

EFFECT OF ACID CITRATE DEXTROSE DURING PLATELETPHERESIS ON FIRST-TIME HEALTHY DONORS: BETWEEN SAFETY AND TOXICITY



Samah, A. El-Nagdy¹, Yara, M. El-Fakharany¹

¹Department of Forensic Medicine and Clinical Toxicology Faculty of medicine, Zagazig University, EGYPT

ABSTRACT

Introduction: During apheresis, anticoagulation is accomplished by use of acid citrate dextrose (ACD). Acid citrate dextrose returns to the donor with the remainder of blood after separation of the targeted blood component. **Objectives:** This study was conducted to assess the potential toxic effects of ACD in first-time blood donors through clinical and biochemical assessment. **Methodology:** Seventy -five healthy plateletpheresis donors were recruited in the study where they were subjected to clinical and laboratory assessment just before the procedure (baseline), at 30 min. & at 60 min. during the procedure and 30 min. post procedure. Clinical evaluation included vital signs evaluation and reporting of any clinical manifestation developed. Biochemical assessment included ABG, serum ionized Ca (iCa), ionized Mg (iMg) and parathyroid hormone (PTH) levels. Also activity of erythrocyte phosphofructokinase (PFK) and hematological parameters including RBCs (million/ul), hemoglobin level (Hb g/dl) and hematocrite (Hct %) were evaluated. **Results:** Apheresis using citrate anticoagulant resulted in changes in mineral homeostasis in the form of hypocalcemia and hypomagnesemia with subsequent tremors (9.3%) and tetany (5.3%). Also, some of the donors exhibited tachycardia and hypotension. Parathyroid hormone (PTH) level increased during apheresis which nearly returned to normal level 30 min. after the procedure while, no significant changes in ABG were detected at different time intervals of the procedure. When RBCs PFK activity was measured, a significant decrease was found during the procedure with significant decrease in RBCs at 60 min. and post 30 min. But no significant changes were detected as regard Hb level and Hct % in comparison to baseline ones. **Conclusion:** Citrate toxicity may occur even with first time exposure in platelet apheresis donors in form of possible developing tremors, tetany, tachycardia and hypotension with decreased calcium & magnesium levels, increased PTH, decreased erythrocyte PFK activity with subsequent decreased RBCs integrity and possible hemolysis.

Key words: Citrate toxicity, plateletpheresis, first-time donors, PFK activity.

I. INTRODUCTION

Blood donation used to be considered a safe procedure with low risk. However, in the last few decades, some hazards were developed during donation. So, more strict precautions are now required during donation procedure (Monika and Tarun, 2014)

Apheresis is a medical procedure in which blood of a donor is passed through an apparatus to separate out one particular

constituent and returns the remainder to the circulation, thus it is an extracorporeal procedure (Mariano, 2017). There are different types of donation including plasmapheresis, erythrocytapheresis, plateletpheresis and leukapheresis (Szczepiorowski et al., 2010).

The standard anticoagulant utilized during apheresis donation procedure is citrate. The most common citrate solutions used are acid citrate dextrose (ACD-A) which is 3% citrate and ACD-B which is 2%

citrate (Lee and Arepally, 2012). Plasma concentration of citrate in the extracorporeal circuit is maintained at 15 – 24 mmol/L to facilitate anticoagulation (Burgstaler, 2006).

Remainder of blood returned to donor will contain citrate (Custer et al., 2012). The amount of citrate returned to the blood donor depends on some factors including; the concentration of citrate anticoagulant in the extracorporeal circuit, the volume of blood returned to the donor, the concentration of citrate within the blood returned to the donor and the rate of blood return to the donor (Burgstaler, 2006).

It was found that some donor developed neuromuscular and cardiac manifestations ranging in severity from mild to severe effects in form of mild dysesthesias (most common) to tetany, seizures or even cardiac arrhythmias (Buchta et al., 2003).

Phosphofructokinase (PFK) is the key and most regulatory enzyme involved in controlling glycolysis. Its activity depends on a large number of metabolites and cofactors with subsequent affection on glycolysis (Wu et al., 2006). Mor et al. (2011) mentioned that ATP and citrate affect activity of PFK and that concentrations of ATP and citrate in the steady state under normal metabolic conditions are apparently sufficient to keep phosphofructokinase-1 relatively inhibited. Hence, it was assumed that exposure of apheresis donors to citrate during apheresis process will affect PFK activity.

Erythrocytes (RBCs) depend solely on anaerobic glycolysis for generation of high energy phosphate required for maintaining the erythrocyte's integrity. So, interruption of this process by inhibition of the involved enzymes including PFK can result in hemolytic anemia (Van Wijk and Van Solinge, 2005).

Taking the above mentioned studies in consideration, it was hypothesized that citrate exposure could cause abnormalities in mineral homeostasis and may affect erythrocyte PFK activity.

So, the aim of this study was to evaluate potential acute toxic effects of ACD during apheresis donation through clinical and biochemical assessment of first-time donors.

