

## ORIGINAL ARTICLE

# Study on integrated treatment of severe burn in batch patients

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**Received:** May 3, 2023

**Accepted:** July 20, 2023

**Online Published:** August 2, 2023

**DOI:** 10.5430/dcc.v9n3p18

**URL:** <https://doi.org/10.5430/dcc.v9n3p18>

## ABSTRACT

**Objective:** To explore the burn treatment and first aid flow mode in batch patients.

**Methods:** A retrospective analysis was performed on the treatment experience of 10 or more patients in the group burn accident admitted to the Third Affiliated Hospital of Inner Mongolia Medical University from 2008 to 2020, in order to acquire the general information (e.g., age, sex [male and female], injury causes and factors, total burn surface area, inhalation injury and compound injury), the time when each first-aid rescue team was in place; the reception time of the triage group; specialist rescue start time; treatment process and treatment outcome in patients with severe burns, such as the establishment time of deep venous access.

**Results:** 67 cases (n = 68) of patients were cured and the curative ratio was 98.5%. The average time from the rescue order of the commander-in-chief to the placement of each medical group was 8.8 minutes, the average reception time of the triage group was 4.5 minutes, the average specialist rescue start time was 18.6 minutes, and the average establishment time of deep vein access for patients with severe burns was about 11.3 minutes.

**Conclusions:** Scientific and reasonable pre-hospital emergency triage and treatment for burn patients can be achieved by implementing integrated treatment.

**Key Words:** Group burn, Severe burn, Burn first-aid

## 1. INTRODUCTION

Group burn refers to a burn incident in which the number of patients is no less than 10,<sup>[1]</sup> mainly due to industrial accidents, natural disasters, urban resident fires, and fires caused by terrorist attacks. It is characterized by a large number of injured patients, complexity, often combined with compound injuries and difficult in treatment. The patients were mainly given primary transport, and lack of effective fluid resuscitation and wound management.<sup>[2]</sup> Improper handling will cause huge loss of personal safety for the people

and affect social stability. In order to get the most timely and effective treatment for group injury patients, a scientific and reasonable organizational process is required.<sup>[3]</sup> Therefore, the author retrospectively analyzed the experience and lessons of the Third Affiliated Hospital of Inner Mongolia Medical University in the treatment of group burn and the establishment of pre-hospital emergency response plan, organizational form, rescue process, personnel & material allocation and patient triage, etc., so as to provide a reference to cope with group burn accidents.

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## 2. DATA AND METHODS

### 2.1 General information

From 2008 to 2020, a total of 69 patients in group burn accidents with no less than 10 people, were admitted by the Third Affiliated Hospital of Inner Mongolia Medical University and included in this study. There were 62 males and 6 females, aged 21.4 to 62.1, with an average ( $36.5 \pm 5.6$ ).

### 2.2 Treatment methods

#### 2.2.1 *Scientific and reasonable triage*

After the injured persons are transferred to the hospital, the senior burn specialists will evaluate the injury condition according to the severity, the inhalation injury, compound injuries and the presence of special causes of burn and poisoning. After the evaluation, the patients are assigned with the registration number and the specific wrist band for the arrangement of the ward, and then transferred to the ward according to the severity. Patients transferred to the ward are immediately treated by each rescue team of Department of Burns, and subsequently undergo a secondary examination.

#### 2.2.2 *Fluid resuscitation*

The fluid rehydration channel shall be established rapidly. The central venous access shall be established in severe patients. In addition, the rehydration therapy is given to these patients according to the vital signs and the urine output. The amount of rehydration is calculated according to the formula proposed by Third Military Medical University.<sup>[4]</sup> At the same time, antioxidants and drugs that are conducive to adjusting the function of microcirculation are applied as soon as possible to enhance the anti-shock effect.

#### 2.2.3 *Early diagnosis and treatment of inhalation injury*

Inhalation injury is one of the main causes of early death in patients with severe burns, and it is necessary to make a diagnosis and give a corresponding treatment quickly and timely. Patients with pre-existing asphyxia or severe inhalation injury shall be immediately given tracheal intubation or tracheotomy to relieve respiratory obstruction. Patients with moderate and severe inhalation injury shall be treated with tracheotomy timely, meanwhile, airway cleaning, oxygen inhalation, respiratory atomization and lavage, etc. are given as well. Ventilator-assisted breathing shall be given to patients who still have hypoxia after respiratory obstruction is relieved. Timely oxygen therapy is performed to patients with carbon monoxide poisoning.

