- Hemorrhage Control
- Sepsis Overview

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Goals:

1) Review the military and civilian evidence for proper tourniquet use in EMS medicine.

2) Briefly discuss hemostatic gauze use in EMS medicine.

3) Review MCEMS protocols for Amputations and for Tourniquets.

4) Discuss sepsis, with an emphasis the various classifications of sepsis syndromes, and on early recognition of possible sepsis by EMS.

5) Review MCEMS protocols for treatment of sepsis syndromes.

6) Review several MCEMS sepsis cases.
Hemorrhage Control in MCEMS
Overview Concepts

- External hemorrhage is a significant cause of potentially preventable death after severe injury.
- Best studied/understood in the military environment, with significant decrease in mortality after implementing guidelines for tourniquet use.
- Lessons learned from the militaries’ experience with hemorrhage control are beginning to be applied to EMS/civilian medicine.
- In January 2014 the NAEMSP and American College of Surgeons published a large review of the literature, and produced a Guideline for external hemorrhage control in the civilian EMS environment.
AN EVIDENCE-BASED PREHOSPITAL GUIDELINE FOR EXTERNAL HEMORRHAGE CONTROL: AMERICAN COLLEGE OF SURGEONS COMMITTEE ON TRAUMA

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ABSTRACT

This report describes the development of an evidence-based guideline for external hemorrhage control in the prehospital setting. This project included a systematic review of the literature regarding the use of tourniquets and hemostatic agents for management of life-threatening extremity and junctional hemorrhage. Using the GRADE methodology to define the...
Hemorrhage Control

Overview Concepts...

- The use of tourniquets and hemostatic agents is not currently widespread in civilian-based EMS medicine.
- How military experience might apply to pediatric, geriatric and non-young/non-healthy individuals is unclear.
- Formal protocols/guidelines for EMS use have been lacking due to:
  - Lack of experience/evidence of civilian benefit;
  - Concerns regarding overuse of these modalities at the expense of basic hemorrhage control methods.
- Tourniquet use is part of the basic EMT psychomotor skill set nationally; tourniquets are required ambulance equipment nationally; hemostatic agents are optional.
Tourniquet Use

The Military Experience

- There is a large body of published evidence from the US Military regarding lessons learned about field control of hemorrhage using tourniquets.

- Much of it focuses on balancing safety and effectiveness.

- Safety: doing as little damage (nerve compression!) as possible...

- Effectiveness: effectively controlling hemorrhage.

- This safety/effectiveness balance is often referred to as “the Yin and Yang” of tourniquet use.

- It is an excellent paradigm for civilian users of tourniquets to always keep in mind.
Military Experience...

- **Theme:** balancing appropriate force to-
  - Occlude severe hemorrhage, while
  - Minimizing damage to underlying tissues
  - Nerves are the structure most vulnerable to the pressure caused by tourniquets

- **How a tourniquet works:** pressure.

- **How a tourniquet works best:** moderate pressure over a safe width

- **Key to effectiveness:** create a pressure gradient across the wall of the proximal blood vessel wall.

- **Key to Safety:** minimize the pressure gradient across the adjacent nerve structures as much as possible.
Military Experience...

- Wider device applied with less force = “safer”...
- “Stacking” 2 or 3 devices along the limb proximal to bleeding= “safer”...
- Using a “strap within a strap” type device more evenly distributes forces around the limb= “safer”
- In 2005 or so the military began issuing the CAT (Combat Application Tourniquet).
- The CAT tourniquet will be the commercial tourniquet used in MCEMS per Dr. Hall.
- It is a “strap within a strap device” designed by retired U.S Army Ranger medics.
CAT Tourniquet
CAT Tourniquet Use

Combat Application Tourniquet®

Instructions for Use: Two-handed Application

To prepare for use, store the C-A-T® in its one-handed configuration

1. Apply tourniquet proximal to the bleeding site. Route the band around the limb and pass the tip through the inside slit of the buckle. Pull the band tight.

2. Pass the tip through the outside slit of the buckle. The friction buckle will lock the band in place.
Pull the band _very tight_ and securely fasten the band back on itself.

