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To Study Serum Calcium And Magnesium In Plateletpheresis Donors.

V.B. Mane, P.E.Jagtap, N.S. Nagane, S. P. Dhonde, G.J.Belwalkar
Department of Biochemistry Bharati Vidyapeeth Medical College and Hospital, Sangli. 416416

***Corresponding Author:**
V.B. Mane
Department of Biochemistry Bharati Vidyapeeth Medical College and Hospital, Sangli. 416416

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Abstract

The apheresis is an efficient method to collect one or more specific blood component. The advantage of apheresis includes the collection of standardized high quality product, collecting more than one product from single donor, cost effectiveness, a higher donation frequency and more specific collection and supply of blood components tailored to donors and recipients needs.[1] The study was conducted on 90 healthy first time voluntary plateletpheresis donors with age group between 21 to 50 years, at Apheresis unit in blood bank Bharati Vidyapeeth Deemed University Medical College & Hospital, Sangli.

Although a significant drop in serum calcium and serum magnesium was observed in all donors.[2] This study was helpful to established guideline for donor safety in plateletpheresis donor and we suggest that the donor should be screened for biochemical investigations serum calcium and serum magnesium in pre plateletpheresis donors which have been included in our study along with the serological and hematological investigations.

In our study we focused more on donors' safety so that we plan the study to investigate serum calcium, serum magnesium in pre and post plateletpheresis donors and whether the biochemical alteration had any clinical consequences. Recently there are no evidences or data which reflect any biochemical alteration for first time donations of plateletpheresis. Most of the blood bank centers did only serological and hematological investigations. So, we suggest that the donor should be screened for biochemical investigations, which have been included in our study along with the serological and hematological investigations.

Keywords: Plateletpheresis; biochemical values; donors safety; serum calcium; serum magnesium; ACD infusion

Introduction

Apheresis is a Greek word which means "to carry away", a technique in which whole blood is taken and separated. From the separated portion, the desired portion (e.g. Plasma or Platelet) is removed and the remaining portion is returned to the circulation.[1] Millions of donors have donated blood by apheresis since its introduction in sixties of the previous century. Various studies on automated plateletpheresis have been conducted to high quality of platelet concentration and its relation to the biochemical parameters. However, safety issues with regards to post procedure, serum calcium, magnesium depletion in donors undergoing plateletpheresis have been only minimally explored .Citrate causes profound and rapid decrease in calcium and magnesium. The other effect is metabolization of citrate to bicarbonate. The reduced calcium and magnesium in most of the donors is considered physiological and of little consequence. However, repeated platelet donations or during prolonged plateletpheresis, citrate accumulation may outpace its metabolism, resulting in hypocalcaemia, which may cause significant donor discomfort.[3] At times, this donor discomfort may be severe enough to require hospitalization of the donor. In manifestations of hypocalcaemia therefore, calcium supplementation may be a failure. Although

prophylactic calcium supplementation during apheresis is a routine practice in many of the transfusion centers, no information is available regarding magnesium supplementation in apheresis donors.[4]

The benefit of therapeutic apheresis is the ability to rapidly, safely, and isovolemically reduce the concentration of a pathological factor or a component of blood (eg, immunoglobulin, leukemic cells).[5] However, even with experienced facilities and personnel, apheresis carries risks. In therapeutic apheresis, the overall rate of adverse events is 5%. These adverse events include, but are not limited to, transfusion reactions. Nausea, perioral tingles vomiting, hypotension, and vasovagal reactions occur with 2% frequency, and pallor, tachycardia, respiratory distress, muscle spasms, or chills/rigors, occur with 1% frequency.[6,7] In addition, apheresis patients require venous access.[8] While peripheral venipuncture is preferable, some patients may require insertion of an apheresis catheter, which carries risks such as hematomas, venous sclerosis, thrombosis, bleeding, and infection. [9.10] Acute citrate induced side effects during blood collection by apheresis are frequent, but usually harmless. Peripheral tingling, slight malaise and nausea are reported by many apheresis donors but are easily relieved by oral calcium tablets.[1,2,6] Magnesium is a divalent cation which has a similar affinity to citrate as calcium. [6, 11]

Assessment of certain biochemical parameters and their derangement in plateletpheresis donors in case of pre and post plateletpheresis, certain biochemical investigations are definitely helpful in providing the guidelines for the transfusion consultant in the management of plateletpheresis. Therefore the estimation of serum calcium and magnesium was performed in pre and post plateletpheresis donor.

