TRAUMA ANESTHESIOLOGY SOCIETY

Is Whole Blood Poised for a Comeback in Civilian Trauma?

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KEY POINTS

- Evidence for successful use of Whole Blood (WB) continues to accumulate in military scenarios
- Early experience from several civilian centers is now appearing
- Preparation is essential in setting up WB as an available clinical product
- Contraindications for receiving WB are allo-antibodies, known non-O blood groups or patients with known malignancy or bone marrow transplantation requiring irradiated products
- Monitoring for post-WB transfusion safety is recommended

Current civilian trauma care, initial experience and recommendations, in many areas has arisen from military medical applications; including massive transfusion protocols (MTPs), balanced transfusion blood component ratios, and damage control resuscitation.[1,2] Whole blood (WB) was routinely used in earlier military conflicts prior to the development and separation of individual blood components,[3] and has seen a renaissance over the last decade during conflicts in the Middle East.[4,5] We review WB as a product, briefly summarize relevant military and recent civilian data and describe an approach to initiating WB at a civilian facility.

Although warm WB is well described in military conflicts, WB in civilian trauma will be cold (stored at 1-6 ºC), with CPDA anticoagulant and a shorter FDA-approved shelf-life (21 days) than individual red blood cells (up to 42 days).

Advantages of WB include:

- Preserved platelet and hemostatic function for up to 1-2 weeks[4,6]
- Less total volume (570 vs 660 ml) and anticoagulant than a combination of individual products
- Better mathematical and clinical effect than the sum of individual products[7]

Potential disadvantages of WB include:

- Decreased availability requiring close collaboration with local blood supplier
- Cost considerations and impact on overall availability of individual components
- Possible immunogenicity in emergency trauma situations. Since group O WB will contain anti-A and anti-B antibodies, testing is necessary to ensure the absence or low dose anti-A or anti-B antibodies (titers from 1:50 to 1:256 are suggested)[8]

Summary of Military Data

Over the last decade, convincing - albeit retrospective - data from combat trauma care has demonstrated the potential efficacy of WB on overall survival,[9] platelet preservation and coagulopathy,[10] and overall blood product use.[11] Limitations of retrospective studies are acknowledged and although groups are frequently well matched, in some cases, favorable outcome measures in the FWB groups have occurred in more severely injured cohorts. Other confounders are variations in transfusion algorithms and studies using a combination of WB and component therapy rather than a pure comparison of WB vs non-WB products. Despite these potential limitations, the strength of the available evidence has led to official recommendation from the Prolonged Field Care Working Group that fresh WB is the first choice in a casualty with hemorrhagic shock.[12]

Recent Civilian Data

Several large trauma centers have recently reported early experience with cold WB availability. The Houston group prospectively investigated modified WB compared to component therapy (1 mWB = 1 RBC + 1 FFP) in 107 patients who also received 1 U of platelets for every 6 mWB or 6 RBC+ FFP. A beneficial effect of mWB on all individual as well as total blood products transfused was only confirmed after sensitivity analysis excluding patients with severe brain injury.[13] In Pittsburgh, a feasibility study in 47 male trauma patients who were emergently transfused up to 2 units of uncrossmatched O+ WB was successful with no adverse safety signal, although, the study was not powered to investigate outcome effects of WB transfusion.[14] The same group also documented no abnormal markers of hemolysis (lactate dehydrogenase, total bilirubin, haptoglobin, creatinine, serum potassium) up to 48-hours post transfusion in 44 patients[8]

Until more robust prospective evidence arises, the collected military data and small civilian studies to date appear to support the feasibility, utility and potential benefit of WB as a possible strategy in massively bleeding trauma patients. Initial findings are reassuring for absence of a significant hemolytic effect from administration of uncrossmatched O+ WB.

Considerations for initiation of a WB program

Experience with the development of a WB program from the Mayo clinic has been published.[15] Based on these, current regulatory and pathology recommendations and inter-disciplinary coordination at our own center, we offer pragmatic recommendations for institutions with similar desires along with a dose of perseverance.

1. Blood supplier

A WB program cannot be achieved without close cooperation of the local blood supplier and medical directors. At our institution, the Gulf Coast Regional Blood Center is providing group O blood from male only donors with a 21-day expiration, no leukoreduction and low anti-A and B titers < 1:200. These titers are dependent on local donors (personal communication, Susan Rossmann). Careful management and stewardship of supplied products is necessary to avoid unnecessary WB expiration and waste.

2. Education

Thorough multi-disciplinary education with physicians (surgical, emergency medicine, anesthesiology, and pathology), nursing, emergency medical technician/technologist and administrator colleagues are necessary for preparation and management of WB. At our institution, use of WB was supported by the chief medical officer, the patient blood management committee and leaders in the afore-mentioned departments. WB is initially available on the Life Flight helicopters and trauma bays with a clearly distinctive label. Known contraindications are publicized, accepting that these may not yet be determined in an acutely injured patient. These include known allo-antibodies, known non-O blood groups or patients with known malignancy or bone marrow transplantation requiring irradiated products.

3. Regulatory hurdles

WB transfusion is under the purview of both the Food and Drug Administration and the American Association of Blood Banks (AABB). AABB approval is necessary for 'variance use' (Standards for blood Banks and Transfusion Services. 2015, AABB, Bethesda, MD, 30th edition) given the recommendation for ABO-group specific transfusion. Revisions to this AABB Standard is anticipated this year (31st edition, personal communication, Yu Bai).

Post WB Transfusion Safety Monitoring

In the ideal clinical situation, transfused WB should match the recipient's ABO group and known Rh D-negative individuals should receive D-ve WB. As opposed to universal donor group O red cells with absent A or B antigens, Group O WB will contain anti-A and anti-B in a similar amount to a unit of FFP and platelets. Testing for low titer of anti-A or anti-B antibodies as mentioned above is necessary to mitigate the small theoretical risk of hemolysis (1:80,000). Follow-up of WB transfused patients should incorporate standard clinical and laboratory markers for hemolysis. Luckily, small civilian studies to date have not identified significant hemolytic concerns.

Conclusion

Civilian use of WB as a resuscitation option for massively bleeding trauma victims is reappearing in clinical practice, based on initial retrospective success from military medical applications. Acute care anesthesiologists should be aware of the WB product, the potential role of WB in a trauma transfusion strategy and post-transfusion surveillance. Substantial effort and collaboration are required in the development and implementation of a WB transfusion program.

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