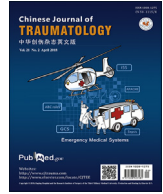




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Review Article

Trauma care system in China

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ABSTRACT

With the development of modern society, high-energy trauma has become an increasing tendency, which brings a great challenge for trauma care. A well-running trauma care system that is composed by pre-hospital and in-hospital care has been proved to decrease the death and disability rate of trauma patients. However, establishment of trauma care system in China is still at the initial stage. Trauma care systems in China and developed countries represented by the United States and Germany are introduced respectively in this article. Construction of regional and hierarchical trauma center, training of specific trauma care team and performance of integrative trauma rescue model are recommended in China.

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In 1980s, three-level classification of Chinese medical disciplines was established, while traumatology had not been an independent discipline till 1990's due to lack of integrated system. Multiple, critical and mass trauma caused by high-energy factors such as road traffic and high falling have an increasing tendency with the development of modern society. Majority of these trauma patients, injured in multiple regions rather than the single one, usually need interdisciplinary cooperation and general surgical treatment, which cannot be achieved by the ongoing specialized-surgery model. Therefore, trauma care systems have been set up sequentially in developed countries since 1970's and have played great roles in trauma rescue. Besides of late growth in economy and slow development in auto industry, striking progress in trauma care also contributes to the fact that injury mortality in China is lower than the global average (65/100000 vs 84/100000). But meanwhile, injury death rate in our country is twice that in most developed countries.¹ Lack of an effective trauma care system is the main reason for this disparity. A care system is no doubt more important than the clinical experience of a doctor, which has been proved by a recent meta-analysis that an efficient trauma care system can decrease the overall mortality of trauma patients by 15%.²

Trauma is a time-dependent disease. The concepts of “platinum ten minutes” and “golden one hour” are proposed to emphasize the

importance of time in trauma care. A mature trauma care aims to ensure the injured patients being sent to the appropriate trauma center rapidly and provided with damage-control or definitive treatment within the golden hour. Mount of clinical evidences have revealed the fact that timely and effective therapy within an hour post-injury can not only sharply reduce the early mortality but also the incidence of complications such as sepsis and MODS after trauma.^{3,4} An integrated trauma care system is huge and complex. To a patient, it covers the whole events of trauma care including pre-hospital care, in-hospital therapy and rehabilitation. While to the public, law making, quality control, funding ensures, education and training, information management, basic research and disaster prevention are involved.

Trauma care in the West

Represented by the United States and Germany, the advantages of trauma care system in the western countries are mainly embodied in pre-hospital emergency network and graded trauma centers.

Pre-hospital trauma care

Proper emergency network distribution, integration of ground and air transportation as well as efficient communication and command guarantee the smooth operation of trauma system. Emergency medical services (EMS), in charge of alarming response, are classified to different levels according to the area jurisdiction and community demand. When arriving the scene, pre-hospital

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team send by EMS begins triage and treatment, then transports patients to the trauma centers. Promptness is the main feature of the whole procedure, which is proved by the fact that in USA 69.2% of injured patients can arrive the level 1 trauma centers within 45 min while 84% arrive the level 2 centers within 60 min.⁵ In Germany, specific laws exactly stipulate the acting time of EMS, in which the time of response to alarming, treatment on the scene and transportation is limited within 15 min, respectively.⁶ Furthermore, air-rescue plays an important role in trauma care in developed countries. There is the most intensive helicopter emergency medical service (HEMS) in Germany that is enough to cover the whole country territory. The trauma patient in any region of the country can receive the air medical service within 15 min after calling HEMS.⁷ There are nearly 300 helicopter rescue tasks a year in USA, which transport more than 250 thousand patients.⁸

There exist differences in both pre-hospital care strategy and rescue team composition between USA and Germany. The strategy “scoop and run/load and go”, generally used in USA, entails as shortest as possible transportation to the nearest trauma center, managing the immediately life-threatening injuries in the ambulance rather than trying to stabilize the patient at the scene. Rescue team mainly consists of paramedics. The other strategy “stay and play/treat then transfer”, used mostly in European countries, brings surgeons and nurses in trauma surgery, even with anesthetists, to the patient and starts resuscitation at the scene to ensure the airway rescuing and hemodynamic stability before transporting the patient.⁹ Both these two strategies have their virtues and faults, so it is difficult to determine which one is better. The approach for pre-hospital care should be decided regarding the mechanism of injury (blunt versus penetrating trauma), the distance to the trauma center (urban versus rural areas) and the level of available resources. Besides of basic life support skill (BLS), rescuers in either strategy must have undergone strict advanced trauma life support (ATLS) training and got relevant certifications, who have more professional knowledge and skills in trauma care. Moreover, either the ambulance or the helicopter, well-equipped for variety of emergent treatment, is more than a transporting vehicle, but also a “mobile rescue unit”.¹⁰

