Primary Sternal Osteomyelitis: A Case Report and Review

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Summary: Primary sternal osteomyelitis (PSO) remains a rare but morbid and challenging condition. Due to the limited reports of PSO in the literature, management of this disease continues to lack consensus. We present a case report highlighting how PSO remained, in our experience, refractory to medical management, and how operative intervention provided resolution, and a review of the literature. (Plast Reconstr Surg Glob Open 2019;7:e2120; doi: 10.1097/GOX.0000000000002120; Published online 12 June 2019.)

Sternal osteomyelitis is a morbid and challenging condition. Most cases of sternal osteomyelitis are secondary, related to median sternotomy, but primary sternal osteomyelitis (PSO) is rare. Risk factors include intravenous drug use, diabetes, and obesity,1,2 but cases with no apparent risk factors have been documented.3,4 This presents a challenge both for the diagnosis and treatment. Most cases are treated with either antibiotic therapy alone or antibiotics with debridement and closure or soft tissue reconstruction with vascularized flap coverage. Due to the paucity of the literature and rarity of condition, there is no clear consensus standard of care. The aim of this report is to highlight a unique case of PSO, treatment strategy, and overview of current state of this condition in the literature.

CASE REPORT

A 66-year-old woman presents with a 15-month history of PSO. She has a significant prior history of traumatic brain injury and intracerebral hemorrhage 20 years prior, hemicolectomy for cecal volvulus 6 years prior, and lumbar spinal fusion for scoliosis 3 years prior, complicated by wound infection, debridement, and consequent paraplegia.

The patient initially reported that she was exercising in January 2016 when a weight bar fell and impacted her chest. Radiographs taken 3 days later confirmed a minor fracture of the sternum and the patient was told to avoid chest exertion for a few months. Two months later, the patient experienced severe weakness and was admitted with Staphylococcus lugdunensis sepsis. A peripherally inserted central venous catheter was inserted and she was treated with an extended course of intravenous antibiotics.

Two months later, a follow-up CT scan revealed a left lower lobe pulmonary embolism, for which the patient was admitted and started on rivaroxaban. The following month, the patient visited a spine surgeon out of concern that the soft tissue coverage over her spinal hardware was thinning, but no exposure/surgical intervention was necessary. After completion of 3 months of intravenous antibiotics, the patient was switched to an oral course of dicloxacillin until December 2016. Repeat CT scan at the time revealed a suspicious focal region of bony sequestrum at the site of the sternal fracture. She was referred to thoracic and plastic surgery for debridement of the sequestrum with partial sternectomy and pectoralis muscle flap coverage which she underwent in May 2017. CT with contrast imaging at several timepoints throughout the clinical course is depicted in Figures 1 and 2.

INDICATIONS

Sternal-manubrial fracture, nonunion and subsequent osteomyelitis failed to heal after prolonged antibiotic therapy alone with obvious sequestrum on CT scan, indicating need for surgical debridement of the bony sequestrum and surrounding nonviable soft tissue, with vascularized muscle coverage for reconstruction.

TECHNIQUE

A partial sternectomy was performed under general anesthesia and regional intercostal nerve block. A midline incision was made over the sternum and dissected to the level of the periosteum. Bilateral pectoralis major muscle flaps were elevated in the submuscular plane minimizing...
the subcutaneous dissection but allowing for complete exposure of sternum and manubrium. The fibrous malunion with a pronounced “step-off” between manubrium and sternum was visualized and wide debridement with resection of all nonviable bone and surrounding fibrous scar tissue was performed. Tissue and bone was sent for culture and pathologic evaluation. No frank purulence was visible on gross examination. The involved sternum and manubrium were soft and appeared to be chronically inflamed. Debridement was performed at the step-off site with rongeur and curette to remove the entire sequestrum. The posterior table was stable with pinpoint bleeding and left intact. The debridement continued caudally to just above the xyphoid, and laterally to the costal margins. The surgical site was irrigated with copious amounts of bacitracin antibiotic irrigation and warm sterile saline. Edges were smoothed over in preparation for reconstruction.

The pectoralis major was undermined in the submuscular plane to the anterior axillary line bilaterally. The subcutaneous dissection extended for 5–6 cm bilaterally to fully mobilize the pectoralis flaps while avoiding the creation of a large subcutaneous dead space. Once the flaps were mobilized, they were advanced to fill the midline defect and secured together using 0 vicryl suture. The pectoralis was closed along the entire length of the midline wound, thereby covering the entire defect. A 19-French channel drain was placed in the midline of the sternectomy defect and a 15-French round Jackson-Pratt drain was placed in the subcutaneous plane. The skin flaps were advanced toward the midline and closed in a layered fashion. The closure was reinforced with Dermabond, and the patient’s closure site was wrapped in Ace wraps to give additional compression and medialize the breast mounds, and to take tension from lateral displacement of the breasts off of the midline incision. Vancomycin was administered post-operatively until culture results returned. Intra-operative culture demonstrated no growth and the patient was discharged on oral dicloxacillin.

