



The Time Axis Management of Severe Trauma Patients

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ABSTRACT

Severe trauma is a "time dependent disease", and there is a "time window" in emergency treatment. If the "time window" is delayed or exceeded, patients may lose the best chance of treatment, in addition, the mortality rate, disability rate and complication rate will increase. In order to treat severe trauma patients better and faster, our trauma care centre introduced the medical system trauma system in April 2019. It provides the time records of the whole process from pre hospital first aid, emergency room, trauma resuscitation room, CT room, operating room, ICU and trauma ward, which forms a time axis and records the whole treatment process. The medical system trauma system can provide data for the quality control of trauma care centre and support for the improvement of diagnosis and treatment process. We strengthened the management of the time axis of trauma patients to continuously improve and optimize diagnosis and treatment process. So we can improve the treatment efficiency and shorten the treatment time, furthermore provide a shortcut for the patients with severe trauma.

Keywords: Severe trauma; Medical system; Trauma system; Time axis; Time window

INTRODUCTION

Trauma has been the first cause of death for people aged 1 to 44 years, and more than 5 million people die. With the development of economy and society, the treatment of trauma, especially severe trauma, has become the major health problem faced by all countries. As the most populous country in the world, China ranks first in terms of the frequency of traumatic accidents and the number of deaths each year, among which traffic accidents have the highest incidence, resulting in high mortality and disability rate, and most of them are young adults. How to improve the overall treatment ability of the patients with severe trauma is a topic that medical workers around the world are cracking [1].

LITERATURE REVIEW

Trauma Care Centre in Our Hospital

The first affiliated hospital of Soochow university was founded in 1883. It is one of the large leading class tertiary hospitals of the ministry of health. Our hospital has nearly 3000 beds. There were 3.803 million outpatients and emergency patients, 156 000 inpatients and about 66000 surgeries per year. The trauma care centre of the first affiliated hospital of Soochow university was founded in 2011. After years of discipline construction, it has formed a comprehensive department integrating pre hospital first aid, emergency room, trauma resuscitation room, trauma ward, trauma ICU and operating room. **Figure 1** shows the first affiliated hospital of Soochow university and trauma care centre [2].

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The trauma care centre has set up a materialized trauma centre based on trauma surgery. At present, there are 30 professional trauma surgeons, which are divided into craniocerebral trauma group, chest trauma group, abdominal trauma group and other sub specialized groups. The trauma centre consists of core department and supporting departments. The core departments include pre hospital first aid, trauma surgery, general surgery, neurosurgery, orthopaedics, urology, thoracic surgery, anaesthesiology, intensive care unit, clinical laboratory and medical imaging department. The supporting departments include cardiovascular surgery, burn surgery, plastic surgery, obstetrics and gynaecology, paediatrics, ophthalmology, otolaryngology, stomatology, psychiatry, rehabilitation department, interventional radiology, traditional Chinese medicine department and blood transfusion department. The trauma care centre is the provincial trauma care centre, which is equivalent to the level I trauma care centre according to the American College of Surgeons (ACS) standard. In the past three years, the numbers of annual trauma inpatients were more than 8000, the numbers of annual trauma surgeries were more than 6000, of which the number of annual severe trauma patients (Injury Severity Score (ISS) ≥ 16) was more than 500, and the numbers of group injury events were about 50 each year [3,4].

Our trauma care centre has created a multi disciplinary collaborative treatment platform which the trauma surgery is as the core. We have realized the seamless connection of all treatment stages from pre hospital to in hospital by the standardizing treatment process Settings. When receiving distress call of the severe trauma patients, the pre hospital doctors will transmit the patients condition to our hospital by the vehicle mounted information linkage system, so that trauma surgeons have a certain understanding of the patients condition and make well preparations. Trauma surgeons prepare the relevant equipment and materials; meanwhile they must call the trauma treatment team to the resuscitation room and wait for the severe trauma patients. After the patients to the hospital, the trauma surgeons should rapidly judge the state of illness and deal with the critical condition according to the principle of "ABCDE", such as airway obstruction, circulation disorders, active bleeding on body surface, etc. If there are serious specialized fatal conditions such as brain hernia, severe shock, pericardial tamponade, big blood vessel rupture and other emergencies, the trauma treatment team will immediately take life saving operation. The diagnosis, examination and treatment must be carried out as soon as possible, so that the severe trauma patients can be effectively treated soonest. **Figure 2** details the treatment process of severe trauma patients [5].



Figure 1: The first affiliated hospital of Soochow university and trauma care centre.

