

Tourniquets for Massive Hemorrhage



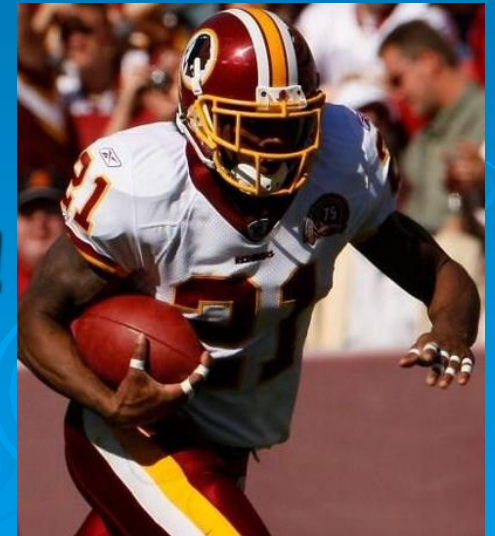
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Bleeding out ...

- Potential for rapid death underestimated
- Once in cardiac arrest, rarely survive
- Even with initial save, high M & M:
 - Respiratory, multi-organ failure
 - Sepsis, thromboembolism, etc
- **SO STOP BLEEDING A.S.A.P.!!**



Tourniquets & EMS: 2010

- Safe and effective when used correctly
- ↑↑ # EMS providers carrying TQs
- “HOW to” is easy. Gotta teach “WHEN”
 - Training sessions = good time for Basics
 - TQ usually *but not only* as a last resort
- Rarely used in ED, staff not familiar

Long history...especially military

- Ancient Greeks and Romans
- European 1500s, 1600s
- Civil War:
 - TQ commonly used & saved lives, but limited medical care
- Later, especially WWs
 - Lots of unnecessary use, prolonged use
 - Delays to definitive care
 - Fell out of military favor due to limb loss
- Civilian use ↓ ↓ also, except for amputations
- Impressions: Lose a limb, save a life
Primum nui nocere

But then...

- **Vietnam**
 - Helicopters, faster times to definitive care
 - KIAs: 67% die in <10 min, but $1/3 > 10$ min
 - Hindsight: TQ might have saved up to 5,000
- **Middle East**
 - TQ easy, safe, effective
 - Time to OR < 70 min



Several recent military studies

- Israeli Defense Force
 - Reviewed 91 TQ uses in 4 yrs; 47% not indicated
 - But complications rare
- Baghdad 2006: 232 pts with TQ: 87% survival
 - If TQ BEFORE shock ensued, 96% survival
 - If TQ AFTER shock ensued, 10% survival
 - Complication of transient nerve palsy 1.7%
 - Amputations caused by TQ: ZERO
 - Case match study of 5 with wounds deemed treatable by TQ but not used, with 13 with TQ: Survival 0% vs. 77%
 - Field witnesses: underestimated the speedy lethality of uncontrolled limb hemorrhage
(Kragh, et al, J Trauma 08, Annals of Surgery 09)

TQ in Orthopedic OR Procedures

- Used for bloodless surgical field
- TQ safe on warm extremity for 2 hours (warm ischemia time in OR), longer if limb is cool
- > 6 hrs, limb loss from TQ likely
- From 2-6 hrs, variable risk
- < 2 hrs, most common complication is transient nerve palsy with NO later problem

Combat = Care under Fire

- Return fire and take cover
- Move casualty to cover
- Apply self aid
- Stop life-threatening limb bleeds with TQ:
 - Trauma Combat Casualty Care Guidelines 2008
- CAN use TQ easily, NOT direct pressure
- Combat wounds (GSWs, IEDs) often arterial
- Similar to civilian tactical EMS/SWAT or disaster situations

Military PHTLS: from ABC to

M Massive hemorrhage

A Airway

R Respirations

C Circulation

H Head injury



Civilian EMS Applications

- Amputations
 - Tactical (SWAT) EMS
 - Mass Casualty Incidents
 - Industrial & farm machinery trauma
 - Watercraft propeller trauma
 - Entrapment / extrication
-
- But what about other penetrating limb wounds?

Debates: Civilian EMS TQ Use

Considerations:

- Rapid transport – but do WE recognize how fast people die from uncontrolled bleeding?
- Civilian weapons usually lower force than in combat – but not always!
- Enough hands for direct pressure – but not always!
- *Is there data? Pending!*



What, when, where, how, who?

