

19. Alexander's Wounds as a Paradigm for War Surgery

Alfredo Musajo Somma

Historians and biography writers have pointed out the problems connected with the wounds which afflicted Alexander the Great during his long military service. Since the 19th century medical historians have analysed the wounds which affected epic heroes as described in the Homeric works and they have also discussed Alexander's wounds. The weapons, wounds and the clinical follow-up of a prominent individual in history like Alexander the Great are paradigmatic of knowledge of ballistic evolution of thrown stones, arrows and darts. Moreover surgical instruments found at archaeological sites in the Mediterranean area help to detail the operative procedure that war surgeons, like Kritodemos of Kos, were asked to cope with even on the battlefield. The Macedonian king's empire eventually stretched from Greece to India; wars became much more extensive than before and thousands of trained soldiers marching across Europe, Africa and Asia were wounded on the battlefields. Dedicated medical teams and innovative field hospitals offered through the centuries better means of surgical

assistance which would not have been thought of in civilian practice.

Conflict between cities was the norm during the Classical Greek era. Trauma care was delivered on the ancient battlefields, using techniques developed and refined in both military and civilian trauma settings.

For nearly 2500 years, Alexander represented a central vision of mankind. His life has the flavour of a fairy story, in part because it inspired so many. Physically beautiful, a fine warrior, educated by Aristotle, born to a royal court, he chose to risk his inheritance confronting the greatest empire in Europe and Asia. He defeated the Persians in every battle and conquered their territory to the very edge of the known world. At the banks of the last river of the Punjab he wept because he had no more lands to conquer. The empire he established over a million square miles survived in various forms for 300 years. He introduced a coinage, a legal system, a form of philosophy and a style of art that transformed culture across Asia. All this he achieved before he died at the age of 32. His life was magnificent in scope, scale and conviction. Ancient commentators were prepared to accept this without concealing his flaws. Classical historians attacked him for massacring populations and destroying ancient cities, for murdering his senior staff and for leading his troops on dangerous and pointless desert crossings. Conservative Athenians saw him as a half-barbarian, capricious Macedonian despot prone to indecent excesses of intemperance and ostentatious displays of vanity. His Macedonian followers were shocked by the respect he showed to local customs after his conquest of the Persian city of Babylon, in modern Iraq. Compared with his drunken father, Philip, or the Persian king Darius, who kept 365 concubines and went to battle with a platoon of pastry chefs, Alexander seems relatively ascetic and level-headed. Most importantly, ancient writers were prepared to allow that, for all his faults, Alexander was still indubitably a hero.

The legendary biography of Alexander, known as the Pseudo-Callisthenes, was written by a native of Alexandria before the 3rd century BC. Primary sources are unavailable because papers by contemporary *epistolographoi* like Onesicritus, Nearchus, Ptolemy, Aristoboulos, Kleitarchos, Ephippos, Callisthenes, Anaximenes are missing; however, secondary literary sources, such as the histories written by Diodorus, Plutarch, Strabo and Arrian are milestones in the interpretation of Alexander the Great's life.

'You may wonder', said Arrian in the introduction to his *Alexandrou Anabasis* 'why I am writing another book on Alexander the Great when there have been so many already' (Arrian, *Alexandrou Anabasis* I, 12, 1–5). Arrian wrote at the end of the 1st century AD. Indeed Arrian's and Plutarch's biographies of the *cosmocrator* offer the opportunity for a systematic record and interpretation of the major

wounds suffered by the king on the battlefield (Table 19.1).

Two wounds inflicted while the king was in Maracanda are worthy of mention:

- 1 during the night invasion in that area, a stone hit Alexander on the neck and the king suffered a transient confusional status with no complications at all;
- 2 an arrow pierced Alexander's leg and a bone was broken. According to Plutarch (*Life of Alexander* 45, 5–6) it was the tibia, while according to Arrian's version (*Alexandrou Anabasis*, III, 30,11) it was the fibula, which suffered a compound fracture.

Alexander suffered another dangerous wound during the Mallian campaign, in the Indian subcontinent, when a high energy arrow was driven towards his chest from a short distance, hitting the sternal bone. 'Air and blood were spitting out from the wound and Alexander fainted' (Arrian, *Alexandrou Anabasis*, VI, 10–11). Kritodemos from Kos, a doctor from the clan of the Asklepiades, operated on Alexander and removed the arrow by breaking the wooden shaft and using proper surgical tools.

