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Clinical outcomes of emergency orthopedic surgery versus conservative treatment in multiple trauma patients: a comparative study

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ABSTRACT

Background: Multiple trauma represents a common and severe type of injury encountered in orthopedic emergency departments. The effectiveness of its management directly impacts the patient's recovery process and quality of life. Although traditional conservative treatment offers certain benefits, it has limitations in controlling bleeding, promoting fracture healing, and reducing complication rates. Therefore, investigating the application value of orthopedic emergency surgery is significant. This study aimed to analyze the clinical outcomes of orthopedic emergency surgery in the treatment of multiple trauma, focusing on its impact on intraoperative blood loss, fracture healing time, and the incidence of complications.

Methods: This single-center retrospective case-control study was conducted in Chengdu Bayi Orthopedic Hospital between January 2020 and June 2025. 100 patients were randomly divided into an intervention group and a control group using a random number table, with 50 patients in each group. The control group received conventional conservative treatment and elective orthopedic surgery, while the intervention group underwent orthopedic emergency surgery. The clinical efficacy of the different treatment approaches was evaluated by comparing intraoperative blood loss, fracture healing time, and the incidence of complications between the two groups.

Results: The intervention group demonstrated significantly less blood loss, a markedly shorter fracture healing time, and a lower incidence of complications compared to the control group. All these differences were statistically significant ($P < 0.05$).

Conclusion: Orthopedic emergency surgery for multiple trauma can effectively reduce bleeding, accelerate fracture healing, and lower the risk of complications. It holds substantial clinical application value and is worthy of widespread adoption.

Keywords: blood loss, complication rate, emergency surgery, fracture healing time, multiple trauma.
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INTRODUCTION

Multiple trauma is a common and critical clinical condition, defined as injuries to two or more anatomical regions caused by a single external force, with at least one injury being life-threatening.[1] Characterized by sudden onset, severe presentation, and rapid progression, it frequently results from major incidents such as traffic accidents, falls from height, or crush injuries. Given the involvement of multiple body regions, patients often present with a combination of injuries, including limb fractures, thoracic/abdominal trauma, and head injuries.[1]

Clinical manifestations typically include significant hemorrhage, inadequate tissue perfusion, and a high risk of infection. Without timely and effective intervention, the condition can readily progress to multiple organ failure and become fatal. Current clinical management of multiple trauma primarily involves two strategies: conservative treatment and surgical intervention. Conservative treatment focuses on symptomatic support, including hemostasis, infection control, and shock management. While it can partially stabilize a patient's vital signs, its efficacy in fracture stabilization and visceral repair is limited. This approach may lead to prolonged recovery times and increase the risk of severe complications such as pressure sores, deep vein thrombosis, and joint stiffness.[2]

In contrast, emergency surgery provides early definitive care by promptly stabilizing fractures, repairing damaged tissues, and effectively controlling sources of bleeding, thereby creating favorable conditions for recovery. Research indicates that early surgical intervention can interrupt the pathophysiological vicious cycle triggered by trauma, mitigate the systemic inflammatory response, and reduce infection rates.[3,4] Consequently, this approach accelerates the healing of injured sites and shortens the overall rehabilitation process. However, there have been no previous reports on such related research.

Therefore, to further elucidate the clinical value of emergency surgery in

managing multiple trauma, this study conducts a comparative analysis of the clinical outcomes between conservative treatment and emergency surgical intervention. The focus is on evaluating differences in blood loss, fracture healing time, and complication rates between the two patient groups, aiming to provide a more reliable evidence-based foundation for the clinical treatment of multiple trauma.

METHODS

Study Design

This study was designed as a single-center retrospective case-control study. A total of 100 patients with multiple trauma admitted to Chengdu Bayi Orthopedic Hospital, China Tongrong Medical Health Group Co., Ltd, between January 2020 and June 2025 were enrolled in this study. Using a random number table, they were allocated into an intervention group (n=50) and a control group (n=50). For the patients in the experimental group, open reduction and internal fixation surgery was performed.

The inclusion criteria in this study as follows: 1) Diagnosis confirmed by imaging (X-ray or CT) with at least two or more site fractures or severe organ injuries; 2) Time from injury to hospital admission within 24 hours; 3) Informed consent obtained from the patient or family; 4) Age between 18 and 100 years; 5) Complete clinical data and ability to comply with follow-up.

