

UNITED STATES MARINE CORPS
FIELD MEDICAL TRAINING BATTALION
Camp Lejeune, NC 28542-0042

FMST 402

Manage Hemorrhage

TERMINAL LEARNING OBJECTIVE

1. Given a casualty in an operational environment, standard field medical equipment and supplies, **treat hemorrhage** to prevent further injury or death. (8404-MED-2002)

ENABLING LEARNING OBJECTIVE

1. Without the aid of references, given a description or list, **identify the types of hemorrhage**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2002a)
2. Without the aid of references, given a description or list, **identify the signs and symptoms of hemorrhage**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2002b)
3. Without the aid of references, given a description or list, **estimate the amount of blood loss**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2002c)
4. Without the aid of references, given a description or list, **identify the methods of hemorrhage control**, within 80% accuracy, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2002d)
5. Without the aid of references, given a description or list, **apply a tourniquet to stop the bleeding**, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2002e)
6. Without the aid of references, given a simulated casualty with life-threatening hemorrhage and a Corpsman Assault Pack, **manage simulated hemorrhage**, to prevent further injury or death, per Prehospital Trauma Life Support, current Military Edition. (8404-MED-2002f)

OVERVIEW

Historically, 20% of all injured combatants die on the battlefield. Of that 20%, approximately 65% will die of massive, multiple trauma and are probably not salvageable. Based on the data from the Vietnam conflict, over 60% of battlefield casualties died of exsanguination (bleeding out) within 3 to 5 minutes and could have been saved with timely intervention. In order to continue to decrease these statistics, you must be able to rapidly identify and manage internal and external hemorrhage. You must also recognize the type of bleeding, apply the appropriate hemorrhage control techniques, understand the varying degrees of risk associated with types of hemorrhage, and understand how to estimate blood loss.

1. TYPES OF HEMORRHAGE

Hemorrhage is defined as blood escaping from arteries, veins or capillaries.

Arterial - if an artery near the surface is damaged, **bright red blood** will gush out in spurts that are synchronized with the heartbeat.

Venous - blood from the veins is **dark red**. Venous bleeding is characterized by a steady, even flow.

Capillary - capillary blood is usually **brick red** in color. If capillaries bleed, the blood oozes out slowly.

External Hemorrhage - Loss of blood from wounds that damage the large vessels of the extremities are a common source of massive external hemorrhage in combat. The cause of external hemorrhage can be varied depending on the setting in which the injury has taken place. Some of these causes include, but are not limited to, gunshots, stabbings, shrapnel, vehicle accidents and blasts. The importance for you lies in the identification of life threatening hemorrhage versus non-life threatening hemorrhage. The difference between life threatening and non-life threatening exists in the amount of blood loss and the class of shock of the patient.

Signs and Symptoms

- Massive blood loss
- Obvious sign and symptoms of shock
- Class III or IV shock

Internal Hemorrhage - Blood loss into the chest or abdomen cannot be controlled in the field. Despite aggressive treatment and fluid resuscitation, casualties with major internal vascular injuries frequently die in the field. The patient with severe internal hemorrhage may develop hypovolemic shock before the extent of the blood loss is realized. Internal hemorrhage requires immediate surgical intervention at a higher capability of care. Bleeding, however slight, from any body orifice is serious, as it usually indicates an internal source of hemorrhage that may not be readily evident. Signs that may indicate serious internal injury (or disease) would include bleeding from the mouth, rectum or blood in the urine. Nonmenstrual bleeding from the vagina is always significant. Internal hemorrhage can be caused by the following examples of injuries: blunt trauma, concussion injuries from blasts, vehicle accidents, falling from heights, collapsing buildings and closed fractures (bones or bone fragments lacerate arteries or large veins).

