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Back to the Future: Whole Blood Resuscitation

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Disclosures

- None

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Outline

1. Brief History of Whole Blood Transfusion
2. Re-emergence of Whole Blood
3. Establishing “Universal” Whole Blood
4. Implementation of Whole Blood Transfusion

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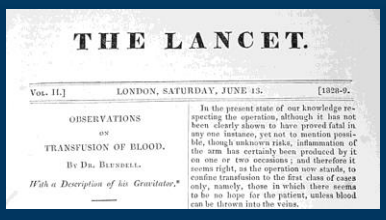
James Blundell



THE LANCET.

Vol. II.] LONDON, SATURDAY, JUNE 13. [1828-9.

OBSERVATIONS
ON
TRANSFUSION OF BLOOD.
By Dr. Blundell.
With a Description of his Gravitator.

In the present state of our knowledge respecting the operation, although it has not been clearly shown to have proved fatal in any one instance, yet not to mention possible, though unknown risks, inflammation of the arm has certainly been produced by it on one or two occasions; and therefore it seems right, as the operation now stands, to confine transfusion to the first class of cases only, namely, those in which there seems to be no hope for the patient, unless blood can be thrown into the veins.

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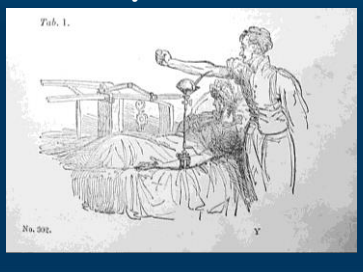
Gravity Transfusion



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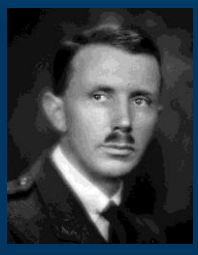
World War I



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World War I

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World War II

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World War II

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Modern Era

ASBP
Armed Services Blood Program

American Red Cross Blood Drive
Save a Life, Give Blood

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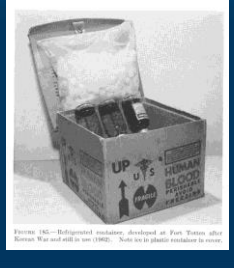
Modern Era



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Civilian & military blood programs became centered on component therapy

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1. Brief History of Whole Blood Transfusion
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OEF, OIF & Beyond

The Journal of TRAUMA® *Injury, Infection, and Critical Care*

Warm Fresh Whole Blood Is Independently Associated With Improved Survival for Patients With Combat-Related Traumatic Injuries

Philip C. Spinella, MD, Jeremy G. Perkins, MD, Kurt W. Grathwohl, MD, Alec C. Beekley, MD, and John B. Holcomb, MD

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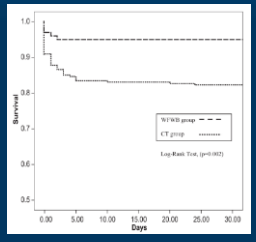
OEF, OIF & Beyond



Variable	WFWB (n = 100)	CT (n = 254)	*p* Value
Stored RBC (U)	9 (7–14)	16 (10–22)	<0.001
Plasma (U)	4 (3–8)	10 (6–16)	<0.001
Apheresis platelets (U)	0	2 (1–4)	<0.001
WFWB (U)	5 (3–9)	0 (0–0)	<0.001
Cryoprecipitate (U)	0 (0–0)	0 (0–1)	0.007
Total RBC (U)	16 (11–22)	16 (10–22)	0.44
Total blood volume (L)	7.4 (5.4–10.4)	9.3 (6.2–13.3)	0.006
Anticoagulant/ additives (L)	1.7 (1.3–2.5)	2.5 (1.6–3.6)	<0.001
Actual blood volume (L)	5.7 (4.1–8.)	6.8 (4.5–10)	0.03
PLT:RBC ratio	0.33 (0.2–0.5)	0.86 (0.6–1.3)	0.001
Plasma:RBC ratio	0.74 (0.55–0.9)	0.73 (0.53–1)	0.73
Massive transfusion (%)	89/100 (89%)	198/254 (78%)	0.017
rFVIIa use (%)	42/100 (42%)	101/253 (40%)	0.72

Data presented as Median (IQR) or as percentages.
rFVIIa, recombinant factor VIIa.

