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UK Triage the validation of a new tool to counter an evolving threat

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ABSTRACT

Introduction: Major Incidents (MI) occur frequently and their unpredictable nature makes prospective research difficult and largely unethical. A key step in MI management is triage; the identification of the critically injured. Within a MI environment this is commonly performed using simple physiological 'tools', such as the Triage Sieve (TS). However the most commonly used tools appear to lack an evidence base. In a previous study, the authors used a military population to compare the performance of the TS to the Military Sieve (MS) at predicting need for Life-Saving Intervention (LSI). The MS differs only with the addition of a measurement of consciousness. The outcome from this study was that the MS outperformed the TS, but could be further improved with small changes to its physiological parameters, the Modified Military Sieve (MMS).

Materials and Methods: Physiological data and interventions performed within the Emergency Department (ED) and Operating Theatre were prospectively collected for consecutive adult trauma patients (>18years) presenting to the ED at Camp Bastion, Afghanistan between March and September 2011. All patients receiving a LSI were considered Gold Standard Priority One. Patients were triaged using the TS, MS, MMS, START (ST) and Careflight (CF) triage tools. Sensitivities and specificities were estimated with 95% confidence intervals and differences were checked for statistical significance using a McNemar test with Bonferroni correction.

Results: 482 patients presented to the ED during the study period, sufficient data was recorded for 335 (71%) with 199 (59%) P1s. The MMS (sensitivity 68.3%, specificity 79.4%) showed an absolute increase in sensitivity over existing tools ranging from 5.0% (MS) to 23.6% (CF). There was a statistically significant difference ($P = 0.0005$) between the MMS and MS.

Discussion: A key limitation to this study, is the use of a military cohort to validate the MMS, a tool which itself was developed using military data. The mechanism of injury also is unlikely to translate fully to the civilian population.

Conclusions: Within a military population, the MMS outperforms existing MI triage tools. Before it is recommended as a replacement to the existing TS in UK civilian practice, it needs to be tested in a civilian environment.

Introduction

Major incidents (MI) frequently occur worldwide and take a variety of different forms. Their unpredictable nature makes prospective research incredible difficult, if not impossible and largely unethical. As with any ill or injured patient, the aim is early identification and transport to the most appropriate centre; triage is the means by which this process is carried out. Stemming from the French verb, *trier* to sort, it was a concept derived from Napoleon's surgeon Baron Larrey, during the Napoleonic wars, where patients were separated by clinical urgency and then transported by *flying ambulances* to further care [1,2]. Despite the regular occurrence of MIs, it was only in the 1990s, that a reflection following a terrorist bombing, gave way to formal training in MI management – Major Incident Medical Management and Support (MIMMS) [3,4]. A key step in the management of MIs, is this concept of triage; the identification of the critically injured.

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MI triage tools typically utilise basic physiology alone to allocate a category to a patient, which depending on the level of derangement corresponds to the clinical urgency. It is a successful process if the category correctly matches the clinical need. Mis-triage, both over and under-triage, holds implications for both patients and the delivering healthcare system alike. Over-triage exists when a non-critical patient is assigned to a critical triage category: this impairs the efficient management of the critically injured and the rate of over-triage has been shown to be directly proportional to mortality [5]. The concern with under-triage – where a critical patient is assigned to a non-critical triage category – is that they may be managed either in a low-acuity facility, unable to provide the appropriate care or that they are delayed in arriving at the appropriate facility.

In the UK, MIMMS teaches a two stage approach to MI triage – primary triage at the scene uses the Triage Sieve (TS) and then secondary triage, usually performed at a casualty clearing station or hospital, utilises the Triage Sort (TSO) [3]. The US and Australia have a single primary triage algorithm alone; the Simple Triage And Rapid Treatment (START-ST) and Careflight (CF) tool respectively (Table 1).

There is a limited evidence base to the existing tools, with questions raised over their validity and reliability [6,7]. With an absence of "real-world conditions" in which to trial them, attempts to validate the tools rely predominantly on the analysis of single patient incidents and trauma registries. Indeed, there is only one prospective trial and that was with paediatric patients [8]. While there are two studies which retrospectively analysed MI data, these studies do have their limitations; large amounts of missing data which lead to assumptions being made – largely because of the difficulty of accurate record keeping during the incident [9,10]. Secondly, there were a limited number of critically injured patients described by both Kahn and Challen; with two and eight priority one patients respectively.

