Original article

Risk factors of developing vasovagal reaction in blood donors: a prospective case-control study

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Abstract:

Introduction: *Vasovagal reaction (VVR) is the most common adverse reaction (ADR) in whole blood donors, giving negative experience and lowering the return rate of the blood donors.* ***Objective:*** *To identify risk factors of developing VVR from whole blood donation.* ***Materials and Methods:*** *A prospective case-control study was performed at the National Blood Centre, Thai Red Cross Society, from August 2022 to April 2023. Whole blood donors, with uneventful donations and with VVR, were randomly selected. Their health history was interviewed, and donation records were reviewed. Risk factors were analyzed for adjusted odds ratio (adj.OR) using multivariate binary logistic regression.* ***Results:*** *There were 151 donors with VVR and 687 controls with no adverse reaction after the donation. The significant risk factors were first-time donation (adj.OR 4.81), previous history of VVR (adj.OR 6.01), sleep duration < 5 hours the night before the donation (adj.OR 9.67), collection time > 600 seconds (adj.OR 2.12), donated volume > 12% of total blood volume (adj.OR 3.11), high-normal pre-donation heart rate (adj.OR 2.33) and high-normal hemoglobin level (adj.OR 9.03). Meanwhile, drinking at least a cup of water (adj.OR 0.18) and low-normal hemoglobin level (adj.OR 0.50) were found to be protective factors.* ***Conclusion:*** *This result enables identification of donors at risk to formulate strategies for reducing the chance and severity of VVR in the future.*

Keywords : ● *Donor adverse reaction* ● *Risk factors* ● *Vasovagal reaction* ● *Whole blood*

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นิพนธ์ต้นฉบับ

ปัจจัยเสี่ยงที่ทำให้เกิดปฏิกิริยา vasovagal ในผู้บริจาคโลหิต: การศึกษาไปข้างหน้าแบบมีกลุ่มควบคุม

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บทคัดย่อ

บทนำ *ปฏิกิริยา vasovagal เป็นปฏิกิริยาไม่พึงประสงค์ที่พบได้บ่อยที่สุดจากการบริจาคโลหิตรวม ทำให้ผู้บริจาคโลหิตได้รับประสบการณ์ในแง่ลบและลดโอกาสการกลับมาบริจาคโลหิตซ้ำ* ***วัตถุประสงค์*** *เพื่อศึกษาปัจจัยเสี่ยงในการเกิดปฏิกิริยา vasovagal ในการบริจาคโลหิตรวม* ***วัสดุและวิธีการ*** *งานวิจัยประเภทการศึกษาไปข้างหน้าแบบมีกลุ่มควบคุม ณ ศูนย์บริการโลหิตแห่งชาติ สภากาชาดไทย โดยสุ่มผู้บริจาคโลหิตรวมในช่วงเดือนสิงหาคม พ.ศ. 2565 ถึงเดือนเมษายน พ.ศ. 2566 ที่เกิดและไม่เกิดปฏิกิริยา vasovagal มาสัมภาษณ์ประวัติสุขภาพและทวนสอบประวัติการบริจาคโลหิต แล้วนำข้อมูลไปคำนวณด้วยสถิติการถดถอยโลจิสติกแบบไบนารีพหุตัวแปรเพื่อหาปัจจัยเสี่ยงในการเกิดปฏิกิริยา vasovagal* ***ผลการศึกษา*** *ข้อมูลจากผู้บริจาค 151 รายที่เกิดปฏิกิริยา vasovagal และกลุ่มควบคุมซึ่งไม่พบอาการผิดปกติหลังการบริจาคโลหิต 687 รายพบว่า การบริจาคโลหิตครั้งแรก (adj.OR 4.81) การเกิดปฏิกิริยา vasovagal ในอดีต (adj.OR 6.01) การนอน < 5 ชั่วโมงก่อนวันมาบริจาคโลหิต (adj.OR 9.67) ระยะเวลาการเจาะเก็บโลหิต > 600 วินาที (adj. OR 2.12) ปริมาณโลหิตบริจาค > 12% ของโลหิตในร่างกาย (adj.OR 3.11) อัตราการเต้นหัวใจที่ปกติแต่ค่อนข้างสูง (adj.OR 2.33) และความเข้มข้นโลหิตก่อนการบริจาคที่ปกติแต่ค่อนข้างสูง (adj.OR 9.03) เป็นปัจจัยเสี่ยงอย่างมีนัยสำคัญ แต่การดื่มน้ำอย่างน้อย 1 แก้ว (adj.OR 0.18) และ ความเข้มข้นโลหิตก่อนการบริจาคที่ปกติแต่ค่อนข้างต่ำ (adj.OR 0.50) เป็นปัจจัยป้องกันการเกิดปฏิกิริยา vasovagal* ***สรุป*** *ปัจจัยดังกล่าวข้างต้นทำให้สามารถระบุผู้บริจาคที่มีความเสี่ยงในการเกิดปฏิกิริยาดังกล่าว ทั้งนี้ เพื่อกำหนดแนวทางในการดูแลผู้บริจาคโลหิต ที่อาจป้องกันและลดความรุนแรงของปฏิกิริยา vasovagal ได้ในอนาคต*

