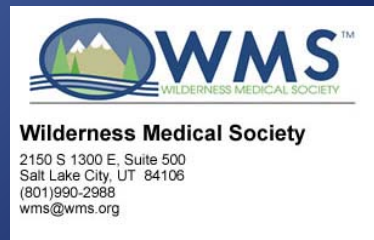


Trauma in the Wilderness

Advanced Wilderness Life Support®

By George Chen, DO MPH



**Disclaimer: This is not an AWLS/WMS sponsored lecture, though it contains summary of what the author learned at the recently attended AWLS course in Moab, Utah.

Objective

- Practical foundation of how to approach trauma care in the wilderness or backcountry setting for medical professionals
- To evaluate necessities of evacuation.
- Methods of management when evacuation is unavailable
- Learn techniques for evacuation
- Innovation of Combat Casualty Care

What's up?

- AWLS is an extension of ATLS into the field
 - Where resources are limited
- What's the bottom line? What's going to work?
- Triage and Decisions to Evacuate?
- What might you want to carry with you as the physician into the wilderness?

BIG picture

- 1. Scene safety
- 2. Massive Hemorrhage
- 3. Primary Survey
- 4. Secondary Survey
- 5. Altered Mental Status
- 6. When to Evacuate
- 7. How to Evacuate

Primary Survey #1

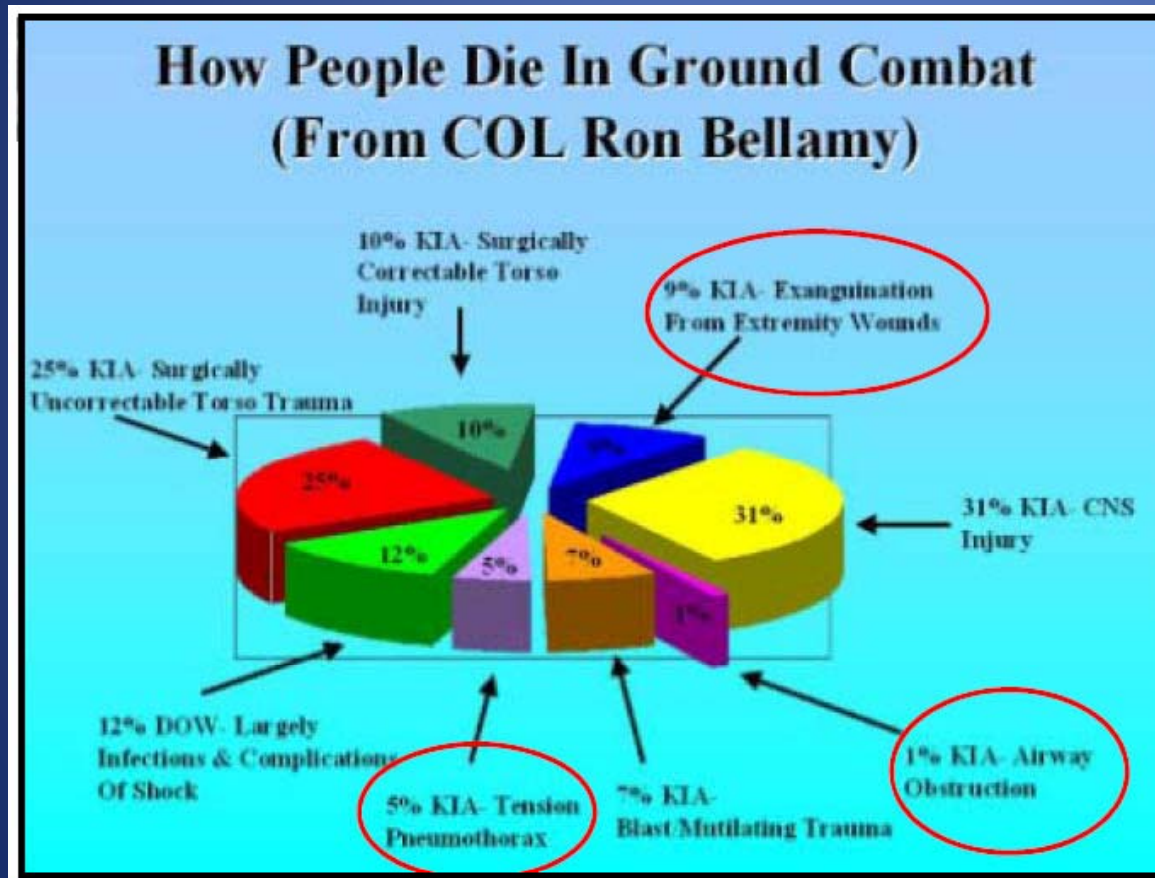
- WHAT'S FIRST?
- → SCENE SAFTY! ALWAYS!

