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Review

Triage in military settings

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ABSTRACT

Triage, a medical term derived from the French word "*trier*", is the practical process of sorting casualties to rationally allocate limited resources. In combat settings with limited medical resources and long transportation times, triage is challenging since the objectives are to avoid overcrowding medical treatment facilities while saving a maximum of soldiers and to get as many of them back into action as possible. The new face of modern warfare, asymmetric and non-conventional, has led to the integrative evolution of triage into the theatre of operations. This article defines different triage scores and algorithms currently implemented in military settings. The discrepancies associated with these military triage systems are highlighted. The assessment of combat casualty severity requires several scores and each nation adopts different systems for triage on the battlefield with the same aim of quickly identifying those combat casualties requiring lifesaving and damage control resuscitation procedures. Other areas of interest for triage in military settings are discussed, including predicting the need for massive transfusion, haemodynamic parameters and ultrasound exploration.

1. Introduction

Triage is a medical term derived from the French word "*trier*". It was used for the first time by a French military surgeon, Baron Larrey, who invented a process of sorting injured soldiers in the 18th century [1,2]. As a surgeon in Napoleon's army, Larrey developed a system for rapidly evaluating casualties and evacuating the salvageable wounded requiring the most urgent care [3]. He instituted these principles while battle was still in progress and triaged without regard to rank. The principles of triage were further practiced during the American Civil War, World War I and II and others conflicts during the 20th century. Triage is defined as the prioritization of patient care based on illness/injury, severity, prognosis, and resource availability, in case of a mass casualty incident (MCI) or an exceptional medical context. The purposes of triage are to identify patients needing immediate resuscitation, to assign patients to a predesigned patient care area,

Abbreviations: ABC-score, Assessment of blood consumption-score; CRAMS-scale, Circulation Respiratory Abdomen Motor and Speech-scale; DCR, Damage control resuscitation; DCS, Damage control surgery; FAST, Focused assessment with sonography for trauma; FTS, Field triage score; GCS, Glasgow coma scale; HR, Heart rate; IED, Improvised explosive devices; MASS, Massive transfusion; MCI, Mass casualty incident; MEDEVAC, Medical evacuation; MIMMS, Major incident medical management and support; MMS, Modified military triage sieve; MS, Military triage sieve; MTF, Medical treatment facility; MTS, Massive transfusion score; NATO, North-Atlantic treaty organization; RR, Respiratory rate; SBP, Systolic blood pressure; SI, Shock index; START, Simple triage and rapid treatment; T-RTS, Triage-revised trauma score; TS, Triage sieve; TTR, Trauma triage rule.

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thereby prioritizing their care and to initiate diagnostic/therapeutic measures as appropriate. In a combat setting, medical resources are restricted and triage is challenging. Limited resources and long transportation times dramatically reduce the threshold of what constitutes a MCI in austere locations and creates ethical and practical difficulties in managing incidents. Additionally, in combat settings, the casualty is part of the mission, in contrast to a civilian setting where the patient is the mission. One of the primary objectives of military triage is to identify those wounded soldiers who can be treated rapidly and return to the battlefield [4]. After a short description of the new face of modern warfare, this narrative review defines different triage scores implemented in military settings. Triage algorithms applied in MCIs by the North-Atlantic Treaty Organization (NATO) and various nations are detailed, including those applied by the French Military Health Service. Other special features of military triage are discussed, including predicting the need for massive transfusion (MASS), the optimal definition of hypotension, the calculation of a shock index (SI) on the battlefield and the growing role of ultrasound techniques. Special situations such as chemical, biological, radiological, and nuclear events are not considered in this review because of their particularly specific patterns [5].

