# Combined Burn and Trauma Care

**Bruce Bennett, CAPT/MC/USNR**

# Disclaimer

**The views expressed are my own and do not reflect the official policy or position of the United States Navy, Department of Defense, or the U.S. Government.**

# Objectives

- Describe civilian combined burn/trauma care
- Priorities of Care for combined burn/trauma
- Describe adjustments in treatment relative to isolated burn or trauma
- Review combat casualty/burn care and relevant care issues to civilian counterparts
- Discuss resource limitations for civilian mass casualty burn scenario

# Combined Burn & Trauma

*Prevalence:*

*The Burn Center* > 300 admits (5%)

RH Trauma Center > 3,000 admits (0.5%)

ISR burn admissions (50%)

# Mortality

- **Overall mortality = 13-17%**

| | |
|---|---|
| Isolated burns | 2% |
| Inhalation injury | 23% |
| Burn + Inh + Trauma | 41 - 55% |

- **Avg BT-Combo = 20% TBSA**
  - Isolated burns = 10% TBSA

# Mechanism of Injury

- MVC account for the majority
  - Anything with a motor
- Auto-Pedestrian collision
- Escape from structure/building fires
- Electrical current
- Explosions
- Assaults

# MVC – Patterns of Injury

- **Trapped in/adjacent to burning vehicle**
  - Typically deep facial & UE burns
  - Inhalation injury
  - Mortality 36 - 50%, with 80% at the scene
- **Thrown (vs fled) the wreckage**
  - Less severe burns: torso & UE
  - No inhalation injury
  - Severe polytrauma with ejection
  - (Less severe burn & trauma injuries)

# Prognosis

- Trauma outcomes → Trauma Centers
- Burn outcome → Burn Centers
- Few General/Trauma Surgeons care for major burns
- Few individuals → substantial clinical experience caring for combined

# Priorities

- Multidisciplinary care
- Modification
  - Pre-op, Intra-op, Post-op
  - Critical Care
- Success
  - Effective triage
  - Timely diagnosis
  - Accurate assignment of surgical priorities

# General Principals

- Trauma = "Golden Hour" takes priority
- "Routine" priorities for surgical management is the same
- Hemorrhagic Shock – *Stop the Bleeding!!*
- Burn care can be flexible

# Assessment of Burn & Trauma

- Scene run BLS/ALS pre-hospital
  - 15 – 30 minute run times
  - PHTLS principles
  - Remove burned clothing / cool burn
  - Usually IV/IO access + IVF
- Local ED vs Trauma Center?
- Air transport (scene/transfer/advanced)

# Assessment of Burn & Trauma

**Burn** *little or BIG?*

- Size of burn?
- Depth & location of burn?
- Inhalation?

**Trauma** *little or BIG?*

- Need an operation?
- Need hardware?
- Timing? (emergent/urgent/elective)

# Procedures

**Emergent**

- Perform through burn
  - Cricothyrotomy, CVC, chest tube, EDT
  - Remove surrounding eschar next opportunity

**Urgent**

- Through "clean tissue" (excise first)
  - Ex-fix, chest tube, CVC, trach

# Operations

- Orthopedics
- Thoracic
- Intraabdominal
- Vascular
- Neurosurgery

# Excision Decision – Ortho Urgency

- **Immediate (hours)**
  - Open Fx
  - Ex fix
- **Early (0-2 days)**
  - Most ORIF
- **Delayed (> 2days)**
  - Complex pelvis
  - Non-long bone
    - Clavicle
    - Scapula

# Excision Decision - Eschar

- Eschar vs partial thickness burns
- Proximity of Eschar
  - Area of injury = only concern
- Size of eschar
  - Small burns = immediate coverage (STSG)
  - Large burns = staged procedures

# Staged Burn Procedures

- Excise eschar at first operation
  - Temporary coverage
    - Homograft (Cadaver)
    - Xenograft
    - Regenerative dermal replacement ("artificial skin")
- Skin graft (STSG) later

# MVC

21 yo driver hit bridge abutment

**A**irway - RSI in field

**B**reathing - ↓ BS L side, Sats 92%

**C**irculation - HR 125, BP 95/70

**D**isability – GCS 3i (12)

**E**xpose – open R femur Fx,
face & R hand burns,
Inhalation Injury

# Initial Stabilization

# MVC

21 yo driver hit bridge abutment

- TBI – LOC
- Inhalation Injury
- Spleen Grade 4
- R Femur Fx – open
- L PTX
- 5% BSA face-head, R hand

