Pre-Hospital Critical Care

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Aims

• What happens now?

• Pre-Hospital trauma care – the scary truth

• What is the evidence?

• Human Factors - again!
What can they do?

• Paramedic
  – Not Ambulance care assistant
  – Not driver
  – Not Ambulance technician
What can they do?

• **C**
  – Pressure dressing

• **A**
  – O₂
  – C-spine collar, blocks and tape
  – Adjuncts
  – 1\textsuperscript{st} and 2\textsuperscript{nd} Gen SGDs
  – Intubate the cardiac arrest patient
  – Needle cric

• **B**
  – BVM
  – Needle thoracocentesis

• **C**
  – IV cannulae
  – IO access (on some vehicles PRU, SORT)
  – IV crystalloid
  – TXA - coming very soon
  – Pelvic binder
  – Splints

• **D**
  – Analgesia (Morphine, Entonox)
  – Spinal immobilisation

• **E**
  – Packaging (scoop stretcher, blankets)
What can they do?

- C
  - Pressure dressing
- A
  - O2
  - C-spine collar, blocks and tape
  - Adjuncts
  - 2nd Gen SGDs
  - Intubate the cardiac arrest patient
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- E
  - Packaging (scoop stretcher, blankets)
What can the team do?

- **C**
  - CAT, military style pressure dressings, haemostatic agents

- **A**
  - O$_2$
  - C-spine collar, blocks and tape
  - Adjuncts
  - 1$^{st}$ and 2$^{nd}$ Gen SGDs
  - Intubate the cardiac arrest patient
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primum non nocere
first - do no harm
Science in Trauma Care

• Practices with strong positive evidence:
  – Access to trauma centers
  – Specialized care (paediatrics, burns, spinal cord injury)
Science in Trauma Care

• Practices with positive evidence:
  – Permissive hypotension (balanced resus)
  – Splinting
  – Pain management
  – Head injury management
  – Hemoglobin-Based Oxygen Carrying Solutions (HBOCs)
Science in Trauma Care

• Practices with no evidence or equivocal evidence:
  – The “Golden Hour”
  – Medical helicopters
  – Trendelenburg position
  – Traction splints
  – Rapid sequence intubation (RSI) in traumatic brain injury (TBI)
Science in Trauma Care

• Practices with negative evidence:
  – MAST/PASG
  – Steroids for acute SCI
  – High-volume fluid therapy
  – Prehospital intubation (non-RSI) in traumatic brain injury
  – Paediatric endotracheal intubation
Science in Trauma Care

- Practices with strong negative evidence:
  - Scene stabilization
Changes in Trauma Practice

• IV Fluid Restriction
• Permissive Hypotension
• Haemoglobin-Based Oxygen Carrying Solutions (HBOCs)
• Less Aggressive Airway Management
• Helicopter Overutilization
IV Fluid Restriction & Balanced Resuscitation

• Raising the BP and restoring perfusion to vital organs are clearly believed to be beneficial after haemorrhage is controlled.

• Growing evidence indicates that raising it before achieving adequate haemostasis may be detrimental.
IV Fluid Restriction & Balanced Resuscitation

- Literature has primarily looked at penetrating trauma.
- The role of fluid resuscitation in patients with blunt trauma is less clear.
- Further studies are needed.
IV Fluid Restriction & Balanced Resuscitation

- Patients with hypotension due to severe haemorrhage from isolated extremity injuries may do better with aggressive prehospital IV fluid resuscitation after hemostasis.
IV Fluid Restriction & Balanced Resuscitation

• Conclusions:
  – More research is needed.
  – Data on penetrating trauma is compelling.
  – Fluid resuscitation probably indicated for moribund patients.
  – Best management strategies for blunt trauma and head injuries is to administer just enough fluid to maintain perfusion.
  – Rapid transport probably remains the best treatment for most trauma cases.
IV Fluid Restriction & Balanced Resuscitation

• Limitations:
  – Most studies on urban trauma patients with short transport times.
  – Findings may not be applicable to rural trauma patients.
Oxygen-Carrying IV Fluids