Triage is another important issue of pre-hospital care, especially for mass trauma. Transporting patients to trauma centers in different levels on basis of injury severity guarantees the reasonable loading of centers at all levels and ensures that high-grade centers can focus on severely injured patients.¹¹

In-hospital trauma care

Specialist consulting systems (multiple discipline team, MDT), in terms of trauma groups, are generally used to treat multiple injured patients in trauma centers of western countries.¹² The trauma group composed by anesthetists, emergency physicians, doctors in general-surgery, neurosurgery and traumatic orthopedics, radiographers and nurses, is led by the senior trauma surgeon. Members of the group perform their own duties in treating patients, which are strictly specified by guidelines issued by the native trauma association. In-hospital emergency center can get injury condition of the patient from pre-hospital rescue team in advance and do preparation in personnel and equipment. Before the patient's arrival, specific organized trauma team has already waited at the rescue region. Shock room is the “main battlefield” of in-hospital care, which is fully-equipped and well-designed in accordance with ATLS principle. In shock room, the patient is performed physical and imagological examination rapidly at meantime of resuscitation and then transported to trauma-ICU (TICU) or emergency operation room if surgery indications exist.¹³ The whole care procedure for a patient in trauma center, from emergent treatment to definitive

therapy and then to rehabilitation, is taken charge by a uniform team. Rehabilitation is to help injured patient live an independent and high-quality life and return to family and society as early as possible. It's worth noting that there is “trauma surgeon” in Germany who can perform emergent and definitive operations in poly-site of the patient as well as post-surgery critical care. Correspondingly, trauma surgery has already been an independently discipline rather than a sub-specialty of surgery.¹⁴

Trauma care in China

Pre-hospital trauma care

Vast territory of China is accompanied by diversified modes in pre-hospital trauma care. There are three main modes in metropolis.¹⁵ 1. Administration command mode (Beijing and Guangzhou): Emergency commanding center, without rescue function by itself, appoints emergency units from different hospitals for rescue task. 2. Affiliation mode (Chongqing): Emergency center is affiliated to a large-scale hospital to be “a department” and owns pre- and in-hospital rescue units by itself. 3. Command and cooperation mode (Shanghai): Emergency center and its substations take charge of pre-hospital rescue and then transfer patients to cooperative hospitals for further care. In addition, pre-hospital rescue in towns and countries mainly rely on local hospitals, or even just health stations. There are some limitations. Firstly, unclear organizational nature raises a question that pre-hospital rescue is belong to a part of the public health system or as an independent medical institution exactly? Secondly, diversity or even chaos exit in the rescue modes, which directly determines the institution structuring, resource requirement, staffing standard and managing mechanism of pre-hospital care. Factually, no integrity in rescue model means no criteria in rescue system. Thirdly, pre-hospital rescue network lacks planning. Unreasonable distribution of rescue resources may lead to the overlarge service radius or even the blind area in which optimal time window of rescue is missed. In addition, self-interest consideration makes it hard for the hospital to be objective and scientific in setting up rescue stations. For this reason, the phenomenon that “seek far and neglect what lies close at hand” is not uncommon. Fourthly, lack of mandatory qualification criterion and access rule for both pre-hospital rescue institutions and staff bring about varying rescue abilities in different places. Moreover, classification processing for different targeted population has not been achieved. Taking injured patients for instance, there are no specific trauma care team for them. Fifthly, high expense and shortage in heliports contribute to the poor development of air rescue. Last but not the least, communication between pre-hospital and in-hospital rescue has not been established that information exchange is blocked.

In-hospital trauma care

There are three main types of in-hospital rescue in China now.¹⁶ The first one is represented by the Second Affiliated Hospital of Zhejiang University, in which the department of emergency and critical care plays the leading role and the relative surgical departments take part in. The second one is the integration mode, created by Wuhan Tongji Hospital. The third mode is also the most common one – temporary specialist consultation. However, for the multiple trauma patients, consultation mode has its innate flaws: 1. Waiting for arrival and argument of consulting doctors delays the optimal rescue timing. 2. Lack of the team work concept and decision maker leads to the mess in rescue procedure. 3. It is not uncommon for doctors in different departments to reject or scramble patients on basis of their own concern and benefit. 4.

Focusing on the parts but neglecting the whole usually bring about mistakes in trauma condition evaluation and rescue sequence.

