Hemorrhage Control in the Prehospital Arena

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Thank You

• Committee on Tactical Combat Casualty Care
• Loyola University
• Mark Belden – AMR Shasta County
The Problem with Hemorrhaging

• Bleeding is the leading cause of preventable death in all types of traumatic injuries\(^1\)

• Current research indicates stopping hemorrhage early is critical to good outcomes\(^1,2\)

• 25% of trauma patients arriving in the ED have established coagulopathy\(^2\)

\(^1\) Kauvar, D. et al, Impact of Hemorrhage on Trauma Outcome, J of Trauma; 2006; 60:s3-s11
\(^2\) Brohi, K et al, Acute Traumatic Coagulopathy, J Trauma; 2003; 54:1127-1130
Pediatric patients blood volume and hypothermia
Slipped in Shower Hit Soap Dish!
Definitive Care
Oxygenation is crucial

• Our body requires oxygen to survive.
• Blood carries the RBCs that transport the oxygen.
• Blood carries the clotting factors that we need.
• The point is to “pounce” on blood loss quickly and aggressively.
• Permissive hypotension versus fluid resuscitation.
• Damage control surgery and care.
Science of Coagulopathy

• Stopped the bleeding… More fluid?
  – “Replace what the patient has lost”
    • If blood has been lost, give blood (hemorrhage)
    • If crystalloid has been lost, give crystalloid (dehydration)-Nausea/Vomiting
  – But what about my two large bore IV’s?!?
    • Not so fast…
      “Prehospital Intravenous Fluid Administration is Associated with Higher Mortality in Trauma Patients: A National Trauma Data Bank Analysis”
Science of Coagulopathy

Is Too Much Fluid Bad???

Two large bore IV's infusing WO

Reverses Vasoconstriction
Dislodges Clots
Hypothermia
Hemodilution

Coagulopathy

MORE BLEEDING!!!
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Science of Coagulopathy

• **Bottom line…**
  – IV fluids
    • Penetrating trauma
      – Little to no benefit
      – Can cause increased mortality
    • Blunt trauma
      – Neither good nor bad

• **So what do we do?**
  – Judicious use of fluids to maintain good MAP pressure
MAP Pressure
2 x Diastolic + Systolic / 3

Given: BP 120/80
(2 x 80) + 120 = 280
280 / 3 = 93.3
MAP of 93.3

Given: BP 90/60
(2 x 60) + 90 = 210
210 / 3 = 70
Map of 70

A MAP of 65 is needed to maintain perfusion to vital organs… Brain, heart, lungs, kidneys…
Hemodynamic Response to Hemorrhage

- Vascular resistance
- Cardiac output
- Blood pressure

Percent of control vs. Percent blood volume deficit

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## Blood Pressure

<table>
<thead>
<tr>
<th>Age</th>
<th>Systolic BP (mm Hg)</th>
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<tbody>
<tr>
<td>0 to 1 month</td>
<td>60</td>
</tr>
<tr>
<td>&gt; 1 month</td>
<td>70</td>
</tr>
<tr>
<td>&gt; 1 year =</td>
<td>70 + 2 X age (years)</td>
</tr>
</tbody>
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- Palpable pulses ~ SBP 70-80 (radial)
- Compare central pulses to distal pulses and quality of them.
- Feel for the temperature break point along the extremity.
- These are lower percentile values
Treatment Priorities

- Stop bleeding
- Prevent initiation of the lethal triad
- Rapid transport to definitive care
The goal is to control hemorrhage

All of the technologies (direct pressure, pressure dressing, packing, wound closure, tourniquet) attempt to achieve 1 aim:

Pressure outside of the bleeding vessel = Pressure inside the injured vessel

Bottom line: Results in **Hemostasis** (clot eventually forms, coagulation)
“Study* finds that nearly 25% of the 4,596 combat deaths in Iraq and Afghanistan between 2001 - 2011 were “potentially survivable”

- 87% of the deaths occur prior to reaching a medical facility
- 91% of potentially survivable deaths were due to uncontrolled blood loss

"Hemorrhage control, both control of torso hemorrhage and junctional hemorrhage are top research priorities," Butler told members of the Defense Health Board on June 25, 2012.

