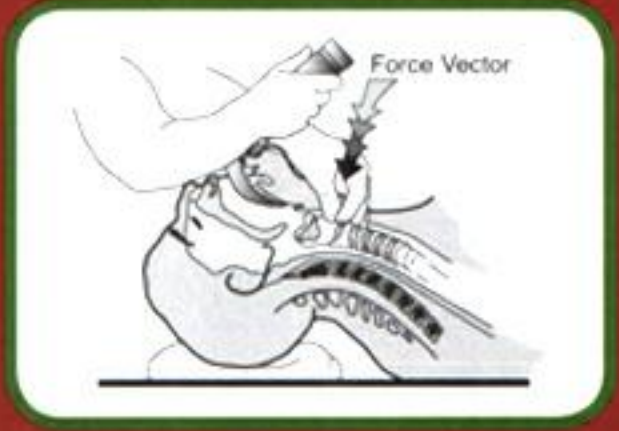
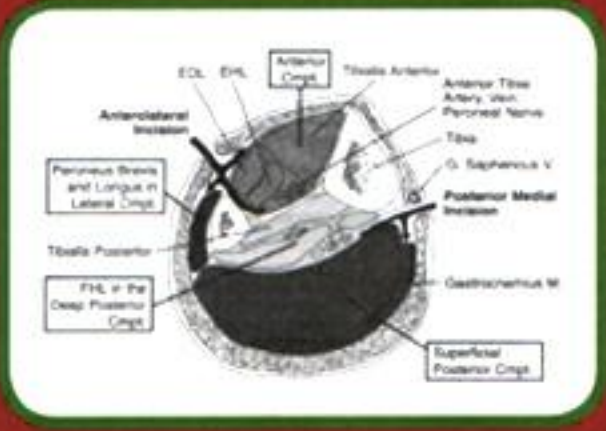
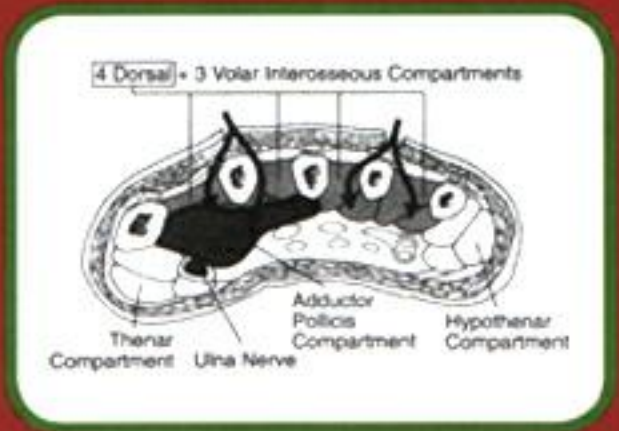
EMERGENCY WAR SURGERY

The Survivalist's Medical Desk Reference

Critical Care and Damage Control Surgery
Triage and Aeromedical Evacuation
Weapon Effects and Parachute Injuries
Shock and Resuscitation • Fractures and Amputations
Radiological, Biological, and Chemical Injuries







DEPARTMENT OF THE ARMY

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"All the circumstances of war surgery thus do violence to civilian concepts of traumatic surgery. The equality of organizational and professional management is the first basic difference. The second is the time lag introduced by the military necessity of evacuation. The third is the necessity for constant movement of the wounded man, and the fourth — treatment by a number of different surgeons at different places instead of by a single surgeon in one place — is inherent in the third. These are all undesirable factors, and on the surface they seem to militate against good surgical care. Indeed, when the over-all circumstances of warfare are added to them, they appear to make more ideal surgical treatment impossible. Yet this was not true in the war we have just finished fighting, nor need it ever be true. Short cuts and measures of expediency are frequently necessary in military surgery, but compromises with surgical adequacy are not."

—Michael E. DeBakey, MD
Presented at Massachusetts General Hospital
Boston, October 1946

THE THIRD UNITED STATES REVISION

of

EMERGENCY WAR SURGERY

IS DEDICATED TO THE

COMBAT PHYSICIAN

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Chapter 1

Weapons Effects and Parachute Injuries

Just as with any medical topic, surgeons must understand the pathophysiology of war wounds in order to best care for the patient.

Treat the wound, not the weapon.

