The misleading appearance of silver nitrate on plain radiography

N Narayan¹, MC Nogaro², A Littlewood⁵, MD Latimer⁵

¹Barts Health NHS Trust, UK

²Milton Keynes Hospital NHS Foundation Trust, UK

⁵Peterborough and Stamford Hospitals NHS Foundation Trust, UK

ABSTRACT

Cauterisation with silver nitrate is commonly used to treat overgranulation. Silver nitrate has a high density and a high mass attenuation coefficient, and it is therefore highly radio-opaque. We present a case in which its topical application to an area of overgranulation was interpreted as a bony fragment by the reporting radiologist in a patient with a supracondylar humeral fracture whose radiograph after removal of K-wires showed a large radio-opaque lesion. Although not a new phenomenon, it is one not widely known, and it can lead to confusion and unnecessary further imaging.

KEYWORDS

Silver nitrate – Radio-opacity – Overgranulation

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CORRESPONDENCE TO

Marie-Caroline Nogaro, Registrar in Orthopaedics, Milton Keynes Hospital, Standing Way, Eaglestone, Milton Keynes MK6 5LD, UK

E: nogaro.mc@gmail.com

Case History

We report the case of a three-year-old girl who sustained a supracondylar humeral fracture. This was treated with closed reduction and K-wire fixation. The fracture healed well and the K-wires were removed under nitrous oxide and oxygen three weeks following the injury. On removal of the wires, considerable overgranulation tissue was noted on the medial side of the elbow, which was treated with silver nitrate.

Plain radiograph of the elbow following the procedure demonstrated a 15mm × 10mm radio-opaque lesion on the medial side of the elbow (Fig 1), which was interpreted by the reporting radiologists to be ‘a large detached bony fragment lying in the cubital fossa’. This diagnostic misinterpretation was noticed in clinic at a follow-up visit by the treating orthopaedic surgeon and reported back to the radiology department. The history of silver nitrate application had not been documented on the radiograph request form. However, previous films were available for comparison.

Discussion

The formation of granulation tissue is a necessary part of the proliferative phase of wound healing. Dermal fibroblasts increase in number and synthesise a network of protein fibrils. Local tissue hypoxia promotes angiogenesis and this protein framework is infiltrated by capillary buds. In normal wound healing, epidermal keratinocytes

proliferate at the margins of the wound before migrating across the newly formed granulation tissue. These keratinocytes form an epithelial membrane and the wound is sealed. Occasionally, the proliferative phase is excessive and granulation tissue is formed well above the height of surrounding healthy tissue. This is described as ‘overgranulation’. The cause of this exuberance is not well understood but it may represent an aberrant response to a persistent inflammatory stimulus.

When overgranulation occurs it impedes epithelialisation and delays wound healing. Various methods have been described to treat overgranulation including topical steroids, steroid impregnated tape and cauterisation with silver nitrate. Silver nitrate inhibits fibroblast proliferation and usually leads to a rapid resolution of the overgranulation.

The mass attenuation coefficient is a standardised measure of attenuation of materials independent of their physical state. This coefficient, however, is dependent on the energy of incident radiation due to K shell effects (assumed to be 50kV in our calculations as this is the standard setting for paediatric elbow radiograph). The mass attenuation coefficient of silver nitrate is 5.97cm²/g,¹ which is approximately 14 times greater than that of cortical bone (0.424cm²/g) at the same incident energy of radiation. It is therefore highly radio-opaque and appears on plain radiograph even when applied as a thin film over an area of overgranulation. Failure to appreciate this as an artefact could, at the very least, lead to further unnecessary imaging.

Figure 1 Radiography demonstrating a large radio-opaque lesion on the medial side of the elbow representing an area of silver nitrate application

Fractures around the elbow represent about 10% of all childhood fractures.² Six separate ossific nuclei appear in sequence during development of the elbow. Accurate assessment of paediatric elbow injury radiograph requires consideration of the position of each of these islands of bone in their cartilage anlage. The topically applied silver nitrate in this case looked remarkably like an abnormal ossific centre and, indeed, was interpreted as such by the reporting radiologist.

Conclusions

This phenomenon has been reported previously.^{3–5} The earliest report that we found in the literature was published in the *British Medical Journal* in 1970.⁵ Nevertheless, it is a phenomenon that is not widely known. We recommend applying silver nitrate for cautery after having procured radiographs as the simplest solution. If not feasible, the use of silver nitrate should be mentioned on the request card to ensure the reporter is aware of this.

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