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Efficacy of Open Reduction and Internal Fixation Versus Conservative Treatment for Rib Fractures

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Abstract: *Objective:* To investigate the efficacy of open reduction and internal fixation versus conservative treatment for rib fractures. *Methods:* The study period was from June 2022 to June 2023, during which 70 patients with rib fractures were grouped by randomized numerical table method, with 30 cases in the observation group and 40 cases in the control group. The observation group implemented open reduction internal fixation treatment and the control group adopted conservative treatment. After treatment, the results of each index in the two groups were compared. *Results:* Treatment-related indexes, lung function indexes, and treatment effects between the two groups were compared ($P < 0.05$). The Visual Analogue Scale (VAS) score and complication rate of the observation group after treatment were lower than those of the control group ($P < 0.05$). *Conclusion:* In the comparison of the efficacy of open reduction internal fixation and conservative treatment for rib fractures, the former exerts a more significant effect and can improve the lung function of the patients, which is worthy of research and promotion.

Keywords: Rib fracture; Open reduction internal fixation; Conservative treatment; Efficacy

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1. Introduction

Rib fractures are common thoracic injuries with various causes, including falls from height, falls, traffic accidents, or direct impact of external forces on the chest. Severe thoracic injury is often accompanied by multiple rib fractures, which can affect respiratory function and easily lead to fluttering of the mediastinum, abnormal respiration, and pose a threat to the patient's life and safety [1]. Therefore, prompt and effective treatment is essential, but conservative treatment has a longer healing time that is unfavorable to the patient's prognosis [2]. The purpose of this paper is to investigate the efficacy of open reduction internal fixation for rib fractures compared to conservative treatment.

2. General information and methods

2.1. General information

Patients with rib fractures admitted in the period from June 2022 to June 2023 were selected and divided into

two groups, with 30 cases in the observation group and 40 cases in the control group. In the observation group, there were 18 male and 12 female patients, ranging from 21 to 72 years old, with an average age of 46.52 ± 2.71 years. Their causes of injuries included 12 cases of fall from height, 10 cases of car accident injuries, 2 cases of crush injuries, 2 cases of fall injuries, and 4 cases of blunt injuries. The types of fractures were 16 cases of single fracture and 14 cases of multiple fractures. The complications were 10 cases of spinal injuries, 12 cases of limb fractures, 5 cases of brain injuries, and 3 cases of abdominal distension and organ injury. In the control group, there were 20 male and 20 female patients, ranging from 22 to 72 years old, with an average age of 46.96 ± 2.09 years. Their causes of injuries were 20 cases of fall from height, 15 cases of car accident injuries, 2 cases of crush injuries, 2 cases of fall injuries, and 1 case of blunt injuries. The types of fracture included 20 cases of single fracture and 20 cases of multiple fractures. The complications were 15 cases of spinal injuries, 15 cases of limb fractures, 5 cases of brain injuries, and 5 cases of abdominal distension and organ injury. The general information of the two groups was not statistically significant ($P > 0.05$).

The criteria for inclusion in this study were patients meeting the diagnostic criteria for rib fracture [3], patients with an AIS-ISS (Abbreviated Injury Scale-Injury Severity Score) score of 9 to 20, and the patients and their families signing an informed consent form, and the study being approved by the Medical Ethics Committee.

The existence of serious chronic diseases, the presence of communication barriers, and a combination of other severe fractures were taken as the criteria for exclusion from this study.

2.2. Methods

Conservative treatment was chosen as the treatment mode for the control group, with the following specific contents: instructing patients to ensure bed rest and encouraging patients to cough up sputum on their own in order to prevent the occurrence of lung infection and sputum accumulation. Based on the degree of inflammation and lung damage of the patients, expectorant and antibiotic medication was given to the patients. For the patients who had pleural effusion, closed drainage of thoracic cavity was required, and the patients' conditions were reviewed once a week. If the patients had hypoxemia and respiratory insufficiency, non-invasive mechanical ventilation was required. For those with pleural effusion, closed pleural drainage was needed, and the patients were reviewed once a week to observe the changes in their conditions.

