Joseph Love, D.O. FACS

Trauma Medical Director
Surgery Program Director

University of Houston School of Medicine

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Contemporary Approach to Resuscitation

Patient Blood Management

University of Houston School of Medicine

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Nothing to Disclose

Patient Blood Management

- A series of ‘rights’
  - Right Patient
    - Right Product
      - Right Reason
        - Right Time
- Who defines ‘right’?
  - Clinical decision informed by evidence
    - Not all hypotension is due to anemia
      - Not all hypoxia is due to reduced red cell mass
        - Not all who are anemic require red cell transfusion

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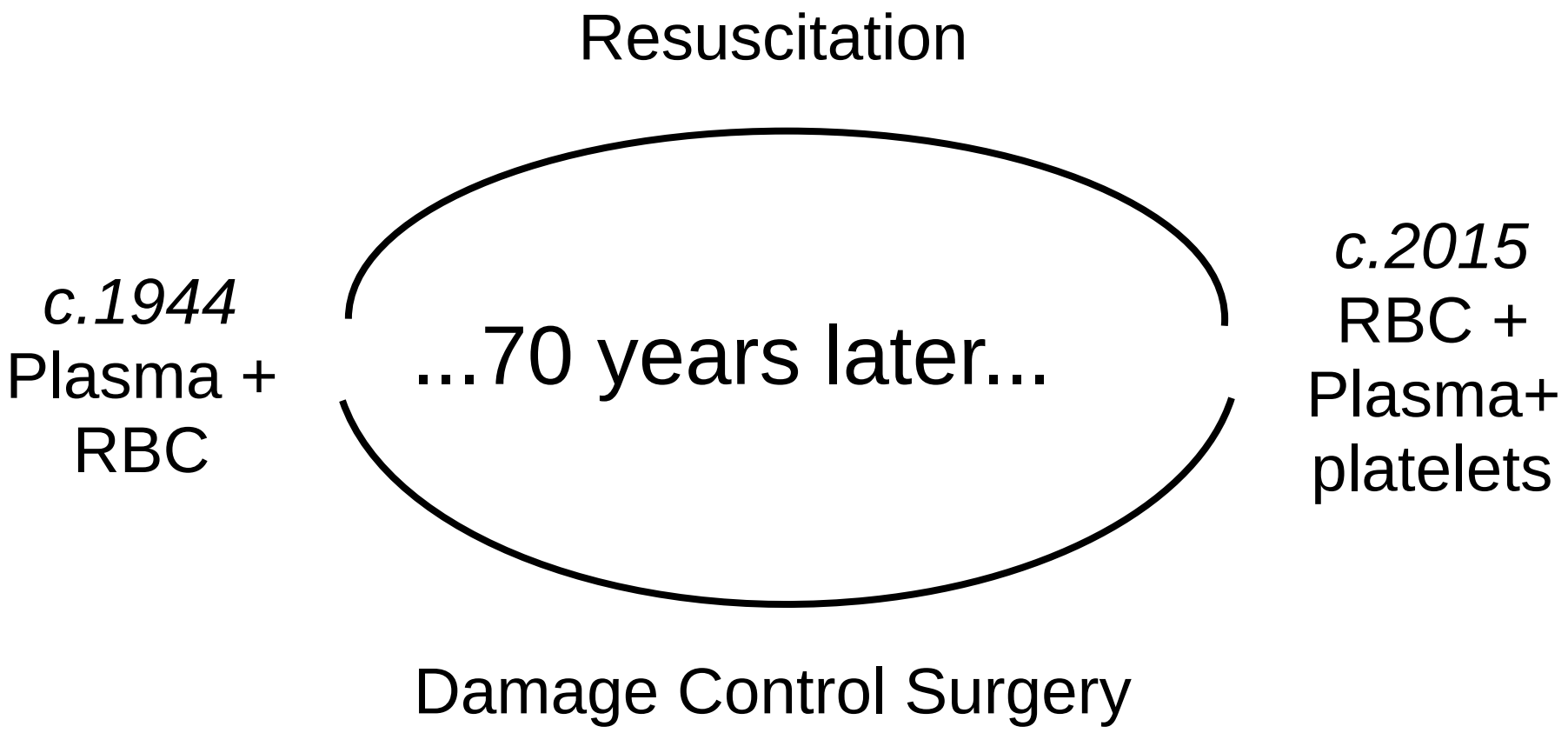
Data can be confusing...

Especially in Houston where there is a focus on trauma resuscitation.

How we got here today



The Nineteenth Century

- Saline infusion was observed to be safer than, and frequently as effective as, blood transfusion.
- Milk was advocated as a potentially effective infusion, because it was thought that the “white corpuscles of milk were capable of being transformed into red blood corpuscles.”
- A report by Routh describes 48 cases of transfusion with 30 survivors up to 1849.
- Two instances of successful transfusion, both administered during leg amputation, are documented from the Civil War.

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Transfusions

- WWI
- 1917 – first use of preserved blood for transfusion
  - Captain Oswald H. Robertson from the United States Army Medical Officer Reserves Corps for the British First Army
  - Battle of Cambrai in the First World War and was remarkably successful.
  - He transfused O-negative blood, which had been stored for 14 days and brought to the front line.

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Transfusions

- WWII
- Albumin and lyophilized (freeze-dried) plasma were being used in combination with whole blood to achieve a balanced resuscitation.

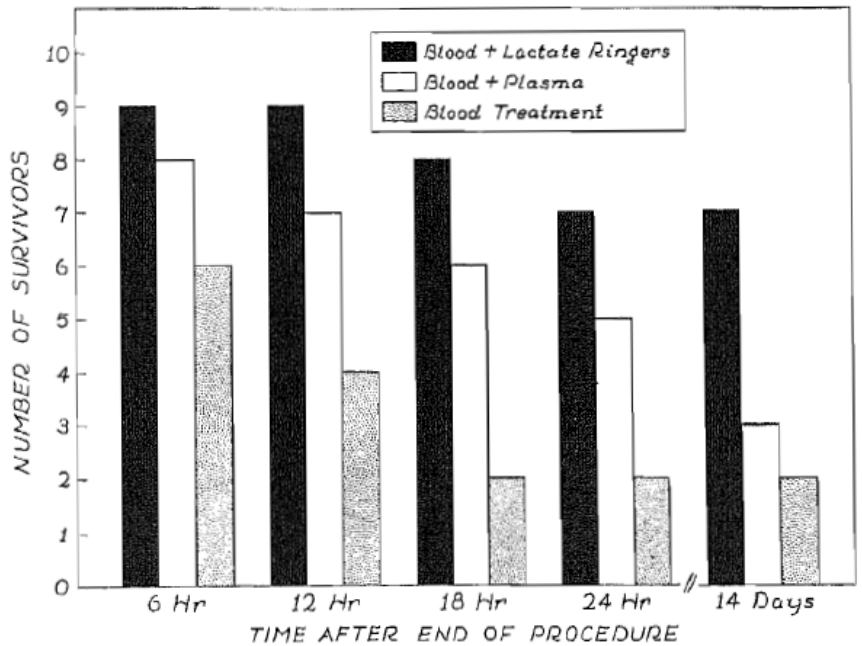
FIGURE 159.—Administration of plasma on beach, only few feet from surf, to survivor of landing craft sunk off coast in first days of invasion of Normandy, June 1944.

Fluid Therapy in Hemorrhagic Shock

TOM SHIRES, MD; DALE COLN, MD; JAMES CARRICO, MD; AND STANLEY LIGHTFOOT, MD, DALLAS

Arch Surg, 1964

Ig. Animals then received fluid replacement consisting of lactated Ringer's solution (5% of body weight) plus shed blood, plasma (10 cc/kg) plus shed blood, or shed blood alone. One hour after



Read before the 71st Annual Session of the Western Surgical Association, Galveston, Tex, Nov 21-23, 1963.

