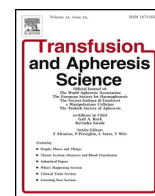




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Effect of pre-donation fluid intake on fluid shift from interstitial to intravascular compartment in blood donors

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ABSTRACT

Background: Fluid shifts from interstitial to intravascular space during blood donation helps in compensating the lost blood volume. We aimed to determine the volume of fluid shift following donation in donors with and without pre-donation fluid intake.

Methods: We studied the fluid shift in 325 blood donors prospectively. Donors were divided in groups with no fluid intake (GI) and either water (GII) or oral rehydrating fluids (GIII) before donation. Fluid shift following donation was calculated based on the difference between the pre and post donation blood volume. The influence of oral fluid intake, age, gender and body mass index (BMI) on volume of fluid shift was analyzed.

Results: The fluid shift was significant between donors without fluids (GI: 127 ± 81 ml) and donors with fluid intake (GII & III: 96 ± 45 ml) ($p < 0.05$). The difference was not significant between donors with water intake (GII: 106 ± 52 ml) and oral rehydrating fluid intake (GIII: 87 ± 41 ml). The shifted fluid volume increased with increasing BMI and decreased with increasing age in females. The fluid shift increased in females than in males.

Conclusion: The age, gender, BMI and VVR did not significantly contribute to the volume of fluid shift following donation. As per our observation, the oral fluids before donation might not contribute to increase in fluid shift in blood donors after donation.

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1. Background

Blood donors in general tolerate the acute blood loss due to blood donation very well. Most blood donors compensate for this loss by various circulatory defense mechanisms. One of the principle mechanisms acting immediately is by restoring the lost plasma volume by influx of fluid from interstitial to intravascular space to restore the plasma volume. Vasovagal reactions (VVR) in blood donors accounts for 53% of all adverse reactions noted; occurring at a frequency of less than 1% in blood donors [1,2]. Most donors with vasovagal reactions recover from it spontaneously within a moderate time except for few, who faint, fall or sustain an injury. Two most commonly followed interventions to reduce vasovagal reactions in blood donors were acute water loading and applied muscle tension [3]. Studies have shown that predonation water intake 30 minutes

before donation has lowered the risk of physiologic reactions to blood donation by preventing orthostatic hypotension and delayed the onset of presyncope reactions. It was also demonstrated that the salutary effects of hydration increased as the interval between water loading and phlebotomy decreased [3]. The pre donation fluid intake is noted to cause more fluids to shift from interstitial compartment to intravascular compartment and hence routinely practiced worldwide to prevent vasovagal reactions [4].

2. Aim

The aim of this study was to estimate the effect of pre-donation fluid intake on volume of fluid shift from the interstitial to intravascular compartment in blood donors.

3. Materials and methods

We conducted a prospective study on 325 blood donors after obtaining permission from institutional ethics committee. Informed consent was obtained from all individual participants included in the study. Donors are divided into 3 groups and ran-

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Table 1
 Donor Groups.

| Group | Pre-donation fluid |
|-------|---------------------------------|
| I | No fluids |
| II | Water (200 ml) |
| III | Oral Rehydrating Fluid (200 ml) |

domly categorized into one of the groups as shown in Table 1. The Group II and III were given pre-donation fluids (Group II- 200 mL water; Group III- 200 mL Oral Rehydrating fluid [ORF] with high sodium concentration and small amount of sugar) at the time of medical examination (Table 1).

Male donors weigh between 45 and 55 kgs donated 350 ml and those weighing greater than 55 kg donated 450 ml. Female donors weighing more than 45 kgs donated only 350 ml. Data related to age, gender weight, height, waiting period before blood donation and duration of blood donation were noted. All donors were also questioned about the risk factors for developing vasovagal reactions – fear of needle, fainting at the sight of blood and adequate sleep.

The blood volume of donor's pre and post donation was calculated using Ogawa's equation, $0.168H^3 + 0.050W + 0.444$ for adult males and $0.250H^3 + 0.0625W - 0.66$ for adult females, where H and W indicate donor height (m) and weight (kg), respectively [5]. Hemoglobin of donors was measured in Sysmex cell counter from the blood samples collected at the time of medical examination and at the end of blood donation. Bag hemoglobin was determined from the mother bag segment after mixing well.

The following method was used to determine the fluid shift

- V1: Pre-donation blood volume; V2: Post-donation blood volume
- Hb1: Pre-donation hemoglobin; Hb2: Post-donation hemoglobin
- Assuming Hb to be constant during the entire process

$$V1 \times Hb1 = V2 \times Hb2 + \text{Bag Hb}$$

$$\text{Bag Hb} = \frac{Hb1 + Hb2}{2} \times \text{Volume donated}$$

$$V2 \times Hb2 = V1 \times Hb1 - \text{Bag Hb}$$

$$\text{Shifted Volume} = V2 - (V1 - \text{Volume donated})$$

The difference between pre and post donation blood volume is calculated as the amount of fluid shift happened during the donation. The influence of two types of oral fluid intake, age, gender and body mass index (BMI) on volume of fluid shift was analyzed. The statistical analysis was performed using chi-square test, paired and unpaired t test. Factors associated with volume of shift fluid were determined using multiple regression analysis.

