Vacuum-Assisted Closure: State of Basic Research and Physiologic Foundation

Reference:

Scientific Literature Review

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Podiatric Relevance
Vacuum assisted closure (VAC) is a commonly utilized therapy among podiatrists. Closure for both surgical wounds and chronic wounds in debilitated patients can benefit from wound VAC therapy. This article focuses on the some common applications for wound VACs, as well as the physiological mechanisms responsible for its efficacy.

Methods
Original studies are referenced describing the physiological response of vacuum assisted closure in relation to blood flow, granulation tissue formation, bacterial clearance, and survival of random-pattern pedicle flaps in swine and rabbit models. In addition, fluid analyses (fluid removal), envenomenation/extravasation, burns, and grafts were also reviewed.

Two physiological mechanisms of wound VAC therapy are described in detail. The first is fluid removal. Excess fluid and edema increases interstitial pressure and makes extravasation and diffusion more difficult. Decreasing the amount of edema decreases the interstitial pressure making extravasation easier and contributes to the removal of factors that impede healing. The second mechanism is mechanical deformation, specifically tissue expansion.

Results
Laser doppler studies in swine and rabbit models demonstrate that local perfusion is increased with wound VAC therapy. Another study demonstrated that granulation tissue filled in significantly faster with pressure settings at 125mmHg. Flap survival is possible with up to a five hour delay before application of VAC. Wound VAC devices were shown to prevent ulcer formation following toxic chemical exposure; serum myoglobin was shown to be diminished in rabbits with crush wounds; less cell death was observed in burn wounds; there was decreased fluid under grafts, an increase in graft stability, and decreased bacterial loads on grafts were observed. Graft sites with VAC application also showed reepithelialization faster than without ??.

Proposed mechanism: 1) Removal of excess interstitial fluid decreases interstitial pressure allowing capillaries to open enabling flow to the peri-wound. Also, substrates which can inhibit wound healing are removed. 2) Stretching the extracellular matrix. The mechanical forces are shown to increase the mitotic rate promoting tissue expansion.

Conclusion
Wound VAC devices have numerous applications for the podiatric professional. This article demonstrates the many conditions in which VACs can be applied and offers a better understanding of the physiological mechanisms supporting its use.