The FMST may see:

- Hematemesis (vomiting of bright red blood)
- Hemoptysis (coughing up of bright red blood)
- Melena (black tarry stools)
- Hematochezia (bright red blood from the rectum)
- Hematuria (blood in the urine)
- Ecchymosis (bruising)
- Rapidly forming hematoma and edema
- Rigidity with or without rebound tenderness upon palpation of abdomen
- Signs of shock

2. **ESTIMATING BLOOD LOSS (EBL)** (see Figure 1)

Gather a quick estimation of blood loss based on the following factors:

- Look for blood surrounding the patient.
- Inspect clothing for blood saturation.
- Inspect bandage saturation for associated blood loss. See Figure 1 for amount of blood each dressing will hold when fully saturated.
- Determine level of shock

	Small Battle Dressing	Medium Battle Dressing	Large Battle Dressing	Abdominal Battle Dressing
Amount of estimated blood	300 ml	750 ml	1000 ml	2500 ml
*EBL	About 6%	About 15%	About 20%	About 50%
*Amounts are based on the average adult blood volume of about 5 liters.				

Figure 1. Estimating Blood Loss Based On Saturation of Dressings

Massive hemorrhage may be fatal within 60 – 120 seconds. Treatment should not be delayed and controlling major hemorrhage should be the first priority over securing the airway.

3. METHODS OF HEMORRHAGE CONTROL

TOURNIQUET APPLICATION

In the trauma casualty, early control of significant external hemorrhage is the most important intervention. Deaths from external hemorrhage can generally be prevented by aggressive use of tourniquets and hemostatic agents. Extremity hemorrhage is the most frequent cause of *preventable* battlefield deaths.

Although not commonly used in civilian trauma care, tourniquets have been shown to save lives in combat. (see Figure 2) Multiple recent studies have confirmed the lifesaving benefit and low incidence of complications from prehospital tourniquet use in combat casualties. Tourniquets are most effective in saving lives if applied before the casualty has gone into shock from blood loss.



Figure 2. Casualty who was saved using a tourniquet

There are currently a variety of tourniquets on the market and some are more effective than others. There are two CoTCCC recommended tourniquets: the Combat Application Tourniquet (CAT) and the SOF Tactical Tourniquet (SOFT-T). They are both windlass-type devices that are light weight and relatively inexpensive. The tourniquet that you will see in your equipment is the CAT.



Figure 3. CAT



Figure 4. SOFT-T

CAT (see Figure 3)

- US Army Institute of Surgical Research and CoTCCC recommended
- Lightweight
- Easy to apply and use

SOFT-T (see Figure 4)

- Special Operations Forces Tactical Tourniquet
- Also recommended by the CoTCCC
- True 1-1/2 inch constriction band
- Aluminum windlass rod
- Application remains the same, regardless of location
- May be a better choice if the casualty has large thighs and needs a tourniquet in that location.

Field Expedient Tourniquet (see Figure 5)

- If CAT is unavailable, choose a material about two inches (2") wide.
- Material such as rope, wire and string should **NOT** be used because they can cut into flesh.
- Tie a strong windlass (stick) to a cravat or other strong material.
- Slide one or two rings on each side of the cravat.
- Tie the cravat around the affected limb, two to four inches above the wound, loosely. (This will allow the windlass to turn, creating circumferential pressure to stop the bleed.)
- Twist the windlass until the hemorrhage is controlled.
- Slide the ring to the windlass and secure windlass to the ring(s).



Figure 5. Improvised Tourniquets

What about those Rings???

Examples of good rings to use:

- Key chain rings
- Sport drink rings
- Boot laces tied into a ring
- Anything that is in a ring shape with the approximate diameter of 1-2 inches

Tourniquet Application during Care Under Fire

As discussed in the Introduction to TCCC, apply the tourniquet proximal to the bleeding site. Time may not permit exposure of the wound and the tourniquet may have to be placed over the uniform. Although this is not the ideal application, it is necessary. Once time permits, the wound should be exposed and re-evaluated and a replacement tourniquet should be applied directly to the skin.







