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The Frequency and Spectrum of Bacterial Contamination of Packed Red Blood Cells and Platelet Concentrate Units from a Sample of Iraqi Blood Donors

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Bacterial contamination of donated blood is defined as the presence of bacteria in the blood components which are collected and/or processed for transfusion. It is the second cause of death beyond ABO-mismatch. The aims were to determine the frequency of bacterial contaminations in stored packed RBC and platelet concentrate units. This cross-sectional study was conducted in Baghdad between 2nd of September to 27th of December 2019. Two hundred samples; 100 samples from packed RBC units and 100 samples from platelet concentrate units were randomly selected. There were 38/100 of platelet concentrate units found to be contaminated, while 28/100 samples studied of packed RBC units were contaminated by bacteria. The high rate of contamination of samples presented. Gram-positive bacteria were the most predominant, and this attributed to poor skin cleansing and antiseptic techniques used prior to donor blood collection.

Keywords: blood donors; bacterial contamination; packed red blood cells; transfusion-transmitted bacterial infection

I. INTRODUCTION

The protection of transfused blood from microbial contaminants is mandatory (Walther, 2008). When the bacteria isolated from both the blood product and the transfused recipient, this called definite cases, but when the recipient's blood is either not cultured or negative, this called probable cases (Perez *et al.,* 2001). If there are no bacteria isolated from the blood product and the recipient is positive, these called possible cases (Perez *et al.,* 2001). The donated blood contamination may happen from two routes are endogenous or exogenous (Cawley *et al.,* 2011; Arewa, 2009). The higher risk for bacterial contamination is among platelets concentrate units (Eder *et al.,* 2017). Transfusion-transmitted bacterial infection (TTBI) associated with a wide spectrum of microorganisms (Perez *et al.,* 2001).

The aims were to determine the frequency and bacterial contaminations spectrum in stored packed RBC and platelet concentrate units.

II. MATERIALS AND METHOD

A. Study Design and Setting

A cross-sectional study was conducted in the National Blood Transfusion Center between 2nd of September to 27th of December 2019.

B. Donor Selection

The samples were collected, processed and separated into packed red cells, platelet concentrate and plasma within 8 hours. Donor's blood that tested positive for transfusion transmissible infections (mainly HIV, HBV, HCV, and Syphilis), and expired blood components were excluded.

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C. Storage Conditions

In the National Blood Transfusion Center (NBTC), blood components are stored in well-monitored and controlled temperature equipment as: blood storage refrigerators from [1°C to 6°C] for red blood cells, a platelet incubator and agitator from [20°C to 24°C].

D. Sample Size

Two hundred samples were included in this study, 100 samples from packed RBC units and 100 samples from platelet concentrate units.

E. Collection and Transportation of Samples

By using standard bacteriological safety and standard aseptic techniques, all samples were processed, transported, and analyzed. Stored packed RBC and platelet concentrate were mixed, and the end of the enveloped tubes were chosen as a site for puncture (Brecher & Hay, 2005).

BacT/ALERT culture bottles are disposable culture bottles that contain 30 ml of complex medium and adsorbent polymeric beads. Whereas the medium consist of the following reactive components: a combination of peptones/biological extracts, anticoagulant, vitamins and amino acids. These culture media are used for quality control testing as they support the growth of aerobic microorganisms (bacteria and fungi).

F. Procedure

Packed RBC and platelets concentrate were cultured utilizing standard methods onto culture media include: Blood (BA), MacConkey (MA), Mannitol salt (MSA), and Urinary tract infection (UTI) agars. Well isolated colonies (3-5) were transferred to glass tube contain (3 ml) DW to measured and adjusted turbidity that represent bacterial cells number per (1 ml) which must be equal to (0.55-0.65 optical density) by DensiCHEK Plus device. Then, swabbed with positive results were further processed in VITEK 2 compact system (bioMérieux, France).

