Microcirculation

Is a functional system that allows the adequate supply of oxygen according to the cellular metabolic demands throughout the organism. The microcirculation of each organ is specifically organized. In general, each nutrient artery that enters an organ branches 6 to 8 times before the arteries are small enough to be called arterioles.

The arterioles have a diameter of only 10-15 microns, they branch between two and five times and reach a diameter of 5-9 microns at their ends when they supply blood to the capillaries. They are composed of smooth muscle and, in the case of terminal arterioles, their muscular layer is not continuous.

At the point where each true capillary originates from a terminal arteriole, there is a smooth muscle fiber that surrounds the capillary and is known as the precapillary sphincter. The precapillary sphincter allows it to respond to metabolic variations.

The regulation of blood flow and the supply of oxygen and metabolites is carried out by modifying the vascular diameter. At any given time, not all capillaries supplied by a single metarteriole are perfused simultaneously. This intermittent capillary blood flow is caused by a phenomenon called vasomotion, which is due to intermittent contraction of the metarteriole and precapillary sphincter.

The changes produced by this phenomenon contribute to a better understanding of the effect of Hyperbaric Oxygen Therapy. Faced with high oxygen concentrations, it has been observed that vasoconstriction occurs in vessels of increasing diameters according to the degree of increase in PO2. The greatest

vasoconstriction occurs in the 1st and 2nd order arterioles, while in the 3rd order arterioles no variation in the constrictive response was found. The greatest vasoconstriction occurred between 1 and 2 TAA with 100% O2.

Numerous studies have shown that despite a decrease in flow caused by vasoconstriction, hyperoxygenation of the arteries causes an increase in PO2 in the tissues. The uptake and transport of oxygen in ischemic areas increases with Hyperbaric Oxygen Therapy because there is an increase in oxygen concentration.

For example, Mathieu and colleagues analyzed how hyperbaric treatment worked in 10 patients with localized ischemia and studied the transcutaneous oxygen pressure TcO2 (using transcutaneous oximetry) and blood flow (with laser Doppler flowmetry). There, they showed that cutaneous blood flow decreased in areas where oxygen pressures increased beyond normal levels, but that this decrease did not take place in areas where oxygen pressure values remained below normal.

It was thus proven that hyperoxic vasoconstriction, in addition to preventing fluid extravasation into the extravascular space, increases tissue perfusion of oxygen and favors the phenomenon of vasomotion and vascular bypass, which is the mechanism for ischemic tissue to receive blood flow in a manner effective.

Another mechanism for recovering damaged microcirculation is angiogenesis and vasculogenesis, which occurs as a long-term response to hypoxia. Thus, the microcirculation is repaired by increasing the production of hypoxia-inducible factor (HIF for Hypoxia Inducible Factor) and the consequent gradient of vascular endothelial growth factor and other cytokines that intervene in vascular repair.

The phenomenon of the maintenance and recovery of the functionality of the microcirculation is not only necessary in the vascular damage of different wounds, but also prevents the development of different pathologies that involve organs such as the intestine, lung, brain, heart.

Hyperbaric oxygenation treatment also induces an increase in HIF with angiogenesis and vasculogenesis that produces repair in the

vasculature of different organs where ischemia may have produced damage to the microcirculation.

In conclusion, microcirculation as a therapeutic target offers an interesting perspective for the treatment of different pathologies. Hyperbaric oxygenation produces physiological effects with a high impact on microcirculation that translate into tissue regeneration and decrease in inflammation associated with hypoxia and recovery of ischemic organs and tissues.

Bibliography

Balaz, D. Komornikova, A. Sabaka, P. Leichenbergova, et al. (2016). Changes in vasomotion - effect of hyperbaric oxygen in patients with diabetes Type 2. Undersea & hyperbaric medicine: journal of the Undersea and Hyperbaric Medical Society, Inc, 43, 123-134. .

Sakai, T., & Hosoyamada, Y. (2013). Are the precapillary sphincters and metarterioles universal components of the microcirculation? An historical review. The journal of physiological sciences: JPS, 63 (5), 319–331.

Drenjancevic, I. Gros, M. Kibel, A. (2009) Influence of hyperbarLa microcirculación es un sistema funcional que permite el adecuado suministro de oxígeno según las demandas metabólicas celulares en todo el organismo. La microcirculación de cada órgano está organizada específicamente. En general, cada arteria nutricia que entra en un órgano se ramifica unas 6 u 8 veces antes de que las arterias sean suficientemente pequeñas para denominarse arteriolas.