Steps to apply a tourniquet using the Two Handed Application (see figure 6):

1. Route the band around the limb and pass the red tip through the inside slit of the buckle. Pull the band tight.
2. Pass the red tip through the outside slit of the buckle. The friction buckle will lock the band in place.
3. Pull the band very tight and securely fasten the band back on itself. When the band is pulled tight, no more than 3 fingers will fit between the band and the limb.
4. Twist the rod until bright red bleeding has stopped and the distal pulse is eliminated. In Care Under Fire, you do not have time to check to make sure the distal pulse is eliminated but you will do that later, when it is tactically feasible to do so.
5. Place the rod inside the clip locking it in place.
6. Secure the rod inside the clip with the strap.

Steps to apply a tourniquet using the **One Handed Application** (see figure 7):

1. Insert the wounded limb through the loop formed by the band.
2. Pull the band tight and securely fasten the band back on itself.
3. Adhere the band around the limb. Do not adhere the band past the rod clip.
4. Twist the rod until bright red bleeding has stopped and the distal pulse is eliminated. In Care Under Fire, you do not have time to check to make sure the distal pulse is eliminated but you will do that later, when it is tactically feasible to do so.
5. Place the rod inside the clip locking it in place.
6. Adhere the band over the rod, inside the clip, and fully around the limb.
7. Secure the rod and the band with the strap.

Instructions for Use: Two-handed Application

<p>1 Route the band around the limb and pass the red tip through the inside slit of the buckle. Pull the band tight.</p> 	<p>2 Pass the red tip through the outside slit of the buckle. The friction buckle will lock the band in place.</p> 
<p>3 Pull the band very tight and securely fasten the band back on itself. When the band is pulled tight, no more than 3 fingers will fit between the band and the limb.</p> 	<p>4 Twist the rod until bright red bleeding has stopped and the distal pulse is eliminated.</p> 
<p>5 Place the rod inside the clip locking it in place. Check for bleeding and distal pulse. If bleeding is not controlled, apply a second tourniquet proximal to the first and reassess.</p> 	<p>6 Secure the rod inside the clip with the strap. Prepare the patient for transport and reassess. Record the time of application.</p> 

Using the Friction Buckle

For two-handed application or when the band becomes dirty, use the friction buckle to lock the band in place.

<p>1 Pass the red tip through the inside slit of the buckle. Pull the band tight.</p> 	<p>2 Pass the red tip through the outside slit of the buckle.</p> 	<p>3 Pull the band tight and securely fasten the band back on itself.</p> 
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Figure 6. Two Handed Application of the CAT