II. METHODOLOGY

II.1. Equipments & Chemicals:

The blood collecting system used was Trima Accel Automated (Terumo BCT software, version 6.0; Terumo BCT, Lakewood, Colorado, USA) (Fig.1). During plateletpheresis procedures, the closed system apheresis kits, and anticoagulant ACD-A in the proportion of 1: 10 – 1: 12 (Fig.1) (blood flow rate 50–80 ml/min) were used. The duration of apheresis procedure was from 60 to 90 minutes (Swarup et al., 2009).

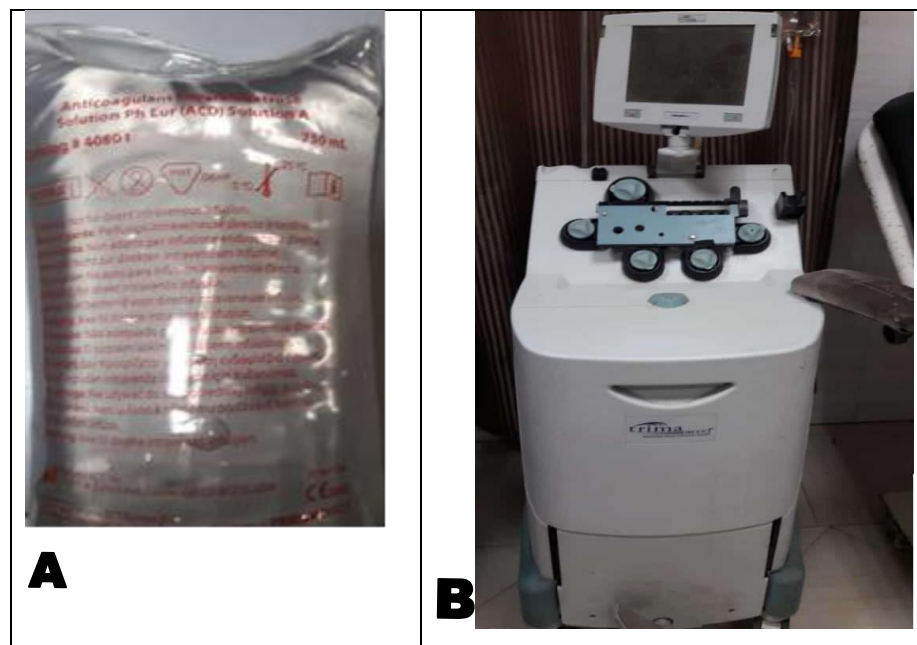


Fig. 1: (A): Acid citrate dextrose A solution used in plateletpheresis procedure. (B): Trima Accel automated blood collecting system used in plateletpheresis.

II.2. Subjects:

Informed consents were obtained from donors who were informed about purpose of the study, its benefit for the community and possible adverse effects that might happen during or after the procedure.

Seventy-five (75) healthy plateletpheresis donors at Blood Bank of Zagazig University Hospitals were included in this study during the period from July 2017 to March 2018.

•Inclusion criteria:

Donors for the first time were selected as per the set criteria for single donor platelet (SDP) preparation according to AABB (the American Association of Blood Banks) guidelines and criteria of National Blood Center (Muhammad et al., 2016) which included the following:

-Age: 18-60 yrs.

-Weight: ≥ 55 kg.

-Hb level: not less than 12.5 g/dl.

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

-Negative tests for HIV, Hepatitis B, Hepatitis C, Syphilis and Malaria.

- Absence of any illness.

-No consumption of non-steroidal anti-inflammatory drugs for last seven days.

- Adequate sleep before donation >5 hours.

- Had taken at least a light meal before donation.

•**Exclusion criteria:** Donors with history of chronic diseases or receiving medications.

II.3. Methods:

The included donors were subjected to clinical and biochemical assessment just before the procedure (baseline, 00 min.), 30

min. and 60 min. during the procedure and 30 min. post-procedure as follows:

II.3.1.Clinical evaluation: Assessment of vital signs (heart rate, systolic blood pressure, diastolic blood pressure and temperature) and recording of any clinical manifestations reported by the donors.

II.3.2.Biochemical assessment:

It was conducted in Zagazig University Hospital Laboratories. One mL of arterial blood was used for arterial blood gases (ABG) assessment. Four ml of blood were collected from sterile diversion pouch placed on apheresis circuit from each donor at the different intervals of the study and used as follow:

- Two ml of blood let to clot and centrifuged for separation of serum, then iCa^{++} and iMg^{+} levels were measured by ion-selective electrode (ISE) method by the AVL 988 4 electrolyte analyzer (AVL Scientific, Roswell, Ga) according to **Zoppi et al. (1996)**.
- The other 2 mL of blood sample were collected in EDTA-containing tubes. Whole blood and aliquots of plasma were used for measuring the following:
 - Parathyroid hormone (PTH): Plasma parathyroid hormone levels were measured by enzyme linked immunoassay method (ELISA) by Human PTH ELISA Kit (ab230931) kit purchased from Abcam PLC (UK) (**Zheng et al., 2018**).
 - Hematological parameters: Erythrocytes (RBCs) count (million/ul), Hb concentration (g/dl), hematocrit (%) were measured using a Sysmex KX-21 N™ automated hematology analyzer (Sysmex Europe GmbH) (**Samuel et al., 2010**)
 - Erythrocytes Phosphofructokinase (PFK) activity: The method used was colorimetric

assay using chemicals supplied by (Sigma Aldrich, St. Louis, MO. USA) as follow; separation of RBC by centrifugation of the sample for 10 min at 400 xg, then washing with normal saline for several times. This was followed by lysis of erythrocytes with the help of sodium phosphate buffer at PH of 7.4. The method depended on conversion of fructose-6-phosphate and ATP is converted to fructose-1,6-diphosphate and ADP by PFK. Adenosine diphosphate (ADP) is then converted into NADH which reduce a colorless agent with the intensity of the colour was measured and was proportional to the activity of PFK (Aniket et al., 2016).

II.3.3.Statistical analysis:

Data was analyzed using Social Statistical Package version10 (SPSS Inc., Chicago, IL). Quantitative data were summarized as mean \pm standard deviation ($X \pm SD$). Test of significance for quantitative data was done using Anova test for comparison between groups. Least significant difference (LSD) for multiple comparisons (Norusis, 1997). significance level was considered at p value < 0.05 .

III.RESULTS

III.1.Clinical Evaluation:

Clinical manifestations reported by the subjects at different time intervals of apheresis procedure showed that the most reported manifestations were lightheadedness (32%) followed by nausea & vomiting and shivering (21.3% & 14.6% respectively). Twitches & tremors represented 9.3% of the manifestations reported. Tetany was detected in 5.3% of the donors during apheresis with no one developed seizures (Fig. 2).

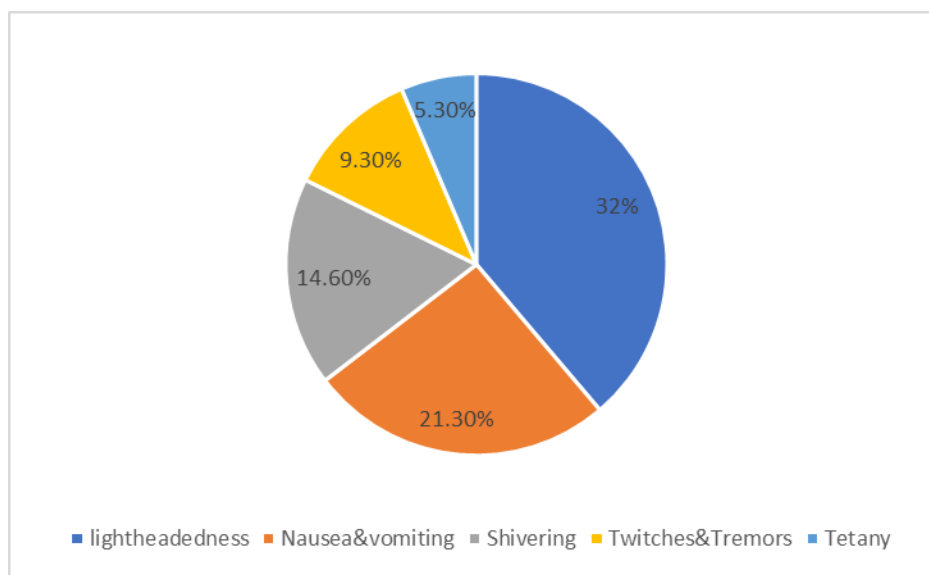


Fig. 2: Percentage of clinical manifestations developed by first time donors during plateletpheresis

Evaluation of vital signs among donors revealed a significant increase of HR assessed at 30 min and 60 min. of procedure when compared with baseline assessment and that assessed at 30 min. post procedure ($p < 0.05$). Also, there was a significant decrease in DBP measured at 60 min. of procedure when compared with baseline

measurement ($p < 0.05$). After apheresis, DBP returned to normal and recorded non-significant difference with baseline measurement ($p > 0.05$). Other vital signs (SBS, RR and Temp.) showed non-significant difference at different time intervals of the procedure ($p > 0.05$) (Table 1).

Table (1): Statistical comparison regarding mean values of vital signs assessed at different time intervals of apheresis among first-time donors using ANOVA and LSD tests:

Vital Signs		Time of sampling				ANOVA TEST	
		Pre-procedure (Baseline)	at min. 30 of procedure	at min. 60 of procedure	30 min. after procedure	F	P
HR		97.59±10.30	105.75±8.36 ^a	109.52±10.04 ^a	100.53±12.42 ^{b,c}	19.71	0.000**
SBP		111.94±13.15	110.45±14.95	111.56±12.73	110.34±14.32	0.25	0.86
DBP		69.31±6.58	67.43±5.43	65.92±8.71 ^a	69.54±7.33 ^c	4.31	0.00**
RR		17.43±2.12	17.51±1.93	18.21±1.87	17.65±2.74	1.93	0.12
Temp.		37.02±0.12	37.04±0.06	37.46±0.02	37.05±0.02	1.42	0.24

HR: heart rate SBP: systolic blood pressure DBP: diastolic blood pressure RR: respiratory rate Temp: temperature min.: minute F: ANOVA **: Significant $p < 0.05$

LSD for repeated measure ANOVA expressed as letters: a: Significant with (pre-procedure (baseline), b Significant with (at min. 30 of procedure) and c: Significant with (at min. 60 of procedure).