คำสำคัญ : ● *ปฏิกิริยาไม่พึงประสงค์จากการบริจาคโลหิต* ● *ปัจจัยเสี่ยง* ● *ปฏิกิริยาวาโซวากัล* ● *โลหิตรวม*

วารสารโลหิตวิทยาและเวชศาสตร์บริการโลหิต. 2567;34:101-10.

Introduction

Donor adverse reactions (ADR) refer to any unwanted symptoms which donors experience during or after blood donation. According to ISBT/AABB/INH 2014[1], all ADR can be categorized into 6 groups as followed; complications with local symptoms (including, occurrence of blood outside the vessels, arm pain, localized infection/inflammation of veins and soft tissues, major blood vessel injury), complications with generalized symptoms (or vasovagal reactions), apheresis-related complications, allergic reactions, other serious complications and other complications that do not belong to the first 5 groups.

Vasovagal reaction (VVR) is one of the reflex syncope, also known as neurally mediated syncope[2], occurring from the autonomic nervous system response to internal (such as changes in posture, fluid loss, fear, anxiety, etc.) and/or external (such as cold, heat, etc.) stimuli. The symptoms included lightheadedness, dizziness, sweating, nausea, vomiting, muscle trembling or stiffness, bradycardia, tachypnea, hypotension, and fainting. They usually resolved on their own within a few minutes after the removal of the stimulus.

A systematic review by Soodejani et al[3] reported that systemic complications with generalized symptoms, or VVR, are the most common ADR from blood donation. Its incidence was estimated to be 1.4-7%[4] of all donations. The AABB Donor Hemovigilance reported the incidence of VVR ranging from 1.32-1.74%[5]. In Asia, a study by Hasan et al in 2023 from Malaysia reported an incidence of 1.5%[6], while two studies from Thailand reported the frequencies as high as 1.85%[7] and 2.52%[8].

VVR directly gives donors a negative blood donation experience, significantly reducing the rate of return. A study in Thailand reported the returning rate of these donors was only 18.9%[7], consistent with international studies that reported to be as low as 27%[9]. This signified the importance of implementing countermeasures to mitigate the risks of having VVR in high-risk donors.

Recently, there are studies on various aspects of VVR from blood donation, such as incidence, risk reduction, and management[3]. Moreover, previous studies reported first-time donation, female, younger age, low body weight, low estimated total blood volume (TBV), and pre-donation anxiety as risk factors for VVR[10,11]. However, the data on the strengths of associations and specific information in Thai blood donors are lacking. Additionally, the effects of physiological and behavioral factors on VVR have been inadequately explored. Therefore, the aim of this study is to determine the subgroups of donors at high risk for VVR in order to generate preventive strategies in the future.

Materials and Methods

Study design

This prospective case-control study was conducted at the National Blood Centre, Thai Red Cross Society over a period of 8 months from August 2022 to April 2023. The study was approved by the Institutional Review Board, Faculty of Medicine, Chulalongkorn University (IRB number 0235/65) and the Research Ethics Committee, National Blood Centre, Thai Red Cross Society (protocol number NBC 8/2565)

Sample size calculation

Sample size was calculated by CDC Epi InfoTM version 7.2 software using unmatched case-control function with Kelsey formula. The confidence interval was at 0.95 with statistical power of 0.8. The prevalence in the control group was set to be 2.5%, according to the data from Ongtilanont et al[8], with the ratio between control and case group of 3:1 and predicted odds ratio of 3.0. The minimum size of the case and control group was 151 and 603, respectively.

