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Original Research Article

Study on Effectiveness of Leukoreduction Filters

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Abstract: Leukocyte contamination during blood transfusion can cause many adverse effects, such as the transmission of cell-associated infectious agents, febrile non-haemolytic reactions, graft-versus-host disease, and immunosuppression. Leukodepleted blood components can minimise most of these adverse effects but the leukodepletion of all cellular blood components is costly. So as to prevent monetary burden to the patient, alternative would be to supply leukodepleted blood components only to the patients at risk . This study included 3,145 units collected by voluntary and replacement donors and subjected to leukoreduction by using leukoreduction filters in the laboratory of the blood bank. Total leukocyte count prior to the procedure and after the procedure was done by using automated cell counter.In this study , it was found that 99.99 % of leukocytes were reduced by using these leukodepletion filters.
Keywords: Leukocyte, graft-versus-host disease.

INTRODUCTION

Five decades ago , whole blood was the only option available to treat anemia, platelet disorders , hypovolemia and other conditions. There has been a gradual and significant shift in blood transfusion strategy of allogenic blood after the concept that blood can be separated to its various cellular and acellular components such as RBCs, WBCs, Platelet concentrate, Plasma and Cryoprecipitate. At present blood and blood components are treated as drugs because of their use in treating the diseases like drugs . Blood transfusion also has many adverse effects like the drugs.Leukocytes constitute one of the cellular component of the circulating blood. Transfusion of leukocytes or granulocyte concentrate has limited use or no specific indication in blood transfusion except uncontrolled bacteremia and septicemia not responding to various antibiotic therapies. Leukocytes in the donor blood unit or granulocyte concentrate can produce severe adverse reactions to the recipient when transfused .These adverse reactions include febrile non-hemolytic transfusion reactions (FNHTR), alloimmunisation, immunomodulation, transfusion of cytomegalovirus (CMV) and other leukotropic viruses [1, 2]. To avoid these type of adverse reactions , removal of leukocytes from the blood unit is recommended by various methods. After the removal of the leukocytes , the unit is labeled as leuko-reduced packed cell or pRBC. Leukoreduced when done on each and every single bag of the blood bank, it is called as universal leukoreduction (ULR) and when it is done for specific groups of patients, it is called as selective leukoreduction(SLR) [3-5].

AIM OF THE STUDY

To study the effectiveness of leukoreduction by using leukoreduction filters

MATERIALS AND METHODS

This study was conducted at a voluntary blood bank where the blood units are collected from the healthy , voluntary and non-remunerated educated donors through blood donation camps. The age ranged from 20 years to 50 years. The study period was between June 2010 and December 2013. Total number of blood units subjected to leukodepletion were 3145. The blood units used for the leukodepletion were fresh blood units (within 5 days of collection). Blood and blood components supplied were whole blood (WB) , packed red cells (pRBC) and washed RBC with and without additive solution. All the blood components were prepared by conventional methods; centrifugation and separation in closed system. Blood and blood components units were grouped according to the ABO system and Rh typed, cross matched with the recipient blood sample before the process of leukoreduction or

before connecting to the lekoreduction filters. All blood and its components were screened for transfusion transmissible infections, which included HIV testing, HBsAg, HCV, Malaria and VDRL by ELISA technique as per the National AIDS Control Organization (NACO) guidelines (25 IBRR). Leukoreduction filters used in this study were from various make like SEPACELL 500 II , BioR and BioP, Hemonetics etc. Total leukocyte count before and after the leukoreduction was estimated using Horiba and Sysmex 3- part hematology cell counter and documented in the register before and after the procedure.

RESULTS AND OBSERVATIONS

A total number of 3,145 blood units were leukodepleted and supplied to patients with various diseases. Most of the units showed total leukocyte count before leukoreduction between 8,000 /cubic mm and 11,000/ cubic mm.

Table 1: Showing Pre-count of the blood units (Before Leukoreduction)

Number of Units	Pre-Count (WBC)
278	4,100-5,000/cu.mm
429	5,100-6,000/cu.mm
478	6,100-7,000/cu.mm
594	7,100-8,000/cu.mm
544	8,100-9,000/cu.mm
425	9,100-10,000/cu.mm
397	10,000-11,000/cu.mm
TOTAL = 3145	

Table 2: Showing Post-count of the blood units (After Leukoreduction)

Number Of Units	Post-Count (WBC)
867	00-05 cells /cu.mm
702	06-10 cells/cu.mm
528	11-15 cells/cu.mm
384	16-20 cells/cu.mm
370	21-25 cells/cu.mm
294	26-30 cells/cu.mm
TOTAL = 3145	

DISCUSSION

Leukoreduction is a process employed to remove white blood cells or leukocytes from the blood or blood components supplied for blood transfusion. After the elimination or reduction of the leukocytes, the blood product unit is labeled as leukoreduced. It is theorized that transfusions of blood products that contain leukocytes or white blood cells may lead to adverse effects through various mechanisms because white blood cells themselves harbor infectious agents and some of the pathogens are more concentrated in white blood cells than the rest of the blood product. It is also theorized by various authors that the donor white blood cells may suppress the recipient's immune system by interacting with the immune proteins and pathways.A meta-analysis study done by Dr. Neil Blumberg and others in april 2007 covering 3093 patients states that, using leukoreduced blood decreases the frequency of post-transfusion infection by 50% [6]. In a previous study, Blumberg and others reported that a change to universal use of leukoreduced blood at Strong Memorial Hospital at University of Rochester reduced post-transfusion infection by 33-45% [7]. Not all countries are practicing universal leukoreduction. As of now, most developed nations have adopted universal leukoreduction of transfusions with the notable exception of the United States [8]. Canada , Britain and France adopted universal leukoreduction in the late 1990s. Leukoreduced products are commonly available in most of the blood banks /centres in the United States and most hospitals use only leukoreduced blood while others use leukoreduced products in certain patient populations only.

