ORIGINAL ARTICLE

Comparison of Haemonetics MCS Plus and Baxter CS 3000 Plus for Platelet Apheresis: Experience at a Tertiary Care Hospital

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ABSTRACT

***Background and Objective*:** Platelet transfusion is one of the most crucial therapeutic approaches in medicine. Single Donor Platelets (SDP) are being preferred because of higher platelet count per unit, leukocyte reduction during collection and fewer donor exposures thus reducing the risk of infection and alloimmunization. This study was conducted to compare Haemonetics MCS plus with Baxter CS3000 plus cell separator in terms of processing time, quality of platelet concentrates, donor experience and individual choice.

***Methods*:** Two hundred platelet pheresis procedures performed on Haemonetics MCS plus during a period from January 2018 to August 2019 were compared with the same number of procedures performed using Baxter CS3000 plus cell separator from July 2015 to April 2019.

***Results*:** The mean platelet count of the product was higher with Baxter, 1741.6 ± 347 x 10^3/µL as compared to1676 ± 301 x 10^3/µL with Haemonetics. No significant difference between the two instruments was observed regarding processing time, product volume and yield.

***Conclusion*:** The two instruments are comparable in terms of time, volume and yield of the product but Haemonetics is better because of donors' comfort and for being operator friendly.

KEYWORDS: Cell separator, Haemonetics MCS plus, Baxter CS3000 plus, Platelet pheresis, Platelet yield.

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INTRODUCTION

Platelet transfusions are widely used in clinical practice. Therapeutic platelet transfusions are given in patients having serious bleeding due to severe thrombocytopenia and/or platelet dysfunction.[1] Platelet transfusions are indicated for prevention of bleeding in case of severe thrombocytopenia secondary to chemotherapy or hematopoietic stem cell transplantation and in thrombocytopenic patients undergoing invasive procedures.[2] Two types of platelet concentrates are available for transfusion; one which is prepared from whole blood donation i.e. Random Donor Platelets (RDP) and the other is Single Donor Platelets (SDP) collected with the help of automated cell separators. Single Donor Platelets offer several advantages over random donor concentrates including higher platelet count per

unit, leukocyte reduction during collection, fewer donor exposures thus reducing the risk of infection and alloimmunization.[3]

A number of apheresis equipment are available in the market which differ in their methodology and performance characteristics. In the literature we find various studies comparing the different aspects of platelet apheresis equipment.[4,5] To the best of our knowledge, this is the first such study from Punjab, in which the experience of platelet pheresis procedures performed on two instruments i.e. Haemonetics MCS plus and Baxter CS 3000 plus is being shared. The current study is therefore carried out to compare both the instruments for processing time and quality of platelet concentrates, product volume, platelet count and any adverse reactions in the donor. It will also help in determining the reason to choose one instrument in preference to other or it would be just a matter of individual's choice and/ or availability.

METHODS

This retrospective comparative study was carried out in the Blood Bank of Shalamar Hospital. Approval of the Institutional Review Board was taken prior to the study vide Letter No: SMDC/IRB/01-9-619. Two hundred platelet pheresis procedures performed using Haemonetics MCS plus (Haemonetics Corp., Braintree Massachusetts USA) during a period from January 2018 to August 2019 were compared with the same number of procedures performed using Baxter CS 3000 plus cell separator (Baxter Healthcare Corp, Fenwal Division, Deerfield Illinois USA) from July 2015 to April 2019.

The donors were selected according to American Association for Blood Banks (AABB)criteria for platelet apheresis and the guidelines established by Safe Blood Transfusion Programme, Government of Pakistan.[6,7] According to these criteria, patients weighing > 50 kg, aged 18 to 60 years, hemoglobin level > 12.5 gm/dl, platelet count > 150 × 10^9/L , absence of any illness, no consumption of non-steroidal anti-inflammatory drugs for the last 48 hours, negative test for HIV, Hepatitis B, Hepatitis C, Syphilis and Malaria at least 2 days after last platelets donation and 8 weeks after last whole blood donation and adequate venous access were included. While the patients not fulfilling the above criteria were excluded.

Informed written consent was taken from all the donors after explaining the details of the procedure. One instrument used for apheresis was Baxter CS 3000 plus, a double needle, continuous type of cell separator. And the second was a mobile, compact and light weight apheresis system known as Haemonetics MCS plus. It is an intermittent flow cell separator and requires single venous access.