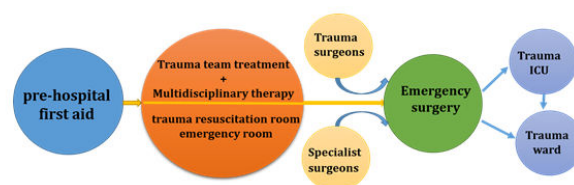


Figure 2: Treatment process of severe trauma patients.

Timeliness of Treatment for Severe Trauma

Several studies have demonstrated that 50% of traumatic deaths happen within 1 hour after the accidents, which indicate that traumatic treatment is significantly time dependent. The severe trauma treatment have "time window". Once the treatment time is exceeds the "time window", patients may lose the best opportunity for treatment, and mortality may be increase. As for the scope of "time window", there is still no unified standard, which needs to be defined in terms of time according to the specific situation of each treatment unit. It is worth affirming that the time concept of first aid develops from the qualitative process to the precise quantitative process. The development of modern emergency treatment for severe trauma puts forward the minimum time requirements for the timeliness of first aid, such as "golden 1 hour", "platinum 10 minutes" and "zero time pass". "Golden 1 hour" refers to the time from the beginning of injury, calling ambulance, ambulance to the scene, transferring the wounded, emergency room treatment in the hospital and finally to the operating room for definitive treatment. It is based on the continuity of pre hospital and in hospital treatment after injury, and it is the best time window to improve the success rate of treatment and reduce the mortality rate. "Platinum 10 minutes" refers to taking all effective measures for necessary first aid within 10 min after injury. This is based on the participation of the wounded or ordinary citizens with the goal of self-help and mutual aid.

At present, the treatment of severe trauma is far from the ideal "golden 1 hour" and "platinum 10 minutes". Some Chinese scholars have proposed the concept of "zero time pass" for trauma treatment. It does not have a specific time

period. It only means that when patients with severe trauma are in the pre hospital or in hospital treatment process, all measures are taken in each treatment link, through first aid, injury assessment, preoperative preparation and preoperative examination in the shortest time. There is no futile inspection and disposal, so that patients can get definite treatment in an acceptable time. In the treatment of severe trauma, as long as all links are correctly and effectively handled in the shortest time, the continuity and integrity of diagnosis and treatment of the wounded in the trauma treatment chain are ensured, and the "zero passing time" of trauma treatment is achieved, which is also the embodiment of treatment timeliness for severe trauma [6,7].

In the emergency treatment of patients with severe trauma, the emergency surgeons must recognize the relationship between the effect of treatment and time. "Time is life, time is speed" explains the general requirements of traumatology. How to manage and shorten the treatment time for the patients with severe trauma? The medical system trauma system may be a solution.

The Medical System Trauma System

The medical system trauma system is a solution for digital trauma care centre, which can realize the digital integration of treatment links including pre hospital first aid, emergency room, trauma resuscitation room, CT room, operating room, ICU and trauma ward. In addition, it can achieve the objective of automatic real time recording treatment data in the all treatment process, and reduce the trouble of manual recording. The system can collect and transmit the vital signs and on site image of patients to the doctors in hospital at accident scene or on the ambulance. While the patient with severe trauma entering trauma resuscitation room, the Radio Frequency Identification Devices (RFID) wristband is bound to automatically record each diagnosis and treatment time, which will form a treatment time axis. The medical system trauma system can extract the holographic data of severe trauma patients treatment, including pre-hospital first aid, treatment in the trauma resuscitation room, emergency surgery, hospitalization and rehabilitation information, that can form the trauma data analysis centre and provide the foundation of continuous improvement for the trauma care centre.

The medical system trauma system can share data with inpatient electronic medical record system, so that the following 25 quality control indexes can be recorded in real time. 25 quality control indexes include:

- Number of severe trauma (ISS \geq 16).
- Average time of pre hospital treatment.
- Ambulance arrival time (alarm time arrival time).
- Time of pre hospital information transmitted to the target hospital.
- Time from pre hospital alarm time to arrival time of the target hospital.
- Time from the start of trauma team to arrive at the trauma resuscitation room.

- Time from arrival at hospital to tracheal intubation.
- Time from arrival at hospital to mechanical ventilation treatment.
- Time from arrival at hospital to blood transfusion.
- Time from arrival at hospital to completion of CT scan.
- Time from arrival at hospital to completion of closed thoracic drainage.
- Time from arrival at hospital to the definitive diagnosis.
- Time from arrival at hospital to the start operation.
- Length of stay in trauma resuscitation room.
- Length of stay in hospital, length of stay in ICU.
- Rehabilitation treatment time.
- Number and proportion of severe trauma patients infected.
- Operation frequency.
- Hospitalization expenses.
- Ventilator use time and incidence of ventilator associated pneumonia.
- Success rate of treatment and mortality.
- Coincidence rate between discharge diagnosis and admission diagnosis.
- Annual number of trauma patients admitted.
- Proportion of patients referred from other hospitals.
- Proportion of trauma patients requiring referral.

