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Emergency Medicine

Systems of medical segregation in mass casualty incidentse

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Summary:

There are many systems of medical segregation currently used in the world for those injured in mass casualty incidents. Although different from each other, they serve one purpose – to do as much as possible, for the highest number of victims. This article presents the main systems of medical segregation. They an essential component of knowledge of Emergency Medical System teams.

Key words: logistics, triage, mass casualty incidents.

Introduction

Mass casualty incidents constitute one of the most difficult, proficiency-demanding emergency service operations in Poland and around the world [1]. The term "mass casualty incident" refers to an event, in which the number of casualties and types of injuries they sustained exceeds the response capabilities of local emergency services, creating a disproportion between the demand for emergency medical aid and the means ensuing from human and material resources of emergency services [1,2]. Beside the mass events observed until now that resulted either from natural causes like earthquakes and tsunamis, or human error such as collapse of the exhibition hall in Katowice, since the end of the Cold War we have been observing a constant increase in the level of terroristic threat as evidenced by the terrorist attacks involving large numbers of casualties in New York, London or Madrid that occurred in the last decade. Rescue operations carried out under those conditions require conducting a triage.

History of triage

The word "triage" comes a from French word "trier" meaning "to segregate". The history of medical segregation of casualties reaches the times of Napoleonic battles, during which the chief surgeon of Napoleon's army, barron Dominic Larrey created "flying hospitals" as a part of military health care system [3,4]. Personnel traveled on horseback through the battlefield and assisted to soldiers with the best prognosis for recovery. Slightly injured soldiers were helped first, so that they could return to battle immediately. It resulted from military logistics, as the main goal of military medicine was not to save lives of soldiers, but to win the battle. Another important moment in triage development was when John Wilson described the rules of medical segregation in mass casualty incidents in 1846, dividing casualties into three groups depending on sustained injuries. The first group consisted of victims with minor injuries, the second group suffered severe injuries and the third – fatal ones. With time, rules of triage were modified and it was used during World War I and II to finally be adapted to the conditions of civilian health care.

One should remember that triage is a dynamic process of patient assessment that requires awarding segregation priority and adjusting rescue operations to victim's condition [5]. Segregation priority, once granted, may change in accordance to changes in patient's condition. The process of patient evaluation – widely known triage criteria - should be based on: severity of injuries, their effects on vital organ functions (respiratory and circulatory system), individual characteristics of the patients (general health status, age) and analysis of the mechanism of injury. Such appraisal, despite the drama of the situation and extraordinary emotions that are associated with it, should be conducted on the grounds of rational reasoning while maintaining calm and thorough assessment of the situation.

Currently used triage algorithms differ from those from Napoleonic times. In the sphere of civilian health care they are adapted to the system of rescue services of a given country [6]. Several triage systems are available (START, SIEVE, SORT, SAVE, etc.). Nevertheless, international guidelines were prepared for dealing with mass casualty incidents, resulting in unification of all segregation procedures. General classification of medical triage systems including examples of scales is presented in Figure 1.

START System

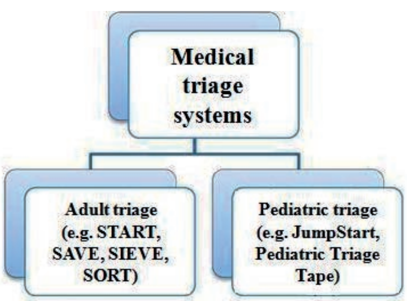

Figure 1: Types of medical triage systems.
Source: author's archives.

The START system was created in the 80's of the twentieth century by a team of doctors from Hoag Memorial Hospital in California working together with the Newport Beach fire department. It is currently one of the best known and most often used segregation algorithms in the world [1,7].

The grounds for this system is allotment of patients to appropriate categories depending on three physiological parameters: respiratory rate, heart rate/peripheral perfusion and state of consciousness (Fig. 2). The first step of START algorithm involves selection of patients who can walk by themselves and require only ambulatory help. They are assigned green identification tags and directed to the waiting area for thorough examination at a later time. Patients with yellow tags belong to the second category. In this group we can include people who are not exposed to immediate danger of life loss, but their injuries require attendance within 24 hours from the event. People in life-threatening condition that require urgent medical aid and the quickest possible transport to a specialist center are given red tags. Patients with minimal chances of survival, without preserved breath and pulse, with extensive crashing injuries, skull wounds with visible brain tissue damage and burns encompassing almost entire body receive black tags. Help will be granted to them at the end, after attending to people with better prognosis.

Assessment of key physiological parameters under the circumstances of a mass casualty incident should not last longer than 30 seconds. It begins with assessment of breathing. If breath is not detected despite securing patency of the airways, the patient is given a black tag without a pulse assessment. If breathing returns spontaneously or tachypnoe >30 breaths/minute appears after securing the airways, then patient receives a red tag. If breathing is preserved at a rate below 30 breaths/minute, the next step in the algorithm involves assessment of pulse or capillary return. If capillary refill time lasts longer than 2 seconds or radial pulse is absent, the patient receives the red tag of urgency. Sometimes, prolonged capillary refill time, decrease in pulse pressure or lack of radial pulse is a result of bleeding from damaged blood vessels. In such cases, bleeding should be stopped before moving on to evaluation of the next patient. When the above parameters are normal, the victim should be examined with regard to the level of consciousness. When the patient follows simple orders, he is given a yellow tag. If it is otherwise – he receives a red one.