Data collection

Whole blood donors at the National Blood Centre, Thai Red Cross Society were randomly selected from August 2022 to April 2023. For the control group, the first 3 donors with uneventful donations were selected each hour by a separate health screening staff, adding up to the total of 15 donors per day. For the case group, 5 donors who first experienced VVR each day,

were selected by the head nurse on each day. Their diagnosis was confirmed by the donation center's physician. After donation and care, the donors' wellness and safety were ensured. Then, the selected donors were sent for an interview by an investigator using the same questionnaire before heading off.

A written informed consent was obtained, followed by a thorough donation history check and medical history interview. The gathered data included the donor general history (age, gender, weight, height, donation frequency, history of ADR, pre-donation blood pressure (BP), heart rate and hemoglobin concentration), donor pre-donation self-preparation (smoking, alcohol drinking, exercise, sleep time, pre-donation water and dietary pattern) and donation information (blood volume collected and collection time).

Weight and height were calculated into body mass indices (BMI), using the WHO formula[12], and total blood volume (TBV), using the Nadler formula[13]. The percentage of donated blood volume were then calculated using TBV and blood volume collected. Donors with declined consent, those with incomplete or missing data, and those who experienced other ADR besides VVR were excluded. All gathered data were recorded into a case record form without any identifiable information.

Statistical analysis

Blood donors in each group were categorized, based on current donor eligibility criteria[14] at that time, into young (18-24 years old), adult (25-65 years old), and old (66-70 years old); gender (male or female); first-time donors and frequent donors (who have donated whole blood at least once); underweight (BMI < 18.5 kg/m^2), normal (BMI 18.5-22.9 kg/m^2) and overweight (BMI ≥ 23.0 kg/m^2); donor pre-donation self-preparation; and pre-donation parameters into low-normal, normal and high-normal.

Data from Microsoft Excel was imported into IBM SPSS version 28 for statistical analysis. The characteristics of each group were analyzed using descriptive statistics and the relationship between each factor and the occurrence of VVR were calculated using Chi-square for *p*-value. The ones with statistical significance (*p*-value < 0.05) were then further analyzed using multivariate binary logistic regression for adjusted odds ratio (adj. OR) and 95% confidence interval (95%CI).

Results

Donor characteristics

A total of 173 VVR cases and 693 uneventful donors were enrolled, interviewed, and had their record reviewed. Twenty-two VVR cases and six uneventful donors were excluded due to incomplete data. All the collected data were validated by a separate investigator.

Most of the donors were females in both groups (120, 79.5% in VVR and 415, 60.4% in control). The majority were overweight (average BMI±standard deviation (SD) 23.11±2.98 kg/m^2 in VVR and 24.48±4.35 kg/m^2 in control). The means±SD for age were 32.28±10.65 and 38.40±12.01 years in VVR and control group, respectively. The means±SD for pre-donation hemoglobin levels were 14.19±1.23 mg/dL in VVR group (males: 15.77±1.28 mg/dL, females: 13.78±0.82 mg/dL) and 14.16±1.16 mg/dL in control group (males: 15.04±1.07 mg/dL, females: 13.58 ±0.80 mg/dL). The other pre-donation vital signs are shown in Table 1. The differences between baseline characteristics of the two groups were not statistically significant.

For the VVR, 45 (29.8%) occurred on the donation bed, 72 (47.68%) occurred in the refreshment room and 34 (22.52%) occurred before the donor headed off, inside the donation center. Vital signs are low-normal with the mean systolic BP of 103.38±13.45 mmHg, diastolic BP of 66.83±11.04 mmHg and heart rate of 69.50 ± 11.81 bpm. Most common symptoms are lightheadedness/dizziness, pallor, sweating and nausea (97.35%, 87.42%, 82.78% and 51.66%, respectively). The other symptoms are listed in Table 2. Four donors had injuries with bruises and/or abrasions associated with falls. The injuries were assessed and treated before heading off.