Historical Background

- A plea for “moderation” is made

  Moore FD Metabolic care of the surgical patient, 1959

  Shires T et al Ann Surg , 1961

  Moore FD, Shires G Ann Surg, 1967

- Supra-normal resuscitation
  Shoemaker WC et al Am J Surg, 1983

- Abbreviated laparotomy for lethal coagulopathy

  Stone HH et al Ann Surg, 1983

Historical Background

- Damage control- improved outcomes with exsanguinating, penetrating torso trauma

  Rotondo et al J Trauma. 1993

- ACS as a result of “massive interstitial” and “retroperitoneal swelling”

  Fietsam R et al Am Surg, 1989

  Eddy VA et al J Tenn Med Assoc, 1994

  Bendahan J et al J Trauma, 1995

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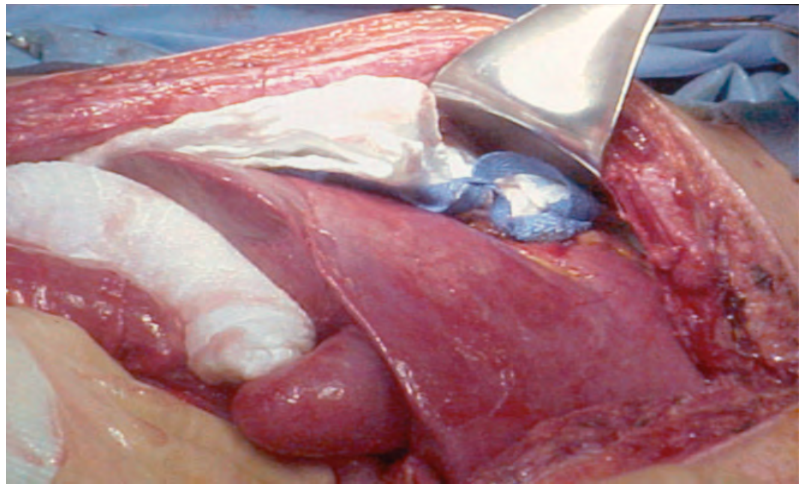
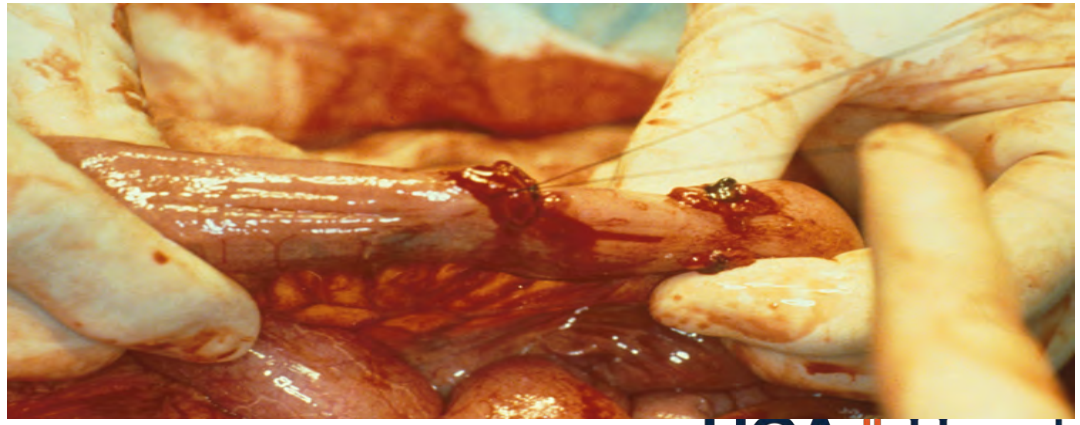
Damage Control

- 1990, Naval code 102 applied to unstable GSW
- STOP hemorrhage, CONTROL bowel spillage,CORRECT triad of death
- Live to come back another day…





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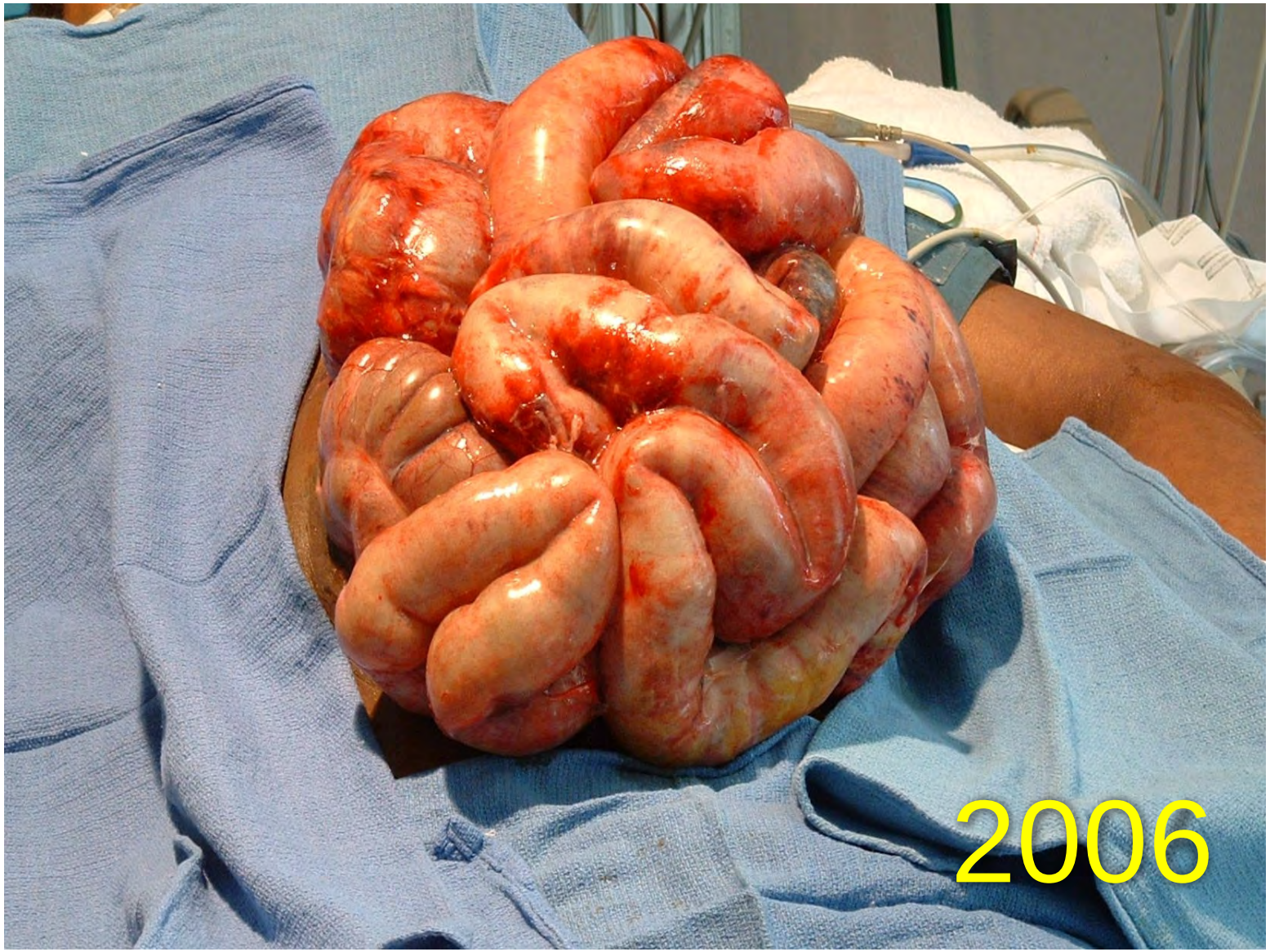
2006

DCR components

- Stop bleeding
- Hypotensive resuscitation
- Minimize crystalloid
- Balanced resuscitation (1:1:2 or 1:1:1)
- Use plasma to resuscitate patients
- Increased platelet use
- Reverse hypothermia and acidosis
- Hemostatic adjuncts

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Who Gets Resuscitated?