Twist the rod until bright red bleeding has stopped and the distal pulse is eliminated.
Place the rod inside the clip; locking it in place. **Check for bleeding and distal pulse.** If bleeding is not controlled, consider additional tightening or applying a second tourniquet proximal side by side to the first and reassess.

Secure the rod inside the clip with the strap. **Prepare the patient for transport and reassess.** Record the time of application.
Tourniquet Use

In 2011 the military performed a large study to identify “pearls and pitfalls” of tourniquet use...

MILITARY MEDICINE, 176, 10:1144, 2011

The Military Emergency Tourniquet Program’s Lessons Learned With Devices and Designs

COL John F. Kragh Jr., MC USA*; CPT Michelle L. O’Neill, AN USA†; Thomas J. Walters, PhD*; Michael A. Dubick, PhD*; David G. Baer, PhD*; Charles E. Wade, PhD‡; John B. Holcomb, MD‡; COL Lorne H. Blackbourne, MC USA*

ABSTRACT Objective: The purpose of this study is to report the device lessons learned from an emergency tourniquet
1. User understanding of how the device works best helped attain better results.

2. Correct user actions (e.g. REMOVE ALL SLACK before twisting) led to device effectiveness.

3. Users often assumed that optimal use required more force, but this was associated with misuse.

4. Placing 5 cm proximal to wound gave best results.

5. Stacking several tourniquets gave good results.

6. Applying over forearm or lower leg was highly effective, and is an appropriate site for tourniquet use.

7. Training should include tourniquet pearls and pitfalls.
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- Proposed a guideline for EMS hemorrhage control...
Prehospital External Hemorrhage Control Protocol

- Apply direct pressure/pressure dressing to injury

Direct pressure effective (hemorrhage controlled)

Wound amenable to tourniquet placement (e.g. extremity injury)

Apply a tourniquet*

Direct pressure ineffective or impractical (hemorrhage not controlled)

Wound not amenable to tourniquet placement (e.g. junctional injury)

Apply a topical hemostatic agent with direct pressure#

NAESMP, January 2014
Recommendation 1:

*Recommend the use of tourniquet in prehospital setting for significant extremity hemorrhage if direct pressure is ineffective or impractical.*

Comments:

- Tourniquets have “clear survival benefits” in this setting.
- Direct pressure may be ineffective in major arterial injury.
- Direct pressure may be impractical with:
  - Limited person power on scene;
  - Unsecure scene;
  - Complex extrication/extraction required.
Recommendation 2:

*Suggest using commercially produced windlass, pneumatic or ratcheting devices that have been demonstrated to occlude arterial flow.*

Comments:

- Tourniquets that impede venous return without adequate arterial occlusion may only worsen hemorrhage and increase complications.
Recommendation 5:

*Suggest against releasing a tourniquet that has been properly applied in the prehospital setting until the patient has reached definitive care.*

Comments:

- Given the relatively short transport times in civilian EMS, the safest option is felt to be to leave the tourniquet in place until at the hospital.
- There may be exceptions for extended/austere environments, and on-line medical control should be consulted.
Tourniquets

MCEMS Protocols...

4050 AMPUTATIONS

General Trauma Care Protocol

Bleeding Controlled
- Large bore IV
- If hypotensive, treat per Traumatic Shock Protocol
- Document neurovascular exam

Uncontrolled Bleeding
- Control with direct pressure to bleeding area or vessel
- If bleeding not controlled with direct pressure, see Tourniquet Protocol
**Indications**

A. A tourniquet may be used to control potentially fatal hemorrhage only after other means of hemorrhage control have failed.
Precautions

A. Applying a tourniquet incorrectly can increase blood loss.

B. Applying a tourniquet can cause nerve and tissue damage whether applied correctly or not. Proper patient selection is of utmost importance.

C. Injury due to tourniquet is unlikely if the tourniquet is removed within 1 hour. In cases of life-threatening bleeding, benefit outweighs theoretical risk.

