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Surgical Approach to Rib Fractures

Turkan Dubus

Abstract

Rib fractures due to thorax trauma are one of the issues that mostly concern thoracic surgeons. Treatment for rib fractures is usually conservative. However, in some cases, fractured rib can cause complicated situations and surgical repair is required. Very serious respiratory problems occur in multiple costa fractures. Therefore, many advantages of surgical stabilization of the thorax wall have been reported. Especially shortening mechanical ventilation, decreasing the duration of intensive care unit stay, is important in preventing complications. Operation indications; Persistent pain despite intercostal block, narcotic and nonsteroidal anti-inflammatory analgesics, It was determined upon the presence of leakage from the thorax tube, intrathoracic hematoma and flail chest deformity. Nowadays, nithinol plates and titanium plates are frequently used in surgeon fixation of the rib fractures.

Keywords: Trauma, rib, fracture, surgical fixation, plaque

1. Introduction

The ribs are rigid and flexible structures that make up the chest skeleton and are a set of twelve paired bones. Pain, tenderness, cracking sound with movement in the chest area in cases such as compression, falling, hitting, and beating due to external factors bring to mind the rib fracture. Simple bumps, severe coughing and even sneezing can cause rib fractures in the elderly, where bones are more fragile. It is important to follow up elderly patients with multiple rib fractures in the hospital to prevent complications such as atelectasis and similar complications that may occur in the late period. If the patients are young, uncomplicated rib fractures can be followed up on an outpatient basis. After Blunt trauma rib fractures of incidence is about 30 to 40% [1].

Multiple rib fractures cause severe respiratory problems such as severe pain, dyspnea, flail chest, and atelectasis. Patients need medical or surgical intervention must be made. While the cracks in the ribs caused by traumas are insignificant, rib fractures can lead to intrathoracic organ and vascular injuries. Due to traumas, 4–9. ribs are often affected. 1.-2. fractures in ribs, subclavian vessel and brachial plexus damage, presence of fractures in one or more of the first 3 ribs of the upper thorax, major vascular injuries such as aorta indicate that the trauma is very severe. The fracture point of the ribs is often on the midaxillary line. In fractures in the lower elevations (9th–12th ribs), intraabdominal organ injuries such as liver, spleen and kidney should be investigated. 10–11. ribs fractures are rare because the ribs are more flexible. As the number of rib fractures increases, the risk increases in direct proportion. Complications may vary depending on the localization of rib fractures. Pneumothorax and hemothorax may develop as a result of the sharp end

of the broken rib causing lung parenchymal damage, and after tube thoracostomy is applied, rib fractures should be intervened [2].

2. Clinical examination

Pain is the most important symptom indicating rib fracture, and it usually increases with coughing, breathing, and movement. Broken rib ends can be felt with palpation at the time of coughing or deep breathing.

3. Diagnostic methods

3.1 X-ray

It is useful in showing displaced rib fractures, hemothorax and pneumothorax. Almost 50% of rib fractures can be missed on chest radiography. Lateral rib fractures can be hidden by rib lines in the absence of significant separation. Lower rib fractures (10–12th) can be observed on thoracolumbar radiographs. Although special radiographs in oblique and bone dose increase the diagnosis rate, it is unnecessary because the treatment will be made according to the clinical findings (Figure 1).

Figure 1.
PA Chest Radiography. Left multiple rib fractures, subcutaneous emphysema.

Figure 2.
Computed tomography (CT). Left displaced rib fractures, subcutaneous emphysema and pneumothorax.

3.2 Computed tomography (CT)

It is possible to detect rib fractures, soft tissue and vascular injuries that cannot be detected by x-ray (**Figure 2**).

3.3 Magnetic resonance imaging (MR)

It shows ridge circumference, soft tissue and organ damage. It is also effective in detecting thinner rib fractures.

4. Treatment approaches

4.1 Medical treatment

Most rib fractures, especially nondisplaced ones, heal spontaneously within about six weeks. In medical treatments, epidural catheter application, nonsteroidal anti-inflammatories, intravenous narcotic sedatives and transdermal narcotic agents can be used.

