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Case Report

Aqueous based Povidone-iodine related chemical burn under the tourniquet (a case report) and literature review

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ABSTRACT

Chemical burn under pneumatic tourniquet is an iatrogenic preventable injury and is rarely reported in the literature. The important mechanisms are maceration, irritation, and prolonged use of the tourniquet and pressure. This rare adverse complication occurred in a 35-year old man who underwent anterior cruciate ligament reconstruction of left knee. 5% aqueous based Povidone-Iodine was used as topical antiseptic and partial thickness burn occurred underneath the area of tourniquet application. Previous reports shows that chemical burns are more common in alcohol based Povidone-iodine than aqueous based. Chemical burn develops when Povidone- iodine does not adequately dry, pools beneath a dependent body part during surgery, or is placed under an occlusive device. To reduce the complications like chemical burn, awareness of the risk and the possible pathogenesis as well as the preventive measures is important in surgical practice.

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1. Introduction

Pneumatic tourniquets have been commonly utilized during orthopedic extremity surgeries to attain a bloodless field facilitating operative procedures. Although tourniquet associated complications like postoperative swelling, delay of recovery of muscle power, compression neuropraxia, wound hematoma with the potential for infection, vascular injury, tissue necrosis, compartment syndrome, and systemic complications have been reported in the literature, the iatrogenic chemical burn during pneumatic tourniquet use has been rarely reported. Here, we report a case of chemical burn to sensitize the orthopaedic surgeons about its possible occurrence.

2. Case report

A 35 year old male underwent anterior cruciate ligament reconstruction on his left knee. The patient did not have thin skin and any underlying skin disease and allergies. The patient's operation was performed under tourniquet control. The tourniquet cuff used was a standard leg tourniquet (18 cm) and was applied with two layers of adequate wool padding. The skin preparation used was a 5% aqueous based Povidone-iodine solution. The set pressure was 270 mmHg which was about 150 mmHg higher than the patient's systolic pressure. The tourniquet compression time was two and half

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hours. When the tourniquet was removed after operation, the burn was seen on the posterior aspect of thigh (Fig. 1). While inspecting the padding where the burn was present, the drape preparation seemed to have run down the patient's thigh during painting and had been left in wet condition underneath the tourniquet. The wound was of intermediate to deep second degree burn of size 7×8 cm. The patient was treated with a saline soaked gauze dressing and was discharged from orthopedic department advising daily dressing. The chemical burn was healed in 3 weeks.

3. Discussion

The chemical burn resulting from tourniquet application cause more in-depth injury to the skin than the abrasion wound because there is greater time exposure and the anesthesia prevents the patient from reacting to the noxious burn stimulus. The iatrogenic chemical burn induced by tourniquet application can have an impact on surgeon patient relationship. The chemical burns are more common in children and old age people where skin is thin and delicate.

Dickinson and Bailey¹ reported four burns in three patients beneath the cuffs of pneumatic tourniquets using alcohol based 10% Povidone-iodine. In all cases, the burns were seen when the tourniquet was removed. All burns were of partial thickness and healed within 4 weeks, leaving minimal scarring. Nahlieli et al.² reported three cases of chemical burns with 10% Povidone-iodine. One of these patients had a partial thickness burn under the tourniquet cuff, after a 2 hour surgery on his right palm. Unlike previous studies, our patient is young adult and had chemical burn due to aqueous based 5% Povidone-iodine. The basic mechanism of tourniquet induced chemical burn involves irritation by antiseptics^{3,4,5} coupled with maceration,^{6,7,8} compression pressure,^{9,10,11} duration of compression, and wetness underneath the tourniquet.^{12,13} Polyvinylpyrrolidone-iodine is a widely used antiseptic which was introduced by Shelanski and Shelanski¹⁴ in 1965. It is a water-soluble compound that results from the combination of molecular iodine and polyvinylpyrrolidone. The commercial preparations available are povidone-iodine solution, scrub, ointment, tincture, and foam; of these, the solution is the most commonly used. The 5% solution generally contains 90% water, 8.5% polyvinylpyrrolidone, and 0.5% available iodine and iodide (pH- 4.5–5.5). Although uncommon,

Fig. 1 – Tourniquet associated chemical burn.

Fig. 2 – Use of elastic stockinette for prevention of chemical burn.

chemical burns have been reported with this solution. Alcohol (70%), which is used for draping, may also cause hypersensitivity. By using alcohol, the epidermal lipid barrier to the skin may be decreased by de-esterification.

To prevent tourniquet associated chemical burn, friction between the skin and the tourniquet should be avoided either by using elastic stockinette (Fig. 2) or surgical glove (Fig. 3) below the cotton roll followed by application of adequate cotton (at least two layers). The applied cotton roll should be uniform in thickness. Movement of tourniquet during draping and compression should be prevented by applying cotton bandage over the cotton and crepe bandage over the tourniquet cuff. Soaking of cotton by Povidone-iodine can be prevented by applying adhesive plaster or antimicrobial incise drape (Ioban) at distal end of tourniquet which acts as barrier occlusion (Fig. 4). The shape mismatch between the tourniquet and the thigh should be considered when applying tourniquet to minimize friction. Very muscular or obese patients tend to have conical shaped thigh. Moving the skin and the soft tissues distally underneath the tourniquet, produce even distribution of pressure to overcome this mismatch. Sarkhel and Stride¹² suggested using the disposable reservoir bag from a single use anesthetic circuit, while the use of surgical glove was proposed by Tomlinson and Harries.¹³ Saleh KJ¹⁵ proposed elastic stockinette for prevention of chemical burns. Tourniquet drapes which are commercially available can also be used. Our department has been using

Fig. 3 – Use of surgical glove to prevent the chemical burn.

Fig. 4 – Use of ioban for prevention of chemical burn.

antimicrobial incise drape (Ioban) as mechanical barrier. On taking these precautions, further occurrence of tourniquet associated chemical burns was prevented (Fig. 4).

The chemical burn due to pneumatic tourniquet is a relatively under-reported problem which may be more frequent than believed. The Povidone-iodine related chemical burn in tourniquet use may be prevented by understanding the mechanism of occurrence of this complication to prevent this devastating iatrogenic injury.

Conflict of interest

All authors have none to declare.

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