- ABC score
  - + FAST
  - SBP < 90
  - HR > 120
  - Penetrating truncal mechanism

Any 2, start your MT protocol

- If you reach for blood in the ED, call for the BB and initiate your MT protocol

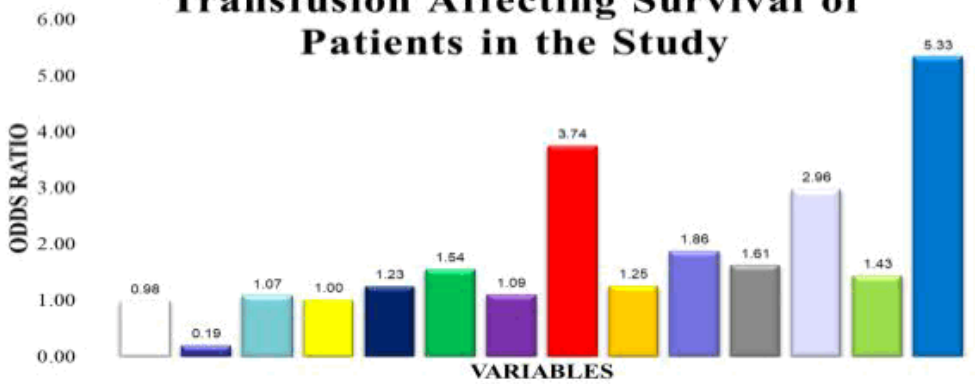
Demographic and Clinical Indicators that may Influence Survival After Blood Transfusion in Pediatric Patients at a Level 1 Trauma Center in Houston, Texas.

Alexjandro Daviano [1,2], Joeseph Love [3,4], Jeffery Tomasek [3,5], Ryan Gunter [3,4], Kyle Kalkwarf [3,4], Jennifer Horney [1,2]

Texas A&M Health Science Center[1], Texas A&M School of Public Health[2], University of Texas Health Science Center[3], Memorial Hermann Hospital Texas Medical Center[4], University of Texas Health Science Center's Center for Translational Injury Research[5]

- All pediatric trauma transports by Life Flight 2011-2016 (N=627)
- 216 (34%) received blood
  - Need for transfusion
    - Blunt injuries
    - Intubation
    - Positive fast
  - Survival associated with MAP 76-97

Figure 1. Demographic and Clinical Characteristics Associated with Blood Transfusion Affecting Survival of Patients in the Study



Many blood products, Concentrates, Proteins and Clear Fluids

- RBCs,
- FFP, Thawed Plasma, Liquid Plasma, Dried Plasma, (single donor, 1600 donors, freeze dried, spray dried)
- Platelets – various preservative solutions and types
- Cryoprecipitate and Fibrinogen concentrate
- TXA, etc
- Many single proteins
- All the clear fluids (colloids and crystalloids)

- Innumerable combinations and big differences in cost
- Compare outcome data?

Blood Product Resuscitation
Improved survival

- Balanced better than Unbalanced
  - Borgman MA, et al. The ratio of blood products transfused affects mortality in patients receiving massive transfusions at a combat support hospital. J Trauma. 2007
  - Pidcoke HF, et al. Ten-year analysis of transfusion in Operation Iraqi Freedom and Operation Enduring Freedom: increased plasma and platelet use correlates with improved survival. J Trauma. 2012.
  - Holcomb JB, et al. The PROMMTT study: comparative effectiveness of a time-varying treatment with competing risks. JAMA Surg. 2013.

- Early better than Late
  - Radwan ZA, et al. An emergency department thawed plasma protocol for severely injured patients. JAMA Surg. 2013
  - Cap AP, et al. Timing and location of blood product transfusion and outcomes in massively transfused combat casualties. J Trauma. 2012.

- Earlier and Balanced = Fewer blood products Given
  - Cotton BA, et al. Damage control resuscitation is associated with a reduction in resuscitation volumes and improvement in survival in 390 damage control laparotomy patients. Ann Surg. 2011
  - Kautza BC, Glue Grant. Changes in massive transfusion over time: an early shift in the right direction? J Trauma. 2012.

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Whole Blood
Whole Blood
O
O
AB


Thermo
ELECTRON CORPORATION
Whole blood =
Trauma 16+ years
Whole Blood
Need blood?
THINK MTP!
Ask Attending
ATTENTION :
When you pull blood for a Trauma patient please ask the Attending:
"Do you want to start the massive transfusion protocol?"

Special Commentary

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

Damage Control Resuscitation: Directly Addressing the Early Coagulopathy of Trauma

John B. Holcomb, MD, FACS, Don Jenkins, MD, FACS, Peter Rhee, MD, FACS, Jay Johannigman, MD, FS, FACS, Peter Mahoney, FRCA, RAMC, Sumeru Mehta, MD, E. Darrin Cox, MD, FACS, Michael J. Gehrke, MD, Greg J. Beilman, MD, FACS, Martin Schreiber, MD, FACS, Stephen F. Flaherty, MD, FACS, Kurt W. Grathwohl, MD, Phillip C. Spinella, MD, Jeremy G. Perkins, MD, Alec C. Beekley, MD, FACS, Neil R. McMullin, MD, Myung S. Park, MD, FACS, Ernest A. Gonzalez, MD, FACS, Charles E. Wade, PhD, Michael A. Dubick, PhD, C. William Schwab, MD, FACS, Fred A. Moore, MD, FACS, Howard R. Champion, FRCS, David B. Hoyt, MD, FACS, and John R. Hess, MD, MPH, FACP

J Trauma. 2007;62:307–310.

Permissive hypotension

Limiting crystalloids

Delivering higher ratios of plasma and platelets

Published in final edited form as:
J Am Coll Surg. 2017 August ; 225(2): 200–209. doi:10.1016/j.jamcollsurg.2017.04.010.

Decreasing the Use of Dan[illegible] Laparotomy in Trauma: A Quality Improvement Proje[illegible]

John A Harvin, MD, FACS[1,2], Lillian S[illegible]CS[1], Mike K Liang, MD, FACS[1], Sasha D Adams, MD, FACS[1,2], Michelle K McNutt, MD, FACS[1], Joseph D Love, DO, FACS[1], Laura J Moore, MD, FACS[1,2], Charles E Wade, PhD[1,2], Bryan A Cotton, MD, MPH, FACS[1,2], and John B Holcomb, MD, FACS[1,2]

[1]Department of Surgery, the University of Texas McGovern Medical School, Houston, Texas

[2]Center for Translational Injury Research, the University of Texas McGovern Medical School, Houston, Texas

- All trauma laparotomies 2013 to 2015
  - Historically 39% DCL
  - Decreased to 23%
  - Open abdomen assoc. with inc complications, mortality when matched.
  - Now DCL 17%

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Published in final edited form as:
Am J Surg. 2018 July ; 216(1): 56–59. doi:10.1016/j.amjsurg.2017.10.044.

THE EFFECT OF DAMAGE CONTROL LAPAROTOMY ON MAJOR ABDOMINAL COMPLICATIONS: A MATCHED ANALYSIS

Mitchell J George, MD, **Sasha D Adams, MD**, **Michelle K McNutt**, **Joseph D Love, DO**, **Rondel Albarado, MD**, **Laura J Moore, MD**, **Charles E Wade, PhD**, **Bryan A Cotton, MD MPH**, **John B Holcomb, MD**, and **John A Harvin, MD**
Department of Surgery and the Center for Translational Injury Research, The University of Texas Health Science Center, 6431 Fannin Street, MSB 4.264, Houston, TX 77030, USA

- DCL trauma patients
  - Delayed closure assoc with increased major abdominal complication
  - Suggested DCL might be over utilized.

