

Plateletpheresis concentrate produced with Fresenius cell separator Iraqi experience

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Abstract

Background: Various types of plateletpheresis instruments are available for single donor plateletpheresis. In plateletpheresis blood is withdrawn from the donor in anticoagulant solution and separated into components. Platelets are retained and the remaining components are returned to the individuals.

Aims: Evaluation of Fresenius COM.TEC; apheresis machine in regard to processing time, platelet (plt) yield efficiency, white blood cell (WBC) content and safety.

Patients and Methods: Twenty two healthy male donors included in single donor plateletpheresis by Fresenius COM.TEC between February 2006 and July 2006 at bone marrow transplantation Center, Medical City Hospital, Baghdad / Iraq.

The donor's age, height, weight, complete blood count, blood group & Rh & vital signs were recorded and they were observed throughout the procedure. Plateletpheresis operational variables and the product variables were assessed.

Results: The plateletpheresis product data which includes, donor platelet count with mean $229.424 \times 10^3/\text{cmm}$ (range $185-336 \times 10^3/\text{cmm}$), product platelet count $\times 10^3/\text{cmm}$ mean $1268.5 \times 10^3/\text{cmm}$ (range $604-2525 \times 10^3/\text{cmm}$), Platelet yield with mean $3.39 \times 10^{11}/\text{cmm}$ (range $2.51-7.57 \times 10^{11}/\text{cmm}$), 90.90% of the product $>3 \times 10^{11}/\text{plt}$. No. of yield with WBC $<1 \times 10^6$ 18 out of 22 donors (81.18%), collection efficiency the mean 48,85% (range 32.18-60.28), the collection efficiency $>50\%$ was seen in 13 out of 22 donors (59.09%).

Few donors exhibited adverse reactions mainly circumoral paresthesia in two donors (9.09%) mild pain at the phlebotomy site in three donors (13.63%). Only one had dizziness which account for 4.54%.

Conclusions: Fresenius COM.TEC; apheresis instrument collected platelets safely, efficiently, with consistent leukoreduction product according to the AABB (American Association of Blood Banks) & with short time.

Keywords: Plateletpheresis, Fresenius COM.TEC, platelet yield

INTRODUCTION

Since platelets first identified in 1881, there has been continuous and accelerating progress in our basic understanding of platelet function.^[1]

The beneficial effect of platelets in the control and prevention of thrombocytopenic hemorrhage was noted

early in this century. In 1910 Duke was the first who showed that the platelets contained in the transfused whole blood decreases the bleeding time and controlled bleeding.^[2] General improvement of the technique of separating platelets from whole blood & availability of

plastic bags in blood banking revolutionized the field of component therapy.^[3]

Platelets (plts) are obtained by two different methods:

1- Plt concentrates from whole blood; pooled random donor plt which is a co-product of blood donation prepared by:

A- plt rich plasma -plt-concentrate .

B- buffy coat -plt-concentrate.^[4]

2- Apheresis plts: apheresis is a term derived from a Greek word that means separate, plateletpheresis is collection of plt from voluntary single donor with the help of an automated cell separator, in which blood is withdrawn from the donor in anticoagulant solution and separated into components. One or more component is retained and the remaining constituents are returned to the donor.^[5] The major advantage of apheresis plts is that enough plts can be collected from a single donor, an average of the equivalent of 6-10 units ($3-5 \times 10^{11}$) plts of random plt concentrate at one time and have now become the main source of plt in many countries.^[6] The reduction in donor exposure by using apheresis plts has the potential advantages of reducing transfusion-transmitted infections and the incidence of alloimmunization.^[7]