All procedures were performed according to the manufacturer's instructions. The donor samples for pre-procedure platelet counts were taken in EDTA vials and were analyzed on Sysmex XS 500i Haematology analyzer. Two ml. of the product from diversion pouch of the platelet bags was taken to determine the product platelet count, using the same analyzer. The volume and platelet count of the product to determine the platelet yield were calculated as follows:

Platelet yield = Volume of the product in ml.×(Product platelet count/µL×1000–conversion factor from µL to ml). The donors were observed for any adverse reactions. The total time taken for each procedure was also recorded.

STATISTICAL ANALYSIS

The data from two apheresis equipment were analyzed using Statistical Package for the Social Sciences (SPSS software, version 20). Mean ± S.D. and ranges were given for quantitative variables like pre-procedure platelet count of donors, platelet count of apheresis product, volume of apheresis product, duration of procedure and yield of a pheresis product. Moreover "t" test was applied to compare two instruments with regards to above mentioned variables. A *P-value* of less than or equal to *0.05* was taken as statistically significant.

RESULTS

In this study, two hundred platelet pheresis procedures done on Baxter CS3000 plus were compared with the same number of procedures performed on Haemonetics MCS plus. All the donors were male. Mean age of the donors was 28.6 ± 4.2 years (range 20–42 years) in Baxter group and 27.5 ± 7.2years (range19–40 years) with Haemonetics. Average weight of the donors was 67

± 6.4 Kg (ranged from 55–72 Kg) and 70.2 ± 7.8 Kg (ranged from 57–74 Kg) in Baxter and Haemonetics group respectively. Most of the donors tolerated the procedure well. A comparison of pre-procedure platelet count of donors, platelet count of a pheresis product, volume of apheresis product, duration of procedure and yield of a pheresis product was made (Table-1). A statistically significant difference was seen in platelet count of the apheresis product obtained with Baxter CS 3000 plus. Two procedures on Baxter CS3000 plus and one on Haemonetics MCS plus had to be terminated early due to impaired flow of blood returning to the donor. Sweating was observed in two donors on Haemonetics MCS plus and three donors on Baxter CS3000 plus. No citrate reaction in form of circum oral numbness and tingling or tetany was found in donors. Also, there was a preferential use of Haemonetics by the Blood Bank staff as two hundred cases on Baxter were performed in 46 months while the same number of procedures were carried out on Haemonetics in only 20 months.

Table 1: Comparison of platelet count, volume, time and yield between two instruments.

Parameter	*Haemonetics Mean ±SD (range)*	*Baxter Mean ± SD (range)*	*P-value**
Pre-procedure platelet count of donors (x10^3/µL)	284.63 ± 60.4 (158-625)	263.15 ± 64.6 (180 – 688)	0.123
Platelet count of apheresis product (×10^3/µL)	1676.0 ± 301.4 (921-3306)	1741.6 ± 347.2 (744 – 2952)	**0.044**
Volume of apheresis product (mL)	267.67 ± 21.0 (175-330)	263.75 ± 21.6 (150 – 340)	0.066
Duration of procedure (Minutes)	73.9 ± 10.6 (50-97)	72.3 ± 8.1 (50-90)	0.087
Yield of apheresis product (× 10^{11})	4.23 ± 0.9 (2.30-9.20)	4.46 ± 1.0 (1.90 – 8.20)	0.976

* t-test

DISCUSSION

The use of therapeutic and prophylactic platelet transfusions is rising in medical practice. The demand for SDP is also increasing due to its advantages over random donor platelets. There is a continuous advancement in apheresis technology with better efficiency and productivity in newer versions of cell separators. In present study, Haemonetics MCS plus was compared with Baxter CS 3000 plus cell separator regarding processing time, quality of platelet concentrates and donors' experience.

The mean platelet count of donors before the procedure in Haemonetics group was 284 ± 60.4 × 10^3/µL, ranging from 158-625 × 10^3/µL whereas with Baxter the count was 263 ± 64.6 × 10^3/µL and ranged from 180 – 688 × 10^3/µL. Pre-donation platelet count requires a minimum of 150 × 10^9/L (or × 10^3/µL) platelets in the donor according to the eligibility criteria for platelet pheresis by AABB. This is because a transient fall in the donor platelet count occurs after the procedure as reported by various studies.[8] Additionally, a direct positive correlation between donors' platelet count before the procedure and yield of platelet concentrate is also well documented.[9,11]

Platelet count of the unit was higher with Baxter, 1741.6 ± 347 (744–2952)×10^3/µL as compared to 1676 ± 301 (921–3306)×10^3/µL with Haemonetics and the difference is statistically significant (*P=0.04*). The above findings are consistent with those of Patel et al.[5] who also reported higher product platelet count with Baxter.