# MVC

## BIG BURN = BIG TRAUMA

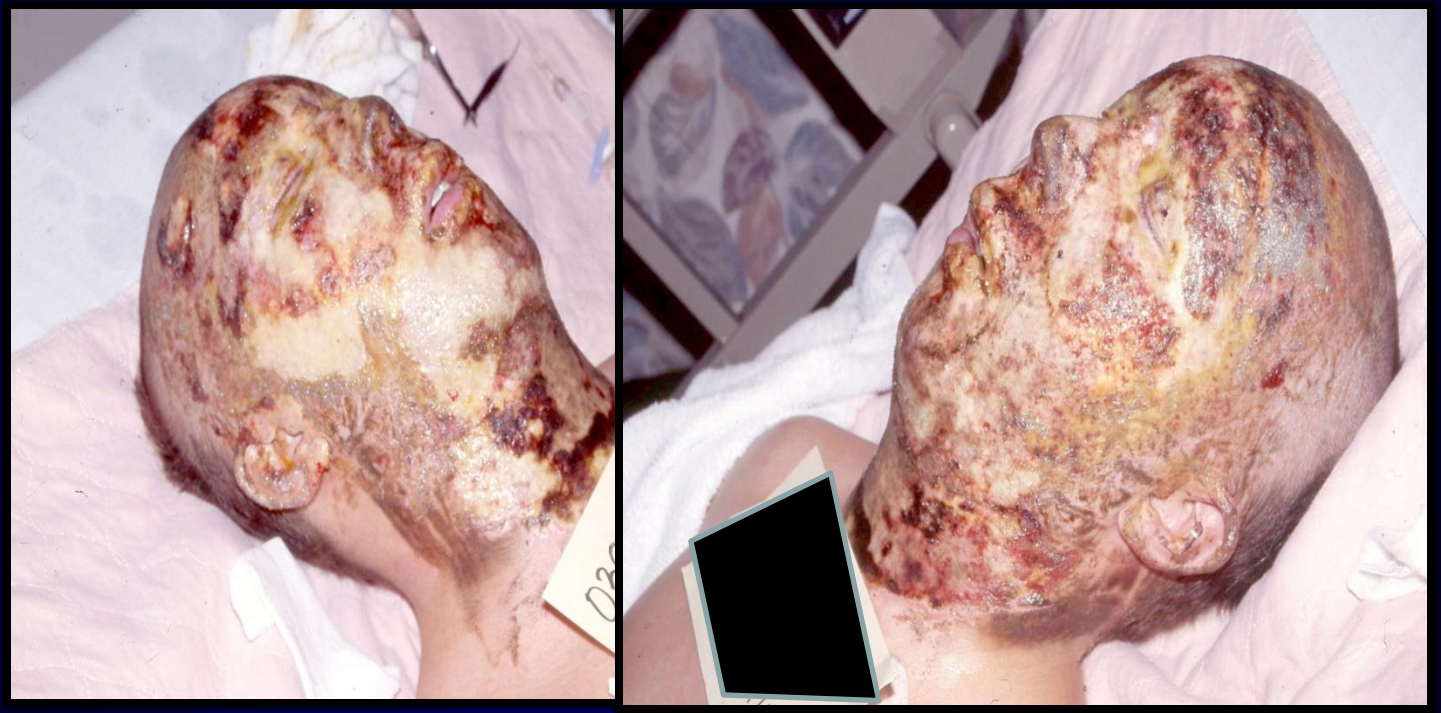
**POD 0**

- L PTX → Chest tube
- Spleen Grade 4 → Splenectomy
- R Femur Fx – open
  → ORIF

# MVC

- TBI – LOC
- Inhalation Injury

NOM
Aggressive wean



# MVC

**PID 3**

- R hand Burns STSG

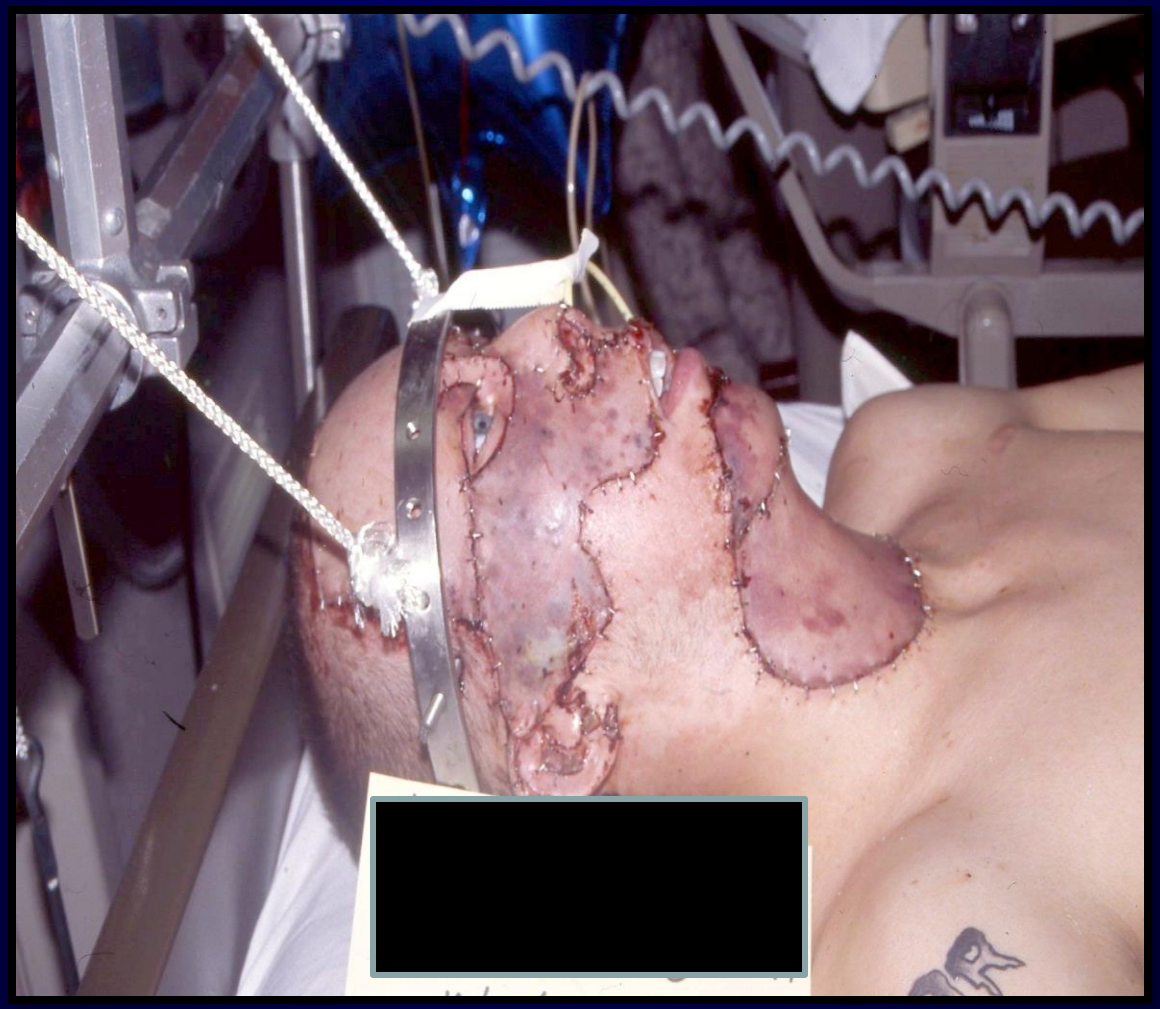
**PID 5**

- Cadaver face-neck

**PID 8**

- STSG face-neck

# Face Graft Protection



# MVC


# Fireworks

27 yo was “drinking all day” setting off fireworks when he held a 3 inch mortar in his right hand…

- Round to the chest
- Respiratory distress
  - Paradoxical chest movement
- Missing chest wall
- 1% BSA 4$^{th}$ degree burn

# Imaging

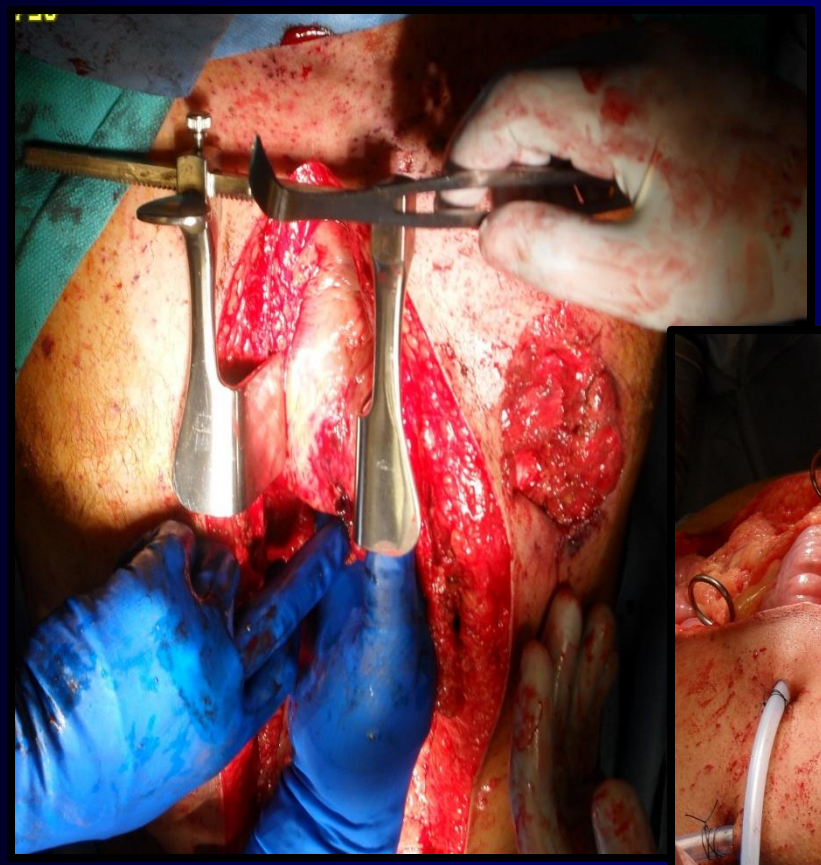
# Fireworks

**PID 0**

- **X-Lap**
  - **Liver injury - debrided**
- **Median Sternotomy**
  - **Cardiac injury - repaired**
  - **Chest wall - reconstruction**

- **XC 4th degree burn chest wall**
- **Guillotine R thumb amp**

# Median Sternotomy / Ex Lap



# Fireworks

- Corneal laceration & FB - Ophtho

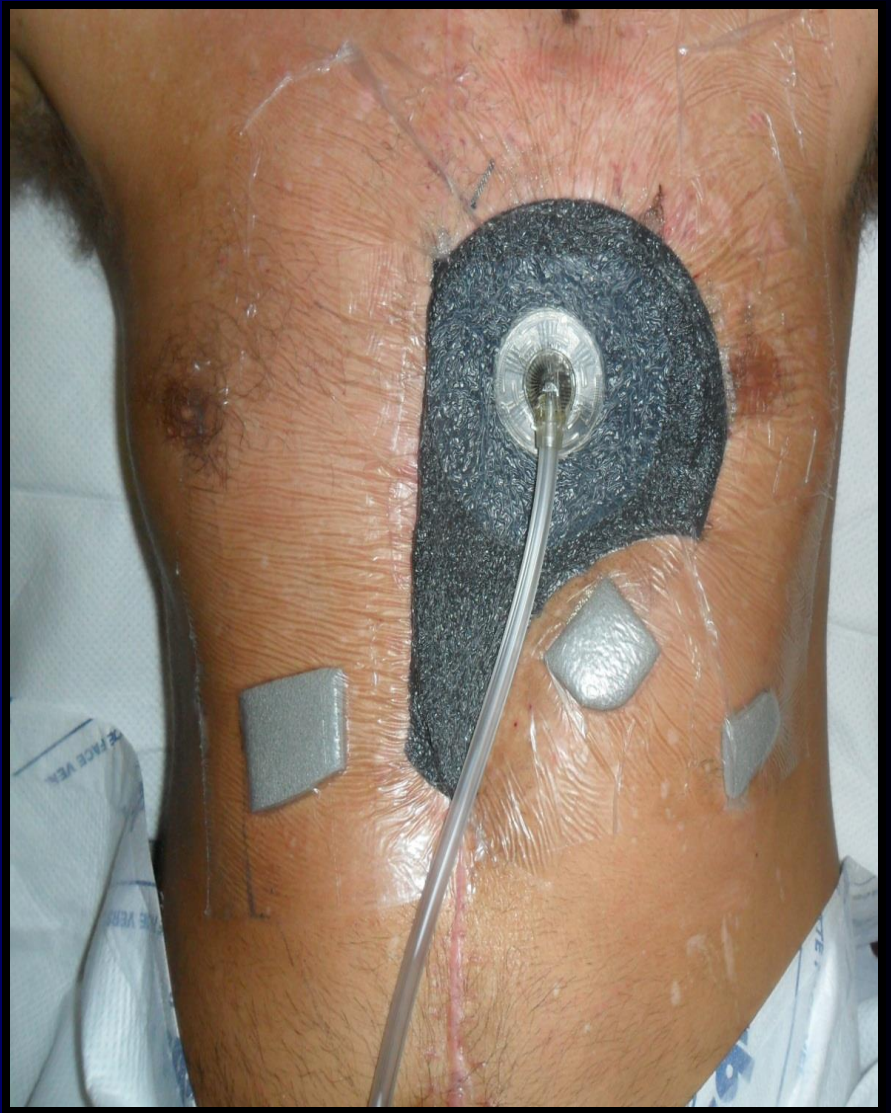
**PID 16**

- Dermal replacement chest

**PID 26**

- STSG (Integra) chest

# Fireworks



# Fireworks

# WAR

# Kinetic Environment

Courtesy David Leeson, *The Dallas Morning News*

# Battlefield Injuries
# IED, GSW, MORTARS, MVA

**Combinations of these and others**

# Battlefield Injuries
# IED, GSW, MORTARS, MVA

# Geographic Impact

- Pre-injury Dehydration
- Heat
- Drainage Ditches
- Altitude
- Cold
- Infectious Disease

# Point of Injury

- Buddy aid
- Medic/Corpsman
- TCCC tenants
  - Return fire
  - Minimal volumes of IVF
- Indigenous flora

# Dirty Wounds

# Ground or Air Evac From Battlefield

# Ground Evac From Battlefield

# Air Evac From Battlefield

# MERT

# Point of Injury

- CASEVAC
  - Permissive vs Non-permissive
  - 30 – 45 minutes out
  - Golden Hour goal to Role II or III
  - Air Force PJ
  - MERT
- Role II (tent)
- Role III structure
- MTF / Reservist General Surgeon