Epidemiology of Injuries

- Weapons of conventional war can be divided into explosive munitions and small arms.
  - o Explosive munitions: artillery, grenades, mortars, bombs, and hand grenades.
  - o Small arms: pistols, rifles, and machine guns.
- Two major prospective epidemiological studies were conducted during the 20th century looking at the cause of injury as well as outcome.
  - o During the Bougainville campaign of World War II, a medical team was sent prospectively to gather data on the injured, including the cause of injury. This campaign involved primarily infantry soldiers and was conducted on the South Pacific island of Bougainville during 1944.
  - o US Army and Marine casualties from the Vietnam War collected by the Wound Data and Munitions Effectiveness Team (WDMET) in Vietnam.

US Casualties, Bougainville Campaign (WW II) and Vietnam

Weapon	Bougainville %	Vietnam %
Bullet	33.3	30
Mortar	38.8	19
Artillery	10.9	3
Grenade	12.5	11
Land mine/booby trap	1.9	17
RPG (rocket propelled grenade)	—	12
Miscellaneous	2.6	—

The most common pattern of injury seen on a conventional battlefield is the patient with multiple small fragment wounds of the extremity.

Anatomical Distribution of Penetrating Wounds (%)

Conflict	Head and Neck	Thorax	Abdomen	Limbs	Other
World War I	17	4	2	70	7
World War II	4	8	4	75	9
Korean War	17	7	7	67	2
Vietnam War	14	7	5	74	—
Northern Ireland	20	15	15	50	—
Falkland Islands	16	15	10	59	—
Gulf War (UK) **	6	12	11	71	(32)*
Gulf War (US)	11	8	7	56	18+
Afghanistan (US)	16	12	11	61	—
Chechnya (Russia)	24	9	4	63	—
Somalia	20	8	5	65	2
Average	**15**	**9.5**	**7.4**	**64.6**	**3.5**

* Buttock and back wounds and multiple fragment injuries, not included

+ Multiple wounds

** 80% caused by fragments; range of hits 1–45, mean of 9

Mechanism of Injury

- For missile injuries, there are two areas of projectile-tissue interaction, permanent cavity and temporary cavity (Fig. 1-1).

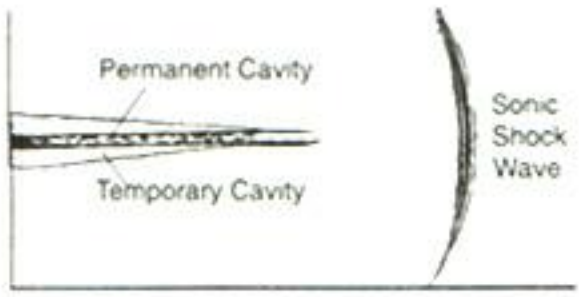

Fig. 1-1. Projectile–tissue interaction, showing components of tissue injury.

- **Permanent** cavity. Localized area of cell necrosis, proportional to the size of the projectile as it passes through.
- **Temporary** cavity. Transient lateral displacement of tissue, which occurs after passage of the projectile. **Elastic tissue**, such as skeletal muscle, blood vessels and skin, may be pushed aside after passage of the projectile, but then rebound. **Inelastic tissue**, such as bone or liver, may fracture in this area.

- The **shock (or sonic) wave** (commonly mistaken for the temporary cavity), though measurable, has **not** been shown to cause damage in tissue.

Explosive munitions have three mechanisms of injury (Fig. 1-2):

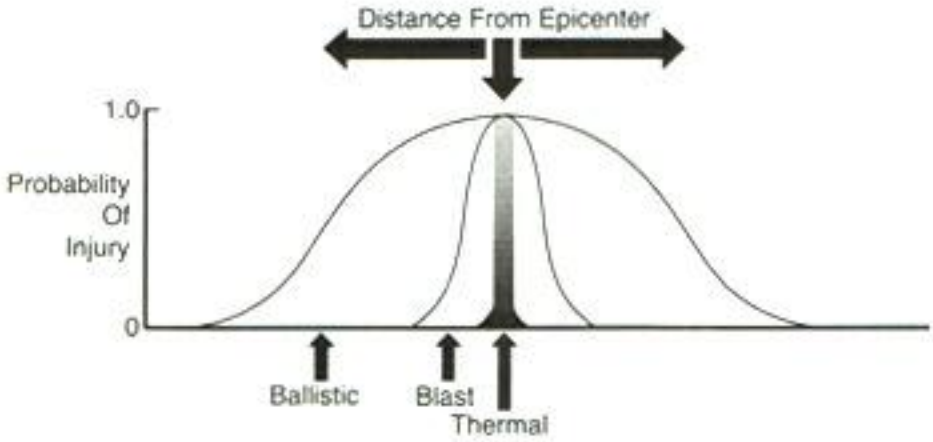

Fig. 1-2. The probability of sustaining a given trauma is related to the distance from the epicenter of the detonation.

