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Surgical reconstruction of traumatic flail chest with titanium plaques

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ABSTRACT

INTRODUCTION: Multiple rib fractures exposes serious respiratory disorders and they are generally treated with non surgical methods. Nevertheless, in cases of long term pain despite medical treatment, parenchymal injury, hematoma, posture disorder and flail chest, surgery is needed. Flail chest, as the most critical form of blunt chest trauma, can disturb the hemodynamic of patient significantly and threaten life. This work has been reported in line with the SCARE criteria.

PRESENTATION OF CASE: A 32 year old male patient referred to our hospital with flail chest in intubated status due to industrial accident. In physical examination, there was displaced dissociation in lower 1/3 of sternum and pericardium was palpated in the subcutaneous tissue. In thorax CT, there was fracture both in the right 7–8. costochondral and in the left 8. costochondral joints. Additionally, crepitation was palpated in these joints. There was flail chest in the right anterior hemithorax and in the lower sternum. Patient was treated with chest wall reconstruction with titanium plaques.

DISCUSSION: In cases of flail chest, after a few days mechanical ventilation, implementing stabilization provides a rapid healing.

CONCLUSIONS: We believe there is significant place of surgery for stabilization in proper cases.

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1. Introduction

Thorax injuries composes a wide spectrum from simple rib fractures to complex chest wall injuries [1]. Flail chest is the most critical form of blunt thorax traumas [2–4]. The pathology is stated as three or more sequential ribs fractured in two places, with or without a sternal component, with accompanying paradoxical movement of the chest wall [5]. In flail chest, with mediastinal flutter related to the paradoxical movement of the chest wall, related to the pressure on SVC and IVC, hemodynamics can be disturbed and the patient can undergo cardiac arrest [6]. Although in most of the cases of chest wall traumas surgical reconstruction is not needed [4–8], surgical stabilization was shown to be useful in certain subgroup of patients [5]. Specific guidelines are deficient for the management of certain combinations of chest wall injuries, because of their low incidence. One instance is the sternochondral dislocation accompanying sternal body fracture [5].

2. Presentation of case

A 32 year old male patient referred to our hospital with flail chest in intubated status due to industrial accident. Arrival blood gas to the intensive care unit was Ph: 7.46 PCO₂: 44 PO₂: 62 Sat: 92. There was air leak from both of the chest tubes which were inserted due to hemopneumothorax in outer center. In physical examination there was displaced dissociation in lower 1/3 of sternum and pericardium was palpated in the subcutaneous tissue. There was fracture and crepitation both in the right 7–8. costochondral and in the left 8. costochondral joints. Flail chest was present in the right anterior hemithorax and in the lower sternum. Right chest tube was conducted to comco. Air leak in the left chest tube was interrupted in 2. day of hospitalization. In the 3. day of hospitalization, after a sternotomy incision, fracture range was accessed (Fig. 1a). Displaced fractures was noticed in the right 7–8. costochondral joints and left 8. costochondral joints and sternum lower 1/3 portion.

2 flat plaques and 8 screws for the sternum and 4 flat plaques and 30 screws for the right 7–8. costochondral and left 8. costochondral joints were used for stabilization (Fig. 1b). 2 hemowak drains were placed under pectoralis muscles. Postoperatively, patient was transferred to the intensive care unit in intubated status. Air leak in the right chest tube interrupted postoperatively. In postoperative 1. day, patient was extubated and mobilized. In postoperative 2. day, left chest tube was extracted. In PO3. day, the patient was trans-