#### 2.2.4 *Wound management*

For chemical burns, the wound shall be rinsed with running water as soon as possible or treated with neutralizers to prevent further aggravation of the injury. Non-chemical burn patients with mild to moderate degree of injury can be left

untreated to make time for patient placement, after which the debridement is performed by a specialist, and further dressing, exposure therapy, or skin grafting is given depending on the location and depth of the burn. For patients with severe and extremely severe degree of burn, the wounds that were not heavily polluted or heavily polluted but already given simple treatment shall be protected with sterile or clean therapeutic drapes to prevent further contamination and avoid re-injury. The debridement shall be performed in time after shock stabilization, and the wounds shall be treated with exposure therapy. Circumferential burn wounds on the trunk or extremities can affect thoracic motion or limb circulation and should be given escharotomy. After patient condition becomes stable after the shock period, the escharotomy shall be performed as soon as possible, and the appropriate skin grafting methods shall be adopted according to the size, location and donor area of the wound, and appropriate skin covering shall be selected to effectively cover the surgical area.

#### 2.2.5 *Prevention and treatment of infection*

The key measures to control infection are to ensure that patients survive the shock period smoothly, correctly manage wounds, prevent complications, protect the intestinal mucosa to prevent enterogenic infections, and rationally use antibiotics according to the principle of antibiotic use. In addition, strict disinfection and isolation are particularly important, patients with severe burns shall be arranged in separate wards. It is necessary to strictly adhere to the principle of sterility when changing dressings, and each bed physician shall minimize going to other patients' wards, and pay attention to hand hygiene in order to avoid cross-infection.

#### 2.2.6 *Early gastrointestinal nutrition and protection of intestinal function*

In addition to supplying energy, early gastrointestinal nutrition can also improve intestinal blood supply, promote the maturation of intestinal mucosal epithelial cells, improve intestinal barrier function, and prevent and control endogenous infections. The addition of glutamine in the early stage of shock can effectively improve the function of the intestinal mucosa. Nutritional support for patients with severe burns is preferably gastrointestinal nutrition, supplemented by intravenous nutrition. The amount of nutritional supplement is calculated according to the formula proposed by Third Military Medical University. Patients in the shock period is preferably given intravenous nutrition to provide energy, while taking a small amount of water or gastrointestinal nutrition solution. If oral administration is not applicable, it is recommended to indwell gastric tube or nasointestinal tube. Small dose is given at first, after adaptation, the dose can be gradually increased. After the shock period, liquid food

can be added, and the nutritional supply is preferably based on whole gastrointestinal nutrition for 1 week after injury, supplemented by intravenous nutrition.

### 2.3 Indicator observation

The following indicators were observed in this study: general information (e.g., age, sex [male and female], injury causes and factors, total burn surface area, inhalation injury and compound injury), the time when each first-aid rescue team was in place; the reception time of the triage group; specialist rescue start time; treatment process and treatment outcome in patients with severe burns, such as the establishment time of deep venous access.

### 3. RESULTS

Five batches of patients in group burn accidents were admitted during 12 years, with 68 cases in total. Burn area ranged from 2% to 98% TBSA. There were 27 cases of patients with extremely severe burn, 9 cases of patients with compound injury and 21 cases of patients with moderate inhalation injury. Whereas, 4 batches of patients were directly

transferred to our hospital from the scene of the accident and not given fluid resuscitation before admission, and the other batch of patients were transferred from the local primary hospital by ambulance, and the fluid resuscitation was given during transport process. The time from injury to admission was less than 8 h. The general information of each batch of patients is shown in Table 1, and the information about compound injury is shown in Table 2. After treatment, 67 cases were cured and 1 case died, with a curative ratio of 98.5%. Through the research and analysis of the emergency process, the average time from the rescue order of the commander-in-chief to the placement of each medical group was 8.8 minutes, the average reception time of the triage group was 4.5 minutes, the average specialist rescue start time was 18.6 minutes, and the average establishment time of deep vein access for patients with severe burns was about 11.3 minutes. Among the 30 patients with inhalation injury, 8 cases had been given tracheostomy before admission, no death due to inhalation injury, 1 case received emergency epidural hematoma removal and 2 cases received manual reposition and plaster fixation.

