Compromised Skin

Hyperbaric Effects on Grafts and Flaps: Reconstructive Work

Skin grafts and compromised skin flaps represent a classical problem involving insufficient oxygen supply to tissue. Plastic surgeons use the grafts and flaps to repair serious damage, and to close or cover wounds. In creating skin grafts or flaps, a strip of skin is sharply removed from all or part of its adjacent tissues. The surgery removes all of the blood supply from the skin graft, and eradicates much of the blood supply in the skin flap.

Skin grafts are especially susceptible to hypoxic injury. Once a graft is in place, the bed and the edges of the graft site provide the only sustenance available until neovascularization occurs. Hyperbaric oxygen therapy (HBOT) maximizes oxygen transfer for these sites. HBOT ameliorates vascular problems triggered by hypoxia. Three of the primary effects of HBOT, hyperoxygenation, edema reduction, and neovascularization, prove particularly useful to surgeons and plastic surgeons.

Providing hyperoxgenation increases the oxygen tension in the graft bed and wound margins up to 1500 percent. In turn, the hyperoxygenation causes a marked increase in the effectiveness of the blood or plasma that reaches the graft through compromised blood vessels. The volume of tissue that derives sufficient oxygen from a single damaged blood vessel increases 16 fold, and marked tissue salvage results. This same effect maximizes the rate new blood vessels mature at the site where the graft ultimately attaches.

Hyperbaric techniques also offer strategies for reducing edema. The edema reduction effect, induced by the relative spasm of a precapillary arteriolar sphincter, helps to limit the swelling of the graft or flap. In addition, an increase in the mean diffusion radii occurs, resulting in the amount of tissue being supplied with oxygen increasing significantly. The high oxygen tensions achievable with HBOT induce large oxygen gradients, increasing macrophage migration, proline synthesis, and neovascularization. Once this neovascularization occurs, the beneficial effects of HBOT for organs begins. Among other things, fluids begin to flow to tissues and organs more readily, limiting damage from reperfusion injury.

Skin grafts, by their very nature, hypoxic. Grafts are used to cover areas that are devoid of skin due to trauma or disease, so the recipient site is ischemic, and it is this site that will provide the support for the graft. The skin graft is cut from all of its blood supply. Next, it is placed upon the compromised tissue base, where it must initially rely completely upon oxygen that diffuses from the base, and later upon rapid angiogenesis from the base and wound margins so that the graft's vascular structure can be reconstructed. Skin flaps must overcome similar problems due to the stretching and twisting of their vascular tree.

HBOT ameliorates the hypoxia, post-operative swelling, and ischemia of grafts and flaps. HBOT provides high concentrations of oxygen to the graft bed so that more oxygen can diffuse into the graft to sustain it during an ischemic period. The anti-edema effect of HBOT improves tissue oxygenation by reducing the distance oxygen must diffuse, and by improving perfusion.

The benefit of HBOT for the preparation of a base for skin grafting and the preservation of compromised skin grafts has been well documented as effective.

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