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INTERVENTIONS IMPLEMENTED TO REDUCE BACTERIAL CONTAMINATION IN BLOOD PLATELETS AT THE NATIONAL BLOOD TRANSFUSION SERVICES IN GUYANA

Running title: Reduction of Platelet Contamination

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ABSTRACT:

This study aimed to determine the prevalence of bacterial contamination in donor-collected platelets components using the diversion pouch integrated blood collection system at the National Blood Transfusion Services, Guyana. This was a single-site cross-sectional, comparative study that was carried out at the blood bank from July 2022 to August 2022. A total of 70 platelet concentrates were collected, 35 samples were from donors swabbed with isopropyl alcohol and the other 35 samples were from donors swabbed with a combination of hand scrub, iodine and isopropyl alcohol. Gram staining, culture, and subculture were done in Trypticase Soy Broth, blood agar and eosin methylene blue agar, Mac Conkey agar, and Chocolate agar. Of the 70 samples tested, 7 (10%) samples had contamination. Of the 7 contaminated samples, 5 samples were contaminated with Gram-negative bacilli, 1 sample each with Gram-negative cocci and Gram-positive cocci. The occurrences of bacterial contamination of platelets were significantly lower when utilizing the combination of hand scrub, iodine, and isopropyl alcohol (1 in 35) in comparison to the usage of isopropyl alcohol alone (6 in 35), as well with diversion pouch ($p \leq 0.05$). A diversion pouch blood collection system in combination with an aseptic method of iodine, isopropyl alcohol, and a hand scrub is an efficacious method in reducing bacterial contamination in platelets.

Keywords: bacterial contamination, platelets, diversion pouch

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INTRODUCTION:

Globally, people are impacted by the serious public health problem of microbial contamination of donor blood and other blood-related derivatives. The existence of bacteria in blood or blood derivatives collected and/or prepared for transfusion is known as bacterial contamination of donated blood. Microbial contaminants, such as bacteria, should be absent from the blood that is ready to be transfused [1]. This necessitates the collection and processing of blood in an aseptic manner. Blood donation systems have generally implemented the redirection of the first flow of blood into a pouch as a way to avoid whole-blood unit contamination from bacteria. Thus, the diversion pouch could be used as an alternative to venipuncture for blood collection [1].

In transfusion medicine, bacterial transmission is still a major issue. This is not a recent issue; the first report of bacterial transfusion transmission from a blood component was documented in 1941, more than 60 years ago. Since the 1970s, significant progress has been achieved in improving the viral threat to the blood supply. Bacterial contamination remains the most common microbiological cause of transfusion-associated illnesses [2]. Bacterial contamination of derivatives from blood, particularly platelets, is the most common infection risk of blood transfusion, occurring in around 1 out of every 2000-3000 platelet infusions [3]. The most common bacterial contamination of blood products is by gram-positive bacteria often found on the skin, such as *Staphylococcus* epidermidis or *Staphylococcus aureus*, *Corynebacteria spp*, and *Bacillus spp* [3]. This contamination occurs as a result of bacteria on the skin moving through the collecting needle into the blood. Gram-negative bacteria are common in the gastrointestinal tract's natural flora and occur when blood is drawn from donors who have bacteria in their circulation but are asymptomatic. Examples include *Acinetobacter*, *Klebsiella*, and *Escherichia coli* [3]. Garraud and Tissot looked at the survival modes of bacteria in the various fractions of blood, and it was proven that contamination of blood components may be traced back to contamination during the collection, preparation, and pooling methodologies. As well as contamination in collecting bags and blood product storage period [4].

