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Review Article

Current trauma care system and trauma care training in China

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ABSTRACT

Trauma is a life-threatening “modern disease”. The outcomes could only be optimized by cost-efficient and prompt trauma care, which embarks on the improvement of essential capacities and conceptual revolution in addition to the disruptive innovation of the trauma care system. According to experiences from the developed countries, systematic trauma care training is the cornerstone of the generalization and the improvement on the trauma care, such as the Advance Trauma Life Support (ATLS). Currently, the pre-hospital emergency medical services (EMS) has been one of the essential elements of infrastructure of health services in China, which is also fundamental to the trauma care system. Hereby, the China Trauma Care Training (CTCT) with independent intellectual property rights has been initiated and launched by the Chinese Trauma Surgeon Association to extend the up-to-date concepts and techniques in the field of trauma care as well to reinforce the generally well-accepted standardized protocols in the practices. This article reviews the current status of the trauma care system as well as the trauma care training.

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With the social development and science & technology (S&T) progress, the diseases become gradually less life-threatening or, at least, somehow under controlled. However, as science & technology (S&T) being well-known as a double-edged sword, which also brings us multiple risky factors that could cause injuries by motor vehicle crashes, industrial accidents, and so on. The “China Injury Prevention Reports” released in 2007 showed that there were about 200 million injured and more than 700 thousand deaths each year in the mainland of China, accounting for 9% of the annual mortalities, ranking No. 5 among the cause of death.¹ For example, the motor vehicle crashes could cause 140 thousand of fatalities worldwide. The amount of fatalities caused by road traffic accidents in China ranked the top two for 20 consecutive years in the world.² According to statistical data released by Ministry of Public Security of China, there are more than 700,000 motor vehicle crashes in the mainland of China each year, which caused about 1.3 million injuries, and 80,000 to 100,000 mortalities. Trauma has become the third cause of death in China following stroke and coronary heart disease.³ Our

study also indicated that there were around 143 thousand highway motor vehicle crashes in China from 2004 to 2015, involving 216.4 thousand fatalities, the overall mortality rate was 33.87%,⁴ the mileage mortality rate was (97.06 ± 44.49)/1000 km, the mileage injury rate (222.54 ± 121.37)/1000 km. Since 1970s, the regionalized trauma care system have begun to boom in the developed countries. These emerging system have rescued many dying patients after trauma (classical trimodal distribution of death after severe trauma gradually evolved into monomodal distribution, 1983 Turkey).^{5,6} Unfortunately, the deaths in the aftermath of trauma in China still follow trimodal distribution, which is believed to march towards the positive direction by vigorously face-lifting the trauma care system and generalizing the modern trauma care concepts and techniques.

Efforts to improve the trauma care system and generalize the modern trauma care concepts and techniques is the key to transform the distribution of the death after severe trauma.

This article aimed to elaborate the current efforts to promote the of trauma care system in the mainland of China, including the China Trauma Care Training (CTCT) program that was initiated and launched by the authors and their colleagues in 2016, and the current trauma care capacity by surveying 30 hospitals in the mainland of China.

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The current pitfalls in the trauma care in China

By the end of 2012, there were 989 Tertiary Class A hospitals in the mainland of China listed in the Annual Health Statistics in China 2013. By accessing to the profiles on their official websites, there were 49 (5%) hospitals with trauma centers, some by the names of department of trauma surgery or department of acute surgery, 147 (15%) hospitals with emergent surgery facilities based on the orthopedics, primarily focusing on bone fractures, such as the orthopaedic trauma/injury department, soft tissue and bone injury defined by Chinese Medicine, orthopaedic trauma department, and hand surgery department, as well as 12 (1.21%) hospitals with specific trauma centers that manage single-organ injuries, which were neurotrauma centers (2 in Tianjin Municipality, 1 in Dongguan, Guangdong Province), abdominal trauma centers (1 in Xinjiang Autonomous Region, 1 in Gansu Province), oral & maxillofacial trauma centers (1 in Sichuan Province, 1 in Hubei Province), ophthalmological centers (1 in Fujian Province, 1 in Zhejiang Province, and 1 in Guangdong Province), burn centers (1 in Beijing Municipality, 1 in Chongqing Municipality).⁷

From January 2010 to December 2014, the authors and their colleagues surveyed 30 hospitals located in Chongqing, Zhejiang, Hubei, Anhui, etc., including 15 tertiary hospitals, 11 secondary hospitals, and 4 primary hospitals. The research aimed to the capacities of trauma care by following the Standard Operating Procedure (SOP) that was set up in advance, starting with the primary objective that was whether a trauma patient was admitted to a specific division, such as acute surgery and trauma surgery.

