

RIB FIXATION: INDICATION, OPERATION TECHNIQUE AND RESULT

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ABSTRACT

Subjects: Rib fractures, depend upon quantity, location, and severity, could cause pain, hemothorax, flail chest. Fixation of broken ribs could refrain or stop those consequences. There have been several methods to fix broken ribs. We applied rib plating method and perform this research to evaluate its outcome and feasibility

Methods: Retrospectively review rib fixation cases in our thoracic department from 11/2015 to 9/2016

Results: There were 33 cases enrolled in the study: 12 patients applied 2 plates, 16 patients with 3 plates, and 5 patients with 4 plates. There was 4 cases of flail chest and no case have with two fractures in the same rib. Postoperatively, patients were free of pain, rib cage volume were restored, retained hemothorax were finished.

Conclusions: Fixation of the broken ribs resulting in completely free of fracture pain, facilitating fracture healing, restoring rib cage volume, finishing retained hemothorax and clotting hemothorax.

Keywords: Rib fixation, rib plating, chest trauma, rib fracture

I. INTRODUCTION

Rib fractures are very common in blunt chest trauma, occupied 10% in general trauma and 33% in chest trauma [1]. Rib fractures may be responsible for the complications that such as hemo thorax, hemo-clotted pleural effusion, if not managed, can lead to empyema.

The rate of complications increases with the number of broken ribs [2]. If the patients had more 3 broken ribs, they should be hospitalized for follow-up and treatment of complications. Fractures of 6 ribs or more can resulted in severe complications, which are life-threatening. Several studies have demonstrated a direct correlation between the number of rib fractures and intrathoracic injury, morbidity, and mortality [2], [3], [4]. Beside that,

rib fractures are always painful and usually take 4 to 6 months for healing. The patient cannot recover quickly and feel hurt or discomfort able when they move the chest.

Multi-ribfractures can create a flail chest, causing paradoxes movement and respiratory failure. Occasionally, multi-ribs fractures can lead to deformation of chest wall. The thorax is distorted and compresses the lung, and volume of respiration is reducel.

Because of the above reasons, like the other bone in the body, the rib fractures need to be fixed to reduce complications, to increase bone healing and restore quality of life.

Currently, there are many studies in the world that demonstrate the benefit of ribs fixation in

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the treatment of chest trauma. Many author presented different method of ribs fixation, but rib plating by plate and screws are widely supported and used by many surgeons. In Vietnam, Cho Ray Hospital is the first place to perform this technique. Therefore, we decided to do this research to evaluate the indications, efficacy and feasibility of ribs plating by the plate and screws.

II. SUBJECTS AND METHODS

2.1. Subjects: We used the case-series report. During 11/2015 to 9/2016, there are 33 patients with blunt chest trauma, hospitalized and performed the ribs fixation by the plates and the screws at Cho Ray hospital.

The indication of ribs fixation include [5], [8]:

1. Broken 3 ribs and more, at any position, with overlap or transverse displacement of one bone and with following factors:

- a. Break 6 ribs or more, continuously.
- b. There are 2 broken positions in a rib or loose pieces.
- c. Deformation of chest wall, restrictive lung expand and reducing volume of chest cavity.
- d. Recurrent of hemo-clotted after operation.
- e. Pain that cannot control by the analgesic intravenous.

2. Flail chest

3. Lung hernia thought the ribs fractures.

4. Nonunion ribs (after 2 month).

2.2. Methods: The patient was examined and performed the routine laboratory examination to evaluate the preoperative status. Contrast-enhanced CT scan and reconstruction the chest skeleton was performed to assess positions, displacement, number of broken ribs and other lesions included.

Technique:

- We used the titanium plate and titanium screws to repaired the broken ribs.

- At first, the position of broken was detected by chest CT scan. After that, we prepared the instruments. Not all the broken ribs need to be fixed. Usually, we repaired 2 or 3 rib fractures continuously or separated which deepened on the status of thorax.

- The plate 8 hole or 6 holes was used. It was crossover the site of broken and connected with the ribs by the screws.

- The length of the screws were chosen follow the thickness of the rib, range from 10mm to 15mm.

- If we opened the pleural cavity for resolve the other lesions, chest drainage was placed after operation.