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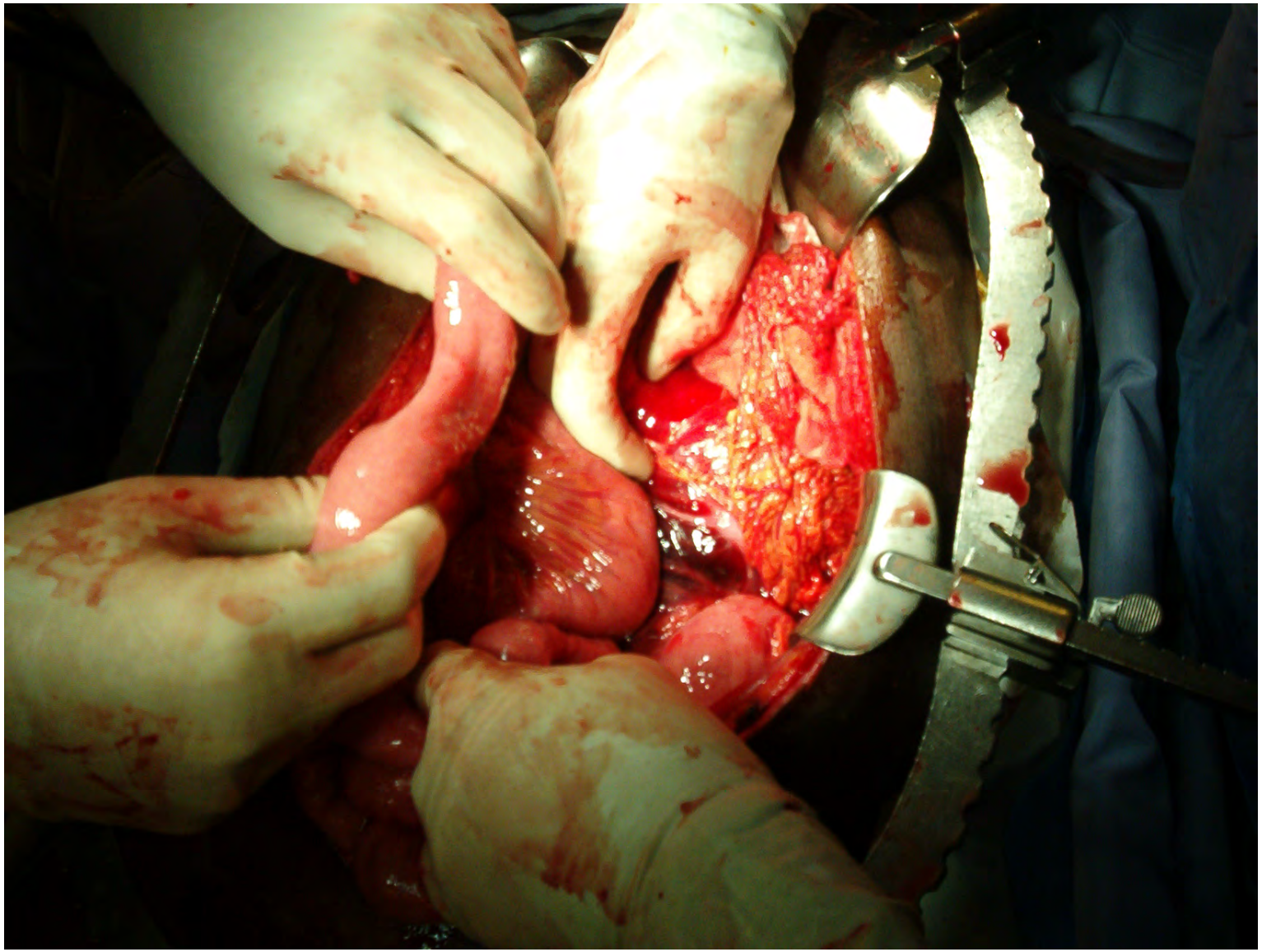


PROPPR Trial (JAMA, Jan 2015)

- no STATISTICALLY significant difference in mortality at 30-days between 1:1:1 and 1:1:2
- lower 3-hour mortality and lower mortality from hemorrhage (both $p<0.05$)

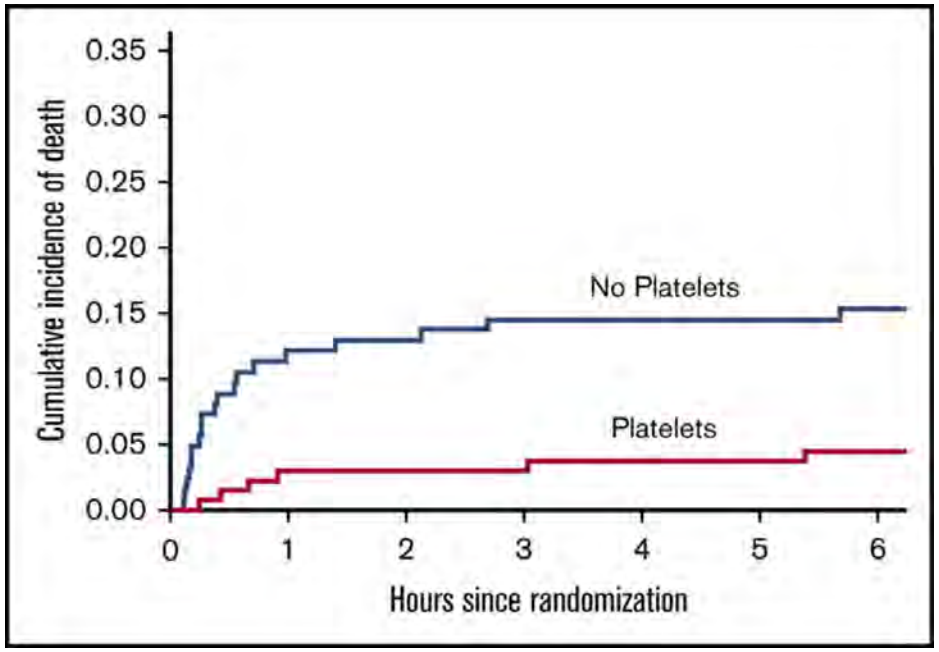
- In 1992, massive transfusion related mortality was 84%
- 20-30% as of the most recent data (Holcomb et al JAMA Surg 2012, Cotton et al Ann Surg 2011)
- Powered the reference mortality (1:1:2) would be around 30% - It was actually around 20%.
- Both 24-hour and 30-day mortality was < 1:1:2 powered for.

Platelet transfusions improve hemostasis and survival in a substudy of the prospective, randomized PROPPR trial

Jessica C. Cardenas,[1,2] Xu Zhang,[3] Erin E. Fox,[1-3] Bryan A. Cotton,[1-3] John R. Hess,[4] Martin A. Schreiber,[5] Charles E. Wade,[1-3] and John B. Holcomb,[1-3] on behalf of the PROPPR Study Group

[1]Division of Acute Care Surgery, Department of Surgery, McGovern School of Medicine, [2]Center for Translational Injury Research, and [3]Center for Translational and Clinical Studies, University of Texas Health Science Center, Houston, TX; [4]Department of Laboratory Medicine, Harborview Medical Center, University of Washington, Seattle, WA; and [5]Division of Trauma, Critical Care and Acute Care Surgery, Department of Surgery, Oregon Health and Science University, Portland, OR

- Early platelet administration is associated with improved hemostasis and reduced mortality in severely injured, bleeding trauma patients.



