

## **Pulsatile Lavage of Open Musculoskeletal Wounds Causes Muscle Necrosis and Dystrophic Calcification**

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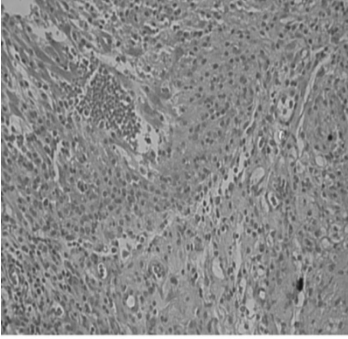
**Purpose:** Adequate wound irrigation of open musculoskeletal injuries is unanimously regarded as indispensable in the prevention of infection by decreasing bacterial load and other contaminants. While the removal versus the further seeding of debris into host tissue has been the subject of numerous studies, the detrimental effects of irrigation on muscle tissue has hardly been reported. This study aims to assess the relative damage to host muscle by pulsatile versus bulb syringe irrigation.

**Methods:** 24 Sprague-Dawley rats underwent hindlimb blast amputation via a column of propelled water following detonation of a submerged explosive. All wounds were irrigated with a 40:1 saline to chlorhexidine solution and had primary closure. There were three treatment groups (each n = 12): Group 1 underwent debridement above the zone of injury (ZOI) with through-knee amputation and 250 mL bulb syringe irrigation; Group 2 underwent both pulsatile lavage and through-knee amputation and irrigated with 1 L of solution using pulsatile lavage (Dental Pik) at 15-20 psi. In Group 3, an additional 6 animals were not subjected to the blast procedure but underwent a 3-cm anterolateral left thigh incision down to muscle, and pulsatile lavage of the wound. The animals were followed with serial AP and lateral radiographs monitoring for the appearance and evolution of any soft-tissue radiopacities until euthanasia at 24 weeks. X-ray-guided excisional muscle biopsies on a few representatives from each group were done at 6 weeks and post euthanasia, and prepped for histologic analysis with hematoxylin and eosin (H&E), Alizarin Red, and Von Kossa stains. Both of the latter are special stains for calcium deposits.

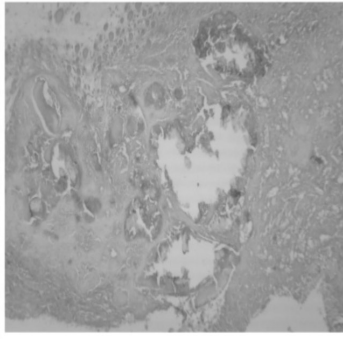
**Results:** All animals treated with bulb syringe irrigation had a benign radiographic course, with no evidence of radiopaque lesions. On the contrary, all animals that were subject to pulsatile lavage at 20 psi developed radiopacities that first appeared at around 10 days postoperatively, increased in density up to around 16 weeks, then showed signs of gradual decrease thereafter. H&E, Alizarin Red, and Von Kossa staining all revealed evidence of tissue damage with an abundance of inflammatory cells, and calcium deposits.

**Conclusion:** Pulsatile lavage when used in trauma-related musculoskeletal injuries may cause additional insult to viable muscle tissue resulting in muscle necrosis, which can be complicated by dystrophic calcification as evident in our results. Bulb syringe irrigation, while not as effective in the removal of debris, appeared to be the safer irrigation option of the two.

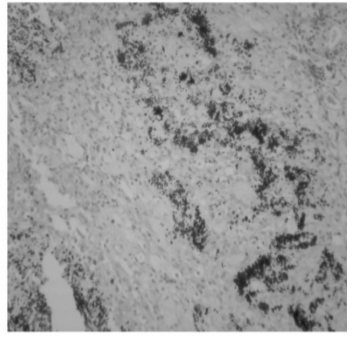
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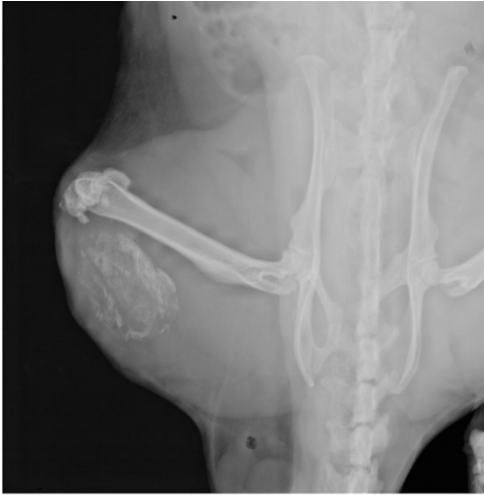
H&E



Alizarin Red



Von Kossa



Dystrophic calcification is apparent in blast amputation (left) and non-blast (right) limbs following pulsatile lavage.