Original Article

Assessment of pre and post donation changes in hematological parameters and serum calcium and magnesium levels in plateletpheresis donors

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Abstarct

Background: Single donor platelet products are preferred over random donor platelet products due to several advantages. However, safety issues with regard to post procedure hematological decrements and serum calcium and magnesium levels in donors undergoing plateletpheresis have been explored minimally. **Aims:** This prospective study was done to analyze the effects of plateletpheresis on donor's hematological parameters and serum calcium and magnesium levels. **Settings and Design:** It is a prospective, cross-sectional study conducted in the department of immunohematology and blood transfusion. **Material and Methods:** This study was undertaken on 150 healthy plateletpheresis donors over a period of 1 year. Blood samples were collected from each donor before and after the procedure, one in ethylenediaminetetraacetic acid (EDTA) vial for estimation of hematological parameters and another in plain vial for serum calcium and magnesium levels. **Statistical Analysis Used:** Paired t-test was used to analyze the data. **Results:** This study included donors in the age group of 18 to 60 years who underwent plateletpheresis on Haemonetics model of a machine (MCS) + intermittent flow cell separator. A statistically significant increase was observed in mean post procedural Hb (0.95%), Hct (0.7%), and red blood cell (RBC) count (1.3%). There was a decrease in mean post procedural platelet count (27.5%), white blood cell (WBC) count (4.02%), mean serum calcium (1.5%), and serum magnesium (5.1%), which was statistically highly significant ($P < 0.001$). No significant change was observed in post procedural mean platelet volume (MPV) and platelet distribution width (PDW). **Conclusion:** Amid the need of increased demand for plateletpheresis, donor safety must be ensured. Failing to do so can be detrimental to blood supply chain, hence stringent programs for post donation screening of plateletpheresis donors need to be established.

Keywords: Cell separators, hematological parameters, plateletpheresis, serum calcium and magnesium

Introduction

Platelet transfusion to prevent hemorrhagic diathesis due to thrombocytopenia has been universally practiced for over 50 years.[1] Whole blood derived platelet concentrates (PC) became the initial standard of care. However, development of alloimmunization and requirement of Human Leukocyte Antigen matched platelets from donors drove the attention toward apheresis procedures. Single donor apheresis platelets (SDAP) allow collection of an adult dose of compatible platelets from a single donor.[2] Although automated cell separators have undergone a lot of technical refinement, attention has been focused more on the quality of PCs than on post procedural platelet count, hemoglobin concentration, or other hematological

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parameter decrements of donor. However, only selected centers have donor follow-up and routine quality programs.[3]

The major expected adverse consequence of apheresis is related to the effect of citrate anticoagulant returned to the donor.[4] It is normally metabolized quickly in the liver. If the amount of citrate infused exceeds the body's ability to metabolize it, the levels of ionized calcium will decrease.[5] Symptoms of citrate toxicity typically appear during the reinfusion phase, when RBC's are reinfused producing transiently higher citrate dose.[6] Magnesium is a divalent cation which has similar affinity to citrate as calcium.[7] During apheresis, magnesium levels decrease depending on the citrate infusion rate, although the fall in magnesium levels is more rapid and takes longer time to recover as compared with calcium.[8,9] Ensuring donor safety is crucial for donor recruitment and retention. Adverse event in a healthy donor can compromise the morale of other voluntary donors, thus interrupting the blood supply chain which will severely compromise general patient care. Hence, present study was undertaken to ensure plateletpheresis donor safety.

Material and Method

This prospective study was done on 150 healthy plateletpheresis donors in the Department of Immuno-hematology and Blood Transfusion over a period of 1 year to analyze the effects of plateletpheresis on donor's hematological parameters and serum calcium and magnesium levels. The study was approved by the institute's ethical committee and donors were enrolled after taking informed consent. Apheresis donors were screened as per directorate general of health services (DGHS) guidelines for screening of apheresis donors and those found medically fit were included in study.