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ORIGINAL ARTICLE

Fresh whole blood use by forward surgical teams in Afghanistan is associated with improved survival compared to component therapy without platelets

Shawn C. Nessen, Brian J. Eastridge, Daniel Cronk, Robert M. Craig, Olle Berséus, Richard Ellison, Kyle Remick, Jason Seery, Avani Shah, and Philip C. Spinella

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TABLE 6. Propensity score used as continuous variable in logistic regression predicting effect of FWB on death

	Odds ratio	95% CI	p Value
FWB use	0.096	0.02,0.53	0.008
Injury Severity Score	1.07	1.03,1.11	<0.001
Glasgow Coma Score	0.72	0.65,0.79	<0.001
Propensity score	9.72	1.45,64.97	0.019

Arrival systolic blood pressure, arrival temperature, use of factor VIIa, total red blood cells, and total plasma administered were used to calculate propensity score.
CI = confidence interval; FWB = fresh whole blood.

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Fresh vs. Cold Stored Whole Blood

Improving access to whole blood requires stockpiling

Cold storage of donated whole blood at 4^{o} degrees C

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Whole Blood	Components
Single donor source	Multiple donor sources
"Walking blood bank" or Prepared in advance	Prepared in advance
Warm or refrigerated	Multiple storage requirements
Provides platelets	Short platelet lifespan

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On Paper: A Superior Resuscitation

	Whole Blood	Blood Component (1:1:1)
Hematocrit (%)	33-44	29
Platelet Count (k/mm^3)	150-350	88
Coagulation Factor (%)	80-90	65
Volume (ml)	450-600	650
Shelf Life	21-35 d	RBC 21-42 days Cryo/FFP 12 months Thawed plasma/PLT 5 days

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Civilian Adoption of Military Trauma Advances

Advances in civilian trauma care are derived from military conflict:

– Triage
– Tactical Combat Casualty Care (TCCC)
– Massive Transfusion Protocols
– Damage Control Surgery

Could whole blood serve a role in civilian trauma care?

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Civilian Resistance to Whole Blood

ABO Compatibility & Hemolysis

Typical emergency release/universal blood units:

	Type O Donor Whole Blood	Universal Blood Components
Red Cells	O Donor	O Donor
Plasma	O Donor	AB Donor*

O Donor Plasma Safety?

→ **Low Anti-A, Anti-B Antibody Titers**

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Civilian Resistance to Whole Blood

Leukoreduction

Many blood centers provide near-universal leukoreduction

Reduces immune-mediated side effects, disease transmission

How to leuko-reduce whole blood?

→ **Platelet-sparing leukoreduction filters**

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Civilian Resistance to Whole Blood

Shelf Life

	Expiration
Red Cells	40+ days
Plasma	12 months
Cryoprecipitate	12 months
Platelets	5 days
Whole Blood	**21 – 35 days**

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Whole Blood Re-Enters Civilian Medicine

PAPERS OF THE 133RD ASA ANNUAL MEETING

A Randomized Controlled Pilot Trial of Modified Whole Blood versus Component Therapy in Severely Injured Patients Requiring Large Volume Transfusions

Bryan A. Cotton, MD, MPH,† Jeanette Podbielski, BSN,† Elizabeth Camp, MSPH,† Timothy Welch, NREMT-P,† Deborah del Junco, PhD,† Yu Bai, MD, PhD,‡ Rhonda Hobbs, MT (ASCP),‡ Jamie Scroggins, MT (ASCP),§ Beth Hartwell, MD,§ Rosemary A. Kozar, MD, PhD,* Charles E. Wade, PhD,*† and John B. Holcomb, MD*† on behalf of The Early Whole Blood Investigators*

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Whole Blood Re-Enters Civilian Medicine

TABLE 5. Sensitivity Analysis Evaluating the Primary and Secondary Outcomes in Those Patients Without Severe TBI

	WB Group (n = 33)	COMP Group (n = 34)	*P*
Median 24-hr RBC transfusions, U	4 (2, 6)	6 (2, 13)	0.02
Median 24-hr plasma transfusions, U	4 (2, 7)	6 (2, 14)	0.02
Median 24-hr platelet transfusions, U	0 (0, 1)	1 (0, 2)	0.09
Median 24-hr total transfusions, U	11 (5, 17)	16 (4, 41)	0.02
24-hr mortality, %	6%	9%	0.62
30-d mortality, %	6%	9%	0.62

Continuous values are presented as median with 25th and 75th interquartile range.

