International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Pre- and Post-Donation Changes in Haematological and Biochemical Parameters in Plateletpheresis Donors: A Prospective Study

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OPEN ACCESS

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Received: 26-05-2026
Accepted: 08-06-2026
Available online: 20-06-2026

ABSTRACT

Background: Plateletpheresis is widely used for collecting high-yield platelet concentrates. Citrate anticoagulant and extracorporeal circulation may induce transient alterations in donor haematological and biochemical parameters. Regular monitoring is essential for donor safety.
Aims and Objectives: To evaluate and compare changes in haematological parameters, serum calcium ($S.Ca^{2+}$), and serum magnesium ($S.Mg^{2+}$) levels before and after plateletpheresis in healthy donors.
Methods: Prospective study at GMC Patiala (July 2024–July 2025). Ninety healthy male donors underwent plateletpheresis using Trima Accel®. Parameters were measured pre-donation, at 60 min intra-procedure, and 30 min post-procedure. Paired t-test; $p \leq 0.05$ = significant.
Results: Significant decreases ($p<0.001$) were observed in Haemoglobin (Hb) (14.54→13.94 g/dL), Haematocrit (Hct), Red blood cell (RBC) count, White blood cell (WBC) count, and Platelet count (PC) (267,533→212,122/µL). $S.Ca^{2+}$ fell from 9.61 to 8.41 mg/dL intra-procedure, recovering to 9.22 mg/dL post-procedure; $S.Mg^{2+}$ declined from 2.06 to 1.36 mg/dL, recovering to 1.83 mg/dL. Adverse events were minimal: 7.8% mild citrate toxicity, 1.1% vasovagal reactions.
Conclusion: Plateletpheresis produces significant but transient and clinically manageable changes within safe physiological limits. Oral calcium supplementation and periodic monitoring are recommended.

Keywords*: plateletpheresis, haematological parameters, serum calcium, serum magnesium, citrate toxicity, donor safety, apheresis.*

INTRODUCTION

Platelet transfusion is a lifesaving intervention for patients with thrombocytopenia or functional platelet disorders. Demand has grown substantially with advances in oncology, haematology, hepatology, and transplant medicine.[1] Plateletpheresis (single-donor apheresis platelets, SDAP) allows collection of therapeutic doses equivalent to 6–8 random donor concentrates from a single donor, reducing recipient exposure to multiple donors and the risk of transfusion-transmitted infections and alloimmunisation.[2]

Modern continuous-flow cell separators such as the Trima Accel®, Amicus, and Cobe Spectra have made plateletpheresis efficient and reproducible. However, extracorporeal circulation and infusion of citrate anticoagulant (ACD-A) chelate divalent cations—notably calcium and magnesium—potentially inducing transient hypocalcaemia and hypomagnesaemia alongside measurable haematological alterations.[3] Symptoms such as perioral paraesthesia, tremors, and carpopedal spasm may occur, particularly in repeat donors.

Ensuring donor safety is fundamental to maintaining voluntary blood donation and an adequate platelet supply. Despite widespread practice of plateletpheresis, published data on these changes—especially from North India—remain limited.[4] This study was therefore designed to systematically document pre- and post-donation alterations in haematological

parameters, serum calcium, and serum magnesium levels in healthy plateletpheresis donors at a tertiary care centre in Patiala, Punjab.

MATERIALS AND METHODS

Study design and setting: Prospective observational study conducted at the Department of Clinical Pathology, in collaboration with the Departments of Immunohematology & Blood Transfusion, and Biochemistry, Government Medical College and Rajindra Hospital, Patiala, over one year (July 2024–July 2025).

Participants: Ninety healthy voluntary blood donors fulfilling DGHS eligibility criteria were enrolled after written informed consent. Inclusion criteria: age 18–60 years, weight >55 kg, Hb ≥12.5 g/dL, hct ≤46%, pre-donation platelet count ≥150,000/mm³, normal leucocyte count, prominent antecubital vein, and ≤24 donations/year. Donors with a history of transfusion-transmitted infections, systemic disease, recent surgery, tattooing within one year, or medication use were excluded.

