“Blood, Plasma and Aviation Fuel”
The Role of the Anesthesiologist in Pre-hospital Resuscitation to Trauma Critical Care in the Austere Environment. Experience from the British Military Operations

Dr Matthew Roberts
Associate Professor of Anesthesiology
Denver Health Medical Center
Lieutenant Colonel (Rtd), Royal Army Medical Corps

Military Trauma Surgery and Anesthesia

Where does the anesthesiologist fit into the modern battlefield?

MEDICAL SUPPORT TO A BATTLE GROUP

Role 1 Regimental Aid Post

Role 2+ Forward Field Surgical Team
Role 3 - 202 Field Hospital
Camp COYOTE, Northern Kuwait, March 2003

Medical Support on Asymmetric Military Operations
Sierra Leone 2000, Iraq 2007 and Afghanistan 2010

Principles of Military Trauma Surgery
Wounds of War

- Multiple
- Extensive – no respect for anatomical boundaries
- Contaminated

Principles of Military Trauma Management

- Rescue and Retrieval - Winning the battle!
- Triage
- Damage Control Resuscitation (10%)
  - C-abc
- Surgery – Debridement, exploration of cavities
- Critical Care
- Strategic evacuation to UK (CCAST)
- Second/Third... look surgery
- Delayed primary suture, grafting
- Plastic surgery/Reconstruction
- Rehabilitation

Expectations of Military Medicine

- Cold War – Utilitarian therapeutic nihilism
- Now – Wherever possibly, achieve peacetime standards of medical care in the field, including critical care
- Be prepared for all (likely) eventualities, including changes to the population at risk and major medical incidents
- Remain able to project medical care in a mobile environment

A Changing Pattern of Wounds

- Helmet
- Body armour
- Effective care at point of wounding
- Rapid retrieval
- Enemy
  - Innovation – IED
  - Intention
Damage Control Resuscitation

• “A systematic approach to major trauma combining the catastrophic bleeding, airway, breathing, circulation paradigm with a series of clinical techniques from point of wounding to definitive treatment in order to minimize blood loss, maximize tissue oxygenation and optimize outcome”

• Hodgetts, Mahoney, Kirkman 2007

Hemostatic Resuscitation

• Acute Traumatic Coagulopathy develops prehospital with or without IV fluids. Severity of injury, prolonged hypotension

• Potentially Compounded by hypothermia, acidosis, loss of clotting factors, administration of crystalloid and plasma poor PRBCs -> Trauma Induced Coagulopathy

• Borgman et al: review of 246 massive transfusions in IRAQ over 22 months.
  – FFP:PRBC 1:8, 1:2.5, 1:1.14
  – Mortality 65%, 34%, 19%

Hemostatic v Hypotensive Resuscitation

• WB Cannon, 1920
  – “Haemorrhage in the case of shock may not have occurred to a marked degree because blood pressure has been too low and flow too scant to overcome the obstacle offered by a clot. If the pressure is raised before the surgeon is ready to check any bleeding that may take place, blood that is sorely needed may be lost”

• Bickell et al. Immediate versus delayed fluid resuscitation for hypotensive patients with penetrating torso injuries.

Hemostatic v Hypotensive Resuscitation

• Rationale
  – Vigorous fluid resuscitation -> increased pressure -> increased bleeding -> dilution of clotting factors.
  – Human studies suggest that energetic fluid delivery is harmful.
  – But prolonged hypotension is harmful, including its contribution to ATC – how long and how low?
  – Sufficient fluid (PRBC/FFP 1:1) to maintain a radial pulse + mentation
  – Minimal (if any) crystalloid
  – Restore normal tissue perfusion asap after arrest of hemorrhage

Trimodal Distribution of Trauma Deaths

Civilian v Military
DCR

Immediate imaging
FAST, Echocard, CT

Battlefield Trauma Life Support
Resuscitative/Damage Control Surgery

Retrieval – MERT
Attending-based resuscitation
Debridement/Irrigation

Hemostatic/Hypotensive resuscitation
Intensive Care

Hellmand Province Afghanistan
Feb 2010

“Contact - Casualties!”
Winning the fire fight

“Care under fire”
Battlefield Trauma Life Support (BATLS)

- A common cause of potentially preventable death in military casualties is peripheral hemorrhage

- C — ABC
  - Control of catastrophic hemorrhage
  - Airway
  - Breathing
  - Circulation

Medical Emergency Response Team (MERT)
Taking the ED to the Casualty

- Senior doctor — Anesthesia or Emergency Medicine
- Emergency nurse
- 2 x RAF Paramedics
- 4 x RAF Regiment soldiers

MERT Capability
Taking the ED to the Casualty
MERT Capability

*Taking the ED to the Casualty*

- Rapid evacuation from point of wounding
- While under fire
- Up to 8 casualties on stretchers
- Resuscitation
- Clinical decision making
  - Direct to Neurosurg unit
  - Initiate MTP at Bastion
  - Right turn
  - Camp Bastion or civilian hospital

**MERT Capability**

*Taking the ED to the Casualty*

- C – Hemorrhage control
- A - Airway and Pain management including RSI (Ketamine Sux)
- B - Oxygen Rx, IPPV, Thoracostomy
- C - IV or intra-osseous access, hemostatic resus, (4units PRBC, 4 units FFP, Calcium, Tranexamic Acid), fluid warmer, CPR
- Wound dressing, splintage
- Warming and packaging for transfer
The Intensive Care Unit

Critical Care Air Support Team (CCAST)

Role 4 – The Royal Centre for Defence Medicine
Queen Elizabeth Hospital Birmingham UK
Further Surgery

Defence Medical Rehabilitation Centre
Headley Court
Pain Management

Lessons to Learn

- Value of good hemorrhage control, Medic training
- Rapid evacuation with in flight (senior MD) resuscitation
- DCR, Hemostatic resuscitation
- Value of critical care capability in Fd Hosp and during repatriation flight
- ? Impacting the very early deaths or just changing KIA for DOW
- Unexpected survivors and redefining unsalvageability
- Repatriation to live or die
Lessons to Learn

- Pain control from point of wounding to rehab
- The injured mind
  - Depression, Alcoholism, PTSD
- Traumatic Brain Injury
- Long term costs?
- How can the achievements of a “mature medical capability” be translated to future expeditionary military operations

http://www.youtube.com/watch?v=-xjbvz-vE2E

“There is nothing more exhilarating than to be shot at without result.”
Winston Churchill

Sierra Leone 2000. Surgery and Anesthesia at Role 1
An airborne operation with minimal equipment and support