4.2 Nerve blocks

If the pain caused by rib fractures is severe and does not pass, intercostal nerve blockage (long-term anesthesia injection) can be applied.

4.3 Surgical fixation

It is an alternative method to prevent pain and complications due to rib fracture. Surgical intervention is the process of stabilizing the chest wall with rib fixations. Especially patients in intensive care, it plays an important role in reducing the duration of mechanical ventilation and the duration of stay in the intensive care unit,

the cost of hospitalization, and the prevention of complications such as infection and morbidity [1].

The flail chest is formed by fractures of at least 3 adjacent ribs in at least 2 different places. Close follow-up of these patients and combating pain and secretions are important. If hypoxia develops in the sail chest, endotracheal intubation and a mechanical ventilator are required in the intensive care unit. With open reduction, rib fixation reduces the morbidity of the patient, and the need for mechanical ventilators and pulmonary infections [3, 4].

The indication for fixation of ribs is usually performing thoracotomy for another reason and applying fixation in this session. The durability of the fixation method to be chosen in the fixation application of the patient is also important. Plate application is very difficult, especially in rib fractures that develop in the posterior. A strong fixation should be provided against breathing, cough and the impacts that may come from outside. Nondisplaced rib fracture ends spontaneously heal by merging with callus formation. However, if the union does not occur at the displaced rib fracture ends, it causes serious pain in the patient (**Table 1**) [4–6].

Cho et al. achieved a successful stabilization using the “bone graft and reconstruction plate” in a patient who had previously undergone stabilization with a kirschner wire but no callus occurred [7]. In a series where fixation is applied to the ribs with the help of an absorbable plate, The application helped the patients to leave the ventilator and even if the application was subjective, it was beneficial [8].

Judet pilates (Toothed plates) (Figure 3a–c)
• Broken lines of ribs should be deperiosteated.   • It should be shaped according to the shape of the rib at the level of the broken line.   • Requires attention in terms of intercostal neurovascular damage during manipulation.
Locking plates (Figure 4a and b)
• Easy to apply   • No need to form   • It does not require any preliminary preparation such as deperiosteering of the ribs   • Relatively wider incision than drilling required
U-Plates (Figure 5a and b)
• Judget and Locking record hybrid   • Can be applied in a shorter, minimally invasive manner   • More durable   • Top of ribs since it is applied partially, the incidence of intercostal nerve damage and associated chronic pain is low
Bio-absorbable plates (Figure 6)
• Polylactide absorbable plaque-absorbable suture materials   • Expensive   • Not easy to apply   • Intercostal nerve compression-suture rupture
Intramedullary plates (Figure 7a and b)
• Difficulty in placing   • Migration, loosening, loss of fixation

Table 1.
Types of plates and properties used in the fixation of rib fractures.

Figure 3.
a–c. Judet plates (toothed plates) and surgical fixation of ribs.

Figure 4.
a and b. Locking plates (locking plates).

Figure 5.
a and b. U-plates.

Figure 6.
Bio-absorbable plates.

(a)

(b)

Figure 7.
a and b. Intramedullary plates.

Figure 8.
Chest Radiographie. Surgical fixation of right rib fractures.

Figure 9.
Use of nithinol plate in rib fractures (Judet plates).

Plate application is more difficult, especially in rib fractures that develop posteriorly. Researchers who found that intramedullary fixation is both easier and safer in these cases also underlined that the rib splint is more advantageous than the kirschner wire [9]. It is also important that the material to be used in stabilizing the rib fractures does not cause problems in later imaging methods (**Figure 8**).

Balçı et al. preferred titanium plate for this purpose and found that the material did not interfere with the visualization in thoracic CT and MRI taken after the plate application [10].

Today, MRI compatible titanium and nithinol plates are more preferred in rib fracture fixations. Very successful results are obtained in the short and long term follow-up of the patients (**Figure 9**).

5. Conclusion

Surgical stabilization of rib fractures reduces the possible pulmonary complications of patients. It shortens the duration of hospital stay and the time to return to work, improves the quality of life of the patients by physiologically improving their breathing.

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