2. The new face of Modern warfare

Modern warfare is described as asymmetric and non-conventional [6]. The destructive power of modern weaponry and the change in enemy operation tempo and tactics are not comparable with previous conflicts from the past. Healthcare providers deployed in combat zones may have to deal with numerous casualties, sometimes even under hostile fire [7]. In Iraq and Afghanistan, as well as in new theatres of war in Africa, improvised explosive devices (IEDs) have become the first mechanism of injury involved in combat injuries [8,9]. As a consequence, since the beginning of the Operations Iraqi Freedom and Enduring Freedom in Afghanistan in 2001, combat casualties injured by IEDs presented mainly multiple lesions due to multiple penetrating injuries. US Army data showed that for 1151 patients a total of 3500 surface wounds and 12,889 injuries occurred, corresponding to an average of 3 surface wounds and 11 internal injuries per casualty [10]. The main causes for the "Died of Wounds" outcome from 2001 to 2009 in US troops involved explosive events and gunshot wounds for 72% and 25% of cases, respectively [11]. Ambushes, IEDs, and other explosive devices illustrate the new face of modern warfare. During the last years, there has been a general trend towards lesions by explosion instead of bullets [12]. Blasts are overwhelmingly the most common wounding aetiology in current conflicts [13]. In modern warfare, IEDs contain more explosive power, produce more and deadlier fragmentation, and use more fuel to increase the size of the fireball produced [14]. Explosions caused by IEDs are destructive and cause multiple lesions on the same patient. Finally, due to advances in personal protective equipment, lesions of the neck, head and extremities have increased significantly in regard to thoracic wounds [12,15]. Facing the new asymmetric and non-conventional characteristics of modern warfare, military medical strategies had to change and adapt to this change, including the process of triage [16].

3. Triage scores, from the civilian setting to the battlefield

3.1. Triage scores developed in civilian trauma settings

In 1989, after decades of derivation and refinement of predictors for injury severity in cohorts of trauma patients, Champion described the Triage-revised trauma score (T-RTS) [17]. This score included three physiological parameters: systolic blood pressure (SBP), respiratory rate (RR) and the Glasgow coma scale (GCS). Each variable was recoded between 0 and 4,4 being the normal value. The recoded data are implemented in an equation in which the GCS is given the greatest weight, followed by the SBP and then the RR. The T-RTS correctly identified 97% of non-survivors as requiring trauma centre care. However, for detection of major trauma patients (defined as an Injury severity score [ISS] $>$ 15), the T-RTS was insensitive, identifying only 59%. A study by Baxt et al. confirmed that the T-RTS was unable to identify surviving patients with major injuries [18]. Finally, there was little evidence to support the use of the T-RTS as a predictor of functional outcome following traumatic injury [19]. Champion's Trauma Score was taught as applicable in the field, but was relatively complex.

Another score, the CRAMS scale (circulation, respiration, abdomen, motor and speech) was supposed to be superior for differentiating patients who would either die or required emergency operation [20,21]. Each category was defined as normal (2 points), mildly normal (1 point), or severely abnormal (0 point). Total scores of 8 or less indicated major trauma and scores of 9 or 10 minor trauma. The CRAMS scale provided a simple and reliable method of separating those patients who could be treated and released from those who might need life-saving surgery.

In 1990, Baxt et al. elaborated the Trauma triage rule (TTR), which appeared to be superior to the CRAMS [22,23]. Following the TTR, a major trauma victim was defined as a patient with an SBP under 85 mmHg combined with a GCS under 5 and who had sustained penetrating trauma of the head, neck or trunk. The TTR was developed to identify patients who would require critical trauma care and significantly reduced over-triage and minimally increased under-triage. It was simple to use because no calculations were necessary. Using the operational definition of major trauma, the TTR had a sensitivity of 92% and a specificity of 92% when tested on a 1004-patient cohort. Furthermore, combining both the TTR and a paramedic judgment was superior overall in triaging trauma patients in the pre-hospital setting [24].

3.2. Triage scores designed for the battlefield

The previous scores were analysed in civilian trauma settings. But in military settings, obtaining physiologic measurements is sometimes more challenging, especially during the Care under fire stage. The military environment is often characterized by a lack of supplies and equipment, delayed or prolonged evacuation times and distances, devastating injuries, provider inexperience, and dangerous tactical situations [11,25]. Combat lifesavers have to make rapid decisions about priority of care, application of lifesaving interventions, and transport destinations on the basis of isolated physiologic data points [26,27]. The military triage context differs from that encountered by most civilian major incident responders. In particular, the casualty clearing station model may not be applicable. Casualties may be evacuated rapidly and directly from the point of injury by helicopter. As a result, cohorts of patients may be transferred to the nearest Medical treatment facility (MTF) on the basis of a single triage assessment, with no time for secondary triage. All casualties cannot be taken at the same time for transport and the sensitivity of the first tool must be as high as possible.

The United States military Joint Theater trauma system on the current battlefield in Iraq and Afghanistan recognized significant differences between combat and civilian casualties, and consequently, the need to validate the existing triage scores for practical use in combat [28,29]. Therefore, medical triage scores have been elaborated specifically for military care.