

# Trauma and Gunshot wounds:

What you need to know to save a life.

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## Introduction

By the time you finish reading this story, a dozen Americans will have died from a trauma death. Trauma is the leading killer of Americans from one to 44 years of age. There are 18 deaths per hour from traumatic injury.

In the military setting, despite the increase in firepower, the number of deaths during war has decreased. In World War II, 30% of the Americans injured in combat died. In Vietnam, this number dropped to 24%. In the war in Iraq and Afghanistan, about 10 percent of those injured have died. The reduction of deaths can be attributed to better trauma systems, timely access to medical care, and newer trauma approaches. This is why it is important for you to know what to do in the event of a trauma.

An understanding of what to do in different trauma scenarios could make the difference between life and death for you or your partner. This article outlines some basic information on acute trauma care and treatment of penetrating injuries. Unless you have thought about how you are going to react to a specific event, mistakes can happen and you don't want to cause more harm. Not knowing what to do is a terrible feeling and can cost a life. By the end of this article, you should have a better understanding of gunshot wounds and be able to initially care for them.

## The Basics

Trauma is generally divided into penetrating or blunt trauma. Penetrating trauma refers to gunshot wounds, stab wounds, and injury from projectiles. Blunt trauma can include assaults, motor vehicle accidents, falls, explosions, and other force mechanisms. This article will mainly focus on penetrating injuries but applies to the initial care of all trauma.

Whatever the cause of trauma, there are a few basic rules to remember. An easy way to remember the approach to an injured patient is the A, B, C, D, E's; Airway, Breathing, Circulation, Disability, Exposure. See Table 1.

- A. A for Airway refers to the victim's mouth and breathing passage. In an unconscious patient, the tongue is the most common cause of obstruction of the airway. Simply positioning the victim can allow them to breathe. A clear breathing passage is vital because once this is blocked, the victim heart will eventually stop beating without oxygen.
- B. B refers to breathing - meaning is the patient actively breathing and is the chest rising and falling symmetrically with each breath. For example, if someone is stabbed in the chest and one side of their chest has no breath sounds and does not rise and fall, there is usually a serious problem such as a lung collapse.
- C. C stands for Circulation. Assessing circulation means assessing the pulse at the wrist, neck, or groin and getting a blood pressure if you have a BP cuff. If you can feel a pulse at the carotid artery, it means the blood pressure is at least 60.
- D. D refers to Disability or neurological deficit. For example, a victim shot in the neck or back may not be moving their arms or legs. This usually means the spinal cord has been injured and moving the patient can make it worse. All of the findings or what you observe about a trauma victim and spontaneous movements of extremities should be communicated to the hospital staff.
- E. E stands for Exposure. You never want to miss a gunshot wound or stab wound as this can have deadly consequences. It is very easy to miss a gunshot in someone's armpit or between the buttocks. If you don't specifically look there, you will miss it. Fully exposing the patient and checking everyone will ensure you haven't missed anything.

### **The "Golden Hour"**

The "Golden Hour" is a term anyone at risk for injury should be very familiar with. It refers to the idea that survival is improved when critical victims are managed by a specialized

team as rapidly as possible. It is not meant to denote exactly 60 minutes but to imply an urgency to seek appropriate medical care and not waste precious time in the field.

In the civilian setting, Emergency Medical Services (EMS) provides an important role in the care of trauma. In the military settings, your medics and evac/rescue crews will serve in this capacity. EMS providers are experts in extricating victims of motor vehicle accidents and treating certain life-threatening injuries. However, several studies are showing that increased time spent in the field with a severe trauma patient may not be the best treatment. Your chance of dying can double in certain situations with maneuvers performed in the field. The goal of EMS or any pre-hospital provider is to get the injured patient to the appropriate trauma hospital as quickly as possible. Taking into account that EMS has to be contacted, then deploy a unit and then initially treat the victim in the field; a significant portion of your "Golden Hour" is already consumed. In the urban setting, knowing where the nearest trauma centers with the best and fastest routes can be crucial to survival. For example, be cognizant that the trauma center 10 blocks away may not have the best capabilities and requires a trip across a busy congested area. Instead, going to the trauma center 15 minutes in the opposite direction may be a better option. Even among trauma centers, there are different levels of expertise and capabilities. Level 1 trauma centers represent the highest level and have 24 hour surgeons and a dedicated team. The Level 2 and 3 centers often do not have in-house coverage; meaning your surgeon will have to come in from home to take care of bleeding. Remember the Golden Hour.