The bacterial risk associated with plt transfusion is high because plts are stored at $22 \pm 2^\circ\text{C}$ rather than the 4°C storage required by red cells. Some studies have suggested a reduction in a bacterial transmission by transfusion with the use of single donor plts.^[8] Vamvakas 2009 concluded that comparing with single-donor plts, plt pools of five concentrates have 5.6 –fold higher risk of bacterial contamination.^[9] Other potential advantages of single donor plt over pooled donor plts beside decreased contamination is the ease of handling, because the need to pool multiple plt concentrate is eliminated.^[10]

Leukoreduction provided by single donor apheresis is important: 1-reduce plt alloimmunization.^[11] 2-prevention of cytomegalovirus (CMV) transmission by transfusion^[12] and 3-reduction in febrile transfusion reactions.^[13]

Aim of the study: The purpose of this study is to evaluate the platelet yield & collection efficacy of plateletpheresis using Fresenius cell separator from single donor & to study adverse donor reactions.

PATIENTS AND METHODS

Twenty two male donors underwent plateletpheresis between February 2006 and July 2006 at Bone Marrow transplantation Center, Medical City Hospital, Baghdad / Iraq.

Donors were selected based on the following criteria according to the Council of European Guidelines.^[14] and Recommendations for apheresis and the standard guidelines established by the American Association of Blood Banks AABB,^[15] the data of the donors were entered into the cell separator program:

1- Weight >50 Kg.

2- Age – 18 to 60 years.

3- Hemoglobin > 12.5gm/dl.

4- Platelet count > $150 \times 10^3/\text{cmm}$.

5- Absence of any illness.

6- No consumption of aspirin or other non steroidal anti-inflammatory drugs for the last 7 days.

7-All donors were negative for viruses: HCV & HIV antibodies & HBsAg as infectious markers using ELISA method & TPHA test for syphilis.

8- At least 3 months since the last blood donation.

9- At least 3days since the last plateletpheresis.

All donors were male normal on physical examination; median age was 34 years (range 20-48 years). Written consent of the donors was taken after explaining the procedure, the time, the possible side effects, & the benefit to the recipients. Complete blood count was carried out by auto analyzer MS9-meletschloesing laboratories (France) & ABO/Rh typing was performed.

The automated cell separator equipment utilizes centrifugal force as the bases of plt collection in a closed system, well trained medical staff were needed. The cell separators may be intermittent or continuous flow cell technique, using a single or double venous access. Continuous flow double venous access Fresenius AS.TEC 204 (Germany) using disposable plt set (C4L), for 5 days plt storage was used in our study the machine parameters were as follows: whole blood flow 50-75ml/min, anticoagulant/whole blood ratio 1:8-12.

A form was used to record the information of the donors & they were followed up for any complications during the procedure. Height, weight, pulse, temperature, blood pressure was recorded. Samples for product plt count & residual WBC count were collected and measured manually. The plt collection bag obtained at the end was

shaken to detach the plt from the wall of the bag & kept for one hour at room temperature 22 ± 2 °C to make it an even suspension.

Plt yield & collection efficiency were calculated as follows:

To calculate the total number of plts in the final product, the following equation is used:

Plt yield = product volume (ml) x product count (plt/ μ l) x conversion factor (1000 μ l/ml).

To calculate the collection efficiency, total plt processed is to be calculated by the following formula:

Total plt processed = [pre+post count (Plt/ μ l) \div 2] x Total blood volume x Conversion factor (1000 μ l/ml).

Collection efficiency = Plt yield \div Total Plt processed x 100%.^[16]

Statistical Analysis:

Data were analyzed using statistical package for social science (SPSS, version 11). Data were expressed as mean \pm SD.

RESULTS

In this prospective study all donors were either relatives or friends of patients. Donors' characteristics were listed in [Table 1] showing age weight, height, TBV (total blood volume) of the donors. The median age was 34 years (range 20-48 years), all were healthy male. Haemoglobin of the donors varies between 12.6gm/dl to 16.6gm/dl & plt count between 150×10^3 /cmm to 265×10^3 /cmm.

