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Research on the Application Value of 5G + Pre-hospital and In-hospital Integrated Fusion System in the Treatment of Severe Trauma Patients in Emergency Department

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Abstract: *Objective:* To explore the clinical application value of 5G + pre-hospital and in-hospital integrated fusion system in the treatment of severe trauma patients in the emergency department, and to provide a scientific basis for optimizing the trauma treatment process. *Methods:* Sixty severe trauma patients admitted to the emergency department of our hospital from January 2025 to December 2025 were selected as the research subjects. They were divided into the observation group and the control group by the random number table method, with 30 cases in each group. The control group adopted the traditional emergency treatment mode, while the observation group adopted the 5G + pre-hospital and in-hospital integrated fusion system treatment mode. The treatment time indicators, treatment effect indicators, and complication occurrence rate of the two groups were compared. *Results:* The pre-hospital response time, pre-hospital emergency time, emergency room stay time, preoperative preparation time, and total treatment time of the observation group were significantly shorter than those of the control group ($P < 0.05$); the rescue success rate of the observation group was significantly higher than that of the control group, the improvement value of ISS score and APACHE II score was significantly greater than that of the control group, and the hospitalization time was significantly shorter than that of the control group ($P < 0.05$); the total complication occurrence rate of the observation group was significantly lower than that of the control group ($P < 0.05$). *Conclusion:* The 5G + pre-hospital and in-hospital integrated fusion system can significantly shorten the treatment time of severe trauma patients, enhance the treatment effect, and reduce the complication rate. It has important clinical application value, which is worthy of promotion and application in all levels of hospitals.

Keywords: 5G technology; Pre-hospital and in-hospital integration; Severe trauma; Emergency treatment; Application value

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1. Introduction

Severe trauma is one of the acute and critical conditions in the emergency department. It has complex clinical manifestations, rapid changes, and a high mortality rate. Approximately 30% of deaths occur within the “golden time” of 6–8 hours after injury. The traditional emergency treatment mode is characterized by the disconnection of pre-hospital and in-hospital information, discontinuous treatment processes, and insufficient multidisciplinary collaboration, which prolongs the patient’s treatment time and affects prognosis [1]. In recent years, with the rapid development of 5G technology, its

high speed, low latency, and large connection characteristics have brought revolutionary changes to the medical field. The 5G + pre-hospital and in-hospital integrated fusion system combines 5G communication technology with emergency medical care to achieve real-time transmission of patients' vital sign data and video images, seamless connection between pre-hospital and in-hospital, and the possibility of entering the hospital upon boarding. This study aims to explore the application value of 5G + pre-hospital and in-hospital integrated fusion system in the treatment of severe trauma patients in the emergency department, providing a practical basis for improving trauma treatment levels.

2. Materials and methods

2.1. General information

This study selected 60 severe trauma patients admitted to the emergency department of our hospital from January 2025 to December 2025 as the analysis subjects. Inclusion criteria: (1) Age ranging from 18 to 70 years old; (2) Injury severity score (ISS) reaching or exceeding 16 points; (3) Admission within 2 hours after injury; (4) Complete clinical medical records. Exclusion criteria: (1) Complicated with severe chronic diseases such as heart, liver, and kidney; (2) Injury caused by burns or electric shock; (3) Pregnant or lactating women; (4) Incomplete clinical data records. All 60 patients were equally divided into two groups, namely the observation group and the control group, with 30 cases in each group. In the observation group, there were 18 males and 12 females, with an age range of 22 to 68 years old, and the average age was 42.35 ± 10.26 years old; in the control group, there were 17 males and 13 females, with an age range of 20 to 69 years old, and the average age was 41.87 ± 11.03 years old. The comparison of basic data between the two groups ($P > 0.05$) indicated that the two groups had good balance and comparability.

2.2. Methods

2.2.1. Control group

Traditional emergency treatment model: Patients call the 120 emergency hotline, and the emergency vehicle arrives at the scene for initial treatment, establishing an intravenous channel, oxygen supply, hemostasis, bandaging, etc., and then transports the patient to the hospital. After the patient arrives at the hospital, emergency doctors conduct an assessment, issue a checklist, complete the examination, and make a clear diagnosis. Then, they request a consultation from relevant departments and arrange for surgery or admission to the ICU for treatment.

2.2.2. Observation group

5G + integrated pre-hospital and in-hospital fusion system treatment model: It mainly consists of 5G emergency vehicles, remote consultation platforms, in-hospital emergency information systems, and multidisciplinary consultation (MDT) teams. The specific treatment process is as follows:

(1) Pre-hospital emergency stage: After receiving the dispatch order, the emergency vehicle immediately establishes a connection with the in-hospital emergency information system via 5G network. Upon arrival at the scene, emergency personnel use portable vital sign monitors, high-definition cameras, portable ultrasound, electrocardiogram machines, etc., to collect real-time data on patients' vital signs (heart rate, blood pressure, blood oxygen saturation, respiratory rate, etc.) and video images, and transmit them via 5G network to the in-hospital remote consultation platform. In-hospital emergency doctors and the MDT team view the patient's condition through the platform in real time, remotely guiding the emergency personnel to perform on-site treatment, such as airway management, fluid resuscitation, thoracic closed drainage, etc. At the same time, the system automatically generates the patient's electronic medical record, entering the patient's basic information and condition data in advance.