Regardless of the applied triage system, the most important role is attributed to the emergency medical team arriving at the scene. The person in charge of the emergency medical team assumes duties of a medical coordinator at the site of the

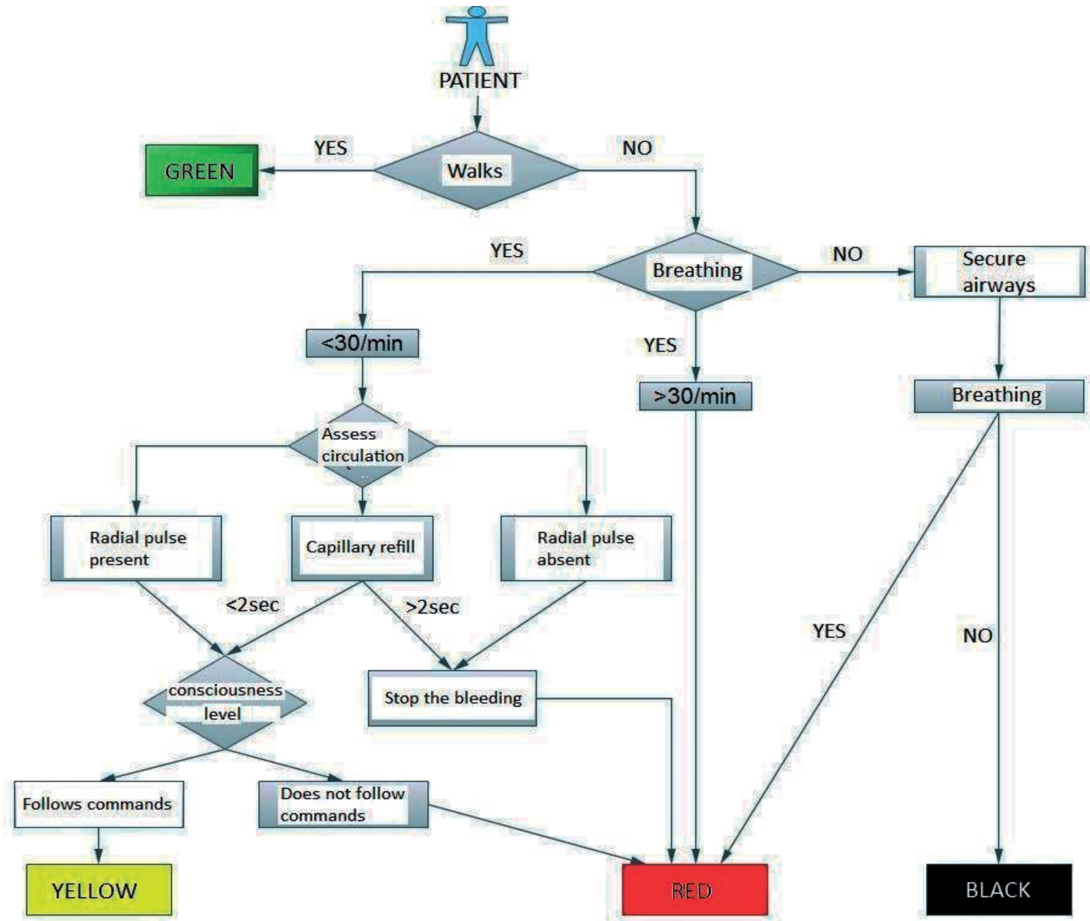

Figure 2: START scheme.
Source: author's archives.

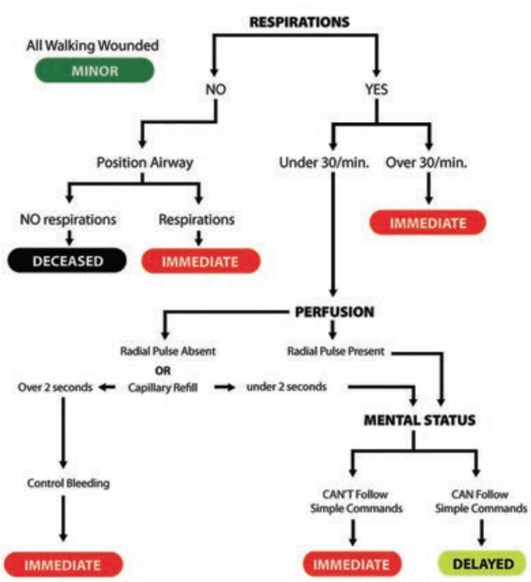

Figure 3: An ex ample of triage armbands.
Source: author's archives.

Figure 4: An ex ample of triage armbands.
Source: author's archives.

incident and his team is responsible for assessment of the situation and organization of rescue actions [8,9]. In order to conduct triage efficiently, people responsible for segregation use various cards or triage armbands. An illustration of such bands is shown in Figure 3.

