BLOOD BEYOND THE HOSPITAL

CONSULTANT IN PRE-HOSPITAL CARE – LONDON'S AIR AMBULANCE

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Traumatic haemorrhage

- Leading cause of preventable death
- Approximately half of all patient deaths in the first 24-h are due to haemorrhage.
- Survival from major traumatic haemorrhage is poor.
- Trauma patients who require substantial transfusion have a mortality greater than 30 %.



So.....





Damage control resuscitation

Damage control surgery

Permissive hypotension

Haemostatic resuscitation

Not just loss and replacement

 25% of all trauma patients have abnormal blood clotting.

- Primary abnormalities
 - Severe acute lysis
 - Low fibrinogen
 - Deranged prothrombin times

50% of shocked major pelvic fractures or torso vascular injury suffers a cardiac arrest before or at ED.



Pre-hospital transfusion challenges

• Logistics – delivery, storage, shelf-life

 Frequency of use (wastage) – population, purpose of service,

Carriage – portability, cold chain, resilience of kit

- Limited trained team members
- Limited IV access
- Time taken to transfuse multiple products
- Warming

• Benefit?!

Blood products in pre-hospital care

- Packed red blood cells
- Plasma
- Fibrinogen
- Red cells & plasma
- Whole blood
- Legislation
- Local need



Pre-hospital PRBC transfusion

- London's Air Ambulance (LAA) launched "blood on board" in March 2012
- 100 transfusions per year (5%)

- Indications:
 - Code red in extremis
 - Traumatic arrest where hypovolaemia is key factor

Specific aeromedical issues

- Weight restricted load on aircraft
- No constant power source available
- Airworthiness
- 12 hr shifts
- Cabin temperature
- Durability
- Portability
- Affordable for charities / NHS

Golden Hour box



- Robust kit
- 4 units (350ml)
- Data logger 2-6C
- Steady state up to 72 hrs

Warming devices

Comparison of the performance of battery operated fluid warmers. Lehavi et al. EMJ 2018 vol 35(9)







Blood Sciences – Blood Transfusion

Barts and The London

HEMS EMERGENCY BLOOD TRACKING FORM

CONTROLLED DOCUMENT

Box 1

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1. Details of Royal London	Hospital									
Royal London Hospital Ti	ransfusion La	boratory		Contact number: Tel (020) 324 60344 Fax (020) 324 60343						
2. Details of blood in HEM	S Golden Hour	Blood Box								
Packaged and checked by (name and position) Jennifer Heyes - Senior Biomedic	cal Scientist			Date packed 12/04/12	Time packed 17.15					
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3. Details of patient and H Hospital/ location to which Patient h	lospital to whic as been sent:	the patient w	as recovered:	Contact number:	207 486					
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TO BE COMPLETED AT R	OYAL LONDO	N HOSPITAL								
The Units listed have been (C	ircle as approp	riate): 🛛 a) Tra	nsfused (1)(2) 3 (4) b)	Returned to Stock 1	1234	c) Sent to discard 1	234			
Signature	Pri	nt name PE	rkins	Position HEMS	്ര	Date 13/4/12	Time Zihoo			

HEMS Team please return the completed form to the Royal London Hospital Transfusion Laboratory

Document Code	UAEM DE FORM 044	Version	01	Issue date	7 th March 2012			
	HAEWI-BI-FORWI-041	Author	Colin Barber	Page	1 of 1			
Approval	Approval is monitored electronically in Q-Pulse							



LAA PRBC outcomes

- Reduced pre-hospital mortality (p<0.01)
- Reduced overall product use (p<0.01)
- Avoids unnecessary waste & allogeneic tissue exposure
- No difference in overall mortality
- Peak in early hospital deaths
- LAA transfusion practice is safe and feasible

Pre-hospital transfusion of red blood cells in civilian trauma patients. Rehn et al. Transfus Med. 2017

ORIGINAL SCIENTIFIC ARTICLES

Pre-Trauma Center Red Blood Cell Transfusion Is Associated with Improved Early Outcomes in Air Medical Trauma Patients

Joshua B Brown, MD, Jason L Sperry, MD, MPH, FACS, Anisleidy Fombona, BS, Timothy R Billiar, MD, FACS, Andrew B Peitzman, MD, FACS, Francis X Guyette, MD, MPH

CONCLUSIONS: Pre-trauma center RBC was associated with an increased probability of 24-hour survival, decreased risk of shock, and lower 24-hour RBC requirement. Pre-trauma center RBC appears beneficial in severely injured air medical trauma patients and prospective study is warranted as PTC RBC transfusion becomes more readily available. (J Am Coll Surg 2015; 220:797-808. © 2015 by the American College of Surgeons)

Pre-hospital blood trials

- PRBC
- "Improved outcomes"
- 6hr survival
- 24hr survival
- Reduced blood product transfusion in 24hrs
- Improved BE / acid base balance on admission
- Feasible with low wastage

Plasma

- Contains plasma proteins, clotting factors, fibrinogen
- Volume resuscitation
- Haemostatic resuscitation
- Restores glycocalyx
- Available as:
 - Fresh Frozen Plasma (FFP) thawed for use (delay)
 - Lyophilised / freeze dried plasma reconstituted
 - Liquid plasma never frozen, platelets