The quality control indexes can provide data for the quality control of trauma care centre and support for continuous improvement of diagnosis and treatment process.

Trauma Time Axis Management

Our trauma care centre introduced the medical system trauma system in April 2019. The medical system trauma system can not only form the time axis of severe trauma patient and trauma database, but also provide the foundation of continuous improvement for the trauma care centre. **Figure 3** shows the time axis of a patient with severe trauma, from which the patient's whole treatment process from pre hospital to discharge can be seen clearly. Because "time is life, time is speed", trauma care centre attached great importance to trauma time axis management. We hope to achieve the goal of "zero passing time", which all treatment links are correctly and effectively handled in the shortest time.

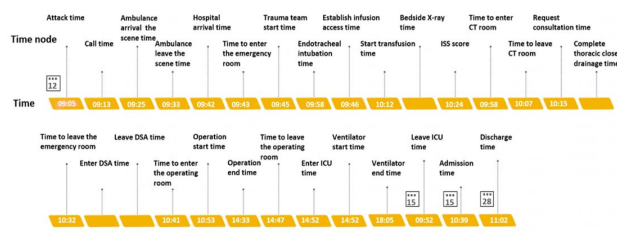


Figure 3: The time axis of a patient with severe trauma.

All members in the trauma care centre had a meeting to analyse and summarize the quality control indexes every month. We analysed the trauma database and strengthened the management of the trauma time axis to find problems in

the treatment process and find solutions to continuously optimize the process. We found that the following problems existed in the treatment of patients with severe trauma, which led to prolonged treatment time and may make the patients miss the optimal treatment time. The problems as follows:

- Many patients in emergency room and noisy environment affected the work efficiency of doctors and nurses.
- It took a long time for the patients with severe trauma to transfuse blood according to the routine transfusion procedure.
- Some surgeons were unskilled with the trauma treatment.
- Many emergency surgeries required the consultation and operated by corresponding specialists.
- The patients with severe trauma often had to wait for surgery because too much elective surgeries and fewer emergency operation rooms.
- The patients with severe trauma who did not need surgery could not be admitted to the trauma ward or trauma ICU in time because there were few vacant beds.

We found the above problems and made the following solutions based on the actual situation of our trauma care centre. The solutions as follows:

- Trauma care centre had established the first trauma resuscitation room in China with the complete bedside examination equipment, where was specially designed to provide emergency treatment for patients with severe trauma.
- The emergency room routinely prepared a certain unit of whole blood of type O for severe trauma patients, so that the time from arrival at hospital to blood transfusion was significantly shortened.
- All members in trauma care centre had received China Trauma Care Training (CTCT) and obtained CTCT certificates, which were proficient in endotracheal intubation, closed thoracic drainage, Focused Assessment with Sonography for Trauma (FAST), deep vein catheterization and so on.
- Many emergency surgeries could carry out by trauma surgeons, so as to save time for consultation with corresponding specialists.
- The operating room provided a green channel for severe trauma patients, so that patients could be operated as soon as possible.
- Trauma care centre guaranteed that the trauma ICU and trauma ward must vacate at least 4 beds for trauma patients every day. In the construction of trauma care centre, we will continue to find and solve problems in the treatment process by using the medical system trauma system, so that trauma patients can get better treatment.

DISCUSSION

Our trauma care centre persistently strengthened the management of the trauma time axis and continuously optimizes the treatment process. We found many quality

control indexes had significant improvement compared with before application of the medical system trauma system. We performed a retrospective study involving severe trauma patients from November 2018 to October 2019. The time from arrival at hospital to blood transfusion, the time from arrival at hospital to endotracheal intubation, the time from arrival at hospital to ventilator therapy, the time from arrival at hospital to completion of CT scan, the time from arrival at hospital to completion of closed thoracic drainage, the time from arrival at hospital to the start of operation and the length of stay in resuscitation room were significantly lower after the application of the Medical system trauma system than before. The mortality was decreased by 8.6%, but there was no statistical difference [8].

CONCLUSION

The viewpoint that trauma is the time dependent disease is widely accepted by trauma surgeons. We hope to achieve the goal of "zero passing time" for trauma treatment. We strengthened the management of the time axis of trauma patients by the medical system trauma system to continuously improve and optimize diagnosis and treatment process. So we can improve the treatment efficiency and shorten the treatment time, furthermore provide a shortcut for the severe trauma patients. In conclusion, trauma surgeons should pay more attention to the management of time axis of severe trauma patients.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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