The average volume of the platelet product was 263.7 ± 21 ml. with Baxter as compared to 267.7 ± 21 ml. with Haemonetics. In platelet concentrates, platelets are suspended in donor plasma which act as a buffering agent. The total volume limits excluding anticoagulant for a Single Donor Platelet unit are 200–400 ml.[12] Lower volumes can result in unacceptably low pH due to reduced buffering capacity of plasma. In the present study, platelet concentrates prepared by both the instruments met the quality control criteria for volume and the difference was not statistically significant *(P=0.06)*. The average time taken for each procedure was 73.9 ± 10.6 (50–97) minutes with Haemonetics while it was 72.3 ± 8.2 (58–98) minutes with Baxter which is comparable *(P=0.87)*. In contrast, Swarup et al.[4] reported a slightly prolonged average time per procedure with Baxter than Haemonetics.

The mean yield of platelet units prepared by Baxter was higher (4.46 ± 1.0 × 10^{11} ranged from 1.90 – 8.20 × 10^{11}) than with Haemonetics (4.23 ± 0.9 × 10^{11}, ranged from 2.30 – 9.2 × 10^{11}) though the difference is statistically not significant. The criteria for maintaining quality control of yield of

platelet concentrate require that 75% of units sampled contain a minimum of 3.0×10^{11} platelets as recommended by AABB. So, in current study, 95% (190/200) bags with Haemonetics and 96% (192/200) with Baxter had platelet yield of $\geq 3.0 \times 10^{11}$ thus fulfilling the standards.

Heba et al.[13] reported a higher mean platelet yield with Haemonetics. The volume of the product in their study was also higher than the present study which is the most likely reason of difference in findings. Singh et al.[14] found the platelet yield of $4.13\pm 1.32 \times 10^{11}$/unit (ranged from 1.22 – 8.9 × 10^{11}/unit) and mean volume of the product as 214.05 ± 9.91 ml (ranged from 200 – 251 ml) with Baxter which are lower than findings reported in the preset study.

Platelet pheresis is a safe procedure and is usually well tolerated by the donors. However, adverse events are observed in few cases. Citrate toxicity is a well-known phenomenon caused by chelation of ionized calcium (Ca^{++}) by the citrate present in acid-citrate-dextrose (ACD).[15] Hypocalcemia can affect neuromuscular and cardiac function. Mostly, mild reactions like circum oral tingling and burning sensation are reported but severe reactions e.g. tetany, seizures, and cardiac arrhythmias can also occur.[16] No citrate reaction was observed in donors in the present study and the most likely reason is that prophylactic oral calcium tablets were given to the donors in the beginning of the procedure. This practice has also been mentioned in previous studies.[17,18]

Vasovagal reactions may occur in the form of sweating, dizziness or syncope. Sweating was observed in three (1.5%) donors with Baxter CS 3000 plus and two (1%) donors with Haemonetics MCS plus. This can be caused by apprehension due to psychological and mechanical factors, and was seen more with Baxter CS 3000 plus, most likely due to the noise and vibrations generated by the machine. Another important factor is that with Haemonetics, single venous access is required while the other arm of the donor is free. In case of Baxter, both the arms are utilized for procedure which creates stress in the donor. These findings are consistent with those of Swarup et al.[4] Similar frequency of vasovagal reactions have also been reported by Bassi et al.[19] in his study. Last but not the least, is the preferential use of Haemonetics by the Blood Bank staff. A large number of cases were performed on Baxter in 46 months while the same number of procedures were carried out on Haemonetics in only 20 months which shows Haemonetics as a user-friendly equipment.

CONCLUSION

Both Baxter and Haemonetics were comparable for certain parameters like time and volume. However, there was an exception of platelet count being higher with Baxter. The donors' experience in terms of comfort level (single needle versus two needles) and adverse effects was better with Haemonetics. Another important aspect is operators' preference for Haemonetics because it is more convenient as compared to Baxter.

LIMITATIONS OF STUDY

That all the donors were male is a limitation of the current study in addition to it being retrospective and dependent upon existing data. The total blood volume processed and the white blood cell count in the apheresis product were not available in the records and so, the collection efficiency and the degree of leucodepletion could not be evaluated in the present study. The authors plan to incorporate both these parameters in a future study.

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CONFLICT OF INTEREST

None to declare.

FINANCIAL DISCLOSURE

None to disclose.

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Author's Contribution

SA: Conception of work, interpretation of data, drafting the work.
NT: Revising the work critically for important intellectual content, final approval of the manuscript.
ASJ, AM and BTA: Acquisition and analysis of data.