III.2. Biochemical assessment:

When ABG was evaluated among different time intervals of apheresis ($p > 0.05$) donors, no significant difference found at (Table 2).

Table (2): Statistical comparison regarding mean values of arterial blood gases (ABG) findings in first time donors at different time interval of apheresis procedure using ANOVA and LSD tests

ABG		Time of sampling				ANOVA TEST	
		00min. (Baseline)	at min. 30 of procedure	at min. 60 of procedure	30 min. post procedure	F	P
	PH	7.37±0.08	7.37±0.09	7.38±0.18	7.36±0.12	0.33	0.81
	PO ₂	90.62±5.93	91.94±6.34	91.82±6.25	91.04±5.94	0.80	0.49
	PCO ₂	35.72±6.21	35.94±4.62	36.03±5.46	35.69±5.84	0.07	0.98
	HCO ₃	24.02±3.51	24.93±4.02	25.21±3.96	23.68±4.57	2.43	0.06

F: ANOVA

P>005 : non significant

Measurement of ionized Ca (iCa) level at different time intervals of apheresis procedure revealed significant decrease at 30 min. and 60 min. of the procedure when compared with baseline value ($p < 0.05$). At the same time, iCa level increased again after the procedure with no significant difference was found between pre and post procedure values ($p > 0.05$) (Table 3, Fig. 3).

Ionized Mg (iMg) level demonstrated a significant decrease at 60 min. of the procedure when compared with baseline measurement ($p < 0.05$), then started to increase again after apheresis with no significant difference determined between baseline value and that reported 30 min. after apheresis ($p > 0.05$) (Table 3, Fig. 4).

Table (3): Statistical comparison regarding mean values of serum ionized calcium (iCa) & ionized magnesium (iMg) levels in first- time donors at different time intervals of apheresis procedure using ANOVA and LSD tests:

Time interval Minerals assessed	Time of sampling				ANOVA test	
	00 min. (Baseline)	min. 30 of procedure	min. 60 of procedure	30 min. post procedure	F	P
Serum ica level (mEq/L)	2.23±0.13	2.10±0.17 ^a	2.07±0.25 ^a	2.19±0.17 ^{b,c}	10.11	0.000**
Serum iMg level (mEq/L)	1.75±0.53	1.64±0.61	1.48±0.49 ^a	1.71±0.51 ^c	3.69	0.01**

ica: serum ionized calcium iMg: ionized magnesium F: ANOVA
 **: Significant ($p < 0.05$). LSD for repeated measure ANOVA expressed as letters: a: Significant with (pre-procedure (Baseline)), b Significant with (at min. 30 of procedure) and c: Significant with (at min. 60 of procedure).

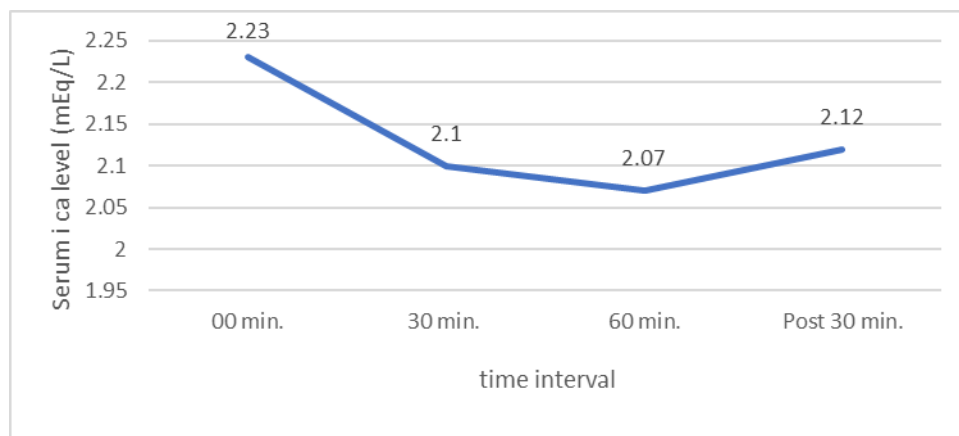


Fig. 3: Mean values of serum ionized calcium iCa level in donors at different time intervals of apheresis procedure.

