

# Triage Applicable in Management of Victims from Explosions in Mosul, Iraq: Prospective Study

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## Abstract:

The triage system can independently analyze and predict accident data, contributing to improving the mortality rate. The purpose of this study was to evaluate accident victims injured in explosion accidents whether ambulance crews appropriately triage trauma patients. This prospective study included 93 patients with blast injuries who presented directly to the emergency department in Al-Jumhori Teaching Hospital in Mosul, Iraq. Data of transport vehicle type, and duration from event to arrival at the emergency department were recorded. The patients were sorted into four groups as follows: small, treated with simple first aid, and discharged from the hospital. The intermediate group was treated with resuscitation, investigation, and monitoring of clinical signs. Severe combination may require immediate surgical intervention. The last group was placed in a quiet room to die peacefully. Most patients were labeled green with an incidence of 43% and red with 19% of patients. Ambulance transported approximately 66.7% of patients, but this method of transport has been associated with a higher mortality rate. Military vehicles were transported at a rate of only 16.1%, they were associated with higher morbidity rate. In the first 20 minutes of the incident, approximately 61.3% of patients presented to the emergency department. The overall morbidity and mortality rates were 4.3% and 7.5%, respectively. The higher mortality rate was associated with a period ranging from 21 to 30 minutes after the accident. In conclusion, triage is an essential component in the context of mass incident response planning, requiring high decision-making skills based on the ability to quickly and accurately identify relevant information during the clinical assessment of patients.

**Keywords:** Surgical intervention, triaging trauma, emergency, mortality rates.

## Introduction

The term "triage" originates from the French verb "trier," which translates to "to sort." It serves as a fundamental component in the management of large numbers of casualties [1]. The primary objective is to ascertain the individuals who will derive the most significant advantages from receiving prompt treatment, hence assuring optimal outcomes for a larger population [2]. The primary role of the triage team is to categorize individuals based on the severity of their injuries or medical conditions,

rather than providing direct medical treatment. Hence, it is advisable for the triage team to refrain from allocating an excessive amount of time to any individual victim [3]. Triage is a widely utilized clinical risk management strategy implemented in emergency rooms globally to effectively handle patient flow in situations where clinical demand surpasses available resources [4]. The primary purpose of systems is to establish a framework that ensures the definition of care aligns with the specific needs of patients and is delivered in a timely fashion. The initial triage methods employed in early emergency rooms lacked a systematic approach, relying instead on intuition [5,6]. Consequently, these methods were not consistent among different practitioners and did not allow for effective evaluation or scrutiny. Despite a decline in fatalities resulting from trauma over the course of the last three decades, it continues to be the most prevalent cause of mortality among individuals in young age. The issue of injury has become progressively more prominent in the global health landscape [7-9]. Every day, a significant number of individuals succumb to fatal injuries, amounting to tens of thousands of deaths. In addition to these fatalities, several thousand others sustain injuries, with a considerable portion experiencing enduring consequences [10]. A significant proportion of injuries are observed in nations with low- and middle-income levels. The significant surge in injured patients results in the overcrowding of hospitals, so causing a strain on available resources that are insufficient to adequately cater to the needs of all sufferers [11]. Hence, it has become unfeasible to accommodate the needs and demands of every individual. Medical professionals should strive to maximize the overall benefit, while acknowledging that it may not be feasible or ethically justifiable to pursue every possible intervention, in order to serve the largest possible population [12]. In order to establish priorities for patient management, it is essential to consider many criteria that encompass both the patients' requirements and the resources that are accessible [13]. The practice of triage involves a careful equilibrium between two factors. The implementation of triage can be feasibly executed at any stage along the continuum of casualty care, with the purpose of establishing a hierarchy for the provision of initial medical assistance and the subsequent transfer of injured individuals to the subsequent level of medical treatment [14,15]. Regardless of any previous treatment or sorting, it is imperative to do triage once again upon the arrival of victims at the hospital. This is due to the fact that the status of patients may have altered during transportation, and the priorities within the hospital setting may diverge from those established in the field [16]. During a surge of casualties, all individuals seeking medical attention at the hospital are subjected to the triage procedure [17]. The primary objective of the present study was to analysis and evaluate of the triage approach utilized in the management of trauma sufferers resulting from explosion incidents in Mosul, Iraq.