We evaluated the results of operation though: the pain score pre and post operation, indication of ribs fixation, the complications in post operation, time of mechanical ventilation in post operation, time of removal chest tube, hospital admission days and recovered the normal movement daily.

III. RESULTS

From 11/2015 to 9/2016, we performed ribs fixation for 33 patients, which were blunt chest trauma.

Table 1: Characteristic of patients

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		N	%
Sex			
	Male	26	76.3
	Female	7	21.2
Mean age		34. 4± 12.3 y-o	
Concomitant lesions			
	No	6	18.2

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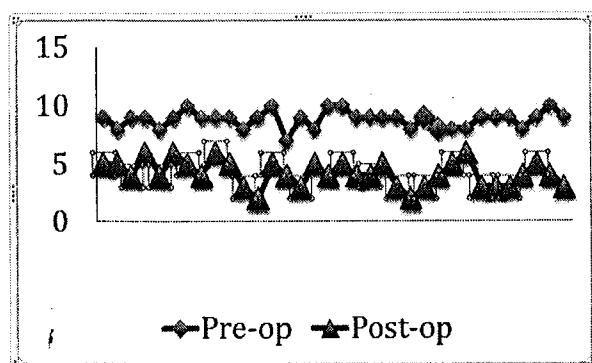
	Head trauma	10	30.3
	Abdominal trauma	13	39.4
	Other bone broken	22	66.7
Number of rib fractures			
	< 2 ribs	1	3.1
	3- 6 ribs	25	75.7
	> 6 ribs	7	21.2
Indication of rib fixation			
	Flail chest	4	12.1
	Chest wall deformity	7	21.
	> 3 rib fractures + pain	15	45.5
	> 3 rib fractures + displacement > 1 bone	4	12.1
	> 3 rib fractures + loose pieces	3	9.1

Table 2: Characteristic of operation

		N	%
Number of rib fixation			
	2 ribs	12	36.4
	3 ribs	16	48.5
	4 ribs	5	15.1
Average time of operation		75.3 ± 26.3 min	
Currently operation			
	Chest drainage	30	90.1
	Removing blood clotted in pleural cavity	5	15.2
	Surture pulmonary lesions	2	6.1
	Clavicular bone fixation	11	33.3
4 cases of flail chest			
Mechanical ventilation in Postop		4	12.1
Mean time of mechanical ventilation		36.4 ± 10.4 house	

Table 3: Results of operation

Complication			
	Infective wound	1	3.1
	Dislocation of screw	1	3.1
Time of removing chest tube		3.2 ± 1.4 day	
Hospital admission days		6.5 ± 2.7 day	



*Image 1: Change of pain score
(Pre-op vs Post-op)*

Image 1 showed the change of pain score between pre-op and post-op (8.3 vs 4.2, $p < 0.001$). It had significantly reduced of pain score with T-test two sides.

IV. DISCUSSIONS

In our study, we collected 33 patients. The ratio Male: Female was 3:1 and mean age was 34 year-old. The patients usually hospitalized in multi-trauma status. At first, we always treated follow the emergency's guideline until the patient was in stable condition more than half of patient (66.7%) had other bone broken. The patient had concomitant head trauma (30.3%) and abdominal trauma (39.4%). Many author showed the good condition for rib fixation when AIS was less than 2 score [5], [6], [7].

There were many indication of rib fixation. The absolute indication was flail chest, chest wall deformity and pain uncontrolled. Tanaka [6] randomized 37 patients with flail chest who required mechanical ventilation to receive surgical stabilization. His study demonstrated that the patient who received rib fixation had shorter duration of ventilation in post operation, shorter duration in ICU, less complicated pneumonia. We indicated the operation to 4 cases of flail chest (12.1%) and the most indication was pain uncontrolled, occupied 45.5%. We had 21% of patients who were indicated by

chest wall deformity. A retrospective study by Solberg et al describes 16 patients who had the chest wall deformity by high-energy accident. He showed significant benefits in term of less total intubation, less ICU length of stay and less chest tube duration. Beside that, in our study, our patients had the significantly change of pain score between pre-op and post-op (8.3 vs 4.2, $p < 0.001$) [9].