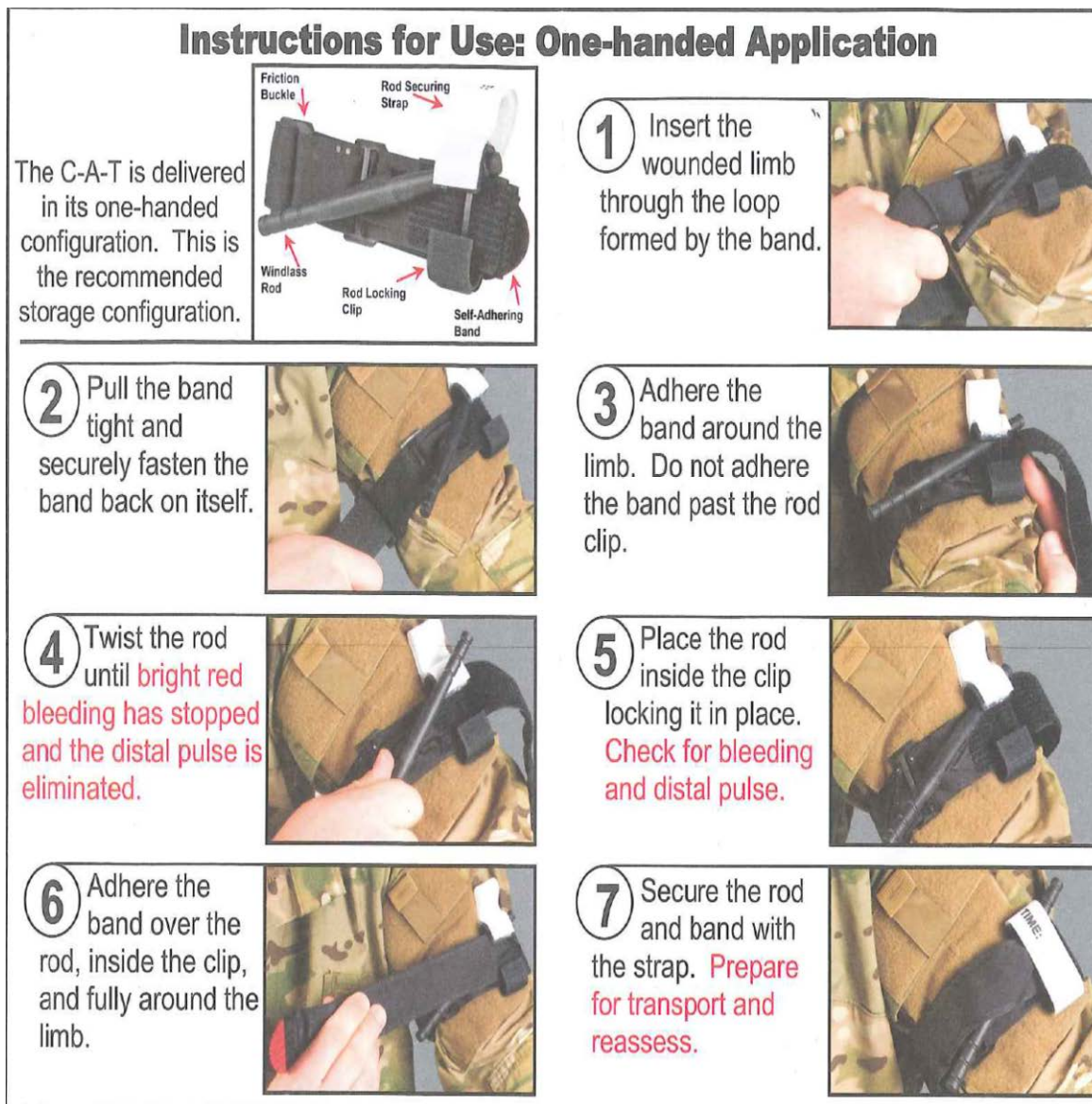


Figure 7. One Handed Application of the CAT

Hemorrhage Control in Tactical Field Care

Using the MARCH acronym, you would begin with “M” and manage **M**assive, life-threatening hemorrhage:

1. Assess for massive hemorrhage and control all sources of life-threatening bleeding. If not already done, use a CoTCCC-recommended tourniquet to control life-threatening external hemorrhage that is anatomically amenable to tourniquet application or for any traumatic amputation. Apply directly to the skin 2-3 inches above wound. **OR**, reassess prior tourniquet application by exposing the wound and ensure the tourniquet was needed and is working. If so, replace the tourniquet which is over the uniform with another applied directly to the skin 2-3 inches above wound (Place second tourniquet before releasing first tourniquet). If tourniquet is not needed, use other techniques to control bleeding.

2. For compressible hemorrhage not amenable to tourniquet use or as an adjunct to tourniquet removal (if evacuation time is anticipated to be longer than two hours), use Combat Gauze as the hemostatic agent of choice. **Combat Gauze** should be applied with at least 3 minutes of direct pressure. If the bleeding site is appropriate for use of a junctional tourniquet, immediately apply a CoTCCC-recommended junctional tourniquet. Do not delay in the application of the junctional tourniquet once it is ready for use. Combat Gauze applied with direct pressure should be used if a junctional tourniquet is not available or while the junctional tourniquet is being readied for use.



Combat Gauze™ Hemostatic Agent

- The only hemostatic agent approved by the CoTCCC is QuikClot Combat Gauze™ (see Figure 8). Combat Gauze™ is a 3-inch x 4-yard roll of sterile gauze impregnated with kaolin, a material that causes blood to clot.