- Ballistic.
  - Fragments from explosive munitions cause ballistic injuries.
  - Fragments are most commonly produced by mortars, artillery, and grenades.
  - Fragments produced by these weapons vary in size, shape, composition, and initial velocity. They may vary from a few milligrams to several grams in weight.
  - Modern explosive devices are designed to spread more uniform fragments in a regular pattern over a given area.

- Fragments from exploding munitions are smaller and irregularly shaped when compared to bullets from small arms.
- Although initial fragment velocities of 5,900 ft/s (1,800 m/s) have been reported for some of these devices, the wounds observed in survivors indicate that striking velocities were less than 1,900 ft/s (600 m/s). Unlike small arms, explosive munitions cause multiple wounds.

- Blast (see Fig. 1-2).
  - The blast effects take place relatively close to the exploding munition relative to the ballistic injury.
  - Blast overpressure waves, or sonic shock waves, are clinically important when a patient is close to the exploding munition, such as a land mine.
  - The ears are most often affected by the overpressure, followed by lungs and the gastrointestinal (GI) tract hollow organs. GI injuries may present 24 hours later.
  - Injury from blast overpressure is a pressure and time dependent function. By increasing the pressure or its duration, the severity of injury will also increase.
  - Thermobaric devices work by increasing the duration of a blast wave to maximize this mechanism of injury. The device initially explodes and puts a volatile substance into the air (fuel vapor). A second explosion then ignites the aerosolized material producing an explosion of long duration. The effects from this weapon are magnified when detonated in an enclosed space such as a bunker.
  - Air displaced on the site after the explosion creates a blast wind that can throw victims against solid objects, causing blunt trauma.
- Thermal.
  - Thermal effects occur as the product of combustion when the device explodes. Patients wounded near exploding munitions may have burns in addition to open wounds, which may complicate the management of soft tissue injuries.

Common Misconceptions About Missile Wounds

Misconception	Reality
Increased velocity causes increased tissue damage.	Velocity is one factor in wounding. An increase in velocity does not per se increase the amount of tissue damage. The amount of tissue damage in the first 12 cm of a M-16A1 bullet wound profile has relatively little soft tissue disruption, similar to that of a .22 long rifle bullet, which has less than half the velocity.
Projectiles yaw in flight, which can create irregular wounds.	Unless a projectile hits an intermediate target, the amount of yaw in flight is insignificant.
Exit wounds are always greater than entrance wounds.	This is untrue and has no bearing on surgical care.
Full metal-jacketed bullets do not fragment, except in unusual circumstances.	The M-193 bullet of the M-16A1 rifle reliably fragments at the level of the cannulure after traversing about 12 cm of tissue in soft tissue only.
All projectile tracts must be fully explored, due to the effects of the temporary cavity.	Elastic soft tissue (skeletal muscle, blood vessels, and nerves) generally heals uneventfully and does not require excision, provided the blood supply remains intact. Temporary cavity effects are analogous to blunt trauma.

Medicine

Military surgeons must assume a leadership role in combat casualty care in a variety of less-than-ideal circumstances. They must know how to configure and prepare the team in a rapidly changing tactical environment, be able to handle an unfamiliar battlefield wound or injury and manage mass casualties, and understand when and how to successfully evacuate the injured patient to a higher level of care.

The result of a collaboration between the U.S. Army's Borden Institute and the Army Medical Department Center & School, *Emergency War Surgery* is an indispensable handbook for the treatment of forward combat trauma. Drafted by experts in various subspecialties, it was then edited and updated by combat surgeons seasoned by tours in Iraq and Afghanistan.

Featuring nearly 200 illustrations demonstrating state-of-the-art practices of forward trauma surgery—as used by military surgeons in far-flung locations around the globe—and utilizing a bulleted manual format for quick reference, *Emergency War Surgery* gives surgeons the tools for skillful organization and speedy assessment, critical for appropriate medical management of both battle and nonbattle injuries.

THE DEPARTMENT OF THE ARMY is headquartered at the Pentagon in Arlington, Virginia, and also authors the *U.S. Army Special Forces Handbook* and the *U.S. Army Survival Manual.*

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