- Is it safe?
- Approaching
- Identifying
- Getting permission to treat
- Evaluate and call for evacuation!

Primary Survey #2

- Massive Hemorrhage (**CARTS**)
 - **C** = Chest
 - **A** = Abdomen
 - **R** = Retroperitoneum/Renal
 - **T** = Thigh/Gluteal
 - **S** = Skin/Street
- Hemostasis
 - 1. Direct pressure (30-60min)
 - 2. Pressure point & elevation (after 20min of DP)
 - 3. CAT tourniquet and Combat Gauze (pressure dressing)
 - Ortho surgery – tourniquet ok for 90 min to 2 hr without sequelae
 - Allow Platelets to work & write tourniquet time on fore-head!

Dr. Bellamy's Vietnam Data



Circled = preventable death

- Uncontrolled hemorrhage is the cause of 10% of combat death
- Controlling hemorrhage in Vietnam could have saved more than 5000 lives

Feb 2008

Injury Severity and Causes of Death From Operation Iraqi Freedom and Operation Enduring Freedom: 2003–2004 Versus 2006

Joseph F. Kelly, MD, Amber E. Ritenour, MD, Daniel F. McLaughlin, MD, Karen A. Bagg, MS, Amy N. Apodaca, MS, Craig T. Mallak, MD, Lisa Pearce, MD, Mary M. Lawnick, RN, BSN, Howard R. Champion, MD, Charles E. Wade, PhD, and COL John B. Holcomb, MC

- 80% of deaths non preventable
- Major leading cause of potentially preventable death was truncal hemorrhage
 - Truncal Hemorrhage – 80%
 - Extremity hemorrhage – 15%
 - Heads – 5%
 - MOF – 5%

Primary Survey #3

- **A = Airway**
 - What's your name?
 - Speak loud, approach on side (minimize neck turning, c-spine)
 - Clear airway
- **B = Breathing**
 - Bilat breath sounds equal?
 - 2 rescue breaths
 - If no obstruction, check pulse (if no pulse in 10 sec, start CPR)
 - If yes obstruction → Heimlich
- **C = Circulation**
 - CPR 30:2, 5 cycles = 2min; check pulse
- **D = Disability**
 - GCS → just use motor. Conscious or not?
 - Neuro exam, pupil exam
- **E = Environment**
 - Get patient out of the elements, think second-harms

Tactical Airway Support

- Airway support is only about 1-11% of preventable death in combat.
- Mostly Face and Head wound
- → use Rescue Position and Nasal Trumpets
- During combat, *While Under Fire* → Surgical Airway is the airway of choice. Combat medics can place one in in **less than 1 minute!**

Secondary Survey

- **A** = Allergies to anything
- **M** = Medications
- **P** = Past Med/Surg Hx, previous injuries/illness
- **L** = Last meal (when & what)
- **E** = Event leading up to

Secondary Survey

- Pain Assessment (**COLDERR-AS**)
 - **C** = Character
 - **O** = Onset
 - **L** = Location
 - **D** = Duration
 - **E** = Exacerbation
 - **R** = Relief
 - **R** = Radiation
 - **AS** = Associated Symptoms

Secondary Survey

- Alter Mental Status (**AEIOU-TIPS**)
 - **A** = Allergies/Anaphylaxis
 - **E** = Epilepsy/Seizure (active or post-ictal)
 - **I** = Insulin (diabetes)
 - **O** = Over-dose (alcohol, medicine)
 - **U** = Under-dose (medicine)
 - **T** = Trauma
 - **I** = Infection (sepsis, meningitis)
 - **P** = Psych
 - **S** = Stroke

Controlling Hemorrhage

- Old method: Tourniquets
- New Method:
 - Hemostatic Agents
 - Resuscitation Techniques
 - New tourniquets