Figure 8. Combat Gauze™

- It has been found in lab studies to control bleeding that would otherwise be fatal.
- It is applied to wounds with moderate to severe bleeding.
- It creates no heat, is inert and non-allergenic
- It can be fit to any size or shape wound, including penetrating wounds.
- QuikClot Combat Gauze™ is the first line treatment of life threatening hemorrhage in a tactical setting that is not amenable to tourniquet or junctional tourniquet application.

Application Procedures: (see Figure 9)

- Expose injury by opening or cutting away clothing.
- Remove excess blood from wound while preserving any clots that may have formed, if possible.
- Locate the source of the most active bleeding.
- Remove Combat Gauze™ from package and pack it tightly into the wound directly over the site of the most active bleeding. (More than one roll of Combat Gauze™ may be required to control the hemorrhage.)
- Combat Gauze™ may be re-packed or adjusted in the wound to ensure proper placement.
- Apply direct pressure quickly with enough force to stop the bleeding.
- Hold direct pressure for a minimum of 3 minutes.
- Reassess for bleeding control.

Tourniquets placed hastily over uniform items may be less effective than tourniquets applied directly to the skin.

During reassessment, if a tourniquet needs to be repositioned, remove sufficient uniform material to place another tourniquet directly over the skin and tighten it. The initial tourniquet can now be released to assess for continued bleeding control.

- Once applied, Combat Gauze™ should not to be removed (except by proper medical authority). If bleeding continues, reinforce would with another roll of Combat Gauze and hold pressure.
- Leave Combat gauze in place and secure with a pressure dressing.
- Document, place empty package near wound, and transport patient.

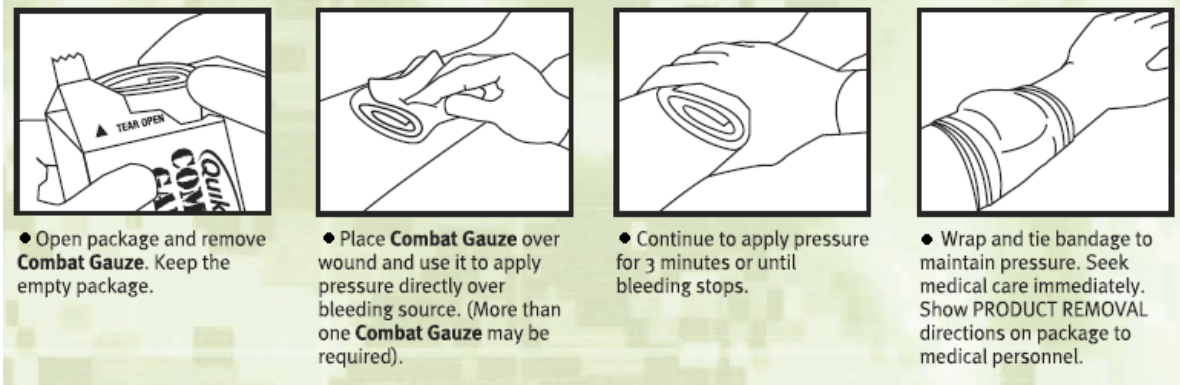


Figure 9. Combat Gauze™

Junctional Tourniquet

Junctional Hemorrhage refers to any hemorrhage in the groin, buttocks, perineum, axilla, and the base of the neck (The areas where the neck and the limbs join the torso are “junctional” areas). Hemorrhage from wounds in these areas cannot be controlled by application of standard tourniquets like the C.A.T. (See figure 11) Groin injuries are the most common form of junctional bleeding where regular tourniquets don’t work. Following the information from the amputation summary below and the statistical data shown in the chart (see figure 12), it is easy to see where tourniquets are working, however, Dismounted Complex Blast Injuries (DCBI) require a treatment that is different from a regular tourniquet.