### **Patients and Methods**

This prospective study was performed on a total of 93 patients evacuated from a major traumatic event and admitted to the emergency department of Al-Jumhori Teaching Hospital in Mosul, northern Iraq, during the period from January 1 to December 30, 2010. Inclusion criteria were all patients exposed to a blast event, all ages, and both genders. Exclusion criteria were for patients presenting to the emergency unit attending more than 10 patients within 15 minutes as well as individuals who were dead on arrival. The triage system was activated when admission exceeded 15% of the total number of beds within a short period. A total of 60 beds were the number of beds in the emergency department at that time. The simple triage and rapid treatment (START) of triage method was used to classify patients into four groups according to priority using established triage tools. The teamwork consisted of two teams, the doctors' team included the team leader, and one of the following: An emergency physician, an orthopedic surgeon, an anesthesiologist, and a cardiothoracic surgeon (mostly a general surgeon), with two or three residents. Besides, nursing team included a team leader with six to seven nurses. Data were collected by recording the relevant information obtained in each case on a detailed triage card prepared for the assessment of major trauma victims in the emergency surgical unit. Each case was studied according to the following: History (from patients or witnesses) including name, age, sex, type of vehicle transport, time of occurrence of the event and duration since trauma event till reach the emergency department. Examination, a rapid physical examination of the patients including the level of consciousness (alert, drowsy or unconscious), respiratory rate (normal, increase or decrease), capillary refilling time (normal, prolonged or severely prolonged), record the anatomical site of injury conducted in body figures drawn in the tag, together with vital sign, Glasgow Coma Scale (GCS), revised trauma scores (RTS) and burn percent. Sorting of patients according to START system and label every patient with color of priority (Table 1,2).

Table 1: The simple triage and rapid treatment system10 (START).

| Mobility           | Can walk?                      | Yes                |                             |            | Delayed             |
|--------------------|--------------------------------|--------------------|-----------------------------|------------|---------------------|
|                    |                                | No                 |                             |            | Assess breathing    |
| Airway & breathing | Can breathing?                 | No                 | Open airway, breathing now? | No         | Dead                |
|                    |                                |                    |                             | Yes        | Immediate           |
|                    |                                | Yes<br>Assess rate |                             | <10 or >29 | Immediate           |
|                    |                                |                    |                             | 10-29      | Assess circulation  |
| Circulation        | CRT > 2 s    Or pulse >120 BPM |                    |                             |            | Immediate           |
|                    | CRT <2 s    Or pulse <120 BPM  |                    |                             |            | Assess mental state |
| Following commands | No                             |                    |                             |            | Immediate           |
|                    | Yes                            |                    |                             |            | Delayed             |

**Table 2: Medical emergency triage tag system in a mass causality incident .**

|                                                                                                                                                                |                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A suggested approach to treatment prioritization of victims is that found in the medical emergency triage tag system. The treatment priorities are defined as: |                                                                                                                                                                                                                                                              |
| Zero priority (black)                                                                                                                                          | Deceased or live patients with obvious fatal and non-resuscitable injuries.                                                                                                                                                                                  |
| 1 <sup>st</sup> priority (red)                                                                                                                                 | Severely injured patients requiring immediate care and transport (e.g., respiratory distress, thoraco-abdominal injury, severe head or maxillofacial injuries, shock or severe bleeding, severe burns).                                                      |
| 2 <sup>nd</sup> priority (yellow)                                                                                                                              | Patients with injuries that are determined not to be immediately life-threatening (e.g., abdominal injury without shock, thoracic injury without respiratory compromise, major fractures without shock, head injury/cervical spine injury, and minor burns). |
| 3 <sup>rd</sup> priority (green)                                                                                                                               | Patients with minor injuries that do not require immediate stabilization (e.g., soft tissue injuries, extremity fractures and dislocations, maxillofacial injuries without airway compromise, and psychological emergencies).                                |

