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The Necessity of Mechanical Debridement

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The Necessity of Mechanical Debridement
Basic Science of Chronic Wounds

Understanding the clinical biology of chronic wound care has required careful study of bacteria and the mechanisms by which bacteria cause human disease in the wound setting. The human immune response system is highly specialized to rid the body of bacteria. Science has shown that human antibodies and white blood cells are equipped to identify and destroy bacteria in the planktonic form where they may be floating in the body fluids.

However, microbiologists have learned that most bacteria (80%) can express a phenotypic response of creating a protective biofilm when circumstances warrant. Bacteria have a special receptor that can be activated by a factor secreted by neighboring bacteria (the quorum factor) that causes the metabolism of the bacteria to slow down. The effect is that these bacteria form a community to combat the human forces attempting to destroy them. The bacteria that were actively reproducing to overwhelm their human host now decrease cell division in favor of production of an extracellular polymeric substance or biofilm. This biofilm acts as a protective coating, making the bacteria very resistant to antibiotics and human immune factors. In many human clinical settings, this biofilm reaction may explain how bacteria manage to infect surgically placed medical devices. These infections become chronic and are difficult to cure unless the foreign material is removed.

In the chronic wound care setting, only recently have researchers considered the possibility that the biofilm may be potentiating infection and allowing the bacteria to resist destruction. Much of the wound debris and fluids are produced in the early chronic inflammation process where the neutrophils, macrophages and the immune complement system are trying to eradicate a burgeoning bacterial infection. Factors such as Interleukin 1 and 6 and matrix metalloproteases appear in levels that are hundreds of times normal, indicating the war that is going on at the microscopic level. Proteases are created both by the white blood cells and by the bacteria and create much of the debris that is manifest by smell, pus, proteinaceous slime and other by-products. The patient experiences the smell, wound drainage and pain caused by local irritants on the local nervous system.

Biofilm is problematic as it allows the bacteria to be harbored and protected from local antibiotics and other treatments. These small communities of bacteria may exist for years without being eradicated. In chronic open wounds and decubitus, the problem is aggravated by host factors such as advanced age, debility, vascular disorders, diabetes, etc., where the human immune response is blunted.

Biofilm is undetectable by the human eye and can only be identified using electron microscopy (EM). A wound may exhibit ugly debris but that does not confirm the presence of biofilm. EM reveals a very thin submicron layer of thick, sticky, tangled substance that harbors the bacteria. This material can penetrate up to 100 microns in the underlying tissues. Biofilm is what allows the bacteria to resist removal and explains the “bloom” that appears 24 hours after the attempt at bacterial removal. When debridement removes the toxic products of inflammation, angiogenesis is stimulated causing fibroblasts to produce collagen and other matrix molecules that promote wound healing.

While antiseptics such as chlorhexidine can kill bacteria in biofilm on contact, they can’t necessarily disrupt or remove the biofilm. That can only be done with mechanical debridement. Surgeons generally agree that repeated mechanical debridement can effectively remove biofilm. Pressurized hydrotherapy, or selective mechanical debridement (SMD), can disrupt and remove biofilm through a pressurized, pulsatile fluid flow. FDA guidelines limit the amount of pressure produced by any jet lavage system to 15 PSI, balancing the risk of driving debris deeper into soft tissues against the benefit of disrupting biofilm that we know lies deeper than the surface.

SMD can be provided at the bedside and in the outpatient setting such as a wound clinic or nursing home. No wall suction or other operating room equipment is needed. Physical therapists, wound care nurses and physicians-in-training can be taught proper SMD techniques and procedures can typically be performed within 10 minutes.

We hypothesize that most patients will undergo sterile wound irrigation daily for approximately four weeks until the wound has been stabilized and is no longer in the chronically infected inflammatory stage. Under this regimen, SMD by wound irrigation has been shown to be highly effective for converting a chronically infected decubitus or wound into a healthy granulating and healing wound.

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