Table 1 Blood donor characteristics in vasovagal reaction (VVR) and control groups

	VVR (n = 151)	Control (n = 687)
Gender *		
Male (%)	31 (20.53)	272 (39.59)
Female (%)	120 (79.47)	415 (60.41)
Age (years)	32.28±10.65	38.40±12.01
BMI (kg/m^2)	23.11±2.98	24.48±4.35
Pre-donation vital signs		
Systolic BP (mmHg)	120.25±13.69	126.18±14.72
Diastolic BP (mmHg)	72.00±10.36	73.97±10.34
Heart rate (bpm)	84.25±11.05	82.21±10.59
Hemoglobin (mg/dL)	14.19±1.23	14.16±1.16
Donation process		
Donation time (sec)	504.94±153.00	449.40±125.73
Blood collected (% of TBV)	11.96±1.71	10.86±1.70

* all data, except gender, were represented as mean±SD

BMI = body mass index; BP = blood pressure; TBV = total blood volume

Table 2 Details on vasovagal reactions (n = 151)

	N (%)
Location	
On donation bed	45 (29.80)
Refreshment room	72 (47.68)
Before heading off	34 (22.52)
Vital signs	
Systolic BP (mmHg)	103.38±13.45
Diastolic BP (mmHg)	66.83±11.04
Heart rate (bpm)	69.50±11.81
Symptoms	
Lightheadedness / dizziness	147 (97.35)
Pallor	132 (87.42)
Sweating	125 (82.78)
Nausea	78 (51.66)
Vomiting	19 (12.58)
Hyperventilation	14 (9.27)
Loss of consciousness	11 (7.28)
Muscle clamping	8 (5.30)
Urinary / fecal incontinence	2 (1.32)
Associated injury *	4 (6.45)

* all injuries are bruising and/or associated with falls

BP = blood pressure

Risk factors for developing VVR

As shown in Table 3, all donor characteristics (gender, age, BMI, and underlying diseases) showed no statistically significant correlation with VVR. The exception was first-time donation, which increases the risk of VVR with an adjusted odds ratio (adj.OR) of 4.81 (95% CI: 2.94-7.86, *p*-value: < 0.001)

For pre-donation preparation, two risk factors included previous history of VVR (adj.OR: 6.01, 95%CI: 3.59-10.06, *p*-value: < 0.001) and inadequate sleep, defined as less than 5 hours of sleep the night before donation (adj.OR: 9.67, 95%CI: 2.96-31.55, *p*-value: < 0.001), were identified. On the other hand, drinking at least one cup of water before donation was a protective factor for VVR with an adj. OR of 0.18 (95%CI: 0.06-0.52, *p*-value: 0.001). Meanwhile, other factors showed no statistical significance.

Interestingly, from all vital signs, only high-normal heart rate showed statistical significance as a risk factor for VVR (adj.OR: 2.33, 95%CI: 1.37-3.97, *p*-value: 0.006). As for pre-donation hemoglobin (Hb), a high-normal Hb was a strong risk factor (adj.OR: 9.03, 95%CI: 1.04-86.79, *p*-value: 0.035) while low-normal Hb was a protective factor (adj.OR: 0.50, 95%CI: 0.30-0.85, *p*-value: 0.002)

Table 3 Statistical analyses between vasovagal reaction (VVR) and blood donor characteristics

	VVR	Control	*p*-value	adj.OR (95%CI)*
Donor characteristics				
Gender			0.470	
Male	31 (20.5)	272 (39.6)		
Female	120 (79.5)	415 (60.4)		
Age			0.782	
18-24 years	39 (25.8)	97 (14.1)		
25-65 years	112 (74.2)	582 (84.7)		
66-70 years	-	8 (1.2)		
BMI			0.731	
< 18.5 kg/m^2	3 (2)	29 (4.2)		
18.5-22.9 kg/m^2	73 (48.3)	257 (37.4)		
≥ 23 kg/m^2	75 (49.7)	401 (58.4)		
Underlying disease			0.317	
Hypertension	1 (0.7)	39 (5.7)		
Diabetes mellitus	-	7 (1.0)		
Others	-	8 (1.2)		
First-time donation	47 (31.1)	94 (13.7)	< 0.001	4.81 (2.94-7.86)
Pre-donation preparation				
Smoking	7 (4.6)	85 (12.4)	0.090	
Drinking alcohol	42 (27.8)	276 (40.2)	0.234	
Sleep time < 5 hours	9 (6.0)	6 (0.9)	< 0.001	9.67 (2.96-31.55)
Have meal > 6 hours	5 (3.3)	19 (2.8)	0.683	
Drink at least one cup of water	137 (90.7)	679 (98.8)	0.001	0.18 (0.06-0.52)
Exercise before donation	6 (4)	87 (12.7)	0.185	
Previous history of VVR	50 (33.1)	69 (10)	< 0.001	6.01 (3.59-10.06)
Pre-donation vital signs				
Systolic BP			0.132	
Low-normal (100-120 mmHg)	84 (55.6)	278 (40.5)		
High-normal (141-160 mmHg)	13 (8.6)	137 (19.9)		
Diastolic BP			0.331	
Low-normal (60-69 mmHg)	71 (47)	265 (38.6)		
High-normal (91-100 mmHg)	8 (5.3)	42 (6.1)		
Heart rate			0.021	
Low-normal (50-59 bpm)	3 (2)	11 (1.6)	0.693	
High-normal (96-100 bpm)	33 (21.9)	82 (11.9)	0.006	2.33 (1.37-3.97)
Hemoglobin (mg/dL)			< 0.001	
Low-normal (M 13.0-13.5 / F 12.5-13.0)	26 (17.2)	158 (23)	0.002	0.50 (0.30-0.85)
High-normal (M 18.0-18.5 / F 16.0-16.5)	5 (3.3)	1 (0.1)	0.035	9.03 (1.04-86.79)
Donation process				
Blood collected > 12% TBV	85 (56.3)	190 (27.7)	0.003	3.11 (2.05-4.74)
Collection time > 600 seconds	37 (24.5)	90 (13.1)	0.032	2.12 (1.29-3.50)