Hemostatic dressings and Powders

- ✦ Generation I
 - ✦ Red Cross Dry Fibrin Bandage
- ✦ Generation II
 - ✦ Hem Con Chitosan dressing
 - ✦ Quick Clot zeolite powder
 - ✦ Celox powder
- ✦ Generation III+
 - ✦ Combat Gauze
 - ✦ Woundstat
 - ✦ Chito Gauze
 - ✦ Celox gauze



*Information in this slide taken from a presentation given by Dr. Wedmore at AWLS 2010

Gen I: Fibrin Dressing

- Effective in Pig study with Arterial bleed and same effectiveness as suturing
- Why not used?
 - Approved for combat used not civilian use
 - Cost \$1000 per bandage

Gen II: QuickClot & HemCon & Celox

- Lots of animal studies; both FDA approved
- **QuickClot**: made of bio-inert powder called Zeolite. Absorb water in wound and concentrate clotting factor to form clot. \$20 a packet
 - Animal Studies: 100% survival with 6mm femoral artery hole
 - Human cases: 103 pts, 92% efficacy
 - Problem: cause exothermic rxn when dissolve in liquid to about 95 deg C at wound edge → cause burns
 - **Gen 1.5 QuickClot**:
 - contained powder, no thermal injury
 - Don't work well in severe hemorrhage
 - J Trauma 2009. (66)2. 1-11.





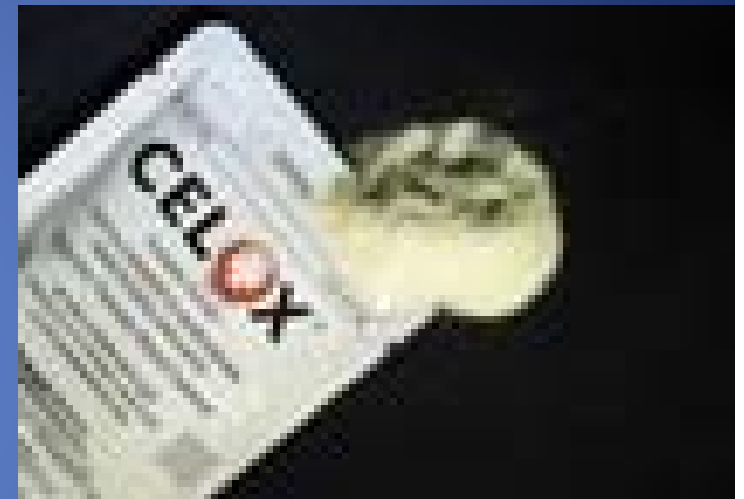
Gen II: HemCon

- **Chitosan** – ground up shrimp shells
- Ionic bond RBC, mobilize clotting factors to site, seals wound
- Antimicrobial and antifungal
- No thermal injury
- Work well to control severe venous and arterial bleed



Gen II: Celox

- Chitosan based
- One animal study
- Cheap
- Powder vs bandage?
 - Embolic risk?
 - Helicopter/airplane
 - Mess?



Gen III: Combat Gauze, Celox Gauze, ChitoGauze, Trauma Stat, Wound Stat

- **Combat Gauze**

- **New first line agent!**

- Best animal study, FDA approved, no human study

- No exothermic rxn, **KAOLIN impreg fabric**

- A clay substance

- Cheap: \$35



Gen III: all in gauze format

- **Wound Stat**
 - Smectite powder; clay like pro-coagulant
 - Pulled by FDA in 2009 for increase embolic risk in animal studies
- **Trauma Stat**
 - Chitosan & Silica based powder
 - Recently studied... up and coming...

Tourniquet

- Boston EMS 2008 – 75min avg use, no comp
- Advantage in combat-under-fire hemostasis
- Could've saved 5000 lives in Vietnam from arterial bleeds

Combat Application Tourniquet (CAT)





Tourniquet IV Basics

How Long can it be left in place?

- Up to 2 hours warm ischemic time standard in orthopedic surgery, though 60-90minutes used as a safety margin
 - Ostman B, Michaelson K, Rahme H et al: Tourniquet-induced Ischemia and Reperfusion in Human Skeletal Muscle. *Clin Orthop*: 2004; 418:260-265
 - Klenerman L. Tourniquet Time—How Long? *Hand*. 1980; 12(3):231-4
 - Horlocker TT, Hebl JR, Gali B, Jankowski CJ, Burkle CM, Berry DJ, Zepeda FA, Stevens SR, Schroeder DR. Anesthetic, patient, and surgical risk factors for neurologic complications after prolonged total tourniquet time during total knee arthroplasty. *Anesthesia & Analgesia*. 102(3):950-5, 2006 Mar.
- Longer if limb is cool
- Total time without risk is variable and unknown until approx 6 hours
- Neuropraxia can occur in as little as 45 minutes

Does a tourniquet need a lot of force?