Military medical treatment on the battlefield was restricted to external injuries. The physicians would not get involved with the fatally wounded; they recognised these cases empirically. Furthermore, a number of injured warriors did not receive medical attention, if this was not considered necessary. In cases of fainting or concussion, pouring water over the warrior or exposing him to fresh air was considered to be sufficient.

Since the Aegean Bronze Age medical practitioners in the Mediterranean area had been able to cope with broken bones or to manipulate joints when healing was almost impossible without reduction and immobilisation.

The process of the clinical condition that we call war trauma begins at the time of the initial energy exchange between the human body and an object. They are moving at different rates, with a differential energy force. Impact between them transfers energy from the hardest object to the softest one. The soft one is usually the body of the soldier. Because energy can neither be created nor destroyed, this interaction of motion with the human body exchanges the energy and produces living tissue damage. All the weapons that pierced the body had to be extracted. Various methods existed for removing them. The dart was pulled out or, if necessary, was cut out of the body. The warriors seemed to be familiar with these techniques as well as the *periodeutes* physicians.

Table 19.1 Synoptic view of Alexander the Great's wounds

WOUND AREA	Head/Neck	Thorax	Shoulder	Thigh	Legs
Weapon	Stone	Arrow	Plutarch: Clod Arrian: Catapult	Plutarch: Darius' sword Arrian: Sword Issus	Arr. Arrow
Geographical area	Maracanda	India (Mallian campaign)	Gaza		Maracanda
Literary ref.	Plutarch 45, 5 Arrian IV, 3, 3	Plutarch 63, 6–13 Arrian VI, 10–11	Plutarch 25, 5 Arrian II, 27, 2	Plutarch 20, 8–9 Arrian II, 12, 1	Plutarch 45, 5 Arrian III, 30, 11
Outcome	Temporary blindness	Sternum impact	Minor bruise	Minor bruise	Open fracture

Few early surgical instruments have been found, but a set made of bronze comes from a Mycenaean chamber tomb at Nauplion excavated in 1971, and dated to 1450 BC. The instruments probably belonged to a palace physician, and were buried with him, indicating the fairly high social status of the occupant. From amongst the instruments found in the grave, of significance are the drills, scalpels, a scoop or spoon and a large pair of denticulate forceps, 34.5 cm long. This suggests that surgery may well have been advanced enough to make proper use of them. Found in the same grave were rasps and grinding stones for the making of medicinal remedies (Protonotariou-Deilaki 1973).

Even if ancient doctors did not know the special injury patterns of aggressive weapons and they had almost no ballistic knowledge, there existed experienced practitioners, like Philip of Acarnania, the doctor who saved Alexander's life in Tarsus in 333 BC. Furthermore, Heraclides of Tarentum, around 70 BC, was the author of a recipe collection, entitled *The Soldier* which may have dealt with military medicine (Heraclides, fr. 7 Gu.).

The treatment of wounds from stones, arrows, lances, *sarissai*, bayonets, gunshot and artillery formed the main repertoire of war surgeons, later emulated by the likes of Ambroise Paré, Baron Larrey and Nikolay Pirogov.

Ambroise Paré (c. 1510–1590)

Ambroise Paré was born in France at Bourg Hersent and followed other members of his family in becoming a barber-surgeon. He gained experience in surgical ingenuity as assistant surgeon first at the Hotel-Dieu, a public hospital in Paris, and then as war surgeon attached to Maréchal de Montejan. The challenge posed by gunshot wounds on the battlefield prompted Paré to practice ligation of vessels for haemorrhages instead of performing the application of the traditional hot iron cauteries. The traditional procedure was simple: a piece of metal was heated over fire and applied to the wound. This would cause tissues and blood to heat rapidly to extreme temperatures, in turn causing coagulation of the blood and thus controlling the bleeding, at the cost of extensive soft tissue damage.

Among various artisan classes of healers only a step made a difference

between barber-surgeons and surgeons. Paré's contributions to surgical practice were recorded as a cumulative experience gained on the battlefield in his book *Apology and Treatise*. Nevertheless, his procedures made powerful and palpable action statements about the effectiveness of surgical practice, solving health problems that were generally beyond the skill of most lay people. Paré served as a surgeon to four kings and still holds a reputation as the father of military surgery.