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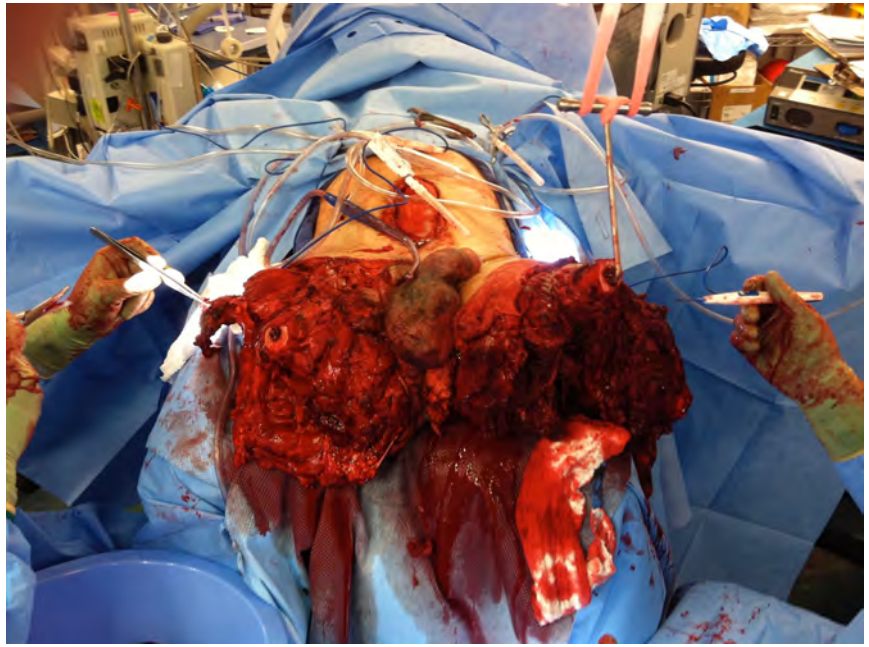
EVERY MINUTE COUNTS: TIME TO DELIVERY OF INITIAL MASSIVE TRANSFUSION COOLER AND ITS IMPACT ON MORTALITY

J of Trauma Acute Care Surg. 2017

- Another review of PROPPER data.
- Delays in MT protocol activation & initial cooler arrival increase in mortality.
- every minute from time of MT protocol activation to time of initial cooler arrival increases odds of mortality by 5%.

Blast injury Afghanistan



Civilian Trauma – lessons learned

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

- 2013 pilot
  - WB reduced use of RBC and plasma transfusion in patients without traumatic brain injury

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 Greebon, 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*

- Pre-hospital utilization
  - 30 mos. 124 MTP
    - 1 Rh - pregnant patient
    - Safe and increased avail of limited resource

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Whole blood on helicopter

Following the evidence
Where it leads…

Added to aircraft
November, 2017
100+ patients
(including peds)

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, Charles E. Wade, PhD,
Joseph D. Love, DO, FACS*, Bryan A. Cotton, MD, MPH
University of Texas Health Science Center at Houston

- No mortality difference
  - Lower of total transfusion
  - No hemolysis
  - Safe alternative to 1:1 transfusion.

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PreHospital Blood Products

Prehospital Transfusion of Plasma and Red Blood Cells in Trauma Patients

John B. Holcomb, MD, Daryn P. Donathan, BS, Bryan A. Cotton, MD, Deborah J. del Junco, PhD, Georgian Brown, RN, Toni von Wenckstern, RN, Jeanette M. Podbielski, RN, Elizabeth A. Camp, PhD, Rhonda Hobbs, Yu Bai, MD, PhD, Michelle Brito, BS, Elizabeth Hartwell, MD, James Red Duke, MD, Charles E. Wade, PhD

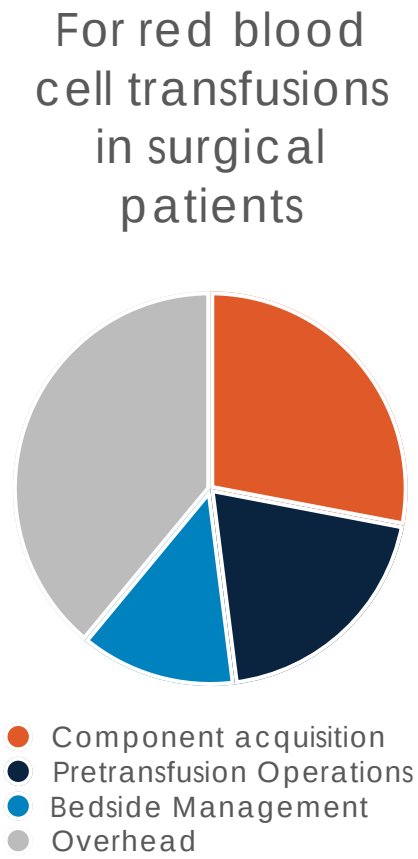
PreHosp Em Care 2014

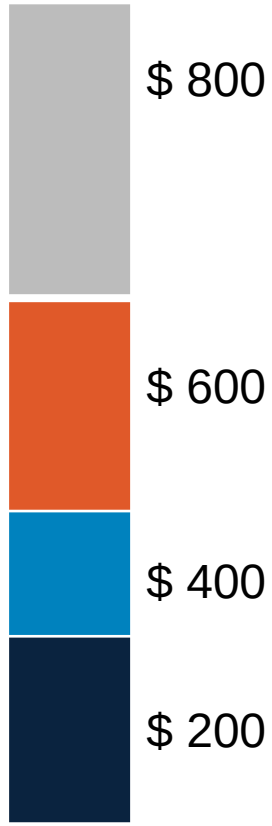
- Prehospital plasma and RBC transfusion was associated with improved early outcomes, negligible blood products wastage.
- Similar to the data published from the ongoing war, improved early outcomes are associated with placing blood products prehospital.
- Thousands of units flown, > 300 patients transfused
- 1.9% wastage

TMC

- Majority of transfusions in the TMC do not reach the level of massive transfusion are for 1-2 units.
- Current practicing guideline rely on clinical perimeters and low transfusion trigger of 6g/dl for non-bleeding patients.
- Bleeding patients present little dilemma
- Small to moderate amounts of blood loss and anemia make up the majority of patient receiving transfusion and may benefit from better management.

Cost of Transfusion





Cost at MHH TMC per unit not including additional overhead, operations and management - ~$275

Shander A et al. Transfusion 2010; 50: 753-65

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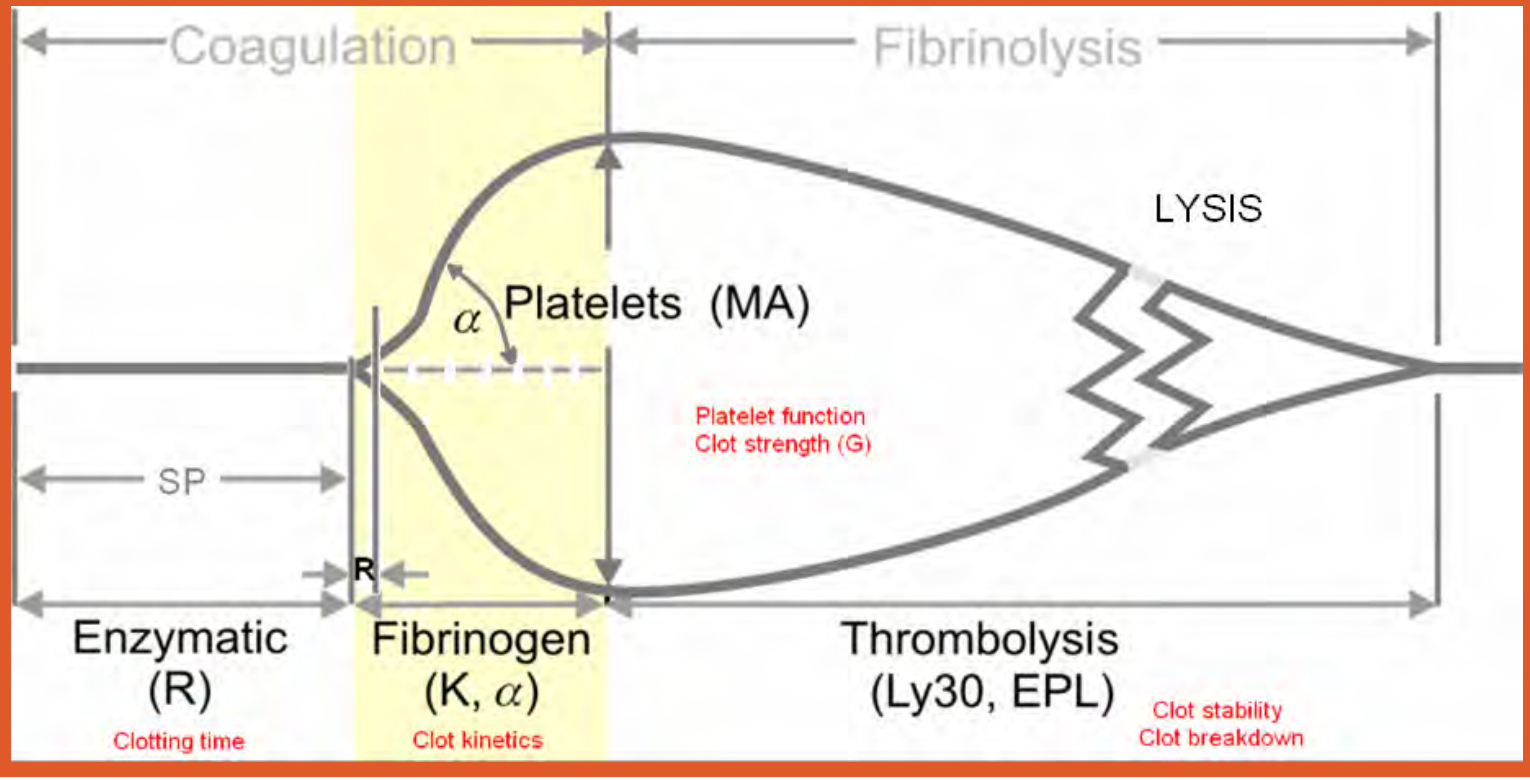
Rapid Thrombelastography Delivers Real-Time Results That Predict Transfusion Within 1 Hour of Admission

