Athletic Recovery Through Cryotherapy

Athletes and individuals who engage in physical activities and strenuous routines are prone to develop musculoskeletal sports injuries, which may result from accidents, improper use of equipment and poor training practices including failure to do warm-up and stretching exercises. Some of the most common types of sports injuries are muscle sprains and strains, ligament or tendon tears, joint dislocation and bone fracture that can eventually affect an athlete's performance. In addition, sports injuriescaneitherbeacute or chronic. Acute injuries occur suddenly while a person performs an activity. On the contrary, chronic injuries may result from over use of certain areas of the body over a long period of time. Both acute and chronic sports injuries are associated with disabling symptoms such as pain, swelling and limited mobility (National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2016).

The moment a person acquires injury, the body reacts by releasing chemicals from damaged cells. This triggers an inflammatory response wherein the blood vessels of the injured area become dilated to increase blood flow, thereby, carrying nutrients to the damaged tissues. Minor injuries, such as sprains and strains, are initially managed with PRICE (Protection-Rest-Ice-Compression-Elevation) therapy. (National Health Service UK, 2015). However, in severe cases, some sports injuries such as those thatcandamage the anterior cruciate ligament (ACL) and medial collateral ligament (MCL) of the knees may require reconstruction surgery and rehabilitation to restore normal function and mobility (American Academy of Orthopaedic Surgeons, 2009).

Application of ice or cold pack as the third element of PRICE therapy, is known to decrease inflammation as it helps constrict blood vessels. Hence, cryotherapy, which utilizes cryochambers with temperatures ranging from–110°Cto–140°C,canpotentially facilitate recovery of body parts affected by various types of sports injuries. Such benefit is also brought about by the alteration of serum mediators of inflammation and serum muscle enzymes. In a study conducted to determine the effectiveness of whole body cryotherapy (WBC) in athletic recovery, it was revealed that WBC can increase the levels of anti-inflammatory cytokine interleukin (IL)-10, and decrease the levels of proinflammatory cytokine IL-2 and chemokine IL-8. This process is also supported by a decrease in the intracellular adhesion molecule-1. Furthermore, cold stimulation also improves athletes' recovery by exerting positive effects on muscular enzymes creatine kinase and lactate dehydrogenase (Banfi, Lombardi, Colombini, &Melegati, 2010). On the other hand, high-intensity and high-duration exercises can also induce metabolic stress and increase temperature, which may eventually cause structural damage and muscle soreness.Hence, exposure of the affected area to cold temperature immediately following the exercise, can reduce the energy demand of the muscles and provide temporary analgesic and anti-inflammatory effects (White & Wells, 2013).

On the contrary, in another study focusing on the effects of cryotherapy on muscle recovery and inflammation after muscle damaging exercise, it was revealed that thoughit cannot significantly alleviate strength decrement and muscle soreness, a mitigation in plasma chemokine ligand 2 was noted after a 20-minute cryotherapy (Crystal, Townson, Cook, & LaRoche, 2013). In addition, a study by Hubbard and Denegar showed that cryotherapy can be effective in decreasing pain related to soft tissue injury. However, further investigation is still needed to evaluate its effectiveness

compared to other rehabilitation techniques (Hubbard & Denegar, 2004).

Aside from facilitating athletic recovery, patients with sports injuries who required surgery may also benefit from cryotherapy. In a study conducted in Brazil, patients who underwent cryotherapy combined with an exercise protocol immediately after ACL reconstruction, experienced less pain and an improvement in the range of motion of the affected knee. As a result, decreased intake of pain medications, reduced length of hospital stay and an improvement in the quality of life were noted among postoperative patients (Dambros, Martimbianco, Polachini, Lahoz, Chamlian, & Cohen, 2012).

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Effects of Cryotherapy on Body Performance

The use of cold therapy to relieve pain and inflammation associated with sports injuries and overuse has been practiced for centuries in different parts of the world. However, in the year 1981, Yamauchi et al. introduced a form of whole body cold-exposure, also referred to as wholebody cryotherapy(WBC),that aims to treat rheumatic diseases. With WBC's noteworthy benefits, it gradually becomes an accepted practice in some parts of the world, not only to facilitate recovery among athletes, but also to improve overall organ function and body performance. In fact, several studies were conducted to determine the benefits of WBC in supporting different organ systems such as the circulatory, respiratory and immune systems (Westerlund, 2009).

Exposure to cold temperature is known to facilitate vasoconstriction. However,prolonged exposure, usually after 30 minutes of cold therapy, may lead to reflex vasodilation (Lippincott Williams & Wilkins, 2009). Moreover, it also stimulates the sympathetic nervous system (SNS), which causes peripheral vasoconstriction and restricts blood to central circulation (Janský & Janský, 2002). Hence, cryotherapy, which utilizes extreme temperatures, can exhibit these effects resulting to better tissue and or ganper fusion that will help meet the oxygen demands of the cells, thereby, facilitating regeneration and healing.

On the other hand, another effect of cryotherapy that shows potential benefit on an individual's well-being is its positive effect on mental health related to hypothalamic-pituitary axis and monoamine regulation, increased β-endorphin levels, hippocampal brain-derived neurotrophic factor normalization, and improved perceptions of self efficacy (Rymaszewska, Ramsey, & Chładzińska-Kiejna, 2008).This premise was supported by a study published in Psychology, Health and Medicine Journal, which showed that ten sessions of WBC can lead to a significant improvement in mood,interms of both psychological and somatic aspects. Furthermore, it was also noted that improvement was more pronounced in patients with worse mental state prior to the commencement of WBC, particularly among women and patients with spinal pains and severe depressive symptoms (Szczepańska-Gieracha, Borsuk, Pawik, & Rymaszewska, 2014).

In addition, cryotherapy is widely used in sports medicine and rehabilitation to facilitate recovery and improve performance among athletes.In a study conducted in San Francisco State University that aims to determine the effect of interval cryotherapy in decreasing fatigue during repeated weight lifting, results have shown that exposure to cold temperature in between weight-pulling can significantly increase the number of total joules and arm pulls. Furthermore, the study also supported the hypothesis that cryotherapy can improve work, velocity and power, as it delays the onset of fatigue(Verducci, 2000).

Aside from those mentioned above, WBC also shows potential benefits on an individual's immune system by altering the antioxidant concentration in the body. In this regard, Dugué et al. embarked on a study that focused on the effects of 12 - week regular exposure to WBC on peroxyl radical trapping antioxidant capacity of plasma (TRAP) among healthy women. Researchers found out that WBC resulted to a mild increase in TRAP (< 5%) which can be associated with improved antioxidant protection (Dugué, et al., 2009). Moreover, according to Stanek et al., a series of ten sessions of 2-min long cryostimulations at -120°C in healthy individuals can increase the level of monocytes (Stanek, et al., 2006). Furthermore, a research paper published in the

European Journal of Applied Physiology supported the premise that ten sessions of 3-min-long exposures to cryogenic temperature(-130°C)has the potential to boost the immune system. Infact,the results showed that the level of IL6 and white blood count, specifically lymphocytes and monocytes, significantly increased after cryostimulation (Lubkowska, Szygula, Klimek, & Torii, 2010). These natural killer cells act as the body's primary defense once bacteria and viruses invade the body. Hence, an increase in the level of both lymphocytes and monocytes will support an individual's immune system in fighting disease-causing micro organisms (Higuera, 2016).

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