(2) Transport stage: During the transportation process, real-time transmission of patients' vital sign data and video images continues. The in-hospital MDT team, based on the patient's condition changes, formulates personalized treatment plans, such as surgical plans, blood transfusion plans, etc. At the same time, the in-hospital prepares various items

in advance, such as the operating room, blood preparation, and examination equipment preparation. For patients requiring emergency surgery, they bypass the emergency department and are directly sent to the hospital and immediately enter the operating room for surgery.

(3) In-hospital treatment stage: After the patient arrives at the hospital, based on the pre-established treatment plan, immediate definitive treatment is carried out. The MDT team is fully involved in the treatment, with seamless coordination among various departments. All examination results and treatment records of the patient are updated in real time to the electronic medical record system, achieving information sharing.

2.3. Observation indicators

2.3.1. Treatment time indicators

Record and compare the following five time indicators of the two groups of patients: (1) Pre-hospital response time: The duration from answering the emergency call to the arrival of the emergency vehicle at the scene; (2) Pre-hospital emergency time: The duration from the arrival of the emergency vehicle at the scene to the patient being removed from the scene; (3) Emergency room stay time: The duration from the patient's arrival at the hospital to leaving the emergency room; (4) Pre-operative preparation time: The duration from the patient's arrival at the hospital to the start of surgery; (5) Total treatment time: The duration from answering the emergency call to the start of definitive treatment (surgery/ICU intervention).

2.3.2. Treatment effect indicators

Compare the rescue success rate, improvement value of ISS score, improvement value of APACHE II score, and hospital stay of the two groups of patients.

Improvement value calculation: The ISS score and APACHE II score are evaluated immediately upon admission and after 7 days of treatment, respectively. The improvement value is calculated using the formula: Admission score minus score after 7 days of treatment.

The determination criteria for successful rescue: The patient's vital signs stabilize after active treatment and can be transferred out of the intensive care unit (ICU) or reach the discharge criteria.

2.3.3. Complication incidence rate

Compare the incidence rate of various complications in the two groups of patients during treatment.

3. Results

3.1. Comparison of treatment time indicators of the two groups of patients

The pre-hospital response time, pre-hospital emergency time, emergency room stay time, preoperative preparation time, and total treatment time of the patients in the observation group were significantly shorter than those in the control group ($P < 0.05$). See **Table 1**.

Table 1. Comparison of treatment time indicators between the two groups (mean ± SD, min)

Group / Statistical value	Pre-hospital response time	Pre-hospital emergency response time	Emergency room stay time	Preoperative preparation time	Total treatment time
Observation group (n = 30)	5.26 ± 1.12	12.58 ± 2.34	15.32 ± 3.26	28.64 ± 5.32	61.80 ± 8.56
Control group (n = 30)	8.74 ± 1.58	18.62 ± 3.15	32.45 ± 5.78	52.37 ± 8.65	112.18 ± 12.34
t-value	9.842	8.431	14.139	12.799	18.374
P-value	0.000	0.000	0.000	0.000	0.000

3.2. Comparison of treatment effect indicators between the two groups

The rescue success rate of patients in the observation group was significantly higher than that of the control group. The improvement values of ISS score and APACHEII score were significantly greater than those of the control group, and the hospitalization time was significantly shorter than that of the control group ($P < 0.05$). See **Table 2**.

Table 2. Comparison of treatment effect indicators between the two groups

Group / Statistical value	Success rate of rescue (%)	Improvement value of ISS score	Improvement in APACHE II score	Hospitalization duration (days)
Observation group ($n = 30$)	28 (93.33)	10.26 ± 2.34	8.54 ± 1.96	14.26 ± 3.58
Control group ($n = 30$)	22 (73.33)	6.58 ± 1.87	5.23 ± 1.54	21.54 ± 4.72
t/χ^2 value	4.320	6.729	7.273	6.731
P-value	0.038	0.000	0.000	0.000

3.3. Comparison of complication rates between the two groups

The total complication rate of patients in the observation group was significantly lower than that in the control group ($P < 0.05$). See **Table 3**.

