Sternal non-union in a professional hockey player: considerations for return to play

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Abstract

We describe a healthy 40-year old professional hockey player with an asymptomatic sternal non-union following aortic root surgery. The purpose of this case report is to make orthopedic surgeons aware of the possibility of this complication following sternotomy, and to discuss the considerations involved in return to play in contact sports. We will discuss our work-up, evaluation, and management of a sternal non-union in a professional athlete. Patient’s consent has been obtained.

Case report

A healthy 40-year old male professional hockey player was treated with an aortic valve repair and replacement of the ascending aorta for a bicuspid aortic valve and ascending aortic aneurysm. The surgical approach involved a partial sternotomy that was repaired with cerclage wires. His recovery was uneventful, and he was cleared by his thoracic surgeon for full non-contact activity at three months from surgery. He was asymptomatic at rest and with exertion, with no tenderness to palpation along the sternum, no evidence of instability with forceful stress, and with full painless range of motion of bilateral upper extremities and normal strength. Because of the history of sternotomy, a CAT scan of the chest was obtained at that time to assess for sternal union prior to clearance to return to full contact activities. This revealed a sternal non-union. A literature search failed to reveal any other reported cases of asymptomatic sternal non-union in athletes. He was not cleared for contact, and was advised to have repeat studies at six months from surgery. A second CAT scan of the chest obtained at six months demonstrated a continued non-union without progression of healing (Figures 1 and 2).

As there were no data available in the literature regarding return to play in contact athletes with an asymptomatic non-union, multiple consultations were obtained, including both cardiac and orthopedic surgeons. The consensus was that he could return to full contact participation as he was asymptomatic at rest and with exertion, with no tenderness to palpation along the sternum, and with full range of painless motion of bilateral upper extremities and normal protective strength. Although there is concern that with a sternal non-union there may be some subtle instability present, it was felt that the sternum still adequately served the purpose of protecting the chest cavity organs and was not at an increased risk for fracture, especially as the patient underwent a partial sternotomy rather than a total sternotomy, and failed to exhibit any evidence of instability with forceful stress. He returned to full National Hockey League participation, and remains asymptomatic.

Discussion

Injuries to the sternum and thoracic cage are relatively frequent in patients involved in motor vehicle accidents, high speed sports activities, and industrial accidents, yet non-union of a fracture of the sternum is exceptionally rare.1 Non-union should be suspected in the following instances: (1) a history of a sternotomy or severe injury to the sternum or chest cage with localized pain and tenderness; (2) persistence of pain over the sternum three months after sternotomy or sternal fracture; (3) radiographic evidence of a persistent fracture line across the sternum; and (4) positive ancillary radiographic tests.2 In doubtful or suspected non-unions, a CAT scan or bone scan should be obtained. In this case, although the patient was asymptomatic, it was felt that due to the high forces and chest wall impact involved in ice hockey that a CAT scan should be obtained as routine pre-participation work-up. There are at least two factors which can contribute to sternal non-union following fracture. First, the sternum receives its blood supply from the internal mammary arteries and intercostal arteries bilaterally, and occasionally an internal mammary vessel may be lacerated by a sternal fracture.2 Second, the sternum is involved in motions of the chest cage (particularly those of respiration and coughing), and movement at any fracture site is known to adversely influence the healing process. With every breath and movement, the sternal fracture or sternotomy is subjected to forces that tend to distract the fragments. This may be one factor that contributes to non-union, and it certainly must be overcome to create an environment in which the non-union can heal.3