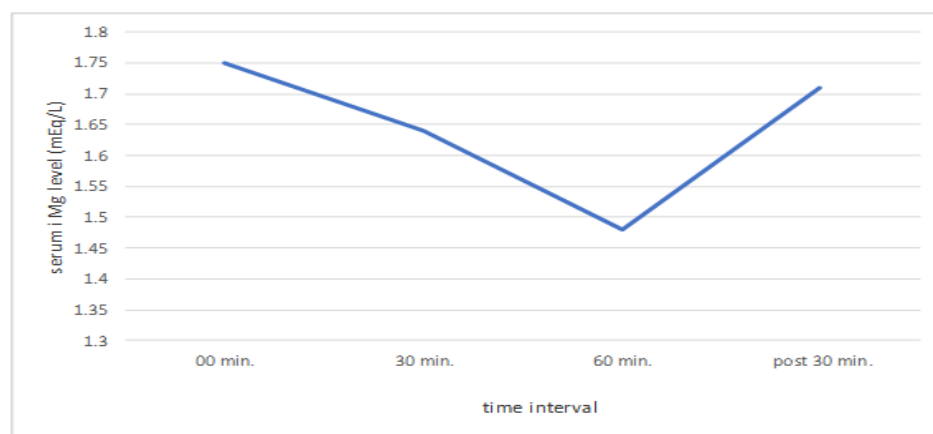


Fig. 4: Mean values of serum ionized magnesium (iMg) level in donors at different time intervals of apheresis procedure.

Assessment of PTH (pg/ml) revealed a significant increase during the procedure when compared with baseline value ($p < 0.05$). The highest increase in PTH level

was detected at 60 min. then started to decrease again after the procedure but, didn't reach the baseline value as measured at 30 min. post procedure (Table 4 & Fig. 5).

Table (4): Statistical Comparison regarding mean values of parathyroid hormone (PTH) level (pg/ml) in first-time donors at different time intervals of apheresis procedure using ANOVA and LSD tests:

	Time of sampling				ANOVA test	
	00 min. (Baseline)	At min. 30 of procedure	At min. 60 of procedure	30 min. post procedure	F	P
PTH (pg/ml)	20.87±4.21	28.87±6.23 ^a	36.61±5.92 ^{a,b}	27.93±4.86 ^{a,c}	108.01	0.000**

F: ANOVA **: Significant: $p < 0.05$ min: minute

LSD for repeated measure ANOVA expressed as letters: a: Significant with (pre-procedure (baseline), b Significant with (at min. 30 of procedure) and c: Significant with (at min. 60 of procedure).

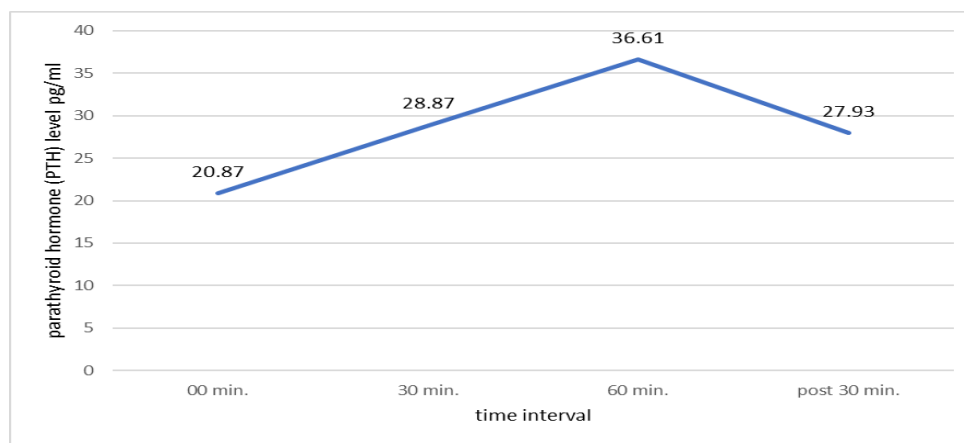


Fig. (5): Mean values of parathyroid hormone (PTH) level (pg/ml) at different time intervals of apheresis procedure.

Erythrocytes Phosphofructokinase activity showed a significant decrease during the procedure when compared with baseline activity ($p < 0.05$), then the activity of the enzyme started to increase again after

the procedure but didn't regain its baseline activity. Also, a significant difference was found between activity measured 30 min. post procedure and that measured as baseline value ($p < 0.05$) (Table 5, Fig. 6).

Table (5): Statistical comparison regarding mean values of erythrocytes phosphofructokinase activity (PFK) in first-time donors at different time intervals of apheresis procedure using ANOVA and LSD tests:

	Time of sampling				ANOVA test	
	00 min.(Baseline)	at min. 30 of procedure	at min. 60 of procedure	30 min. post procedure	F	P
Erythrocyte PFK activity (nmole/min/unit number of RBCs)	0.698±0.028	0.684±0.015 ^a	0.652±0.031 ^{a,b}	0.672±0.023 ^{a,b,c}	45.58	0.000**