As for the observation group, open reduction internal fixation treatment was adopted: general anesthesia with single-lumen tracheal intubation was performed, and double-lumen tracheal intubation was given to those who have serious lung injury, increased airway secretion, and aggravated lung infection. First of all, the fracture site of the patient was cleared and a curved incision was made at the fracture site; if the fracture was located in the lateral wall of the patient's chest, a longitudinal incision was made. The patient was instructed to stay in the supine position. The fractured end of the patient's ribs was fully exposed, an appropriate size of the rib bone plate was selected and its angle was adjusted with a special instrument to match the fractured end of the ribs, and then a special instrument was used to clamp and fix the rib bone plate.

2.3. Observation indexes

The treatment-related indexes, complications, Visual Analogue Scale (VAS) scores before and after treatment, lung function indexes, and treatment effects of the two groups were compared.

The visual analogue scoring method was used to assess the pain intensity of patients, using a straightedge as an assessment tool, with a scale of 0 to 10, of which 0 = no pain, and 10 = the most severe pain. Patients were instructed to mark the corresponding numbers according to their feelings of pain.

The efficacy of treatment was also measured [4]. After the treatment, the patient's pain disappeared and the

fractured part recovered intact, indicating that the treatment was very effective; while the patient's pain was significantly reduced after the treatment and the fractured part recovered, which was regarded as effective; the patient's pain still existed after the treatment and the fracture had not healed, which was regarded as ineffective. Total effective rate included very effective rate plus effective rate.

2.4. Statistical analysis

The statistical software used in this study was SPSS25.00, and the measurement data were expressed in the form of mean ± standard deviation (SD) and tested by *t*-test, and the count data were expressed in the form of % and tested by χ^2, and for the data with $P < 0.05$, the difference was statistically significant.

3. Result

3.1. Comparison of treatment-related indexes between the two groups

The treatment-related indexes of the two groups were statistically significant ($P < 0.05$), as shown in **Table 1**.

Table 1. Comparison of treatment-related indexes

Group	Cases (n)	Duration of hospitalization (days)	Fracture healing time (weeks)	Time out of bed for functional exercise (days)
Observation group	30	15.22 ± 1.52	10.78 ± 2.41	4.22 ± 1.12
Control group	40	25.85 ± 1.79	13.96 ± 2.71	7.88 ± 1.78
t	-	26.195	5.091	9.881
P	-	0.000	0.000	0.000

3.2. Comparison of complications between the two groups

Compared with the control group, the complication rate of the observation group was lower ($P < 0.05$), as presented in **Table 2**.

Table 2. Comparison of complication rates in the two groups (n, %)

Group	Cases (n)	Lung infection	Thoracic deformity	Pulmonary hypotension	Total
Observation group	30	0	1	0	3.33
Control group	40	2	8	1	27.50
χ^2	-	-	-	-	7.049
P	-	-	-	-	0.008

3.3. Comparison of VAS scores before and after treatment

Based on **Table 3**, the VAS scores of the observation group were lower than those of the control group in 1 day, 7 days, and 14 days after treatment ($P < 0.05$).

Table 3. Comparison of VAS scores before and after treatment (points)

Group	Cases (n)	Before treatment	1 day after treatment	7 days after treatment	14 days after treatment
Observation group	30	8.22 ± 2.41	6.22 ± 1.41	4.22 ± 1.41	3.02 ± 0.41
Control group	40	8.23 ± 2.45	7.52 ± 1.97	5.88 ± 1.69	4.22 ± 1.79
t	-	0.017	3.070	4.359	3.596
P	-	0.987	0.003	0.000	0.001

3.4. Comparison of lung function indexes between the two groups

According to **Table 4**, the lung function indexes of the observation group, including the forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), and maximum voluntary ventilation (MVV) were better than those of the control group ($P < 0.05$).

Table 4. Comparison of lung function indexes (%)

Group	Cases (n)	FVC	FEV1	MVV
Observation group	30	92.52 ± 2.74	103.96 ± 5.11	88.82 ± 2.45
Control group	40	86.33 ± 2.01	94.25 ± 2.76	79.32 ± 2.01
t	-	10.910	10.210	17.811
P	-	0.000	0.000	0.000

3.5. Comparison of the treatment effects of the two groups

The treatment effect of the observation group was better compared with the control group ($P < 0.05$), as shown in **Table 5**.