*adjusted odds ratio (adj.OR) calculated by multivariate binary logistic regression of factors with *p*-value < 0.05

M = male; F = female; BP = blood pressure; TBV = total blood volume; VVR = vasovagal reaction

Lastly, longer donation time (> 600 seconds) increased the risk of VVR (adj.OR: 2.12, 95%CI: 1.29-3.50, *p*-value: 0.032), as well as donating blood more than 12% of TBV (adj.OR: 3.11, 95%CI: 2.05-4.74, *p*-value: 0.003).

Scoring system for predicting high-risk VVR donor

Considering 6 significant risk factors that could be accessed during the pre-donation period (excluding blood collection time), a scoring system was constructed based on adj.OR as in Table 4. Using data collected from enrolled donors, and the cut-off score of 2, the sensitivity was 62.91% and the specificity was 75.25%, suggesting an acceptable prediction for donor with low risk of developing VVR when score is < 2. However, further validation study on the scoring system using another data set is needed.

Table 4 Scoring system for screening high-risk donor

Factors	Score
Sleep time < 5 hours the night before donation	2
High normal hemoglobin	2
Previous history of vasovagal	2
First-time donation	1
Blood collected > 12% TBV	1
High normal heart rate	1
Comparing to data collected from enrolled donors	
Total score	**Frequency of VVR % (n/n)**
0	5.24 (18/343)
1	16.52 (38/230)
2	22.90 (30/131)
3	40.78 (42/103)
4	64.71 (11/17)
5	84.62 (11/13)
6	100 (1/1)

Suggestion: consider additional management at score ≥ 2

Discussion

To date, research and studies have shown that VVR after blood donation is related to multifactorial conditions, including donor physiological and psychological status, donation process and environmental condition at the donation site. Despite the different donor characteristics described as risk factors, the most important and common risk factor is the first-time donation, as we found to have an adj. OR of 4.81. A study by Wiersum-Osselton et al[15] reported VVR occurred in first-time donors at least 8-10 times more than repeated donors. As shown by Eder et al[16], it was found that the rate of VVR recorded in first-time blood donors was as high as 10%. The reason is thought to be from donor psychological conditions, including anxiety and fear from donating blood for the first time without prior experiences.

VVR from the first donation can leave a negative impact on donors and cause them to be more vulnerable to experience VVR in subsequent donations. In this study, we found previous history of VVR as a strong risk factor with the adj.OR of 6.01. Gillet et al[17] also reported blood donors who experienced a reaction at their first donation have a higher risk of vasovagal reaction at least until the third donation. Therefore, preventing VVR in the first-time donation is crucial for optimal donor care. In contrast to previous reports, this study failed to demonstrate female and younger age as risk factors. This might be due to a low number of male and younger donors in the population of this study.

