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Case Report

Cement Burn Leading to the Amputation of the Lower Leg

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Abstract

Cement burns are a rare injury, which can occur after long exposure to the skin. We present the case of a 72-year-old man who sustained a cement burn of his lower leg. The late presentation of the injury in conjunction with his comorbidities resulted in an amputation of his lower leg.

Keywords: *Cement Burns; Amputation; Lower Leg*

Introduction

In the process of making concrete, cement and water induce a chemical reaction, which releases heat up to 70°C. When exposed to the skin, burns can be caused. The severity largely depends on the exposure time. In most cases, cement can be removed early enough before it causes injuries. As such, the most common cases present themselves with a dermatitis type of redness. In our case, however, prolonged exposure led to extensive soft tissue necrosis resulting in the amputation of the lower leg due to the patient's comorbidities and neglect.

The Case

A 72-year-old man presented himself in the A&E department. Three weeks ago, he had helped his son pour a foundation during renovation work. During the process, liquid concrete had flowed into his rubber boot. He only noticed it when the concrete became hot inside the boot. He then took off the boot and his pants. His lower leg and foot showed severe redness. He briefly cooled the redness with water and was able to continue working after changing his clothes. In the following days, he paid little attention to the redness. He apparently ignored the discoloration until it reached its current extent. He did not seek medical attention for the injury.

The patient is, considering his age, quite active and, along with his wife, self-sufficient. There is a history of coronary heart disease. He has been smoking 20 cigarettes per day since his youth and suffers from an insulin-dependent diabetes mellitus with a known diabetic polyneuropathy.

Findings

The left lower leg and foot present as follows: extensive, deep, circular, and medially emphasized necrosis formation in the distal third of the lower leg and the entire dorsal surface of the foot, with mummification of all the toes.

Figure 1

For treatment planning, an angiography CT scan was initiated. It revealed a massive sclerosis below the trifurcation with long-segmented stenosis and complete occlusion of the arteries as from the mid third of the lower leg.

Treatment

Admission was made with the intention of a soft tissue debridement. In accordance with the CT findings, deep necrosis was found in an overall atrophic soft tissue envelope. Debridement followed by vacuum therapy and two-stage soft tissue coverage was no longer considered feasible. Therefore, a lower leg amputation was performed.

Discussion

In the production of concrete, cement is often used. Cement contains calcium oxide, silicon dioxide, aluminium oxide, iron oxide, and sulfate. Calcium oxide reacts with water to form calcium silicate hydrate (CSH) with the release of heat. During the curing process of concrete, temperatures of about 50 to 70 degrees Celsius can be generated, known as "hydration heat". Additionally, the chemical reaction induces an alkaline pH. This can cause further tissue damage by dissolving proteins and collagen, dehydrating cells, and saponifying fat. Both factors, heat and an alkaline surrounding, can lead to injuries that are referred to as "cement burns".

In 1995, a classification of cement burns was done by Xiao and Cai, taking into consideration the mechanism of cement injury on the skin [1]. Three types of burns can be produced by cement: by abrasion, blast or heat [2]:

- Abrasion burns are the most frequent injuries and are located mostly on the lower limbs, affecting knees and lower legs with less than 5% of the skin surface [2].
- Blast burns are produced by explosions and are rare, but more severe, with systemic damages [3].
- Heat burns are explained by thermal damage, a chemical process that induces the production of alkaline substances with destructive effects on the skin [4].

The injuries are relatively rare. Even in specialized burns centres, their share varies between 1 and 2% [5]. Almost 80% of them occur in do-it-yourselves, and more than half of this group do not work with adequate protective equipment or are unaware of the risks. Most injuries involve the lower legs and knees. In all cases, less than 10% of the skin's surface is affected [2,5-7]. The studies found full- thickness burns in 50 to 66% of their cases, with an operation being required in 20 to 34%.

In 1963, a first case of a grade 3 burn to the shins was described by Rowe [8]. Their patient had been kneeling for 21/2 hours in ready-mixed cement. A similar injury was described by Vickers [9] in two patients that spent several hours with wet cement inside their boots. Further reports found the same injury pattern. They had a long exposure time with wet cement, in general 2 to 6 hours, in common [10-12].

When wet cement does come into contact with the skin there are often no immediate symptoms, and this may lead the worker to maintain contact. The extent of tissue damage then depends on the temperature and duration of exposure. Denaturation of cellular proteins can occur as early as 40 to 44°C, while cell death occurs at 45°C with an exposure time of about one hour. At 70°C, a third-degree burn can occur in just one to two seconds.

One particularity of thermal injuries is that the full extent may not be immediately apparent due to the presence of the "stasis zone." This refers to a narrow zone of thermally damaged skin cells that can progress to complete necrosis, known as "afterburning". The stasis zone is caused by impaired microcirculation due to blood vessel constriction, edema formation and subsequent reduced blood circulation. Thus, a superficial second-degree burn (grade 2a) with blistering can progress to a deep second-degree burn (grade 2b), which then requires an expanded treatment approach involving necrosectomy and skin grafting.

Initial treatment must therefore aim at removing all cement immediately by washing with liberal amounts of water. The exposed area needs to be kept dry. In the case of inflammation or blistering, the affected skin needs to be dressed and carefully followed up for the development of a deeper burns.

In cases of advanced injury, treatment for a thermal injuries of grade 2b or higher involves surgical intervention, which must be tailored to the general treatment plan. Since thermal injuries of grade III or higher often accompany complex overall injuries, they must be taken into consideration. The surgical approach involves necrosectomy followed by soft tissue coverage. Depending on the condition of the wound, definitive wound closure can be achieved with a clean wound bed. Temporary vacuum therapy is available to reduce the burden of dressing changes for the patient and promote wound bed granulation.

The aesthetic and functional outcome after treatment can be limiting. Besset [13] found sequelae in 88% of medically treated patients and in 18% of patients treated surgically.

In the case of our patient, the removal of the necrotic tissue would not have been beneficial. The extent of the necrosis was too advanced in the periphery, and preserving or partially preserving the tissue through amputation was not possible due to the lack of perfusion. The underlying distal polyneuropathy likely contributed to the delayed recognition of the thermal reaction, allowing for the profound development of the injury.

Conclusion

When handling cement, attention must be paid to its potentially hazardous effects. In addition to effective protection, it is important to avoid all skin contact and, in the event of exposure, to intervene break through immediately and keep under surveillance. This means that an intervention can be initiated at an early stage in order to avoid more extensive damage.

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