*Eastridge et al. J Trauma Acute Care Surg. 2012; 73 (S431-#437)
Causes of Death

#1 – Hemorrhage

#2 – Tension Pneumothorax

#3 – Airway Obstruction
Basics

• Hemorrhage control
  • Prior Techniques
    • Direct pressure
    • Pressure dressing
    • Elevation (ineffective)
    • Pressure point compression (ineffective)
PHTLS

“The use of ‘elevation’ and pressure on ‘pressure points’ is no longer recommended because of insufficient data supporting their effectiveness” (PHTLS, 7th Ed, 2011. p.115)
New Recommendation

• Hemorrhage control
  • Direct pressure
  • Pressure dressing
  • Tourniquet

(PHTLS, 2011)
Indications Tourniquet

Hemorrhage from an extremity that cannot be controlled with direct pressure or a pressure bandage
Contraindications Tourniquet

- There are no absolute contraindications to tourniquet application when faced with the appropriate clinical situation.
Care Under Fire Guidelines

• Stop *life-threatening* external hemorrhage if feasible:
  • Direct providers to control hemorrhage by tourniquet and packing wounds.
  • Apply the tourniquet proximal to the bleeding site, over the clothing, tighten, and move the patient.
How do you apply direct pressure?
How long do you apply direct pressure?
Improvised Windlass Tourniquet

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Improvised Windlass Tourniquet

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Improvised Windlass Tourniquet
Care Under Fire/Active Shooter/Hostile Event

Where a tourniquet can be applied, it is the first choice for hemorrhage control in Care Under Fire.
When is Bleeding Life-threatening?

- Is there pulsatile or steady bleeding from the wound.
- Blood is pooling on the ground.
- The overlaying clothes are soaked with blood.
- Bandages or makeshift bandages used to cover the wound are ineffective and steadily becoming soaked with blood.
- There is traumatic amputation of the arm or leg.
- There was prior bleeding and the patient is now in shock (unconscious, confused, pale).
Tourniquet Application

• Apply without delay if indicated
• Both the casualty and the medic are in danger while a tourniquet is being applied in the hot zone – don’t use tourniquets for wounds without significant bleeding.
• The decision regarding the relative risk of further injury versus that of bleeding to death must be made by the person rendering care.
Hemorrhage Control

- **Tourniquets**
  - For life threatening hemorrhage
  - First line for life threatening arterial bleed
  - Not just for active shooter
Tourniquet Application

• Apply the tourniquet without removing the uniform or clothing – make sure it is clearly proximal to the bleeding site.
• Tighten until bleeding is controlled.
• Tightening the tourniquet is the major method to apply pressure.
• The windlass is a secondary adjunct.
• May need a second tourniquet applied just above the first to control bleeding.
• Don’t put a tourniquet directly over the knee or elbow.
• Don’t apply over an impaled object.
Tourniquet Application

• Document application time.
  • Don’t be afraid to write on the patient!
Pearls

• Tighten the tourniquet until bleeding is controlled.
• If the first tourniquet fails to control the bleeding, apply a second tourniquet just above (proximal to) the first.
• Time of tourniquet application should be relayed to each provider that assumes.
• Instruct patient to inform every care provider that they come in contact with that a tourniquet has been placed and its location.
**Limb amputation:** 2nd tourniquet goes above the 1st

**Extremity amputation:** 2nd tourniquet *can* go above the injury
Anatomy of a C-A-T™

The Combat Application Tourniquet™ (C-A-T™) (Patent Pending) is a small and lightweight one-handed tourniquet that completely occludes arterial blood flow in an extremity.
One-Handed Application to Arm

Step 1: Insert the wounded extremity through the loop of the Self-Adhering Band.
Apply 2 to 3 inches above the bleeding site.
One-Handed Application to Arm

Step 2: Pull the Self-Adhering Band tight and securely fasten it back on itself.
One-Handed Application to Arm

Step 3: Adhere the Band **tightly** around the arm.
Do not adhere the band past the clip.
Should not be able to slip fingers underneath.
One-Handed Application to Arm

Step 4: Twist the Windlass Rod until bleeding has stopped.
Check for bleeding and distal pulses.
If there are pulses or continued bleeding, tighten more or apply a second tourniquet.
One-Handed Application to Arm

Step 5: Lock the Windlass Rod in place with the Windlass Clip™.
One-Handed Application to Arm

Step 6: Adhere the Self-Adhering Band over the Windlass Rod – for small extremities, continue adhering the band around the extremity.
One-Handed Application to Arm

Step 7: Secure the Windlass Rod and Self-Adhering Band with the Windlass Strap – grasp the Windlass Strap and pull it tight, adhering it to the opposite hook on the Windlass Clip
One-Handed Application to Arm

Hemorrhage is now controlled.
Step 1
Route the band around the limb, pass the red tip through the slit of the buckle, and position tourniquet 2-3" above the bleeding site. If the most proximal bleeding site is not readily identifiable, place the tourniquet as high as possible on the limb.
Step 2