F: ANOVA

** : Significant

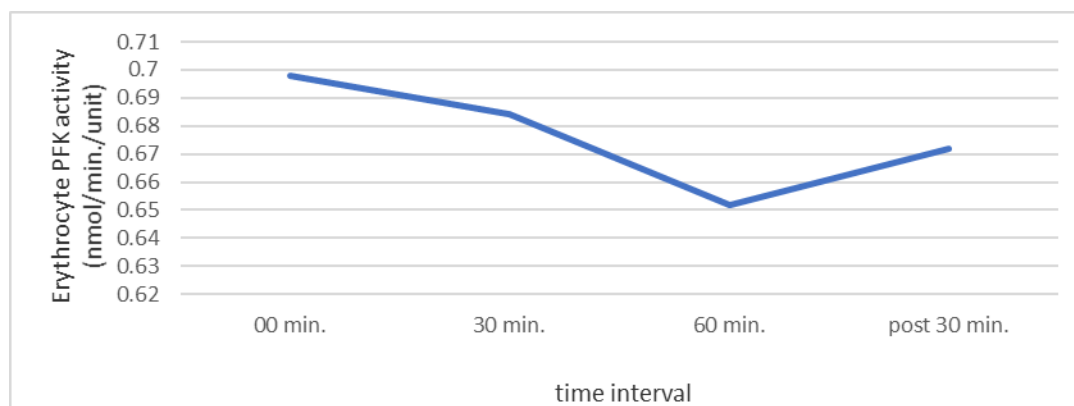


Fig. (6): Mean values of erythrocytes phosphofructokinase activity (PFK) at different time intervals of apheresis procedure.

When hematological parameters were assessed in apheresis donors, Only RBCs showed a significant decrease at 60 min. of the procedure and at 30 min. post apheresis when compared with baseline

value ($p < 0.05$) (Table 6). On the other hand, no significant changes were found when Hb level (g/dl) or Hct % were compared at the different time intervals of the procedure ($p > 0.05$) (Table 6).

Table (6): Statistical comparison regarding mean values of hematological parameters in first time donors at different time intervals of apheresis procedure ANOVA and LSD tests

Hematological parameters	Time of sampling				ANOVA test	
	0.00 min (Baseline)	min. 30 of procedure	min. 60 of procedure	30 min. post procedure	F	P
RBC (million/ul)	5.01±0.14	4.96±0.71	4.11±0.34 ^a	4.15±0.52 ^a	80.6	0.000**
Hb (g/dl)	12.25±0.62	12.18±0.73	12.15±0.66	12.17±0.68	0.31	0.82
Hct (%)	38.48±0.71	38.37±0.59	38.34±0.67	38.24±0.91	1.4	0.25

F: ANOVA **: Significant: $p < 0.05$ min: minute. LSD for repeated measure ANOVA expressed as letters: a: Significant with (pre-procedure (baseline)), b Significant with (at min. 30 of procedure) and c: Significant with (at min. 60 of procedure).

IV. DISCUSSION

Apheresis is a procedure used for collecting specific blood components by using a needle inserted in arm vein which pass through an extracorporeal circuit machine to separate the component desired. The separated component is removed and the remainder is returned to the donor by the same needle or via a needle in the other arm. Acid citrate dextrose (ACD) is added to the

machine to prevent coagulation of blood. The returned blood to the donor hence contain citrate (Crookston and Novak, 2010). The aim of this study was to evaluate the possible toxic effects of citrate in apheresis donors for the first time.

Clinical evaluation of the donors enrolled in the study revealed that the most reported symptoms were lightheadedness, nausea, vomiting and shivering followed by

twitches & tremors. Tetany complicated 5.3% of the donors while no one of the donors developed seizures.

These results coincide with that of Bolan et al. (2001) who detected fall in ca level by about 33% which resulted in an increase of nerve excitability with subsequent paresthesia, shivering, light-headedness, twitching, and tremors. They stated that some donors developed nausea and vomiting and with cases of more ca decrease, the symptoms progressed to carpopedal spasm, tetany, and seizure.

Moreover, Bell et al. (2007) reported a case of severe citrate toxicity during first time platelet apheresis in a 40-year-old female donor with past medical history of hypertension, hyperlipidemia, reported medications included bumetanide, pravastatin. Thirty minutes from the start of the procedure, the donor developed tingling around the mouth, hands, and feet followed by severe facial and extremity tetany. They attributed these manifestations to citrate-induced hypocalcemia which was aggravated by bumetanide; a loop diuretic that may cause significant hypocalcemia.

When vital signs were assessed among donors, tachycardia and decrease of diastolic blood pressure were recorded during the procedure, but returned to normal when evaluated 30 min. after apheresis.

Toyoshima et al. (2006) explained hypotension following infusion of citrate at a rate >1.0 mmol/kg/h by hypocalcemia which is more severe with increased infusion rate of citrate. Tachycardia also reported in such cases and is believed to be a reflex for hypotension.

The results of the study revealed not significant elevation in both bicarbonate level and partial pressure of CO₂ (PCO₂) when assessed during apheresis procedure.

These findings are explained by Kramer et al. (2003) who mentioned that exogenous citrate is metabolized by mitochondria of renal, hepatic and skeletal tissues which result in consumption of three hydrogen ions and release of three bicarbonate molecules per one citrate molecule causing blood alkalinity.