Table 3. Comparison of complication rates between the two groups (%)

Group / Statistical value	Infection	Fat embolism syndrome	Stress ulcer	Coagulation dysfunction	Organ dysfunction	Overall incidence rate
Observation group ($n = 30$)	2 (6.67)	0 (0.00)	1 (3.33)	1 (3.33)	0 (0.00)	4 (13.33)
Control group ($n = 30$)	6 (20.00)	2 (6.67)	4 (13.33)	3 (10.00)	2 (6.67)	17 (56.67)
χ^2 value	-	-	-	-	-	10.912
P-value	-	-	-	-	-	0.001

4. Discussion

Severe trauma is one of the major public health problems currently faced by the world, with high mortality and disability rates. There are three peaks in trauma deaths, the first peak occurs within minutes to one hour after injury, accounting for 45–50% of severe trauma deaths, mostly caused by severe brain injuries, heart or major blood vessel ruptures, etc.; the second peak occurs within 6–8 hours after injury, which is the "golden time" for trauma rescue, accounting for 30% of trauma deaths, mostly caused by ruptures of brain, chest, abdominal blood vessels or solid organs and severe hemorrhagic shock; the third peak occurs several days or weeks after injury, accounting for 20% of trauma deaths, mostly caused by severe infections and multiple organ failure [2]. The traditional emergency treatment model adopts "segmented" management, with pre-hospital emergency care and in-hospital treatment relatively independent, and information is mainly transmitted orally or in writing, with information lagging and inaccuracy, patients need to be re-evaluated and examined upon arrival at the hospital, prolonging the treatment time, and the multidisciplinary collaboration is not timely, there is a lack of effective communication and coordination among departments, affecting the treatment effect. How to shorten the treatment time for patients with severe trauma and improve the treatment success rate is a challenge in the field of emergency medicine.

The 5G + pre-hospital and in-hospital integrated fusion system mainly consists of 5G emergency vehicles, remote consultation platforms, in-hospital emergency information systems, and MDT teams. The 5G emergency vehicle is equipped with portable vital sign monitors, high-definition cameras, portable ultrasound, electrocardiogram machines, etc., which collect real-time information such as patients' physiological parameters and video images, and transmit it via

5G network to the in-hospital remote consultation platform. In-hospital emergency doctors and MDT teams can view the patient's condition in real time, remotely guide the pre-hospital emergency personnel to conduct on-site treatment, and formulate individualized treatment plans in advance, preparing for treatment. Patients are immediately subjected to definitive treatment upon arrival at the hospital, achieving the goal of "entry into the hospital upon boarding" [3,4].

The results of this study show that the pre-hospital response time, pre-hospital emergency time, emergency room stay time, preoperative preparation time, and total treatment time of the observation group were significantly shorter than those of the control group ($P < 0.05$). The reason is that the 5G + pre-hospital and in-hospital integrated fusion system realizes information sharing between pre-hospital and in-hospital, in-hospital doctors can understand the patient's condition in advance and make various preparations; at the same time, the application of the remote consultation platform enables in-hospital experts to provide real-time guidance to pre-hospital emergency personnel for treating patients, improving the quality and efficiency of pre-hospital emergency care. Moreover, for patients requiring emergency surgery, they are directly bypassed from the emergency department and directly enter the operating room upon arrival at the hospital, significantly shortening the preoperative preparation time [5].

In terms of treatment effect, the rescue success rate of patients in the observation group was significantly higher than that of the control group, the improvement values of ISS score and APACHE II score were significantly greater than those of the control group, and the hospital stay time was significantly shorter ($P < 0.05$), indicating that the 5G + pre-hospital and in-hospital integrated fusion system can significantly improve the treatment effect of patients with severe trauma. ISS score and APACHE II score are important indicators for measuring the severity and prognosis of trauma patients, and the improvement values of patients in the observation group were significantly greater than those of the control group, indicating that this system can effectively improve the patient's condition and promote their recovery [6].

In terms of complication rates, the total complication rate of patients in the observation group was significantly lower than that of the control group ($P < 0.05$). Severe trauma patients have severe conditions and large traumas, and are prone to various complications, such as infection, fat embolism syndrome, stress ulcers, etc., which can prolong the hospital stay and increase the mortality rate. The treatment time of the 5G + pre-hospital and in-hospital integrated fusion system is shortened, the treatment quality is improved, which can effectively prevent and reduce the occurrence of complications, providing a guarantee for the patient's recovery. This study also has some limitations, such as a limited sample size and a single-center study. The representativeness of the research results needs to be further improved. In the future, multi-center and large-sample clinical studies are needed to further confirm the clinical application value of the 5G + pre-hospital and in-hospital integrated fusion system. It is also necessary to further optimize the system functions, enhance the system stability and security, and provide more powerful technical support for trauma treatment.

5. Conclusion

In summary, the 5G + pre-hospital and in-hospital integrated fusion system can significantly shorten the treatment time for severely injured patients, enhance the treatment effect, and reduce the incidence of complications. It has important clinical application value. The system combines 5G technology with emergency medical services, achieving seamless connection between pre-hospital and in-hospital and efficient collaboration among multiple disciplines, providing faster, more efficient, and higher-quality medical services for severely injured patients.

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Disclosure statement

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