Investigations, available investigations in causality unit had been done according to clinical needs of every patient. This included: blood group and cross match, Hb %, U\S, plain x-ray, CT-scan. Treatment was according to clinical status of every patient, and it consisted from the following: intravenous line insertion (more than one line in severe cases), fluid isotonic saline (IV), wide spectrum antibiotics, ant tetanus serum (ATS), urinary catheterization, and operation type and operative findings. On other hand, outcome was one of the following: Discharged well on outpatient treatment for patient with green category, referred to other hospital, no operation done and admitted to surgical ward for further conservative management, admitted to surgical ward in emergency unit for surgical decision within 24 hour, urgent operation done to the patient and admitted to the ward and then either discharge well without handicap or with handicap or dead before discharge, dead on table, dead on resuscitation , and arrived dead. Statistically, the data were descriptively processed using SPSS (version 25), tabulated into frequencies and percentages, and presented in appropriate tables and figures.

### **Results**

The results data showed that the age group most at risk was within the age group (20-29) years, where it reached (28) cases and constituted 30.1% of the total cases. Followed by the age group (30-39) years, about (25) cases constituted 26.9% of the total. In contrast, only 5 cases under 10 years of age were recorded, at a rate of only 5.3% of the total. Patients over the age of 50 accounted for only 4 cases (4.3% ) of the total cases. As for gender, out of the 93 cases studied, males constituted 86 cases (92%) of the cases, while females represented only 7 cases (8%) , as shown in Table (3).

**Table 3: Baseline characteristics of the studied patients**

| Characteristics |        | Frequency<br>N=93 | %    |
|-----------------|--------|-------------------|------|
| Gender          | Male   | 86                | 92   |
|                 | Female | 7                 | 8    |
| Age<br>(years)  | 1-9    | 5                 | 5.3  |
|                 | 10-19  | 10                | 10.7 |
|                 | 20-29  | 28                | 30.1 |
|                 | 30-39  | 25                | 26.9 |
|                 | 40-49  | 21                | 22.6 |
|                 | ≥ 50   | 4                 | 4.3  |

As for Table (4) regarding the occurrence of triage tags, 40 patients were classified as green, which had a higher incidence (43%) among the other colors. The second most common color was yellow (35 patients, 38%). The red color was 18 patients (19%), and finally the black color was 0.

**Table 4: Types of triage tags in studied patients**

| Tag    | No | %  |
|--------|----|----|
| Green  | 40 | 43 |
| Yellow | 35 | 38 |
| Red    | 18 | 19 |
| Black  | 0  | 0  |

Three types of salvage were used: ambulances, military car, and civilian car. The most common type of salvage was ambulance (62) of all (93) patients (66.7%) were transferred. As for the other two types, military vehicles transported 15 patients (16.1%), and civilian vehicles transported 16 patients (17.2%). The mortality rate associated with ambulance salvage was 11.3%, while the other two types of rescue operations were associated with no deaths. Injuries rates associated with military cars (13.3%) were higher than the other two types. While the infection rates of diseases associated with the rescue of ambulances and civilian vehicles were 3.2% and 0%, respectively, as shown in table (5).

**Table 5: salvage types**

| Salvage      | No=93 | %    | Dead=7 | %    | Handicap=4 | %    | Well=82 | %    |
|--------------|-------|------|--------|------|------------|------|---------|------|
| Ambulance    | 62    | 66.7 | 7      | 11.3 | 2          | 3.2  | 53      | 83.9 |
| Military car | 15    | 16.1 | 0      | 0    | 2          | 13.3 | 13      | 86.7 |
| Civilian car | 16    | 17.2 | 0      | 0    | 0          | 0    | 16      | 100  |

Table (6) represents the time from the injury until presentation to the emergency unit, where the most common duration of the injured patient's presence was between 11-20 minutes, with an incidence of 35.5% followed by duration of less than 10 minutes,

with an incidence of 25.8%. That is, approximately 61.3% of patients were presented to the emergency unit within the first 20 minutes.