Pre-hospital plasma

- US trials
 - COMBAT no stat sig difference in mortality
 - PAMPer reduced 30 day mortality compared to standard care (Sperry et al. NEJM 2018)
- Thawed fresh frozen plasma 5 day shelf life
 - feasible but high wastage due to short shelf-life
- Freeze dried plasma
- Liquid plasma >7 day shelf-life

International pre-hospital products

- Europe
 - Austria fibrinogen (FinTIC)
 - France, Germany, Denmark, UK – lyophilised / thawed plasma
 - Norway plasma, low titre O
 WB
- Military
 - US whole blood (Afghanistan)
 - UK MERT PRBC & thawed plasma
 - Israel low titre whole blood
 - Norway special forces warm whole blood

- Australia
 - PRBC
 - Not using TXA routinely
- New Zealand (Auckland)
 whole blood
- USA
 - PRBC
 - Thawed plasma trials
 - Low titre O whole blood

Original Investigation

Transfusion of Plasma, Platelets, and Red Blood Cells in a 1:1:1 vs a 1:1:2 Ratio and Mortality in Patients With Severe Trauma The PROPPR Randomized Clinical Trial

John B. Holcomb, MD; Barbara C. Tilley, PhD; Sarah Baraniuk, PhD; Erin E. Fox, PhD; Charles E. Wade, PhD; Jeanette M. Podbielski, RN; Deborah J. del Junco, PhD; Karen J. Brasel, MD, MPH; Eileen M. Bulger, MD; Rachael A. Callcut, MD, MSPH; Mitchell Jay Cohen, MD; Bryan A. Cotton, MD, MPH; Timothy C. Fabian, MD; Kenji Inaba, MD; Jeffrey D. Kerby, MD, PhD; Peter Muskat, MD; Terence O'Keeffe, MBChB, MSPH; Sandro Rizoli, MD, PhD; Bryce R. H. Robinson, MD; Thomas M. Scalea, MD; Martin A. Schreiber, MS; Deborah M. Stein, MD; Jordan A. Weinberg, MD; Jeannie L. Callum, MD; John R. Hess, MD, MPH; Nena Matijevic, PhD; Christopher N. Miller, MD; Jean-Francois Pittet, MD; David B. Hoyt, MD; Gail D. Pearson, MD, ScD; Brian Leroux, PhD; Gerald van Belle, PhD; for the PROPPR Study Group

JAMA. 2015;313(5):471-482. doi:10.1001/jama.2015.12



PROPPR (plasma, platelet, RBC) trial JAMA 2015

- Multi-centre RCT
- 1:1:1 vs 1:1:2
- Low numbers
- No stat sig difference in 24 hr or 30 day mortality
- Higher rate of haemostasis
- Reduced numbers of death due to exsanguination
- UK guidelines changed on this basis

NHS Blood & transplant (UK)

- Offered support to advance pre-hospital capability
- Current limitations
 - UK blood donations split for component therapy
 - Products must be leuco-reduced (vCJD)
 - Current filters remove platelets (not by design)

• Whole blood is not currently available in UK

Our wish list

- 1:1:1
- Plasma: PRBC: platelets
- Fibrinogen
- All in one bag
- Stored between 2-6C
- Through one IV line
- No mixing with water

Platelets

- We were told: "Stored at room temperature, constant agitation"
- We weren't told: that they have better function at 4C
- Shortened time in circulation but that's ok for severe bleeding
- Cold platelets might be useful in trauma
- Lost from whole blood when leuco-reduction filter used
- Could be useful if they were kept in "blood"



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- Stored between 2-6C
- Through one IV line
- No mixing with water
- Platelet sparing filter.....





REVIEW ARTICLE

Whole blood for hemostatic resuscitation of major bleeding

Philip C. Spinella,^{1,2} Heather F. Pidcoke,² Geir Strandenes,^{3,4} Tor Hervig,⁴ Andrew Fisher,⁵ Donald Jenkins,⁶ Mark Yazer,⁷ James Stubbs,⁸ Alan Murdock,⁹ Anne Sailliol,¹⁰ Paul M. Ness,¹¹ and Andrew P. Cap²

- Transfusion. 2016:56;S190-S202
- US Army data
- WB superior or equivalent to blood product txn
- 4C platelets have better function than warm (22C) platelets
- Leukoreduced, platelets spared.

Norway (PHC and special forces)

Military-civilian co-operation

- 2013 Freeze dried plasma
- 2014 PRBC
- 2015 Special forces
 - warm, WB donation to "buddy"
 - Pre-screened personnel ABO compatible
 - Fit to continue special ops work after donation
- 2018 Low titre O all forces
- Developed protocol for Emergency Donor Panel
 - Rapid blood group 40s
 - Blood borne virus screen 60s



PREHOSPITAL FEASIBILITY STUDY



















"RC & plasma" - why do this study?

- Interest in pre-hosp product delivery
- No safety / efficacy studies exist
- Need to establish feasibility of delivery to a Major Trauma Centre
- Shorter shelf life 14 days vs 35 days
- Potential to increase wastage O neg

RC&plasma progress

- 64 RC&plasma transfusions
- Most had pre-transfusion samples
- Logistical advantage fewer actions to deliver transfusion
- 475 ml per unit
- Efficient delivery schedule
- Wastage in Emergency Dept training increased
- Too early to comment on coagulation parameters