4. Results

A total of 325 donors (male: 277 and female: 48) participated in the study. First time donors among males and females were 40% (111/277) and 66% (32/48) respectively. None of the repeat blood donors enrolled in the study had fainting episodes during previous donations. Two male donors had risk factors for vasovagal reactions – fear of needle prick and faint on sight of blood (0.6%). The mean waiting time before blood donation was 5 min in all groups. The average time taken for collecting 350 mL and 450 mL blood was 5.5 ± 1.4 minutes and 6.2 ± 1.3 min respectively. The mean drop in hemoglobin between pre-donation (14.8 ± 1.24) and post donation (14.4 ± 1.25) was only 0.35 ± 0.20 g/dL. The donors profile in each group were mentioned in Table 2.

We estimated the difference in blood volume before (V1) and after donation (V2) to the effect of water and ORF intake on to the circulating blood volume. Though hemoglobin decreased following

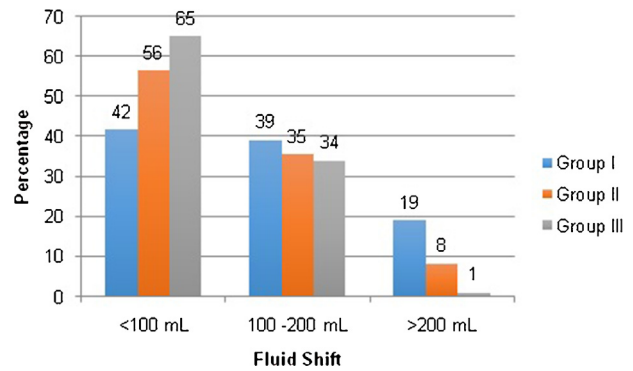


Fig. 1. xxx.

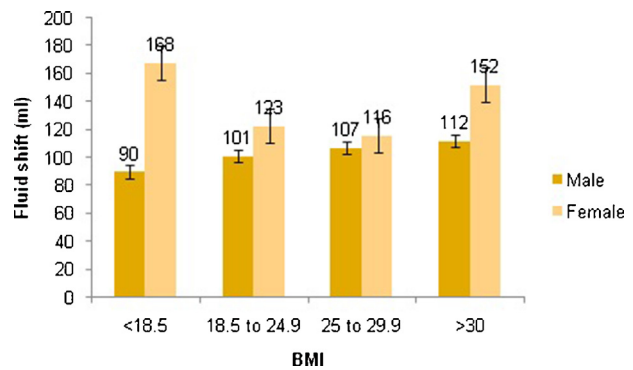


Fig. 2. xxx.

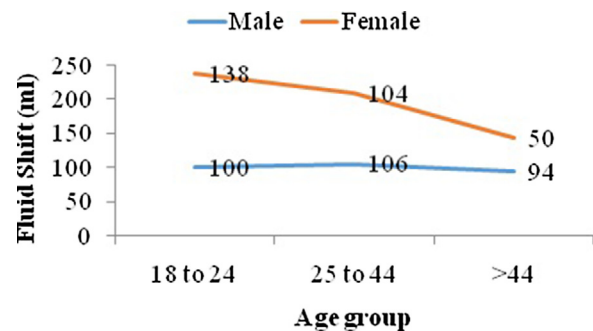


Fig. 3. xxx.

blood donation, the mean volume of fluid shifted from interstitial to intravascular compartment ($V2 - V1$) was greater in females (126 ± 72 mL vs 104 ± 62 mL). The volume of fluid shifted was also higher with 450 mL donations (450 mL: 106 ± 62 mL vs 350 mL: 94 ± 58 mL). Males donating 450 mL of blood had greater fluid shift than 350 mL (450 mL: 106 ± 62 vs 350 mL 90 ± 57).

Post hoc comparisons to evaluate the differences among group means was conducted using Tukey HSD test. The fluid shift was significant between donors with no fluids (Group I: 127 ± 81 ml) and donors with fluid intake (Group II & III: 96 ± 45 ml) ($p < 0.05$). The difference was not significant between donors with water intake (106 ± 52 mL) and ORF intake (87 ± 41) and on volume of blood collected. Group I had large number of donors with more than 200 mL fluid shift during the donation process (Fig. 1).

The shifted fluid volume increased with increasing BMI, but the difference was not significant, however female had a higher fluid shift within the same range of BMI (Fig. 2). The shifted fluid volume decreased with increasing age in females and among males age group 25 to 44 had higher movement of fluid (Fig. 3).

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