In this study, it was found that using leukodepletion filters with the laboratories of the blood bank , one can achieve four log reduction of the total leukocyte count. When the unit of blood (approximately 450 ml) is collected there will be 4,000 to 11,000 WBCs /cu.mm, sometimes still higher count. Even after the blood component processing, 90% of these white blood cells remain with the RBCs, 8% of these white blood cells remain with the platelets as mononuclear cells;and 2% of cells remain in an unit of fresh frozen plasma (FFP). The intent of leukoreduction is to reduce the number of white blood cells in the blood unit.

Indications of Leucodepletion are 1) Reduction of non-haemolytic transfusion reactions , 2) Reduction of HLA alloimmunisation that may lead to patients becoming refractory to platelet transfusions e.g. patients requiring long term platelet therapy as in Aplastic anaemia and MDS, 3) Reduction of CMV transmission e.g. in patients awaiting organ transplantation, 4) Reduction in the risk of Yersinia enterocolitica contamination of RBC, 5) Possible reduction of Prion Disease, 6) Reduction in the incidence of transfusion associated Graft Versus Host Disease (TA-GVHD).

Efficacy of leucocyte filters

According to the various trials and observations, the leucocyte filters currently available are capable of providing the desired level of leucodepletion. Present day filters provide a minimum of 4 log depletion of white blood cells and many filters are commercially available with various brand names [9,10]. It has been observed that loss of red cells while filtering blood ranges from 30 – 45 ml depending from filter to filter and about 12 to 15 percent of the platelets are also lost. The product loss during filtration of Single Donor Platelets (SDP) can range anything form 45 to 50

ml. Leucodepletion filters for platelets are different as they are supposed to retain platelets during filtration. Unfortunately, the loss of platelets during this procedure has been reported to be anything from 9 to 35 percent. This is quite high and may result in an increased frequency of transfusions and donor exposures to compensate for the loss during processing [11]. The time taken for filtration varies from filter to filter and can take anything from 10 to 20 min. Current generation of apheresis machines and disposable sets used are capable of achieving a 4 log leucodepletion, obviating the need for filtration [12,13].

Bedside filtration

Bedside filtration means the application of bedside blood or blood-product filters to leukoreduction administration sets for transfusing blood or blood products to neonates, patients with immunosuppression and organ transplant cases. According to the national and international standards, all blood components should be transfused through an administration set, containing an integral filter. According to the authors , Accorsi et al, and Seghatchian, reiterate that within a few hours of collection, platelet aggregation occurs and after a day or two, the leukocytes start losing their viability and combine with the aggregating platelets and results in microaggregate formation which can lead to complications [14,15]. Later on precipitation of fibrin thread occurs leading to consolidating of fibrin thread into a fibrin polymer and finally forming stable microaggregate. The size of the microaggregate varies between 10-200 unimicron (μm), and is of similar size to precapillary arterioles of the lungs. Inadvertent infusion of the microaggregate within blood products can result in the occlusion of blood vessels and can lead to serious complications by releasing biochemically active components which can lead to respiratory distress. The transfusion of chronically ill and immune-comprised patients, of whom neonates with low birth weight , preterm babies form a major part, often require a greater level of leukocyte depletion. Recent developments in this field have enabled leukocyte depletion by filtration to be performed, either at the patient bedside, or in the blood bank [15]. The complications which occur clinically at the bed side as a part of transfusion therapy can be prevented to a large extent by appropriate useof blood or blood-product filters [16].

Types of bedside blood-product filters

At prestent, two types of blood-product filters are available for bedside use during, namely leukodepleting filters and microaggregate blood filters. The pore size for a leukodepleting bedside blood-product filter is normally between 20-40 μm, while microaggregate filters are larger and they range between 170 and 240 μm. The pore size of the bedside filters plays a major role in preventing even microscopic pathogens and debris, such as viruses from entering the circulatory system [17].

CONCLUSION

Leukocytes in blood unit and platelet concentrates can be considered as a contaminant that may lead to serious morbidity and even mortality in recipients especially neonates, organ recipients and patients with immunomodulators. Remoal of leukocytes from blood components before transfusion by leucocyte depletion filters prevent or at least delay leucocyte mediated adverse reactions in the recipient. It reduces the incidence of Febrile Non-Hemolytic Transfusion Reactions significantly and also helps in preventing the other adverse effects caused by white blood cells when transfused along with the cellular components of blood. By use of leucodepleted filters, the WBC count in the packed cell unit and platelet concentrates can be reduced to greater than 99.9%.

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