Table 5. Comparison of the treatment effects of the two groups (n, %)

Group	Cases (n)	Very effective	Effective	Ineffective	Total effective rate
Observation group	30	19	10	1	96.67
Control group	40	20	5	15	62.50
χ^2	-	-	-	-	11.349
P	-	-	-	-	0.001

4. Discussion

In thoracic trauma, rib fracture is a common injury that causes patients to experience severe pain, accompanied by coughing, dyspnea, movement difficulty, and other adverse conditions. Mediastinal swing can also occur in patients with serious symptoms, not only on the patient's effective ventilation to a certain extent but also on the body's blood reflux, resulting in a series of pathophysiological performance, such as reduced blood pressure, shortness of breath, hypoxemia, etc., thus it is crucial to provide effective treatment at an early stage [5]. Pressure bandage fixation is the chosen traditional treatment, but this method is likely to result in increased compression of the lungs and thorax by external forces, thus causing thoracic deformity, and may also cause different degrees of impact on pulmonary function; while traction requires patients to remain bedridden for an extended period, which is ineffective for the stabilization of the thorax. In the traditional surgery, commonly selected internal fixation materials are Kirschner's needle, silk thread, and so on, but these materials are prone to issues such as instability, easy detachment, and looseness, limiting their overall effectiveness and application. With the continuous development of internal fixation technology, open reduction internal fixation has remarkable efficacy and firm fixation, which can ensure that the patient's thoracic shape is well restored. This is a relatively simple operation that can make up for the shortcomings of external fixation and promote the improvement of the patient's respiratory function [6,7].

In this study, the treatment indexes of the observation group were better compared with the control group, indicating that the open reduction internal fixation treatment is more conducive to shortening hospitalization time and time to get out of bed, so as to restore various functions at an early stage compared with the traditional

treatment. This may be because internal fixation surgery can provide a good fixation of the patient's chest, avoid causing damage to the fracture end of the patient's lung tissue, and produce a better repairing effect of the damaged lung tissue [8]. Comparing between the two groups, the observation group had a lower incidence rate of complications, thus indicating that internal fixation surgery is safer compared with conservative treatment. The reason for this is that this procedure can effectively remove the pneumoperitoneum and blood in the chest cavity of the patient, restore the patient's thoracic volume, facilitate the discharge of sputum to reduce the risk of lung infection, prevent the occurrence of thoracic deformities and other complications, and accelerate the process of recovery of the patient's lung function. The indications for this surgery include: obvious fracture malposition; thoracic deformity caused by fracture, the intercostal nerve is compressed by the fracture, which causes intractable chest pain; other injuries in the thoracic cavity; the conditions of mechanical respiration are not met and accompanied by severe respiratory distress; accompanied by the collapse of the chest wall, and the presence of paradoxical respiration. In these cases, surgical treatment is preferred. Research shows that the human lung function mainly depends on the stability of the patient's lung tissue function and the integrity of the thoracic structure. In this study, various lung function indexes in the observation group were better than those of the control group, which shows that the internal fixation surgery can play a corrective role for the patient's damaged thorax and repair the diseased lung tissues, so as to avoid the impact of the fracture on the patient's lung function and enable recovery of the normal pulmonary function as soon as possible.

In an article by Yang *et al.* [9], patients with severe thoracic trauma were taken as the research object and grouped into the observation group and the control group by the randomized numerical table method with 62 cases each. The former group was treated by open reduction internal fixation and the latter group was treated by conservative treatment. In the comparison of treatment-related indexes, the observation group's time to get out of bed (3.14 ± 1.36 days), hospitalization time (8.25 ± 1.45 days), and fracture healing time (49.66 ± 8.04 days) were shorter than that of the control group (6.15 ± 1.75 days for the time to get out of bed, 11.26 ± 1.84 days for hospitalization time, and 60.32 ± 8.39 days for fracture healing time). In addition, in the comparison of complication rate between the two groups, the complication rate of the observation group (3.23%) was lower than that of the control group (16.16%), which is similar to the results of this paper. These suggest that compared with the conservative treatment, open reduction internal fixation has a better treatment effect and higher safety, accelerates fracture healing, and shortens the hospitalization time, thus reducing economic pressure.

5. Conclusion

In summary, this study concluded that in patients with multiple rib fractures, open reduction and internal fixation is an effective and safe treatment that is worthy of further promotion and application.

Disclosure statement

The author declares no conflict of interest.

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