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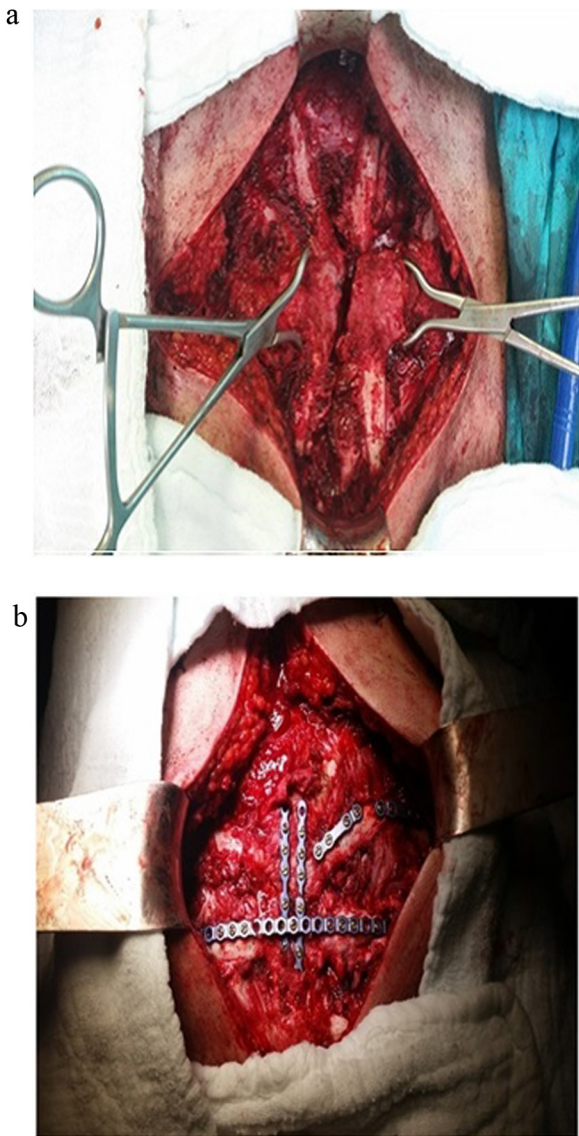


Fig. 1. a) Preoperative view of the chest wall. b) Postoperative view of the chest wall.

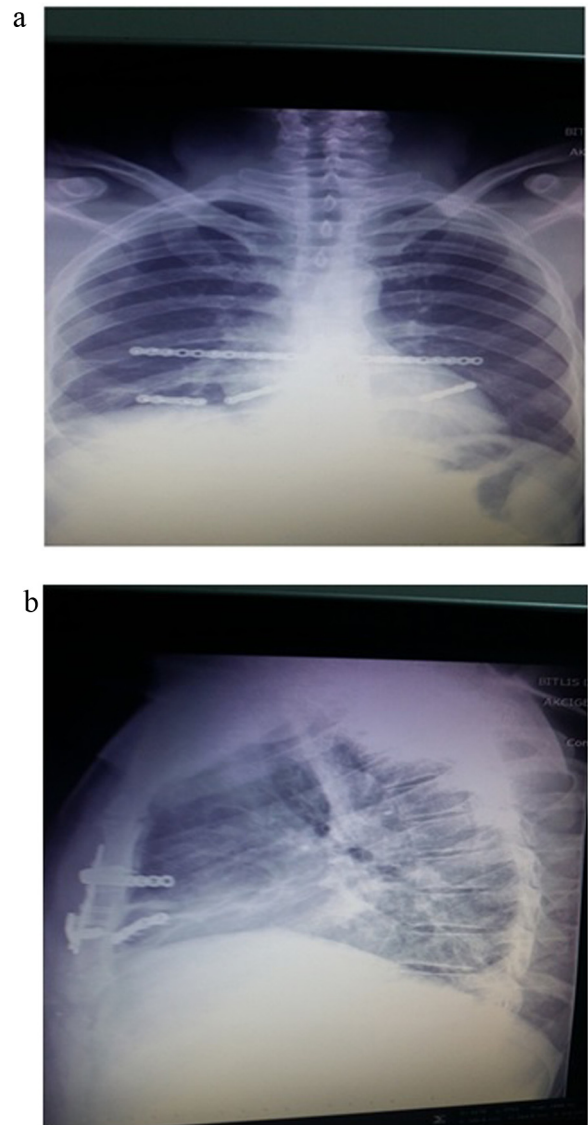


Fig. 2. a) Posteroanterior view of postoperative graphy. b) Lateral view of postoperative graphy.

ferred to service. In PO5. day, right chest tube and hemowak drains were extracted. Patient was discharged from hospital in PO13. day with a prominent healing in respiratory functions and recovery of pain. In postoperative 2. month policlinic control, patient had no chest wall deformity, breathing voice was equal in both hemithorax and PA graphy (Fig. 2a) and lateral graphy (Fig. 2b) was evaluated as normal.

3. Discussion

Although most of the patients with rib fractures are followed in a conservative manner; unavoidable respiratory insufficiency despite aggressive medical treatment, severe chest wall deformity, persistent pain, inability to end mechanical ventilation, thoracotomy needed for another reason are the indications for surgical stabilization [2–7]. In our case, because of flail chest composing a wide area of the anterior chest wall, stabilization provided a rapid and effective benefit in the early period.

Except bilateral ribs, fractures on the anterior cartilage area can cause flail on sternum [5]. In our case, basic factor disturbing the

hemodynamics of patient was displaced fractures on the anterior cartilage area and sternum.