Amputation summary:

- Amputation rates for evacuated Marines increased from 6 to 18% (a 200% increase over baseline.)**
- The rate in December 2010 was 38%.**
- The double amputation rate increased by 3 fold in the last 4 months.**
- Increased genitalia injuries.**
- Most of the amputations are high proximal injuries which are extremely disabling.**

IEDS Iraq vs Afghanistan:

Iraq

- **Large amount of explosives – recycled 155 shells**
- **Command or vehicle-detonated**
- **Destroy vehicles**

Afghanistan

- **Smaller amount of explosives**
- **Homemade explosives**
- **Personnel pressure-detonated**
- **Designed to maim**



Dismounted Complex Blast Injury (DCBI)



Figure 10. DCBI

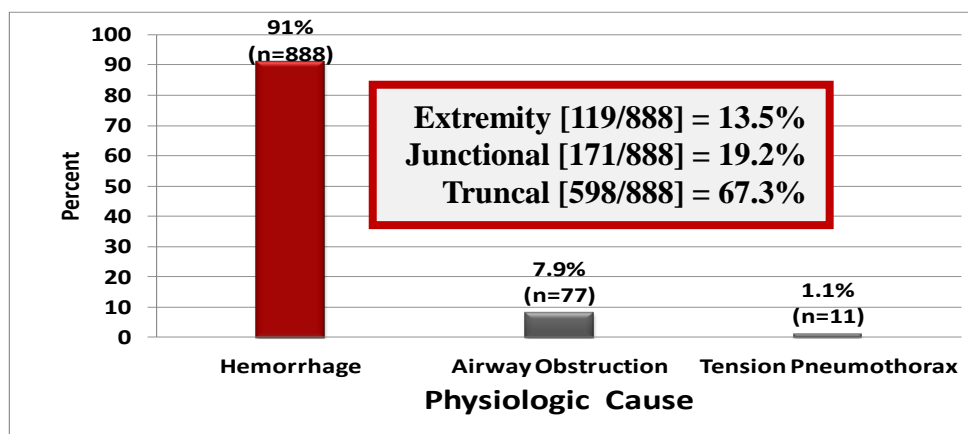


Figure 11. Death from Hemorrhage

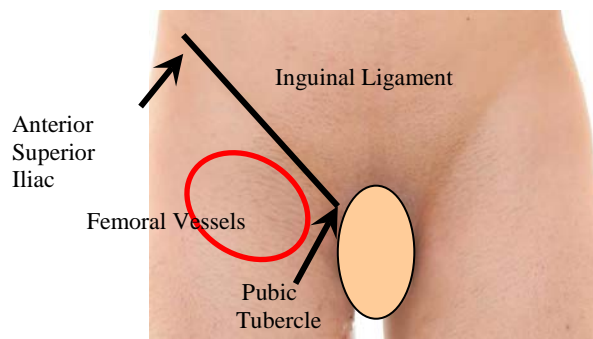


Figure 12. Superficial Anatomy of the Groin

Although a tourniquet may stop the active bleeding, it also prevents venous blood from returning to the heart. If arterial blood continues to flow past the tourniquet, pressure can build up distally in the limb and create a compartment syndrome. This is why the tourniquet should be tightened until there is no longer a distal pulse – to minimize chance of harm from a developing compartment syndrome.

Tourniquet Points to Remember

- **Damage to the arm or leg is rare if the tourniquet is left on for less than two hours.**
- Tourniquets are often left in place for several hours during surgical procedures.
- In the face of massive extremity hemorrhage, it is better to accept the small risk of damage to the limb than to have a casualty bleed to death.
- Tourniquets have historically been frowned upon in civilian trauma settings. **In combat settings, they are the biggest lifesaver on the battlefield!** They are NOT A PROBLEM if not left in place for too long.
- All unit members should have a CoTCCC approved tourniquet at a standard location on their battle gear. **It should be easily accessible if wounded – DO NOT bury it at the bottom of your pack!** Each Marine and Sailor having a tourniquet at the unit's standardized location is critical, and should be a pre-mission inspection item.
- Tourniquets should be left in their protective packaging until needed to treat casualties. Harsh environments may contribute to tourniquet failure if not left in packaging.
- Training tourniquets should never be used as mission tourniquets; repetitive applications may cause tourniquet failure.
- When a tourniquet has been applied, **DO NOT** periodically loosen it to allow circulation to return to the limb.
 - Causes unacceptable additional blood loss
 - It HAS been happening, and caused at least one near fatality in 2005
 - Periodically loosening the tourniquet to allow intermittent flow to the limb is an unnecessary practice in the first place, and allows further blood loss in a casualty who cannot afford it.
 - Tightening the tourniquet enough to eliminate the distal pulse will help to ensure that all bleeding is stopped, and that there will be no damage to the extremity from blood entering the extremity but not being able to get out.