D. A commercially made tourniquet is the preferred tourniquet. If none is available, a blood-pressure cuff inflated to a pressure sufficient to stop bleeding is an acceptable alternative. Other improvised tourniquets are not allowed.
Tourniquets

MCEMS Protocol 4010

Technique

A. First attempt to control hemorrhage by using direct pressure over bleeding area.
B. If a discrete bleeding vessel can be identified, point pressure over bleeding vessel is more effective than a large bandage and diffuse pressure.
C. If unable to control hemorrhage using direct pressure, apply tourniquet according to manufacturer specifications and using the steps below:
   1. Cut away any clothing so that the tourniquet will be clearly visible. NEVER obscure a tourniquet with clothing or bandages.
   2. Apply tourniquet proximal to the wound and not across any joints.
   3. Tighten tourniquet until bleeding stops. Applying tourniquet too loosely will only increase blood loss by inhibiting venous return.
   4. Mark the time and date of application on the patient’s skin next to the tourniquet.
   5. Keep tourniquet on throughout hospital transport—a correctly applied tourniquet should only be removed by the receiving hospital.
Summary Pearls

- Apply direct pressure first, tourniquet is second line.
- Know your device- employ it properly!
- Remove ALL SLACK from CAT before using windlass.
- More force is likely NOT the answer- wider/stacked= safer.
- Tighten enough to stop arterial flow.
- Make tourniquet visible to all other providers.
- Once properly applied, leave in place until at hospital.

Though protocol states “after other interventions have failed”, clearly severe, exsanguinating bleeding may be treated with tourniquet as primary hemorrhage control agent.
Hemostatic Dressings

- Decisions about if, and which, product will be used in MCEMS have not been made yet.

- **But know this:**
  - You have to firmly **pack** the wound with the hemostatic gauze.
  - You have to apply good **direct pressure** (at least 3 minutes worth in the military’s experience).
  - Generally bulkier, gauze-type products have shown greater immediate and 10 minute bleeding control.
  - More to come at a future time.
Questions or comments on this topic?
Sepsis Syndromes Overview
Overview Concepts

- Much like STEMI, Stroke and Trauma, sepsis is now a syndrome which ideally receives:
  - early recognition,
  - early, aggressive treatment,
  - early pre-notification of the receiving ED

- Like STEMI, Stroke and Trauma, there is clear evidence that EARLY and aggressive recognition and treatment saves lives.

- Many of the notions you currently have regarding what constitutes a patient with a sepsis syndrome may be very erroneous.

- So, let's look at what constitutes a sepsis syndrome in modern medicine.
S.I.R.S.

- Systemic Inflammatory Response Syndrome
- It is not a diagnosis. But its presence must be explained.
- It is a syndrome which argues for some sort of inflammatory process - infection, sepsis, trauma, pancreatitis, burns, many others.
  - So, SIRS does not = sepsis
  - But, vigilance for the SIRS syndrome puts you on the scent EARLY of a patient who may have a sepsis syndrome.
- JAMA, 1995, admitted patients:
  - 3% mortality in patients without SIRS
  - 6% in those with 2 SIRS criteria
  - 10% in those with 3 SIRS criteria
  - 17% in those with all 4 SIRS criteria
A patient has the Systemic Inflammatory Response Syndrome if they have **2 or more of**:

1. Temperature >38 (100.4F) or <36 (96.8F)
2. Heart Rate >90
3. Respiratory Rate >20 (or PaCo2<32 on ABG)
4. WBC’s <12,000 or <4,000; or >10% bands

- The first 3 are the only ones that typically can be assessed in the EMS environment.
- Although with transfers you may/should be aware of the WBC counts as well.

- Does your patient meet SIRS criteria is the leaping off point.
The 4 Sepsis Syndromes

1) Systemic Inflammatory Response Syndrome

2) SEPSIS = SIRS, plus:
   a suspected or documented infection.

3) SEVERE SEPSIS = SEPSIS, plus:
   AMS, hypotension, hypoxemia, no urine output, lactate > 2

4) SEPTIC SHOCK = SEVERE SEPSIS, plus:
   refractory hypotension needing pressor support
despite adequate volume resuscitation
So, notice...

- A patient with 2 or more SIRS criteria and an EMS suspected infection has SEPSIS:
  - Their BP will/may be normal!
  - Their mentation will/may be normal!
  - Yet, they have sepsis by modern definition.