The National Blood Transfusion Service (NBTS) collects voluntary blood donations (10,000 units of whole blood yearly) at several places around Guyana during blood drives, resulting in minimally standardized sample collection techniques, which could put blood components at risk of contamination. Despite standard operating protocols being in force at blood banks and hospitals to minimize microbiological contamination of blood bags in storage, contamination from bacteria does occasionally

occur [5], [6]. Bacterial contamination is more common in platelet concentrates than in RBC components, since bacteria may live and multiply at the temperature levels used for PLT (20-24 degree Celsius), but not for RBC (1-6 Degrees Celsius). Because of the growing knowledge and clinical importance of bacterial contamination of blood components, standards have been implemented to reduce bacterial infections [3]. Even after transfusion, and especially after the transfusion of platelets, bacterial sepsis remains a serious concern. Bacterial contamination of whole blood is a result of natural skin flora. Skin disinfection before venipuncture is critical for lowering the risk of post-transfusion infection [7]. Cleansing the arm with detergent and water makes it easy to get rid of the temporary flora. After washing the skin, blood culture findings reveal 2% to 6% rate of positive cultures [7].

METHODOLOGY:

Platelet donor samples were obtained from the National Blood Transfusion Service and transported to the University of Guyana Lab, where they were analyzed throughout July and August 2022. A total of 70 platelet components were collected, stored appropriately, and transported to the University of Guyana's Laboratory for processing. A prospective and convenient sampling method was used. All platelet concentrates were packed and placed in an ice cooler. The ice cooler was equipped with a thermometer for temperature control (ideal temperature: 22 degrees Celsius). The platelet components were then transported within two days after collection from the National Blood Transfusion Bank to the University of Guyana Laboratory.

In the lab, 5 ml of the platelet concentrates were injected into vials containing 50 ml of Trypticase Soy Broth, after which they were placed in the incubator and then observed for approximately 7 days for any signs of turbidity. The vials with turbidity were gram-stained and then sub-cultured on MacConkey agar, Chocolate agar, and Blood agar. As opposed to Chocolate agar, which was incubated anaerobically at 37°C for 48 hours, MacConkey and Blood culture plates underwent aerobic incubation for 24-48 hours. Upon detection of growth, a gram stain was done and checked under the microscope to differentiate between gram-positive and gram-negative organisms [8].

Data were entered into an Excel spreadsheet and analyzed using SPSS Version 21.0 Software. Data was graphically presented using Bar charts, Pie charts, and Tables. Permission was given by the Institutional Review Board (IRB# 027/2022) and the director of the National Blood Transfusion Service before commencing this research. All patient information was kept confidential.

RESULTS:

A total of 70 samples were collected in the study, 35 of which were exclusively from donors whose phlebotomy sites had been cleaned with

isopropyl alcohol. Another 35 samples were collected from donors whose arms had been scrubbed with liquid soap before being cleaned with isopropyl alcohol and iodine. Table 1 shows the summary of the result obtained. Out of the 70 samples that were taken, 7 (or 10%) showed signs of growth, while 63 (or 90%) showed no growth. Gram-negative bacilli (5), Gram-negative cocci (1), and Gram-positive cocci (1) were the different bacterial types identified.

Table 2 shows that when the donors were swabbed with isopropyl alcohol, growth was seen in 6 (17.1%) of the 35 samples; therefore, no growth was seen in the remaining 29 (82.9%) samples. With a combination of both iodine and isopropyl alcohol and hand scrub, growth was seen in 1 (2.9%) sample from a total of 35; the remaining 34 (97.1%) samples had no growth.

Table 1: Overall findings of the study

Variables	N (%)	p - value
Type of swabbing		
Isopropyl alcohol	35 (50%)	
Iodine + Isopropyl alcohol	35 (50%)	
Presence of bacteria		
Growth	7 (10%)	
No growth	63 (90%)	p≤ 0.05
Type of bacteria		
Gram negative bacilli	5 (7.1%)	
Gram negative cocci	1 (1.4)	
Gram positive cocci	1 (1.4)	
No growth	63 (90.0)	p≤ 0.05

Table 2: Percentage of growth with different Aseptic Techniques used

Presence of bacteria	Type of swabbing		
	Isopropyl alcohol	Hand scrub + Isopropyl alcohol + Iodine	p - value
Growth	6 (17.1%)	1 (2.9%)	
No growth	29 (82.9%)	34 (97.1%)	0.04