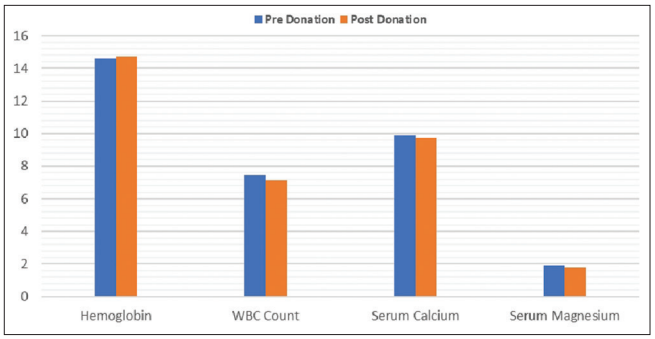
Exclusion criteria included history of any medication including calcium supplementation, any systemic disease, History of blood donation in last 3 months, minor surgery in last 3 months, major surgery in last 6 months, previous blood transfusion in last 12 months, ear piercing or tattoo in last 1 year, and history of any high risk behavior. Two blood samples were collected from each donor before the procedure, one in EDTA vial for estimation of hematological parameters and another in plain vial for serum calcium and magnesium levels. The target yield for the procedure was set at 3.5×10^{11} platelets per unit. The anticoagulant used was acidified citrate dextrose-A (ACD-A) in the ratio of 1:9 and blood flow rate of 80 ml/min. After the completion of procedure, 2 samples were collected in EDTA, and plain vial within 30 min. These samples were tested again for hematological parameters and serum calcium and magnesium levels. Hematological parameters, that is, hemoglobin, hematocrit, platelet count, WBC count, RBC count, MPV, and PDW were analyzed by fully automated three part cell counter Sysmex KX – 21 and serum calcium and magnesium levels by fully automated analyzer. Paired t-test was used to analyze the data.

Results

The study included a total of 150 healthy first time donors who underwent plateletpheresis on Hemonetics MCS + intermittent flow cell separator. Mean value of ACD infused in these procedures was 339.1 ± 38.51 ml (237 – 458 ml). The mean age of the donors was 30.45 ± 8.005 (18–55) years. There was a statistically significant increase of 0.14 g/dl (0.95%) in the post procedural mean Hb level from 14.59 ± 1.17 g/dl to 14.74 ± 1.20 g/dl. The post procedural mean Hct of donors increased from 42.94 ± 3.43% to 43.28 ± 3.55% and post donation mean RBC count increased from $5.06 \times 10^6/\mu l \pm 0.44$ to $5.13 \times 10^6/\mu l \pm 0.43$ both of which were statistically highly significant. A statistically significant decrease was observed in post donation mean platelet count from $266.75 \pm 50.73 \times 10^3/\mu l$ to $193.43 \pm 43.38 \times 10^3/\mu l$ and post donation mean WBC count from $7.46 \times 10^3/\mu l \pm 1.53$ to $7.15 \times 10^3/\mu l \pm 1.52$. Serum calcium and magnesium levels also decreased significantly from 9.91 ± 0.39 mg/dl to 9.75 ± 0.38 mg/dl and 1.94 ± 0.25 mg/dl to 1.84 ± 0.24 mg/dl, respectively [Table 1]. There was no significant change in post donation mean MPV and PDW [Graph 1 and Flowchart 1].

Discussion

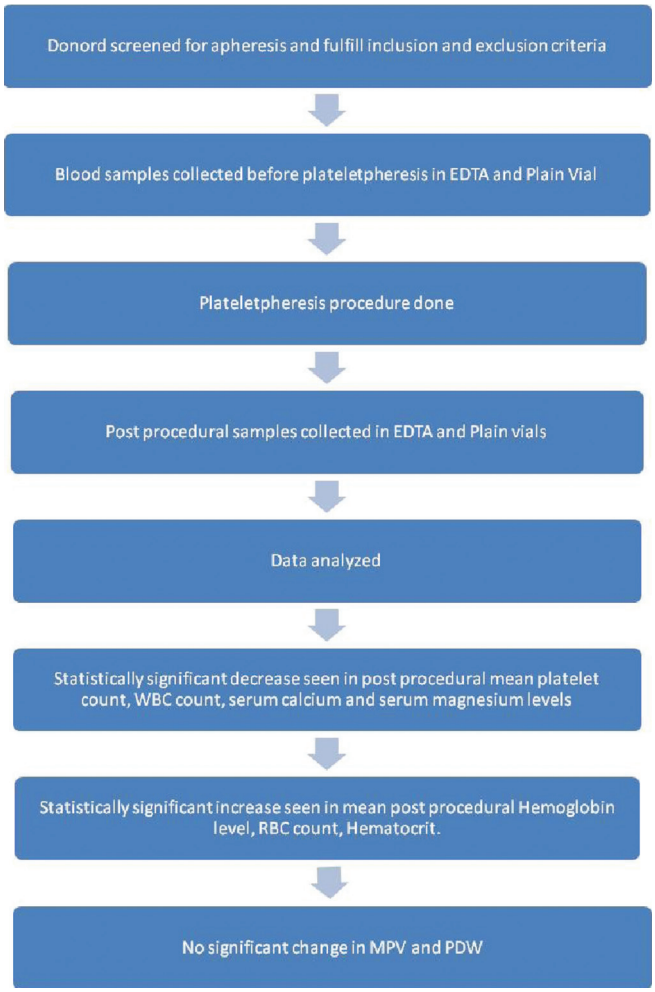
Increase in awareness regarding use of single donor platelets and the availability of technology has resulted in increased platelet apheresis procedures.[10] A sudden surge in platelet requirement is observed specifically during dengue outbreaks. Studies confirm that timely platelet transfusion in cases of dengue hemorrhagic fever and dengue shock syndrome helps prevent severe hemorrhagic complications. Also, it was observed that transfusion of SDAP reduces the need of repeat transfusions, fasten recovery, and decrease the length of hospital stay as compared with patients who receive PC. This puts stress on the already diminished donor pool.[11] Various studies have been conducted to investigate the quality of PCs; however, safety issues with regard to post procedural hematological parameter decrements and serum calcium and magnesium levels in donors undergoing plateletpheresis have been explored minimally. It is well established that the first generation apheresis devices caused significantly greater looses of red cells during plateletpheresis



