Successful operative rib fixation of traumatic flail chest in a patient with osteogenesis imperfecta

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Abstract

Increasing attention has been directed towards operative rib fixation of traumatic flail chest; reported benefits include more rapid weaning from the ventilator, decreased intensive care unit stays, decreased complications and improved functional results. The outcomes of this surgical intervention in patients with osteogenesis imperfecta, a rare condition characterized by low bone density and bone fragility, are unknown. This case demonstrates that, in the management of traumatic flail chest in a patient with osteogenesis imperfecta, surgical fixation can be successful and should be considered early.

Keywords: Osteogenesis imperfecta • Flail chest • Rib fixation • Rib fracture • Operative management

INTRODUCTION

Osteogenesis imperfecta (OI) is a rare genetic disorder prominently characterized by low bone density and bone fragility [1]. The clinical expression of OI is highly variable [1]. Patients with OI are more susceptible to fractures from traumatic causes, both in frequency and severity [1, 2]. Recent literature has demonstrated benefits in operative repair of flail chest [3]. Surgical rib fixation for traumatic flail chest in OI has not been previously described and outcomes are unknown.

CASE REPORT

A 52-year old female with OI was transferred to our institution, a level-1 trauma centre, from a referring hospital as an unrestrained passenger in a high-speed motor vehicle collision. During initial evaluation, physical examination and adjunctive imaging demonstrated a traumatic left pneumothorax with flail chest, for which she received immediate tube thoracostomy. She sustained bilateral pulmonary contusions and numerous other injuries including: facial, bilateral rib, bilateral upper extremity, thoracic and lumbar transverse process, pelvic and right lower extremity fractures. Her medical history was significant for OI diagnosed at age 19 and a recent diagnosis of intracranial aneurysms. The OI subtype was unclassified due to its late onset, extraskeletal manifestation (blue sclerae) and no known family history of the condition. She had previously sustained multiple fractures of all four extremities and ribs. Her medications included oral narcotics, vitamin D supplementation and three prior infusions of intravenous zoledronic acid, most recently in the month preceding her trauma.

The patient was admitted to the Surgical Intensive Care Unit (SICU). On post-trauma day (PTD) 1, she underwent operative stabilization and repair of extremity fractures. Postoperatively, her respiratory status deteriorated and she required orotracheal intubation (PTD 2). A thoracic-level epidural pain catheter was considered but not advised in the setting of numerous spine fractures. Given her impaired respiratory mechanics, a course of action predicated on operative management was planned. She subsequently underwent posterolateral thoracotomy and open reduction and internal fixation of her comminuted left rib fractures (PTD 4). Three-dimensional computed tomography reconstruction of the rib fractures is displayed in Fig. 1.

Intraoperatively, to avoid additional fractures, a Finochietto retractor was not used. A pulmonary parenchymal laceration was noted underlying the displaced fragments of the fifth and sixth left ribs. This was repaired with absorbable suture. The flail segment, spanning from the second to the ninth rib, was stabilized with the Synthes MatrixRib plating system (Synthes CMF, West Chester, PA, USA). The cortical bone was thinner than normal rib cortex. A Freer elevator was used to ensure appropriate fit of the plates to the underlying rib. Furthermore, additional screws (at least four on each side of the fracture), and a higher proportion of smaller (6 mm) screws, had to be utilized. In one location, the slenderness of the cortical bone required additional 0 Ethibond sutures placed through the rib to secure the plating system. Ventilatory extubation parameters were met on postoperative day (POD) 2; however, extubation was delayed until POD 4 due to poor cough and continued high pain requirements. Her two operatively placed thoracostomy tubes were removed on POD 5. Following operative repair of additional extremity fractures, she was downgraded from the SICU on POD 8 (PTD 12). The remainder of her hospital course was uncomplicated and she was ultimately discharged home on PTD 19. A Chest x-ray of her surgical rib fixation prior to discharge is displayed in Fig. 2. In the follow-up period of 16 months, she has experienced no complications related to her operative rib fixation.

DISCUSSION

Rib fractures remain a common injury following blunt chest trauma, with respiratory insufficiency the most concerning physiological disturbance. Flail chest segments are associated with higher morbidity...
and mortality, given the underlying pulmonary contusion and impaired mechanics of respiration [3]. Complications including respiratory failure necessitating mechanical ventilation, protracted ICU stays, chronic pain, deformity and disability are not uncommon. While not yet clearly considered the standard of care, operative fixation of traumatic flail chest has gained recent traction [3]. Recently, a reduction in ventilator days and ICU stay was demonstrated in traumatic flail chest in a prospective randomized controlled trial [3].

The operative and perioperative care of the surgical patient with OI depends on the classification of OI, phenotypic expression and severity of symptoms [4]. Owing to deformities in the chest wall and spine, patients with OI are at higher risk for pulmonary complications or respiratory failure [4, 5]. Restrictive physiology provides limited reserve, causes muscle weakness, and predisposes to pulmonary infections following rib fractures; consequently, pulmonary compromise is the leading cause of death among patients with OI [1, 2, 4, 5]. As such, we had a low threshold for intubation at early signs of respiratory distress. Furthermore, confronted with both impaired mechanics of respiration and underlying pulmonary contusions, surgical fixation of the traumatic flail segment was sought early.

Other considerations include careful manipulation of the airway and neck during intubation [4]. As many patients are not narcotic-naive, increased narcotic requirements may also be encountered [4]. Some patients with OI may demonstrate a higher tendency towards coagulopathy due to abnormal platelet-endothelial cell interactions from collagen abnormalities [4]. If suspected based on coagulation studies, a preoperative haematology consultation should be considered, and both desmopressin and recombinant factor VIIa have been described in the management of coagulopathy in surgical patients with OI [4]. Finally, additional considerations in the management of fractures in OI include the prevalence of osteoporosis, thin or slender cortical bone, as well as malunion and non-union complicating repairs [1, 2].

Studies on the surgical treatment of orthopaedic injuries in OI are limited and have focused primarily on the management of extremity fractures. Numerous studies have demonstrated the effectiveness of surgical fixation of long-bone fractures with intramedullary rods as the mainstay of treatment [1, 2]. Bisphosphonates have also been studied and used extensively as an adjunctive therapy in the management of patients with OI, and may reduce the rate of healing complications [1, 2]. No prior published reports have described the management of rib fractures in OI. Owing to a predisposition to pulmonary morbidity and mortality, in the management of traumatic flail chest, surgical fixation can be successful and should be considered early in a patient with OI.

Conflict of interest: none declared.

REFERENCES