Sternotomy is a common surgical approach used for cardiac and aortic arch surgery. The incidence of sternal non-union remains less than 1% after median sternotomy and is encountered even less often after trauma.4 The percentage of patients with a sternal non-union following a sternotomy is, however, likely underreported as radiographic evidence is necessary for the diagnosis and not routinely obtained by cardiothoracic surgeons post-operatively. Often a work-up for sternal non-union is performed only if the patient continues to be symptomatic. Sterile sternal non-union is defined as a persistent fracture of the sternum after three months without signs of healing. When symptomatic, this condition is characterized by sternal instability, pain, and the absence of infection.4 The pathogenesis of sternal non-union following thoracic surgery is dependent on what Wu et al. have designated as extrinsic and intrinsic risk factors. Extrinsic risk factors include any environmental or systemic effects on healing. These would include both operative and post-operative events, such as bilateral internal thoracic artery harvest, prolonged pump time, prolonged ventilatory dependence, and low cardiac output. Recognized systemic factors of sternal non-union include the use of steroids, poor nutritional status, chronic obstructive pulmonary disease, and diabetes. Intrinsic factors are characteristics of the fracture and bone that contribute to the likelihood of sternal non-union. These include technical errors in sternotomy, osteoporotic bone, multiple longitu- nal and transverse fracture lines, fracture gap, decreased vascularity of the bony segments, and instability.5 We were unable to identify any of these factors in our patient.

Sternal non-unions may be difficult to detect on routine radiographs due to supra-position of multiple bones on most projections. The chest cage and sternum may have been deformed at the level of the sternotomy, and
Callus formation may distort the entire sternotomy. However, with a non-union there is generally localized pain and tenderness on clinical examination, and later radiographs will show some new bone formation at the fracture or sternotomy site. A CAT scan may be needed to make a diagnosis of a non-union, as in this case. A bone scan may also be a helpful ancillary test.

Regardless of the cause of the sternal non-union, few studies have addressed its treatment. Mayba describes a series of 18 patients who sustained sternal fractures, 2 of whom went on to symptomatic non-unions. Both of these patients were treated with open reduction and internal fixation and healed without complication. Wu et al. presented 6 cases of sterile sternal non-union, including its presentation, treatment with open reduction and rigid-plating fixation, and outcomes. The series consisted of 6 sterile sternal non-unions, 4 of whom received median sternotomies closed with parasternal cerclage wires. All patients complained of sternal pain and remained symptomatic for more than three months. Because sternal non-union is a rare complication, there is no consensus on how to treat these patients. A few methods have been developed over the years that involve various techniques, including some type of fixation, either rigid or semi-rigid, with or without bone grafts. Wu et al. had success with all 6 cases treating the non-union with open reduction and plate fixation. All patients went on to heal clinically and radiographically without complication, and were asymptomatic at the six and 18 month follow-ups.

This case represents a previously unreported clinical situation of an asymptomatic sternal non-union following a sternotomy in an athlete participating in contact sports at professional level. We present this to make orthopedic surgeons aware of the possibility of a non-union following sternotomy. We currently do not have any published guidelines regarding the risk of visceral injury when a non-union is present. We allowed the player to return to play based on clinical criteria of absence of symptoms during antero-posterior and medio-lateral sternal compression, absence of pain with bench press maneuvers and return to non-contact hockey, and a discussion of the theoretical chance of either thoracic visceral injury or creation of symptoms at the non-union site with a contact injury. Also, a partial sternotomy used during the surgical approach rather than a total sternotomy provided added reassurance of stability and protection. There is no literature available that we can use to make a rational decision regarding return to play, and we would need a large series of similarly treated patients to adequately counsel players regarding future risks. Based on our experience with this athlete, we recommend checking a CAT scan in patients with a recent history of sternotomy prior to returning to contact sports to allow documentation of sternal healing, and suggest that asymptomatic non-union patients be asked to refrain from contact play for six months following surgery to allow formation of stable fibrous tissue at the sternotomy site. It is also recommended to reassess the patient for any symptoms of sternal pain or signs of sternal instability once they have returned to full contact sports.

References
1. Bertin K, Rice RS, Doty DB, Jones KW. Repair of transverse sternal nonunions using metal plates and autogenous bone graft. Ann Thorac Surg 2002;73:1661-2.
2. Gibson LD, Carter R, Hinshaw DB. Surgical significance of sternal fracture. Surg Gynec Obstet 1962;114:443-8.
3. Mayba II. Nonunions of fractures of the sternum. JBJS 1985;67:1091-3.
4. Wu L, Renucci J, Song DH. Rigid-plate fixation for the treatment of sternal nonunion. J Thor Cardiovascular Surg 2004;128:623-4.