Silver nitrate stain masquerading as a heterotopic ossification

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ABSTRACT
Silver nitrate is a commonly used substance in the cauterization of the traumatic soft tissue wounds to stop bleeding. As an inorganic compound with high density, silver nitrate is very radiodense. We present a case of topical silver nitrate application on a fingertip laceration of a 32-year-old diabetic woman, which was misinterpreted as heterotopic ossification. The appearance of silver nitrate on radiographic studies is not widely known, which can lead to misdiagnosis, further unnecessary imaging, and inappropriate surgery.

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Introduction
Silver nitrate is commonly used to cauterize bleeding wounds, overgranulation tissues, skin tags, and warts. The silver nitrate stain, because of its inherent high density, may have the radiographic appearance mistaken for bony structures or foreign bodies. Our case report illustrates a silver nitrate stain misdiagnosed as heterotopic ossification.

Case report
We report the case of the radiographic appearance of a silver nitrate stain at a site of soft tissue wound cauterization, which was misinterpreted as a heterotopic ossification. The patient is a 32-year-old diabetic woman who presented to the emergency department for a laceration of the ring finger pulp using a mandoline slicer. To stop the bleeding, the emergency room physician used topical silver nitrate to cauterize the finger pulp wound. There were no radiographs obtained at the time of injury.

Eight days later, the patient returned to the emergency department with an infected ring finger, in excruciating pain. To monitor her blood sugar, the patient reported performing daily finger pricks using her index, middle, and ring fingers. On physical examination, the tip of her ring finger was swollen, black, and oozing pus. She was admitted for IV antibiotic and pain management, pending surgical debridement. During this admission, a radiographic series of the ring finger was obtained to rule out osteomyelitis. There was no radiographic evidence of osteomyelitis. However, in the soft tissue of the fingertip at the site of the open wound, there is a 1.0 × 0.3 × 0.8 cm well-circumscribed dense structure, separate from the adjacent intact distal phalanx. On radiographs, it has the density and appearance of bone (Figs. 1 and 2). The radiologist described the finding as a bony structure, with cortical bone and bone marrow matrix, interpreting it as a heterotopic ossification in a very unusual location.

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Because of the infection and intense pain, the patient was taken to the operating room for wound debridement and removal of heterotopic ossification. The area of blackened soft tissue at the tip of the finger was debrided by an experienced hand surgeon. The excised blackened tissue was found to be soft and somewhat liquefied, without any extrasosseous bony structure (heterotopic ossification) in this location. After draining the pus, the surgical specimen was sent to pathology for culture and analysis.

Since the pathology report did not find heterotopic ossification, a postoperative radiographic series was obtained. Compared to the initial radiographic series, the extrasosseous bone-like structure previously diagnosed as heterotopic ossification was no longer present (Figs. 3 and 4). This clearly illustrates that the silver nitrate stain, debrided during surgery, was initially mistaken for heterotopic ossification.

**Discussion**

Silver nitrate is an effective topical chemical agent, often used in the emergency department, to cauterize wounds and burns. Due to its ease of use and efficacy, it can be administered during the critical management of bleeding wounds, causing rapid hemostasis by accelerating the clotting process. Silver nitrate functions as a cauterizing agent by delivering free silver ions, which bind to tissue, obstructing vessels and forming scabs. This serves as a treatment benefit in the cauterization of superficial blood vessels in the nasal cavity to stop nose bleeds. It also has antimicrobial properties. Silver nitrate can be utilized to heal oral ulcers. It is used to remove hypergranulation tissues in stoma and wound and eliminate unwanted skin tags and warts.

As an inorganic compound, silver nitrate with the chemical formula of AgNO₃, has a high density, high mass attenuation coefficient and is, therefore, very radiopaque [1]. Because of this inherent high radiodensity, silver nitrate can easily be mistaken for bony structures or foreign bodies on radiographic studies [2]. In our case report, the silver nitrate stain was misdiagnosed for a heterotopic ossification.

Heterotopic ossification or traumatic myositis ossificans is a formation of extraskeletal bone in muscles and soft tissues. As a common complication of trauma and surgery, a hematoma can develop into a heterotopic ossification. Conceptually, the resulting heterotopic ossification is a tissue formation.
Dynamic and phasic, heterotopic ossification reflects the sequential process of an irregular bone maturation. As a result, the classic radiographic appearance of mature intramuscular heterotopic ossification is represented as a well-developed, well-circumscribed radiodense structure with bone cortex and bone marrow matrix, separate from the adjacent bones, with a zonal ossification process [3].

Without the presenting clinical history for silver nitrate use, it is reasonable for the radiologist in our case report to misinterpret the radiographic finding of a silver nitrate stain as a heterotopic ossification. When the silver nitrate disperses into the wound bed, it has the density and radiographic appearance strikingly similar to bone. Despite the highly unusual location for a heterotopic ossification to appear at the finger-tip pulp, this may be consistent with a hematoma resulting from the history of daily finger prick trauma to monitor blood sugar in our diabetic patient.

In reviewing the literature, there are a few case reports demonstrating silver nitrate stain as false positives for avulsion fractures [4] and foreign bodies on plain radiographs and computed tomography [2,5,6]. Our case reports a silver nitrate stain as a cause of misdiagnosis for heterotopic ossification. Taking into consideration the history of silver nitrate cauterization during radiologic interpretations can prevent misdiagnosis and avoid unnecessary surgical intervention.

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