

Management of hot tar burn using vitamin E ointment containing petroleum and polyoxyethylene sorbitan

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ABSTRACT

Tar burns are primarily an occupational hazard associated with the road paving or roofing industry. Management of tar burns requires safe and effective removal of solidified tar from the skin using a dissolution or emulsifying agent to prevent inflicting further injury and pain. We report a case of a patient with tar burns on 10% of his body surface area involving the lower arms bilaterally and splashes to the facial area. The tar was efficiently removed with Webber Vitamin E Ointment without toxicity, irritation, or other complications.

RÉSUMÉ

Les brûlures causées par le goudron relèvent principalement des risques professionnels associés au pavage des routes ou à la pose de bitume sur les toits. Le traitement des brûlures causées par le goudron exige l'enlèvement sûr et efficace de la substance solidifiée à l'aide d'un dissolvant ou d'un émulsifiant afin d'éviter d'aggraver la blessure et d'intensifier la douleur. Nous faisons état, dans le présent article, d'un cas de brûlure causée par du goudron et touchant 10% de la surface corporelle, soit la partie inférieure des deux bras et des zones ponctuelles de la face. La pommade Webber Vitamin E Ointment a permis l'enlèvement efficace du goudron, et ce, sans effets toxiques, irritation ou autres complications.

Keywords: tar burn, tar removal, vitamin E ointment

CASE REPORT

A 27-year-old male was injured while working as a road paver. He was beside a hot tar bucket and slipped, splashing molten tar onto the majority of his lower arms bilaterally, as well as upper arms and face. He was noted on scene to have first- and second-degree burns

covering approximately 10% of his body surface area. Ice packs and cold water were applied to his arms at the scene and en route to hospital.

On presentation at the hospital emergency department (ED) 20 minutes after the accident, Tween 80 or Neosporin cream (which contain polyoxyethylene [20] sorbitan mono-oleate and polyoxyethylene sorbitan, respectively, both known to emulsify tar) was ordered, but neither was available in the hospital. Local pharmacies were contacted; only 90 mL of Tween 80 could be located from a local compounding pharmacy. This product was delivered, and mineral oil was used to soak the arms in the interim, with occlusive dressings being applied. A search for other possible products ensued. It was identified that vitamin E ointment made by Webber contained petroleum and polyoxyethylene (20) sorbitan mono-oleate (polysorbate 80), ingredients previously reported to be effective for tar removal. Five 30 g jars were delivered from a community pharmacy. Tetanus toxoid was not given as the patient had received his last booster approximately 5 years ago.

Approximately 2 hours after the patient's arrival at the ED, Webber Vitamin E Ointment (Consortium J.L.F. Inc., Boucherville, QC) was liberally applied to both arms. Because the ointment was viscous and heavy enough to form a coating on the skin, no dressings were found to be necessary. The patient was cooperative and sat for 2 hours very gently rubbing the ointment, which emulsified the tar, allowing its removal. Examination of the skin revealed first- and second-degree burns with minimal blistering. The patient was discharged 4 hours after the initial

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presentation at the hospital. At the follow-up visit 48 hours later, the burns were noted to be greatly improved, with no signs of infection or further complications (Figure 1).

DISCUSSION

Tar burns primarily occur as a result of roofing or paving mishaps. They require prompt cooling and treatment to remove the product from the skin as prolonged contact may increase the burn severity and the risk of infection. They tend to occur in young males and usually involve less than 10% of total body surface area.^{1,2} Tar is heated to temperatures of 232°C (449.6°F) for roofing and 140°C (284°F) for road paving. It rapidly cools to between 93°C (199.4°F) and 104°C (219.2°F) on contact with skin.³ This immediate transfer of heat to the skin can lead to serious burn injuries. Although heated tar is considered sterile, the nonsterile skin beneath the cooled and solidified tar may be a source of bacterial infection.⁴ Previously published case reports describe complications including infection, thromboembolism, and death.⁵

The cornerstone of treatment is the removal of the solidified tar from the skin. Without an agent to dissolve tar, removal from the skin surface can be very painful and can cause further injury and infection as viable skin and hair follicles are also debrided.⁴ Because tar burns are relatively uncommon, treatment recommendations are based largely on case reports. The agents used depend more on hospital availability and physician preference than evidence. Tar removal is based on the chemical principle that a substance is best



Figure 1. The left arm of the tar burn patient approximately 48 hours after tar removal using Webber Vitamin E Ointment.

dissolved by another substance of close structure or related affinity. Tars are complex mixtures derived from long-chain petroleum and coal hydrocarbons and contain sulphur, nitrogen, and oxygen, forming a solid or semisolid cementitious material with thermoplastic properties.⁶ Petrolatum jelly, composed of long-chain aliphatic hydrocarbons, was thus identified to be an effective ingredient for dissolving tar.

