Concepts in Healing Technologies

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The Game Ready Equine Accelerated Recovery System brings the precise application of some well established medical and physiologic principles together. The controlled combination of cold and compression works synergistically to intervene in the altered metabolic and circulatory pathways of both acute and chronic injuries. Lymphatic function and oxygen delivery are able to be maximized while vascular pressures are allowed to return to normal through the restoration of capillary vasomotion. By **cooling** the affected tissues of a bodypart, Henry's Law (a basic principle of physics) tells us that the dissolved oxygen content in the vascular and interstitial fluid will be increased. Just by enhancing oxygen delivery to the injured area we can decrease the amount of secondary hypoxic injury associated with an acute injury. Additionally, research has shown that **compression** will maximize the application of cryotherapy (it allows the bodypart to become colder, P. Janwantanakul, 2006) and increase the lymphatic flow by up 30-fold (Guyton, 2002). The following pages will explain some of the basic physiology involved in an "accelerated healing process".

Lymphatic function helps to regulate some of the factors that impact post-injury swelling. First, it lowers the solute concentration of interstitial fluids and therefore to a large extent shifts oncotic pressure back into the vessels. Second, it controls total fluid volume in the tissues. Lymphatics not only remove particulate matter like proteins and cellular debris, but also free fluid of edema. Third, it has an impact on the total fluid pressure of the tissues. Proteins due to leakage and formation from micro and macro injury are responsible for much of the edema or swelling found after hard work or trauma. Changes in local metabolism and immune function are responsible for additional inflammation when the edema is not removed. Restoration of normal tissue flow is essential in order for healing to move beyond the acute stages or for the tissues to resume normal functions after workout recovery. According to normal medical physiology (Guyton, 2002) the factors which maximize normal lymphatic flow are: (1) Contraction of surrounding skeletal muscles (2) Movement of the parts of the body (3) Pulsations of arteries adjacent to the lymphatics and (4) Compression to the tissues by objects outside the body; all of which are interrupted after injury. The type of influence these four factors have on the lymphatics is described by Guyton's Textbook of Medical Physiology as **"Intermittent Compression"**.

Cryotherapy has long been recognized for its benefits as a post injury

treatment. Reducing the temperature by only 10 degrees will decrease tissue metabolism by 50%. Even a small decrease in the temperature of a traumatized area of the body reduces the inflammatory infiltration of immune cells, reduces the expression of central inflammatory mediators, reduces bleeding and helps to restore normal vasomotion to the local capillaries. Investigators know that in traumatized tissues there is a zone of cell death and damage post injury due to factors such as hypoxia and oxidative damage from the infiltration of leukocytes (Orthopedics Today, 2006). At the cellular level local cooling appears to reduce propagation of acute microvascular injury, preventing leukocyte-dependent tissue destruction and escalation of secondary tissue damage after musculoskeletal soft-tissue trauma. Vasoconstriction of blood vessels due to sympathetic vasoconstrictor activity occurs as a result of hypothermia used as post traumatic treatment. This cold mediated reflexive vasoconstriction is a valuable effect in both open and closed traumatic wounds. ICAM-1 (intercellular adhesion molecule-1) expression in targeted tissues has been shown to be attenuated demonstrating significantly reduced granulocyte and mononuclear phagocyte infiltration into nerve with intra-ischemic hypothermia (N. Kawamura, et.al., 2006). The same reperfusion injury study was able to demonstrate a reduction in Cytokine (TNF-α and IL-6) positive cells and NF-κB expression, a central inflammatory mediator responsible for the initiation of many inflammatory pathways. Neural response, metabolic changes through temperature as well as a reduction in chemotaxis are all accomplished by use of cold and compression.

Henry's Law accounts for the manipulation of the partial pressure of oxygen in physiologic fluid. The amount of gas dissolved in a liquid is directly proportional to the pressure of the gas in the atmosphere or to that pressure exerted on a fluid. On the flip side, the amount of gas dissolved in a liquid is inversely proportional to the temperature of the liquid. In other words, as temperature drops the dissolved gas in a fluid will increase. The benefits of higher oxygen content are the basis of Hyperbaric oxygen therapy. Improvements in O_2 diffusion distance, fibroblast migration, antibiotic efficacy and vascular function to name a few are accomplished with elevated dissolved oxygen content. Accounting for the physiologic coefficient of oxygen dissolved in plasma, changing the temperature from 37 degrees Celsius to 4 degrees Celsius would roughly double the dissolved oxygen content. Doubling the dissolved oxygen content will triple the diffusion distance and make the conduit of oxygen delivery both wider and more rapid (Sheffield PJ, Smith AP, 2002). The injured cells of the traumatized tissue can now be delivered adequate oxygen when the increased effusion (diffusion distance), oxidation and catabolism would otherwise starve these cells of oxygen.

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