Table 1. Donors characteristics.

| Age (years); median (range) | Weight (kg); mean \pm SD | Height (cm); median (range) | TBV (L); mean \pm SD |
|-----------------------------------|-------------------------------|-----------------------------------|---------------------------|
| 34 (20-48) | 89.772 \pm 13 | 172.637 (155-190) | 5,261 \pm 58 |

TBV = Total blood volume.

Swirling was observed in an individual unit & scored according to subjective observation.

Score O: Homogeny turbid & not changed with pressure.

Score 1: Homogeny swirling only in some part of the bag & is not clear.

Score 2: Clear homogeny swirling in all part of the bag.

Score 3: Very clear homogeny swirling in all part of the bag.^[3]

Swirling score 3 was observed in 19/22 which is 86.36%, while score 2 was seen in 3/22 which is 13.64% of cases.

Data of the procedure are shown in [Table 2], which includes blood volume processed, the flow rate ml/min, the time of separation, acid citrate dextrose-A (ACD-A) volume used & the product volume.

Table 2. Plateletpheresis procedure data.

| | median (range) |
|-----------------------------|---------------------|
| Blood volume processed (ml) | 3,347 (3,252-3,383) |
| Flow rate (ml/min) | 57 (51-66) |
| ACD-A volume (ml) | 371 (273-450) |
| Product volume (ml) | 282.37 (229-300) |
| Time of the procedure (min) | 66.55 (61-66) |

[Table 3] illustrates plateletpheresis product data which includes, donor plt (platelet) count with mean 229.424×10^3 /cmm (range $185-336 \times 10^3$ /cmm), product plt count mean 1268.5×10^3 /cmm (range $604-2525 \times 10^3$ /cmm), Plt yield with mean 3.39×10^{11} /cmm (range $2.51-7.57 \times 10^{11}$ /cmm), 90.90% of the product with $>3 \times 10^{11}$ plt. No. of yield with WBC $<1 \times 10^6$, 18 of 22 donors (81.18%), collection efficiency the mean 48, 85 % (range 32.18-60.28%), the collection efficiency $>50\%$ was seen in 13 of 22 donors (59.09%).

[Table 4] summarizes the donors adverse reactions Few donors exhibited adverse reactions mainly circumoral paresthesia 2 out of 22 donors 9.09% which is due to the effect of the returned anticoagulant (citrate) that causes hypocalcaemia^[13] and mild pain at the phlebotomy site in 3 out of 22 donors 13.63%. Only one had dizziness which account for 4.54%.

None of the donors experienced any other side effects as hematoma, nausea, vomiting, syncope or tetany.

Table 3. Platelet pheresis product data.

| | |
|--|--------------|
| Donor plat. count x10³/cmm | |
| Range | 185-336 |
| Mean | 229.428 |
| Product plt count x10³/cmm | |
| Range | 604-2525 |
| Mean | 1268.5 |
| Plt yield x10¹¹/cmm | |
| Range | 2.51-7.57 |
| Mean | 3.39 |
| >3 x10 ¹¹ | 90,90% |
| No. of yield with WBC <1 x10⁶ | 18 (81.18%) |
| Collection efficiency% | |
| Range | 32.18-60.28% |
| Mean | 48.85% |
| >50% | 13 (59.09%) |

Table 4. Adverse donor reactions.

| Adverse donor reactions | No. | Percentage (%) |
|---|------------------|----------------|
| Citrate toxicity (Circumoral paresthesia) | 2 | 9.09 |
| Venipuncture Pain at phlebotomy site (Hematoma) | 3 | 13.63 |
| Blood pressure changes | Nausea /vomiting | -- |
| | Syncope | -- |
| | Dizziness | 1 4.54 |

DISCUSSION

A variety of cell separators are available for plateletpheresis yet scant data concerning plateletpheresis with Fresenius COM.TEC cell separator.^[17, 18, 19] In the present study 22 donors were selected for single donor plateletpheresis which were performed by Fresenius COM.TEC cell separator. This study documented the important parameters of proper platelet collection such as, swirling separation time, plt yield, collection efficiency, & WBC content.