Medical and military historians have rightly pointed out the futility of war as well as the apparent inability to learn from past experience. Too often military commanders have placed more value on personal pride and reputation or on weapons and equipment than on human lives.

Dominique-Jean Larrey (1766–1842)

Baron and French military surgeon, born July 8, 1766, Beaudéan, Hautes-Pyrénées. Since he was a teenager, from the age of fifteen, he used to study surgery and therefore served his uncle in his surgical practice. Only six years later, he moved to Paris to study under Antoine Louis (1723–1792) and Pierre Joseph Desault (1744–1795), chief of surgery at the Hôtel-Dieu.

After a short period in the army, Larrey met the commander of an artillery brigade, Napoleon Bonaparte, and in 1792 became *Chirurgien aide-major* of the Army of the North (the army of the Rhine). In this way Larrey gained great clinical experience in the battlefield, evaluating its disorganisation: there was a delay in the clinical assistance and then the victims often died. Therefore he suggested the use of *ambulances volantes* – flying ambulances, as he later described in his report from the Italian Campaign of 1797. Larrey's system of horse-drawn wagons to carry the wounded soldiers from the battlefield to field hospitals was used. The wagons were of two sizes (with the small carrying two patients, and the large, four), and were ventilated and had storage space for medicines and other needed items.

After the Italian Campaign, Larrey was appointed as professor at the École de Médecine Militaire at Val-de-Grâce, but soon after he was in the battlefield again as *Officier de santé en chef* for the Egyptian campaign, where he also used to work with the well known surgeon Baron René Nicolas Dufriche Desgenettes (1762–1837). Larrey performed 70 amputations and seven trephinations in Acre in 1799 and wrote about diseases as trachoma, bubonic plague, leprosy and typhus. When he came back to Paris (August 1799) he worked as *Chef-Chirurgien* at the Consular-guard hospital and became medical doctor only in 1803 – even though his dissertation had been ready since 1797!

From 1805 the position of *Inspecteur-générale du service de santé des armées*

allowed Larrey to be in the battlefield again: the War in Spain (1808) was an occasion to study and to perform leg amputations and to treat frostbites. The experience thus gained was really important during the Russian Campaign (winter 1812): soldiers' frozen legs suffered no pain during amputations and the wounds were treated with snow and ice. During the march to Moscow Larrey performed 200 amputations in a day at Borodino, and more than 300 during the retreat at the Berezina River. Moreover, Larrey was among the first surgeons to amputate at the hip. He served during 25 major campaigns including 60 large battles, through the Revolution and the Napoleonic years. Larrey was also a proponent of immediately amputating a damaged limb rather than waiting until it became gangrenous, at which point it was usually far too late to save the limb or the life (Richardson 1974).

Sorting casualties is universally accepted as the best means of coordinating a large number of patients with war injuries. Sorting means classifying casualties by characteristic medical and health features according to three types of criteria, namely diagnosis: gravity of the injury; prognosis: predictable survival; and logistic: evaluation of demand for care and possibilities for evaluation. The sorting process, called '*triage*' by Larrey, was designed to allocate resources to those most in need of urgent care. Today, many of his techniques still prevail in modern medicine (Remba *et al.* 2010).

Nikolay Ivanovich Pirogov (1810–1881)

An expanded humanitarian assistance role for nurses and ancillary personnel was stressed during the Crimean war (1854–6) by Nikolay Pirogov, the surgeon in charge for health services to the Imperial Russian Army. Grand Duchess Helena Pavlovna (1806–73) left St Petersburg with 28 nurses on November 18, 1854 for Simferopol where they arrived almost one month later. They were immediately trained to cope with the triage of casualties under Pirogov's orders.

Thus, during the Crimean War, it was on the Russian side that for the first time in history (November–December 1854) a medical service system of Sisters of Mercy was created, consisting of women working in field conditions for the care of the wounded and sick soldiers. This selfless activity was carried out by the Sisters of Mercy from the Community of the Elevation of the Cross, the Compassionate Widows from the Imperial Widows' Houses and the local women from Sebastopol and other regions of the Crimea. At the same time, on the other side of the front line at the disposition of the allied troops, the first prominent British nursing administrator, Miss Florence Nightingale (1820–1910), began her noble activity, arriving in Scutari on 4 November 1854.