**Table 1.** Burn patient general information (n)

Group Burn Incident	The Number of Burn Patients	Gender Proportion (Male/Female)	Average Age (years old)	Total Burn Surface Area (TBSA)		
				< 50%	80%-50%	> 80%
Gas Explosion in Coal Mine	16	15:1	41.2	11	3	2
Gasoline Flame	12	8:4	38.7	9	1	2
Smelting Furnace Explosion	11	11:0	34.6	5	3	3
Calcium-carbid Furnace Explosion 1	17	17:0	28.8	10	5	2
Calcium-carbid Furnace Explosion 2	12	11:1	34.5	6	6	0

**Table 2.** Information about compound injury (n)

Group Burn Incident	Craniocerebral Injury	Fracture	Blast Injury of the Lungs	Inhalation Injury		
				Mild	Moderate	Severe
Gas Explosion in Coal Mine	1	1	4	0	4	2
Gasoline Flame	0	0	0	3	2	4
Smelting Furnace Explosion	0	0	1	4	2	2
Calcium-carbid Furnace Explosion 1	0	1	0	2	2	0
Calcium-carbid Furnace Explosion 2	1	0	0	0	3	0

### 4. DISCUSSION

#### 4.1 Scientific and reasonable emergency plan is the key to ensure the success of rescue

A comprehensive emergency rescue mechanism can mobilize hospital resources in the shortest time to ensure the organized deployment of rescue work. The first-aid rescue plan shall

be regularly rehearsed, and all aspects of the process shall be evaluated, so that the emergency plan can be continuously improved. According to the comprehensive strength of the hospital and the treatment capacity of Department of Burns, the author’s affiliation has formulated a pre-hospital first-aid rescue plan for a large number of injured people in severe

burn accidents: (1) Organizational structure: Under the leadership of the hospital, there is a treatment group, a patient triage group, a personnel deployment group, and a material supporting group. (2) Job responsibilities: The commander-in-chief is responsible for the overall process, coordination and liaison work, and summarizes the injury and treatment situation, and communicates with the higher health authorities and the media. The treatment team is mainly composed of medical staff in Department of Burns, and is responsible for the treatment of burns in burn patients. The leader of the treatment team shall be the director of Department of Burns, who is responsible for the establishment of the overall first-aid rescue treatment plan and the individualized treatment plan for severe burn patients. The director of the department shall divide the existing medical staff in the department into one or more first-aid rescue teams for the severe and the mild burn patients as soon as possible, and each treatment team shall have at least one senior specialist as the team leader. The number of the treatment team for the severe burn patients is determined according to the number of severe burn patients, and each team for the severe burn patients is responsible for the treatment of one or two cases of severe burn patients. The treatment team for the mild burn patients is responsible for the treatment of the patients with moderate and mild burns. At the same time, the director of the department sends a senior specialist to Emergency Department (the dispatched personnel can be the leader of each team or the director himself/herself) to assist Emergency Department in carrying out initial diagnosis and triage of patients. The patient triage group is mainly composed of medical staff in Emergency Department, and under the guidance of the senior specialist from Department of Burn, it is necessary to make a diagnosis and triage of the patients. The personnel deployment team consists of Medical Division and Nursing Department, and is responsible for the deployment of medical staff from various departments to support the triage and treatment process. The material supporting team is composed of logistics, pharmacy, equipment and blood bank personnel, and is responsible for the supply of rescue materials. (3) First-aid rescue process: When a rescue task occurs, the commander-in-chief shall immediately activate the emergency plan, quickly acquire the cause of the accident and the situation of the injured, and release the treatment task to each group. The treatment team shall formulate the corresponding plan (indicating the required personnel and rescue materials) according to the cause of injury, the number of injured people, and the injury situation, and then report to the commander-in-chief. The members of the first-aid rescue team work in groups in a division of labor. Each group performs its own duties according to the plan, and deploys personnel and materials

in the shortest time. When a catastrophic group incident occurs and exceeds the treatment capacity of the hospital, the commander-in-chief shall report to the higher level of health authority, which will coordinate and organize the injured to be transferred to other medical treatment centers, or dispatch a supporting team from a nearby burn treatment center.