Besides donor characteristics, pre-donation behavior and preparation are also important for a successful and uneventful donation, for example, healthy diets and avoiding heavy exercise, as mentioned by many donation centers globally. However, there are very few studies that showed the effectiveness of each one individually. We were unable to show that smoking or drinking alcohol, exercising, and eating more than 6 hours before donation yielded a higher risk of developing VVR. However, our data showed that sleep for less than 5 hours the night before the donation, which was the cut-off used according to the current donor health screening criteria[14], gave a higher risk of VVR, with the adj.OR as high as 9.67 (p-value < 0.001). Similarly, Takanashi et al[18] showed that sleep duration of less than 6 hours resulted in a higher VVR risk as much as first time donation and recommended that the amount of sleep time before should be asked before the donation. Furthermore, we found that drinking at least a cup of

water can reduce the risk of VVR (adj.OR 0.18), like what was mentioned in a systemic review[9]. Lewin et al[19] also mentioned, in addition to water, pre-donation salty snacks can reduce the incidence of VVR by over 15%.

Previous studies[16,18] showed the relationship between BMI and TBV in development of VVR, but this study found no statistical significance. However, we found that donating blood with the volume more than 12% of TBV increased the VVR rate (adj.OR 3.11). Current guidelines on blood donation[14,20] stated that blood volume donated each time should not exceed 15% of TBV, which may result in a grade 1 hemorrhagic shock[21]. Yet, small changes in hemodynamics may have already occurred before that. Because the volumes of blood collected (350 mL or 450 mL) depended on donor body weights, our studies did not reveal higher VVR risk in donors with lower BMI, thus lower TBV. Nevertheless, it can be concluded that donors who have more relative blood loss are at higher risk of developing VVR.

Another risk factor found was a high-normal pre-donation hemoglobin (Hb) level (adj.OR 9.03). Similarly, Odajima et al[22] found that high Hb level was associated with higher VVR in a dose response manner. Hemoconcentration from mild dehydration might be one of the main reasons. Wiersum-Osselton et al[15] suspected other underlying issues untold by donors, such as smoking, yet their studies could not show a statistical significance. On the other hand, this study found a low-normal pre-donation Hb as a protective factor (adj. OR 0.50). A higher tolerance to blood loss than those with higher Hb is suggested, yet a more focused study is needed for further understanding.

Pre-donation vital signs measuring is one of the required procedures done prior to donation, aiming to assess donor overall health status. They are thought to be predictors of problems during and after donation, especially VVR. However, previous studies gave variable results. This study found only a high-normal heart rate (> 90 bpm) as a risk factor with a statistical significance. Anxiety and/or low cardiovascular fitness might be responsible for these relatively high heart rates, but the exact reasons remain unclear.

Lastly, the donation process can also be a potential risk factor in developing VVR, the result showed blood collecting time over 600 seconds was a risk factor with the adj.OR of 2.12. Meanwhile, no other studies mention the relationship between collection time and VVR. However, a longer collection time might be due to a low flow rate, that can be the result of small vein size, undereffective venipuncture or incorrect position. This might cause donor stress, uneasiness, and fear, that eventually lead to the development of VVR.

With the identified risk factors, a suitable management may provide a significant reduction in rate of VVR. These include requirement for donor to drink water before entering the donation area; donor education for pre-donation preparation, especially avoiding sleep deprivation; waiting and relaxing for donor with high heart rate; and maybe a volume-adjusted blood donation according to donor weight and height. Moreover, a thorough vigilance system for high-risk donor, such as, providing high-risk identification tag; specialized care during donation with more on-donation-bed observations time and post-donation vital signs measurement. These may provide more safety and less severity by faster detection and prompt management.

The limitations of this study, firstly, this study involved only the donors at the National Blood Centre, Thai Red Cross Society, which had a lower percentage of males and young donors comparing to other blood donation sites. This might make some possible risk factors failed to show statistical significance due to a small number of particular donors. Secondly, only acute, on-site, VVR was included. Therefore, it might not be able to say that delayed-onset and off-site VVR had the same risk factors. Moreover, due to the low number

of VVR with higher severity, this study was not able to find such cases during the time of data collection. Lastly, psychological factors, such as donor idea on donation and fear, were not included because of donor recall-bias and difficulties in grading them.

Conclusion

First-time donation, previous history of VVR, sleep time less than 5 hours before donation, donation time > 600 seconds, donated volume > 12% of TBV, high-normal heart rate and hemoglobin were found as risk factors for VVR. This data helps to identify a group of donors who are at high risk for developing VVR from donation. Moreover, this information will enable us to formulate strategies for donor management, providing an uneventful, safer, and positive experience in blood donation.

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