# Role II

# Role III

# Role IV

# Role V

# Current Route from Injury to Definitive Care

BAS
Level 1

CASEVAC
1 Hour

Forward Surgical
Teams
Level 2

TACTICAL
MEDEVAC
1-24 Hours

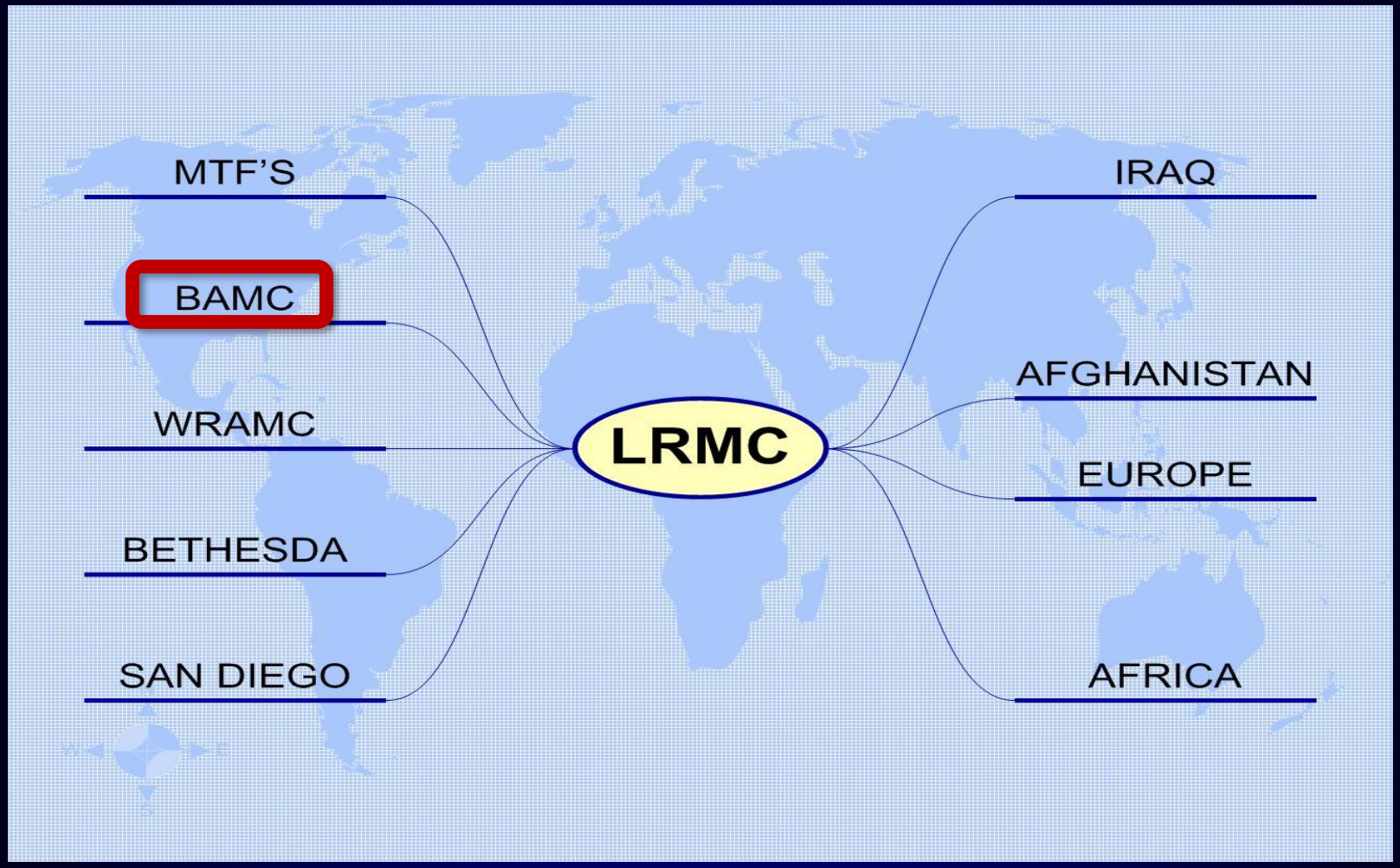
CSH, EMEDS, EMF
Level 3


STRATEGIC AE
24-72 Hours


Definitive Care
Level 4

SURGICAL CAPABILITY PUSHED FAR FORWARD

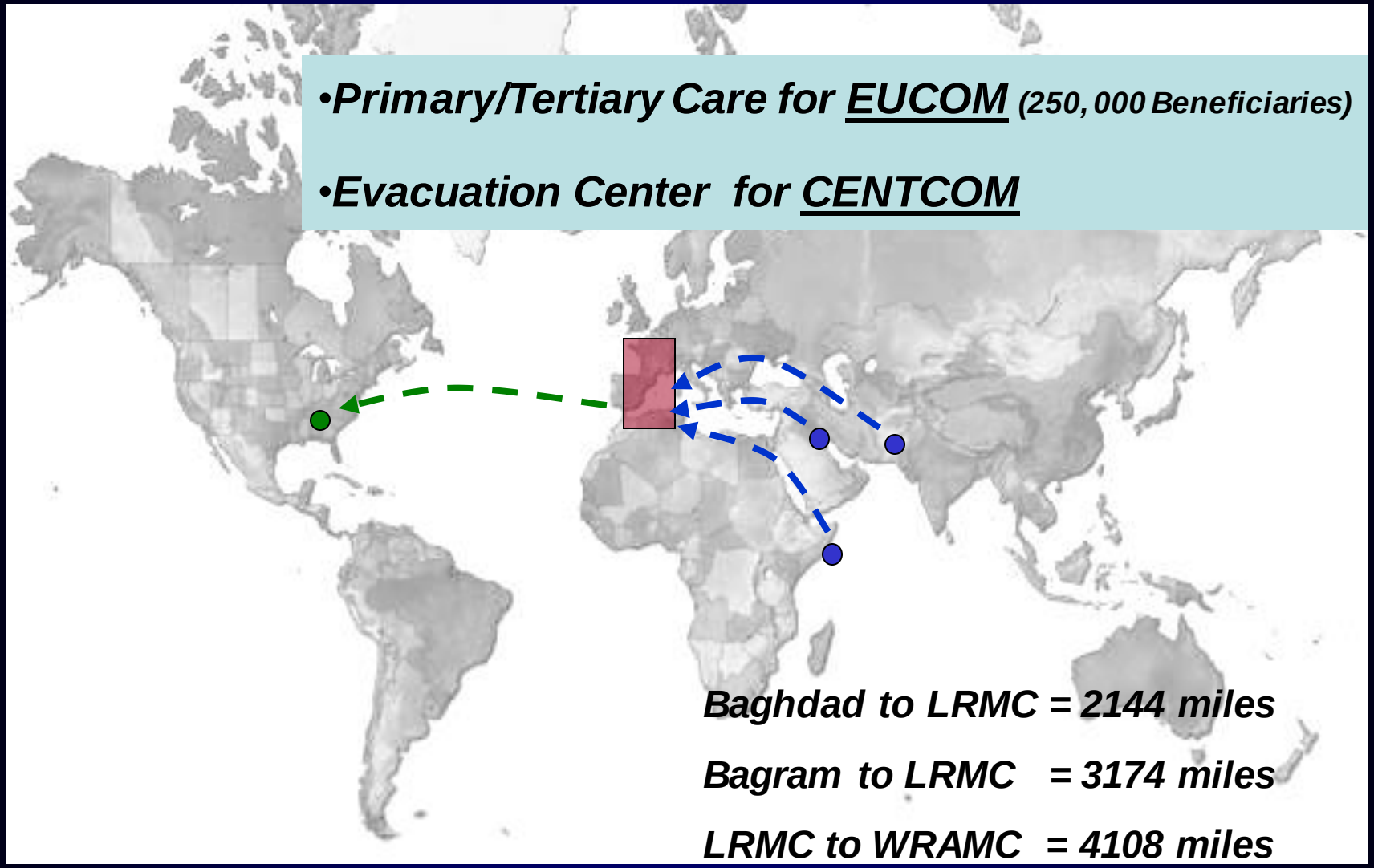
# Patient Movement



# Ramstein AFB to LRMC

# LRMC – Patient Unloading

# One Organization
# Two Missions



# Combination of Wound Mechanisms

- Penetrating
- Blunt
- Thermal
- Fall
- Blast
  - Primary
  - Secondary
  - Tertiary
  - Quaternary (burn)

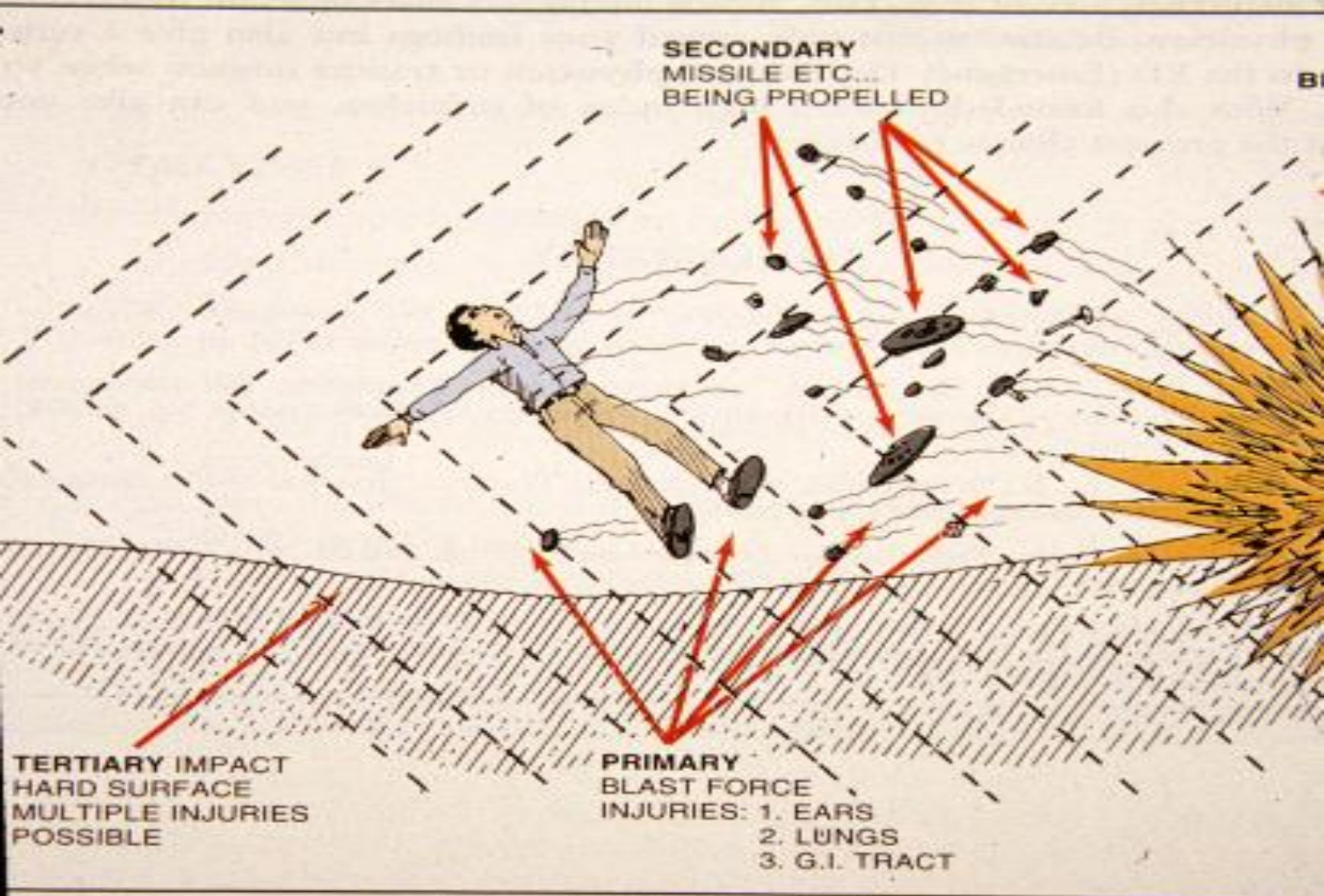



**Figure 1-16** ***Blast injury.***

# Blast

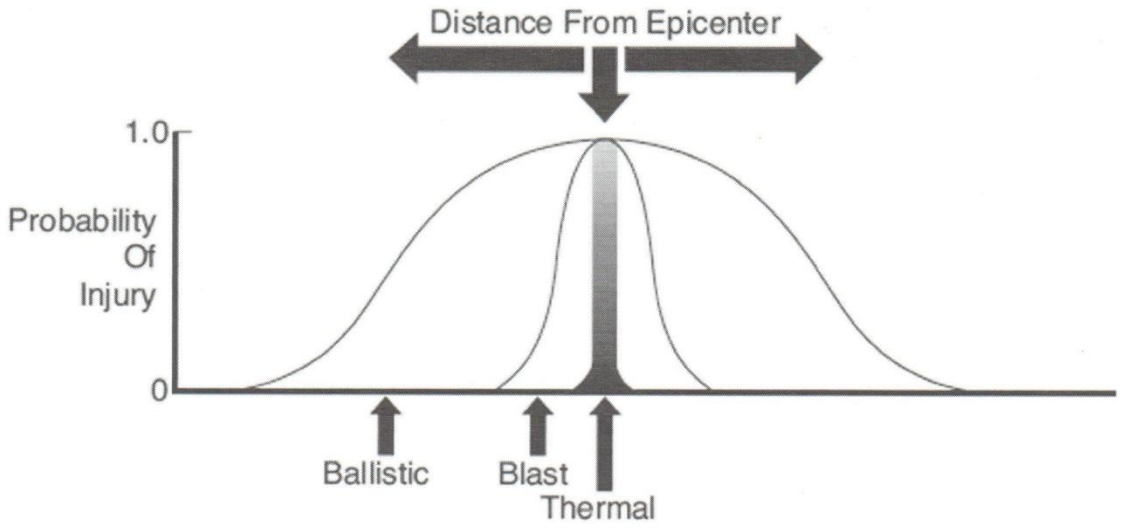
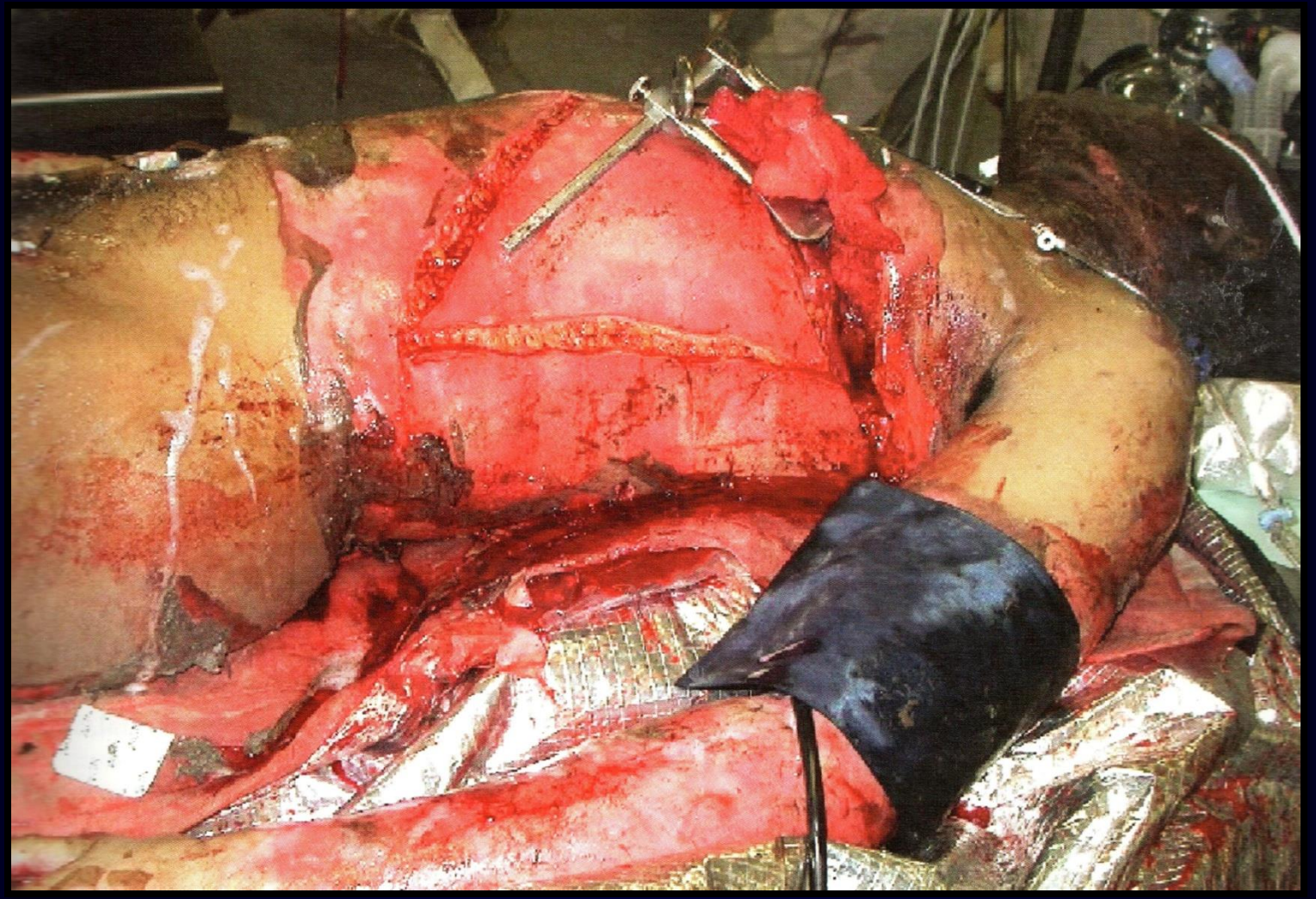



FIGURE 2. *Combat blast injuries often depend on the proximity of the individual to the detonation. In the case examined here, the patient was in close proximity to the epicenter of the explosion.*

*War Surgery in Afghanistan and Iraq; Borden Institute*

# Multiple Wounding Mechanisms



*War Surgery in Afghanistan and Iraq; Borden Institute*

# Austere Environment

*War Surgery in Afghanistan and Iraq; Borden Institute*

# Austere Environment

*War Surgery in Afghanistan and Iraq; Borden Institute*

# Abdominal Compartment Syndrome

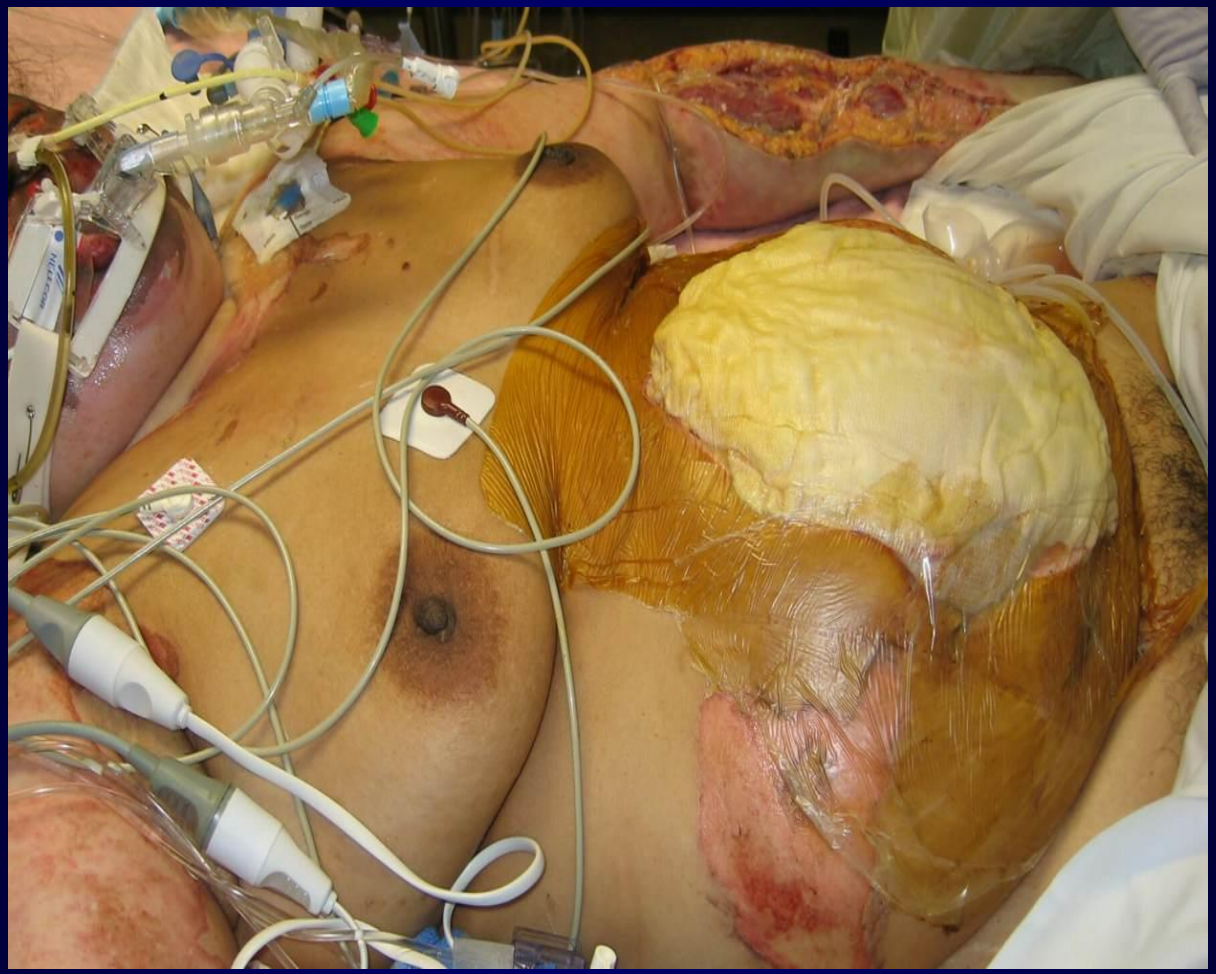
- Measure bladder pressure every 4 hrs for the first 24 hrs
- IAH = IAP > 12 mmHg (adults)
- IAH = IAP > 10 mmHg (kids)
- ACS = IAH > 20 + renal or pulmonary compromise