There are 3 peaks of death when it comes to deaths following trauma. The first occurs at the scene of injury. For example, people who die at the scene of a motor vehicle accident have typically sustained such severe head or spinal cord injury or massive blood vessel injury that they die at the scene. Safety features such as seat-belts and bullet proof vests have reduced this initial peak of death. In penetrating trauma, victims of gunshot wounds who die at the scene have typically sustained GSW to the chest striking the heart or major blood vessel. Even in the best of hands, these victims are typically unsalvageable. The second peak of death occurs within 6 hours of injury and stems from internal bleeding and brain swelling. A regional trauma system of Emergency Medical Services and better access to Trauma Centers has helped to reduce this peak. The third peak of death is a few weeks after injury and occurs in the Intensive Care Unit from infection and multi system organ failure.

## Where do people heavily bleed? How long does it take?

The main principle of field trauma care for the “lay” person is to stop ongoing blood loss. Applying direct pressure on a bleeding wound is the most effective technique. This simple maneuver will almost always stop the bleeding.

The average adult male has 5 liter of blood in the body. Typically blood pressure begins to drop (hypotension) when 20 - 30% is lost. Death can occur when 40% of blood loss occurs and the volume is not replaced. There are five areas where people can bleed large amounts causing shock. They are the chest, abdomen, pelvis/retroperitoneum, long bones (eg. Femur) and at the scene (bleeding from an open wound onto the floor).

1. **CHEST BLEEDING:** Massive chest bleeding typically comes from the blood vessels that run from the center of the chest cavity up to the head and down to the abdomen. These large blood vessels called the aorta and the vena cava take blood to and from the heart. The heart and the lungs can also be involved and can bleed heavily. The rib cage can also bleed if one of the blood vessels underneath each rib is injured but this bleeding tends to be at a slower rate.
2. **ABDOMINAL BLEEDING:** Abdominal bleeding can occur from large solid organs such as your liver, spleen or kidney as well as the blood vessels feeding the intestines. All of these internal organs have a rich blood supply and when injured can bleed large amounts. The bleeding to these structures is unable to be controlled in the field and these patients require emergent transfer to an acute care setting.
3. **PELVIS/RETROPERITONEAL BLEEDING:** Pelvis/retroperitoneal bleeding occurs when the pelvis, which is really a ring of bones, is broken. The blood vessels that run along the bones are torn and bleed heavily. The retroperitoneum is the area behind the abdomen and your intestines. This is where the very large blood vessels, namely the aorta and inferior vena cava, are located. When either of these structures is injured, bleeding is often massive. Nature purposely placed these structures in the middle of our bodies and in front of the vertebral column to specifically

protect them from injury. Not much can be done in the field to control this type of bleeding.

4. **LONG BONE BLEEDING:** Bleeding from the long thigh bones of the leg can be significant. Bleeding can be controlled in extremity injuries with heavy manual compression. The typical mechanism is your leg being pinned into the dashboard during a motor vehicle crash. A gunshot wound to the leg can either fracture the femur or hit a major blood vessel causing hemorrhage. One can lose a liter and a half of blood into each thigh with a femur fracture. Reducing the fracture can help minimize this and “unkink” any blood vessels that provides circulation to the lower leg.
5. **OPEN WOUND BLEEDING:** If a person has not bleed into one of the internal cavities of the body such as the chest or abdomen or areas outlined above, the only other place the blood could have gone is on the floor. Open wound can bleed out and that’s why it is important to communicate to the doctors the amount of blood loss in the field.

### **To “drop” someone instantaneously**

In order to kill someone or incapacitate them instantaneously, you typically need to strike the central nervous system (brain or spinal cord) or heart/major blood vessel. The major superficial blood vessels that are at risk for injury and death are the carotid, radial/brachial, femoral, and popliteal vessels. The major deep blood vessels are the aorta, iliac artery and vein, and vena cava. Even a gunshot to the brain sometimes does not incapacitate a victim. The bullet traversing both hemispheres or parts of the brain will typically “drop” someone. When it comes to blood vessels, striking the major chest blood vessels will also incapacitate someone almost instantaneously.

### **How to control bleeding**

Pressure, pressure, pressure. It cannot be overstated that simply putting direct pressure on a bleeding wound will stop or control most bleeding. You should press with whatever amount of force it takes for the bleeding to slow down and hopefully stop. If direct pressure doesn’t work, compressing the nearest artery feeding that area often works. This is why it is important to learn the basic anatomical path of the major blood vessels

so that you know where to press and occlude them. If these steps don't work, a tourniquet may be needed.