J Trauma, 2011

Bryan A. Cotton, MD, MPH, Gabriel Faz, MD, Quinton M. Hatch, MD, Zayde A. Radwan, BS, Jeanette Podbielski, BSN, Charles Wade, PhD, Rosemary A. Kozar, MD, PhD, and John B. Holcomb, MD



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How we use TEG

TABLE 7. Current Memorial Hermann Hospital Transfusion Recommendations Based on Abnormal r-TEG Values in Bleeding Patients

Laboratory Values	Blood Product Transfusion
ACT > 128	Plasma and RBCs
r-value > 1.1	Plasma and RBCs
k-time > 2.5	Cryoprecipitate / fibrinogen / plasma
α-angle < 56	Cryoprecipitate / fibrinogen / platelets
MA < 55	Platelets / cryoprecipitate / fibrinogen
LY30 > 3%	Tranexamic acid
PT > 18.0	Plasma
aPTT > 35	Plasma
INR >1.5	Plasma
Platelet count < 150×10^9/L	Platelets
Fibrinogen < 180 g/L	Cryoprecipitate / fibrinogen

TEG Burns

Plasma in burn resuscitation

- FFP reduced the amount of crystalloid infused by 4L.
- 10% decrease mortality between groups but not significant due to study being underpowered
- Less Respiratory failure in the FFP group.

Upcoming

- Pediatrics
- Titers
- Whole blood
- Freeze dried plasma

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Decision to transfuse

- Traditionally based on:
- Unstable: ABC score
- Stable:
  - Hemaglobin concentration
  - Platlet count
  - Prothrombin time

  - TEG – allows for component based therapy

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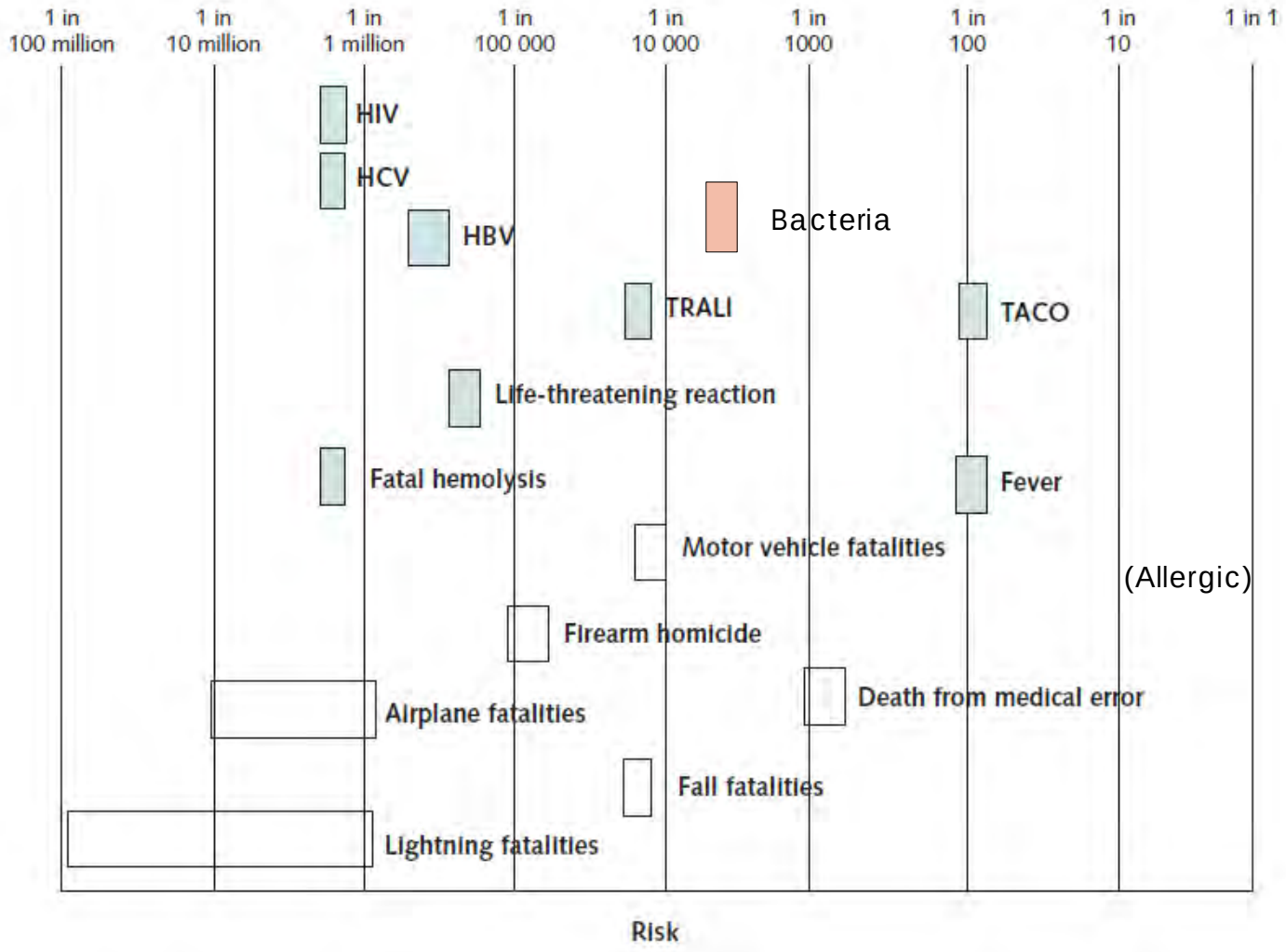
Transfusion Risks