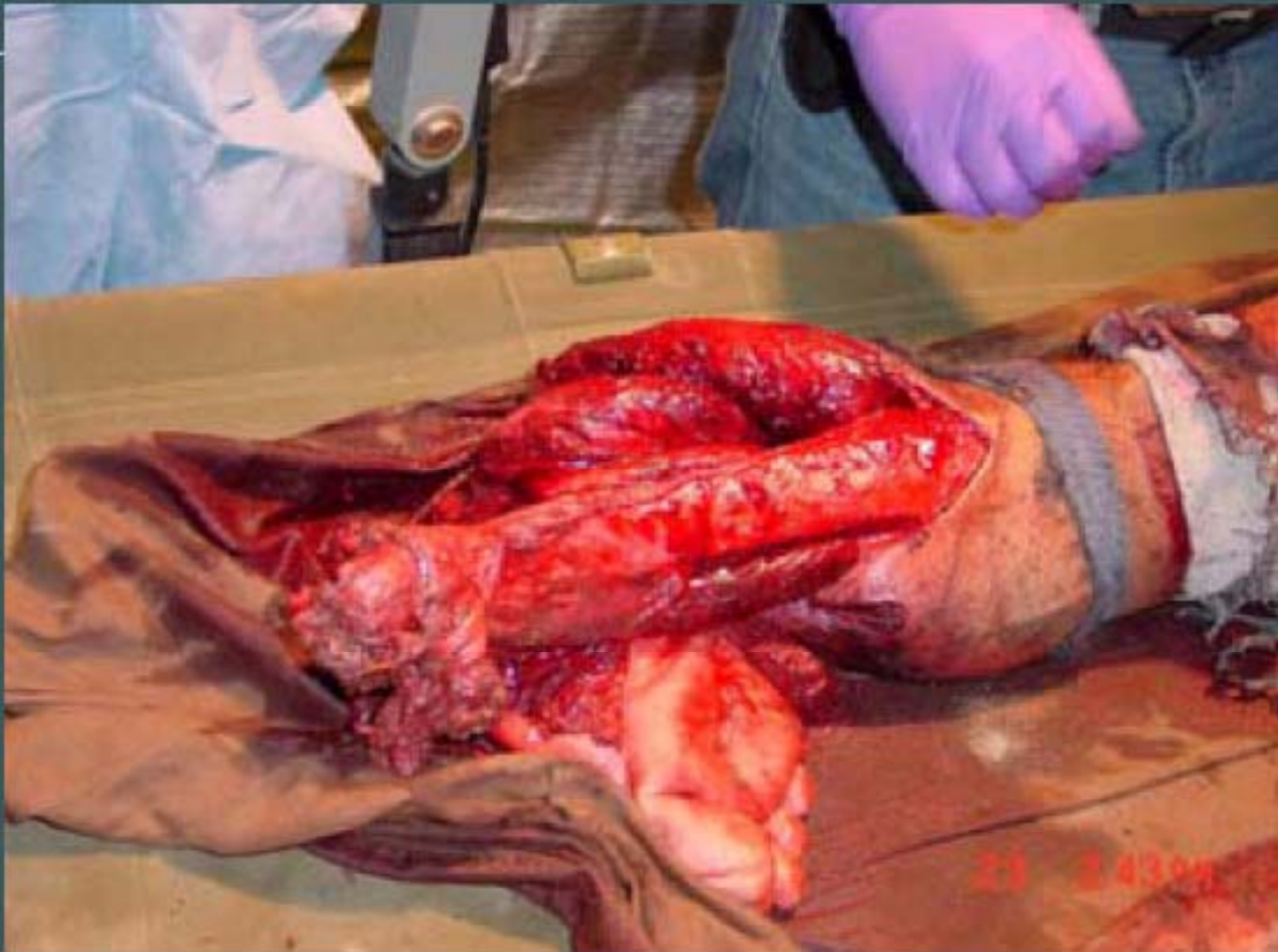
- Yes
- It must have a windless, ratchet or cam to work