Table 6: Time since blast event till presentation to emergency unit

| Time of injury (minutes) | No | %    |
|--------------------------|----|------|
| $\leq 10$                | 24 | 25.8 |
| 11-20                    | 33 | 35.5 |
| 21-30                    | 21 | 22.5 |
| 31-40                    | 11 | 11.8 |
| $> 40$                   | 4  | 4.3  |

The results also confirmed permanent disability in four patients, and the morbidity rate was approximately 4.3%, as shown in figure (1). While the total number of deaths was seven, the mortality rate was 7.5% as shown in figure (2). Of these seven patients, five died from head injury, while the other two patients died from severe hypovolemic shock.

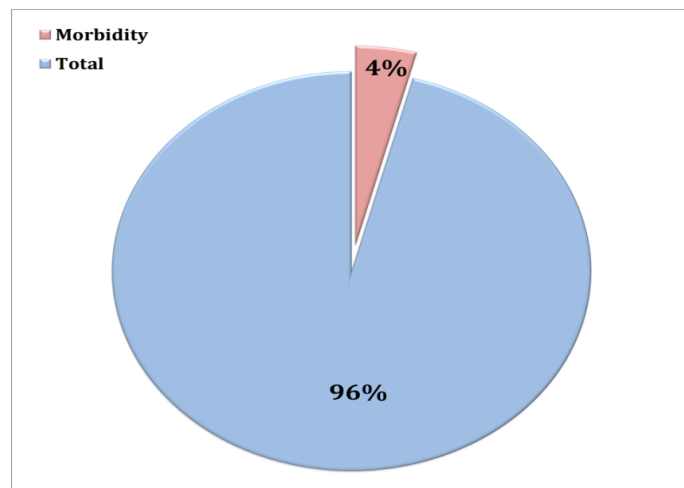


Figure 1: Morbidity rate among studied patients.

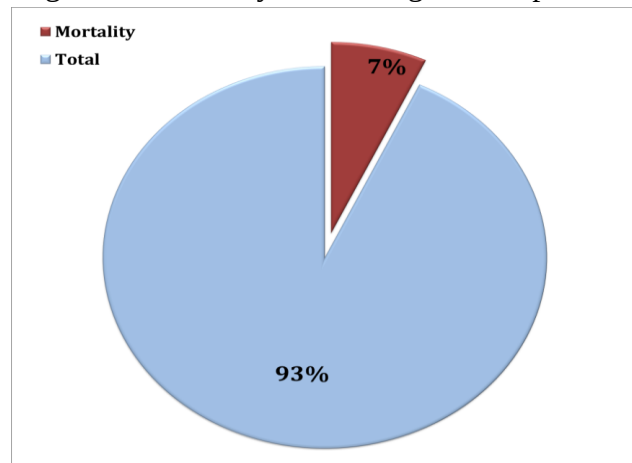


Figure 2: Mortality rate among studied patients.

As for Table (57) regarding the mortality rate in relation to the time since injury, the highest mortality rate was 14.3%, which was recorded with a period ranging from (21-30) minutes. Duration between 11-20 minutes associated with mortality rate of 9.1%. Duration of less than 10 minutes had a mortality rate of 4.2%. Finally, a duration exceeding 30 minutes was no mortality rate recorded.

Table 7: Mortality rates according to injury onset time.

| Time of injury (minutes) | Total=93 | %    | Dead =7 | %    |
|--------------------------|----------|------|---------|------|
| ≤ 10                     | 24       | 25.8 | 1       | 4.2  |
| 11-20                    | 33       | 35.5 | 3       | 9.1  |
| 21-30                    | 21       | 22.5 | 3       | 14.3 |
| 31-40                    | 11       | 11.8 | 0       | 0    |
| > 40                     | 4        | 4.3  | 0       | 0    |

