18th ANNUAL CONFERENCE
RIVER of DREAMS
envisioning best practices in trauma care
The Mangled Extremity: Best Practice for Optimal Outcomes

Kristen Ray R.N., MSN
Learning Objectives

At the end of the session, participants will be able to:

• Verbalize the initial management principles and priorities for a patient with a mangled extremity.

• Discuss the importance of post operative vascular assessments in relation to normal and abnormal findings.

• Define two optimal functional outcomes for the patient with a mangled extremity.
Disclosure Statement

- I, Kristen Ray R.N., MSN disclose no conflict of interest relative to this educational activity.
Successful Completion

- To successfully complete this course, participants must attend the entire event and complete/submit the evaluation at the end of the session.
- Society of Trauma Nurses is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.
What is a Mangled Extremity?
What is a mangled extremity?

- Four functional structures of an extremity
  - Nerves
  - Vessels
  - Bones
  - Soft Tissues

- Definition: “Injury to three of these four elements” (Cannon & et al., 2012)
Causes of a Mangled Extremity

- Blunt Trauma
  - Motor Vehicle Crashes
    - MCC, Ped Strucks
  - Industrial
    - Machinery
    - Farm
  - Falls from Heights
  - High-Velocity Gunshots
  - Explosion/ Blast Injuries

(Bongiovanni, Bradley & Kelley, 2005)
The Managed Extremity: Before the Patient Arrives
Prehospital Information...

- Mechanism of Injury
  - How did it happen?
  - Was it High or Low energy?
  - How did patient look during injury and after?
  - What was the environment?
    - Industrial, MVA, etc.
    - Weather

(Walsh, 2009) (Prasarn, Helfet & Kloen, 2012)
Prehospital Information...

- How long did it take to access patient?
  - Time is Tissue...

- Pulses/ movement/ sensation in the extremity?

- Tourniquet in place?
  - What time went on

- Permissive Hypotension for transport.....
Preparing for patient arrival

- Warm blankets, fluid and blood available
- Pain Management
  - Anesthesia at bedside ready to intubate
- OR tourniquets.....
The Initial Management
What's First?

- Remember ABC’s
- Don’t get distracted by outward injuries
- Get information from patient
  - PMHX, Medications
  - Last PO
  - Family contact
- Don’t be fooled by distracting injuries!!
Initial Management

- Airway
- Breathing
- Circulation
  - Warm blood or fluid
    - Blood preferred over fluid
  - Warm patient
    - Even in summer use warming techniques

**LIFE OVER LIMB**

(Prasarn, Helfet & Kloen, 2012)
Initial Management: Control Hemorrhage

- EMS tourniquet
  - Time on
  - Time off

- OR tourniquets
  - Time inflate
  - Note any time taken down for pulse check or bleeding check
  - Note amount of pressure
  - Different from Limb Occlusion Pressure
    (McEwen, 2015)
Initial Management: OR Tourniquets Continued

• Common Complications
  • Nerve
  • Post- tourniquet syndrome
    • Long term post-operative swelling
  • Compartment Syndrome
  • Pressure Sores
    • Kerlix, then mesh covering
  • Further Necrosis
    • 6 hour perfusion time (Fryberg & Schinco, 2008)
  • Thrombosis (McEwen, 2015)
The Initial Management

- Medication
- Pain and Sedation
  - Large amounts..... Watch airway.
- Antibiotics
  - Ancef 2 grams
- Tetanus

(Frykberg & Schinco, 2008)
• Pulses on arrival
  • Doppler
• Detailed description of extremity
  • Don’t just state “mangled”
• Time tourniquet went up
  • Anytime take down to check pulses
• Movement and Sensation
• Photos are highly recommended
  • Get consent!!!

(Prasarn, Helfet & Kloen, 2012)
The Managed Extremity: Surgical Management
Surgical Management

- Damage Control Surgery
  - For life-threatening bleeding in abdomen and chest
    - LIFE OVER LIMB  Reduction and stabilization for limb by splinting
  - Amputation vs Limb Salvage
  - Definitive control of bleeding
    - Vascular ligation or vascular shunt placement

Surgical Management
Amputation

• Mangled Extremity Severity Score (MESS)
  • A form of guidelines recreated in 1990’s
  • 4 variables:
    • Skeletal/ soft tissue injury
    • Limb ischemia
    • Shock
    • Patient Age
  • Score 7 or greater Amputation

• Weakness of Study
  • Self-fulfilling nature inherent

(Higgins, Klatt & Beals, 2010)
Surgical Management
Amputation

Risk Factors:

- MESS score $\geq 7$
- Gustilo III-C injury
  - Comminuted, open tib-fib fx with vascular disruption
- Sciatic or tibial nerve, or 2 out of 3 upper extremity nerves transected
- Prolonged ischemia
  - 4-6 hours
- Crush or destructive soft tissue injury

- Significant wound infection
- Multiple/ severely comminuted fx’s/ segmental bones
- Old age/ severe comorbidities
- Lower versus Upper extremity
- Unable to re vascularize due to injury or failure of revascularization