ACS = Abdominal compartment syndrome

IAP = Intra-abdominal pressure

IAH = Intra-abdominal hypertension

# Abdominal Compartment Syndrome



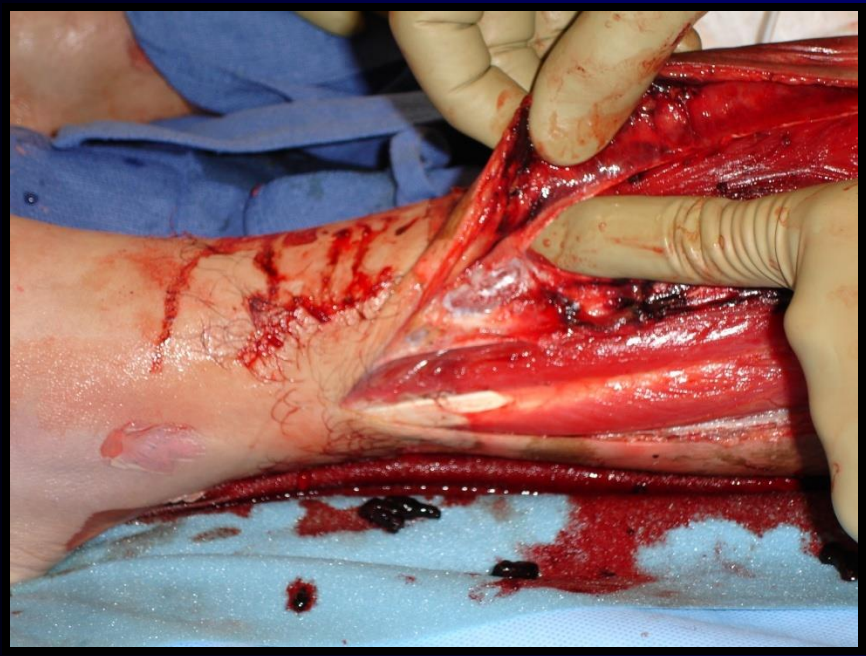
60-88% Mortality

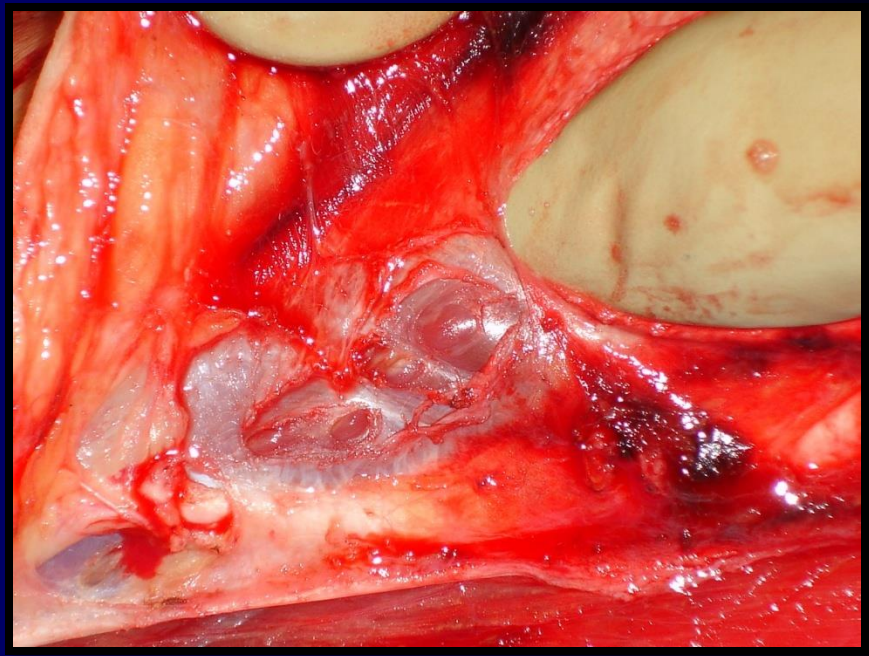
# Extremity Compartment Syndrome

- 2005 – 2006 OIF/OEF casulaties
  - 494 fasciotomies (294 patients)
  - 17% fasciotomy revision
    - Fascia extended 63%
    - Skin extended 14%
    - Additional compartment opened 41%
  - Burn to extremity and escharotomy in theater were greater in revision group
  - Fasciotomy delay to Role IV: amp/mort

# OIF / OEF

# OIF / OEF





# OIF / OEF Burns

- Clinical Practice Guideline
- Burn Care Flow Sheet
  - Continuum of care documentation
  - Reduction in over-resuscitation
- Abdominal Compartment Syndrome
- Incidence of Fasciotomy
- Silver Nylon Dressings
- Burn Transport Team

# OIF / OEF Burns

- Revised Burn Care Guidelines
  - 2 ml/kg/%TBSA
  - MAP > 50 mmHg
  - U/O > 30 ml/hr
  - Mild acute renal insufficiency
  - Theater Burn flow sheet

# JTTS Burn Resuscitation Flow Sheet

Page 1

Date: | Initial Treatment Facility:

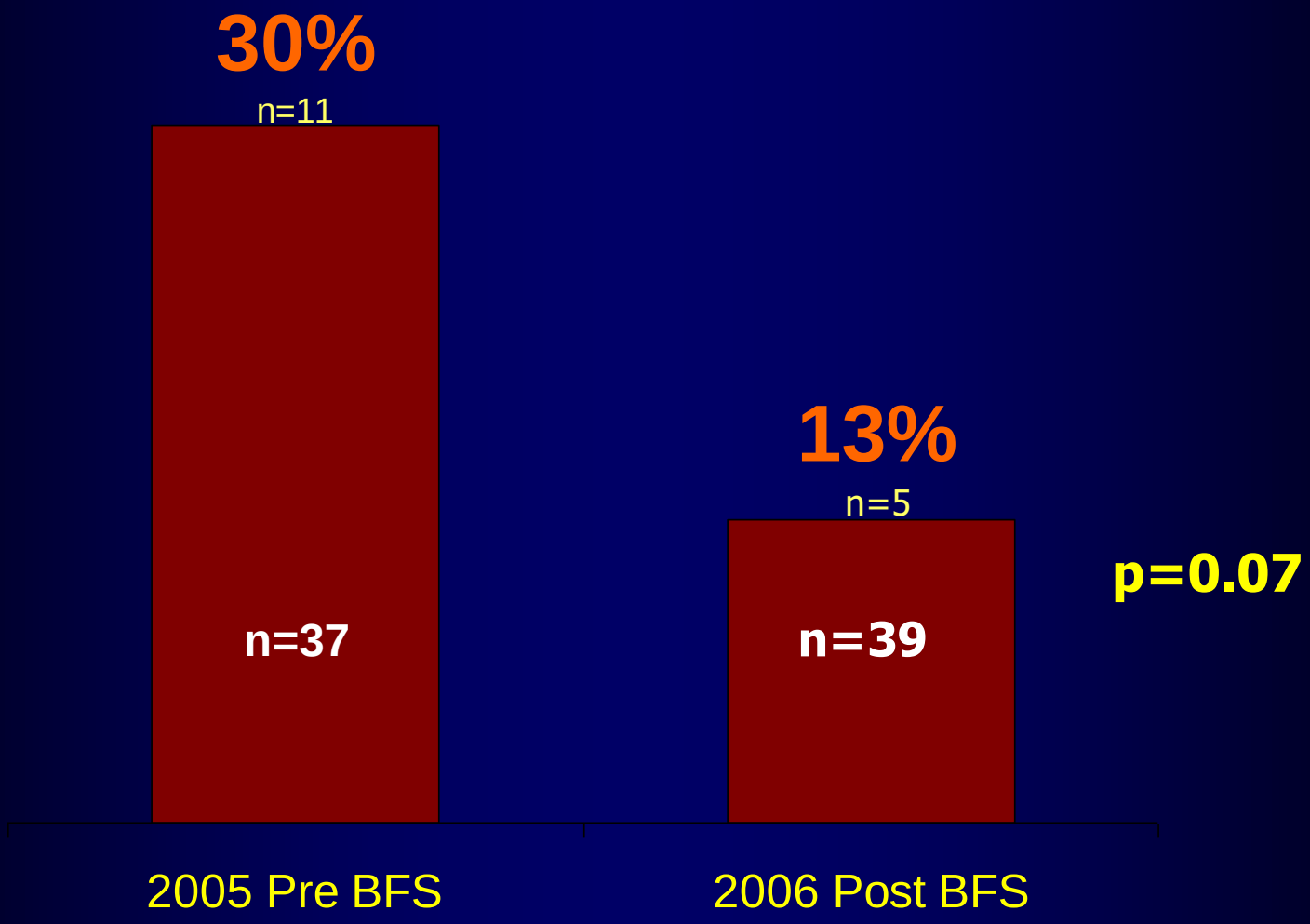
| Name | SSN | Pre-burn Est. Wt (kg) | %TBSA | Estimated fluid vol. pat. should receive 1st 8 hrs | 2nd 16th hrs | Est. Total 24 hrs |
|---|---|---|---|---|---|---|
| | | | | | | |

