Microcirculation and Cellular Response to Ischemia and Reperfusion Injury

Soft tissue distortion is now recognized as the causative factor for vessel crimping and resultant ischemia associated with PresShear™ necrosis of the human body's soft tissue. Recognition of this fact has greatly changed the thought process and resulting procedures used to prevent and heal PresShear™ ulcers. The simple but highly unreliable interface pressure readings reliance has been replaced with a more scientific understanding of microcirculation, cellular physiology, oxygen free radicals, and reperfusion injury. These facts bring into question some of the past standards used in determining the proper selection of prevention and treatment surfaces in PresShear sore disease management. These questionable concepts include relying on interface pressure readings (which do not attempt to address shear) and accepting reactive hyperemia as a beneficial occurrence when selecting support surfaces.

Once the PresShear necrosis problem is addressed at a microcirculation level, then these pre-existing paradigms (fail in the presence of scientific fact) do not represent actual scientific facts. First, I refer you to the summary "The human body is 3-dimensional and not 2-dimensional." This summary defines the fallacies of interface pressure readings (pad or bladder) in predicting the soft tissue response to various support surface media (solid, liquid, gas). The most compelling facts relating to soft tissue survival abide in the microcirculation and cellular physiology realm. In the following review, these highly complicated physiologic responses will be summarized by how they relate to the PresShear sore disease entity.

The first and most important fact one must recognize is that blood flow delivers nutrients and oxygen to the tissue of interest, and removes by-products from metabolic activity of the tissue. This explains the need for good nutrition (proteins, glucose, minerals) and oxygenation of the blood. This nutritional component for prevention and treatment of PresShear ulcers is paramount in any successful protocol. The second fact is the need to maintain normal blood flow throughout the vascular system. This unrestricted flow of blood is important to prevent migration of neutrophiles to the endothelial lining of the vascular system. It is important to recognize that restricted blood flow causes the laminar flow to change within the lumen of the vessel, and this event causes turbulent flow to occur on a macro level as well as causing the cellular components (RBCs, WBC, Platelets) to migrate from the central flow pattern to a peripheral pattern. This migration of cellular components to the luminal wall causes the inflammatory response that includes: free radical

formation, resultant circulation leakage of RBC, neutrophiles and fluid with resultant interstitial edema and inflammation.

If not corrected, this event leads to cellular death and more inflammation. Thus, a self-sustaining reaction occurs which leads to the necrosis of cells constituting the tissue (PresShear ulcer). One can only guess when this complicated event will occur because of the many facts i.e. size of the vessel, health of the vessel, distribution of the vessel, the nutritional status, the metabolic needs and the general health, that affect this event. The understanding of reperfusion injury (oxidative stress) must be addressed due to the fact that re-oxygenation can and does create increased cellular damage through formation of oxygen free radicals. Free radical formation occurs by two means: an enzymatic change (Xanthine oxidase) and neutrophilic respiratory burst. The proper utilization of a support surface device that provides flotation therapy can assist in minimizing this negative activity of restricted blood flow.

After the body's response to ischemia is recognized, some of the past unproven themes concerning the effectiveness of support surfaces should be re-evaluated. These concepts should be analyzed, studied and then confirmed or disproved based on objective scientific data. It is the feeling of this author that the scientific data will confirm placing a patient on a cost-effective non-soft tissue distorting surface (flotation) to a depth equal to the soft tissue thickness between the bony prominence and aggressively addressing the nutritional needs of the patient.