Bilateral Deltoid Myositis Ossificans in a Weightlifter Using Anabolic Steroids

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abstract

A 40-year-old male weightlifter presented with a 6-month history of a painless mass in the right deltoid. He had no history of trauma to the shoulder other than an arthroscopic rotator cuff repair a few weeks earlier. Physical examination showed a firm, nontender mass located longitudinally and coinciding with the deltoid, measuring 12×14×4 cm. There was no limitation in range of motion or functioning. Magnetic resonance imaging (MRI) and computed tomography (CT) scans suggested a lobulated, heterogeneous mass with multiple areas of calcification that raised suspicion for soft tissue sarcoma vs myositis ossificans. Marginal resection of the soft tissue mass was performed, and pathologic studies confirmed the diagnosis of xanthogranulomatous myositis ossificans with dystrophic calcifications and central cystic degeneration. At 2-week follow-up, the patient had improved range of motion and pain, but he noted a second soft tissue mass in the left deltoid. The MRI and CT scans showed a 10.5×16×3.4-cm linear, lobulated lesion with multiple calcifications, similar in appearance to the contralateral deltoid. The patient admitted to frequently injecting anabolic steroids into his deltoids. Because the patient was asymptomatic on the left side and the MRI appearance of the left deltoid mass was similar to that of the myositis ossificans seen on the right side, the patient opted for nonsurgical treatment. This is a rare case of myositis ossificans occurring bilaterally in the deltoids after repeated injections of anabolic steroids. There is currently no known association between anabolic steroids and myositis ossificans. This condition often mimics malignant neoplasms, illustrating the necessity of resection for diagnostic confirmation.
Myositis ossificans is a form of heterotopic ossification that usually affects active adolescents and young adults. The incidence is slightly higher in male patients than in female patients. It is usually the result of direct trauma (60%-75% of cases) or intramuscular hematoma formation. The most common location for myositis ossificans is the anterior thigh, but any area may be affected, with a higher incidence of cases noted near long bone diaphyses.

Regardless of etiology, patients typically present with tenderness and swelling at the site and are typically unresponsive to activity modification. The diagnosis of myositis ossificans can be difficult because the masses can mimic various soft tissue sarcomas. Nonsteroidal anti-inflammatory drugs (NSAIDs) are often used as therapy once a diagnosis is made, but surgery may be considered if there is continued pain, difficulty with range of motion, or suspicion of malignancy.

This report describes a case of myositis ossificans arising in the bilateral deltoid muscles of an avid bodybuilder without a history of trauma, but with an extensive history of anabolic steroid injections in the deltoid muscle bilaterally.

**CASE REPORT**

A 40-year-old male systems engineer had a 6-month history of a painless right deltoid mass. He denied any history of trauma, but was an avid weightlifter and had undergone arthroscopic right rotator cuff repair a few weeks before presentation. He noticed that the mass had become larger over the past 6 months. On further questioning, he admitted to having injected anabolic steroids into his deltoid muscles many years ago.

Physical examination showed a firm, nontender mass located longitudinally within the deltoid muscle, measuring approximately 12×14×4 cm. He had full range of motion and no tenderness to palpation. No adenopathy or other lesions were identified.

To further characterize the lesion, magnetic resonance imaging (MRI) and thin-cut computed tomography (CT) scans were obtained. These studies showed a linear, lobulated heterogeneous mass within the deltoid muscle, with multiple areas of signal enhancement, consistent with calcifications (Figures 1-2). This suggested a differential diagnosis of soft tissue sarcoma vs myositis ossificans, with the latter being more likely. The patient was advised to undergo resection of the lesion for both diagnostic and therapeutic purposes.

Surgery was performed and showed that the mass was indeed located within the deltoid and was surrounded by a cuff of normal-appearing deltoid muscle. The mass was resected en bloc fashion without violating the tumor or contaminating the surrounding tissue. It was then sent to pathology for histologic diagnosis.

Examination of the excised mass showed a 7.4×3.4×3.4-cm yellow, rubbery mass that was cystic and filled with thick, yellow fluid. There was a central sinus tract throughout the cyst. Histologic examination showed multiple granulomas, with some areas of calcification noted. The diagnosis of xanthogranulomatous myositis ossificans with dystrophic calcifications and central cystic degeneration was made.

At 2-week follow-up, the patient noted improved pain and range of motion in the operative extremity, and scar massage was initiated. In addition, treatment with indomethacin for myositis ossificans was initiated. The patient reported that he felt a new lesion in the left deltoid region. He had aspirated it, draining a white-yellow thickened liquid. When MRI and CT scans were obtained of the left upper extremity, they showed a similarly characterized lesion as the myositis ossificans in the right deltoid. This lesion was 10.5×16×3.4 cm, linear, and lobulated, with multiple calcifications (Figures 3-4). Because the new lesion resembled the myositis ossificans on the opposite side and was relatively asymptomatic, the patient opted not to have the mass excised.