G. Statistical Methods

Interpretation of results was performed according to VITEK 2 compact system special software to identify bacterial species and strains.

III. RESULT AND DISCUSSION

About 38/100 (38%) platelet concentrate units were found to be contaminated by bacteria. The Gram positive bacteria were the predominant 30(79%) vs 8(21%). *Bacillus subtilis* was the most frequent 24/38 (63%), followed by *Staphylococcus epidermidis* 6/38(16%), *Escherichia coli* 4/38(10.5%), *Proteus mirabilis* 2/38(5.2%), and *Pseudomonas aeruginosa* 2/38(5.2%), as shown in Table 1.

Table 1. Bacterial contamination in platelet concentrate units

Bacterial growth	**No. (%)**	**Gram stain**	**No. (%)**	**Bacteria**	**No. (%)**
Detected growth	38 (38%)	G +ve bacteria	30 (79)	*Bacillus subtilis*	24 (63)
				S. epidermidis	6 (16)
		G –ve bacteria	8 (21)	*E. coli*	4 (10.5)
				Proteus mirabilis	2 (5.2)
				P. aeruginosa	2 (5.2)
No growth	62 (62%)	_	_	_	_

About 28/100 (28%) packed RBC units were found to be contaminated by bacteria. The Gram positive bacteria were the predominant 23(82%) vs 5 (18%). *Bacillus subtilis* was the most frequent 19/28(67.8%), followed by *Escherichia coli* 5/28(18%), and *Staphylococcus epidermidis* 4/28(14.2%), as shown in Table 2.

Table 2. Bacterial contamination in packed RBC units

Bacterial growth	No. (%)	Gram stain	No. (%)	Bacteria	No. (%)
Detected growth	28 (28)	G +ve	23 (82)	*Bacillus subtilis*	19 (67.8)
				S. epidermidis	4 (14.2)
		G -ve	5 (18)	*E. coli*	5 (18)
No growth	72 (72)	_	_	_	_

In this study, the overall rates of bacterial contamination of packed RBC and platelet concentrate were 38% and 28%, respectively. Those were much higher than that recorded by similar studies in other countries like Egypt: 17.9% (Samia *et al.,* 2014), Ethiopia: 9.2% (Agzie *et al.,* 2019), Uganda: 3.5% (Aloysius, 2013), USA: 0.2% (Kuehnert *et al.,* 2001), UK: 0.15%, (Williamson *et al.,* 1999), and France: 0.1% (Wanger *et al.,* 1994). This could be attributed to poor infrastructure setup and practice of infection control standards, including lack of thorough inquiry about any recent febrile and diarrheal illnesses at level of donor selection, and poor adherence to standard antiseptic measures prior to blood collection.

The rate of contamination was higher among platelet concentrate than packed RBC units, 38% vs 28%. This could be explained by storage conditions, as platelets are stored between 20 - 24 °C, which provide a favourable environment (Eder *et al.,* 2017; Makuni, 2015).

Bacillus subtilis was the predominant, followed by *Staphylococcus epidermidis*, *Escherichia coli*, *Proteus mirabilis* and *Pseudomonas aeruginosa*. Our finding were as Agzie *et al.* (2019), as their findings showed that the majority were Gram-positive bacteria. However, this study, consisting of findings of most of the studies conducted in African countries as Kenya (Hassall *et al.,* 2009), Nigeria (Aboderin, 2017) and Ghana (Adjei *et al.,* 2009).

The requirement to assess the rate and spectrum of blood product contaminations is mandatory. The clinical impact of the transfusion of contaminated blood products on patients, particularly immune-compromised secondary to haematological malignancies and chemotherapy assessment is the goal. Blood banks must be notified about the necessary measures to control the transmission of infection and contamination of blood components.

IV. CONCLUSION

Bacterial contamination is common and presented at a high rate. Gram-positive bacteria were the most predominant, and this attributed to poor skin cleansing and antiseptic techniques used prior to donor blood collection.

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