There has been significant discussion as to what constitutes the 'priority one' patient. In 1990, Baxt suggested a 'resource-based' definition as a means for defining the priority one patient, consisting of five life-saving interventions (LSI) [11]. Reflecting changes in trauma care, four further 'resource-based' definitions have been published, two of which were as a result of a Delphi process [12–14]. It is the authors' opinion that in a MI, the 'resource-based' definition is both more relevant and logical as an outcome for triage in comparison to previous measures, such as mortality (Table 2).

In a previous study [14], the authors used a UK military trauma database to compare the TS to the Military Triage Sieve (MS). The MS is currently in use by the UK Armed Forces and is the TS with the addition of conscious level. The addition of consciousness assessment to the TS gave an absolute increase in sensitivity of 5.2% (58.5% sensitivity, 95% CI 58.4%–62.1% for MS, compared to 53.2% sensitivity, 95% CI 49.4%–56.8% for TS). The study went further to propose the Modified Military Sieve (MMS), which projected a sensitivity and specificity of 71.2% and 79.3% respectively.

Table 2
Resource based definition of a P1 casualty (modified from Garner)[14].

Airway	• Intubation for low GCS or airway obstruction (actual or impending) or Surgical Airway • Oral or nasal airway for impaired ventilation with GCS < 13
Breathing	• Any kind of thoracostomy (needle, finger, tube) Positive pressure ventilation for ventilator inadequacy
Circulation	• Tourniquet or haemostatic agents applied to control bleeding • Central line or IO access for resuscitation • >4 units blood products, >4 litres crystalloids, or inotropes given • Proximal amputations • Fasciotomies for actual/suspected compartment syndrome • Laparotomy or thoracotomy or pericardial window • Ex-fix to pelvis or open femur fracture for haemorrhage control • Surgical proximal vascular control Peri-arrest rhythm or cardiac arrest requiring A(C)LS
Disability	• Immediate neurosurgery Spinal nursing for proven unstable c-spine fracture
Environmental	• Active re-warming for initial temperature less than 32 °C Chemical antidotes (OPs, CO, HCN)

The aim of this study was to prospectively validate within a combat environment the MMS. The objectives were to identify the ability of the MMS to predict the requirement for a LSI as previously defined by Horne et al and to compare its ability against existing MI triage tools – TS, MS, ST and CF.

Materials and methods

Physiological data (both pre-hospital when available, and on arrival in hospital), and interventions performed within the Emergency Department (ED) and Operating Theatre, were prospectively collected for consecutive adult trauma patients (>18 years) presenting to the ED at Camp Bastion, Helmand Province, Afghanistan between March and September 2011. Data was collected by the author (SH) and the deployed Trauma Nurse Coordinator (JW), on a separate data sheet, allowing for the calculation of existing triage tools. Injury mechanism was not specifically recorded.

Requirement of at least one LSI from Fig. 1, or death within the ED was used as the gold standard definition of a Priority One (P1) patient. Only patients for whom data on interventions was recorded, (including no intervention) were included in the study. All those not receiving a LSI were classified as not-P1.

Triage of patients using the TS, MS, MSS, ST and CF was compared with the gold standard. To be classified as Not-P1 by a triage tool, the patient was required to have all physiological parameters recorded and normal. Patients who were intubated were assumed to have been intubated for a low GCS, unless the GCS was specifically stipulated. For patients without data recorded for

Table 1
Comparison of existing MI triage tools.

Method	1st Assessment	2nd Assessment	3rd Assessment	4th Assessment
START	Walking?	Breathing? Rate > 29	Palpable Pulse?	Obeys Commands?
Careflight	Walking?	Obeys Commands?	Breathing? Palpable Radial Pulse?	
Triage Sieve	Walking?	Breathing? <10 Rate > 30	Heart Rate > 120	
Military Sieve	Walking?	Breathing? <10 Rate > 30	Heart Rate > 120	Unconscious?
Modified Military Sieve	Walking?	Breathing? <12 Rate > 24	Heart Rate <40 Rate > 120	Unconscious?