### Discussion

The process of triage, which involves the assignment of treatment and evacuation priorities, becomes necessary in situations where the quantity of injuries exceeds the availability of competent assistance and other resources [18]. The usage of triage principles enables the team leader to effectively assign personnel and make informed decisions regarding the prioritization of patients in the resuscitation room [19]. Ideally, ambulance control would have conducted a triage process to allocate some of the patients to nearby hospitals [20]. However, the feasibility of this approach may be hindered by geographical constraints. Triage is a system of clinical risk management employed in emergency department worldwide to manage patient flow safely when clinical need exceeds capacity. Following the completion of resuscitation procedures, it may be necessary to conduct additional triage assessments in order to determine the appropriate transfer of patients to specialized medical facilities, such as neurosurgery or burns units [21]. Injury is an increasingly significant health problem throughout the world, and represents the leading cause of death between ages 1 and 44 years old [22]. In the present study, it was observed that majority of the cases were in the age group 20-29 years old (30.1%). This observation is in contrast with the findings of Lichtveld et al. [23] and Cook et al. [24], who showed that the age group between 30-40 years was the most prevalent. This phenomenon can be attributed to the observation that individuals in our community who are in their youth exhibit heightened levels of inventiveness and a propensity for engaging in risky behaviours, so exposing themselves to potential harm. In our series, males dominated females in the ratio of 12:1, this dominance of male was in agreement with Lichtveld et al [23] and Stewart et al [25], but with less incidence. About 40 patients were tagged as green which had a greater incidence (43%) among other colors. The yellow color comprised 38%. The



red color was 18 patients (19%), and the black color was zero. These results were in agreement with Lehmann et al [26] and Okumura et al [27] in which the green color with 65%, yellow color 30%, red color 20%, and black color zero. Regarding salvage types, there are three types were used, ambulance, military cars and civilian cars. The most common type of salvage was by ambulance, it transferred 66.7% of the patients. Other two types, military cars transferred (16.1%) and the civilian cars transferred of patients (17.2%).

The most common duration of injured patients' presentation was between 11- 20 minutes by an incidence of (35.5%). This followed by the duration of less than 10 minutes by incidence (25.8%). About (61.3%) of incidents are presented to emergency unit within first 20minutes. The incidence was less in study conducted by Cornwall et al [28], which was (48%) in first 20 min. Incidence of morbidity complaining from permanent handicap, was (4.3%). The total mortality was (7.5%). The major cause of death was head injury. The mortality result by Utter et. al [29] was (14.7%). The incidence of mortality in relation to duration of presentation to emergency department was (14.3%) associated with duration between 21-30 min. The duration between 11-20 minutes was associated with mortality of (9.1%). The duration of less than 10 minutes was associated with (4.2%) mortality rate. While the duration above 30 minutes associated with no mortality rate. However, in a previous study by Wyatt et al [30] , death with (7%) and (17%) occurring in the second and third duration, respectively. This may be due to better management of patients who would otherwise die of preventable causes in the latter two peaks, or because of differences in the mechanism of injury. The mortality incidence associated with ambulance salvage was (11.3%), while the other two types of salvage were associated with no mortality. But the morbidity associated with military hummer salvage was higher than other two types by (13.3%), while morbidity associated with ambulance and civilian car salvage were (3.2%) and zero percent respectively. This may be explained that ambulance crews the more severely injured patients, while the other types crews the ambulant patients or the patient nearby from periphery of the event. While the higher morbidity associated the military hummer salvage means that this type of salvage does not do a proper pre-hospital measure of patients transport. The morbidity and mortality related to civilian car salvage were zero because they only crews patients that walking from the event to nearby civilian cars.

### **Conclusion**

The present study was undertaken to focus light upon the pattern of blast injuries in relation to various factors in Mosul. The results of the present study are summarized that majority of the patients were male. The age group of 20-29 years was most commonly involved in trauma cases. Ambulances were transported most patients but associated with higher incidence of mortality, while military cars were transfer less of them but associated with higher incidence of morbidity. The first 20 minutes of



incident, more than half of patients were presented to emergency unit. The higher incidence of mortality was associated with duration between 21-30min.

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