Critical Ischemia Time, Perfusion, and Drainage Function of Vascularized Lymph Nodes

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Background: Vascularized lymph node transfer is a promising surgical treatment for lymphedema. This study investigated the effect of ischemia on the lymphatic drainage efficiency of vascularized lymph node flaps and the critical ischemia time of lymph nodes.
Methods: Twenty-four lymph nodes containing groin flaps in 12 Sprague-Dawley rats were dissected. Clamping of the vascular pedicle was performed for 0, 1, 3, 5, 6, or 7 hours; then, each was allowed to reperfuse by means of the vascular pedicle for 1 hour. Perfusion and ischemic changes were assessed using indocyanine green lymphography; laser Doppler flowmetry; and histologic studies with associated lymphatic vessel endothelial hyaluronan receptor-1, CD68, 4′,6-diamidino-2-phenylindole, terminal deoxynucleotidyl transferase-mediated dUTP nick end-labeling, and glutathione assay stains.
Results: The mean latency period of the groin lymph node flaps was 247 ± 67, 83 ± 15, 72 ± 42, 30 ± 18, and 245 ± 85 seconds in the 0-, 1-, 3-, 5-, and 6-hour groups, respectively. Perfusion detected by laser Doppler was 85.2 ± 14.5, 87.2 ± 36.7, 129.8 ± 33.7, 140.4 ± 148.5, 156.1 ± 91.4, and 41.2 ± 34.8 perfusion units at ischemia times of 0, 1, 3, 5, 6, and 7 hours, respectively. Cell damage measured by glutathione was 46.8 ± 10.2, 67.7 ± 14.2, 62.8 ± 15.4, 126.6 ± 5.9, 259.0 ± 70.3, and 109.1 ± 27.5 at ischemia times of 0, 1, 3, 5, 6, and 7 hours, respectively. Histologically, as ischemia time increased, hemorrhage and congestion became more severe.
Conclusions: The critical ischemia time of vascularized lymph nodes is 5 hours in the rodent animal model, verified by indocyanine green lymphatic fluid uptake, laser Doppler perfusion, and histologic assessments. Interestingly, lymphatic drainage and perfusion of vascularized lymph nodes were improved with an increased ischemia time before the critical 5 hours was reached. (*Plast. Reconstr. Surg.* 142: 688, 2018.)

One of the main factors contributing to surgical success of free tissue transfer is the quality of blood flow to tissue after its disruption.[1,2] Minimizing tissue insult reduces complication rates and improves outcomes in free tissue transfer.[3,4] Ischemia is defined as a condition of inadequate blood supply to an area of tissue,[5] where the extent of tissue damage is determined by both the magnitude and duration of the ischemic insult.[4] Critical ischemia time is defined as the maximum amount of time that tissue can sustain ischemia without permanent injury.[6–8]

Previous research has demonstrated the ischemia time of various tissues, including skin, fat, nerve, muscle, bone, and organs.[9] Each tissue type has a different ischemic tolerance based on its baseline metabolic activity and temperature.[10,11] With composite tissue, such as digit replantation or free fibula osteoseptocutaneous flaps, the

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