The research was carried out in the form of face-to-face interview and the field survey. Field survey covered both the hospital settings and the layout of the emergency departments, including: 1. The hospital profiles, such as the resident population, the hospital accreditation, the beds of hospital and the reputation of specialties of the hospital; 2. The infrastructure for trauma care, such as the emergency department accessibility, the blood bank capacity, the interaction between surgery and other clinical department, for example the intensive care unit, besides the preparedness of the resuscitation unit and operation facility in the emergency department; 3. The trauma care capacity, including availability of 24/7 trauma care service, accessibility to the 24/7 imaging service, for example the CT scan and sonography, the massive casualty care triage protocol, and the definitive surgical care for trauma patients, the distance between the blood bank and the local blood facilities as well as the operation room, the regular storage of blood products, as well as the adverse perspectives in the trauma care; 4. The pre-hospital responding capacity, involving in the amount of the ambulances, the medical evacuation capabilities, the responding time, and so on.⁸

Our study found that there were specialized trauma care facilities in 11 tertiary hospitals (73.33%), 4 secondary hospitals (36.36%) and 3 primary hospitals (75.00%). The common adverse aspects were listed as followed: 1. External factors: the less desirably regulated operation of local EMS system, lacking of effective inter-hospital transferring, no mandatory setups for trauma care required by legislation, no specialty as the trauma surgery in the promotion system, the timing-consuming training and the expanding scope of trauma care; 2. Internal factors: the restrained development of Trauma Surgery due to expansion of traditional Orthopedics and General Surgery, the less efficient operation of trauma care facilities; the lower time-sensitive management of the polytrauma patients approached by intra-hospital consulting regime, the less satisfactory spatial accessibility among different interacting functional units which might include the emergency department, radiology, blood bank and operation room, either maybe in different buildings or floors; confusing standard protocol

referring to trauma care that led to low cost-efficiency by unnecessary patient transferring. Besides all the common matters, the different issues existed in different hospitals which tangled the thriving of trauma care: 1. In tertiary hospital, the unique path for trauma care was less taken into consideration due to the comprehensive and expansive layout of the hospital with standard mature disciplines. Those who have established acute care surgery department mainly focused on poly-trauma and intensive care with abdominal trauma and disease as supplementary. There is a prevalent lack of care capacities either for brain or major thoracic injury which is much more time sensitive, that require prompt intervention in the local facilities rather than inter-hospital transferring. 2. In primary and secondary hospital, the traffic is poor, the first-aid setups are far behind, long distance away from emergent department and insufficient blood products storage of blood bank are still quite common, it even takes more than two and half hours to acquire the blood products; lacking of fundamental disciplines such as vascular surgery, neurosurgery, thoracic surgery or other specialties; very few of intensive care unit, blood bank, etc; inadequate capacities of trauma surgery, critical care and resuscitation management; no regular bed or resuscitation room for trauma patient in emergency department; Intra-hospital consultation mode was employed to handle major trauma patients; prolonged pre-operation time.

Strategies for improving trauma care system in Chinese hospitals

Compared with other health services, trauma centers take more responsibilities and missions. Developed countries such as United States has built up trauma care system since 1970s, which established Level I–IV designated trauma centers with different roles which specify the tasks at each level and achieved great success.⁹

Regarding to the urgent needs for major trauma management, efforts should embark on the reinforcement of the construction of trauma center so as to strengthen the essential trauma care capacity of hospitals in China.

Firstly, national development top level design is needed, government should make a deliberate policy, it may comprise: (1) Establishing and improving regulations and standards for designated trauma center to suit the local status under the framework of tertiary hospitals, the local hospitals and the clinics, which include standards for trauma center accreditation as well as the clarifications for the requirements and the responsibilities, rights and obligations. (2) Trying to build and perfect that the costs of the trauma care commensurate with the trauma center level. (3) Setting up the “trauma/acute care” as a new discipline in medical college or university. (4) Strengthening injury and trauma care capacity by certificated trauma training program and professional promotion system of trauma surgery faculty.