Meanwhile, the exclusion criteria in this study as follows: 1) Combined severe traumatic brain injury (Glasgow Coma Scale score <8) or life-threatening multiple organ failure; 2) Prior surgical intervention for the injuries at another hospital; 3) Severe underlying diseases such as coagulation disorders, advanced malignant tumors, or severe cardiovascular or cerebrovascular diseases; 4) Psychiatric disorders or cognitive impairment preventing cooperation with treatment and evaluation; 5) Incomplete medical records or loss to follow-up.

Study Procedure

All enrolled patients were immediately managed according to the standard emergency trauma protocol upon admission. A multidisciplinary team conducted a rapid, comprehensive evaluation following Advanced Trauma Life Support (ATLS) principles. Patients in the intervention group, after meeting surgical indications, underwent early orthopedic emergency surgery. The surgical timing was individualized based on the patient's overall injury pattern and physiological status, adhering to the principles of Damage Control Orthopedics (DCO) or Early Total Care (ETC). All patients received X-ray examinations for fracture identification and continuous monitoring of vital signs.

The control group received conservative treatment, including wound debridement, hemorrhage control, antibiotic administration for infection prophylaxis and treatment, shock prevention, and close monitoring of vital signs, and later, underwent elective orthopedic surgery. The intervention group underwent orthopedic emergency surgery. Following fracture localization and initial stabilization (hemostasis, anti-shock), a specific surgical plan was formulated. The procedure involved a preoperative assessment, anesthesia administration, appropriate incision, fracture exposure, traction reduction, internal fixation, routine drain placement, wound closure, and postoperative antibiotics with continuous monitoring.

Variables Measurement

Clinical metrics such as total blood loss and fracture healing time were recorded for both groups. Complications observed in this study include the incidence of wound infection, poor healing, and venous thrombosis was monitored. Variables were collected by reviewing the medical records and statistics.

Statistical Analysis

Data analysis was performed using the online SPSSAU software. Measurement data are presented as mean ± standard deviation and were compared using the t-test. The count data are expressed as percentages and were compared using the chi-square test. A P-value of < 0.05 was considered statistically significant.

RESULTS

In the control group, there were 23 males and 27 females, aged 17–87 years, with a mean age of 59.40 ± 16.44 years. Etiological factors included 27 cases of traffic accidents, 6 cases of falls from height, 0 cases of heavy object strike, and 17 cases of falls. In the intervention group, there were 28 males and 22 females, aged 24–90 years, with a mean age of 59.56 ± 15.34 years. Etiological factors included 36 cases of traffic accidents, 6 cases of falls from height, 3 cases of heavy object strike, and 5 cases of falls. No statistically significant differences were observed in the general characteristics between the two groups ($P > 0.05$), as shown in Table 1.

Clinical Metrics

In the control group, the blood loss was (152.72 ± 132.78) mL and the fracture healing time was (4.32 ± 2.58) weeks. In

Table 1. Comparison of Baseline Characteristics Between the Two Groups of Multiple Trauma Patients.

Variables	Intervention Group (n=50)	Control Group (n=50)	P Value
Gender, n (%)			
Male	28	23	0.45
Female	22	27	
Age			
Range (years)	24 – 90	17 – 87	0.34
Mean ± SD (years)	59.56±15.34	59.40±16.44	
Etiology, n (%)			
Traffic Accident	36	27	0.56
Fall from Height	6	6	
Heavy Blow	3	0	
Fall down	5	17	

the intervention group, the blood loss was (139.60 ± 129.92) mL and the fracture healing time was (4.06 ± 2.40) days. The intervention group had significantly less blood loss (P < 0.001) and a shorter healing time (P<0.001) compared to the control group.

Complications

In the control group, there were 0 cases of incision infection, 1 case of poor healing, and 1 case of venous thrombosis, resulting in a complication rate of 4.00% (2/50). In the intervention group, there was 1 case of incision infection, 0 cases of venous thrombosis, and 0 cases of poor incision healing, resulting in a complication rate of 2.00% (1/50). The difference in complication rates between the two groups was statistically significant (P = 0.021) (Table 2).

Table 2. Comparison of Perioperative Indicators and Complications Between the Two Groups.