Ashbell and colleagues reported success using Neosporin ointment (Johnson and Johnson Consumer Companies Inc, New Brunswick, NJ), which uses a petrolatum base, in removal of tar from skin.⁷ De-Solv-It (Orange-Sol Medical Products Inc., Gilbert, AZ), a citrus and petroleum-based solvent and cleanser, has also been used for tar removal by liberal application to the affected area and then gentle wiping. De-Solv-It is reported to be nontoxic and nonirritating and has also been safely used for eye injuries with tar and asphalt by copious irrigation of the eye.⁴

Polyoxyethylene sorbitan (polysorbate, Sigma, St. Louis, MO), containing a mixture of ethers, esters, and sorbitol anhydrides, was identified by Demling and colleagues to be an effective emulsifying and dispersing agent for tar removal.⁸ Tar emulsification is achieved through the hydrophilic and lipophilic properties of polyoxyethylene sorbitan, which promotes micelle formation and lowered surface tension.⁴ Neosporin cream (polymyxin B, neomycin, gramicidin) contains polyoxyethylene sorbitan and differs from its ointment form in that it does not contain petrolatum and uses a water-soluble base. Reportedly, Neosporin cream is a more effective surface-active agent for tar than Neosporin ointment,⁹ allowing faster tar removal perhaps because polyoxyethylene sorbitan actively emulsifies tar rather than dissolving it. A subclass product is polyoxyethylene 20 sorbitan mono-oleate, branded as Tween 80 (ICI Americas, Inc.), a nonionic surfactant and emulsifier often used in foods, cosmetics, and pharmaceutical compounding. This viscous, yellow liquid is more water soluble than Neosporin cream and may emulsify tar more rapidly.⁹

A number of common household products have also been reported to successfully dissolve and remove tar, including butter,¹⁰ mayonnaise,¹¹ and sunflower oil.¹² Use of these products generally involves liberal application directly onto the tar-covered areas or via soaking gauze and applying dressings. Other products that have been used historically but are no longer recommended include kerosene, gasoline, acetone,

alcohol, ether, and aldehydes.¹³ Local damage and absorption through the epidermis lead to complications and risks for systemic adverse effects.

With the knowledge that petroleum and polyoxyethylene sorbitan are effective in dissolution of tar, we identified Webber Vitamin E Ointment, an ointment with a petrolatum base also containing polyoxyethylene (20) sorbitan mono-oleate (polysorbate 80). Other ingredients include 30 IU vitamin E in the form of d-alpha-tocopheryl acetate derived from vegetable oil, cetyl esters, tocopheryl acetate, sorbitan sesquioleate, methylparaben, and propylparaben. This product essentially carries two active ingredients known to dissolve and emulsify tar, thereby making it unique in comparison with other previously reported products used for tar removal and possibly explaining its efficacy and efficiency. Because the ointment forms an occlusive layer on the skin, it permits prolonged contact time without the use of dressings, allowing enhanced micelle formation and dissolution of tar without the complications of dressings adhering to skin and absorbing the dissolution agent. Although the vitamin E ointment does not contain antibiotics, no infection emerged in our patient as a result of the burn, and in general, prophylactic use of antibiotics is generally unnecessary.²

One advantage of vitamin E ointment over the other reported products is the speed with which tar can be removed after application. The usual duration necessary to allow full dissolution of tar ranges from 12 to 24 hours with petrolatum products, with some reports of the need for hourly reapplications.⁷ Agents requiring the technique of dressing changes have been reported to take up to 1 to 5 days.⁵ Baby oil was reported to take 1 to 1.5 hours,¹⁴ and butter may take 20 to 30 minutes.¹⁰ The speed of tar dissolution is difficult to compare between case reports due to the differing size of body surface area affected between patients. In our case, the rate-limiting step was the gentle rubbing away of emulsified tar, a slow process requiring approximately 1.5 hours for both arms, but the emulsification of tar was observed almost immediately. A potential added benefit may include the antiinflammatory properties of vitamin E, although its effects on wound healing are controversial.¹⁵

Tar removal using an appropriate agent should be rapid, painless, and safe without causing irritation or inflicting further injury. Despite tar burns being an uncommon cause of burns, ready access to a suitable agent is necessary to limit the depth and severity of the burn and to decrease the risk of infection. Webber

Vitamin E Ointment is an effective, efficient, and safe tar-emulsifying agent that allowed tar removal without further irritation or injury. The cost for one 30 g jar is approximately \$9, and it has a shelf life of at least 4 years. In comparison, Tween 80 costs approximately \$12 for a 100 mL bottle and has a shelf life of approximately 1 year. Neosporin 15 g tubes of cream costs approximately \$2.25 and ointment costs approximately \$7, but Neosporin has been associated with contact dermatitis in 1 to 6% of the population with intact skin and increased risk of sensitization in compromised skin,¹⁶ which is potentially concerning when applying Neosporin to a large tar burn area. Webber Vitamin E Ointment may be a superior agent for hospitals to stock for tar burn emergencies, although direct comparative studies are necessary to allow definitive comparisons.

CONCLUSION

Tar burns require a nontoxic and nonirritating agent to allow timely removal from the skin to prevent complications and to allow management of the injured site. Hospitals should have a ready supply of a tar-dissolving or -emulsifying agent on hand, and Webber Vitamin E Ointment appears to be a valid alternative to Neosporin cream or ointment and Tween 80.

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