In addition, Callan et al. (2008) stated that metabolic alkalosis has complicated massive blood transfusion due to conversion of excess citrate into bicarbonate citrate intoxication as a result of citrate metabolism in the liver where it is converted into bicarbonate. Also, Bicakci and Olcay (2014) investigated metabolic changes due to citrate in patients who received blood transfusion and demonstrated metabolic alkalosis and respiratory acidosis as a result of citrate metabolism.

Absence of metabolic abnormalities in apheresis in contrary to that developed in massive blood transfusion can be explained by more citrate in stored blood (3 g/unit of RBC) used for transfusion. Karina et al. (2014) mentioned that liver can metabolize up to 3 gm of citrate in 5 minutes and infusion rates more than 1unit of RBC/5 min can result in metabolic alkalosis.

In consistent with these results, Kai & Yuan (2015) stated that metabolic alkalosis is reported as a well-known hazard of massive blood transfusion, but it is not stated as a complication of non-massive blood transfusions.

A significant decrease of ica level was detected at 30 & 60 min. of apheresis with iMg level significantly decreased at 60 min. of the procedure. Then the levels returned again to normal level where non-

significant differences were found between pre and post procedure values.

These results coincide with that of Kai and Yuan (2015) who stated that the anticoagulant effect of citrate is mediated through reversible chelation of divalent cations including calcium and magnesium affecting their normal physiologic functions. Also, Walter et al. (2016) mentioned that ACD disrupt coagulation by chelating calcium ions in the blood forming calcium-citrate complex with resultant hypocalcemia.

Also, Bolan et al. (2001) stated that infusion rate of citrate during plateletpheresis is adjusted so that metabolism, redistribution and short period of apheresis procedure prevent accumulation of citrate to toxic level. In cases of longer procedure duration or increased rate of infusion, citrate accumulation in blood will overwhelm its metabolism resulting in marked decrease in calcium and magnesium levels and this may explain development of citrate toxicity in some donors during apheresis.

Joseph et al. (2013) and Bialkowski et al. (2016) declared that during apheresis, citrate is infused at a rate higher than its removal to permit short runs. They added that although donors can generally tolerate up to 20% decrease in ca level, rapid infusion can be associated with citrate toxicity in the form of hypocalcemia with neuromuscular excitability or even seizures. In consistent with this, Humpe et al. (2000) Stated that ACD infusion rates of 0.8, 1.0 and 1.2 ml ACD-A/min/L were accompanied by declines in calcium levels by 10-15%, 15-25% and 20-35% respectively.

Sigler et al. (2018) conducted a study on 206 patient underwent 1176 therapeutic plasma exchange procedures in which ACD

formula A (ACD-A) was used for anticoagulation together with iv calcium replacement. Despite uses of prophylactic iv calcium, patients developed hypocalcemia in 63 out of the 1176 procedures performed.

Parathyroid hormone was increased during apheresis when compared to pre-procedure value and decreased again after the procedure but still a significant difference was found between 30 min. post procedure and pre-procedure measurements.

These findings are in consistent with that of Bolan et al. (2003) and Muhammad et al. (2016) who stated that increase in PTH is short-lived reaching its maximum at the end of apheresis procedure, then start to decline again to reach nearly the baseline as early as 30 minutes after termination of citrate infusion. Hebert et al. (1997) explained increase in PTH in apheresis donors by sensitization of G-protein coupled receptors on surface of parathyroid gland and kidney upon decline in blood ca concentration with subsequent stimulation of secretory cells to release PTH.

On the other hand, a study carried out by Amrein et al. (2010) demonstrated elevation of PTH level up to one day after the procedure.

Chen Y. et al. (2009) compared the effects of citrate infusion and saline infusion on bone markers in 10 male plateletpheresis who were divided into 2 groups. Samples were collected at the beginning, in the middle and at the end of apheresis process and found that citrate infusion was accompanied by a significant increase of PTH together with decreased ca level when compared with saline infusion. Chu et al. (2010) explained that by the essential role of PTH in regulating serum calcium, so any change in ca level will affect PTH.

Assessment of erythrocytes PFK activity revealed a significant decrease during procedure intervals when compared with pre-procedure value and although the enzyme activity started to increase again after apheresis, but it didn't reach the baseline activity, with a significant difference found when comparing activity measured 30 min. post procedure and that measured pre-procedure. When hematological parameters were evaluated, a decrease in RBCs but not in Hb level or hematocrit % was detected.

Sola et al. (1994) who stated that citrate has an inhibitory effect on PFK. Michael and Harold (2012) mentioned that genetic deficiency of erythrocyte PFK is associated with hemolysis and reticulocytosis.

These findings are also supported by that of Mlakar and Legis (2006) & Ros and Schulze (2013) who stated that citrate play a role in suppression of the enzyme activity.

Aleksandra and Matic (2010) Suggested interaction of citrate with a citrate allosteric site on PFK although this has not been studied on a sub molecular level.