Secondly, hospital should take the responsibility of emergency trauma care. When a life-threatening trauma patient arrives at hospital, stopping bleeding, decontamination, decompression, airway management, vascular surgery, and other damage control surgery should be performed immediately. Therefore, the “golden hour” concept must be really implemented and the multi-disciplinary regime of trauma care and related protocols targeted trauma patient should be re-constructed. The protocols we proposed are listed as: (1) building up a multi-disciplinary “trauma/acute care surgery” division to manage major trauma patients in the hospitals meeting the requirements for the designated trauma center; while in the less desirable hospitals, a full trauma care service should be provided by a specialized multi-disciplinary trauma team and the management should also be optimized. (2) establishing trauma resuscitation area (TRA) in emergency department, providing goal-directed resuscitations as well as the essential imaging and

damage-control surgeries, such as bleeding control and decompression; (3) improving the “hardwares”, such as clear traffic road around the hospital, especially the emergency departments, offering better instruments and equipment regarding to ambulances and the emergency departments, etc. All issues should be considered when planning a new or rebuilt trauma center.^{8,10} (4) Until not being designated as an independent discipline, should the trauma surgery be established by integrating trauma surgery, critical care/intensive care, and the acute abdominal surgery, which should be the cornerstone for this specialty and therefore the faculties could depend on and, somehow, being self-sustaining.¹¹

Launching and implementation of CTCT

The first priority is always given to cost-efficient management of trauma patient when responding an emergency. The projects such as “Advanced Trauma Life Support” advocated by the American Association for the Surgery of Trauma (AAST) in 1978^{12,13} and the “Primary Trauma Care Course (PTC)” by the World Primary Trauma Care Foundation in 2004¹⁴ have set up good examples for the trauma training curricula. Also, the Primary Trauma Care in China has made great success from 2010 to 2013.¹⁵ Hereby, the expert panel from the Chinese Trauma Surgeon Association vigorously propelled a training program with independent intellectual property rights to be implemented.

CTCT is a continuing medical education program with high-quality, which focuses on trauma care. This program is initially advocated by many famous trauma experts in China, including Academician Zheng-Guo Wang, Xiao-Bing Fu. CTCT program is supported by Trauma Surgeon Branch affiliated to Chinese Medical Doctor Association, and undertaken by CTCT expert committee. The program was initiated in May 2015, and officially launched in July 2016 in Xining, Qinghai Province.

CTCT program is designed for those medical staffs who are mainly engaged in pre-hospital and in-hospital trauma care. The training curricula are developed according to the rules of evidence-based medicine, latest international advances on trauma care and current situation in China. It includes the medical practice, operation procedure, construction of multidisciplinary trauma team and trauma center. The purpose of this program is to help the trainees to care major trauma patients and massive casualties following standardized process more safely and efficiently.

The mission of CTCT program is to be the highest-quality training course on trauma care and a public service activity in China. The CTCT course is strictly complied with the following three rules: right training time (one-and-half-day), right number of trainees (less than 50), and right number of instructors. CTCT course is implemented with the unified textbook, PowerPoint materials, and the unique ID number for instructors and students. The course comprises of pre-lecture discussion, pre-course test, theoretical lectures, video lectures, workshops, case discussions, simulation scenarios, post-course test and Q&A seminars. The high quality of training is guaranteed by the enriched content, utility for clinical practice, and the interactive teaching strategies.

The board of CTCT experts committee is composed of some famous experts on trauma care in China. Prof. Lian-Yang Zhang, Xiang-Jun Bai and Mao Zhang are served as co-chairmen of CTCT committee. The number of instructors of CTCT course is 35 until March 2017. The instructor should meet the following qualifications: (1) actually involved in trauma care, with profound comprehension and experience of managing major trauma; (2) senior attending doctor; (3) having completed the CTCT training course; (4) possessing passion for trauma education with rich teaching skills, and having successfully experienced teaching under instruction. In future, more traumatic experts and young talent will become CTCT lecturers, thus speeding up CTCT progress in China.

The CTCT office is located in the Editorial Office of Journal of Trauma Surgery. If you are interested in the CTCT course, please visit the website at <http://www.cswkzz1999.com> or follow our Wechat account of “cswkzz” for more information.