**DISCUSSION**

Myositis ossificans is a non-neoplastic condition defined as heterotopic ossification of the soft tissue. Presentation can occur at any age, but is most common in active adolescents and young adults. The oldest known patient with myositis ossificans was an 83-year-old Japanese woman, and the youngest known patient was a 5-month-old girl. The pathogenesis of myositis ossificans in the context of trauma (myositis ossificans traumatica) has been studied, but remains theoretical. The current hypothesis contends that rapidly proliferating mesenchymal cells eventually differentiate into osteoblasts as a re-
result of localized tissue anoxia, resulting in ectopic bone production. Damage to soft tissue leads to the creation of prostaglandins, attracting inflammatory mediators to the site of injury and upregulating ectopic bone formation.8-10

In the absence of blunt trauma, cases have been reported in the context of infection, drug abuse, and burns, and some cases are of unknown etiology. In these cases, repetitive minor mechanical injuries, chronic inflammation, and ischemia are believed to be associated with the development of myositis ossificans.11,12 The current patient admitted to remote anabolic steroid use, with injection into both deltoids, so perhaps the steroid use, combined with repetitive minor mechanical injuries sustained via his vigorous weightlifting regimen, could explain the etiology of his disease. To the authors’ knowledge, there are no other documented cases of bilateral deltoid myositis ossificans in the literature.

Patients typically present with localized tenderness, swelling, and decreased range of motion.13 The differential diagnosis can include various bony and soft tissue sarcomas, necessitating further diagnostic imaging, laboratory studies, and histologic analysis to rule out malignant processes.14,15 Clearly, the current patient had an atypical presentation of myositis ossificans, with painless lesions found bilaterally in the absence of conventional trauma. Initial radiographic changes are often observed, with scattered calcifications sometimes visible in the early stage of disease. During the acute phase, ultrasound and MRI scans can be used to localize the lesion, but the findings are nonspecific.16 The rate of bone maturity varies from 2 to 6 months. The use of CT scans can provide a 3-dimensional view of the forming bone and can be useful during the maturation phase; CT scans are also useful for observing the zoning phenomenon, where mineralization occurs at the periphery and resembles a ring on CT scan. The center of the lesion is filled with immature fibroblasts and occasionally cartilage. This is an important diagnostic feature of myositis ossificans and helps to distinguish it from osteosarcoma, which mineralizes centrally.17

In the earlier stages, when ossification is immature, periosteal osteosarcoma and synovial sarcoma must be ruled out. Mature myositis ossificans may show characteristics similar to those of parosteal osteosarcoma, chondrosarcoma, and metastatic carcinoma. Metastasis to skeletal muscle is rare, but ossifying skeletal muscle metastases from the large bowel and thyroid adenocarcinomas have been reported.18,19 Laboratory tests, such as serum alkaline phosphatase and erythrocyte sedimentation rate, are useful in the presence of known traumatic etiology. In the absence of trauma, these studies have not been shown to reliably predict the maturity of ectopic bone, as in myositis ossificans traumatica.16,20

Treatment of myositis ossificans typically does not require surgery because this condition is usually self-limited and can regress spontaneously over time. Pharmacologic treatment with NSAIDs, especially indomethacin, has been used for heterotropic ossification because NSAIDs inhibit prostaglandin action.4 This treatment has been found in some studies to reduce muscle catabolism in the case of myositis ossificans, but in other studies it decreased the overall torque and force generation of affected muscles.21,22 Surgical intervention is indicated if limited function and/or pain persists after maturation of heterotopic bone, if neurovascular impingement occurs, or if the lesion becomes unusually large, suggesting malignant transformation. Surgery is not recommended before 6 months because of the latency of maturation that sometimes occurs.7,8 In the current patient, imaging studies could not rule out sarcoma and the lesions had become very large.

Histologic analysis confirmed the diagnosis of myositis ossificans. Three types of histologic myositis ossificans have been described in the literature.7,23 Type I is described as highly cellular, with islands of osteoid, and can be confused with parosteal osteosarcoma. In the current patient, the lesions showed multiple cystic structures, with scattered calcifications, in yellow fluid, consistent with a diagnosis of type I myositis ossificans. Type II lesions are mainly osteoid and consist of young bone, with osteoblastic rimming and rare cellular areas. Type III lesions have mature bone and cartilage as well as dense, fibrous connective tissue surrounding the lesion.
This case report suggested a previously unknown association between anabolic steroid injections and myositis ossificans. It is known that repeated microtrauma from submuscular injections can cause myositis ossificans, but it is unknown whether anabolic steroids are also causative. There is also the question of whether anabolic steroid injection acted as a foreign body reaction or a tumor-inducing agent. This has been observed, for example, in polymyositis caused by leuprolide depot injections for prostate cancer, but has not yet been studied as a potential cause of myositis ossificans or other soft tissue tumors with the use of anabolic steroids. Although further investigation is warranted, myositis ossificans should be considered a complication of anabolic steroid injection.

**References**