In flail chest, we had 4 patients and the duration of mechanical ventilation in post operation was 36.4 house. Many researches demonstrated the significant benefits in surgical patients who had flail chest [6], [7]. Granetzy et al. [5] in 2005 randomized 40 patients who experienced fractures of 3 or more ribs with paradoxical movement to receive either conservative or surgical treatment. Both groups demonstrated significant improvement in measurements of PaO_2 and PaCO_2 after the interventions suggesting that both methods were effective. However, the results indicated that patients in the surgical group experienced significantly fewer days on mechanical ventilation (2 vs. 12; $p < 0.001$), fewer days in the ICU (9.6 vs. 14.6; $p < 0.001$) and fewer total days in the hospital (11.7 vs. 23.1; $p < 0.001$). Furthermore, the surgical group exhibited a significantly less restrictive pattern on pulmonary function tests two months after treatment ($p < 0.001$). The respective results for the surgical vs. conservative group for FVC was 75.0% vs. 66.5%, for TLC was 90.7% vs. 85.8% and for FEF75 was 65.6% and 60.4%.

We had 2 cases of complications (6.2%) in post operation and no morbidity, a case of infective wound and a case of screw translocation. Tanaka [6] followed up 6 months of surgical patients and no complication was recoded. A case review of Campell et al [10] in 2009, mean duration of follow up patient was 3.9 month. This study presented 5 cases of wound infective and a case of non-healing rib broken. In the other study, Admed [11] made a 10 year reviews of

surgical rib fixations. The wound infections in post operation was 15% and 4% of patients had septic. In the long-time follow up, a case review of Mayberry et al (2006), which had 48.5 month of mean time follow up, showed that the surgical patients had better of quality of live (RAND-36 score), it had signification [12].

V. CONCLUSIONS

Rib fixations are necessary in the patients who had flail chest, chest wall deformity and pain uncontrolled. This technique can be approved in Vietnam conditions. The rate of complications and morbidity is low. The surgical patients can quickly recover.

REFERENCES

1. Ziegler DW, Agarwal NN. The morbidity and mortality of rib fractures. *J Trauma* 1994;37(6):975-979.
2. Sirmali M, Türüt H, Topçu S, et al. A comprehensive analysis of traumatic rib fractures: morbidity, mortality and management. *Eur J CardiothoracSurg* 2003; 24:133.
3. Brasel KJ, Guse CE, Layde P, Weigelt JA. Rib fractures: relationship with pneumonia and mortality. *Crit Care Med* 2006; 34:1642.
4. Lee RB, Bass SM, Morris JA Jr, MacKenzie EJ. Three or more rib fractures as an indicator for transfer to a Level I trauma center: a population-based study. *J Trauma* 1990; 30:689.
5. Granetzny A, Abd El-Aal M, Emam E, et al. Surgical versus conservative treatment of flail chest. Evaluation of the pulmonary status. *Interact CardiovascThoracSurg* 2005; 4:583.
6. Tanaka H, Yukioka T, Yamaguti Y, et al. Surgical stabilization of internal pneumatic stabilization? A prospective randomized study of management of severe flail chest patients. *J Trauma* 2002; 52:727.
7. Anavian J, Guthrie ST, Cole PA. Surgical management of multiple painful rib nonunions in patient with a history of severe shoulder girdle trauma: a case report and literature review. *J Orthop Trauma* 2009; 23:600.
8. Karmy-Jones R, Holevar M, Sullivan RJ, et al. Residual hemothorax after chest tube placement correlates with increased risk of empyema following traumatic injury. *Can Respir J* 2008; 15:255.
9. Solberg BD, Moon CN, Nissim AA, Wilson MT, Margulies DR. Treatment of chest wall implosion injuries without thoracotomy: technique and clinical outcomes. *J Trauma* 2009;67:8-13; discussion.
10. Campbell N, Conaglen P, Martin K, Antippa P. Surgical stabilization of rib fractures using Inion OTPS wraps-techniques and quality of life follow-up. *J Trauma*. 2009;67:596-601.
11. Ahmed Z, Mohyuddin Z. Management of Flail chest injury: internal fixation vs endotracheal intubation and ventilation. *J ThoracCardiovasc Surg*. 1995; 110:1676–80. [PubMed: 8523879]
12. Mayberry JC, Terhes JT, Ellis TJ, Wanek S, Mullins RJ (2003) Absorbable plates for rib fracture repair: preliminary experience. *J Trauma* 55:835-839.