Material and Methods:-

Proposed research work was carried out in Department of Biochemistry, Bharati Vidyapeeth Deemed University Medical College & Hospital, Sangli. Period of the study was from 2018 to 2020 with approval of Institute of Ethical Committee (IEC/ Dissertation 2017-18/247).

The study was conducted on 90 healthy first time voluntary plateletpheresis donors with age group between 21 to 50 years, at Apheresis unit in blood bank Bharati Vidyapeeth Deemed University Medical College & Hospital, Sangli. Details of plateletpheresis were explained to each donor who gave their consent before the procedure. Average weight of donors was 75.5 kg and average height was 5 feet 6 inch. The mean hematological value of apheresis donor for platelet was 301 x 10^3 / cumm. and haematocrit average was 44.56%. The average time taken for per procedure was 66.7 minutes and average product volume was 321.9 ml. All procedures were performed by using cell separator machine Fenwal Amicus Cell Separator (Baxter Healthcare Corporation Deerfield IL USA). All plateletpheresis procedures were performed following the departmental standard operating procedure (SOP) using closed system apheresis kits and ACD anticoagulant in the proportion of 1: 12. The end point of each procedure was based on the target yield of 3 X 10^{11} platelets per unit maintaining a blood flow rate for all collections at 50-80 ml/min. To measure the pre and post donation biochemical analytes, whole blood sample (5ml) was collected in plain vial just before and within 30 min after completion of the procedure, taking all aseptic precautions. Serum calcium and serum magnesium were measured on fully automated analyzer AutoQuent Meril 400 . The principal of this machine is based on the colorimetric method.

Statistical Analysis:-

All graphics and statistical comparisons were performed with spreadsheet software (Excel, Microsoft) .The statistical analysis was done using "t" test. All results were calculated as mean ± SD and a "p" value of <0.05 was considered statistically significant. Mean values were compared using the paired 't' test. bivariate correlation is obtained to check the relationship between serum calcium and serum magnesium in pre and post plateletpheresis donors.

Result:-

After each procedure , the concentration of serum calcium and serum magnesium was decreased significantly in donors ($p<0.001$). Table No. 1 and graph No.1 shows that the mean level of serum calcium was 9.42 mg/dl. before starting plateletpheresis while post procedure it was observed to be 8.49 mg/dl. The difference between pre and post levels of serum calcium was 0.93 mg/dl,

Volume 5, Issue 1; January-February 2022; Page No 406-411

indicating that the level of serum calcium falls significantly after plateletpheresis. (P<0.000). Table No. 2 and graph No.2 we observed significantly decreased level of serum Magnesium in post procedure as compared to pre procedure (P <0.000) in plateletpheresis donors. The level of serum magnesium pre procedure was 2.50 mg/dl and that of post procedure was 2.20 mg/dl. The difference between pre and post procedure was 0.30 mg/dl.

Table No. 1 Concentration of serum calcium in pre and post plateletpheresis donors

Serum calcium	Mean mg/dl ± S.D.	Std. Error Mean	"t"	"p" value
Pre Plateletpheresis	9.42 ± 0.385	0.051	19.81	0.000
Post Plateletpheresis	8.49 ± 0.32	0.023		

Graph No.1 Concentration of serum calcium in pre and post plateletpheresis donors