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Validation of Civilian Whole Blood

2019 EAST PODIUM PAPER

Safety profile and impact of low-titer group O whole blood for emergency use in trauma

James Williams, BS, Nicholas Merutka, BS, David Meyer, MD, MS, Yu Bai, MD, PhD, Samuel Prater, MD, Rodolfo Cabrera, BSN, EMT-P, John B. Holcomb, MD, Charles E. Wade, PhD, Joseph D. Love, DO, *and* **Bryan A. Cotton, MD, MPH**, *Houston, Texas*

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Validation of Civilian Whole Blood

TABLE 6. Multivariate Logistic Regression Models Evaluating the Impact of LTO-WB on 30-Day Survival and Post-ED Blood Product Transfusions

30-d Survival

	Odds Ratio	95% CI	*p*-Value
LTO-WB	2.19	1.010–4.767	0.047
Age	0.97	0.958–0.998	0.032
Chest AIS score	0.98	0.790–1.229	0.898
Prehospital SBP	0.99	0.985–1.010	0.723
Arrival base value	1.13	1.049–1.221	0.001
Blunt mechanism	1.09	0.470–2.572	0.827
Post-ED blood transfusions			
	Odds ratio	**95% CI**	***p*-value**
LTO-WB	0.47	0.239–0.941	0.033
Age	0.99	0.974–1.008	0.302
ISS	1.06	1.029–1.096	<0.001
Prehospital SBP	0.99	0.986–1.008	0.623
Arrival base value	1.01	0.949–1.083	0.670
Blunt mechanism	1.72	0.823–3.608	0.148

95% CI, 95% confidence interval.

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A "Universal" Resuscitation…

Low Titer O Negative Whole Blood "LTO-WB"

Type O → → → Universal ABO compatibility

Rhesus Negative → → → No alloimmunization

Low Titer → → → Minimized anti-A/B antibodies

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LTO-WB…Not Sustainable

Type O Negative = Not sustainable
- Narrow donor pools
- Competition with other O Neg products

Type O Positive = Risk of alloimmunization
- Females of child-bearing age
- Pediatric patients

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The Switch to LTO+WB

	LTOWB Units	Anti A/B Titers	Expiration	Eligible Patients
UPMC	Pre-hospital 0 In-hospital 4	<1:50	21 d	Males > 18 years Females > 50 years
Mayo Clinic	Pre-hospital 0 In-hospital 2	<1:200	14 d	Males > 18 years Females > 55 years
UT San Antonio	Pre-hospital 2 In-hospital 4+	<1:256	35 d	Males > 10 years Females > 50 years
UT Houston	Pre-hospital 2 In-hospital 4+	<1:256	21 d	All Males Females > 50 years

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Validating LTO+WB vs. LTO-WB

2021 EAST PODIUM

Can RH+ whole blood be safely used as an alternative to RH– product? An analysis of efforts to improve the sustainability of a hospital's low titer group O whole blood program

C. Cameron McCoy, MD, Kelsey Montgomery, MD, Madeline E. Cotton, BS, David E. Meyer, MD, MS, Charles E. Wade, PhD, *and* Bryan A. Cotton, MD, MPH. *Houston, Texas*

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TABLE 7. Hemolysis Panels at 3-hour, 24-hours, and 48-hours Comparison Between Rh+ and Rh– LTO-WB Groups Based on Recipient Rh Status