Procedure: All procedures were performed on the Trima Accel® continuous-flow cell separator with ACD-A anticoagulant. Target yield ≥3.0 × 10^{11} platelets/unit. Oral calcium supplementation (500 mg + 300 IU Vitamin D_2) was provided to all donors. Procedure duration was 1.5–2 hours.

Sample collection and analysis: Pre-donation samples were collected in EDTA and plain vacutainers. Additional samples were obtained at 60 min intra-procedure and 30 min post-procedure. Haematological parameters were analysed on the Med Source Alpha Count 60 (Coulter principle); serum calcium by Arsenazo III colorimetric method (650 nm); serum magnesium by Xylidyl Blue method on the Erba Mannheim XL-1000.

Statistical analysis: Data were entered in Microsoft Excel 2021 and analysed using the paired t-test. p≤0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS

All 90 plateletpheresis donors were male, with a mean age of 33.30 ± 7.93 years (range 19–48 years), the largest group being 29–33 years (26.7%). Mean donor weight was 71.36 ± 7.37 kg. Repeat donors constituted 65.5% of the cohort; 47.8% had prior whole-blood donation history. B-positive (34.5%) and O-positive (33.3%) were the predominant blood groups. Mean platelet yield was 3.19 ± 0.36 × 10^{11}/unit, with 60% of donors achieving yield >3 × 10^{11}/unit.

Table 1. Comparison of haematological parameters before and after plateletpheresis (n=90)

Parameter	Pre (Mean±SD)	Post (Mean±SD)	% Change	p-value
Hb (g/dL)	14.54±1.25	13.94±1.21	−4.1%	<0.001
Hct (%)	44.26±3.24	42.41±3.29	−4.2%	<0.001
RBC (×10^{12}/L)	4.90±0.34	4.68±0.38	−4.5%	<0.001
WBC (cells/µL)	7360±992	6943±1033	−5.7%	<0.001
Platelet (×10^3/µL)	267.5±64.8	212.1±55.2	−20.7%	<0.001
MPV (fL)	10.41±1.33	10.10±1.23	−3.0%	<0.001

Hb, haemoglobin; Hct, haematocrit; RBC, red blood cell count; WBC, white blood cell count; MPV, mean platelet volume. All values represent statistically highly significant (HS) changes.

All haematological parameters showed statistically significant post-donation reductions (p<0.001). Haemoglobin fell by 4.1%, attributable to haemodilution and minor RBC loss in the circuit. The most pronounced change was in platelet count, which fell 20.7%—the targeted and expected consequence of the procedure; no donor developed clinically significant thrombocytopenia. Only three donors had post-procedure Hb <12.0 g/dL with no clinical anaemia. MPV showed a small but significant decline, possibly reflecting preferential removal of larger, more active platelets.

Table 2. Serum calcium and magnesium at baseline, 60 min intra-procedure, and 30 min post-procedure (n=90)

Parameter	Baseline (Mean±SD)	60 min Intra-procedure*	30 min Post-procedure*
S. Ca^{2+} (mg/dL)	9.61±0.49	8.41±0.51	9.22±0.46
S. Mg^{2+} (mg/dL)	2.06±0.09	1.36±0.15	1.83±0.15

**p<0.001 vs. baseline (paired t-test). S.Ca^{2+}, serum calcium; S.Mg^{2+}, serum magnesium.*

Serum calcium showed a significant 12.5% decline from 9.61 mg/dL at baseline to 8.41 mg/dL at 60 minutes intra-procedure, with partial recovery to 9.22 mg/dL at 30 minutes post-procedure. Serum magnesium fell more steeply (34%), from 2.06 to 1.36 mg/dL, with partial recovery to 1.83 mg/dL. Both reductions are explained by citrate-mediated chelation of divalent cations; recovery reflects rapid hepatic, renal, and muscular metabolism of citrate.

