

Chapter 6

Hemorrhage Control

“The hemorrhage that takes place when a main artery is divided is usually so rapid and so copious that the wounded man dies before help can reach him.” – COL H.M. Gray, 1919

Stop the Bleeding!

- Hemorrhage is the leading cause of preventable death on the battlefield.
 - 90% of combat fatalities occur forward of medical care.
 - Half of these casualties bleed to death, $\frac{1}{5}$ from extremity trauma (10%–15% of all deaths).
 - Although bleeding is a main cause of death, the vast majority of wounds do not have life-threatening bleeding.

Under Fire

Get the patient out of the line of fire — prevent further injury. Control obvious external bleeding once out from under fire. If you must remain under fire, stop external bleeding with use of a tourniquet.

Do not endanger the casualty or yourself with unnecessary treatment.

Stay engaged in the firefight if necessary.

Keep Your Head Down

Sites of Hemorrhage

- External.
 - Extremity injury (most common cause of massive external blood loss in combat), scalp, and torso wounds.
 - Usually associated with an open fracture or amputation.

Direct Pressure Is Central to Treatment

- Internal.
 - ◆ Chest, abdomen, pelvis, and closed extremity fractures.

- ◆ High mortality if the casualty is not expeditiously transported and salvage surgical procedures performed.
- ◆ Controlled (hypotensive) resuscitation may be necessary.

Internal Torso Bleeding Requires Surgical Control

Treatment—First Responder

- External hemorrhage from extremity wounds.
 - **Direct pressure** at site of injury is the most effective and preferred method of hemorrhage control.
 - ◆ If direct pressure fails to stop the hemorrhage, it signifies deep, massive, or arterial injury, and will require surgery or advanced hemostatic agents.
 - ◆ Hold pressure for at least 5 minutes before looking to see if it is effective.
 - ◆ Impaled foreign bodies should not be removed because profuse bleeding may occur.

Pitfall: A Bandage Does Not Equal Direct Pressure!

A bandage may wick blood from the wound without stopping the bleeding.

A bandage hides ongoing bleeding.

Hemostatic bandages currently being developed may stop bleeding.

- ◆ **Elevation** of the extremity will decrease most bleeding—this is an under-appreciated technique.
- ◆ **Point compression of the proximal artery.**

Pitfalls of Blind Clamping

Blind clamping into the wound is more likely to cause additional injury than to control bleeding.

Risk–Benefit Decision: Judgment that other measures are not successful should be exercised before applying clamps in a wound. Field wound exploration is not recommended.

- ◇ May help slow bleeding while attempting to gain better control at the wound site.
- ◇ May require compression at the pressure point for up to 20 minutes to provide hemostasis.
- ◇ Table 6-1 shows the recognized pressure points.

Table 6-1. Recognized pressure points.

Bleeding Site	Lower				
	Hand	Forearm	Arm	Leg	Thigh
Artery Pressure Point	Radial/Ulnar Wrist	Brachial Inner upper arm	Axillary Axilla	Popliteal Behind knee	Femoral Below groin crease

Tourniquet May Be First Choice in Combat

- ◆ A **tourniquet** should be applied if previous techniques fail.
 - ◇ Use a tourniquet early, rather than allow ongoing blood loss. Substitutes for issued tourniquet include belt, torn cloth, gauze, and rope, among others.
 - ◇ Rapid method to secure hemorrhage control.
 - ◇ Does not require constant attention; allows first responder to care for others — extends resources.
 - ◇ Tourniquets should not be removed until the hemorrhage can be reliably controlled by advanced hemostatic agents or until arrival at surgery.
 - ◇ Tourniquet placement on the forearm or leg may not compress the vessels, which lie between the double long bones. Tourniquets on the upper extremity should be placed on the upper arm and if bleeding from the lower extremity is not controlled by a tourniquet on the leg, it should be moved to the thigh where the vessel may be more easily compressed.

Pitfalls of Tourniquet

Application for more than 2 hours may increase limb loss.

Risk–benefit decision: Don't avoid a tourniquet in order to save a limb, and then lose a life! Use of tourniquet does not always lead to limb loss.

- ◆ **Clamping vessels:** If there is continued bleeding and a damaged vessel can be readily identified, a hemostat may be used to clamp the vessel.
- ◆ **Limb splints** will decrease bleeding associated with fractures and soft tissue injury by aligning, stabilizing, and returning the limb to length.
- ◆ Military Anti-Shock Trousers (MAST) possible uses.
 - ◇ Controls hemorrhage from massively injured / mangled lower extremities.
 - ◇ Provides temporary stabilization of pelvic fractures to decrease hemorrhage.
 - ◇ Splints fractures of lower extremities.

Pitfalls of MAST

Protracted MAST use leads to compartment syndrome and ischemic limbs.

Respiratory compromise occurs due to diaphragmatic elevation.

Increased torso bleeding.

Pressure changes within aircraft (caused by altitude changes) affect inflation pressure.

Requires close monitoring in aircraft.

- ◆ **Scalp bleeding:** can be significant due to the rich vasculature of the scalp.
 - ◇ Responds to direct pressure.
 - ◇ Compression dressings must be applied if you cannot provide ongoing direct pressure.
 - ◇ Difficult to apply and maintain direct pressure.