SAVE system

During catastrophes, e.g. earthquakes, where the number of casualties is enormous, rescue is prolonged and it is impossible to transport patients to hospitals in the first phase of the rescue operation, it is often necessary to attend to patients and hold them (even for several days) in special field hospitals organized at the site [10]. Triage conducted under such circumstances differs from traditional segregation systems. Therefore, a SAVE (Secondary Assessment of Victim Endpoint) system was developed allowing for segregation and securing of casualties with limited medical resources for a period of a few hours to even several days. SAVE scale evaluates prognosis of patient survival on the basis of trauma scores and determines expected benefits with regard to available medical resources [9,11].

Among parameters evaluated in this segregation system, we take into consideration the type of sustained injury and age. Elderly patients with burns covering more than 70% of body surface, who cannot be treated at the site due to necessity of involving significant medical resources (both human and equipment), are assorted to the waiting area. The opposite is true for young people with GCS of 12, who only require securing of the airways (securing airway patency will consume minor resources while considerably increasing chances of survival). They will be directed to the zone of urgent medical aid.

Among representative elements of victim assessment taken into consideration when applying SAVE system, we may distinguish the following: Glasgow coma scale (GCS) assessment, evaluation of limb injuries (MESS scale), chest injuries associated with disruption of vital functions, abdominal injuries with hypotension resistant to treatment, spinal cord injuries.

STM system

The STM system (Saccotriagemethod) is based on evaluation of three parameters: breathing, pulse and best motor response [6,12]. Patient may maximally receive 12 points and the minimum number of points is 0. Patient is assorted to one of three groups based on that number. Patients with 9 to 12 points have high evacuation priority level. Those, who received 5-8 points come second and persons with 0 to 4 points constitute a group for deferred evacuation (Table 1).

TRIAGE SIEVE

Triage SIEVE, which is also called a screening segregation system, is most commonly used in Australia and Great Britain. Similar to the START system, triage SIEVE distinguishes 4 categories of patients. They are allocated to particular categories on the basis of vital function assessment: respiratory rate, heart rate or peripheral perfusion. In this system, capillary return, considered unreliable at low ambient temperatures, was replaced with pulse rate examination.

Table 4: Scheme of an STM system

Assessed Parameter	Value	Points
respiratory rate (/min)	10-24 25-35 >36 1-9 0	4 3 2 1 0
heart rate (/min)	61-120 >120 41-60 1-40 0	4 3 2 1 0
motor response	follows orders localizes pain withdraws from pain flexion or extension response no response	4 3 2 1 0

Analogous to the START system, the green-labeled group [category T3] is not in a life-threatening condition and patients' symptoms require merely ambulatory aid. Also, the lives of patients in T2 category (yellow) are not immediately endangered. They should be attended to within 4 hours from the event. Category T1 (red) refers to patients in urgent need of lifesaving actions. According to Triage SIEVE there is also a fourth category of patients [T4]. This group was not assigned a color. It consists of patients with minimal chances of survival and their rescue was postponed until after patients from group T1 and T2 are attended to [6,9,13].

JumpSTART System

In 1995 doctor Lou E. Roming introduced the JumpSTART system. This is a specific modification of the START system accommodated to segregation of pediatric patients below the age of eight [10,14]. Patients older than 8 years are evaluated according to adult algorithms. Medical triage of patients below the 8th year of life is conducted in a way similar to adults – according to the ABCD scheme. The main difference is in the proceeding in the absence of breath after securing airway patency. If it were an adult, the victim would have been considered dead. In case of a child, an additional assessment of peripheral pulse should be completed. If breathing is absent but pulse is preserved, the rescuer should perform 5 rescue breaths. Child is declared dead and assigned a black tag if rescue breaths prove unsuccessful or both breathing and pulse are absent. A red tag is also reserved for patients weighing under 10 kg, requiring suction of airway secretions and for children suffering from open fractures, burns covering over 10% of body surface and large wounds even if the physiological parameters are within normal ranges·

It should be remembered that a child is not a "little adult." Child's physiological and psychological response to injury differs significantly from adult's. Due to a relatively small body mass, the effect of a force exerted on a child is proportionally greater than in case of an adult. Therefore, one should suspect internal injuries in a child despite the lack of external signs of injury. This is why red color is also reserved for patients weighing less than 10 kg, requiring suction of airway secretions or children suffering from open fractures, burns covering more than 10% of body surface and large wounds even if the physiological parameters are within normal ranges.

The next problem regards evaluation of consciousness level using AVPU scale (A-alert, V-voice, P-pain, U-unconscious). One should remember that the level of consciousness is a very sensitive indicator of perfusion disturbances in children. A child able to focus attention on one thing is not suffering from consciousness disruption [14].

PediatricTriageTape

In case of pediatric triage we observe a method similar to the Braslow Tape, which simplifies calculations of doses of medications and sizes of rescue equipment during resuscitation of pediatric patients. It is called a PediatricTriageTape [14]. This is a tape divided into four segments. Each one of them contains an appropriate triage algorithm "triage sieve" with segregation criteria adjusted to a specific age group, constituting sort of a Cheat Sheet for medical rescue personnel.

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