The positive experience of battlefield hospital organisation led Pirogov to

become an international representative of the Russian Red Cross during the Franco-Prussian war and, few years later, Chief-surgeon in the Russian-Turkish war for the independence of Bulgaria. He organised the first triage of mass casualties during the Crimean war (McKinnon and Tinker 1997), where ancillary surgical assistance was also offered by Dasha Mikhailova (1836–1910) or Lady Sebastopolskaia, Mary Seacole (1805–1881) or “Lady with a cup” and Florence Nightingale or “Lady with a lamp” (Musajo Somma and Aceto 2008).

Wounds from a lance or bayonet have nowadays been replaced by the potential of irradiation from atomic, hydrogen, and ‘dirty’ bombs. Managing the injured persons from biological and chemical warfare has become a new challenge. New weapons systems, such as fuel air explosive, can create a devastating number of casualties not yet experienced. Use of the term *modern* is always dangerous unless the appreciation is for ‘current’ war. Even acknowledging many new challenges and new developments, it still falls to the surgical team to treat patients who have sustained missile wounds, and they labour under less than ideal circumstances, trying to avoid infection. Because we have not been able to eliminate war in the recorded history of the world, we should remain prepared to continue to manage combat casualties to the best of our abilities, based on previous experience and new resources through emerging technologies.

Terrorism is a different form of war and the bomb is its weapon of choice. Explosion induces four classes of injury: primary blast injury is induced by the blast itself; secondary blast injury is caused by the projectiles; tertiary blast injury is caused by the thrust of the victim against stationary objects and by wind disruption; and quaternary blast injury results from fire and heat generated by the explosion. In addition, a mechanism induced by the toxicity of the explosive material has been recognised. This last mechanism is the result of toxic materials from the explosive absorbed by the human body, leading to different haemodynamic alterations. It is the combination of these simultaneously acting mechanisms that causes the unique clinical entity observed among victims of bomb explosion.

The interrelationship between war and advances in medicine is both fascinating and paradoxical. It is an irony of the highest order that war, arguably the most destructive societal force in the cause of suffering and loss of human life, has been the most effective agent in the advancement of medicine, the discipline most dedicated to preserving life and relieving pain. The intimate connection between these two apparently contradictory and dissimilar domains dates back to ancient times.

Although it is somewhat difficult to reconcile the fact that the organisational, therapeutic and procedural advances we have come to enjoy were conceived by the horrible events of war that cause so much human pain, suffering, and loss of

life, we realise that war is only the milieu in which these advances take place. War concentrates injuries and disease in such overwhelming numbers into specific points in time, thus challenging creative minds to find unique solutions to seemingly unsolvable problems.

Bibliography

- Arrian, *The Campaigns of Alexander*, trans. A. De Selincourt (rev. J. R. Hamilton), Harmondsworth, 1981.
- McKinnon, J. G. and Tinker, A. 1997: 'Nikolai Ivanovich Pirogov and the Crimean War', *Clinical and Investigative Medicine*, 20(4), 35.
- Musajo Somma, L. and Aceto, G. 2008: 'Oltre Florence Nightingale: l'assistenza ancillare ai soldati in guerra', 355–60 in G. Armocida and I. Gorini (eds), *Storie di Guerra, di Medicina e di Letteratura. 44° Congresso della Società Italiana di Storia della Medicina*, Brescia.
- Protonotariou-Deilaki, E.: Πρωτονοταρίου-Δεϊλάκη, Ε. 1973: 'Ακροναυπλία και ανασκαφικά έρευναι εις περιοχήν Ναυπλίας', *Αρχαιολογικόν Δελτίον*, 28 (Β'1 Χρονικά), 90–4.
- Remba, S. J., Varon, J., Rivera, A. and Sternbach, G. L. 2010: 'Dominique-Jean Larrey: the effects of therapeutic hypothermia and the first ambulance', *Resuscitation* 81(3), 268–71. Epub 2009 Dec 29.
- Richardson, R. G. 1974: *Larrey: Surgeon to Napoleon's Imperial Guard*, London.
- Salazar, C. F. 2000: *The Treatment of War Wounds in Graeco-Roman Antiquity*, Leiden.