Hemorrhage Control Strategies Trauma

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Clinical Case

- Scene flight rural area
- MVC, prolonged extrication
- ALS and Fire/Rescue present
- LZ in movie theatre parking lot
- Pick-up T-boned a 4 dr sedan
- Passenger in traumatic arrest
- Driver brought to helicopter
- 4 inch scalp laceration temporal region
- HTN: Systolic BP 220, no meds
Clinical Case: Scalp laceration

Head of Stretcher

Pulsatile bleed

Presentation shared with permission:
Bill Schneider CFRN, Life Link III
Use Case: Scalp laceration
Objectives

• Explain the impact of bleeding in trauma

• Recognize the importance of rapid hemorrhage control

• Classify wounds on the spectrum of bleeding

• Select appropriate intervention for type of bleeding

• Understand how iTClamp fits into an overall hemorrhage control strategy
The Hemorrhage Problem

- 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\(^2\)

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\(^1\) 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
Military Incidence

A new USAISR 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)
Hartford Consensus

Joint Committee to Create a National Policy to Enhance Survivability from Mass Casualty Shooting Events

**T H R E A T**

1. Threat suppression

2. **Hemorrhage** control

3. **Rapid Extrication** to safety

4. **Assessment** by medical providers

5. **Transport** to definitive care

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No bleeding is minor and every blood cell counts!
… toward ensuring continued perfusion of the body’s tissues.
~ PHTLS Chapter 8 Shock
Scalp Lacerations

• Fatal Hemorrhage From Simple Lacerations of the Scalp

  • Frequent occurrence

  • Even “trivial” lacerations of blood-rich areas such as the scalp may bleed profusely and persistently

  • In one published report shown to be the cause of death in multiple cases where it was not initially obvious.

Treatment Priorities

- Stop bleeding
- Prevent initiation of lethal triad
- Rapid transport to definitive care
Hemorrhage Control Interventions

• Most rapid and appropriate method for hemostasis:

  • Direct pressure
    • Manual
    • Pressure dressings
    • iTClamp
    • Hemostatic Agent
  
  • Indirect Pressure
    • Manual
    • Tourniquet
  
  • Tranexamic Acid (TXA)
Hemorrhage Control Strategy

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

-> Results in STASIS (clot eventually forms)
Direct Pressure / Gauze

- Pressure can be applied with or without gauze
- Continuous application of pressure and wound packing is the key factor in stopping bleeding, not the type of gauze\(^6\).

- Standard gauze performs just as well as hemostatic gauze\(^6\).

iTClamp = “Mechanical Direct Pressure”

Pressure outside of the bleeding vessel = Pressure inside the injured vessel
1. HEMO ”STASIS” -> BLEEDING STOPPED (emergency over)
2. STASIS -> CLOT FORMS OVER TIME
Trauma Clamp

- iTClamp
  - Rapid application and hemorrhage control
  - Cessation of blood flow at the point of injury in seconds
  - Maintains distal flow
  - Minimal pain
iTClamp – Mechanism of Action
• Longer wounds – multiple devices (RULE OF THUMB)
• Obvious feedback when devices not placed correctly
iTClamp: Evidence

- **Life Threating hemorrhagic swine model**: 100% treated with iTClamp survived vs. 60% with standard gauze

- **Pre-clinical Cadaver Study**: 100% effective at controlling fluid loss in all compressible zones
  - No change with patient movement

- **Clinical Use**
  - Over 100 reported clinical uses has shown no failures or adverse outcomes

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8 Mottet, K. et al. Evaluation of the iTClamp in a Human Cadaver Model. J of Trauma; March 2014; 76:3
Hemostatic Agents

• Kaolin Agents (e.g. QuikClot)
  • Key ingredient – kaolin clay
  • Absorbs water from wound which increases concentration of clotting factors

• Chitosan Gauze (e.g. Celox)
  • Key ingredient – chitosan
  • Swells, gels and clots

• All Hemostatics
  • Should be packed into the wound, ideal for cavitating wounds
  • Require 3-5 minutes of direct pressure
  • Are generally 80% effective with a 30% rebleed rate

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Extremity Tourniquets

- Commercial Tourniquets
  - Designed for significant extremity trauma
  - Ineffective for junctional bleeds
  - Provides circumferential pressure
  - Application may cause significant pain
  - Despite proper training, approx. 80% are not tightened adequately\(^\text{10}\)

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Junctional Tourniquets

• Combat Ready Clamp (CRoC)
  • Designed for inguinal and axillary bleeds
  • Occludes distal circulation with built-in compression disk
  • Requires device specific training and assembly

• Junctional Emergency Treatment Tool (JETT)
  • Designed for massive inguinal groin injuries
  • Only effective for lower extremity trauma
Challenges with Current Devices

SLOW: 5 – 15 minutes

LIMITED: No single device works for all injuries

PAINFUL: Cause additional trauma

EXPERTISE: Require medical knowledge and extensive training
Spectrum of Bleeding Wounds