Date & Time of Inury

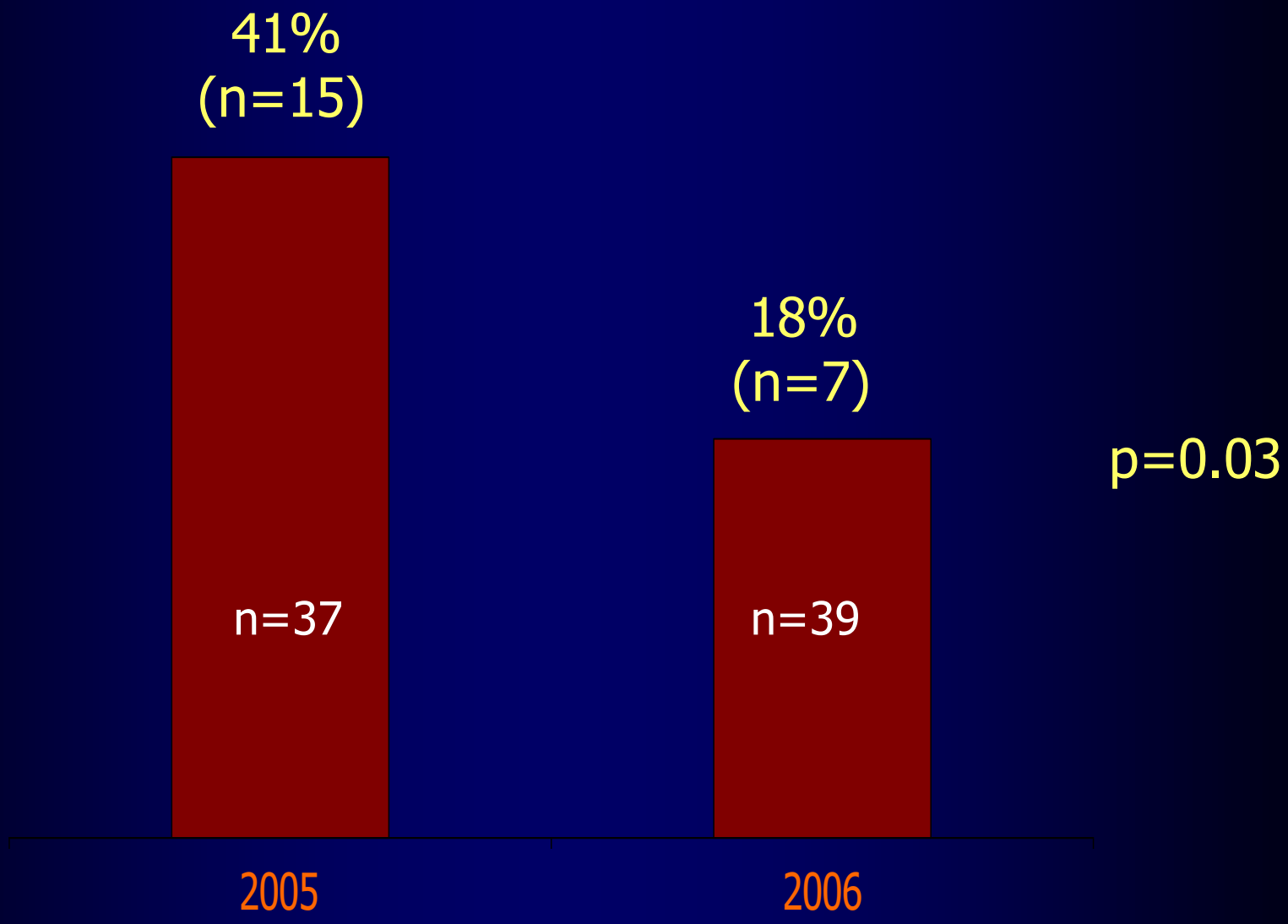
BAMC/ISR Burn Team DSN 312-429-2876

| Tx Site/ Team | HR from burn | Local Time | Crystalloid / Colloid | TOTAL | UOP | Base Deficit | BP | MAP (>55) / CVP | Pressors (Vasopressin 0.04 u/min) |
|---|---|---|---|---|---|---|---|---|---|
| | 1st | | | | | | | | |
| | 2nd | | | | | | | | |
| | 3rd | | | | | | | | |
| | 4th | | | | | | | | |
| | 5th | | | | | | | | |
| | 6th | | | | | | | | |
| | 7th | | | | | | | | |
| | 8th | | | | | | | | |
| | Total Fluids: | | | | | | | | |
| | 9th | | | | | | | | |
| | 10th | | | | | | | | |
| | 11th | | | | | | | | |
| | 12th | | | | | | | | |
| | 13th | | | | | | | | |
| | 14th | | | | | | | | |
| | 15th | | | | | | | | |
| | 16th | | | | | | | | |
| | 17th | | | | | | | | |
| | 18th | | | | | | | | |
| | 19th | | | | | | | | |
| | 20th | | | | | | | | |
| | 21st | | | | | | | | |
| | 22nd | | | | | | | | |
| | 23rd | | | | | | | | |
| | 24th | | | | | | | | |
| | Total Fluids: | | | | | | | | |

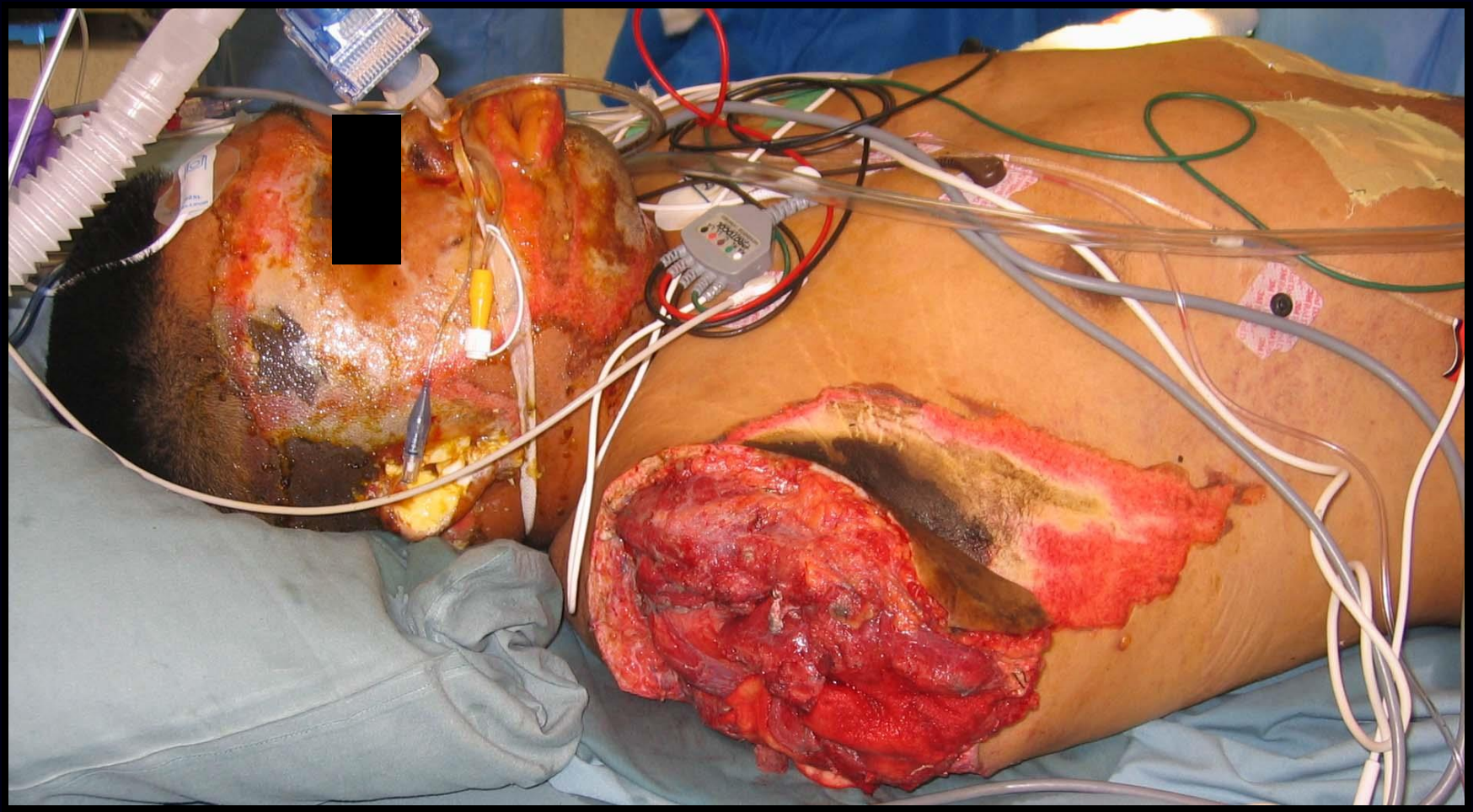
# Incidence of ACS



# Mortality Pre and Post BFS



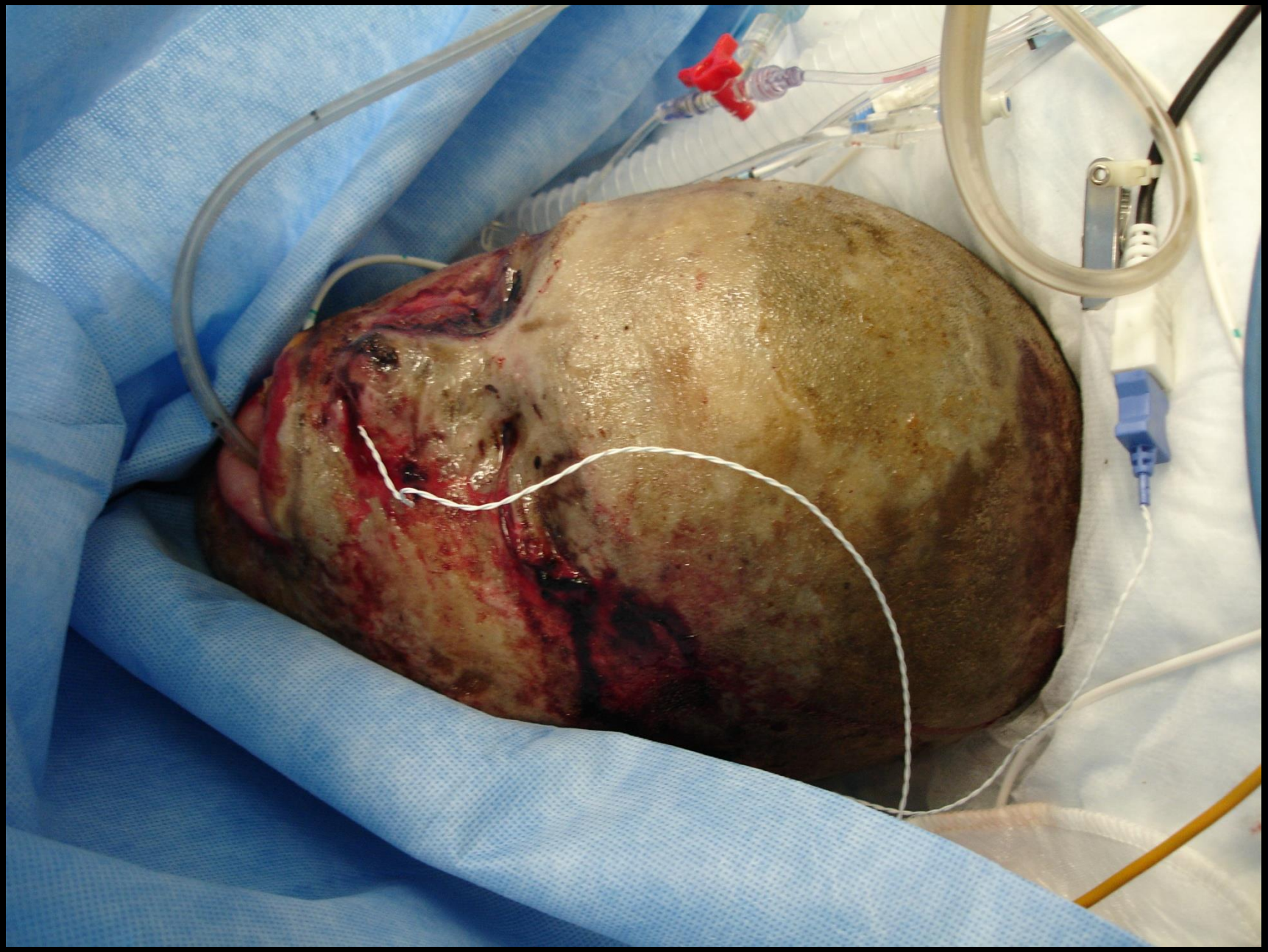
# OIF / OEF



# OIF / OEF

# OIF / OEF

20 y/o M Soldier, IED Blast, Severe 80% 3rd Degree Burns, Open L Tibia Fxs, Bilateral Ankle Dislocations, Calcaneus Fxs



