Understanding, Managing, and Preventing

Blood Donor Reactions in Teenagers

DEVELOPED BY A WORKING GROUP OF THE ABC SCIENCE, MEDICAL, AND TECHNICAL COMMITTEE

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Background

Blood donation is a safe and common activity that meets a critically important community need. When adverse events occur, most are mild and consist primarily of hematomas and vasovagal reactions (VVRs). This white paper reviews VVR-related research and provides recommendations to Recruitment, Collection, Medical, and other colleagues for preventing and managing VVRs in teenage donors.

Two-to-five-percent of whole blood (WB) donations result in some manifestations of a VVR, most of which are mild/"pre-faint" in nature. Common symptoms and signs include lightheadedness, nausea, vomiting, and pallor. More severe syncopal reactions can, when associated with falls, result in significant injuries. VVRs are particularly frequent in teenage donors and are induced by the physiological consequences of hypovolemia, hypotension, and bradycardia.

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Both the American Red Cross (ARC) and Vitalant (formerly Blood Systems, Inc.) have published their experiences with VVRs in teenage donors. In ARC's experience, teenage donors seen in 2006 accounted for about 10% of collections but one-third of all observed VVR reactions. At that time, ARC's syncope rate for 16-17-year-old donors was twice as high as that for 18-to-24-year-olds and 14-times higher than seen among older adults; moreover, VVRs in the 16-17-year-old group led to approximately 50% of all injuries among their donors.[1] Syncope and injury rates at Vitalant for 2007 were 22 and 1.4 per 10,000 donations, respectively, with the combined syncope/injury rate being three times higher in the youngest donors compared to their older counterparts. Vitalant's subsequent implementation (in 2008-2009) of evidence-based mitigation strategies reduced the incidence of VVRs among teens by 15-30%, though VVRs in this group remained significantly more common than in older donors.[2]

VVRs can occur from the time the donor arrives at the donation site (i.e., before the donation process begins) until well after the donation is complete and the donor has departed. Such reactions have been associated with: (1) fear; (2) first-time donor status; (3) young age; (4) low estimated blood volume (EBV) and body weight; and (5) female gender.

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Review of Research

Research identifying psychological and physiological factors contributing to VVRs informs evidence-based mitigation strategies and is summarized as follows:

Fear

Fear of blood and needles has long been suspected to be a risk factor for VVRs. Only recently, however, has the relationship been studied systematically. France and colleagues at Ohio University have demonstrated that fear is one of the strongest predictors of presyncopal symptoms – even after controlling for age and the number of previous donations. His group also has found a pre-donation assessment of fear to be potentially useful in identifying donors likely to benefit from interventions to reduce VVRs.[3]

Blood volume

The maximum allowable blood volume removed from a whole blood (WB) donor is capped by AABB Standards at 10.5 mL/kg or no more than 15% of the EBV. For a blood donor whose EBV is approximately 3,500 mL, this equates to a maximum collection volume of 525 mL. Many blood centers collect in 500mL bags and, in an effort to prevent VVRs, some limit WB collections obtained from young donors to those donors having an EBV >3.5 L, which is calculated based on the donor's gender, height, and weight. ARC reported a 20% reduction in presyncopal and syncopal events compared to baseline (i.e., from 877.9 to 705.5 per 10,000; p = 0.001) following implementation of this strategy.[4] Vitalant has reported similar findings.[2,5]

Physiologic approaches for mitigating VVRs

The pathophysiology of the vasovagal response has been well characterized,[6,7,8] and techniques to moderate the changes that produce VVRs (specifically hypovolemia, hypotension and bradycardia) have been described by various groups.[2,9,10] Details follow.