MINOR BLEEDING

DIFFICULT TO CONTROL BLEEDING

TRAUMATIC AMPUTATIONS

GAUZE

iTClamp™

TOURNIQUET

SEVERITY
Phases of Care

CARE UNDER FIRE  TACTICAL FIELD CARE  TACTICAL EVACUATION

Platinum 10

The Golden Hour
Spectrum of Mass Casualty Care

Triage - Seconds

Stabilize - Minutes

Transport - Hours
Multiple Wounds

- Male 39 yo. pt.
- Self harm, mental health issues
- HR 112, Systolic BP 100 mmHg
- Manual pressure failed to control bleeding
- 2 clamps applies, controlled bleeding and provided hands-free option to deliver other care and manage scene
Multiple Locations

- Attempted suicide
Scalp Wounds

- Scalp wounds are difficult to dress and transport
- Can be life threatening, time consuming, and delay other care or interventions
- Patients can go to CT scanning earlier with iTClamp in place
Neck wounds

- Pre Hospital stab wound to neck
- Buddy aid pressing on wound
- EMS applied clamp and closed wound

- Pt. with basal cell carcinoma removal 2/52 previously
- 1 litre blood loss into four large EMS dressings
- Clamp applied by nurse on arrival at ED
- When clamp removed only a dressing required
Neck/Face Wounds
Head and Neck Stabbing

Stab wound 1 (neck):
Between internal & external carotid arteries (no damage) to the pharyngeal venous plexus of the C spine which caused a severe retropharyngeal bleeding & hematoma which in turn caused a difficult endotracheal intubation.

Stab wound 2 (head):
iT clamp controlled the massive arterial haemorrhage, because stab wound dissected the temporal artery. The iT clamp caused a pressurized haematoma close to the artery and formed a stable clot formation between iTClamp and cranial roof which was removed during the surgical repair. “In this case the iTClamp was lifesaving!”
Use Case: Palmar Artery Laceration

• Man walking with coffee cups falls while holding coffee cup long laceration to palm of hand

• Patient holds manual pressure per self all the way to hospital.
Difficult Anatomy

- Patient knifed by husband
- Scapula wound
- Two clamps applied
Difficult Anatomy

81 yo male attacked by Wild Boar
Difficult Anatomy

- Male 65 yo. patient
- Fell onto broken ceramic mug
- Lacerated superficial palmar artery
- Blood ‘spraying up cubicle walls’
- Clamp applied by ED nurse
- Bleeding controlled and transferred to specialist centre for ‘plastics’ repair
Difficult Anatomy
Industrial Injuries - Chainsaws
• Patient fell through glass window
• Palmar and digital artery transected
• Estimated 1 litre of blood lost
• Pressure dressing in transit failed
• Clamp used in conjunction with gauze
• No emergency surgery facility on site
• Transferred to plastics hospital for controlled repair some hours later
• The clamp took the ‘emergency’ out of the bleeding
Prehospital

• 36 yo male, whose right leg was crushed in an industrial accident
• Two tourniquets on thigh due to massive bleeding on scene
• 2 units pRBCs in helicopter
• BP 180/120, HR 130 on arrival
Use Case - Crushed Leg

**Arrival assessment**

- Two open wounds
  - Large medial wound with open, segmental tibial fracture
  - Small 3 cm wound lateral to knee joint with open fibular head fracture and large degloving injury
- Tourniquet taken down revealing significant bleeding from smaller wound
- Degloved space packed with hemostatic gauze and the wound closed over packing with iTClamp
ED / Trauma Room Course

- Controlled arterial hemorrhage with iTClamp
- Conduct a complete patient assessment
Outcome

• Controlling hemorrhage allowed for:
  • Complete ED assessment
  • A single definitive operation with orthopedic and vascular repair
  • Vascular intervention was done in a controlled situation nine (9) hours after arrival
  • Bleeding injury was found to be a torn popliteal artery
Summary

- Bleeding is a significant problem in trauma
- Rapid control of bleeding will affect patient outcomes
- Different strategies (wound closure, packing, pressure, pharmacological agents) alone or in combination will provide effective hemorrhage control
- iTClamp is a rapid and easy yet safe and effective solution for hemostasis by wound closure
Early Users

- Københavns Brandvæsen
- FinnHEMS
- British Association for Immediate Care
- Houston Police Department
- Mayo Clinic
- University Hospital Southampton
- Mount Sinai Hospital
- Dyersburg Regional Medical Center
- Hospital Wing
- University Hospitals
- Memphis Division of Fire Services
- Suwannee County Fire Rescue
- Morton Plant Mease
- New York Presbyterian
- Memorial Hermann
Summary

Bleeding out is a timed event

Q: Who can stop the clock?
Questions?
FAQ’s

Q: Does the iTClamp hurt to apply?
A: After a brief needle poke, iTClamp does not cause pain (or damage the skin in anyway).

Q: How long can the iTClamp be left on?
A: Safe on animals at 6 hours. It is intended for temporary closure. Times in excess of 12-24 hours carry an elevated risk of infection when placed on a contaminated wound.

Q: Does the iTClamp come in multiple sizes?
A: No. Current size is easily handled. Larger wounds can be closed by multiple devices in series.
FAQ’s

Q: How much blood is lost in the hematoma?
A: During trials average size was 50% greater than controls (40-50 ml) and less than the size of the hematoma in a packed wound.

Q: Can a wound be packed first and then device applied?
A: Yes. Depends on how much time is available for treatment.

Q: What are the contraindications?
A: Can’t be applied to eyeballs and wounds where the skin cannot be approximated.

Q: When will the iTClamp be available?
A: Available now. iTClamp 50 is approved for use in the US, Canada and Europe.