# OIF / OEF

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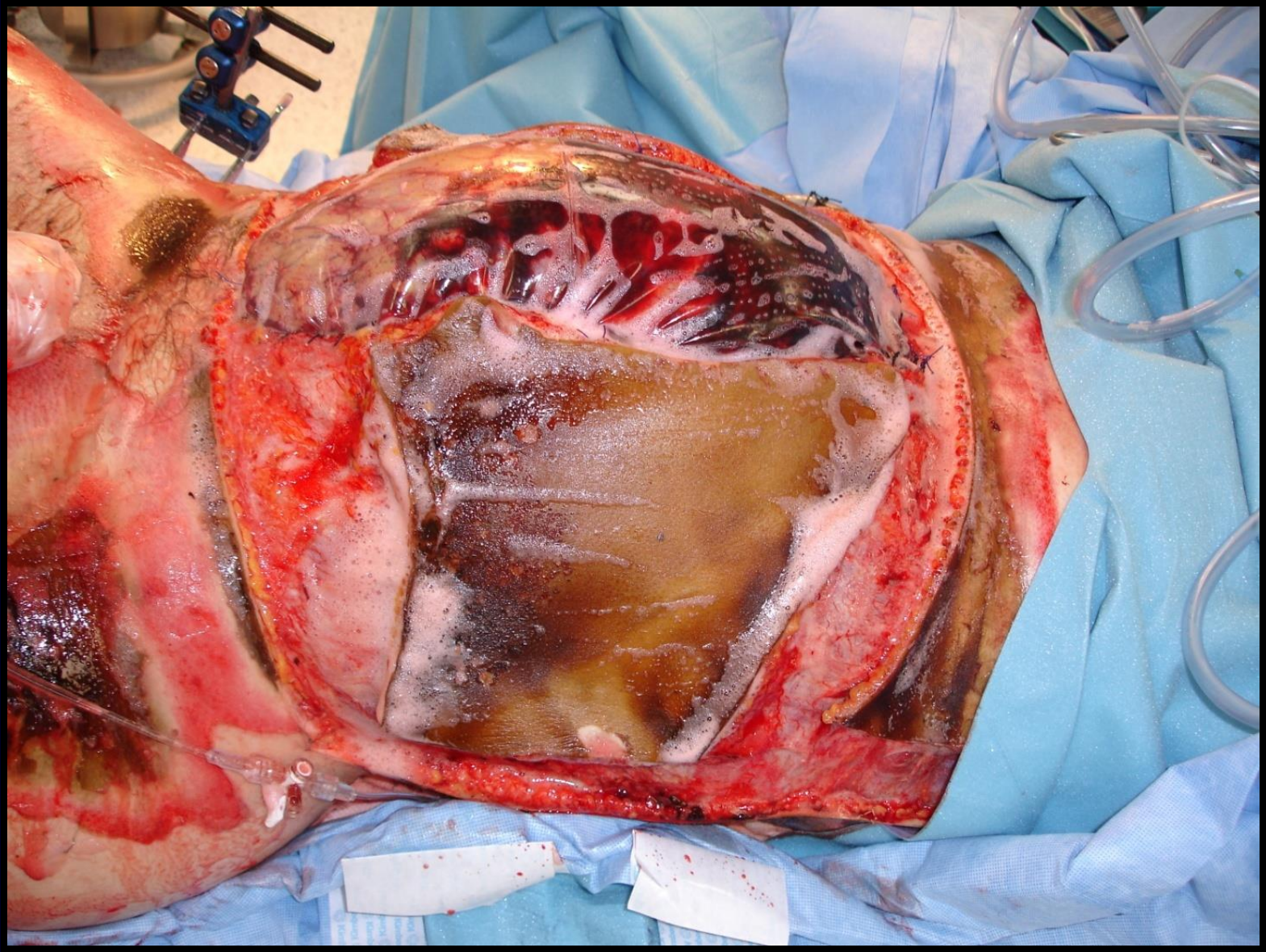