Graph 1: Comparison of pre and post donation changes in Hemoglobin, WBC count, Serum calcium and magnesium levels in plateletpheresis donors

Table 1: Comparison of pre and post-donation hematological parameters of the donors showing effect of the plateletpheresis procedure

Parameter	Pre donation	Post donation	Mean decrease (−)/increase (+) (%)	Statistical significance (*P*)
Hb (g/dl)	14.59±1.17	14.74±1.20	+ 0.14	0.004
Hct (%)	42.94±3.43	43.28±3.55	+ 0.33	0.034
Platelet count ($\times10^3$/µl)	266.7±50.73	193.4±43.38	−73.32	0.000
WBC count ($\times10^3$/µl)	7.46±1.53	7.15±1.52	−0.30	0.000
RBC count ($\times10^6$/µl)	5.06±0.44	5.13±0.43	+ 0.07	0.000
MPV (fl)	9.71±1.53	9.77±1.75	+0.06	0.948
PDW (fl)	13.15±3.25	13.01±3.01	−0.13	0.735
Serum calcium (mg/dl)	9.91±0.39	9.75±0.38	−0.15	0.000
Serum magnesium (mg/dl)	1.94±0.25	1.84±0.24	−0.1	0.000



Flowchart 1: Summary of the study

as compared with more recent versions. These losses have been attributed to several factors such as blood loss in the void volume of the apheresis kit, the technique applied, and mechanical hemolysis by pressure pump.[12] This has raised concerns that frequent collection of blood cells particularly the platelets could result in large cell losses that might lead to transient clinically significant problems in donors.[13] UK guidelines in 1990 recommended regular analysis of complete blood count, total protein, and albumin in repeat apheresis donors, to assess their suitability for continuing apheresis.[14] The drug and cosmetic act, which is the regulatory body in blood transfusion services in India has no such established guidelines.[15]

In thist study, we observed a statistically significant increase in post donation Hb, Hct, and RBC count, which was similar to studies by Sachdeva *et al*.[16] and Love *et al*.[17] However, Das *et al*.[11] and Tendulkar *et al*.[18] in their studies found significant reductions in post procedure Hb and Hct. The difference is due to two main reasons. First, the difference in blood loss in the void volume of apheresis kit at the end of procedure. Haemonetics MCS+ has very less void volume of about 10 ml as compared with other machines. Second, this decrease could be a result of saline infusion commonly done during plateletpheresis with most machines. In our study, saline infusion was not done during procedure and hence no hemodilution as compared with other machines. Also, as the samples were collected within 30 min of the procedure, physiological mechanisms could not come into action which could be another reason for increase in Hb.

A mean decrease of 27.4% was seen in post donation platelet count which was statistically highly significant ($P < 0.001$). Similar findings were observed by Rajput *et al*.,[19] Das *et al*.,[11] Suresh *et al*.,[20] Love *et al*.,[17] and Lazarus *et al*.[21]

Mean WBC count in our study decreased by 4.1% because blood components collected by all automated cytapheresis contain donor leukocytes. This was in concordance with a study by Suresh *et al*.,[20] Das *et al*.,[12] Beyan *et al*.,[22] and Gite *et al*.[3] No significant changes were observed in mean MPV and PDW.

A mean decrease of 1.5% was seen in serum calcium levels and serum magnesium levels decreased by 5.1% which were statistically highly significant. This was in concordance with a study by Garg *et al*.,[23] Solankhi *et al*.,[24] Mercan *et al*.,[8] Bolan *et al*.,[9] and Das *et al*.[11]

Conclusion

To fulfill the ever increasing demand for SDAP, higher platelet yield and higher donation frequencies are followed. This puts immense pressure on the already limited resource group of plateletpheresis donors. But amid this crisis, if safety of donors is ignored, it can disrupt the blood supply chain which is

essential for primary physicians. Hence, stringent programs for post donation screening need to be established to ensure donor well-being and hence a constant blood supply.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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