### **Tourniquets**

The use of tourniquets is somewhat controversial and should not be a first line maneuver. The issue with tourniquet is that they stop blood flow to any structure below it. Therefore you are stealing oxygen from getting there and preventing toxic metabolites from leaving. This can cause organ failure and possibly death when the tourniquet is released. The way I look at it is if bleeding can't be controlled with pressure, you have no choice. We can deal with complications later.

Most extremity bleeding can be controlled with direct pressure. When bleeding is uncontrolled with pressure, a tourniquet should be used. If you do need to place a tourniquet, it should be broad and tight enough. Whatever type of tourniquet used, it should be placed as far down as possible and not over a joint space (as the artery dives deep here and can't be compressed by the bone). In addition, a tourniquet should not be applied over exposed muscle without skin (to avoid slipping). Again, it should be evaluated and removed as soon as possible and converted to a pressure bandage if possible. Tourniquets are very successful at controlling extremity bleeding. Like everything in Trauma, time is of the essence. Muscle can only be deprived of circulation and oxygen for only 4 - 6 hours. After that, the muscles and nerves have typically died and therefore amputation of the limb is required. Releasing the tourniquet at times can buy you more time, but at the cost of blood loss. Remember, it's "life over limb".

Tourniquets can be very painful. All you have to do is remember a doctor's visit when they pump up the blood pressure cuff for a few seconds. This tends to hurt until the cuff is released. An important point to remember with tourniquets is that they are not without complications; most importantly, reperfusion syndrome. As the toxic metabolites build up and oxygen is deprived in the area below the tourniquet, victims can become very sick and even die.

I personally think a standard blood pressure (BP) cuff is the best tourniquet since almost everyone knows how to apply it and it can be removed easily. You generally have to pump up the BP number to twice your blood pressure. So if your BP is 120/80, you need to pump it up to a number of 220 - 240 at least.

## GUNSHOT WOUNDS

In order to better understand the damage inflicted to the body by bullets, it is important to understand the different components of wounding. Bullets cause damage from both direct and indirect mechanisms. The direct mechanisms include the cutting from the original bullet and fragments passing through flesh. This is the main cause of damage from low velocity bullets. Indirect mechanisms include stretch and displacement of flesh from the bullet cavitation effect. This is mainly seen with medium to high velocity weapons.

There are 3 main components of wounding with gunshot wounds.

1. Penetration: Penetration refers to the flesh which is destroyed or disrupted by the passing projectile. A bullet fired at the abdomen must penetrate approximately 7 inches in order to reach the major blood vessels to cause significantly bleeding and sometimes instantaneous death.
2. Cavitation is the second component and consists of a “shock-wave” like effect. Temporary cavitation can be up to 10 times the diameter of a medium to high velocity bullet. The permanent cavitation is the hole left by the bullet itself. Damage will depend on the elasticity of the organ or tissue. Muscle, blood vessels, lung and bowel are relatively elastic and therefore have a less permanent cavitation effect. Liver and brain on the other hand are relatively inelastic and cavitation becomes permanent resulting in significant damage.
3. Fragmentation is the last component. Projectile fragments or secondary fragments such as bone are sent off and create their own paths through flesh. This is a major cause of tissue disruption with high velocity bullets.

Never underestimate the size and trajectory of a gunshot wound. Gunshot wounds, with the exception of shotgun wounds, appear relatively small and unimpressive. But beware. The internal damage from the above mechanisms is quite significant. In addition, never assume a bullet travels in a straight line. We have seen hundreds of cases of the most

amazing trajectories. For example, I have seen a patient shot in the leg with the bullet sitting in his chest. Don't necessarily focus on the wound itself.

## **MANAGEMENT OF GUNSHOT WOUNDS**

The basic treatment of gunshot wounds depends on the area(s) struck. Generally, gunshot wounds should be covered by a dry dressing or a clear transparent dressing if available. Manual pressure should be applied if the wound is bleeding. Once at a definitive care center, we will clean the wound, possibly debride some edges, and change the dressings daily. A gunshot is never sutured closed as the infection rate is very high. Bullets drag clothing into the wound and along the bullet track. Since clothing is of course not sterile, the wound is prone to infection if closed. Open wounds almost never get infected.

We will now go over how to handle gunshot wounds from head-to-toe.

### ***GSW to HEAD***

Gunshot wounds to the head are typically fatal if the bullet crosses both of the brain hemispheres or hit the brain stem which is responsible for control of basic vitals. We have all seen miraculous cases with GSW to the head with victims walking around and talking. There is no real treatment in the field to treat this. Head elevation or seated positioning and rapid transport to a trauma center with neurosurgical capabilities is key.

