



Systemic analysis of pre-hospital trauma emergency treatment in Zhengzhou

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ABSTRACT

Objective: To analyze the data of pre-hospital emergency treatment in Zhengzhou from 2007 to 2016, and evaluate the current situation of pre-hospital trauma emergency treatment, in order to provide a scientific basis for effective use of first aid resources and enhance success rate of trauma emergency treatment. **Methods:** Retrospective analysis was conducted based on pre-hospital emergency resources of Zhengzhou Emergency Medical Rescue Center from 2007 to 2016. **Results:** The total number of pre-hospital emergency treatment cases was 9 305 687 from 2007 to 2016 in Zhengzhou, of which 418 882 were trauma cases. The top five causes of injury were traffic accident injury, cutting injury, beating injury, crushing injury and falling injury. The top five emergency treatments used were oxygen, hemostasis, dressing and fixation, fluid supplementation, analgesics and sputum aspiration. According to different directions of diagnosis, the pre-hospital emergency patients were divided into four groups: emergency treatment group, emergency observation group, admission to general ward group and admission to ICU group. There was no statistical difference in the ages among the four groups ($P>0.05$). There were significantly statistical differences in gender composition among the four groups, with more males than females ($P<0.01$). Significant statistical differences also showed in CRAMS scores among the four groups ($P<0.01$). Before and after the training of primary trauma care, there was no significant difference in the constituent ratio of the trauma ($P>0.05$), but the mortality of the trauma, the average arrival time, and the mean treatment time were significantly different ($P<0.01$). **Conclusions:** The number of pre-hospital emergency trauma patients increased year by year, but the constituent ratio changed little. CRAMS score is important for the patients triage. Through the training of primary trauma care, the constituent ratio of death was reduced, and the average treatment time was shortened.

1. Introduction

Zhengzhou city, locates in Henan province, central of China. As the center of the great cross of China's transportation, it symbols an important transportation hub. Zhengzhou city includes 6 districts and 5 counties. The total area of Zhengzhou is 6 405.3 square kilometers. The permanent residents of Zhengzhou are about 9.2 million. In recent years, with the development of social economy, frequent engineering construction, surging social vehicles

and proliferation of floating population, trauma has gradually become the first killer of people's health. Studies have shown that more than half of the trauma deaths occurred at the scene and in transit[1], so pre-hospital emergency treatment is an important part of emergency treatment. In the process of pre-hospital trauma emergency treatment, inaccurate judgment on severity of injury will results in poor treatment outcomes. Currently, CRAMS score is widely used as a quantitative index of trauma to guide the treatment

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and triage of patients[2], but its role and limitations need to be further confirmed. In order to improve the outcome of pre-hospital trauma treatment, Zhengzhou Emergency Medical Rescue Center organized primary trauma care (PTC) training for medical staff in 2010, but the effect of the training has not been reported in literature. In view of this situation, we summarized the emergency treatment of pre-hospital trauma in Zhengzhou from 2007 to 2016, and the report is as follows.

2. Materials and methods

2.1. Source of data

Pre-hospital emergency information was collected by visiting "120" Command and Control System Information Platform of the Zhengzhou Emergency Medical Rescue Center to find patients' electronic information recording calling "120" for help between 1 January 2007 to 31 December 2016.

2.2. Contents and methods

Retrospective analysis was carried out on the pre-hospital emergency data of Zhengzhou, and the epidemiological rules of trauma patients were summarized. The causes of injury, emergency treatment, CRAMS score, PTC training and other aspects were studied, and the current situation of pre-hospital emergency trauma were summarized and analyzed.

2.3. Statistical analysis

Statistical method selection: *Chi-square* test was used for comparison of the composition ratio; *t-test* was used for comparison of mean values between two groups; Analysis of variance was used

for comparison of mean values among multiple groups; *SNK-Q* test was used for pair-wise comparison of mean values between multiple groups. A level of $P=0.01$, $P<0.01$ was considered statistically significant. Microsoft Office Excel 2010 and SPSS 17.0 software were applied for the statistics and charts processing.

3. Results

3.1. General information

From 2007 to 2016, the total number of pre-hospital emergency treatment cases in Zhengzhou was 9 305 687, among which the total number of trauma cases received was 418 882, with a composition ratio of 45.01%. The top three pre-hospital emergency treatment diseases were trauma, cardiovascular and cerebrovascular diseases, and digestive system diseases (Table 1). From 2007 to 2016, the number of pre-hospital emergency trauma patients receiving treatment increased year by year, but the composition ratio did not change much.

3.2. Cause of injury analysis

According to the classification of the causes of trauma, 187 709 patients were injured in traffic accidents, with a composition ratio of 44.81% (187 709/418 882). There were 75 121 cases of cutting injuries, with a composition ratio of 17.93%; 58 548 cases of hit injury, 13.98% (75 121/418 882); 48 205 cases of pressure injury, 11.51% (48 205/418 882); 37 618 cases of falling injuries, 8.98% (37 618/418 882). Burns occurred in 4 467 cases, with a composition ratio of 1.07% (4 467/418 882); Electric injury 3812 cases, 0.91% (3 812/418 882). The top three causes of injury are: traffic accident injury, cutting injury and hit injury, among which traffic accident injury always ranks the first (Table 2).

Table 1

General situation of pre-hospital emergency trauma patients in Zhengzhou from 2007 to 2016.

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Trauma	19 297	27 748	32 991	37 861	42 007	44 833	46 386	48 735	57 882	61 142
Cardiovascular and cerebrovascular	9 874	10 968	13 129	14 237	14 982	15 432	16 031	16 811	29 742	27 544
Digestive	2 336	2 071	2 462	2 876	3 024	3 568	4 067	4 858	7 601	7 231
Respiratory	2 276	2 298	2 942	3 178	3 429	3 624	3 879	4 246	8 210	7 882
Gynecological and pediatric	2 251	2 472	2 873	3 081	3 332	3 248	3 689	4 210	4 449	4 761
Poisoning	1 152	1 349	1 654	1 879	2 056	2 423	2 678	2 898	3 052	3 162
Other	6 945	13 695	17 459	21 520	22 906	24 103	22 693	20 178	23 150	31 559

Table 2

Causes of injuries of pre-hospital emergency trauma patients in Zhengzhou city from 2007 to 2016.

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Traffic injury	7 907	12 337	14 956	17 438	19 446	20 135	20 689	21 692	25 427	27 682
Cutting injury	3 376	5 194	5 838	6 460	7 782	8 712	7 985	8 947	9 762	11 065
Hit injury	2 876	3 609	4 848	4 643	5 834	5 828	6 957	6 842	8 796	8 315
Pressure injury	2 392	3 074	3 629	4 175	4 168	5 391	5 598	5 365	7 148	7 265
Falling injury	1 932	2 497	2 969	3 886	3 692	3 586	3 923	4 683	4 942	5 508
Burns	369	419	296	541	389	403	483	429	649	489
Electric injury	227	378	263	376	368	398	394	398	583	427
Other	218	240	192	342	328	380	357	379	575	391

3.3. Application of emergency treatment

The usage of all kinds of emergency treatments for pre-hospital emergency were listed as following: There were 365 265 times of oxygen inhalation (87.2%; 365 265/418 882), 304 108 times of hemostasis dressing (72.6%; 304 108/418 882), 202 320 times of liquid supplement (48.3%; 202 320/418 882), 90 059 times of analgesic drugs (21.5%; 90 059/418 882), 41 050 times of sputum aspiration (9.8%; 41 050/418 882), 36 442 times of debridement (8.7%; 36 442/418 882), 25 970 times of embolia (6.2%; 25 970/418 882), 19 687 times of vasoactive drugs (4.7%; 19 680/418 882), 6 702 times of electrical defibrillation (1.6%; 6 702/418 882), 6 283 times of mechanical ventilation (9.0%; 6 283/418 882), 5 026 times of tracheal intubation (1.6%; 5 026/418 882), and 3 769 times of cardiopulmonary resuscitation (9.0%; 3 769/418 882).

3.4. Application of CRAMS score

Pre-hospital emergency trauma patients were divided into four groups according to the different measures that will be taken after diagnosis: emergency treatment group, emergency observation group, admission to general ward group and admission to ICU group. Differences in mean age among the four groups were statistically significant (Analysis of variance, $P < 0.01$). Also, there were significant larger number of male patients than female patients among the four groups (Chi -square, $P < 0.01$). There were significant statistical differences in the mean CRAMS scores among the four groups (Analysis of variance, $P < 0.01$), and there were statistically significant differences between the mean numbers ($SNK-Q$ test) (Table 3).

Table 3

Comparison of patients assigned different destinations for pre-hospital trauma emergency treatment in Zhengzhou from 2007 to 2016.

Triage	n	Average age (years)	Gender [n(%)]		CRAMS (score)
			Male	Female	
Emergency treatment	191 842	41.76±10.78	119 901 (62.50)	71 941 (37.50)	7.89±0.58
Emergency observation	107 239	44.38±11.04	57 265 (53.40)	49 974 (46.60)	6.56±1.72
General ward	83 356	43.96±12.82	48 596 (58.30)	34 760 (41.70)	5.72±1.35
ICU	36 445	45.78±13.12	22 012 (60.40)	14 433 (39.60)	4.91±0.97
<i>F</i> or X^2 value		$F=2\ 046.44$	$X^2=2\ 188\ 117$		$F=106\ 453.4$
<i>P</i>		$P < 0.01$	$P < 0.01$		$P < 0.01$

Pre-hospital emergency trauma patients were assigned for three destinations according to the CRAMS score range: 9-10 points (minor injury) group; 6-8 points (calumniation) group; and less than 6 points (serious injury) group. There were significant differences in patients' average age, gender compositions and

CRAMS scores among patients assigned for different destinations (emergency treatment, emergency stay, general ward, and ICU) in each group (Chi -square test, $P < 0.01$) (Table 4).

Table 4

Triage of different CRAMS scores in pre-hospital emergency trauma patients in Zhengzhou from 2007 to 2016, [n(%)].

CRAMS (score)	Emergency treatment	Emergency observation	General ward	ICU	X^2	<i>P</i>
9~10	167 217 (86.47)	20 768 (10.74)	4 176 (2.16)	1 215 (0.63)	74 758.4	$P < 0.01$
6~8	20 987 (12.75)	81 669 (49.61)	57 853 (35.14)	4 126 (2.51)	12 648.2	$P < 0.01$
<6	3 638 (5.98)	4 802 (7.89)	21 327 (35.04)	31 104 (51.10)	5 347.4	$P < 0.01$

3.5. Significance of PTC training

The trauma patients were divided into two groups: before and after the PTC training. Number of patients in the two groups was not significant different (Chi -square test, $P > 0.05$). Significant difference in percentage of trauma deaths after rescue was found between the two different PTC groups. (Chi -square test, $P < 0.01$). The average arriving time and rescue time were significant different too (t -test, P both < 0.01) (Table 5).

Table 5

Comparison before and after PTC training among medical staffs in Zhengzhou.

	Total number	Trauma cases[n(%)]	Deaths after rescue	Trauma deaths[n(%)]	Arrival time(min)	Rescue time(min)
Before PTC	354 610	159 904 (45.09)	934	298 (31.91)	20.82±1.38	16.58±2.78
After PTC	575 957	258 978 (44.96)	558	129 (23.12)	17.36±1.58	15.13±2.62
<i>T</i> or X^2 value		$X^2=1.46$		$X^2=13.21$	$t=3.69$	$t=3.25$
<i>P</i>		$P > 0.05$		$P < 0.01$	$P < 0.01$	$P < 0.01$

4. Discussion

From 2007 to 2016, the number of trauma patients in pre-hospital emergency treatment in Zhengzhou has gradually increased, and percentage of trauma cases has always been the largest among patients accepting pre-hospital emergency treatment, indicating that trauma has always been the main disease, as well as the most important factor affecting people's life safety in pre-hospital emergency treatment. This is consistent with domestic and abroad literature reports[3]. Therefore, it is of great significance to improve the level of pre-hospital trauma emergency treatment to ensure people's life safety. Scholars from abroad have long been committed to improving the research on trauma treatment, especially the research on multiple injuries[4]. We should also be committed to improving the trauma treatment system, standardizing the process of trauma treatment, and improving the success rate of trauma treatment.