	Rh+ LTO WB (n = 448)			Rh– LTO WB (n = 189)		
	Rh+ Recipient (n = 407)	Rh– Recipient (n = 41)	p	Rh+ Recipient (n = 170)	Rh– Recipient (n = 19)	p
3-h Creatinine, mg/dL	1.2 (0.9–1.6)	1.3 (1.0–1.7)	0.686	1.1 (0.9–1.5)	0.9 (0.8–1.3)	0.226
3-h Potassium, mmol/L	4.1 (3.7–4.5)	3.9 (3.6–4.6)	0.530	4.1 (3.8–4.5)	3.9 (3.8–4.3)	0.453
3-h T Bili, mg/dL	1.1 (0.7–1.8)	1.0 (0.8–1.1)	0.630	1.0 (0.7–1.4)	0.8 (0.6–1.3)	0.307
3-h LDH, u/L	443 (312–698)	389 (286–537)	0.203	481 (292–698)	403 (294–554)	0.646
3-h Haptoglobin, mg/dL	59 (32–81)	64 (37–90)	0.469	57 (34–102)	65 (23–100)	0.917
3-h P/F ratio	355 (236–471)	258 (186–358)	0.035	342 (227–480)	331 (209–396)	0.461
24-h Creatinine, mg/dL	1.0 (0.8–1.5)	1.0 (0.8–1.2)	0.818	0.9 (0.7–1.4)	0.8 (0.6–1.2)	0.362
24-h Potassium, mmol/L	4.1 (3.7–4.4)	4.1 (3.8–4.3)	0.806	4.1 (3.8–4.4)	4.2 (3.6–4.3)	0.608
24-h T Bili, mg/dL	1.0 (0.6–1.5)	0.9 (0.6–1.9)	0.864	0.6 (0.4–1.0)	0.7 (0.6–1.4)	0.263
24-h LDH, u/L	473 (345–626)	315 (264–502)	0.106	389 (275–493)	309 (261–448)	0.555
24-h Haptoglobin, mg/dL	63 (22–102)	74 (68–117)	0.236	71 (32–118)	113 (39–168)	0.353
24-h P/F ratio	335 (243–404)	344 (188–372)	0.570	356 (287–473)	284 (184–410)	0.181
48-h Creatinine, mg/dL	0.9 (0.7–1.3)	1.0 (0.8–1.4)	0.389	0.8 (0.7–1.2)	0.7 (0.6–1.1)	0.309
48-h Potassium, mmol/L	4.0 (3.7–4.3)	3.8 (3.6–4.0)	0.056	4.0 (3.6–4.3)	3.8 (3.8–3.9)	0.165
48-h T Bili, mg/dL	0.8 (0.6–1.4)	0.8 (0.6–1.5)	0.960	0.5 (0.4–0.8)	1.1 (0.4–2.1)	0.239
48-h LDH, u/L	439 (277–610)	552 (470–595)	0.431	356 (255–554)	218 (76–525)	0.218
48-h Haptoglobin, mg/dL	98 (42–141)	147 (132–163)	0.104	118 (77–169)	148 (78–206)	0.496
48-h P/F ratio	303 (183–388)	265 (190–475)	0.686	325 (247–375)	340 (248–403)	1.000

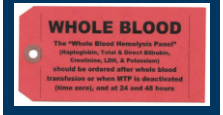

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TABLE 8. Complications, Outcomes, and Resource Utilization Comparison Between Rh+ and Rh− LTO-WB Groups Based on Recipient Rh Status

	Rh+ LTO WB (n = 448)			Rh− LTO WB (n = 189)		
	Rh+ Recipient (n = 407)	Rh− Recipient (n = 41)	*p*	Rh+ Recipient (n = 170)	Rh− Recipient (n = 19)	*p*
TRALI	0.3%	0.0%	0.725	0.0%	0.0%	1.000
TACO	0.0%	0.0%	1.000	2.6%	0.0%	0.823
Clinical transfusion reaction	0.7%	0.0%	0.591	0.0%	0.0%	1.000
Renal failure	9.1%	4.0%	0.267	7.1%	14.3%	0.267
Pneumonia	22%	15%	0.297	12.6%	21.4%	0.286
Sepsis	25%	15%	0.153	26.9%	21.4%	0.606
Venous thromboembolism	6.0%	3.8%	0.564	5.5%	0.0%	0.291
ALI/ARDS	3.5%	0.0%	0.223	3.2%	7.1%	0.376
Hospital-free days	9 (0–22)	12 (0–21)	0.616	12 (0–23)	11 (0–20)	0.985
ICU-free days	20 (0–28)	22 (0–27)	0.896	25 (4–28)	19 (0–24)	0.082
Ventilator-free days	26 (0–30)	28 (0–29)	0.764	29 (14–30)	27 (0–30)	0.398
Survive to D/C	74%	71%	0.595	78%	79%	0.935

