

Heterotopic Mesenteric Ossification after Blunt Abdominal Trauma and Multiple Surgical Operations

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We present a case of a 26-year-old man with mesenteric heterotopic ossification following blunt abdominal trauma and multiple surgical operations. Computed tomography 10 months after the initial trauma demonstrated linear, branching opacities within the small bowel mesentery that had a cortical and trabecular structure indicative of mature bone. We found only 25 reports in the literature of small bowel mesentery heterotopic ossification. The significance of this non-neoplastic process is three-fold: (1) patients often present with bowel obstruction ; (2) the process tends to worsen or reoccur after repeat laparotomy, and (3) rare forms of malignant neoplasms such as extraskeletal osteosarcoma may have a similar appearance.

Introduction

Heterotopic ossification is the process of bone deposition in the extraskeletal soft tissues. This commonly occurs after trauma, but the exact mechanism is unknown. It most frequently affects the musculature, typically in the lower extremities, but can also be observed in tendons, fasciae, subcutaneous fat, and periosteum

[1]. Classically, this form is well circumscribed, round and easily identified [1,2]. Rare lesions occur intra-abdominally, with the most common location being in the mesentery. Generally, these patients are male, elderly and have a history of abdominal trauma and/or surgeries and present with bowel obstruction [2,3].

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Abbreviations: CT, computed tomography

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Case Report

A 26-year-old man, previously in good health, presented with polytrauma after being involved in a high-speed motor vehicle crash. Radiographs demonstrated multiple pelvic ring injuries and extremity fractures. An initial CT scan of the abdomen demonstrated lacerations of the spleen and liver, but with no signs of active bleeding. There were no signs of bowel injury; however, pelvic fluid was observed. Retroperitoneal hematoma extended cephalad from the pelvic ring

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Figure 1. 26-year-old man with polytrauma who developed mesenteric ossification. CT scan one week after the initial trauma shows retroperitoneal hematoma and open mid-line abdominal wound to relieve abdominal compartment syndrome.

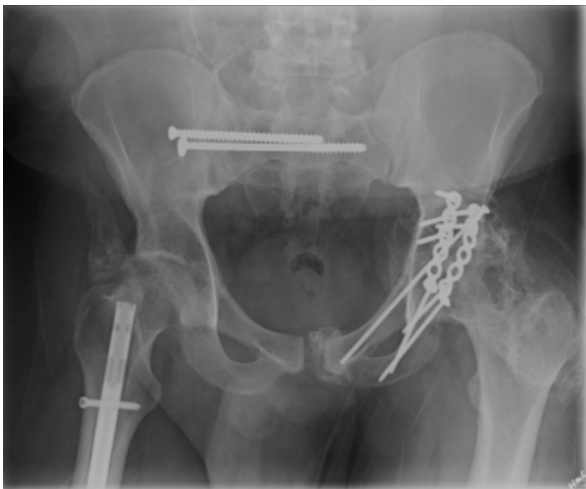


Figure 2. 26-year-old man with polytrauma who developed mesenteric ossification. AP pelvis radiograph 10 months after initial trauma showing bony densities at the insertion site of the right femoral IM rod, overlying the left hip, overlying the symphysis pubis, and overlying the lower abdomen.

injuries. The patient did not proceed directly to surgery because his course was complicated by severe respiratory distress from bilateral pulmonary embolisms. Following stabilization, the patient developed abdominal compart-

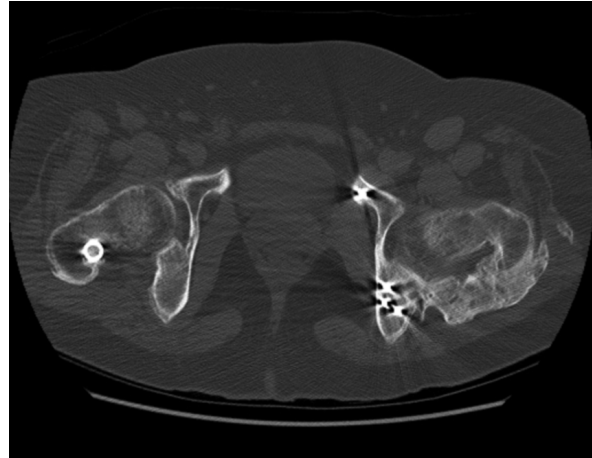


Figure 3. 26-year-old man with polytrauma who developed mesenteric ossification. Axial noncontrast CT shows extra-articular fusion of the left hip by heterotopic ossification.

ment syndrome and laparotomy was performed. At surgery, the patient was found to have fecal peritonitis from bowel rupture with intestinal ischemia and several segments of necrotic bowel. Both the distal ileum and ascending colon were resected because of their nonviability. The retroperitoneal hematoma was observed, but not disturbed. The ventral abdominal wound was left open. The patient's CT scan one week post-trauma showed no signs of ossification (Fig. 1). Numerous unsuccessful operations were carried out over the ensuing weeks in an attempt to close the patient's ventral wound. The wound was managed with a vacuum assisted closure initially, followed by a temporary silastic closure. A skin graft closure was completed nearly 40 days after his initial trauma. During the ventral hernia closure, heterotopic ossification could be palpated around the rim of the wound.