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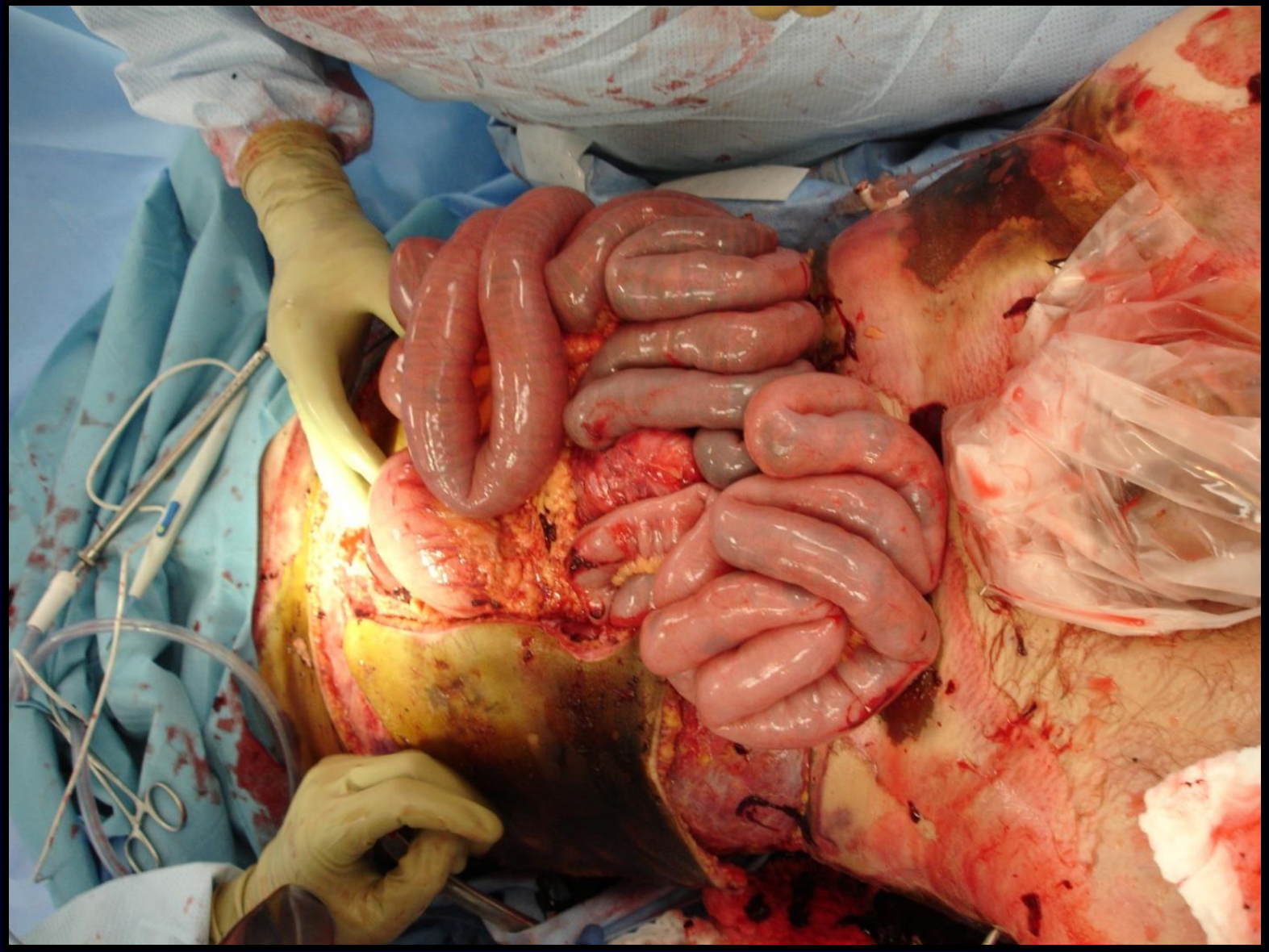
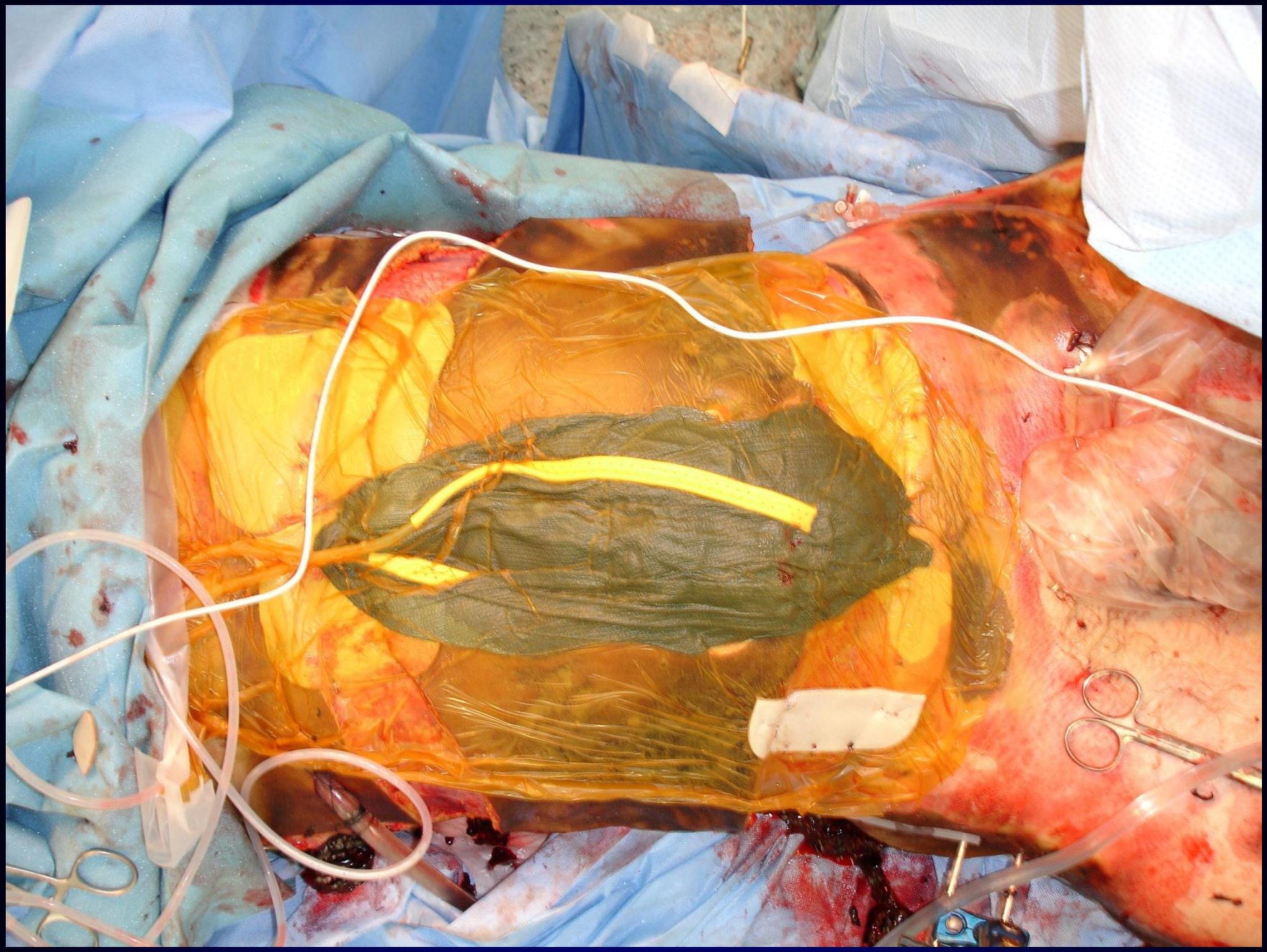
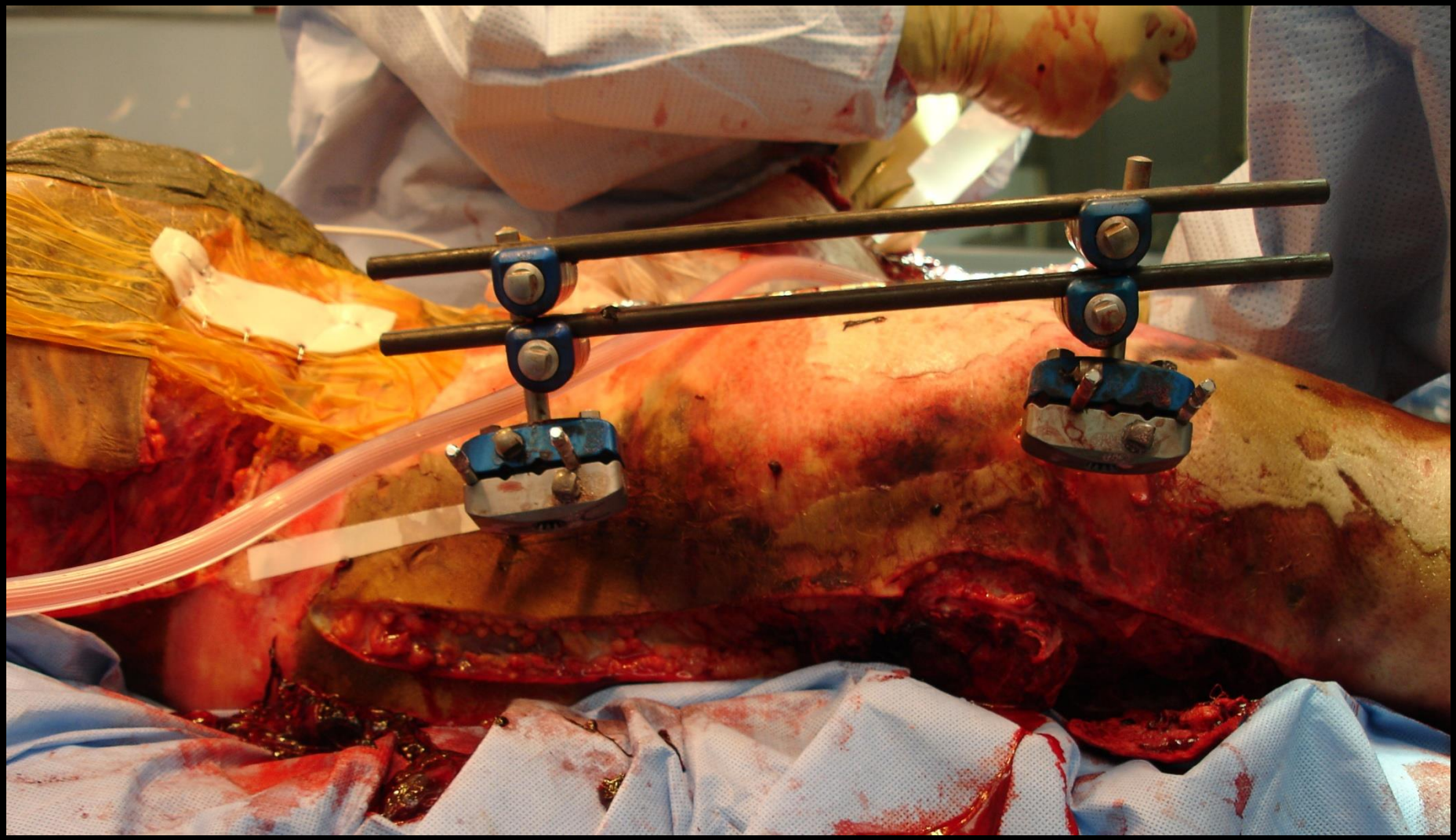






# OIF / OEF

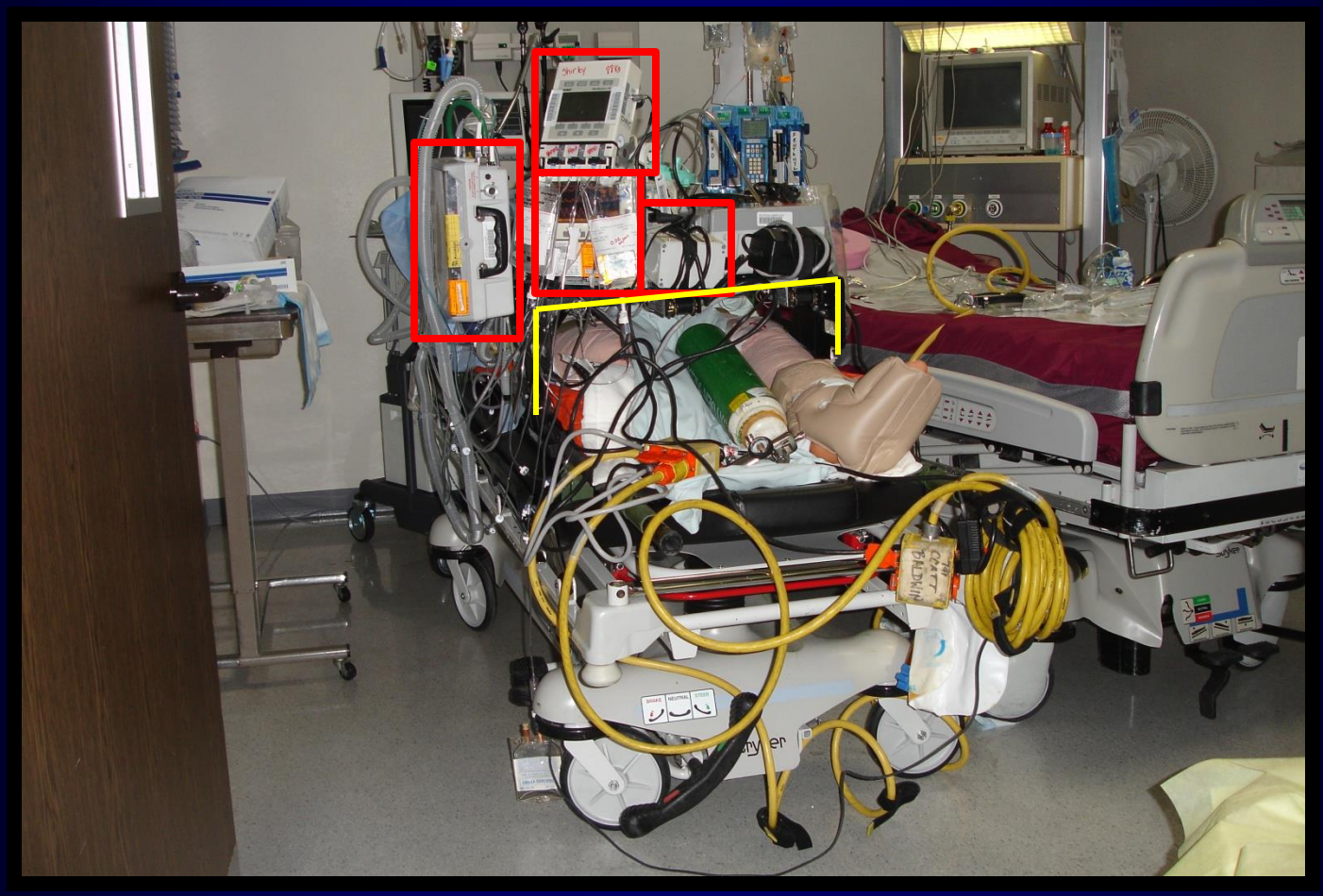
# Critical Care Air Transport Teams

- Critical care team
  - Physician
    - Surgeon
    - EM
    - Anesthesia
    - Cardiology
    - Pulmonary
  - Respiratory therapist
  - Nurse

# Critical Care Air Transport Teams

- Aviation medicine trained
- Monitoring equipment
- Medications
- Sensory-deprived environment

# ICU Patient Preparation



CCAT (ICU) Patient Packed Up For A/E Flight

# Critical Care Air Transport Teams

- Critical Care in less than ICU setting
  - 1 to 4 ICU patients
  - 40,000 feet
  - 6 to 12 hours
- Critical asset to make this system function

# Critical Care Air Transport Teams

- No civilian analog

?Mass burn casualty patient distribution?

# Objectives

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# Perspective

**Please use the presentation to honor the wounded warriors by educating others about their life changing sacrifices.**

# THANK YOU