Tourniquet V Basics



- Does a tourniquet need to be released every so often to allow blood flow? (non tactical or initial stabilization use)
 - No this only leads to bleeding
 - It can be attempted to be released when other bleeding control measures have been implemented
 - If the above doesn't work then it should be left in place until the casualty reaches definitive medical care
 - If one doesn't work put a second above the first

Wound requiring tourniquet



**Information in this slide taken from a presentation given by Dr. Wedmore at AWLS 2010

Practical Tourniquet Considerations

- 1. no neurovascular worries for 60-90min
- 2. ok up to 2 hrs warm ischemic time
- 3. If more than 6hrs, then limb amputation before release of tourniquet
- 4. In combat → **Tourniquet on first, then Combat gauze** → then release tourniquet

Airway



Breathing

- Open Chest Trauma
 - Chest Seal: Asherman, Borlin, Hyfin, H & H, Hydrogel, Halo
- Some has 'valves' and some not
- Taping on 3 sides don't work well, just cover the whole defect!
- Halo Chest Seal is the best and stickiest!



Tension Pneumothorax

- If chest seal used, and pt is in respiratory distress = TP → use Needle Decompression
 - >14 g angiocath to MCL or MAxL
- MC error, not deep enough or too medial
- If the opening is less than $\frac{3}{4}$ diameter of the trachea, then it will not 'suck.' Tape up the defect. If tension, then stick a needle in and leave it open!
- Chest tube not indicated in the field (dirty, 50% misplaced)

Circulation

- All casualties need vascular access!
- Peripheral IV, IO, FAST
- 1-2L of LR/NS resuscitation in 45min until whole blood is avail
- Keep tissue perfusion, avoid ischemia and hypotension
- **Goal is Radial Pulse Palpable (SBP >85) and mental status**

Cube and Weight

Effect of Different Solutions on Plasma Expansion

Volume infused (mL)	Type of Fluid Infused	Plasma Volume Expansion (mL)
1,000	D5W	100
1,000	lactated Ringer's	250
250	7.5% hypertonic saline	1,000
500	5% albumin	375
100	25% albumin	450
500	Pentastarch	750
500	hetastarch	500-600

Resuscitation

- TCCC pre-hospital fluid of choice = **Hextend**
 - 1:1 volume expansion
 - No bleeding risk up to 1.5L
 - past 1L, use NS or LR (1:3 volume expansion)
- **Plasma**
 - The best choice
 - Clotting factors
 - Everyone carry one of their own; powder form to come...

Antibiotics

- Wound to Abx time is crucial
- TCCC drug of choice is Moxifloxacin
- Levaquin is DOC now

Pain Control

- Acupuncture – 10/10 → 1/10 in 5 ear needles
- Mobic
 - 90% COX2
 - No platelet effect, not sulfa
 - Long half life 15-20hrs
- Actiq 1600mcg
 - Only for extreme injuries, with physician monitoring
 - Tape to finger, if falls asleep, it gets pulled out
 - 90% reduction of pain in 15min
 - Peak 10-20 min
 - Half life 6-7hrs
 - Minimal effective dose is 800mcg

Wound Management

- General rule:
 - Fully Expose affected area
 - Hemostasis; amt of bleeding allow self cleansing
 - Assess neurovascular flow and musculoskeletal function (reduce fx and joints)
 - Clean wound (pressure, at least 60ml/cm of injury)
 - Definitive care
 - Perforated duct tape work as well as steri-strips
 - Tie hair together to close scalp wound
 - Abx for dirty/puncture wounds or sx of infxn, most wound infxn start around 48hrs in the back country

Fractures & Sprain/Strain & Dislocations

- Reduction
- Immobilize in functional position
- Check neurovascular flow
- RICES for 72hrs
 - Rest, Ice, Compression, Elevate, Stabilize



Life Threatening Fractures

- C-Spine
 - C-spine precaution, NEXUS vs Canadian Rules
 - Collar, backpack belts
- Pelvis
 - T-pot, belt, sheet → over level of greater trochanter and pubis
- Femor
 - Reduce, buddy splint legs, check for shock

Evac

- All traumas...

Reference

- AWLS[®] course and manual
- Tactical Combat Casualty Care (TCCC) guidelines
- Innovations in Combat Casualty Care: Civilian Application by Ian Wedmore, MD, FACEP

Questions?