No: WW2 style



Yes:



Wide band, rounded edges, uniform material, ratchet
Don't make your own

Procedure

- Use wide band, not cord or surgical tubing
- Leave at least 2 inches of uninjured tissue between wound and TQ
 - *Thigh GSW or mangled: place more proximal*
- Tighten until bleeding stops and/or distal pulse gone (if too loose, venous bleeding ↑)
- Needs a lot of force: ratchet or windlass to do final tightening & secure it
- Leave limb uncovered

Comments:

- Belt or BP cuff won't hold for long
- Military study: CAT, SOFT, EMT all excellent

Civilian EMS Use

- Generally try direct pressure first:
 - review technique + correct use of pressure drsg (& put direct pressure on top of drsg)
- Can try elevation & pressure points but hard to maintain, less effective, and no evidence
- Use for amputation, and for any other life-threatening rapid hemorrhage in extremity—doesn't have to be spurting!



Myth: Only for amputations

- Although that was the NAEMSP guideline in 2006...
- TQ is safe and effective for short use in massive hemorrhage from penetrating limb trauma when combined with rapid transport to definitive care
- Most Trauma Surgeons now agree with TQ—Florida COT is pushing strongly to adopt as civilian EMS standard of care

Myth: Always try direct pressure first

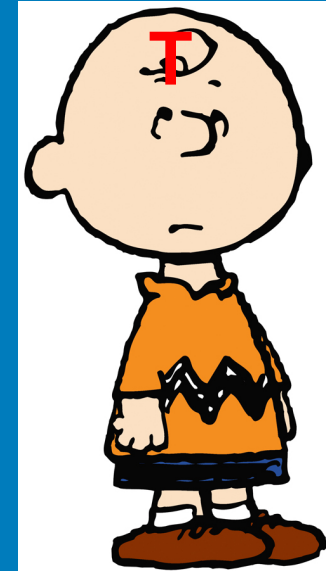
- **Direct pressure**
 - may delay txp, miss deep bleeding site, or be done poorly
 - takes 10-15 min to stop bleeding!
- **Can use TQ as first choice if:**
 - Entrapment/extrication
 - Multiple bleeding sites
 - Injury not amenable to direct pressure
 - High risk scene—must move victim out fast
 - Need EMS hands for airway, breathing, etc.
 - Multiple victims/MCI
 - Total darkness or other bad environment



Myth: Never release prior to arrival at ED

- Usually NOT, but YES, IF:
 - placed as 1^o care due to lack of resources, extrication, etc
 - transport time > 60 minutes (>30?)
 - extreme pain (pain med!)
 - bleeding stopped, pt not in shock, & can watch closely
- Procedure:
 - Apply direct pressure prior to release & maintain after
 - Leave TQ loosely on limb in case need to reapply fast
 - Serial reassessments of limb and patient
- If bleeding resumes or VS deteriorate, re-tighten and leave on until arrival
- Don't release if used for amputated limb

Civilian EMS use – SAFETY



- Document time applied
- Do not cover up the TQ
- Mark patient and triage tag
- Safe hand-offs!!! Clearly inform receiving EMS medic, RN, MD of TQ presence and TT
- ED: Physician must see patient stat
- Never overestimate what the next provider knows

TQ risks

- Distal ischemia
 - Compartment syndrome
 - Gangrene
 - Limb loss
 - Rhabdomyolysis
 - Bone necrosis
- Local pressure injury to soft tissues
- Vascular spasm
- Nerve damage
- ↑ bleeding
- ↑ limb edema
- SIRS
- Venous thromboembolism
- Excessive limb edema
- Circulatory overload in CHF patient
- Plaque fracture
- Problems with release
 - Acidosis, ↑ K⁺
 - Arrhythmia
 - Brief coagulopathyBP
 - Transient ↓

TQ: Bottom Lines

- Saves lives, also limbs
- Fast, easy to train & use
- Safe when used appropriately as one component of quality trauma care
- Belongs in BLS & ALS bag of tricks
- Needs data collection in civilian EMS
 - Case studies in publication