V. CONCLUSION

Exposure of plateletpheresis first-time donors to citrate may cause citrate toxicity manifested clinically by light headedness, nausea, vomiting, tremors, twitches, tetany, tachycardia and hypotension with alteration of biochemical parameters in the form of decreased calcium & magnesium levels, increased PTH, decreased erythrocyte PFK activity with subsequent decreased RBCs integrity and possible hemolysis.

VI. RECOMMENDATIONS

From the previous results, the following are recommended:

1-Readiness for managing possible serious reactions including severe hypocalcemia, hypomagnesemia associated with tetany, seizures and hemodynamic instability with establishing a plan to manage any complications during blood donation.

2-Perform pre-procedure assessment of serum calcium and magnesium levels together with evaluation of possible hemolysis after apheresis to identify cases requiring heightened cautions.

3-Further studies are recommended to study a safe alternative for acid citrate dextrose as an anticoagulant in plateletpheresis procedure.

VII. ACKNOWLEDGEMENT

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تأثير حمض الدكستروز سترات أثناء عملية فصل الصفائح الدموية على المتبرعين الأصحاء لأول مرة : ما بين السلامة و التسمم

سماح عادل النجدي يارا محمد الفخراني

قسم الطب الشرعي والسموم الاكلينيكية -كلية الطب البشرى- جامعة الزقازيق

مقدمة: تستخدم مادة حمض الدكستروز سترات لمنع التجلط أثناء عملية فصل الصفائح الدموية ثم تعود تلك المادة لجسم المتبرع مرة اخرى عن طريق الدم العائد اليه بعد اتمام عملية الفصل .

الهدف من البحث: هو تقييم التأثير السمي لمادة حمض الدكستروز سترات في المتبرعين الاصحاء لأول مرة عن طريق التقييم الاكلينيكي والمعملى.

طريقة الدراسة: اشترك في هذه الدراسة عدد 75 من المتبرعين الاصحاء (متبرعين للمرة الأولى) وقد خضعوا للفحص الاكلينيكي ومتابعة الوظائف الحيوية وتسجيل اى عرض يحدث اثناء عملية الفصل كما تم قياس الغازات بالدم ونسبة الكالسيوم المتأين و الماغنيسيوم المتأين وهرمون الغدة الجاردرقيه و نشاط انزيم الفسفوركتوكينيز بكرات الدم الحمراء و نسبة الهيموجلوبين والهيماتوكريت وعدد كرات الدم الحمراء فى الاوقات الاتية (دقيقه00) قبل البدء فى عملية الفصل (والدقيقة 30و60) أثناء عملية الفصل ثم 30 دقيقة بعد الانتهاء من عملية الفصل.

النتائج: وقد اظهرت النتائج حدوث نقص فى نسبة الكالسيوم و الماغنيسيوم المتأينين و صحب ذلك بعض الرعشات بنسبة (9.3%) و الكزاز بنسبة (5.3%) من المتبرعين بينما رصدت الدراسة انخفاض ذو دلالة احصائية فى ضغط الدم و سرعة نبضات القلب. كما وجدت زيادة ذات دلالة احصائية فى مستوى هرمون الغدة الجار درقيه اثناء عملية الفصل ثم قل بعد انتهاء عملية الفصل ب 30 دقيقة و لكنه لم يعد الي المستوى الطبيعى له بينما انخفض نشاط انزيم الفسفوركتوكينيز مصاحبا بنقص فى كرات الدم الحمراء بينما لم يحدث تغيير ذو دلالة احصائية فى مستوى الهيموجلوبين او نسبة الهيماتوكريت.

الاستنتاج: من نتائج الدراسة تم استنتاج ان مادة حمض الدكستروز سترات قد أحدثت تسمم للمتبرعين بفصل الصفائح الدموية للمرة الاولي فى صورة رعشات و الكزاز و زيادة نبضات القلب و انخفاض ضغط الدم مع نقص فى نسبة الكالسيوم و الماغنيسيوم المتأينين و زيادة مستوى هرمون الغدة الجاردرقيه مؤقتا اثناء عملية الفصل ثم قل بعد انتهاء عملية الفصل ب 30 دقيقة لكنه لم يعد الي المستوى الطبيعى له مع نقص فى نشاط الفسفوركتوكينيز لخلايا كرات الدم الحمراء مما أدى إلى ضعفها و سهولة تكسيرها.

التوصيات: الاستعداد للتعامل مع المخاطر المحتملة من نقص حاد فى مستوى الكالسيوم و الماغنيسيوم فى الدم و المرتبطين بحدوث الكزاز و نوبات التشنج و كذلك عدم الاستقرار فى الدورة الدموية اثناء عملية الفصل و ايضا يوصي بقياس مستوى الكالسيوم و الماغنيسيوم فى الدم للمتبرعين لأول مرة قبل البدء فى عملية الفصل مع تقييم شامل لاحتمال حدوث تكسر فى كرات الدم الحمراء بعد عملية الفصل.