

Battlefield Trauma, Traumatic Shock and Consequences: War-Related Advances in Critical Care

Carrie E. Allison, MD*, Donald D. Trunkey, MD, FACS

KEYWORDS

• Trauma • Shock • History • Battlefield • Wound care • War

Over the course of history, while the underlying causes for wars have remained few, mechanisms of inflicting injury and our ability to treat the consequent wounds have dramatically changed. Success rates in treating war-related injuries have improved greatly, although the course of progress has not proceeded linearly. Homer's *Iliad* records the wounds of 147 soldiers with an overall mortality rate of 77.1%.¹ During the Civil War, 14% of soldiers died from their injuries, and that number was down to less than 4% in Vietnam.² These significant improvements in mortality, despite a concurrent increase in the lethality of weapons, have occurred primarily as a result of progress in three key areas: management of wounds, treatment of shock, and systems of organization.

WOUND CARE

The anthropologic record illustrates that care of traumatic wounds predated written history. Skulls uncovered in the Tigris-Euphrates Valley, the shores of the Mediterranean, and in meso-America show that trepanation was used to treat skull fractures and possibly epidural hematomas as far back as 10,000 BC.¹ Healing of man-made holes in these specimens suggests that the procedure was performed with some degree of success.³ Fractures and dislocations were treated with knitting of bones.

The oldest written history referring to surgical treatment of traumatic wounds appeared in 1700 BC in the 282 Laws of King Hammurabi's Code.⁴ Written by the Akkadians, the code outlined reimbursement to surgeons for success and punishment for failure. "If a physician make a large incision with an operating knife and cure it, or if

Department of Surgery, Oregon Health & Science University, 3181 SW Sam Jackson Park Road, L223, Portland, OR 97239, USA

* Corresponding author.

E-mail address: hinkc@ohsu.edu (C.E. Allison).

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he open a tumor (over the eye) with an operating knife, and saves the eye, he shall receive ten shekels in money. If a physician make a large incision with the operating knife, and kill him, or open a tumor with the operating knife, and cut out the eye, his hands shall be cut off." There was essentially no understanding of anatomic or physiologic relationships in these times.

Though otherwise extremely diverse, most ancient cultures shared in common the use of poultices to treat wounds and infections using a combination of plant extracts, resins, and spices. While many of these were later found to be active against *Staphylococcus* and *E coli*, they were probably chosen primarily for their ability to make the wounds less malodorous.¹ Three ancient medical texts, the Kahun, (1825 BC), Ebers (1550 BC), and Smith Papyri (1600 BC), commonly accepted as the oldest extant medical texts, describe in detail the treatment of wounds. The latter describes 48 surgical cases and includes the use of poultices containing fats and oils, fresh meat, leaves of willow (containing small amounts of aspirin), honey, and "green-pigment" (a copper-containing toxic bactericidal), as well as incantations against pestilence.⁵ Abscesses were treated by use of a "fire-drill," a heated metal object that probably provided cautery in addition to draining pus.¹

A millennium later in Greece, Homer's description of wounds and their treatment in the *Iliad* and *Odyssey* (800 BC) showed relatively little change from Egyptian techniques. Homer recorded 147 wounds,⁶ mostly treated by human beings, although a few were described as miraculously healed by the gods. Odysseus, when injured, was treated with a bandage and an incantation to stop his bleeding. It is interesting that while the use of cautery is described during Homer's time, the use of such an *epaoide* (song or charm recited over the wound) for hemostasis was equally as common.¹ The use of tourniquets was condemned as they were believed to make bleeding worse.

Penetrating trauma caused by arrows, swords, maces, and animal bites were well described in Greek literature. Homer details the removal of an arrow from the thigh of Eurypylyus by his comrade Patroclus⁶ in the *Iliad*, which was followed by rinsing the wound with warm water, application of an analgesic, and an herbal styptic (contracting agent). Solutions of warm wine and vinegar were commonly used for irrigation and antisepsis. As observed in earlier cultures, Homer also describes blunt injuries treated with reduction of dislocations and setting of fractures.

The era of 450 BC onward in Greece, known as the "Golden Age of Pericles," was a time of great expansion and documentation of medical knowledge. Hippocrates trained in the tradition of the Asclepieia, with knowledge passed down over nearly a millennium.⁶ His 72-volume work of medical dicta, later entitled the *Corpus Hippocratum*, was unprecedented for its scope and volume. Hippocrates outlined the treatment for several types of injuries, including the setting of fractures, draining of abscesses, and trepanning head injuries. In *On Head Wounds*, Hippocrates described how an injury on one side of the head produced a contralateral deficit, that a brain injury could be localized by questioning of the patient, and that trepanation should occur within 3 days to prevent suppuration.⁶ Debridement of bone fragments before setting fractures and tourniquet necrosis to induce autoamputation of severe extremity wounds was suggested. Several of the techniques described, such as mechanisms for reducing dislocations, continue to be used to this day.

However, not all Hippocratic dicta led to the advancement of medical science. While soft tissue abscess drainage and tube thoracostomy for empyema are described,⁷ this era also marked the beginning of the theory of "laudable pus," in which suppuration was believed to be required for some types of healing. Pus formation was encouraged by placing items, such as greased wool, into the wound. Paradoxically, it was also understood that some wounds would heal better without suppuration, and antiseptic

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