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The Switch to LTO+WB… The New "Universal"?

- Performance in prehospital resuscitation
- Shelf life & coagulation performance
- Logistics compared to component MTP
- Safety across all trauma patients

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Advancing Access to Whole Blood

THE AMERICAN ASSOCIATION FOR THE SURGERY OF TRAUMA
ADVANCING TRAUMA AND ACUTE CARE SURGERY THROUGH COMPASSION, DISCOVERY, AND DEDICATION

PREHOSPITAL WHOLE BLOOD TRANSFUSION IS ASSOCIATED WITH INCREASED SURVIVAL AND LESS BLOOD TRANSFUSIONS

Cameron McCoy MD, Kelsey Montgomery BS, James Williams MD, David Meyer, Charles Wade, Bryan A. Cotton MD,MPH

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Prehospital Whole Blood

	Whole Blood	Component	p
Patients	220	146	
ISS	27	19	<0.05
Arrival SBP	92	102	0.028
Lactate	4.4	3.4	0.051

Pre-hospital Whole Blood

- Survival OR 2.18 (p<0.05)
- Reduction in transfusion 58% (p<0.05)

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Age of Whole Blood Matters

AAST 2020 PODIUM PAPER

The prehospital use of younger age whole blood is associated with an improved arrival coagulation profile

Thomas Clements, MD, Cameron McCoy, MD, Scott Assen, MD, Jessica Cardenas, PhD, Charles Wade, PhD, David Meyer, MD, *and* **Bryan A. Cotton, MD, MPH**, *Houston, Texas*

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TABLE 4. ED and Post-ED Blood Products Administered to Patients Receiving Young (≤14 Days of Cold-Storage Time) and Old (>14 Days of Cold-Storage Time) Units of WB

	YOUNG (n = 153)	OLD (n = 67)	p
ED RBC, units	1 (0–5)	1 (0–5)	0.287
ED plasma, units	1 (0–5)	2 (0–6)	0.220
ED platelet, units	0 (0–1)	0 (0–1)	0.936
ED WB, units	0 (0–0)	0 (0–0)	0.593
post-ED RBC, units	1 (0–4)	0 (0–5)	0.506
post-ED plasma, units	0 (0–2)	0 (0–2)	0.713
post-ED platelet, units	0 (0–1)	0 (0–2)	0.301

Data are presented as median number of units transfused with associated interquartile ranges in parenthesis.
RBC, red blood cell.

TABLE 3. Arrival Vital Signs and Laboratory Values of Patients Receiving Young (≤14 Days of Cold-Storage Time) and Old (>14 Days of Cold-Storage Time) Units of WB

	YOUNG (n = 153)	OLD (n = 67)	p
Heart rate, bpm	113 (92–133)	110 (90–122)	0.453
Systolic blood pressure, mm Hg	102 (82–130)	97 (75–124)	0.151
Diastolic blood pressure, mm Hg	64 (50–80)	59 (40–78)	0.053
Glasgow Coma Scale	3 (3–15)	3 (3–15)	0.267
Hemoglobin, g/dL	12.4 (10.6–13.7)	12.8 (10.4–14.2)	0.429
Platelet count, ×1,000	198 (137–255)	170 (131–229)	0.050
Lactate, mmol/L	4.7 (3.4–6.8)	3.8 (2.4–6.5)	0.034
Base excess	−7 (−10 to −3)	−4 (−8 to −1)	0.052
r-TEG ACT, s (<128 s)	113 (105–121)	113 (105–128)	0.880
r-TEG α time, min (<2.5 min)	1.7 (1.3–1.8)	1.8 (1.2–2.1)	0.024
r-TEG α angle, ° (>60°)	73 (70–76)	71 (66–75)	0.014
r-TEG MA, mm (>55 mm)	63 (58–68)	60 (55–65)	0.063
r-TEG LY30, % (<3%)	0.6 (0.0–2.7)	0.6 (0.0–1.8)	0.612

All data are presented as median with interquartile range in parenthesis. Normal r-TEG values for our institution are found in parenthesis alongside the associated variable. LY30, clot lysis at 30 minutes.