- If you think they have sepsis (as above), and they are altered, hypotensive, hypoxic, they have SEVERE SEPSIS.

- Early fluid resuscitation is the key early treatment.

- The ideal:
  - Early EMS recognition of syndrome
  - Early EMS fluid resuscitation
  - Early EMS notification of ED of sepsis syndrome
**Shock** is a state of decreased tissue oxygenation. Significant vital organ hypoperfusion may be present without hypotension. Home medications and/or comorbidities may also limit development of tachycardia.

**Goal** is to maximize oxygen delivery with supplemental oxygen and assisted ventilations (if needed), and to maximize perfusion with IV fluids.

Adult with SBP < 90 mmHg AND/OR signs of poor perfusion

- ABCs
- Complete set of vital signs
- Full monitoring
- \(O_2\) via NRB facemask @ 15L/min
- IV access
- ALS transport

Signs of poor perfusion?

- Altered mental status
- Tachycardia
- Cool, clammy skin
- Venous lactate > 4 (see below)
Septic Shock
Defined by:

1. Presence of Systemic Inflammatory Response Syndrome (SIRS)

   AND

2. Suspected infection

   AND

3. Signs of hypoperfusion (hypotension or elevated venous lactate)

   SIRS criteria:
   - HR > 110
   - RR > 24
   - Temp > 100.4° F or < 96.8° F

   The initial treatment of septic shock involves maximizing perfusion with IVF boluses, not vasopressors.
Sepsis; Protocol 3100

**Pediatrics**

20cc/kg boluses; up to total of 60cc/kg.

Contact base for ongoing age appropriate hypotension.
Summary Pearls...

- A heightened EMT awareness for possible sepsis syndromes is the KEY to thinking of the diagnosis.
- Understand that hypotension **IS NOT** part of the early recognition of sepsis syndromes!!
- Know the SIRS criteria. Apply them to your patient. Do they meet 2 of them?; do you suspect an infection as well?- they have sepsis.
- Fluid resuscitate early and aggressively if they have sepsis syndrome and can tolerate fluid boluses.
- No pressors until adequate fluids have been administered.
- Notify ED in your report that patient meets SIRS/ SEPSIS/ SEVERE SEPSIS/ SEPTIC SHOCK criteria
Case #1

- 71 yo male
- CC: “Breathing difficulties”
- HPI: SOB and N/V since prior evening. V x 20. Fever to 101 degrees. 3/10 CP, constant since yesterday.
- PMH: DVT on coumadin, COPD on oxygen, HTN
Case #1

- VS: 134/84, HR 118, RR 28, SaO2 92 on 4 lpm
- PE: Anxious, pale, diaphoretic, warm to touch. Speaking full sentences, but using accessory muscles. Wheezing upper lobes, tight lower. + edema with warm left leg
Case #1

- SIRS vs Sepsis?
  - SIRS criteria – HR, RR, T
  - Sepsis criteria – Source?

- Care: What would you do?

- Care: Neb, NRB, bolus 250 cc but further IVF withheld to not exacerbate SOB

- Course: HR up, BP down 96/56

- Hospital: ETT, ICU, Septic shock. Flu +, cellulitis of LLE. Still in hosp 3 weeks later.
Case #2

- 3 yo male
- CC: Near syncope at daycare
- HPI: Patient was standing in line for recess when he looked pale and like he was going to pass out. MOC states cough last night.
- PMH: asthma, croup 3 weeks ago
Case #2

VS: 92/50, 128, 34, SaO2 95 RA

PE: Lethargic, lying on floor of office, skin dry/hot. CR > 4 sec, + flaring, accessory muscle use. No stridor. + congestion in lower lobes, + cough. BG 92
Case #2

- SIRS vs Sepsis?
  - SIRS criteria – HR, RR, T?
  - Sepsis criteria – Source?

- Care: Saline neb with symptomatic improvement. No IV started.

- Course: Sats OK, BP OK, RR 28

- Hospital: RUL and RLL pneumonia. Sepsis.
Sepsis Syndromes in MCEMS

Questions or comments on this topic?
No mas