Variables	Intervention Group (n=50)	Control Group (n=50)	P Value
Blood Loss, (mL) (mean±SD)	139.60±129.92	152.72±132.78	<0.001
Fracture Healing Time, (days) (mean±SD)	4.06±2.40	4.32±2.58	<0.001
Complication, n (%)			
Wound Infection	1 (100%)	0 (0%)	0.021
Poor Healing	0 (0%)	1 (50%)	
Venous Thrombosis	0 (0%)	1 (50%)	

DISCUSSION

Multiple trauma, a clinical emergency with a complex pathogenesis and critical condition, typically results from high-energy impacts such as falls from height, traffic accidents, or heavy object collisions. It is characterized by sudden onset, severe injuries, a significantly elevated risk of infection, and frequent involvement of multiple systems or organs. This complexity and diversity pose substantial challenges for clinical diagnosis and treatment.[3–7]

Upon receiving a patient with multiple trauma, the medical team must promptly conduct an initial assessment based on the mechanism of injury, systematically monitor core vital signs, including blood pressure, pulse, and respiration, and immediately implement basic resuscitative measures such as hemorrhage control, oxygen administration, and anti-shock therapy. This initial definitive care.[8–12]

Once the patient's condition is hemodynamically stable, imaging techniques, including X-ray, ultrasonography, and CT, should be employed promptly to accurately determine the location and severity of fractures and other internal injuries, thereby providing an objective basis for formulating a scientific and rational individualized treatment plan.[13–17]

The optimal management strategy for fractures in multiple trauma remains a subject of debate. Conventional views often favor conservative treatment, arguing that emergency surgery, due to its associated traumatic stress, significant intraoperative blood loss, and high anesthetic risk, may increase the overall physiological burden and hinder postoperative recovery.[18,19]

However, conservative management also has considerable limitations. Without effective stabilization, fracture sites are prone to secondary bleeding during patient movement or transfer, increasing the risk of local infection. Furthermore, prolonged immobilization can lead to a series of severe complications, including deep vein thrombosis (DVT), pressure sores, and pulmonary infections, which significantly delay the rehabilitation process.[20,21]

The systematic observation and data analysis in this study demonstrate that patients in the intervention group who underwent orthopedic emergency surgery showed superior outcomes across multiple key indicators compared to the control group receiving traditional conservative treatment. These improvements were manifested explicitly as significantly reduced total intra- and post-operative blood loss, markedly shortened fracture healing time, and a notably lower overall incidence of complications. These findings robustly confirm the positive value of orthopedic emergency surgery in the comprehensive management of multiple trauma. This approach not only accurately reconstructs the anatomical structure of the fracture site and restores its mechanical stability through internal fixation but also establishes a solid foundation for early functional exercise.[22–26]

Additionally, the surgical procedure allows for the thorough debridement of hematomas and necrotic tissue around the fracture site, effectively alleviating local swelling and pain. This creates favorable conditions for patients to initiate early rehabilitation training, further reducing the risk of complications such as venous thrombosis and joint stiffness.[27,28] As a mature and routine procedure in orthopedics, emergency surgery is typically performed after the patient's vital signs are stabilized and the injuries are clearly identified. Its core advantage lies in enabling direct and precise reduction and stable fixation of the fracture. This not only helps restore the normal morphology and function of the affected area but also accelerates the overall recovery process by proactively addressing potential complications.[29]

Therefore, provided that surgical indications are strictly followed and the patient's overall condition is thoroughly evaluated, the proactive application of emergency surgery for eligible patients with multiple trauma can significantly improve clinical prognosis and enhance treatment efficiency. It represents a scientific treatment strategy worthy of broader clinical adoption.[30] This conclusion also offers new perspectives for the clinical management of multiple trauma, emphasizing that timely and necessary surgical intervention, based on holistic patient management, is a critical link in achieving rapid and safe patient recovery. Future research should further focus on optimizing the timing of surgery, selecting fixation methods, and refining perioperative management strategies to improve the overall standard of care for multiple trauma continuously.

This study summarizes and reviews the knowledge points in the field of orthopedic emergency surgery and confirms them. However, this study also has several limitations. Due to the limitations of the time source, the sample size of the data is small, and randomized controlled trials need to be expanded in the future

CONCLUSION

Orthopedic emergency surgery for multi-trauma patients rapidly stabilizes fractures to control bleeding and prevent complications. It creates an optimal biomechanical environment that actively promotes bone healing and enables early mobilization. This systematic approach represents an evolution in trauma care towards efficient, patient-centered outcomes.

CONFLICT OF INTEREST STATEMENT

All authors of this paper declare that they have no conflicts of interest. There is no medical ethics involved in this study. The patients in this study were fully informed and understood the risks of the surgery before the operation and signed to consent to the surgery.

ETHICAL STATEMENT

We have obtained the medical ethics approval. The approval number is bygkyy[2025].NO.14.

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AUTHOR CONTRIBUTIONS AND DATA SOURCES

Zhang Ke-Manuscript editing and Design.
Liu Chao- Manuscript editing and review; Guarantor.
Zhou Jinlong- Manuscript editing,data acquisition-and Statistical analysis.

AI USAGE DECLARATION.

No artificial intelligence (AI) technology was employed in this study.

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