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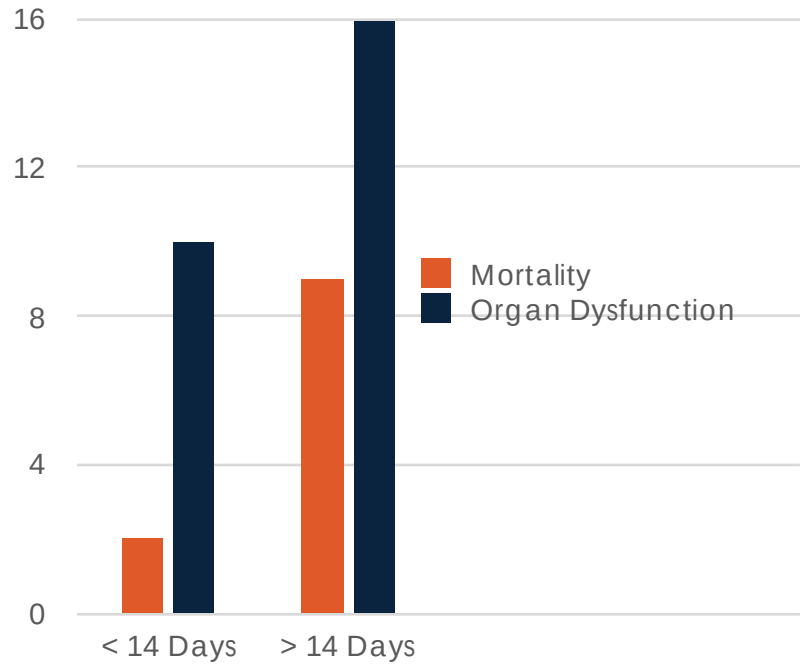
Retrospective Studies/Transfusion Risks

- Storage Period of Red Cells
  - Does it matter?



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Ann Emerg Med. 2018 Nov 14. pii: S0196-0644(18)31326-X. doi: 10.1016/j.annemergmed.2018.09.033. [Epub ahead of print]

Older Blood Is Associated With Increased Mortality and Adverse Events in Massively Transfused Trauma Patients: Secondary Analysis of the PROPPR Trial.

Jones AR[1], Patel RP[2], Marques MB[3], Donnelly JP[4], Griffin RL[4], Pittet JF[5], Kerby JD[6], Stephens SW[7], DeSantis SM[8], Hess JR[9], Wang HE[10]; PROPPR Study Group.

- From PROPPER data
  - RBCs > or = 22 days independently associated with increased mortality

Cryopreserved deglycerolized blood is safe and achieves superior tissue oxygenation compared with refrigerated red blood cells: A prospective randomized pilot study

J Trauma 2013

Loic Fabricant, MD, Laszlo Kiraly, MD, Connor Wiles, Jerome Differding, MPH, Samantha Underwood, MS, Thomas Deloughery, MD, *and* **Martin Schreiber, MD,** *Portland, Oregon*

- 57 patients were randomized
- No significant differences were noted in hematocrit, TEG, transfusion reactions, or clinical outcomes.
- StO2 was higher in the cryopreserved group

On going multi-center frozen vs stored RBC study

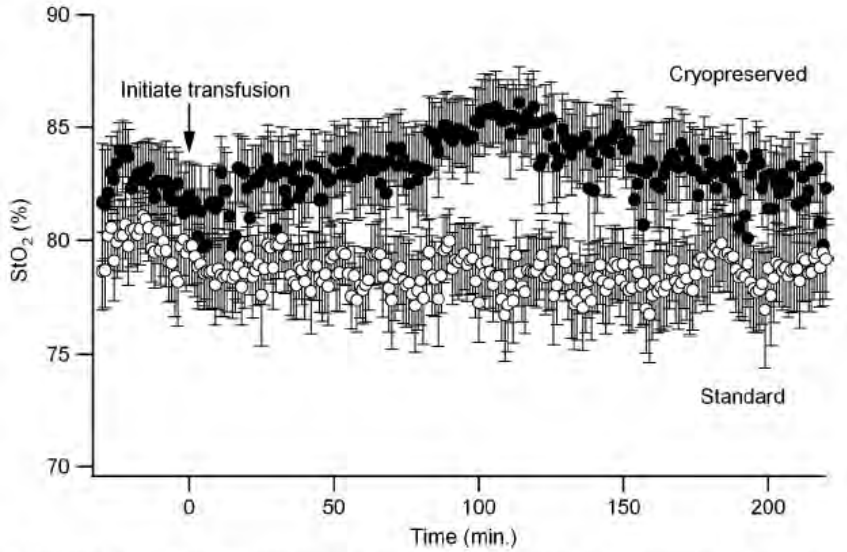

Figure 2. Tissue oxygenation. Mean tissue oxygenation over time. *Black circles* indicate cryopreserved blood. *White circles* indicate standard preserved blood. *Bars* represent SEM. $p = 0.03$, for combined data from 0 minute to 180 minutes.

AABB Expert Panel Practice Guideline
Recommended Red Cell Transfusion Indications

Restrictive Transfusion Strategy

Stable hospitalized patients

Adult and pediatric ICU patients: 7g/dl

Post-operative patients: 8g/dl – or – symptoms

(angina, orthostatic hypotension or tachycardia unresponsive to fluids, heart failure)

Stable hospitalized patients with preexisting cardiovascular disease

8g/dl – or – symptoms

(angina, orthostatic hypotension, tachycardia unresponsive to fluids, heart failure)

Stable hospitalized patients with acute coronary syndrome

No consensus recommendation due to the fact that large prospective data is not available. Further study is warranted. However the small RCTs that exist tend to favor the "liberal" threshold.

Role of symptoms vs Lab results?

"Decisions should be influenced by symptoms as well as Hb"

Standard practice should be to initiate transfusion with 1 unit of blood rather than two and monitor for improvement in symptoms.

Carson JL et al. JAMA doi:10.1001/jama.2016.9185

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AABB Expert Panel Practice Guideline

Recommended Plasma Transfusion Indications

1. Trauma with massive transfusion – transfusion indicated
2. Trauma or surgery without massive transfusion – no recommendation for or against transfusion
3. Warfarin-related intracranial hemorrhage – Suggest plasma transfusion (low quality evidence) - Kcentra recommended most recent chest guidelines.
4. Warfarin anticoagulation without intracranial hemorrhage – no recommendation for or against transfusion
5. Bleeding on Xa inhibitors - PCCs

Roback JD et al. Transfusion 2010; 50: 1227-39.

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Restrictive Transfusion Strategies

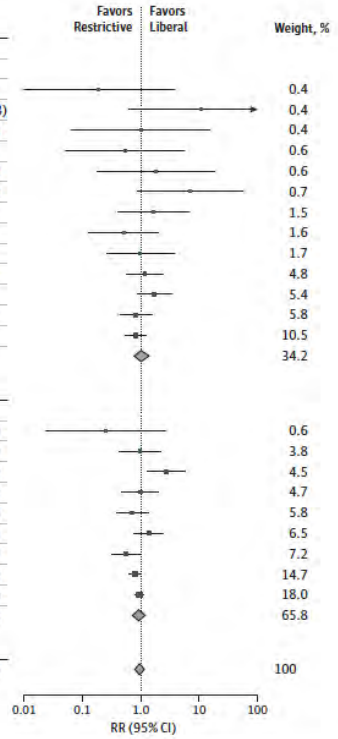
Study	Patient Population	Arms	Primary Outcome
TRICC NEJM 1999	838 Critical Care patients [RCT]	7 g/dL (n=418) vs 9 g/dL (n=420)	30 Day ACM: (18.7% vs 23.3%, p = 0.11)
TRACS JAMA 2010	502 Cardiac Surgery with Cardiopulmonary Bypass [RCT, NI study]	8 g/dL (n=249) vs 10 g/dL (n=253)	NI margin for 30 day ACM predefined at -8%: Observed between group difference 1% [95% CI, -6% to 4%], p = 0.85.
FOCUS NEJM 2011	2016 Patients with CAD/ Risk of CAD after Hip Fracture Surgery [RCT]	< 8 g/dL (n=1009) vs 10 g/dL (n=1007)	Death or inability to walk across room unassisted at 60 days: Abs Risk Difference 0.5 percentage points [95% CI, -3.7 to 4.7]
Acute UGI Bleed NEJM 2013	921 Patients with severe Upper GI bleeding [RCT]	< 7 g/dL (n=461) vs < 9 g/dL (n=460)	45 Day ACM: 91% restrictive vs 95% liberal; HR for death with Restrictive Strategy 0.55 [95% CI: 0.33 to 0.92], p = 0.02.