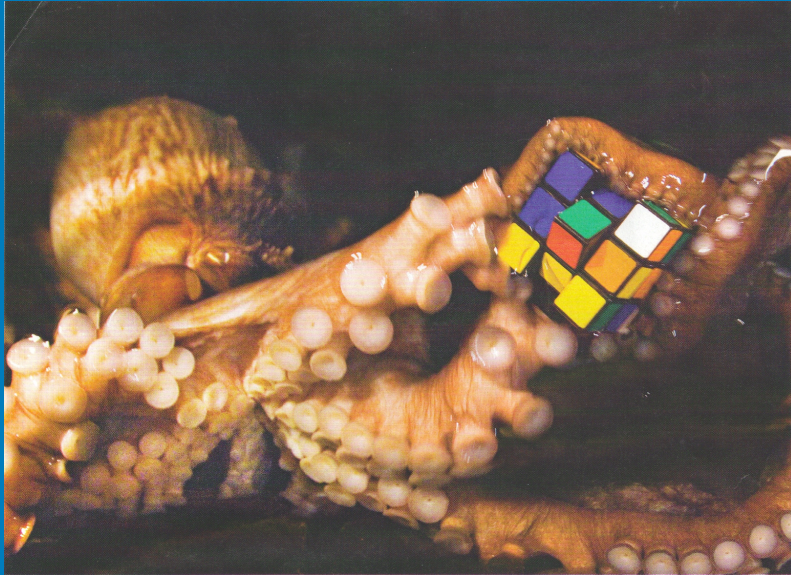
Want more info?

Great article:

- **Doyle G, Taillac P: PEC 2008; 12:241-56**

**Additional info & references in 2009 & 2010
slides posted at gatheringofeagles.us**

- **Dr. Fabbri 2009 – more science, references**
- **Dr. Schrank 2010 – implementation and training, references**



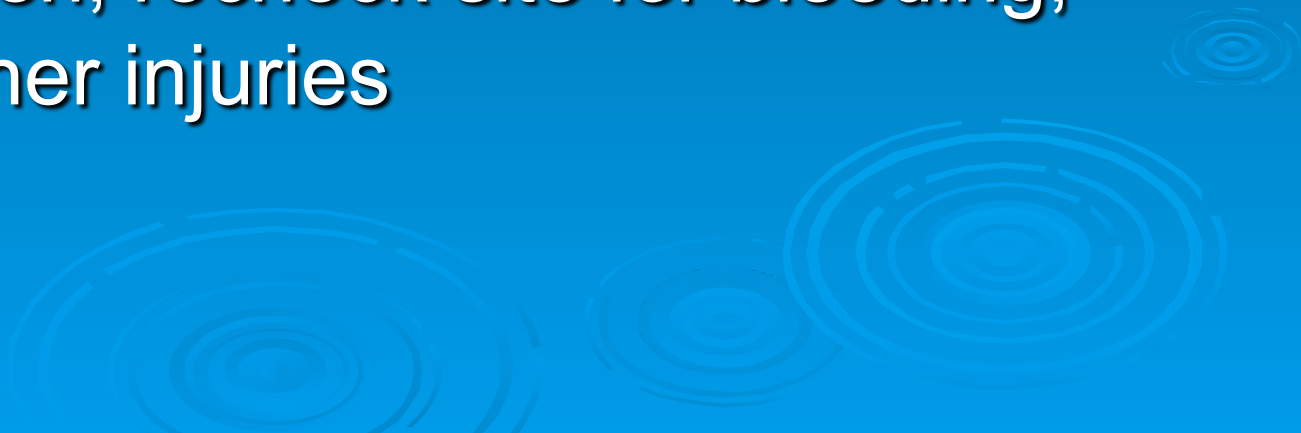
TQ implementation in your EMS system

- Local decisions:
 - Selection of specific TQ
 - Indications for use
 - Indications for removal
 - Documentation requirements
- Protocol: above items; technique for application, removal; monitoring of patient and limb; transfer of care
- Notify receiving hospitals
- QM tracking for safety, efficacy

TQ Training for EMS

- In addition to TQ info, module should briefly re-teach the basics
 - Recognition and management of shock
 - How to do direct pressure and pressure dressing correctly
 - General approach to trauma
- Skill Training:
 - Scenarios re when to use, remove
 - Each learner should apply TQ to self & partner (briefly!), with skill and knowledge checked by instructor

TQ training

- Location 2" above wound for arms or lower legs, consider most proximal site for thigh wounds
 - If bleeding continues, tighten more
 - If bleeding resumes, tighten more
 - If VS worsen, recheck site for bleeding, look for other injuries
- 

BACK TO BASICS: SHOCK

- **Prevention: STOP THE BLEEDING**
- **Recognition: Initial stages often missed**
- **Management:**
 - **Airway, Breathing**
 - **STOP THE BLEEDING**
 - **Role of IV fluids?**
 - **GET TO DEFINITIVE TREATMENT:**
 - **Blood products**
 - **Surgeon**

Recognition: Hemorrhage

	<u>Bld loss</u>	<u>Pulse</u>	<u>BP</u>	<u>RR</u>
Class 1:	<15%	<100	NI	NI
Class 2:	15-30%	>100	NI	20-30
Class 3:	30-40%	>120	↓	30-40
Class 4:	>40%	>140	↓↓	>35