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Whole Blood Logistics

Popular rapid infuser used for hemorrhage resuscitation

NOT for the administration of platelets

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Whole Blood Logistics

	Baseline	Filter	Belmont70	Belmont100	Filter+Pressure
Platelet Cnt.	168	134	**97***	**94***	130
A-angle	72	74	71	71	74
MA	63	65	58	59	65
ETP	803	781	**1203***	**1228***	813
Peak	56.5	53.6	**96.1***	**119***	60.8
ttPeak	18.5	18.7	**13.4***	**11.7***	18.1

(*p<0.05)

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Is Whole Blood for All Trauma Patients?

THOR 2018

Prehospital low-titer cold-stored whole blood: Philosophy for ubiquitous utilization of O-positive product for emergency use in hemorrhage due to injury

Ashley C. McGinity, MD, Caroline S. Zhu, Leslie Gresham, MD, Elly Xenakis, MD, Elizabeth Waltman, MBA, Eric Epley, Danielle Cobb, MD, Rachelle Jonas, Susannah E. Nicholson, MD, Brian J. Eastridge, MD, Ronald M. Stewart, MD, and Donald H. Jenkins, MD. San Antonio, Texas

Many centers will not administer LTO+WB to female patients < 50 years

Hemolytic Disease of the Fetus & Newborn

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LTO+WB for Young, Rh- Patients?

- 80% of the general population is Rh+
  - Over 30 months, 124 MTPs were performed
    - 26 (21%) female patients
      - 18 of 26 (15% of study population) were of child-bearing age
        - 16 of 18 underwent type & screen
          - 1 of 16 women was Rh-
            - In the setting of severe trauma & induced immunosuppression, anti-D conversion is likely 3-30%
              - Therefore risk of alloimmunization is 0.012 to 0.12 patients/year

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Ultimately, is Whole Blood Better?

SOUTHERN SURGICAL ASSOCIATION ARTICLES

Impact of Incorporating Whole Blood into Hemorrhagic Shock Resuscitation: Analysis of 1,377 Consecutive Trauma Patients Receiving Emergency-Release Uncrossmatched Blood Products

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Reduction in 24-Hour Blood Use

Table 6. Multivariable Analyses Evaluating the Impact of Low-Titer Group O Whole Blood on 24-Hour Blood Product Use Among All Patients

	Unweighted analysis		Weighted analysis	
24-hour blood product use	**Rate ratio (95% CI)**	**p Value**	**Rate ratio (95% CI)**	**p Value**
Whole blood group	0.38 (0.21-0.70)	0.002	0.93 (0.91-0.96)	<0.001
Age, per year	1.00 (0.99-1.02)	0.602	0.996 (0.995-0.997)	<0.001
Male sex	1.80 (0.98-3.26)	0.055	1.22 (1.18-1.26)	<0.001
ISS, per point	1.07 (1.04-1.09)	<0.001	1.023 (1.022-1.024)	<0.001
Scene SBP, per mmHg	0.99 (0.99-1.01)	0.639	0.998 (0.998-0.991)	<0.001
Arrival lactate, per mmol/L	1.12 (1.02-1.25)	0.019	1.038 (1.036-1.039)	<0.001

CI, confidence interval; ISS, Injury Severity Score; SBP, systolic blood pressure; WB, whole blood arm.