- *Emphasize clinical, not just laboratory indicators*
- *Whenever possible: single unit transfusion, then reassess*

Does a Restrictive Transfusion Strategy Decrease All-Cause Mortality?

Figure 1. Comparison of 30-Day Mortality Using Restrictive vs Liberal Hemoglobin Transfusion Thresholds in Randomized Clinical Trials

Source	Restrictive Transfusion Threshold: No. of Deaths	Restrictive Transfusion Threshold: Total No.	Liberal Transfusion Threshold: No. of Deaths	Liberal Transfusion Threshold: Total No.	RR (95% CI)	Weight, %
Restrictive threshold, hemoglobin <8 to 9 g/dL						
Lotke et al,[75] 1999	0	62	0	65	Not estimable	
Blair et al,[53] 1986	0	26	2	24	0.19 (0.01-3.67)	0.4
Foss et al,[63] 2009	5	60	0	60	11.00 (0.62-194.63)	0.4
Carson et al,[58] 1998	1	42	1	42	1.00 (0.06-15.47)	0.4
Webert et al,[86] 2008	1	29	2	31	0.53 (0.05-5.58)	0.6
Cooper et al,[61] 2011	2	23	1	21	1.83 (0.18-18.70)	0.6
Carson et al,[56] 2013	7	55	1	55	7.00 (0.89-55.01)	0.7
Parker,[78] 2013	5	100	3	100	1.67 (0.41-6.79)	1.5
Bracey et al,[54] 1999	3	215	6	222	0.52 (0.13-2.04)	1.6
Bush et al,[55] 1997	4	50	4	49	0.98 (0.26-3.70)	1.7
Hajjar et al,[68] 2010	15	249	13	253	1.17 (0.57-2.41)	4.8
Gregersen et al,[64] 2015	21	144	12	140	1.70 (0.87-3.32)	5.4
Jairath et al,[72] 2015	14	257	25	382	0.83 (0.44-1.57)	5.8
Carson et al,[60] 2011	43	1009	52	1007	0.83 (0.56-1.22)	10.5
Subtotal	121	2321	122	2451	1.05 (0.78-1.40)	34.2
Heterogeneity: $\tau^2=0.02$; $\chi^2_{12}=13.14$; $P=.36$; $I^2=9\%$						
Tests for overall effect: z score = 0.31; $P=.76$						
Restrictive threshold, hemoglobin <7 g/dL						
DeZern et al,[87] 2016	1	59	2	30	0.25 (0.02-2.69)	0.6
Hébert et al,[70] 1995	8	33	9	36	0.97 (0.42-2.22)	3.8
de Almeida et al,[79] 2015	23	101	8	97	2.76 (1.30-5.87)	4.5
Lacroix et al,[74] 2007	14	320	14	317	0.99 (0.48-2.04)	4.7
Walsh et al,[85] 2013	12	51	16	49	0.72 (0.38-1.36)	5.8
Murphy et al,[76] 2015	26	1000	19	1003	1.37 (0.76-2.46)	6.5
Villanueva et al,[84] 2013	19	416	34	417	0.56 (0.32-0.97)	7.2
Hébert et al,[69] 1999	78	418	98	420	0.80 (0.61-1.04)	14.7
Holst et al,[71] 2014	168	502	175	496	0.95 (0.80-1.13)	18.0
Subtotal	349	2900	375	2865	0.94 (0.74-1.19)	65.8
Heterogeneity: $\tau^2=0.05$; $\chi^2_8=16.09$; $P=.04$; $I^2=50\%$						
Tests for overall effect: z score = 0.53; $P=.59$						
Overall	470	5221	497	5316	0.97 (0.81-1.16)	100
Heterogeneity: $\tau^2=0.04$; $\chi^2_{21}=29.75$; $P=.10$; $I^2=29\%$						
Tests for overall effect: z score = 0.29; $P=.77$						
Tests for subgroup differences: $\chi^2_1=0.34$; $P=.56$; $I^2=0\%$						



The size of the data markers indicates the weight of the trial; RR, relative risk. Trials published after 2012 have been published since the prior AABB transfusion guidelines.

Carson et al. JAMA Guidelines from the AABB online Oct 2016

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R-TEG Graphical Display in the ED

- We no longer send PT / PTT / INR, fibrinogen and platelet counts

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PAPERS OF THE 132ND ASA ANNUAL MEETING

Admission Rapid Thrombelastography Can Replace Conventional Coagulation Tests in the Emergency Department

Experience With 1974 Consecutive Trauma Patients

John B. Holcomb, MD, Kristin M. Minei, BS, Michelle L. Scerbo, BS, Zayde A. Radwan, BS, Charles E. Wade, PhD, Rosemary A. Kozar, MD, PhD, Brijesh S. Gill, MD, Rondel Albarado, MD, Michelle K. McNutt, MD, Saleem Khan, MD, Phillip R. Adams, MD, James J. McCarthy, MD, and Bryan A. Cotton, MD, MPH

Ann Surg 2012

UT Health Science Center and
Memorial Hermann Hospital
Houston, TX

HCA Houston Healthcare℠

How we use TEG.

TABLE 7. Current Memorial Hermann Hospital Transfusion Recommendations Based on Abnormal r-TEG Values in Bleeding Patients

Laboratory Values	Blood Product Transfusion
ACT > 128	Plasma and RBCs
r-value > 1.1	Plasma and RBCs
k-time > 2.5	Cryoprecipitate / fibrinogen / plasma
α-angle < 56	Cryoprecipitate / fibrinogen / platelets
MA < 55	Platelets / cryoprecipitate / fibrinogen
LY30 > 3%	Tranexamic acid
PT > 18.0	Plasma
aPTT > 35	Plasma
INR >1.5	Plasma
Platelet count < 150×10^9/L	Platelets
Fibrinogen < 180 g/L	Cryoprecipitate / fibrinogen

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Concept

- Not rigidly ratio driven
- Not rigidly TEG (or ROTEM) driven
- Incorporates the elements of time and logistics and personnel specific to our site
- Plasma is our primary resuscitation fluid

- Patients not bleeding --- no transfusion

Summary

- Considering the speed, charges, and global functional information obtained, TEG is superior to CCTs.
  - acute care surgery group, emergency medicine, orthopedics, anesthesia, neurosurgery, pediatric surgery

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What we do today

- Identify patients who need resuscitation
  - Prehospital and hospital (early is key)
- Use blood products, limit crystalloid, no artificial colloids
- Transfuse in a balanced fashion, starting with the first units
  - Platelets and plasma early
  - First 6 units from the prehospital to hospital are WB
  - Looking at group A plasma
- Documented improved outcomes (less transfusion with WB)

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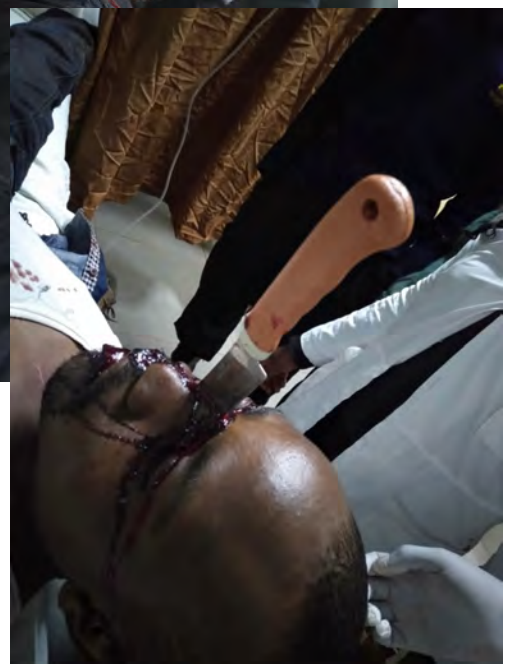

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