Converting a Tourniquet to a Dressing

- Tourniquet use is the first line of hemorrhage control while in the Care Under Fire phase. Only when in the Tactical Field Care phase, and after the application of the MARCH acronym, should you even consider converting a tourniquet to a pressure dressing. It may be advantageous to convert a tourniquet to another method of hemorrhage control. Reasons to consider converting a tourniquet include if evacuation times will be delayed beyond 2 hours and if tourniquet pain is difficult to treat. Only a combat medic/Corpsman/PJ, a PA, or a physician should loosen tourniquets.

Do **NOT** convert a tourniquet to a pressure dressing under the following conditions:

- The casualty is in Class III or IV shock (you will learn what this is in the Shock lesson).
- There has been a complete amputation below the tourniquet.
- There is no one to monitor the casualty for rebleeding.
- Tourniquet has been in place for more than 6 hours.
- Short transport time to surgical intervention (within 2 hours after application).
- Tactical or medical considerations make transition to other hemorrhage control methods inadvisable.

- **Note: If the casualty will be delayed beyond 2 hours, re-assess the need for the tourniquet at the 2-hour point.** Consider removing the tourniquet if bleeding can be controlled by other methods.

Directions for converting a tourniquet:

1. Apply Combat Gauze to the wound per instructions
2. Loosen the tourniquet slowly.
3. Apply direct pressure for at least 3 minutes to the Combat Gauze
4. Observe for bleeding.
5. If bleeding remains controlled, cover the Combat Gauze with a pressure dressing.
6. Leave loose tourniquet in place.
7. If bleeding is not controlled without the tourniquet, re-tighten it.
8. Don't take the tourniquet off and discard it; You may need it if the bleeding starts up again.
9. Monitor for re-bleeding under dressing.

Other considerations when using tourniquets:

Do NOT place a tourniquet below the knee or elbow or over a joint due to there being two bones, i.e., Tibia/Fibula below the knee, and Radius/Ulna below the elbow, which can splint the hemorrhaging vessel and make it impossible to control the bleed.

Application tightness - apply tourniquet tight enough to block arterial flow. Generally, the bigger the limb, the tighter the tourniquet. So a leg will require more pressure to control bleeding than an arm will. If injured limb is still present, check distal pulse to ensure it is occluded.

It may be necessary to use more than one tourniquet to control severe bleeding. A second tourniquet should be applied just proximal to the first, if needed. Another thing to remember is that a tourniquet will be painful for the conscious casualty to tolerate but don't stop tightening until the hemorrhage is controlled. Pain management should be considered provided the casualty does not have signs of Class III or IV shock.

You must document placement of a tourniquet by placing a "T" and the time of application on the casualty's forehead or other conspicuous spot. After application, do not cover a tourniquet under any condition, leave it exposed to ease monitoring for continued hemorrhage.

4. After you've completed the *MARCH* algorithm you must return to re-assess bleeding. Take care of any non- life-threatening bleeding with the following:

Direct Pressure

Direct pressure, applied over a bleeding site, is the initial technique used to control external hemorrhage for non life-threatening bleeding. Most external hemorrhage is readily controlled by direct pressure at the bleeding site, even carotid and femoral bleeding! Performing direct pressure correctly requires two hands pushing against the wound, while the casualty is lying on a flat and hard surface for counter pressure. You must lean into the delivery of direct pressure and never let up on it to check the wound. If you need to perform other procedures, a pressure dressing can be made using bandages and ace wraps. If direct pressure fails to control extremity hemorrhage, the next step is to use a tourniquet.