Morbidity factors associated with flail chest comprises mechanical ventilation, pneumonia, chest wall deformities and chronic pain. Pulmonary contusions can worsen the patient’s prognosis. Anterior flail segments have been reported to have higher morbidity rate compared to lateral [6]. Our patient’s flail segments were also on anterior location, but there wasn’t an associated prominent pulmonary contusion.

The most frequent treatment modality for flail chest is mechanic ventilation today [4–8]. However, in the literature, it’s reported that surgical rib stabilization demonstrated coherent results compared to conservative management, regarding duration of mechanical ventilation, duration of hospitalization in intensive care unit and total duration of hospitalization, incidence of pneumonia, and need for tracheostomy in flail chest patients [1]. Our patient was also extubated and taken out of the intensive care unit without any postoperative complication soon after the surgical stabilization.

Data on the surgical stabilization of lateral flail chest evolves today, however, reports on the surgical approach to sternochondral disjunction are rare. A few case reports have been published regard-

ing use of the Nuss procedure and modified Ravitch procedure for sternal stabilization [5]. We used 2 flat plaques for sternum and 4 flat plaques for ribs with fractures on sternochondral junctions after a sternotomy incision.

In addition to locked plates, other osteosynthesis materials like rib clamp systems can be used or an internal bracing of the chest wall can also be performed by the way of bars [8]. However, clamp systems have significant risk of implant failure and bars have the risk of sternum fracture [8]. In our case we used titanium plaques. Locked plate osteosynthesis has evolved to the most widespread and safest method for the surgical therapy of sternum and rib fractures [8].

4. Conclusion

Stabilization of rib fractures with titanium plaques is a safe and easy method giving rapid results [9]. For this reason, in proper cases, we believe there is significant place of surgery for stabilization.

Conflicts of interest

None declared.

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Ethical approval

The ethical approval has been exempted as it was not necessary in this case report by our institution.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

TA gathered the patient's data and wrote the manuscript. TA, BA, CB participated in the surgery. TA, BA, CB reviewed manuscript. All authors approved the final manuscript.

Registration of research studies

Registration of our study at <http://www.researchregistry.com> is waived because it registers case series or other group studies or first in man cases, our case is a single patient which is not a first in man.

Guarantor

Tuba Apaydin, MD.

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References

- [1] G. Kasotakis, E.A. Hasenboehler, E.W. Streib, N. Patel, M.B. Patel, L. Alarcon, et al., Operative fixation of rib fractures after blunt trauma: a practice management guideline from the Eastern Association for the Surgery of Trauma, *J. Trauma Acute Care Surg.* 82 (3) (2017) 618–626.
- [2] B.J. Bibas, R.A. Bibas, Operative stabilization of flail chest using a prosthetic mesh and methylmethacrylate, *Eur. J. Cardiothorac. Surg.* 29 (2006) 1064–1066.
- [3] S.T. Liman, A. Kuzucu, A.I. Taştepe, et al., Chest injury due to blunt trauma, *Eur. J. Cardiothorac. Surg.* 23 (2003) 374–378.
- [4] C. Engel, J.C. Krieg, S.M. Madey, et al., Operative chest wall fixation with osteosynthesis plates, *J. Trauma* 58 (2005) 181–186.
- [5] G. Estremera, E.C. Omi, E. Smith-Singares, The modified Ravitch approach for the management of severe anterior flail chest with bilateral sternochondral dislocations: a case report, *Surg. Case Rep.* 4 (1) (2018) 8.
- [6] M. Aaron, Ranasinghe, A.J. Jonathan, Hyde, R. Timothy, Graham, Management of flail chest, *Trauma* 3 (2001) 235–247.
- [7] A. Eraslan Balci, E. Ayan, Özalp K. ve ark, Posterolateral kosta fraktürlerinde operatif fiksasyon: Titanyum materyal ve radyolojik uyumluluğun değerlendirilmesi, *Türk Göğüs Kalp Damar Cer Derg* 13 (2005) 37–40.
- [8] S. Schulz-Drost, S. Krinner, A. Langenbach, D. Mersch, S. Grupp, F.F.A. Hennig, et al., The operative management of flail chest injuries with concomitant sternal fracture, *Chirurgia (Bucharest, Romania)* 112 (5) (2017) 573–593.
- [9] R.A. Agha, A.J. Fowler, A. Saetta, I. Barai, S. Rajmohan, D.P. Orgill, for the SCARE Group, The SCARE statement: consensus-based surgical case report guidelines, *Int. J. Surg.* 34 (2016) 180–186.

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