CT FINDINGS

CT scan in June 2016 demonstrated upper sternal fracture with osseous destructive change and multiple small osseous fragmentation with mild-to-moderate surrounding soft tissue thickening compatible with a history of fracture and osteomyelitis. Calcification within the center of the osseous destructive changes was noted and consistent with a possible bony sequestrum. Osseous destructive region measured 3.6 x 2.3 x 2.1 cm³ (transverse [TR], anterior-posterior [AP], cranio-caudal or coronal [CC]).

With respect to the extensive posterior spinal orthopaedic hardware related to scoliosis surgery, lucency was seen around the T5, T6, and T7 bilateral pedicle screws, suggestive of loosening. There were stable, mild anterior wedging compression fractures at T3-T6. There was also a stable moderate T9 compression fracture status-post kyphoplasty.

Repeated CT scan in December 2016 demonstrated increased collapse and decreased spacing between the upper and lower sternal fracture with the development of anterior displacement of the lower sternum relative to the upper sternum. Increased sclerosis was observed at the margins of the fracture, suggestive of healing. Punctate osseous fragmentation within the fracture site was
less conspicuous, and the minimal retrosternal soft tissue thickening abutting the anterior mediastinum was diminished.

**DISCUSSION**

This case demonstrates a PSO in the setting of a sternal fracture that may have seeded hematogenously from the patient’s previous spinal hardware infection.

There are approximately 100 reports of PSO in the American literature. In 1926, Wilensky and Samuels reviewed all 23 cases of sternal osteomyelitis that had been reported at the time. They suggested that the actual disease location on the sternum was likely the result of some sort of local trauma, and attributed to damage of the sternal vascular supply. Trauma sequelae was suggested to occur in one of 2 ways: in the first, focal thromboembolic formations develop between the periosteum and surface of the sternum, with purulence accumulating between these 2 layers due to the firmness of the periosteum. Of note, posterior abscess formation would potentially result in mediastinal, interpleural and pericardial suppuration, and other significant consequences. The second sequelae involves infection at the cancellous aspect of the sternum, with advancing destruction of bone that was reported to require resection for management.5

Mir-Sepasi et al reported 4 patients, 3 confirmed heroin users and one suspected of, which developed sternal osteomyelitis with *Pseudomonas aeruginosa* as the infectious agent in all cases. They emphasized immediate x-rays of the sternum, describe that it is mandatory to obtain bacterial cultures. Radioactive scans are suggested for following disease course and extent. Treatments were historically begun when cultures and antibiotic sensitivities were determined, but this paradigm shifted in the 1990s when Shukla advocated for empiric *Staphylococcus aureus* coverage, given that *Staphylococcus* had become the most common bacterial cause of PSO and is reported in a majority of the literature. Biesecker et al reported one case due to *S. aureus* (while the other case reported had no growth on cultures). Glushakow et al reported a patient presenting with spiking fevers, chest pain, flu like symptoms, a pyarthrosis of the manubriosternal joint, and negative cultures, but after exploration of the joint, biopsy yielded osteomyelitis with cultures that grew *S. aureus*. Mitapalli reported a 56-year-old man after 1 week of chest bruising to present with *S. aureus* cultures that did not respond to methicillin, followed by a smear from sternal aspirate to present with *S. aureus* cultures that did not grow on culture. In 1985, Kelly and Chetty put together a table with all organisms before and after 1926, reflect on trauma-related results, cite *S. aureus* as most common cause, and cite how while antibiotics may at times make surgery unnecessary, there is tremendous value in operative approach. Gill and Stevens reports that less than 10% of PSO patients will resolve with antibiotic therapy alone.

For surgical resection, limited resection and curettage of the sternal osteomyelitis sites are an established aspect of treatment approach, even when antibiotic regimens...
are initiated/demonstrate efficacy. The anterior layer of the sternal periosteum should be removed, but the posterior should not, to stabilize the bony thorax, allow for osteogenesis/sternal healing, and partition the mediastinum.

Classen et al10 summarize the principles of surgical management as laid out by Mir-Sepasi et al1, describing healing as something that should be allowed with secondary intention, antibiotic coverage should continue for 6 weeks, to use antistaphylococcal penicillins or vancomycin for severe S. aureus (most common bacterial source), antipseudomonal aminoglycosides (second most common) in concert with renal and audiometric function panels. Mortality has dropped from 27% in Wilensky’s time to 0% at this time. History of heroin use is suggestive.10

Unfortunately, surgical debridement recommendations are based on noncontrolled, nonprospective data. They bring the total number of PSO cases up to 57, and this includes removing some of the Wilensky patients due to sepsis.9

Walker and Pate11 reported 2 cases of aspergillosis PSO without underlying blood dyscrasia, or immunodeficiency, or malignancy. The factor of note was heroin use and region.11

Early diagnosis is challenging in this patient population because of the lack of risk factors—a primary osteomyelitis of the sternum in the absence of a drug abuse history, alternative infectious site, or surgical history leaves a wide differential diagnosis for chest pain.

Local trauma has been cited as a probably source of PSO since the earliest reports.5 Our case supports this possibility.

CONCLUSIONS

This report highlights a challenging case of PSO, refractory to prolonged antibiotics that resolved with surgical debridement and coverage with vascularized regional tissue. It is unclear which patients will benefit from conservative, nonsurgical management. Most cases reported are nonresponsive to conservative treatments. From this case and review of the literature, we believe operative intervention to be the mainstay treatment for the majority of PSO.

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