Amputation level after frostbite—role of bone scan.  
A case report

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Abstract

Background: Frostbite is defined as the damage sustained by tissues while subject to temperatures below their freezing point. Severity of tissue damage is variable, but frequently can result in amputation. Early surgical debridement is contraindicated in almost all patients because it can take weeks for definitive demarcation of nonviable tissues to occur. Bone scan is indicted in the evaluation of frostbite injuries and helps to establish an early prognosis.

Clinical case: We present the case of a 42-year-old male who experienced frostbite injury in the fingers and toes after >24 h at 8,000 m. The patient was treated with anticoagulant and topical therapy for 6 weeks. During this period, two consecutive bone scan studies were carried out showing no changes in the level of vascularization. However, clinical improvement is important. Devitalized tissues were delimited to the level marked by the bone scan; therefore, amputation was performed.

Conclusion: Bone scan remained invariable, which can assist us in determining amputation level early without delaying surgery.

Key words: frostbite, bone scan, amputation level.

Introduction

When tissues remain at temperatures below their freezing point (0.55°C),1 unrecoverable injuries will occur; their gravity is proportional to the temperature and the duration of the exposure.2

In the last 20 years, frostbite has ceased to be a problem exclusive to the military population and has become one that affects civilians who are homeless or who participate in winter sports.3 The consequence of these lesions in the extremities can be disastrous, occasionally requiring amputation,4 with serious consequences for young and active patients. Currently, after the freezing of tissues, an average of 6 weeks is expected for surgery or amputation in order to minimize the tissue to drying,5 hoping that this surgical delay dedicated to the treatment of revascularization allows for the recovery of part of the ischemic tissue.6

Bone scan is a complementary examination to monitor the level of vascularization of the tissues, which can help determine the early level of amputation without having to delay surgery.

Clinical Case

We present the case of a 42-year-old male with no relevant medical history. He was an experienced mountaineer, remaining at about 8,000 m for >24 h. He suffered from ophthalmia from the snow with quick vision loss and frostbite of the distal third of his nose, left earlobe, both feet up to his ankles and hands halfway up to his carpus. He received anticoagulant therapy and topical cures by the medical unit staff of the expedition. He was admitted to our hospital 7 days later with necrotic sores in the nasal appendix and left earlobe.

Hands

The patient had superficial and deep second-degree frostbite in P3 and P2 of the 2nd, 3rd, 4th and 5th fingers of both
hands; first degree frostbite in P2 of the first finger of the left hand; tissue involvement halfway up the carpal in both hands without being able to clinically determine their level of depth (Figure 1).

**Feet**

The patient had superficial and deep second-degree frostbite from the distal to the metatarsophalangeal joint of all the toes on both feet with more tissue involvement closer to the ankle and with undetermined depth (Figure 2).

We performed a $^{99m}$Tc-MDP bone scan in two phases with cobalt markers in the distal ends of the fingers, resulting in no uptake of all his toes, affecting P1, P2 and P3 and reaching more than the metatarsophalangeal joints of all. In the hands we observed no uptake in P1 and P2 of all the fingers, without observing involvement of the proximal interphalangeal joint except for the first finger of both hands, which was conserved (Figures 3 and 4). The patient was hospitalized and treated for snow ophthalmia and completely recovered visual acuity. He received topical and systemic anticoagulant therapy. Bone scan was repeated after 13 days. Although clinical improvement was observed in the hands and feet, except for the carpal and ankle, delineation of the necrotic areas of the fingers was also clear. Bone scan demonstrated no notable changes in relation to the previous control study (Figures 5 and 6).

After 6 weeks, once the necrotic areas were delimited and without scintigraphic changes, we performed amputation of all toes with curettage of the head of the first two metatarsals and partial skin closure. Amputation was done of the distal phalanges and part of the middle phalanges in the second to fifth fingers of both hands following the line of necrosis and scintigraphic signs, with partial or total skin closure depending on the soft tissue friability. The patient also underwent nasal and left ear scarectomy of the necrosis. He was discharged after 54 days of hospitalization with...
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good aspect of the stumps and without complications for ambulatory monitoring of the injuries.

Discussion

Classical therapeutic regimens have contraindicated early surgical treatment for frostbite, which does not occur until a clear demarcation of nonviable tissue and takes place about 45 days later. Early surgery is only considered in cases where there is an associated trauma requiring surgical treatment, infection, or compartment syndrome. Even if an amputation or radical debridement is necessary, delaying the surgery is recommended by at least 6 to 8 weeks after frostbite because damage to the adjacent tissues can affect healing. Faced with this classic trend, a debate arises for those who advocate early surgical approach based on the findings of scintigraphy with $^{99m}$Tc-MDP.

There are publications that highlight bone scan to detect the extent of bone necrosis and determine the level of amputation as early as 2 to 4 days after exposure to cold. During a retrospective study of 92 patients with severe frostbite, it was observed that the scan with $^{99m}$Tc in the first days after frostbite marked exactly the level of amputation in 84% of cases. The study by Banzo et al. reached similar conclusions and suggests that bone scan is a useful tool in frostbite injuries in order to establish an early prognosis.

In conclusion, in the case of the patient reported here, we found that clinically the lesions were defined with the passage of time; however, scintigraphic images did not change from the first to the second study, indicating from the beginning what the level of the amputation will be. Accordingly, we believe that the bone scan is a reliable marker for allowing surgical treatment and early functional recovery of the patient’s injuries.
References