Evaluation of swirling is a simple noninvasive procedure that can be performed by visual inspection of the plt bags against light, is useful for routine quality control of each plt concentrate. Visual inspection of swirling correlates with plt morphology, the presence of swirling indicates discoid morphology & absence is indicative of spherical morphology. In the current study Score 3 was observed in 86.36% & score 2 was seen in 13.64% of cases. Ravindra et al.^[3] reported score 3 in 90% of cases, while score 2 was seen in 10% of cases, both results full fill the recommended criteria of AABB.

Since in our new word, productivity, which is simply (doing more in less time) is important feature of plt yield when evaluating a new instrument.

In the current study the median separation time taken per procedure was 66.55 (61-66) minutes, which is as expected in procedures using double needle procedures using both arms, time tend to be shorter since the blood is drawn & returned after plt separation through different catheters. With single needle procedure a set volume is drawn and processed in the first part of the cycle and returned in the second part, the donor blood undertakes 3-4 cycles of draw & return. The time taken for those machines using intermittent flow rate is longer 71.47 min. as showed by Col D et al on 40 cases.^[16] Waleed A in Iraq observed shorter time with mean of 59, 6min 2003 but only 20% of the twenty donors had the required plt yield of 3 x10¹¹ /bag.^[20] Rajendra C et al. in June 2011 Comparing 5 different types of cell separators on a total 447 donors over 28 months, they regarded Fresenius cell separator as donor friendly after analyzing parameters related to donor comfort such as donation time & processing time.^[21] In the current study the blood volume processed was 3,347 ml (range 3,232-3,383ml) to reach a target plt yield with mean 3.39 x10¹¹ (range 2.51-7.37 x10¹¹). Plt collected by plateletpheresis are stored in donor plasma, which serves as buffering agent against drop in PH in the plt concentrate from anaerobic conditions & elevated lactic acid production.^[22] Coffe et al. recorded the French experience on plt pheresis with Fresenius COM.TEC cell separator the blood volume processed was 4,606±2291 & the mean separation time was between 87-109 min which is longer than our result to a target Plt yield of 4,47 x10¹¹ to 5,9 x10¹¹.^[18] While Moog et al. using the same equipment reported a processed blood volume of 2,826±409 ml in a donation time of 55±11min shorter than our duration, the mean plt yield was 3,11±0.40 x10¹¹ which is also less than our values.^[19]

An important advantage of the use of plateletpheresis is obtaining a product of plt labeled as leukoreduced, which means leukocytes $<5 \times 10^6$ per concentrate according to USA standers (15) & $<1 \times 10^6$ per concentrate according to European standers.^[14] In the current study No. of yield with WBC $<1 \times 10^6$ were 18 out of 22 donors (81.18%), while Coffe et al.^[18] reported a higher results reaching 97%, yet both results met the AABB standers as well as the more stringent European guidelines.

Collection efficiency is an important issue when evaluating instruments, in our study we noticed that products with $>50\%$ collection efficiency were found in 13 out of 22 (59.09%), this result was similar to those found in literature: 52-55 %.^[17, 18, 19]

Less procedure-related side effect is an important consideration for the donors.

The most common side effects are citrate related.^[18, 19, 23] The incidence of citrate toxicity varies from 0.11 to 16% in different studies.^[24, 25] In the present study it was noticed in 9.09% of the donors, which was mild & clinically not significant. This adverse effect were treated well by reducing the ACD infusion rate, the amount used &/or oral calcium supplementation.^[17, 18, 19]

Conclusion

Plateletpheresis performed by Fresenius COM.TEC is efficient, safe, with Leukoreduction of the plt product according to the AABB with low separation time, yet in the developing countries the high coast and more technical expertise required are regarded as limitation.

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