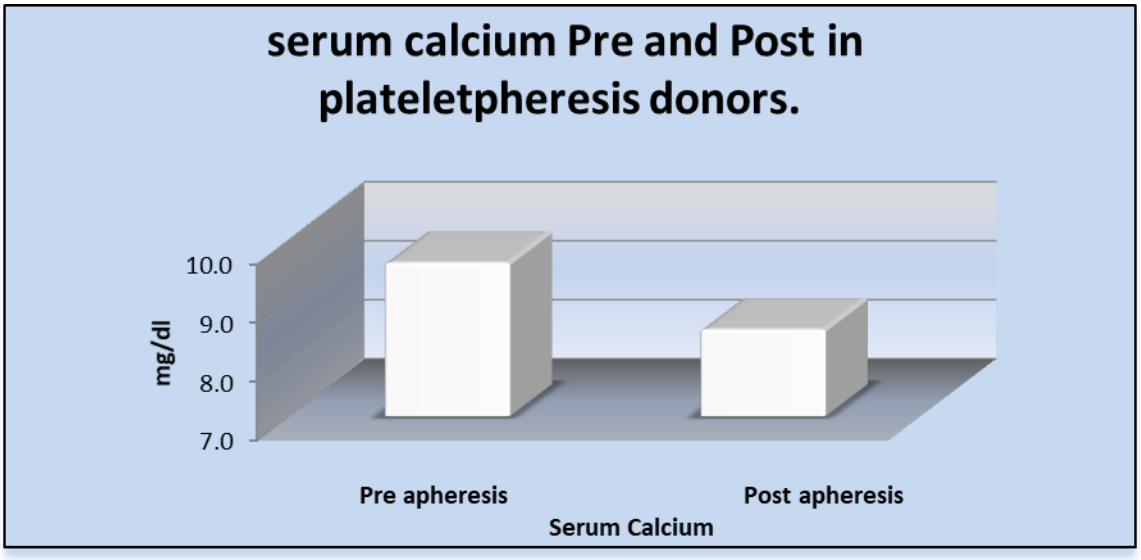
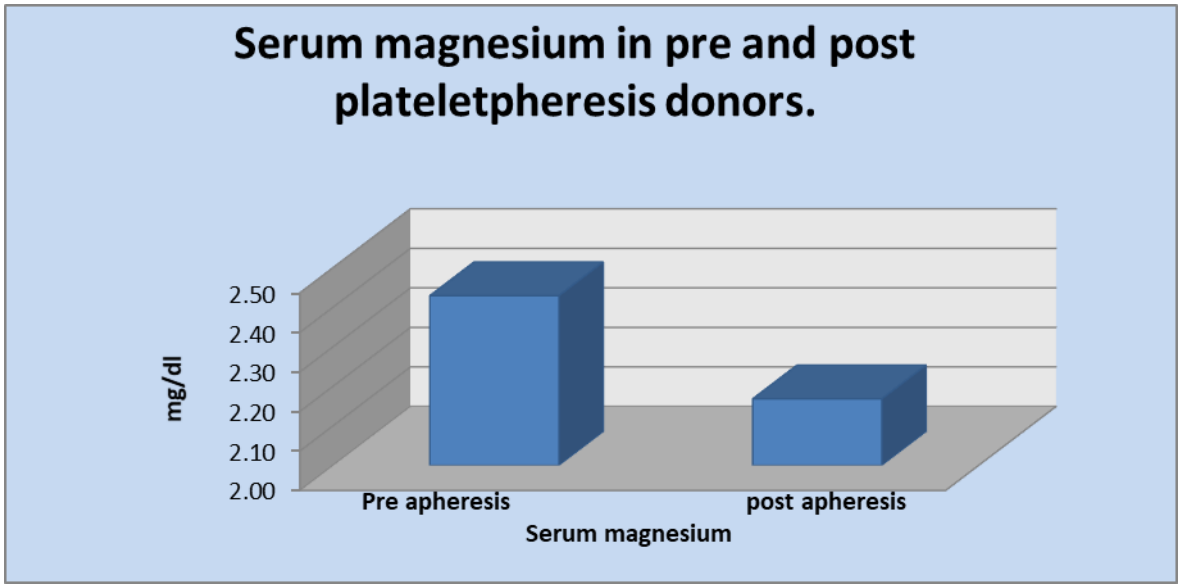


Table No. 2 Concentration of serum magnesium in pre and post plateletpheresis Donors

Serum Magnesium	Mean/mg/dl ± S.D.	Std. Error Mean	"t"	"p" value
Pre plateletpheresis	2.50 ±0.31	0.035	10.16	0.000
Post plateletpheresis	2.20 ±0.19	0.019		

Volume 5, Issue 1; January-February 2022; Page No 406-411

Graph No.2 Concentration of serum Magnesium in pre and post plateletpheresis donors



All values are expressed as mean ± S.D. statistical comparison between concentration of serum calcium and serum magnesium in pre and post plateletpheresis donors. Decreased mean level of serum calcium and serum magnesium in post plateletpheresis donors is highly significant (P< 0.000).

Discussion:-

Millions of donors have donated blood by apheresis since its introduction in sixties of the previous century. The apheresis is an efficient method to collect one or more specific blood component, such as platelets, (plateletpheresis), plasma (plasmapheresis), and peripheral blood stem cell. The advantage of apheresis includes the collection of standardized high quality product, the possibility of collecting more than one product from single donor, cost effectiveness, a higher donation frequency and more specific collection and supply of blood components tailored to donors and recipients needs. [1] In therapeutic apheresis, whole blood is removed from the patient into an instrument that separates its components via a centrifugation process. The goal is to selectively remove a substantial proportion of one or more components while returning the remaining components to the patient or donors, with or without replacement of the removed component. The rationale to use therapeutic apheresis can be based on knowledge of the disease pathophysiology or evidence that therapeutic apheresis is clinically beneficial. Many patients admitted to the critical care or general medicine services may benefit from apheresis. Donors' safety issue in plateletpheresis have, received relatively little attention. Presently we noted that no biochemical investigations are being done in those who donated platelet by apheresis for the first time. During procedure symptoms of hypocalcaemia were treated by administration of 2-3 oral calcium tablets, donors who showed the symptoms. In our study after plateletpheresis all donors showed symptoms of hypocalcaemia and hypomagnesaemia.