### ***GSW to FACE & NECK***

Gunshot wounds to the face and neck are often troublesome. Since your face and neck have excellent circulation, bleeding is often heavy. In addition, the airway can become obstructed by blood, teeth, and swelling. Manual pressure should be applied to a bleeding wound and leave the victim in the upright position. Direct pressure should be strong enough to stop the bleeding. Avoid pressing over a large area as you can compromise blood flow to the brain or shift the trachea causing an airway obstruction. Emergency Medical Services often times place a cervical collar and back-board to immobilize a gunshot victim by protocol. However, the incidence of spinal cord injury caused by movement is exceedingly rare and therefore time should not be wasted with immobilization of the victim. Paralysis following gunshot wounds happens

instantaneously when the bullet rips through the spinal cord. It generally does not occur with moving fractures or other means.

### ***GSW to CHEST & BACK***

Gunshot wounds to the chest can hit a variety of organs. The lungs, heart, and major blood vessels can be struck and typically can be fatal if not immediately treated. A collapsed lung or pneumothorax will manifest with difficulty breathing. A tension pneumothorax is a collapsed lung that is building up pressure and causing collapse of adjacent organs. A hemothorax is blood in the chest cavity. Upon arrival to a trauma center, the trauma team will place a chest tube to relieve these conditions and drain blood.

Sucking chest wounds occur when air is seen traveling in and out of a wound with each breath. Never completely occlude these sucking chest wounds as you can cause a build up of pressure within the chest and cause a life-threatening tension pneumothorax. Sucking chest wounds are very rare in the civilian setting with low velocity bullets but may be seen with medium and high velocity bullets. A three-sided tape technique with an occlusive dressing is indicated to manage these wounds.

Direct pressure should be applied to a bleeding wound but it is often hard to compress chest bleeding as the structures that are bleeding are protected by the bony rib cage. If you are trained, needle decompression should be used if you suspect a tension pneumothorax.

### ***GSW to ABDOMEN***

Gunshot wounds to the abdomen can cause bowel damage as well as significant bleeding. Manual pressure with a dry dressing is indicated for an actively bleeding wound but oftentimes it is difficult to compress the internal bleeding source. This is why it is important to transport to a trauma center ASAP where a trauma surgeon can go in and operate immediately.

### ***GSW to the extremities***

Arm or leg gunshot wounds can bleed heavily if a blood vessel is struck. Direct manual pressure is indicated to initially control bleeding. An injured blood vessel can either bleed externally or sometimes clot and block blood flow to the remainder of the

extremity. Both are emergencies requiring a surgeon. You should press hard enough to stop the bleeding. Tourniquets, as described above, may sometimes be needed. Large skin defects, from for example shotgun wounds, may require topical clotting agents to help control bleeding. Typically, direct pressure is almost always enough.

### **Take-Home Points**

The most important take-home message from this article should be an appreciation for time. The clock begins running with the initial trauma and every minute thereafter counts. Transporting a patient after the A, B, C's and after initially bleeding is controlled is the key to success. For an injured patient, getting to a dedicated trauma center and perhaps an operating room will directly predict survival. Having an understanding of basic mechanisms of injury and how to treat specific injuries will increase the likelihood of a better outcome. At a minimum, you should be trained as a first responder and be certified in Basic Life Support/CPR.

As important as it is to aide others, you need to be aware of the importance of protecting yourself. Always be prepared and carry a minimum amount of medical supplies. If your occupation requires you to carry a knife or gun, there is no excuse not to carry some medical supplies. Although a medical bag in your car trunk may be useful, having the necessary medical supplies on you is far more optimal and could mean the difference between life and death.

TABLE 1

The Basics	What to evaluate	Action to take
A: Airway	Assess the airway Look, listen, and feel	Open the mouth and airway Remove any foreign bodies or loose teeth Use head tilt-chin lift or jaw thrust maneuver if cervical spine injury is suspected.
B: Breathing	Assess breathing Is the chest rising & falling?	Provide assisted respirations if the patient is not breathing
C: Circulation	Check pulses	Start CPR if you don't feel a pulse
D: Disability	Is the victim able to talk? Is victim moving extremities?	Prevent neurological injury by making sure not to unnecessarily move the patient, especially don't turn the head.
E: Exposure	Look for all stab wounds and gunshot wounds in armpits, groins, etc.	Direct pressure if bleeding wound Do not remove impaled objects.