Until the June 2017, the CTCT project has carried out 21 trainings in 14 provincial administrative areas, including 9 trainings in 2016. The number of the cumulative trained students is 1162 (Table 1).

In countries such as the United Kingdom, the implement of ATLS has improved trauma treatment and effectively reduces patients' mortality.^{16,17} ATLS certification has been widely considered to be necessary for the treatment of trauma patients, and more than 2 million physicians have obtained the ATLS qualification.¹⁸ As the CTCT implementation time is still short, there is still no data about the impact of CTCT on the Chinese trauma treatment, but the comparison of CTCT test results of before class and after class indicates that the project has enhanced the trauma treatment efficiency of the trained Chinese physician, and has increased the safety factor for trauma patients.

Table 1
The CTCT progress by the end of June, 2017.

Locations	Time	Undertaken hospitals	Person in charge	Number
Xining	2016.07.22–24	Affiliated Hospital of Qinghai University	Guo-Qiang Jia	34
Jinan	2016.09.09–11	Qianfoshan Hospital of Shandong Province	Gang Zhao	56
Hangzhou	2016.10.20–22	The Second Affiliated Hospital of Medical College of Zhejiang University	Mao Zhang, and Xiao-Gang Zhao	54
Xingyi	2016.10.28–30	People's Hospital of Xingyi City in Guizhou	Jin Deng, and Ren-Ju Xiao	51
Suzhou	2016.11.04–06	First Affiliated Hospital of Suzhou University	Feng Xu	49
Yuyao	2016.11.24–26	Yuyao People's Hospital of Zhejiang Province	Zi-Long Li	66
Chongqing	2016.11.30–12.02	Diping Hospital of the Third Military Medical University	Lian-Yang Zhang	34
Zhangzhou	2016.12.08–10	PLA No. 175 Hospital	Yi-Gang Yu	73
Tianjin	2016.12.15–17	The Affiliated Hospital to Armed Police Logistic College	Hao-Jun Fan, and Qun Xia	81
Sanya	2017.01.05–07	People's Hospital of Sanya City	Xiong Zhu, and Zhen-Hao Wang	40
Urumuqi	2017.02.16–18	First Affiliated Hospital of Xinjiang Medical University	Baiheti Paerhati	60
Jinhua	2017.02.23–25	People's Hospital of Jinhua City in Zhejiang	Xiao-Gang Zhao, and Ming-Wei Huang	60
Yubei	2017.03.02–04	Third Affiliated Hospital of Chongqing Medical University	Lian-Yang Zhang, and Bo-Gang Yan	40
Nanning	2017.03.16–18	People's Hospital of Guangxi Zhuang Autonomous Region	Yin Shen	56
Wanzhou	2017.03.23–25	Three Gorges Central Hospital of Chongqing	Lian-Yang Zhang, and Yong-Fu Zhong	50
Haozhou	2017.04.06–08	People's Hospital of Bozhou in Anhui	Shu-Li Hao	50
Hangzhou	2017.04.21–04.22	The Second Affiliated Hospital of Medical College of Zhejiang University	Mao Zhang, and Xiao-Gang Zhao	52
Zhangjiagang	2017.04.27–04.29	First People's Hospital of Zhangjiagang	Feng Xu, and Lei Li	82
Shiyan	2017.05.11–05.13	People's Hospital of Shiyan City in Hubei	Xiang-Jun Bai	31
Wenzhou	2017.05.25–05.27	The Second Affiliated Hospital of Wenzhou Medical College in Zhejiang	Da-Qing Chen	59
Changzhi	2017.06.15–06.19	Changzhi people's Hospital in Shanxi	Ya-Dong Cheng	52

With China's rapid development of economic construction and continued improvement of national strength, the health care emergency response system is increasingly valued, and trauma center construction is increasingly attached more importance by authorities, hospital managers and clinical experts. Construction of trauma centers has become an innovative choice of many hospitals. We should construct an intra-hospital trauma rescue process in line with the development trend of modern medicine, follow the damage control strategy and perform emergency treatment within the golden time and establish continuous improvement mechanism especially in the discipline and talent construction, including the actively promotion of CTCT project, which will lay a solid foundation for improving the intra-hospital severe trauma management ability of China.

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