CASE REPORTS

Regional intravenous calcium—an effective method of treating hydrofluoric acid burns to limb peripheries

J M Ryan, G M McCarthy, P K Plunkett

Abstract

An effective method of providing pain relief in hydrofluoric acid burns is reported, using a Bier's block type technique and regional intravenous calcium gluconate. This method allows satisfactory analgesia and prevents further tissue destruction, without the risk and added discomfort of increased tissue tensions associated with local infiltration of calcium.

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Keywords: hydrofluoric acid; burns; calcium; Bier's block

Two patients with hydrofluoric acid burns to the periphery of a limb presented in pain to the accident and emergency (A&E) department.

Case 1

A 44 year old male presented to the A&E department of St James's Hospital, 12 hours after sustaining a burn to his right foot while working with hydrofluoric acid. Immediately after the burn he had washed his foot and applied calcium gluconate gel, in accordance with recommended procedure. He continued to complain of severe pain at the site of the burn and was unable to sleep that night.

On examination, he had a 2 cm diameter blister with surrounding erythema over the lateral aspect of his right foot (fig 1). The blister was deroofed and local injection of calcium gluconate was attempted, on the advice of the plastic surgery team, but had to be stopped because of pain at the injection site.

It was decided to use intravenous calcium gluconate in the manner of a Bier's block in an attempt to produce analgesia and minimise the continuing tissue destruction.

PROCEDURE

The patient was attached to a cardiac monitor. A dorsal vein on the foot was cannulated and, following limb elevation, a tourniquet was applied to the calf. A double cuff was inflated to 300 mm Hg. Fifteen millilitres of 10% calcium gluconate mixed with 15 ml of water

were injected intravenously. This led to rapid and complete pain relief. The tourniquet was deflated gradually after 10 minutes, without any systemic side effects. A povidone-iodine (Betadine) dressing was applied to the wound and the patient was admitted to hospital. He required no further analgesia after the regional infusion of calcium.

Formal debridement of the wound was later carried out under general anaesthesia and a split skin graft was applied. Subsequent recovery was complete and uneventful.

Case 2

A female worker, whose occupation entailed exposure to hydrofluoric acid for the purpose of cleaning radio valves, attended the A&E department. She had been exposed to hydrofluoric acid the previous day, and had received first aid, using calcium gluconate gel. Overnight, her symptoms had failed to settle. Examination showed damage to the pulp of her index finger, with obvious extension beneath the nail. An intravenous regional block using calcium gluconate was performed in a similar fashion to the case described above. Resolution of her pain was achieved within minutes, allowing continued management on an outpatient basis. The skin overlying the radial side of the pulp of her index finger subsequently sloughed, leaving her with a slight degree of tissue loss, but a reasonable cosmetic result.

Figure 1 Hydrofluoric acid burn on the foot.

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Discussion

Hydrofluoric acid is commonly used in industry as a cleaning agent for metals and glass.¹ Burns resulting from contact with it may present early or late to the A&E department. Early presentation, with severe pain, occurs with concentrations of greater than 20%.² Burns resulting from more dilute forms of the acid may present with delayed onset of pain, erythema, and crust formation at the site of the burn. One of the characteristic features of hydrofluoric acid burns is intense and often delayed pain. This may occur despite standard first aid treatment. The pathophysiology is said to be the permeability of the fluoride ion, which enables it to rapidly penetrate skin, subcutaneous tissues, and bone. Rapid binding of calcium by the fluoride ion forms insoluble salts, and the ensuing drop in local tissue calcium interferes with cellular function and causes cell death. Cell death in turn releases large amounts of potassium, which irritates nerve endings, causing severe pain.

Methods of treating these burns are aimed at local pain control and prevention of progressive tissue damage. The most effective of these has repeatedly been shown to be the local infiltration of calcium gluconate or application of topical calcium carbonate to bind the fluoride ion, forming an insoluble salt.^{1,3} This removal of the free fluoride ion prevents progressive tissue necrosis and achieves simultaneous pain control. More recently, the identification of severe hypocalcaemia associated with fluoride loading has raised concerns over the life threatening, rather than limb threatening, nature of this injury.^{4,5}

Topical and local infiltration using gel or local injection are, however, not without problems. Gel may be ineffective, particularly in delayed presentations. Local infiltration is often found to be to exceedingly painful, and has the added disadvantage of potential

compromise to the local circulation, possibly requiring concomitant fasciotomies when treating digital burns.² The use of local anaesthetic infiltration is contraindicated, as the cessation of pain is used as an indicator of effective treatment.¹ Intra-arterial infusion has been advocated, but is technically more demanding and potentially more hazardous.

Regional intravenous calcium injection using a Bier's block technique satisfies all the aims of effective treatment of hydrofluoric acid burns. The 15 ml of 10% calcium gluconate, if released suddenly, can cause flushing, headache, and arrhythmia, so we recommend the use of a double cuff tourniquet and cardiac monitoring during the procedure. Despite these potential problems we feel that this amount of calcium is safe, given that there is rapid binding to fluoride. Furthermore, the risks must be balanced against the hazards of continued tissue destruction and the need for adequate pain relief. Both these patients received rapid and complete analgesia, tissue necrosis was halted, and possible systemic effects from either the burn or its treatment were avoided. This procedure is technically much simpler and seemingly safer than intra-arterial infusion. It is easy to perform in an A&E department when the patient first presents. Doctors working in A&E departments should be aware of this procedure, which can be used effectively to treat hydrofluoric acid burns to both upper and lower limbs.

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Stun gun injury

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Abstract

A case is presented of injury by a "stun gun." The different types of electric shock devices produced commercially are summarised and the potential injuries discussed.

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Keywords: stun gun; electrical burn

Case report

A 58 year old man attended the accident and emergency (A&E) department after being attacked with what he described as a "cattle

prod" during a robbery. He described sparks being emitted from the device, which was deliberately applied to the dorsum of his right hand as he tried to defend himself. Examination revealed a partial thickness electrical burn to the hand, with extensive soft tissue swelling. The wound was dressed and he was reviewed in the clinic.

Figure 1, taken 10 days after the assault, shows the haematoma secondary to the deep soft tissue injury. Just visible are the contact points of the electrodes on the skin. The haematoma was aspirated and the injury resolved in four weeks.