DISCUSSION:

The study evaluated the prevalence of bacterial contamination in platelet components using diversion pouches at the National Blood Transfusion Service. First, before phlebotomy, cleaning the blood collection area is an essential step in reducing the likelihood of spreading pathogens during transfusion. It has been demonstrated that the diversion pouch is crucial for minimizing bacterial contamination. Diverting the first 10-15 ml of blood is an effective means of mitigating the percentage of contamination with bacteria [9]. The most frequent cause of gram-negative bacteria such as *E. coli* is occult bacteremia [10]. Consequently, all gram-negative organisms should be viewed as potentially dangerous to the donor's health. The presence of fever, rigors, and hypotension is indicative of the importance of other characteristics of the organisms, such as the strain's virulence, in transfusion-associated sepsis [9]. Before venipuncture, epidermal cleaning is essential for reducing the incidence of post-transfusion infection. As mentioned earlier, human skin has two different bacterial floras: transient and residential [10].

Thyer and fellow co-authors found that when a needle is inserted into the skin to collect blood, results in a passage of live bacteria or the transfer of bacteria from tiny pedicle flaps created by the needle into the bags that collect [11]. A skin surface that has been scarred by prior donations [12] makes it considerably more challenging to obtain thorough decontamination of the region [13].

The first part of blood collection should be diverted to collateral bags for biological validation testing of the unit. This prevents the first inflow of blood-carrying pathogens or epidermal shards from the donor to infiltrate the collecting bag and infecting it. The transfusion community and the FDA have taken many steps to reduce the risk of microbial contamination of transfusion products during the period of collection. More efficient sanitation of the phlebotomy site is an apparent first step. The FDA has spoken out concerning the need for appropriate antibacterial implementation and scar tissue complications. To sanitize the collecting locations, more efficient disinfectants have been advocated, and the practice of inefficient antibacterial agents such as green soap has been deterred [14]. In tests involving hospitalized patients, however, FDA found that some skin disinfection treatments utilizing isopropyl alcohol accompanied by an infusion of iodine, which had been claimed to be better than those using povidone-iodine, were ineffective. Once the venipuncture needle punches out an epidermal lump as it penetrates through the skin, sterilization of the surface of the skin is limited. This unsterilized epidermis component can be taken into the collection of blood and developed [11].

Cold temperatures might reduce the rapid growth of microorganisms in transfusion items during storage. This is a typical procedure for red blood cells since it inhibits the development of the majority of bacterial species and lowers the possibility of sepsis caused by transfusion. Platelets, inversely, lose their ability to function properly when kept at low temperatures. Short exposure to cold can cause irreparable platelet damage that severely reduces their capacity to circulate [15].

Transfusion with blood components that are contaminated with exogenous bacteria or other agents can cause fatal complications [16]. To reduce pathogen contamination, a series of particular activities and processes known as aseptic methods are carried out under strictly controlled settings. Making use of such methods is vital because they safeguard both the donor and patient from infection and stop the spread of infections. At times, cleaning (removal of dirt and other impurities), sanitizing (reduction of microorganisms), or disinfecting (removal of the majority of bacteria but not those with high resistance) techniques are insufficient to prevent infection [16]. Through interaction with the environment, people, or equipment, pathogens can infect the patient. Any therapeutic environment may benefit from utilizing aseptic techniques, which is why they should always be used to preserve asepsis, the absence of harmful organisms, in the clinical context [16].

Conclusion & Recommendations:

In transfusion medicine, bacterial transmission continues to be a major concern. It can be concluded based on our findings that the contamination of platelet concentrates via the diversion pouch occurs at a significantly lower proportion when compared to that of the traditional collection bag. Under this study, the most efficient way to disinfect skin is to use a hand scrub in conjunction with isopropyl alcohol and iodine.