- Any idiot can recognize Class 3 Bleeds (Trauma Center criteria)—but shock starts way before that!
- Elderly, pedi, folks on beta blockers don't get tachy before they crash
- Persistent pulse > 100 is not just anxiety!
- Don't assume agitation + smell of EtOH is "just drunk"
- Anxiety and agitation are early signs of shock

Back to Basics: A's & B's

- **Airway: Keep it open**
 - Snoring (“he’s just drunk”) is not a patent airway
- **Breathing:**
 - Oxygenation: High flow O2 even if nl O2 sat
 - Ventilation:
 - Positive pressure breathing drops preload & BP
 - Ventilate at 8-10 breaths/minute in shock MAX
 - If assisted ventilation, End tidal CO2 goal 30-35

Hemorrhage Control

BACK TO BASICS:

- Direct pressure
 - Don't stop too soon
 - Bleeds thru—add gauze & press harder
 - Pressure dressing + direct pressure
- Elevate limb
- Pressure points
- Fractures: immobilize (pelvis, too)



Apply direct pressure on external wounds with sterile cloth or your hand, maintaining pressure until bleeding stops

ADAM

EMS Concern: Scene Time

- **Must keep track of time!!**
- **“Scoop and run” vs. “stay and play”**
- **Goal: MAX of 10 minutes on scene for major trauma**
- **Reminder that if mechanism of injury is high risk, then patient who looks like “minor” injury may crash as a surprise—so still not good to “stay and play”**
- **Common preventable delays: trying to get IV access on scene vs in route or not at all, or to intubate when BVM is good enough**

Fluids: Access and Delivery

- **IV access: yes if fast but don't delay transport by more than 1-2 minutes; personal safety is important if trying to start in a moving ambulance**
- **IO in adults:**
 - Proximal tibia, distal femur, humerus, sternum
 - Must flush with 10 ml saline to get good flow
 - Use pressure bag
 - Fine for any fluid, drug, blood transfusion
 - Awake patient: push lidocaine (3 ml of 1:10,000), wait 2-3 min, then flush and use

Fluid Resuscitation: Goals

- **General goal; how much is enough?**
 - Restore and maintain adequate tissue perfusion
 - But is hemorrhage controlled or uncontrolled???
 - Clinical parameters: vital signs
- **Reassessment of response to IV bolus:**
 - Rapid and maintained—great!
 - Transient—still bleeding somewhere; re-bolus and get to ED
 - Non-responder—still bleeding and/or has more problems; re-bolus and get to ED & surgeon ASAP

Permissive hypotension

- **Controlled hemorrhage: Aggressive IVF to normal systolic BP is the goal**
- **But lower BP goal used for years in UGI bleeds, elective surgery, aortic aneurysms**
- **Potentially uncontrollable hemorrhage:**
 - **Deep torso injury, penetrating or blunt**
 - **Borderline BP is best goal in animal studies & randomized controlled trials in human trauma:**
 - **Houston (1980s) penetrating torso wounds**
 - **Baltimore (1990s) penetrating and blunt**

Permissive hypotension

- Wound forms initial “soft clot” until fibrin added (takes 1/2 hr); until then, easy for clot to break apart
- Increased systolic BP risky before hemostasis:
 - Dislodges soft clot
 - Accelerates bleeding
 - IVF dilution of RBC mass and clotting factors
 - Limits oxygen delivery to tissue
 - Inhibits clot formation
- Protocol for uncontrolled hemorrhage:
 - IVF non-responder → permissive hypotension with goal SBP ~80 mmHg, palpable radial pulse, conscious

More food for thought: What's next for prehospital trauma care?

- **Better monitors of tissue perfusion?**
 - Sublingual capnometry
 - Tissue spectroscopy
- **Blood substitutes/HBOCs ?**
- **Estrogens/progesterone dose for shock?**
- **ITDs ?**

Another Device: ITDs & Trauma

- Impedance Threshold Device
- Creates greater negative intrathoracic pressure during patient's own breaths
- **BUYS TIME** in hypovolemic shock

ITD and hypovolemic shock

- **Hemodynamic effects:**
 - **↑ Preload**
 - **↑ Coronary perfusion**
 - **↑ Cardiac output, MAP, stroke volume**
 - **↓ Intracranial pressure so ↑ cerebral blood flow**
- **Successful use by military in conscious patients with hemorrhagic shock**
- **Useful for nontraumatic hypovolemic states**

Tourniquet References

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