Table 3. Adverse events during plateletpheresis (n=90)

Adverse Event	Number (n)	Percentage (%)
Mild citrate toxicity	7	7.8%
Severe citrate toxicity	0	0.0%
Vasovagal reaction	1	1.1%
Haematoma formation	0	0.0%
Overall adverse events	8	8.9%

All events were managed conservatively without discontinuation of the procedure.

Adverse events were infrequent and mild. Seven donors (7.8%) experienced perioral tingling due to mild citrate toxicity, managed by reducing infusion rate and providing oral calcium. One donor (1.1%) had a transient vasovagal reaction that resolved with Trendelenburg positioning. No haematomas or severe reactions occurred.

DISCUSSION

This study comprehensively evaluated haematological and biochemical perturbations in 90 healthy plateletpheresis donors at a North Indian tertiary care centre. The donor profile—young adult males (mean age 33.30 years), mean weight 71.4 kg—is consistent with studies by Syal et al.[5] (mean age 30.45 years), Dogra et al.,[6] and Patidar et al.,[7] indicating that plateletpheresis donors are predominantly young, healthy adults. Female exclusion reflects stricter eligibility thresholds and sociocultural factors—a pattern widely reported across Indian studies.[2]

The 4.1% reduction in haemoglobin and 4.2% decline in haematocrit are attributable to haemodilution, saline infusion, and minor RBC loss retained in the apheresis circuit, consistent with a meta-analysis by Ashok et al.[8] reporting a mean Hb reduction of 0.5–0.8 g/dL. The 20.7% decline in platelet count is an expected procedural outcome; recovery occurs within 7–14 days via compensatory thrombopoiesis.[1] The WBC decline reflects transient leucocyte entrapment in the extracorporeal circuit—findings corroborated by Nikhil et al.[12] and Das et al.[7]

The significant intra-procedural decline in $S.Ca^{2+}$ (12.5%) and $S.Mg^{2+}$ (34%), followed by partial but incomplete recovery at 30 minutes, corroborates results from Farahat and Sharaf,[3] Solanki and Agarwal,[15] and Mane et al.[23] Citrate in ACD-A forms stable complexes with ionised calcium and magnesium, rendering them unavailable for coagulation and neuromuscular function. The steeper fall in magnesium is clinically important as hypomagnesaemia is not reversed by calcium supplementation and takes longer to normalise, a finding also noted by Garg et al.

The overall adverse event rate of 8.9% (predominantly mild citrate toxicity) is comparable to Kumawat et al.[9] (7.22%), Bassi et al.[20] (6.1%), and Dogra K et al. (4.6%), and lower than the 18% reported by Patidar et al.[7] All events were managed conservatively, confirming the safety profile of the Trima Accel® platform.

Limitations: Single-centre design; all-male cohort; absence of repeat-donation follow-up; limited biochemical parameters (ionised calcium, parathyroid hormone, and ferritin were not assessed). Future multicentre studies with larger, sex-diverse populations and longer follow-up are recommended.

CONCLUSION

Plateletpheresis using continuous-flow cell separators produces statistically significant but transient, clinically manageable decrements in haematological parameters and serum electrolytes. No donor in this cohort developed clinically significant anaemia, thrombocytopenia, or severe adverse reactions. Oral calcium supplementation, adequate hydration, and close intra-procedural monitoring should be standard practice. Periodic haematological and biochemical profiling (every 3–6 months) is advised for regular donors to detect cumulative effects early and sustain voluntary platelet donation programmes.

ACKNOWLEDGEMENTS

The authors thank all voluntary donors, the staff of Departments of Pathology, Immunohematology & Blood Transfusion, and Biochemistry at GMC Patiala, and the ethical committee for approval. No extra financial burden was placed on donors.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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