REFERENCES:

1. Levy JH, Neal MD, Herman JH. Bacterial contamination of platelets for transfusion: strategies for prevention. Crit Care. 2018; 22(1):271. https://doi.org/10.1186/s13054-018-2212-9
2. Barbara JA, Regan FAM, Contreras MC. Transfusion microbiology. Cambridge University Press; 2008.
3. Agzie M, Niguse S, Tsegay E, Kahsay G, Mahmud MA. Bacterial contaminants of stored blood and blood components ready for transfusion at blood banks in Mekelle, Northern Ethiopia. BMC Res Notes. 2019 Mar;12(1):169.
4. Garraud O, Tissot J-D. Blood and Blood Components: From Similarities to Differences. Front Med. 2018; 5. https://www.frontiersin.org/articles/10.3389/fmed.2018.00084
5. Vieira PCM, Lamarão LM, Amaral CE de M, Corrêa AS de M, de Lima MSM, Barile KADS, de Almeida KLD, Sortica VA, Kayath AS, Burbano RMR. Residual risk of transmission of human immunodeficiency virus and hepatitis C virus infections by blood transfusion in northern Brazil. Transfusion. 2017 Aug; 57(8):1968–76.
6. Solves Alcaina P. Platelet Transfusion: And Update on Challenges and Outcomes. J Blood Med. 2020;11:19–26.

7. Kjellberg G, Holm M, Lindvall G, Gryfelt G, van der Linden J, Wikman A. Platelet function analysed by ROTEM platelet in cardiac surgery after cardiopulmonary bypass and platelet transfusion. Transfus Med. 2020 Oct; 30(5):369–76.
8. Gunvanti R, Lakshmi JT, Ariyanachi K, Saranya M, Kamlakar S, Sakthivadivel V, Gaur A, Nikhat SS, Sagar T, Chenna K and Vidya MS. (2022) 'Blood Culture Contamination Rate as a Quality Indicator - a Prospective Observational Study.', Maedica. Romania, pp. 311–316.:https://doi.org/10.26574/maedica.2022.17.2.311.
9. Canellini G, Waldvogel S, Anderegg K, Tissot J-D. Bacterial Contamination of Platelet Concentrates: Perspectives for the Future. Lab Med. 2010 May 1; 41(5):3015.https://doi.org/10.1309/LMQO2P2BSG1XXCSH
10. Centers for Disease and Prevention. Bacterial Contamination of Platelets. CDC.2022.https://www.cdc.gov/bloodsafety/bbp/bacterial-contamination-of-platelets.html
11. Thyer J, Perkowska-Guse Z, Ismay SL, Keller AJ, Chan HT, Dennington PM, et al. Bacterial testing of platelets - has it prevented transfusion-transmitted bacterial infections in Australia? Vox Sang. 2018 Jan; 113(1):13–20.
12. Lee CK, Wong HK, Ho PL, Tsoi WC, Lee KY, Tsui GTF, Chua E, Leung JNS. and Lin CK. Significant bacterial contamination risk reduction with the use of diversion pouch. Transfus Med. 2012 Dec; 22 (6): 404–8.
13. Buchta C, Nedorost N, Regele H, Egerbacher M, Körmöczi G, Höcker P and Dettke, M. Skin plugs in phlebotomy puncture for blood donation. Wien Klin Wochenschr. 2005 Feb; 117(4): 141–4.
14. Goldman M. Bacterial contamination of platelet concentrates: where are we today? Vox Sang. 2004;87(s2): 90–2. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1741-6892.2004.00460.x
15. de Korte D, Marcelis JH, Verhoeven AJ, Soeterboek AM. Diversion of first blood volume results in a reduction of bacterial contamination for whole-blood collections. Vox Sang. 2002 Jul; 83 (1): 13–6.
16. Khodair SA, El-Shalakany AH, Shalaby SM. Bacterial Contamination of Stored Blood and Blood Components Ready for Transfusion at the Blood Bank. Egypt J Med Microbiol. 2020;29(3):53–7. https://ejmm.journals.ekb.eg/article_251379.html