In recent years, with the economic development, rapid growth of

vehicles and the increase of floating population, traffic accident injuries have ranked the first cause of death and disability in pre-hospital emergency treatment, and abroad literatures have reported the same[5-7]. China's emergency medical service system includes three parts: pre-hospital emergency, hospital emergency department and emergency intensive care unit. However, the shortage of emergency stations and professionals are still common in most regions. In order to improve the success rate of trauma treatment, the first-aid measures of "golden hour" and "platinum ten minutes" after injury are particularly important, so the focus of pre-hospital trauma first-aid is on the treatment at the scene and in transit[8]. According to literature reports, the response time to trauma emergency treatment was 5.5 min in Tokyo, Japan; 5-8 min in Sao Paulo, Brazil; Within 5 min in Seattle, the United States; 11 min in Beijing[9], and about 18 min in Zhengzhou. It shows that there is still a considerable gap between our city and the international level.

The ratio of advanced life support in pre-hospital trauma emergency treatment in our city is low. The main causes of early death of trauma patients are hemorrhagic shock and airway obstruction, so trauma resuscitation should be actively carried out. The effect of early resuscitation is directly related to the occurrence of multi-organ failure in the later stage of trauma[10]. The primary task of pre-hospital trauma emergency treatment is to keep the airway unobstructed, so as to win the opportunity for future treatment. Therefore, for critically ill patients, endotracheal intubation and tracheotomy should be actively adopted to ensure the airway unobstructed. On the premise of hemostasis, early fluid resuscitation[11] should be carried out to ensure tissue perfusion and avoid irreversible damage of heart, brain, kidney and other important organs caused by insufficient perfusion. The scoring system is an essential and objective criterion in judging the injury of patients with trauma. CRAMS score is simple to use, convenient for operation, and quick to determine the injury. This study showed that CRAMS had stratified significance in the judgment of patients' injuries, and could be used as the basis for triage of trauma patients. A number of studies have shown that the total score of CRAMS for judging injury is 9-10 for mild trauma, 7-8 for severe trauma, and less than 6 for extremely severe trauma. Patients with trauma less than 6 should be transferred to the ICU for treatment as soon as possible[12]. The deficiency of CRAMS score lies in the lack of judgment on traumatic complications, such as acute respiratory distress syndrome, multi-organ dysfunction syndrome, etc[13]. Therefore, CRAMS should be applied under the consideration of patient's medical history, physical examination, auxiliary examination and comprehensive judgment of injury.

PTC is a set of trauma management measures implemented by the international trauma treatment committee, aiming at training clinicians to provide standardized, rapid and practical treatment for patients with severe trauma, which has been widely promoted around the world[14]. Through the comparison of the treatments before and after PTC training in Zhengzhou, this study shows that the PTC training of medical staff in our city shortens the time and reduces the mortality rate of trauma treatment. At present, PTC training has been carried out in many cities in China, which plays a great role in improving the ability of emergency wound treatment. For example, after the PTC training, 85% of trainees expressed obvious benefits in professional theory and clinical skills in Guangxi province[15], and abroad literatures reported satisfactory results in PTC training as well[16]. Obviously, The effect of PTC

training has been approved at home and abroad, and PTC training is worthy of promotion and popularization.

This study focused on the analysis of the epidemiological law of pre-hospital trauma first aid, showing the progress of pre-hospital trauma first aid, but there is still a long way to go to improve the success rate of pre-hospital first aid and reduce the mortality rate of treatment. The number of 120 first-aid stations in our city is far from sufficient, and there are still some defects such as the shortage of first-aid personnel and inadequate professional equipment configuration. The first-aid level of trauma in our city is behind the international average level, so we should strengthen theoretical learning, continue to promote PTC training, and constantly improve the level of treatment.

Conflict of interest statement

The authors report no conflict of interest.

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