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The use of low-titer group O whole blood for the resuscitation of civilian trauma patients in 2018

There is increasing military and civilian evidence that the early intervention with blood products in patients with traumatic bleeding saves lives.[1,2] There are many advantages of using whole blood (WB) in trauma resuscitation. WB contains less physiologically inert fluid, that is, fluid that does not carry oxygen or contribute to hemostasis, compared to reconstituting WB using additive solution containing red blood cells (RBCs) and a unit of plasma and WB platelets (PLTs), it provides balanced resuscitation while simplifying the logistics of the resuscitation as one bag can be administered instead of three, and the cold-stored PLTs in WB may provide improved hemostasis compared to room-temperature PLTs.[3] In addition, according to the 31st edition of the AABB Standards for Blood Banks and Transfusion Services,[4] WB no longer needs to be ABO identical to the recipient. Instead, it must be provided in a manner such that the RBC component is ABO compatible with the recipient. If WB is to be administered in a situation where the patient's ABO group is unknown and therefore the plasma component of the unit might be incompatible with the recipient, the Standards mandate that the transfusing facility must have policies dictating the maximum number of units that can be used, the maximum titer of anti-A and -B that a WB unit can contain, and how to monitor the recipient for potential hemolytic adverse events after transfusion. In effect, if WB is to be used early in the resuscitation of a patient whose ABO group is unknown, low-titer group O WB (LTOWB) must be utilized.

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Due to the change in the AABB standards that permit the use of LTOWB in situations where the recipient's ABO group is unknown,[4] it is likely that the use of this product will begin to increase in the United States. Thus, the time was propitious for the THOR (Trauma, Hemostasis & Oxygenation Research network)/AABB working party to conduct a survey of the 15 American sites, and a hospital in Norway, that are either currently using LTOWB or are in the advanced planning stages of implementing an LTOWB program as a guide for other hospitals that are considering commencing such a program (Table 1).

Among the 16 respondents (Table 2), there were five hospitals that did not have a limit on the number of LTOWB units that could be administered to traumatically injured patients, although at two of these hospitals there was a requirement for the blood bank physician to communicate with the trauma team about the patient's ongoing blood needs. Four of these centers provided the number of LTOWB units in their hospital's inventory, and the mean (±SD) was 16 (±5) units. Note that in the 31st edition of the AABB Standards, Standard 5.27.1.1 does not specify a maximum number of LTOWB units that can be transfused per patient, but rather it requires each hospital to develop their own policy to that effect. At the remaining 11 sites that have a limit on the number of LTOWB units per patient, the mean (±SD) number of units that could be administered per patient was 5 (±1) units. Interestingly, five of 16 (31%) of the respondents indicated that LTOWB could be administered to both trauma and nontrauma patients who are massively bleeding, whereas the remaining 11 of 16 (69%) respondents indicated that LTOWB was only administered to trauma patients.

Roughly half of the sites (9/16, 56%) use leukoreduced LTOWB. The most common definitions of low-titer anti-A and -B was less than 200 followed by less than 256. The hospital in Norway uses two requirements to qualify a low-titer unit: IgM titer of less than 250 and IgG titer of less than 500 (listed as "other" for Question 6 in Table 1). Of the 11 respondents who indicated the method by which the anti-A and -B titers were performed on their LTOWB units, seven (64%) used the saline tube without anti-human globulin (AHG) technique; one of these seven centers performs a 5-minute room temperature incubation before centrifugation.

Most of the respondents stored the LTOWB as such for either 21 days (7/16, 44%) or 14 days (5/16, 31%); half (8/16, 50%) of the hospitals discard an unused LTOWB unit, while some (6/16, 38%) produce an RBC unit once the LTOWB unit reaches its maximum storage length as mandated in the local policy. One hospital keeps LTOWB units available in the prehospital setting for up to 14 days and if they are not used in that setting, they are added to the hospital blood bank's LTOWB inventory for trauma patients for up to 35 days. Another hospital uses LTOWB units for trauma patients for up to 21 days; after that time, they can

TABLE 1. Demographic information on the LTOWB programs at the 16 hospitals who responded to the THOR/AABB survey