#### **4.2 The rescue team is the heart of first aid rescue**

Focusing on the needs of personnel and materials for treatment by the treatment team, the commander-in-chief coordinated the cooperation of other groups to maximize the use of hospital resources. When setting up a treatment team, medical staff should be deployed properly. In the rescue process, it is necessary to ensure the rescue for severe patients, but also not to ignore the treatment of mild patients, so as to achieve both the light and the heavy. The leader of the treatment team shall analyze the problem from the overall perspective, adhere to the principle of helping the wounded to receive better treatment, understand the injury at the first time, formulate a first-aid rescue plan (indicating the required personnel, equipment, medicines, etc.), and report to the commander-in-chief for the deployment.

#### **4.3 Emphasize the advance of technological power<sup>[4]</sup>**

Extend the technical strength of burn specialties to Emergency Department or even the scene of the accident, assess and classify the injuries, assist in the triage and first-aid rescue for the scene or the triage group, quickly and accurately report the accident situation to the commander-in-chief of the hospital, and lay the foundation for the preparation of human and material resources for the hospital. Fluid resuscitation shall also be carried out on the scene of critically ill patients, and patients with possible asphyxia shall be immediately given tracheostomy to ensure ventilation, and the evacuation method, time and precautions during transport shall be determined according to the severity of the injury.

#### **4.4 The multidisciplinary cooperation shall be emphasized**

The causes that lead to group injury accidents are different, resulting in various complications, such as combustion accidents prone to inhalation injury, explosive accidents prone to detonation injuries and brain trauma, collapse accidents prone to fractures, etc., therefore, it is necessary for relevant departments to enhance technical forces to assist in triage, so that the triage work is more scientific and reasonable, avoiding the occurrence of new triage errors. For severe compound injuries that require emergency treatment, immediate treatment measures shall be carried out.

#### 4.5 Triage and transport

If there are a large number of injured people, exceeding the treatment capacity of the burn department, secondary triage and transport are required. First of all, it is necessary to evaluate the injury for each injured person, judge the tolerance of the injured and choose the appropriate patient. According to the possible changes in the condition, there are sufficient medical personnel, medicines, instruments and equipment.<sup>[5]</sup> Choose the right transportation tool to evacuate quickly and efficiently, ensuring that patients are resuscitated and documented during evacuation. In patients with inhalation injuries or deep burns to the head and face, the prophylactic tracheostomy shall be performed to avoid asphyxia during transport. The results of this study show that the time from the rescue order issued by the commander-in-chief to the preparation of each group of personnel, the reception and triage, or the start of first-aid rescue is relatively short, which is comparable to the advanced level in China.<sup>[6]</sup> The curative ratio of patients is close to the national advanced level.<sup>[7]</sup>

#### 4.6 Strengthen the construction of regional group burn treatment network

The current emergency plan can still complete the treatment task of dealing with ordinary group burn incidents, but it is insufficient in the face of catastrophic group burn events.<sup>[8]</sup> Therefore, it is hoped that the government will increase investment and establish a feasible regional group burn treatment network based on the experience of group burn treatment<sup>[6]</sup> and the international group burn emergency plan.<sup>[7]</sup> It is not only necessary to select tertiary hospitals with the most advantages in burn treatment in various munic-

ipal administrative centers to establish comprehensive burn treatment centers, but also to strengthen the training and information sharing platform of burn first-aid knowledge for personnel in emergency response units to ensure that the injured can receive scientific, reasonable, rapid and efficient transfer treatment and information communication at the scene. It is necessary to establish triage centers in secondary hospitals with early treatment of burns and first-aid triage capabilities, in order to treat patients with mild burns. Through the construction of a multi-level burn treatment network, in the face of sudden group burn incidents, the resources of the entire region can be maximized to save patients' lives. In summary, through the implementation of the group burn emergency model, the establishment of a comprehensive organization, a reasonable first-aid rescue process, and the full use of the medical and logistical support resources of the entire hospital, burn patients can obtain scientific and reasonable pre-hospital emergency triage and treatment, and acquire good treatment results.

#### FUNDING

Health Research Project of Metallurgical Safety and Health Branch of The Chinese Society for Metals (JKWS201832); Natural Science Foundation of Inner Mongolia Autonomous Region (2020MS03022); Health Science and Technology Project of Inner Mongolia Autonomous Region (202201523); Joint Project of Inner Mongolia Medical University (YKD2021LH057).

#### CONFLICTS OF INTEREST DISCLOSURE

The authors declare they have no conflicts of interest.

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