■ Maintenance of blood volume

The source of donation-associated orthostatic central hypovolemia is two-fold, i.e., (1) the loss of up to 550 mL during whole blood donation, plus (2) pooling of blood in the lower extremities immediately after the phlebotomized donor assumes an upright position.[8] While it seems logical to prevent or replace the volume loss with fluid, studies to determine what fluid to use and when to administer it reveal that not all approaches are created equal.[9]

Early studies involving students who were provided with approximately 500 mL water either before or during donation demonstrated an immediate increase in blood pressure. However, the effect was minimal and transient in healthy, euvolemic donors, lasting only 10-30 minutes, after which the water migrates from the intravascular to extravascular space.[11] To sustain blood volume expansion, replacement fluids must remain intravascular. A whole blood donation of 550 ml results in a loss of approximately 320 mL of plasma water and 2.9 g NaCl (1.2 g elemental Na). Replacement of both fluid and sodium prolongs the time the fluid remains in the intravascular space, thereby supporting blood pressure. This

can be accomplished either through the intake of isotonic drinks containing electrolytes (i.e., salt and glucose) or via water plus oral salt replacement (e.g., salty snacks). In addition, the inclusion of glucose in replacement fluids may take advantage of the glucose-sodium transporter that speeds gastrointestinal absorption.[12,13] Morand and colleagues showed that, while both water and isotonic drinks reduced VVRs, only isotonic drinks were effective against delayed reactions and post donation fatigue.[9]

- **Muscle tensing maneuvers (MTMs) such as applied muscle tensing (AMT) and Dutch leg crossing**

  During AMT, the large muscles – particularly those in the thighs and buttocks – are squeezed intermittently (e.g., 5 second "on" and then 5 seconds "off"), which empties the large capacitance veins in the lower extremities and increases central blood volume, cardiac filling pressure, stroke volume and cardiac output. Dutch leg-crossing is a similar maneuver in which one foot is crossed over the other while squeezing the thighs and gluteal muscles. Morand demonstrated that MTMs decreased VVRs by 36%,9 a finding confirmed by others.[2,14]

Time course of VVRs and mitigation strategies

Bravo and co-workers identified donor factors associated with increased risk of VVRs at specific times relative to donation[5]:

- **Prior to venipuncture (Period 1),** the VVR reaction rate is low (0.004%) and caused mainly by emotional stimulation of brain areas responsible for hypotension and bradycardia. Donors at greatest risk are young, first-time donors who are fearful of needles or the process in general.
- **During phlebotomy (Period 2)**, about 40% of VVRs happen. The donor is recumbent and VVRs are more likely to occur when blood loss is maximal at the end of the collection, with a sharp peak at the time of needle removal. A small EBV is the primary risk factor.
- **At the time the donor stands up (Period 3a)**, the decrease in upper body blood volume due to pooling in the lower extremities may exacerbate the phlebotomy-associated reduction resulting in vasovagal symptoms or syncope within the first minutes after rising. In the period between standing and 6 minutes later, 30% of VVRs occur. Moreover, approximately 90% of all reactions will have occurred before departure from the donation site. Risk factors for Period 3a are youth, low EBV and inexperience.
- The remaining 10% of VVRs occur **after the donor leaves the collection site (Period 3b)**. Although small in relative incidence, these account for a disproportionate share of injuries since they more often are unobserved and, thus, affected donors are not immediately supported by trained staff. Risk factors in Period 3b are low EBV, female gender, youth and inexperience.[2,5]

The above findings suggest that, for any given period, not all mitigation strategies are expected to be equally effective. For example, the timing of MTMs is likely to be most important during the following times of greatest risk for VVRs[9,14]:

- Toward the end of the collection and while the needle is being removed (Period 2).
- As the donor assumes a standing position (i.e., when MTMs may counteract the orthostatic hypotension associated with pooling of blood in the lower extremities [Period 3a]).

- Anytime the donor feels symptoms of a VVR (an interval during which MTMs can have an almost immediate response by raising the blood pressure and potentially aborting a pending VVR; note: the impact of MTMs is augmented by instructing the donor to lie down immediately, a measure that also can immediately increase cardiac filling and prevent syncope [as well as reduce the risk for and/or severity of VVR-related injuries]).