- Perflurocarbon emulsions
- Hemoglobin-based oxygen carrying solutions (HBOCs):
  - PolyHeme®
  - Hemopure®
HBOCs

- Hemopure®
  - Derived from bovine blood
  - Approved for use in South Africa & Russia
  - Intensive study still underway in the US.
HBOCs

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>BIOPURE’S OXYGEN THERAPEUTICS</th>
<th>RED BLOOD CELLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STORAGE</td>
<td>Room temperature (2° to 30° C)</td>
<td>Refrigerated</td>
</tr>
<tr>
<td>SHELF LIFE</td>
<td>36 months</td>
<td>42 days</td>
</tr>
<tr>
<td>PREPARATION</td>
<td>Ready to use</td>
<td>Testing, typing and crossmatching</td>
</tr>
<tr>
<td>COMPATIBILITY</td>
<td>Universal</td>
<td>Type specific</td>
</tr>
<tr>
<td>EFFECTIVENESS</td>
<td>Immediate oxygen delivery</td>
<td>Dependant on length of storage</td>
</tr>
<tr>
<td>PURITY</td>
<td>Processed to remove infectious agents</td>
<td>Tested and screened for infectious agents</td>
</tr>
<tr>
<td>RAW MATERIAL</td>
<td>Bovine hemoglobin - abundant, controlled source</td>
<td>Limited availability, not controlled</td>
</tr>
</tbody>
</table>
HBOCs

• PolyHeme®
  – Solution of chemically-modified hemoglobin derived from discarded donated human blood.
  – Hemoglobin extracted and filtered to remove impurities.
HBOCs

• PolyHeme®
  – Chemically-modified to create a polymerized form of hemoglobin designed to avoid problems previously experienced with hemoglobin-based blood substitutes:
    • Vasoconstriction
    • Renal dysfunction
    • Liver dysfunction
    • GI distress
  – Polymerized hemoglobin incorporated into a solution that contains 50 grams of hemoglobin per unit (the same as transfused blood).
HBOCs

• PolyHeme®
  – Product must be refrigerated.
  – Shelf-life is 1 year.
  – Clinical prospective randomized controlled trial of prehospital usage started Sep 2003 in several US cities (1-year, 700-800 patients).
  – Paramedics cannot be blinded for study as PolyHeme looks like blood.
  – Patients who receive PolyHeme will receive up to 6 more units if needed during the first 12 hours.
HBOCs

• California
  – UCSD (San Diego)
  – Scripps Mercy (San Diego)
• Colorado
  – Denver H&H (Denver)
• Delaware
  – Christiana (Newark)
• Illinois
  – Loyola (Chicago)
• Indiana
  – Wishard (Indianapolis)
  – Methodist Hospital (Indianapolis)
• Kentucky
  – U of K (Lexington)
• Minnesota
  – Mayo (Rochester)
• Ohio
  – Metro Health (Cleveland)
• Pennsylvania
  – Lehigh Valley (Allentown)
• Tennessee
  – UT (Memphis)
• Texas
  – Memorial-Hermann (Houston)
  – UTHSCSA (San Antonio)
• Virginia
  – Sentara (Norfolk)
  – VCU (Richmond)
HBBOCs

- Artificial polymerized hemoglobin can transport oxygen within the plasma.
HBOCs

- HBOCs look quite promising for prehospital and battlefield emergency care.
- Further recommendations await result of first prehospital study.
Helicopters

- Are EMS helicopters effective in decreasing mortality and enhancing trauma care?
Helicopters

- Initial studies in the 1980s showed that trauma patients have better outcomes when transported by helicopter.
- Today, other than speed, helicopters offer little additional care than provided by ground ambulances.
- Unless the area is geographically remote
Helicopters

- The number of medical helicopters in the United States has increased from 400 to >700 in the last 4 years.
- The UK has seen a proliferation of doctors on helicopters recently.
Helicopters (US Accidents)
Helicopters

Occupational Deaths per 100,000/year (U.S. 1995-2001)

Source: Johns Hopkins University School of Public Health
Helicopters

• An EMS helicopter (HEMS) pilot or crew member flying 20 hours/week for 20 years would have a 40% chance of a fatal crash.