Bandages and Dressings

A bandage is any material used to hold a dressing in place. It can be applied to wrap or bind a body part or dressing. The bandage also provides additional pressure to the dressing or splint and protects and covers the dressing completely.

Things to keep in mind about bandages/dressings

- Ensure the dressing is tight enough.
- Provide pressure over the entire wound.
- Dressings must cover the entire wound, bandages must cover entire dressing.
- Leave the fingers and toes exposed
- Assess circulation and neurological status using **PMS**:
 - P**ulse (check pulses in extremities)
 - M**otor (movement)
 - S**ensation (can the patient feel you touching them?)
- If hemorrhage continues:
 - DO NOT** remove the first pressure dressing; apply a second one over the first

The following provides brief information regarding the types of bandages and dressings that you may encounter:

Kerlix gauze

Advantages:

- Extremely absorbent
- Weave of material makes roll semi-stretchable
- Sterile
- Good for packing cavities

Disadvantages:

- Looses bulk when wet
- Catches debris and snags very easily

Aspirin use on the battlefield?

The use of aspirin or any other blood thinner while in a combat setting can lead to increased blood loss not only during surgical procedures, but also when injured on the battlefield. Aspirin is not sold over the counter at exchange outlets while deployed, nor should it be given to Marines or Sailors without a doctor's order. Be sure to educate your Marines and other Sailors on this topic.

Ace wrap

Advantages:

- Can be applied quickly
- Gives pressure to the entire affected area
- Provides excellent support for sprains and strains

Disadvantages:

- Can decrease peripheral circulation

Cravats or Triangular Bandages (37"x37"x52")

Advantages:

- Versatile
- Come in small packages with safety pins
- Can be used as a tourniquet

Disadvantages:

- Has very little absorbency

Combination Dressing/bandage

"H" Bandage Combat Dressing (See Figure 17)

These pressure dressing bandages are 4" wide elastic wraps with 8" x 10" absorbent cotton pad attached close to the end of one side of the elastic wrap. On the other side of the absorbent pad, in the middle on the elastic wrap side is a hard plastic H-anchor that allows for wrapping the dressing around the anchor to apply pressure directly over wound. It also gives it the ability for self-application. Pressure dressings can be applied to extremity, chest, abdominal, and head wounds.



Figure 17. "H" Bandage

Instructions for use

- Open and remove pressure dressing.
- Place pressure dressing over injury with steady pressure, isolating Velcro end.
- Pull draped elastic end and secure to Velcro end.
- Feed wrap through lower leg of H anchor, pulling firmly.
- Wind wrap back around injury site and feed wrap through upper leg of H – anchor, pulling firmly.
- Continue wrapping elastic wrap around injury site, keeping the wrap tight.
- Firmly attach Velcro end of wrap and secure with plastic hooks on sides of wrap.
- For fractures of the arm, the elastic wrap can be used as a sling or swathe.

Expedient (Improvised) Dressing and Bandages

- Patient's clothing.
- Patient's equipment.



CASUALTY ASSESSMENT AND HEMORRHAGE CONTROL

Care Under Fire Phase: Hemorrhage control is the only intervention performed during this phase! You must be able to recognize “life-threatening” hemorrhage. For extremity hemorrhage, use a tourniquet.

Tactical Field Care Phase: M.A.R.C.H. Massive Hemorrhage: Assess and control all sources of life-threatening bleeding. Use a tourniquet to control hemorrhage that is anatomically amenable to tourniquet application. For compressible hemorrhage not amenable to tourniquets, use COMBAT GAUZE as the hemostatic agent of choice. Apply with at least 3 minutes of direct pressure. If the bleeding site is appropriate for use of a junctional tourniquet, immediately apply a CoTCCC recommended junctional tourniquet. Combat Gauze with direct pressure should be used if the junctional tourniquet is not available or while the junctional tourniquet is being readied for use.

References:

Prehospital Trauma Life Support, current Military Edition
TCCC Guidelines, 28 OCT 2013