While the MTM-related approaches described above are simple, compliance – especially among highest-risk young donors – is a challenge that diminishes their effectiveness.

Recommendations[10,15,16]

The focus herein is on two categories of intervention: (1) reducing the emotional stressors (especially fear) of donation, and (2) preventing/counteracting the responsible physiologic changes. These recommendations are based, wherever possible, on the peer-reviewed literature. Where that is lacking they are based on the experience of the authors of this white paper.

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Pre-donation education: Blood collectors have the opportunity to educate young donors (and, where applicable, their parents) about the donation process in advance of the actual donation. The goals are several-fold, i.e., to: (1) address and reduce common fears; (2) screen young donors for fear and, when necessary, counsel at-risk donors about additional methods to decrease reactions (or even to decide whether donation is right for them); and (3) impart information about appropriate hydration and electrolyte intake during the day preceding – up to the time immediately before – the blood donation.

Blood donation area set-up and environment: The development and application of best practices for set-up of the collection environment allow for optimizing: (1) pre-donation hydration/nutrition, (2) consistent donor flow, (3) easy staff access to donor beds, (4) private reaction recovery (that ideally prevents donor A from seeing donor B's incipient reaction and can be accomplished by the thoughtful positioning of donor beds), and (5) a comfortable and welcoming post-donation refreshment area.

Staff supervision and phlebotomy skills: Increasing the staffing at sites expected to support young donors (who more often require additional time and attention for preventing and managing reactions) may lead to enhanced donor care. When staff are trained to recognize fearful donors (who may appear anxious, be sweating and/or trembling, and/or openly express their fears), and to provide them support, they may anticipate early reactions, thereby allowing for prompter intervention and reduced severity.

Taking into account EBV: Methods used to estimate blood volume, coupled with implementation of WB collection devices that can be programed to limit WB donation volumes to <15% of EBV, may be considered as additional safety interventions.

Fluid and electrolyte/salt support: Isotonic drinks, or water plus salty snacks, serve as optimal forms of pre- and post-donation hydration/nutrition.

Muscle tensing: Training and requiring staff to teach and encourage MTMs for all donors has proven valuable to many collection programs. Inexperienced donors might be encouraged to perform these maneuvers: (1) during phlebotomy, (2) at the first sign of a reaction, and (3) when preparing to leave the donor bed. This instruction is particularly helpful when provided as part of the pre-donation education and again while a donor is in the donation chair prior to phlebotomy. Some programs use digital clocks or other user-friendly/interactive devices to prompt the donor to perform MTMs on a regular basis (e.g., 5 seconds "on" and 5 seconds "off"), thereby distracting the donor and making the overall process more enjoyable. Delaying the use of MTMs until the reaction has actually occurred is less effective than using it for preventing the reaction.

Post donation instructions: Providing donors with post-donation instructions – including how to recognize a reaction and what actions to take immediately (e.g., sitting/lying down and then initiating MTMs immediately upon feeling light-headed) – empowers them to make smart and effective decisions on their own behalf. The provision of recommendations about fluid and electrolyte needs during the hours to few days after donation also may minimize our donors' risk of delayed reactions.

Reporting of intervention effectiveness: We recommend that blood collectors review and report their experiences with new strategies for reducing reactions in young blood donors. Adding these results (whether favorable or not) to the scientific literature will further our understanding of what interventions are most practical and effective.

Summary

VVRs affecting teen donors constitute an important contributor to serious, donation-related injuries. They also lead to collection inefficiencies plus reduced donor satisfaction and return rates. While the blood community has made inroads in identifying the causes of VVRs and methods for their prevention and management, we must press for systematic, standardized, and constantly improving approaches. This white paper focuses on what we can do now and encourages us to learn and do even more in this important area.

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