Well-developed rescue system in western countries makes up for problems mentioned above in some extent while these shortcomings are rather prominent in our country. Following are the main causes: 1. People. In primary hospitals, the emergency room (ER) doctor only plays the role of a messenger. After arriving at ER, specialists form a temporary team without command and coordination, as well as standardized rescue procedure and criterion so that therapy efficiency and effect cannot be ensured. 2. Time. In USA and Europe, the time-points that specialists are informed and they arrive at ER are accurately recorded. In case of any delay, the doctor involved must make explanation.¹⁷ In this way, the fast team-up is guaranteed. In fact, the time limitation for the arrival of consultation, especially for the emergent consultation, has been clearly ruled in our country. However, it is poorly executed due to lack of supervision. 3. Site. Shock room is a standard practice in trauma center, which is large enough to accommodate a trauma team of 5–10 members. Shock room is fully equipped to meet the requirement of resuscitation, basic imaging examination (X-ray, etc.), emergent surgeries (fracture fixation, closed thoracic drainage, etc.). Shock room is located close to radiology department, ICU and operation room (OR) so further imaging exam, intense care and surgery become convenient, which will shorten the transportation time.¹⁸ However, shock room has not been established widely in our country and specific assessments and treatments are required by different specialists, which results in delaying emergent process. 4. Disciplines are categorized more and more elaborate nowadays that doctors from different departments only focus on their own specialties but neglect the patient's overall status. 5. Rehabilitation is carried out late and lacks systematic planning due to weak awareness, which tends to result in different kinds of short-term and long-term complications. Above all, in view of the current trauma care system in China, the integrative trauma care may fit multiple trauma patients best at present. In this mode pre-hospital station, ER, OR, TICU, general ward and rehabilitation facility form a functional entirety with a stable and professional trauma care team in charge of the whole therapy process.

Some considerations and recommendations

Establishment of hierarchical and regional trauma centers

Integrative rescue mode has become a main stream trend, but it is impractical to promote it all around the country. On one hand, the integrative mode requires large, advanced equipment and top-ranking personnel, which is a kind of medical resources waste for a primary hospital to bear such a huge burden. On the other hand, it is a great challenge to harmonize the conflict of interest between trauma surgery and other disciplines, especially for primary hospitals, in which trauma patients account for a large portion of surgical resident patients. A single trauma center cannot improve the rescue level of the whole region, no matter how perfect it is. Therefore, the regional and hierarchical trauma center system is an urgent need to establish a rescue network covering from metropolis to countryside.

We suggest establishing a three-level trauma center system with definitive rules about the obligation for each level and the relationship among the three. This system refers to the trauma center classification and management system in USA and combines the practical situation of population and medical resources distribution in China. The main principles are as followed: 1. Detailed regulations must be made regarding the required rescue capacity, medical equipment and personnel resource for trauma centers at all levels. 2. High level trauma center should not only provide

medical service, but also undertake task about clinical and basic research, professional trauma surgeon training and public education. 3. Improving the institutional connection between trauma centers in different levels is conducive to patient transportation.

Personnel training

Although trauma surgery has played more and more important role in trauma rescue, there are great challenges for the development of the discipline itself and specialist in it, such as awkward disciplinary definition and talent outflow cause by prolonged and difficult culture period. Our suggestions are followed as: 1. Clarify the status of trauma discipline to provide a platform for personnel training. Hospital administration should introduce relevant policies to support, motivate and stabilize discipline troop. 2. Standardizing the trauma care system is beneficial to the systematic training for trauma practitioners. Based on the regional needs as well as the hardware and software conditions of relevant hospitals, trauma care service should be established hierarchically to make talent cultivation more targeted. 3. Setting up the training and certifying mechanism to improve trauma rescuers' professional skills. We need to draw up Chinese trauma care guidelines, training programs like ATLS in USA, or ETC in Europe and evaluation projects such as trauma rescue technology examination.^{19,20} It is encouraging that China Trauma Care Training (CTCT), initiated by Chinese Medical Doctor Association and trauma surgeon section, is being held successively all around the country aimed to promote the 'Chinese mode' of trauma care system.

Information construction

Trauma patients in our country are in huge number and abundant species. However, due to the deficiency in data registration, the material available for scientific researches is extremely limited. A standardized, practical and shared trauma database can be important to rescue in scene, fast transportation, information exchange between pre- and in-hospital and scientific research.

Conclusion

The epidemiological data shows an increasing trend in trauma incidence and its harmfulness to public health and social development. Furthermore, great changes in injury mechanism and injury characteristics have brought bigger challenge for trauma care.²⁰ Nevertheless, integrated trauma care system has not been established in China to face it. Besides of introducing advanced experience from western countries, we must explore our own trauma care system. To sum up, we suggest that establishing hierarchical and regional trauma centers, training specific trauma care team and promoting integrative trauma rescue mode are the right way.

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