In our study we observed the mean level of serum calcium was 9.42 mg/dl. before starting plateletpheresis while post procedure it was observed to be 8.49 mg/dl (Table No. 1 and graph No.1). The difference between pre and post levels of serum calcium was 0.93 mg/dl, indicating that the level of serum calcium falls significantly after plateletpheresis. (P<0.000) Possible reasons for decreased levels of serum calcium in post plateletpheresis may be due to the relatively higher volume of Acid Citrate Dextrose (ACD) infused as the primary anticoagulant in apheresis procedures.[8] The anticoagulant effect of citrate results from its ability to chelate calcium ions resulting the unavailability of calcium ions to participate in biological reactions such as the coagulation cascade. The liver, kidneys and muscles rapidly metabolizes citrate, releasing the bound calcium. Despite compensatory mechanisms, citrate infusion can result in the decrease in total calcium levels to a point where symptoms develop in the donor. This can be

Volume 5, Issue 1; January-February 2022; Page No 406-411

explained, as about 20% of unmetabolized complex citrate with calcium is excreted by kidneys and may result to hypocalcaemia.[12]

We observed significantly decreased level of serum Magnesium in post procedure as compared to pre procedure (P <0.000) in plateletpheresis donors (Table No. 2 and graph No.2). The level of serum magnesium pre procedure was 2.50 mg/dl and that of post procedure was 2.20 mg/dl. The difference between pre and post procedure was 0.30 mg/dl. Determination of changes in magnesium activity during citrate infusion would therefore help in the assessment of its role in the side effects of plateletpheresis. Hypocalcaemia and hypokalemia are usually associated with hypomagnesaemia. Release of calcium from the sarcoplasmic reticulum is inhibited by magnesium. Thus hypomagnesaemia results in an increased intracellular calcium level may also be the cause of decreased plasma calcium level.[13] R. Swaminath et,al. in 2003 reported that proximal tubular magnesium reabsorption is proportional to sodium reabsorption, and a reduction in sodium reabsorption during long-term intravenous fluid therapy may result in magnesium deficiency. [14]

S. Rapoport et,al. in 1949 reported that, the pH value of 5.03 for the acid preservative, which corresponds in composition to a solution of disodium citrate, may be predicted from the molar ratios of sodium citrate and citric acid present in it, on the basis of the known pK values of the 3 acid groups of citric acid. When ACD solution is added to blood, only the citric acid significantly affects the pH of blood, since at the pH range prevailing in blood, trisodium citrate has an insignificant buffering power. This causes metabolic acidosis and phosphate depletion, which leads to increase the urinary pH and increase the urinary excretion of citrate, may result in hypomagnesaemia.[15]

Conclusion:

We know that apheresis and blood donation are generally considered to be safe procedures .The incidence of adverse effects or side effects in donors have not been determined in large multi centre during series of donations. Plateletpheresis citrate infusion causes citrate toxicity which affects on cations like Ca^{2+}, Mg^{2+} and also on protein pool. In apheresis ACD is used as an anticoagulant. ACD rapidly gets metabolized in liver, kidney and muscles. Citrate has been used for more than half a century to anticoagulate stored blood, and it has been the anticoagulant of choice in plateletpheresis procedure for more than two decades.

We conclude on basis of findings of present study, as serum Calcium and serum Magnesium decreased significantly after plateletpheresis. So, if any plateletpheresis donor has already decreased biochemical parameters which are below normal level, then these donors may be face the severe adverse reactions during apheresis donations. Hence, it is better to refuse these donors till the levels are reached at normal.

Presently, there is no history or record available for previous biochemical investigation for those who donate plateletpheresis for the first time. Most of the blood bank centers did only serological and hematological investigations. So, we suggest that the donor should be screened for biochemical investigations, which have been included in our study along with the serological and hematological investigations. These biochemical investigations will be definitely useful in providing the guidelines for the transfusion consultant in the management of plateletpheresis.

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Volume 5, Issue 1; January-February 2022; Page No 406-411

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Volume 5, Issue 1; January-February 2022; Page No 406-411