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Improved 30-day Survival

Table 5. Multivariable Analyses Evaluating the Impact of Low-Titer Group O Whole Blood on 30-Day Survival Among All Patients

	Unweighted analysis		Weighted analysis	
30-day survival	**Odds ratio (95% CI)**	**p Value**	**Odds ratio (95% CI)**	**p Value**
WB group	4.10 (2.22-7.45)	<0.001	1.59 (1.28-1.98)	<0.001
Age, per year	0.97 (0.96-0.98)	0.001	0.99 (0.98-0.99)	<0.001
Male sex	0.46 (0.24-0.87)	0.018	0.77 (0.60-0.98)	0.04
ISS, per point	0.93 (0.92-0.95)	<0.001	0.95 (0.94-0.96)	<0.001
Scene SBP, per mmHg	1.00 (0.99-1.01)	0.286	1.009 (1.006-1.012)	<0.001
Arrival lactate, per mmol/L	0.82 (0.76-0.88)	<0.001	0.89 (0.87-0.92)	<0.001

CI, confidence interval; ISS, Injury Severity Score; SBP, systolic blood pressure; WB, whole blood arm.

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Outline

1. Brief History of Whole Blood Transfusion
2. Re-emergence of Whole Blood
3. Establishing "Universal" Whole Blood
4. Implementation of Whole Blood Transfusion

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Future Considerations

Can Whole Blood serve as the *civilian trauma resuscitation of choice*?

→ Is WB feasible for other healthcare systems?

→ What other modalities are competing with WB?

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Future Considerations

Whole Blood Feasibility

→ Cost compared to components?

→ Sustainability across US healthcare systems?
- Critical access, rural locations
- Prehospital access to whole blood

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Future Considerations

Will whole blood find applications outside trauma?

→ Non-traumatic hemorrhagic shock

→GI bleeding
→Obstetric hemorrhage
→ Elective surgical bleeding

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How are we doing it?

TYPE 1 TRAUMA PROTOCOL:

For patients that are activated as a Type 1 trauma, blood bank transports a cooler containing:

1. For male patients ≥ 18 years of age and female patients ≥ 50 years of age: 3 units group O whole blood (see below for monitoring protocol)
2. For all other patients, if age unknown, or if whole blood is unavailable: 3 units group O red blood cells and 3 units of group A or AB plasma.

This does not represent an activation of the MTP. To obtain additional blood products in an expedited fashion, the massive transfusion protocol must be activated (see below).

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How are we doing it?

WHOLE BLOOD SAFETY MONITORING PROTOCOL:

Whole blood (WB) is a blood product that adds approximately 500 mL of O-positive WB to a preservative anticoagulant. Whole blood is leukocyte reduced via a platelet sparing filter. WB is low titer (Anti A, Anti B < 1:100), CPD anticoagulated with a shelf life of 21 days and is stored at 1-6C. As an O-positive product with low titer levels of Anti A and Anti B, a low risk of hemolytic transfusion reaction exists when used in an un-cross-matched fashion.

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How are we doing it?

Serial hemolysis labs must be obtained on all patients who receive whole blood:

Whole Blood Hemolysis Monitoring Laboratory Panel:

- Labs:
  - Haptoglobin
  - Total & Direct Bilirubin
  - Lactate Dehydrogenase (LDH)
  - Creatinine
  - Potassium
- Panel will be ordered:
  - On arrival to the hospital unit (floor, ICU, other location) following initial trauma stabilization
  - 24 hours following admission
  - 48 hours following admission
- The trauma surgery or SICU service will be responsible for ordering the necessary labs, monitoring results of the hemolysis panel and reporting possible hemolytic transfusion reactions to transfusion services.
- Should a patient who received whole blood be ready for discharge prior to 48 hours, the third hemolysis monitoring panel may be cancelled if the prior two panels do not demonstrate evidence of hemolysis.

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How are we doing it?

→ Trauma 1 Protocol is an easy starting point…3 units

→ Establish provider comfort with use and institutional safety data in a well-known population (adult male trauma patients)

→ Once established, discuss expansion of inclusion criteria and other patient populations/service lines

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Conclusions

→ Whole blood is an old therapy with new interest

→ LTOWB has demonstrated improved blood utilization, earlier access to balanced transfusion and improved patient outcomes

→ Universality will require overcoming age/gender barriers and establishing feasibility across systems

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Questions?

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