1. How many units of LTOWB can a patient receive?	
Mean (±SD) at the 11 sites with a limit on the number of LTOWB units	5 (±1), range (4–8)
Number of sites without an upper limit of LTOWB units	3
Number of sites without an upper limit of LTOWB units, but the transfusion and trauma physicians must communicate about the patient's ongoing needs	2
2. What type(s) of patient(s) qualify(ies) to receive LTOWB?	
Trauma patients only	11 (69)
Trauma and all nontrauma massive bleeding recipients	5 (31)
3. What is the D type of the LTOWB supplied to males?	
D+ only	6 (38)
D– only	3 (19)
D+ and D– are available	7 (44)
4. What is the D type of the LTOWB supplied to females?	
D+ only regardless of her age	2 (13)
D– only regardless of her age	2 (13)
D– if she is of reproductive age (defined locally), D+ if she is older	5 (31)*
D+ LTOWB is only provided to females older than reproductive age (defined locally)	5 (31)
LTOWB is not provided to females of any age	2 (13)
5. Is the LTOWB leukoreduced?	
Yes	9 (56)
No	7 (44)
6. What is the maximum titer of antibodies in LTOWB?	
<50	2 (13)
<100	1 (6)
<200	9 (56)
<256	3 (19)
Other	1 (6)
7. By what method is the anti-A and -B titer determined?	
Saline tube without AHG	7 (64)
Saline tube with AHG	1 (9)
Automated instrument	2 (18)
Gel card with and without AHG	1 (9)
8. What is the maximum storage length (days) for LTOWB units for use in trauma patients?	
10	2 (13)
14	5 (31)
21	7 (44)
35	1 (6)
Other	1 (6)
9. If your center uses LTOWB in nontrauma patients, is the storage length the of the units the same as for trauma patients?	
Yes	4 (80)
No	1 (20)
If No to Question 9, please specify the maximum storage length of LTOWB units for use in nontrauma patients	35 days
10. What do you do with unused LTOWB units that exceed storage length for trauma patients?	
Discard it	8 (50)
Produce an RBC unit	6 (38)
Use it as LTOWB for nontrauma patients	2 (13)
11. Do you offer LTOWB for pediatric trauma or massive bleeding patients? (Do not include use in priming CPB pumps)	
Yes	2 (13)
No	14 (88)
12. Please indicate if you monitor the following hemolysis parameters *specifically* in your LTOWB recipients (indicate all that apply)	
Lactate dehydrogenase	6 (38)
Bilirubin (total, fractionated, unfractionated etc.)	8 (50)
Haptoglobin	6 (38)
Reticulocyte count	1 (6)
Urinalysis	1 (6)
Direct antiglobulin test	4 (25)
Creatinine or other kidney function tests	5 (31)
Other laboratory testing that is performed specifically on LTOWB recipients (please specify)	1 (6)
No laboratory monitoring for hemolysis is performed	6 (38)
13. From where do you obtain LTOWB units?	
Collected in-hospital only	2 (13)
Purchased from blood supplier only	14 (88)

(Continues)

TABLE 1. Continued

* For Question 4: one hospital stocks both D+ and D– LTOWB and would transfuse D+ LTOWB to an D+ female of reproductive age once her D group becomes known.

AHG = anti-human globulin.

TABLE 2. Names of the participants in this survey

Brooke Army Medical Center, San Antonio, TX
Cincinnati University, Cincinnati, OH
Cooper University, Camden, NJ
Emory University, Atlanta, GA
Haukeland University Hospital, Bergen, Norway
Intermountain Medical Center, Salt Lake City, UT
Johns Hopkins University, Baltimore, MD
Mayo Clinic, Rochester, MN
Penn Presbyterian Medical Center, Philadelphia, PA
University California at Los Angeles, Los Angeles, CA
University of Oregon, Portland, OR
University of Pittsburgh Medical Center, Pittsburgh, PA
University of Texas, Houston, TX
University of Texas, San Antonio, TX
University of Washington in St Louis, St Louis, MO
Wake Forest University, Winston-Salem, NC

be used for up to 35 days for other bleeding patients such as those in the operating room (listed as "other" for Question 8 in Table 1). One American hospital[5] and the Norwegian hospital offer LTOWB for use in traumatically injured children; the American hospital requires that potential pediatric recipients of LTOWB be at least 3 years old and at lease 15 kg, while the Norwegian hospital does not have any limits on qualifying pediatric recipients. Finally, most respondents (10/16, 63%) perform some degree of laboratory monitoring for hemolysis amongst the LTOWB recipients (see Question 12 in Table 1), including one hospital that measures the plasma hemoglobin concentration and

performs a peripheral blood film along with a complete blood count on their LTOWB recipients. Six (38%) hospitals do not perform specific hemolysis monitoring on their LTOWB recipients.

This survey demonstrated how LTOWB is being used among the early adopters in the United States and in Norway. The practice is variable in terms of how many units are available per patient, the definition of low-titer anti-A and -B, and the storage length of the LTOWB units, among other variables. Hospitals that are considering implementing an LTOWB program can use these data as a benchmark to guide the creating of their new policies.

CONFLICT OF INTEREST

The authors have disclosed no conflicts of interest.

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