accepted June 5, 2003.

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