(Higgins, Klatt & Beals, 2010)
(ACS, 2005) & (Scalea et al., 2011)
Don’t Close Traumatic Amputations!!
Surgical Management
Limb Salvage

• Debridement and removal of tissue

• Quick stabilization of fractures
  • External Fixator placement

• Temporary closure
  • Gauze
  • Negative pressure dressing
  • Antibiotic Beads

(Cannon et al, 2013)
Surgical Management
Post-Operative Considerations

- LIFE OVER LIMB!!!
- Continued Resuscitation
- Neurovascular Checks
  - Skin temperature
  - Color
  - Capillary refill
  - Palpable Pulses
    - If vascular repair may not be able to palpate right away
    - Doppler
- Signs & Symptoms of infection
- Signs of Compartment Syndrome
  - Think above area of injury too
- Pain Management
- Education & support
  - Patient and Family

(Frykberg & Schinco, 2008)
Complications

- Continued Hemorrhage
- Fat Embolism
- Pulmonary Embolism
- Compartment Syndrome
- Infection
- DVT

- Rhabdomyolysis
- Many operations with either amputation or limb salvage
- Physiological hardship
  - Depression
  - Thoughts of suicide

(Frykberg & Schinco, 2008)
(Cannon et al., 2013)
Outcomes of Amputation vs Limb Salvage
LEAP vs METAL Studies
High Energy Limb-Threatening Lower Extremity Injuries (LEAP)

• Prospective, Observational NIH funded
  • About $6 Million
• 8 Level 1 trauma Centers
• 601 Patients
  • 51 Traumatic Amputations
  • 128 Immediate & delayed amputations
  • 422 Hospital Reconstructions
    • 26 late amputations
• 24 months followed patient
LEAP Study
Sickness Impact Profile (SIP)

- Morbidity and complications
- Impairment/functional Limitations
- Quality of Life
  - Satisfaction scoring
- Direct/Indirect Cost

- High SIP rate factors
  - Hospitalization
  - Low education
  - Nonwhite race
  - Poverty
  - No Health Insurance
  - Poor Social Support
  - Poor Self Efficacy
  - Smoking
  - Involvement with Litigation (O’Toole, 2015)
LEAP Study....

Patient Demographics

- Poor
  - 38% No Health Insurance
  - 25% Below Poverty Line
- Education
  - 70% High School Grads
- Substance Abuse
  - 2 times National Average as “Heavy” Drinkers
- Personality Differences
LEAP Study Outcomes

- No difference in:
  - Return to Work- no change in 7 years
    - Amps 53%
    - Recon 49%
  - SIP
    - Rehospitalization: Amp 34% vs Recon 48%
    - Osteomyelitis: Amp 3% vs Recon 9%
    - More Surgery: Amp 5% vs Recon 19%
  - Cost Lifetime
    - Salvage: $163k
    - Amps: $509k
  - Patient Satisfaction
    - Function, Pain and Depression
    - 7 years Limb Salvage better outcome

(O’Toole, 2015) (Prasan, Helfet & Kloen, 2011)
The Military Extremity Trauma Amputation/ Limb Salvage Study (METALS)

- 324 Service members deployed to Afghanistan or Iraq
- 87.9% Blast Injuries
- Higher amount of amputations
- Less available multi-disciplinary surgical team available
- First Surgical Intervention
  - Role 3 ‘combat hospital’
    - Trauma Bay with surgeons, OR, some x-ray

(Doukas et al., 2013)
METALS Study

- No Difference:
  - Patient Satisfaction between amps/ salvage
    - SIP
- Far Less
  - Rehospitalization
  - Reoperations
- Received Earlier rehabilitations and Prosthetics
- Patient population
  - Young
  - Support

(Doukas et al., 2013)
LEAP vs MEATALS

• Same Conclusion:
  • No difference in Patient Return to work Late Complications Rehospitalization

• Contrast:
  • All Amputations from METALS patients received Prosthesis
  • METALS: no discussion of cost
  • LEAP : Difficult population due to many factors

• Which Is Right???
In Conclusion

- Remember:
  - ABC’s
  - LIFE OVER LIMB
  - Tourniquets
  - Documentation

- Damage Control Surgery
  - Amputation vs Limb Salvage
  - LIFE OVER LIMB
In Conclusion

- Post Operative Concerns
  - Neurovascular Checks
    - May have delay in palpable pulse if vascular repair
    - Skin color, temperature and cap refill
  - Complications
    - Compartment syndrome
    - Infection
  - Intervene early!!
In Conclusion

- Amputation vs Limb Salvage
  - Research still unclear
  - Many algorithms available
    - May or may not be helpful
  - Look at patient demographics
    - What are changes of getting a prosthesis?
- Communication and Education with patient and family
Special Thanks To:

- Ellen Plummer R.N., MSN, MBA, D.L., M.J., CCRN
- Lynn Gerber-Smith R.N., MS
- Diana Clapp RN, BSN, NREMT-P
- Robert V. O’Toole M.D.
References: