Combat Casualty Care Research at the U.S. Army Institute of Surgical Research

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The views expressed in this presentation are those of the authors and do not reflect official policy or position of the Department of the Army, Department of Defense, or the U.S. Government
Mission of the US Army Institute of Surgical Research

Optimizing Combat Casualty Care

• Provide requirements driven combat casualty care medical solutions and products for injured soldiers from self-aid through definitive care across the full spectrum of military operations

• Provide state-of-the-art burn, trauma, and critical care to Department of Defense beneficiaries around the world
The Research Philosophy of The U.S. Army Institute of Surgical Research

Battlefield Medical Problems

Data Driven Questions

Laboratory Research

Clinical Research
Survival With Emergency Tourniquet Use to Stop Bleeding in Major Limb Trauma

COL John F. Kragh, Jr., MC, USA,* Thomas J. Walters, PhD,* David G. Baer, PhD*, LTC Charles J. Fox, MC, USA, Charles E. Wade, PhD,* Jose Salinas, PhD,* and COL John B. Holcomb, MC, USA*
Survival: Tourniquet Use to Stop Bleeding in Major Limb Trauma

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The life of Bryan Anderson was saved with 3 tourniquets
ISR Contributions to Improved Combat Casualty Care For Soldiers

2004 Army Greatest Invention – Hemcon Dressing
2005 Army Greatest Invention – Combat Tourniquet
2007 Army Greatest Invention – Damage Control Resuscitation
2008 Army Greatest Invention – Combat Gauze Dressing
2009 Army Greatest Invention – Burn ResuscitationDecision Support

- Hemostasis Innovations
- rFVIIa to treat coaguopathic bleeding
- Fluid warmers to prevent hypothermia
- Hypothermia prevention kit
- Intraosseus Infusion Systems
- Hextend
- Antibiotics by medics
- Pain control by medics
- Improved burn wound diagnostic tool
- Joint Theater Trauma System
- Battlefield burn prevention
  - Safe burning of waste
  - Use of Nomex gloves
  - Burn prevention shirt
- Needle Thoracentesis to treat pneumothorax pre-hospital
- Ultrasound to diagnose pneumothorax
- Individual First Aid kit
- Vehicle First Aid kit
- Fresh Whole Blood
- Tourniquet use guidelines and doctrine
- Hypotensive resuscitation guidelines
- Renal replacement therapy for burn
- Blood product resuscitation
- Impedance threshold device for hypovolemia

As of: 26 Sep 05
Damage Control Resuscitation

• Recent Accomplishments
  – Tourniquets
  – 2\textsuperscript{nd} and 3\textsuperscript{rd} Generation Hemostatic Dressings

• Current Focus Areas – Reducing KIA and DOW Rates
  – Hemostatic Resuscitation – Restore volume, avoid coagulopathy, provide oxygen carrying capacity
  – Avoid giving blood products to those who do not need them
  – Prevent hypothermia
Blood Research Program

• Recent Accomplishments
  – Transition of Freeze-Dried Plasma and Cryo-Preserved Platelets to Advanced Development (clinical trials)

• Current Focus Areas
  – Understanding basic mechanisms of trauma-induced coagulopathy
  – Developing improved platelet storage systems
  – Developing blood product pathogen reduction technologies
Recent Accomplishments
- Defining the injury patterns and resulting functional outcomes
  - Open fractures
  - Soft tissue defects (muscle and nerve)
  - Wound irrigation and debridement

Current Focus Areas
- Animal modeling of traumatic injury
  - Segmental defects (bone and muscle)
  - Wound contamination and infection
- Muscle Regeneration
- Delivery of autologous stem cells to treat defects
- Establishment of the Major Extremity Trauma Research Consortium
  - Partnership between military treatment centers and civilian trauma centers
  - Clinical trials comparing
    - Autograft vs. allograft with recombinant Bone Morphogenetic Protein -2
    - External fixation (circular fixation) vs. early internal fixation
    - Systemic antibiotic therapy vs. antibiotic therapy with local antimicrobial delivery
Pain Control

• Recent Accomplishments
  – Defining the relationship between pain control and Post Traumatic Stress Disorder
  – Influence of anesthetic agents on Post Traumatic Stress Disorder

• Current Focus Areas
  – Use of virtual reality immersive environments for pain control
  – Intranasal ketamine for battlefield pain control
  – Intravascular thermal regulation during surgery
Advanced Capabilities for Emergency Medical Monitoring

- **Recent Accomplishments**
  - Impedance threshold device to support cardiac output during central hypovolemia

- **Current Focus Areas**
  - Investigation of mechanisms of tolerance to hypovolemia
  - Development of wearable physiologic status monitor
  - Remote triage devices and algorithms
Combat Casualty Care Engineering

- **Recent Accomplishments**
  - Development of decision support technology for burn resuscitation
  - Analysis techniques for vital signs to improve situational awareness

- **Current Focus Areas**
  - Integration of existing vital signs to improve decision support
  - Analysis of vital signs collected in the deployed pre-hospital and emergency department environment
  - Ventilator support after lung injury (smoke inhalation and blunt trauma)
  - Development of improved metrics for adequacy of resuscitation
Clinical Trials

• Recent Accomplishments
  – Continuous renal replacement therapy
  – Burn injury prevention through fire retardant garments

• Current Focus Areas
  – Multicenter clinical trials
    • Engineered skin grafts
    • Transfusion triggers in burn surgery
    • Assessment of rehabilitation requirements
    • Donor site dressings
    • Prospective evaluation of transfusion ratios
    • Decision support, decision assist
Medical Countermeasures for Ocular Trauma
Science Program

• Assessment of military ocular trauma
  – Laser-induced eye injury from military systems
  – Ocular Injury from blast (new – FY2011)
  – Biophysical models
  – Ocular trauma research roadmap

• Triage and Treatment of Ocular Trauma
  – Retinal Injury: Mechanisms and Taxonomy
  – Pharmacological Intervention- Stem Cell Therapies
  – Advanced imaging diagnostics (OCT, SLO)
  – Vision and performance metrics
  – Advanced Aidman Vision Screener
  – Informatics – Laser exposure incidents

• Laser Bioeffects – Force Protection
  – Exposure Guidelines - Field Safety (AR 11-9)
  – Injury prevention – Health Hazard Assessment
  – Military eye protection systems (MEPS)
Summary

• ISR provides requirements driven combat casualty care medical solutions and products
• ISR’s mission space is trauma, head to toe, minus the brain
• Extensive collaborations with clinicians ensures rapid response to emergent problems
• The partnership between the ISR and the DHB Tactical Combat Casualty Care subcommittee has been extraordinarily successful