- ◇ Requires circumferential head application.
- ◇ Vertical mattress suture closure sometimes is necessary to control bleeding scalp edges.
- ◇ A readily identified bleeding vessel can be clamped, but the wound should generally not be explored.
- ◇ Avoid pushing fragments into brain when applying pressure, but control hemorrhage even at the expense of exposed brain.
- ◇ Protection of exposed brain with nonadherent gauze or plastic can minimize injury.

◆ **Internal bleeding.**

- ◇ Blood loss into the abdomen or chest cannot be controlled in the field and requires immediate evacuation for salvage or definitive surgery.
- ◇ Stabilization of pelvic fracture with MAST garment, or by wrapping the pelvis tightly with a wide strap (such as a folded sheet), may reduce pelvic bleeding.
- ◇ Open torso injuries. If direct pressure does not stop the hemorrhage, consider inserting a tamponade with a balloon (Foley) catheter into the wound, and then with balloon inflated pulling back to compress the bleeding site.

Dressings, bandages, hemostatic agents, and controlled hypotension. Dressings promote hemostasis, protect wounds from mechanical injury and contamination, immobilize tissues, and provide physical and psychological support to the patient.

● **Application of dressings and bandages.**

- Control all bleeding.
- Assess neurologic status and circulation of extremity before and after applying a dressing or bandage.
- Immobilize suspected fractures.
- Keep dressing as clean as possible.
- Dressings should cover the entire wound.
- Bandages should cover the entire dressing.
- Avoid skin-to-skin contact.
- Leave fingers and toes exposed.

o **Reinforcement.**

- ◆ If at all possible, **do not** remove the first dressing.
- ◆ If the dressing becomes thoroughly saturated, reevaluate the wound for a source of bleeding amenable to direct pressure, and consider advanced hemostatic agents or a proximal tourniquet. Blood loss into the dressing can be estimated from Table 6-2.

Table 6-2. Blood loss.

Size designation	Small	Medium	Large	ABD
Measurement (inch)	4 x 7	7.5 x 8	11.75 x 11.75	18 x 22
Saturation (mL)	300	750	1,000	2,500

- o Coagulopathy. Blood loss, massive fluid resuscitation, and drop in body temperature may lead to inability to form clot.
 - ◆ Keep patient warm (above 34°C).
 - ◆ Use warm fluids.
 - ◆ Use crystalloid fluids sparingly.
 - ◆ Transfuse with fresh whole blood (less than 24 h old).
- o Hemostatic agents: new products and bandages are available in several forms:
 - ◆ Powders: placed in wound, then covered with a dressing.
 - ◆ Dressings: impregnated with hemostatic agents.
 - ◆ Injectables.
 - ◇ Intravenous: augment clotting cascade of body.
 - ◇ Intracavitary: through wounds to control internal bleeding.
 - ◆ Two=component “glues”.
 - ◆ If an advanced hemostatic agent is used after a tourniquet has been placed, the tourniquet may be carefully removed after the agent has achieved hemostasis and the wound observed for hemorrhage. If hemorrhage recurs, return to the tourniquet.

Hemostatic Agents

Product	Source	Mechanism	Advantages	Disadvantages
Hem-Con	Shrimp shell polysaccharide & vinegar	Sticks to blood forming plug	FDA approved, inexpensive	
Quik-Clot	Volcanic rock	Acts as a selective sponge for water/dehydrates blood	FDA approved, inexpensive, easy to store, long shelf life	Thermal injury, requires removal from wound
Fibrin bandage	Fibrinogen/thrombin	Activates clotting mechanism	Natural clotting mechanism reactions	Not FDA approved, allergic expensive

Two Field Hemostatic Agents

- Two agents are recommended by the US Tactical Combat Casualty Care Committee: 1) HemCon, 2) QuikClot.
- If standard measures such as elevation and pressure dressings do not control bleeding, it is recommended that tourniquet be used and that the first agent be HemCon. If this dressing fails, it should be removed and QuikClot used if the bleeding is life threatening.
- If the bleeding is external and not at a site where a tourniquet can be applied, HemCon and QuikClot can be used if conventional pressure dressings fail.
- Both products are to be used only on external sources of hemorrhage.
- HemCon dressing is a firm 4 x 4 inch dressing that is sterile and individually packaged. It works by adherence to the bleeding wound and has some vasoconstrictive properties. The blood and clot in the wound should be removed before application.

- QuikClot is a granular zeolite that absorbs fluid and causes hemostasis. It has handling properties similar to sand. When applied it can generate significant heat during the absorption process. Blood and clot should be wiped out of the wound prior to application.
- Remember, pressure must be applied for 3–5 minutes at the bleeding site, after application of a hemostatic dressing.

Field Hemostatic Dressings Considerations

Use should be delayed until after a trial of conventional dressings.

Do not use on minor injuries.

Use on internal wounds is not yet recommended.

Must apply pressure to the bleeding site after application.

Risk of inadequate contact of HemCon to the bleeding tissues in deep wounds.

Heat generation from QuikClot.

- o **Controlled resuscitation** (hypotensive resuscitation).
 - ◆ Resuscitation as a method of hemorrhage control. The needs of organ perfusion must be carefully balanced against the risk of increased bleeding as blood pressure rises. Excessive fluid resuscitation may increase bleeding and rebleeding. Prior to definitive hemorrhage control, a lower-than-normal blood pressure may be accepted. Small volumes of resuscitation fluid are still required in those casualties with decreased mentation due to hypotension (ie, decreased or absent radial pulse).