A Case Report of a Polytraumatized Patient with Severe Anterior Flail Chest

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Abstract

Flail Chest (FC) is a most life-threatening complication of chest blunt trauma and it is defined as the fracture of three or more consecutive ribs, resulting in a paradoxical movement of a segment of the thoracic wall during spontaneous breathing. A 46 year-old patient had clinical presentation of post-traumatic, with a Computed Tomography (CT) scan showing multiple fractures of chondral-sternal cartilage and sternal fractures. In a few hours the patient’s respiratory functionality and hemodynamic worsened so the patient underwent early Surgical Stabilization of Rib Fractures (SSRF). In this case we preferred to use the STRATOS system, placing rib clips with a connecting bar from the third rib to the fifth rib, with a positive outcome. Surgical stabilization of anterior FC is a safe procedure and reduces mortality, morbidity, duration of mechanical ventilation, Hospital Length of Stay (HLOS) and Intensive Care Unit Length of Stay (ICU-LOS). In polytraumatized patients, early stabilization of the anterior chest improves respiratory function, so as to safely allow any further necessary surgical interventions.

Introduction

Flail Chest (FC) is a life-threatening complication of chest trauma [1-3] with a mortality rate ranging from 10% to 33% [1-7]. FC is defined as the fracture of 3 or more adjacent ribs, resulting in a paradoxical movement of the broken chest [1-3]. FC management includes pain and pulmonary dysfunction treatment and surgical fixation in selected cases [8,9].

Case Presentation

Here we present the case of a 46-year-old man, who presented at the emergency department for high energy trauma, by accidental fall from a roof. The patient had significant chest and abdominal pain, tachycardia, hypotension and hypoxia. Blood gas analysis at presentation showed hypoxic respiratory failure with normocapnia (pH 7.34; PaO₂ 70.3 mmHg; pCO₂ 40.6 mmHg; HCO₃ 22.1 mmol/l; sat 91%). He needed intravascular volume resuscitation, as well as inotropic and vasoactive infusions. Computed tomography showed sternal-chondral cartilage fractures from 1st to 7th left ribs, in anterior arches with dislocated sterno-chondral joints and sternal fracture (see the 3D reconstruction in Figure 1), multi-fragmented fracture of L3 and D12, multi-fragmented fracture of sacrum and acetabular roofs. The patient had bilateral lung contusion and subcutaneous emphysema at the level of the left pectoral muscle. After 3 h we decided to proceed with the surgical stabilization of the anterior thorax, due to the impaired respiratory function, and a left tube thoracostomy was placed due to the appearance of hypertensive pneumothorax.

Surgical Procedure

The patient was placed in the supine position and the procedure was performed through a vertical midline incision from below the sternal notch up to the tip of the xiphoid process. The pectoral fascia (with muscles) was divided and released from its attachment mediually, so as to expose the fractures. The osteochondral transitions were fractured with a significant diastase between cartilage and bone (Figure 2). The Strasbourg thoracic osteosynthesis system (STRATOS system) [10,11] consisted of titanium rib clips available in different angles (straight, 45°, or 22,5° left and right) and the connecting bars, also available in different lengths. Using the STRATOS we started placing the rib clips on both the right and left third ribs, and then we connected them with the titanium bar. We did the same for the fourth and fifth rib (Figure 3). The sternal fractures were stabilized with 3 vicryl sutures. Two drainage tubes of lower caliber were placed in the submuscular space. Finally, we covered the implant with the pectoralis major muscle. The post-surgery chest-CT scan and Chest-XR (CXR) showed a right positioning of the STRATOS (Figure 4). On day 2 of hospitalization
important right pneumothorax was found on control CXR, so a tube thoracostomy was positioned in the right chest. On the third day after the effective chest wall stabilization we were able to proceed with the spinal stabilization intervention, positioning the patient in a prone position. The supine position did not result in the rupture of the bars, moreover the post-surgery CT showed their non-dislocation (Figure 5). On day 5 of hospitalization he underwent orthopedic surgery to stabilize the sacrum. Air leaks were interrupted in the left chest tube on day 8 of hospitalization and in the right chest tube on day 9. All tubes were removed on day 9 of hospitalization. On day 10 he needed an orthopedic reoperation to reposition a surgical screw, so on the same date he underwent tracheostomy. On day 15 the patient was weaned from mechanical ventilation and on day 20 he was moved to the ward for further treatment and rehabilitation, since he no longer needed support mechanical ventilation. The 6-month follow-up was characterized by normal chest X-ray findings and good respiratory function test results.

Discussion

The management of FC remained controversial for many years [5,12]. Although most of the patients with rib fractures are followed in a conservative manner [2,12,13], unavoidable respiratory insufficiency despite aggressive medical treatment and FC are the indication for surgical stabilization [3,5,14]. The last guidelines suggested operative management in FC, with beneficial effects on morbidity and mortality, moreover SSRF reduced incidence of pneumonia, need of tracheostomy and resource expenditure, because it decreased the duration of mechanical ventilation, HLOS and ICU-LOS [1,3,8,15]. The maximum benefit of SSRF is obtained with early surgery within 24 h to 72 h of injury, in order to avoid prolonged mechanical ventilation and its associated complications [3,16]. Conversely one of the disadvantages of SSRF is that it requires general anesthesia, which is always a risk for a traumatized patient [5]. When the inability to end mechanical ventilation occurs or the thoracotomy becomes necessary for another reason, such as hemothorax, the indication for SSRF is mandatory [1,17,18]. Multiple techniques have been described, such as the use of metal plates or clips [1], absorbable plates [8,10], intramedullary fixation [5], Judet struts and U-plate [7], but there have not been any comparative studies. The treatment of FC could be complicated by wound infection, hardware failure or migration or breaking, and malunion/nonunion of the fracture site [3,19]. In polytraumatized patients with an unstable spine fracture and associated CF, supine surgery is not possible without first stabilizing the anterior chest or using chest supports, because prone positioning can have variable effects on ventilation and hemodynamics [20]. In our experience we report better results with a surgical approach at an early time, rather than a conservative approach, and we prefer to use the STRATOS system, because it allows a firm reconstruction, simple to handle and to fix, avoiding instability or paradoxical movement.
Our sternal stabilization ensured the possibility of performing other surgical interventions, such as vertebral stabilization in the prone position.

**Conclusion**

Surgical stabilization with STRATOS of severe FC is a safe procedure and reduces mortality and morbidity, as well as improving respiratory dynamic. In polytraumatized patients, sternal stabilization guarantees the possibility of safely performing life-saving surgeries, even in the prone position.

**References**