Pull band **TIGHTLY** and fasten it back on itself all the way around the limb, but not over the rod clips. Band should be tight enough that tips of three (3) fingers cannot be slid between the band and the limb. If the tips of three (3) fingers slide under band, retighten and re-secure.
Step 3
Twist the rod until bleeding has stopped.
This hurts!!!!!!
Step 4
Snap the rod inside a clip to lock it in place. Check for bleeding and distal pulse. If bleeding is not controlled, or distal pulse is present, consider more tightening or applying a second tourniquet above and side-by-side to the first. Reassess.
Step 5

Route the band over the rod and between the clips. Secure with the grey securing strap. Record time of application.
After a Tourniquet has been Applied

- After any tourniquet application, monitor the patient closely to ensure that the tourniquet remains tight and that bleeding remains controlled.
- Reassess – reassess– reassess!
Tourniquets – Kragh et al
Annals of Surgery 2009

• Ibn Sina Hospital, Baghdad, 2006
• Tourniquets are saving lives on the battlefield.
• Better survival when tourniquets were applied before casualties went into shock.
• Estimated 31 lives saved in this study by applying tourniquets prehospital rather than in the ED.
Tourniquets – Kragh et al
Journal of Trauma 2008

• Combat Support Hospital in Baghdad.
• 232 patients with tourniquets on 309 limbs.
• CAT was best field tourniquet.
• No amputations caused by tourniquet use.
• Approximately 3% transient nerve palsies.
Tourniquet Mistakes to Avoid!

• Not using one when you should.
• Using a tourniquet for minimal bleeding (risk versus benefit analysis).
• Putting it on too proximal.
• Taking it off when the casualty is in shock or has only a short transport time to the hospital.
• Not making it tight enough – should eliminate the distal pulse.
Tourniquet Mistakes to Avoid!

• Not using a second tourniquet if needed.
• Waiting too long to put the tourniquet on.
• Periodically loosening the tourniquet to allow blood flow to the injured extremity.

• These lessons learned have been written in blood.
Tourniquet Pain

- *Tourniquets HURT when applied effectively.*
- Does not necessarily indicate a mistake in application.
- Does not mean you should take it off!
- Consider analgesia if appropriate.
Tourniquets During MCI Events

• *In START Triage: once a tourniquet is applied the patient is automatically an Immediate/Red patient!*
Not the time to buy your tourniquet on eBay

• Avoid “knock offs”.
• They break and don’t function well.
Hemorrhage Control in Those Hard to Reach Areas

- Some wounds are located in places that a tourniquet (a standard or junctional) cannot be applied, such as:
  - Neck
  - Axilla (armpit)
  - Groin
- The use of a hemostatic agent (e.g., Combat Gauze) is generally not tactically feasible in the hot zone because of the requirement to hold direct pressure for 3 minutes.
- Israeli Bandage is an excellent choice.
Israeli Bandage Video
How do you pack a wound?
The incision and drainage approach for an abscess.
Pack it like you mean it! 
The hemorrhage control method!
Combat Gauze (impregnated, not the powder)

- Tested in a safety model.
- Widely fielded in the DoD.
- Case series from the battlefield and the civilian sector:
  - CG is effective at stopping bleeding.
  - No safety issues reported.
- Recommended by CoTCCC as first choice for hemostatic dressing.
Combat Gauze Directions (2)
Pack Wound Completely

- Pack Combat Gauze tightly into wound and directly onto the source of bleeding.
- More than one gauze may be required to stem blood flow.
- Combat Gauze may be re-packed or adjusted in the wound to ensure proper placement.
Bring a friend with you!

• *Many hands make quick work!*
Patient stabbed by spouse
Scapula wound
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Questions Guaranteed But Answers Are Not

ASK HARD QUESTIONS
Test Review Question 1

• Tourniquets are inherently dangerous and should be used when there are no other options.
  
  • True
  • False
Test Review Question 1

- Tourniquets are inherently dangerous and should be used when there are no other options.

  • False
Test Review Question 2

• The Israeli Bandage is an excellent choice for junction area wounds such as groin, axilla, and neck.

  • True
  • False
Test Review Question 2

- The Israeli Bandage is an excellent choice for junction area wounds such as groin, axilla, and neck.

  - True
Test Review Question 3

- Packing a wound, you need to be exceedingly gentle and not apply pressure or risk damaging the local tissues.
  - True
  - False
Test Review Question 3

• Packing a wound, you need to be exceedingly gentle and not apply pressure or risk damaging the local tissues.

• False
Test Review Question 4

• You should intermittently loosen then tourniquets on the way to the hospital.

• True
• False
Test Review Question 4

• You should intermittently loosen then tourniquets on the way to the hospital.

  • False
Test Review Question 5

- Nerve injuries and amputations occur frequently when tourniquets are used even appropriately.
  - True
  - False
Test Review Question 5

• Nerve injuries and amputations occur frequently when tourniquets are used even appropriately.

• False
Thank You