Ten months after the initial trauma, as part of an evaluation for left hip stiffness, the patient had radiographs of the pelvis that demonstrated densities around both hips and over the lower abdomen (Fig. 2). On CT, these densities had a well-defined cortex and internal trabecular structure, indicative of mature bone (Figs. 3 and 4). The left hip stiffness was found to be the result of heterotopic bone bridging the greater trochanter and the posterior acetabular wall (Fig. 3). The abdominal densities were demonstrated to be within the small bowel mesentery, and had the morphology of branching

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Figure 4. 26-year-old man with polytrauma who developed mesenteric ossification. (A) Axial noncontrast CT demonstrates a large ventral hernia filled with bowel and covered by a skin graft. In the mesenteric fat, there are multiple linear branching opacities that appear contorted and trabeculated, separate from the bowel or abdominal wall (arrows). (B) Coronal CT reformation demonstrates the superior inferior orientation of the heterotopic ossification (arrows). (C) Sagittal CT reformation demonstrates the craniocaudal orientation of the heterotopic ossification (arrows). (D) Bone settings shows the cortical and trabecular structure of the mesenteric heterotopic ossification (arrows).

sheets (Fig. 4). The diagnosis of mesenteric heterotopic ossification was made on the basis of this imaging.

Discussion

Heterotopic ossification is the development of bone at extraskeletal sites. The most familiar form for radiologists is the localized heterotopic ossification that occurs in the muscles following blunt trauma and hemorrhage, commonly called myositis ossificans. It commonly occurs in the extremities, and is seen most often in young male athletes [1]. Although it usually follows blunt trauma, it may also be associated with infectious, neurological, or idiopathic etiologies. It has been well described after traumatic spinal cord injury, paralysis, burns, hip arthroplasty, and abdominal scar formation [1,4,5]. Rarely, a similar process may occur within the mesentery.

Mesenteric heterotopic ossification, also called

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intraabdominal myositis ossificans [3] or mesenteritis ossificans [6], is extremely rare, with only a couple dozen or so cases reported in the literature to the best of our knowledge [2-4,6-17]. In a few of these cases, the omentum was concurrently involved [2,6,7,9]. The first reported radiologic findings of intra-abdominal ossification affecting the mesentery we could find was published in 2001 by Hakim and McCarthy [8]. We reviewed the literature and only a few cases of intra-abdominal heterotopic ossification are described in regards to radiologic imaging.

On review of the literature, the vast majority of cases involved adult men whose most common presentation was bowel obstruction. Both trauma and abdominal surgery have been consistently identified as antecedents to mesenteric heterotopic ossification. Two cases involved penetrating abdominal trauma [8, 9]. One case affected a woman who presented with appendicitis [13]. Histologically, most cases showed minimal atypical mitosis or anaplasia. The classic “zoning phenomenon” of immature osteoid surrounded by maturing osteoid and osteoblasts was often observed [2-4,6,7,9-11].

The mechanism for intra-abdominal heterotopic ossification is unproven, but its morphologic appearance is quite similar to myositis ossificans [2], and it is likely to occur by a similar mechanism. According to Kaplan et al. [18], four key events are necessary for the development of heterotopic ossification in the soft tissues. The first is an inciting stimulus such as surgical or mechanical trauma; however, ischemia, venous stasis, edema and inflammation have been implicated as well [3,4,12,18]. Next, inductive signaling pathways must be formed at the site of injury. During this process, there must be a population of undifferentiated mesenchymal cells, like inducible osteoprogenitor cells, that can respond to various signals. Finally, the environment must be suitable for osteogenesis. Only a very small percentage of patients who have surgical or mechanical trauma develop heterotopic ossification [19].

The differential diagnosis for intra-abdominal densities after trauma or surgical exploration should include: heterotopic ossification, dystrophic calcification, osseous neoplasia, oral contrast extravasation, and foreign material [3,8,9,10]. Distinguishing among them radiologically may require a high degree of clinical suspicion. If little or no history is available, the diagnosis can be particularly problematic because of its rarity. For example, Hakim and McCarthy [8] reported a case of a

50-year-old man presenting with bowel obstruction who had a history of a stab wound to the left flank two years earlier. A preoperative abdominal radiograph showed densities that were thought to be barium extravasation, but at surgery, heterotopic bone was found obstructing the bowel. A postoperative CT with contrast described some residual heterotopic ossification but also misinterpreted it as barium extravasation [8]. This illustrates the high level of suspicion needed to accurately diagnosis this entity and also the importance of history in context of the study. Additionally, Tonino and colleagues described a similar case of multiple gunshot wounds to the abdomen in which a CT scan one month later was read as oral contrast medium leakage even though the exact location of leakage could not be found [9]. Densities with a well-defined cortex and internal trabecular pattern on imaging suggest mature bone rather than contrast leakage or dystrophic calcification. Dystrophic calcification typically causes faint radiodense areas that are punctate and irregular [9]. Additionally, mineralized neoplasms such extraskelatal osteosarcoma or extraskelatal chondrosarcoma generally show irregular, immature growth patterns rather than the mature trabecular bone seen in heterotopic ossification. Lastly, oral contrast leakage will evolve on serial images with collection occurring in dependent areas [3,8,10], and there will be no internal structure.

The recognition of heterotopic mesenteric ossification is important because of its propensity to recur and cause bowel obstruction [4]. Treatments that have been suggested to decrease regrowth include anti-inflammatory medications, disphosphonates, and radiotherapy [3,12]. Tonino and colleagues reported a case of mesenteric ossification that was treated with indomethacin and showed no increase in size after three months [9]. We were unable to find any cases documented in the literature in which mesenteric heterotopic ossification has undergone malignant degeneration.

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