• Since 2002, more people have been killed in air ambulance crashes than aboard U.S. commercial airlines, though the helicopters travel just a fraction of the distance.
Conclusions

- Helicopter transport of trauma patients may be over utilized.
- Utilization criteria must be studied and revised.
- Relatively few trauma patients benefit from helicopter transport.
- Data is probably not applicable to rural areas.
Airway Management and Thoracotomy

• And then, there is airway management and resuscitative thoracotomy. Do you have the rest of the afternoon?

• And REBOA too.....
A MAN trapped in a flooded drain died today after a dramatic battle to save his life while Britain was battered by torrential rain.
Goal

Get the *right patient* . . .

. . . to the *right place*

. . . in the *right amount of time*. 
“Human factors”

• Aviation / CRM
• Drills / checklists
• Safety culture
human error factors

human accidents

Error factors

human accidents
Technology

- **www.emrs.scot.nhs.uk**
- App
- Locality guides
- Critical care numbers
## EMRS Pre-Hospital Blood Transfusion Checklist

**ONLY BREAK SEAL ON BLOOD BOX IMMEDIATELY PRIOR TO ADMINISTRATION OF BLOOD**

<table>
<thead>
<tr>
<th>v</th>
<th>PRE-TRANSFUSION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unseal and open box - remove unit to be transfused</td>
</tr>
<tr>
<td></td>
<td>Close box immediately once unit to be transfused has been removed and ensure vacuum seal clicked tight</td>
</tr>
<tr>
<td></td>
<td>Ensure that data logger remains in the box</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>v</th>
<th>CRC CHECKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Check unique donation number on blood and label match</td>
</tr>
<tr>
<td></td>
<td>Confirm blood type as O negative</td>
</tr>
<tr>
<td></td>
<td>Confirmed blood not expired</td>
</tr>
<tr>
<td></td>
<td>Check blood looks normal and contains no large clots</td>
</tr>
<tr>
<td></td>
<td>Transfuse via a filtered blood giving set and the Belmont Buddy Lite</td>
</tr>
<tr>
<td></td>
<td>Administer Tranexamic Acid 1g as per Code Red SOP</td>
</tr>
</tbody>
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<tr>
<th>v</th>
<th>COMMUNICATION</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Make a “Code Red” call to the receiving ED if indicated</td>
</tr>
<tr>
<td></td>
<td>Advise of Pre-Hospital transfusion during pre-alert call</td>
</tr>
</tbody>
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<thead>
<tr>
<th>v</th>
<th>PRIOR TO LEAVING RECEIVING HOSPITAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pink labels attached to runsheet and copy handed over</td>
</tr>
<tr>
<td></td>
<td>Ensure box, unused units and logger return to base</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>v</th>
<th>ON RETURN TO BASE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Complete Blood Box Movement Log</td>
</tr>
<tr>
<td></td>
<td>Complete Immediate Blood Use Audit Form</td>
</tr>
<tr>
<td></td>
<td>Completed blue labels in blood box with any unused units</td>
</tr>
<tr>
<td></td>
<td>Opened box should be labelled - Do not use</td>
</tr>
<tr>
<td></td>
<td>Unopened box should be labelled as before mission</td>
</tr>
</tbody>
</table>

www.emrs.scot.nhs.uk
- Shared mental models
- Bandwidth overload
- Cognitive aides
- Checklists
- Situational awareness/ task fixation
- Diagnostic bias
- Flat heirarchy
- Closed loop communication
Summary

• What happens now — **SAS, ScotSTAR EMRS**

• Pre-Hospital trauma care — **is scary**

• What should we do? — **Do no harm first**

• What is the evidence? - **Hmmm**

• Human Factors — **Don’t just pay them lip service**
Question everythiing