Reducing postischemic damage by temporary modification of reperfusate calcium, potassium, pH, and osmolarity.


Abstract

This study was designed to determine if ischemic damage could be reduced by modifying blood composition upon reperfusion. After control data had been obtained in seven dogs on prolonged cardiopulmonary bypass, 71 dogs underwent 1 hour of ischemic arrest with topical hypothermia (left ventricular temperature 16 degrees C). We measured left ventricular performance (isovolumetric function curves), compliance (intraventricular balloon), blood flow (microspheres), metabolism (oxygen consumption), and water content (wet/dry weights) before and 30 minutes after ischemia. The initial reperfusate was 500 cc of oxygenated blood given over a period of 5 minutes. Without temporary reperfusate modification, postischemic left ventricular performance was depressed 40% +/- 3%, compliance fell 50% +/- 12%, water content rose 2.5% +/- 0.1%, and left ventricular blood flow and oxygen uptake increased only minimally when cardiac work was increased (function curve). These deleterious changes were reduced significantly, but not prevented, by the following isolated reperfusate modifications: (1) lowering amount of ionic calcium available for cell entry, (2) raising pH to 7.8 to counteract acidosis, (3) raising potassium level to maintain arrest and reduce metabolic demands, and (4) increasing osmolarity (mannitol, 360 mOsm) to counteract edema. In contrast, by combining these modifications to achieve a hypocalcemic, hyperkalemic, alkalotic, and hyperosmolar blood perfusate, it was possible to attain 104% +/- 1% recovery of myocardial performance, 80% +/- 1% restoration of compliance, 60% less postischemic edema, and near-normal augmentation of left ventricular flow and oxygen uptake to meet increasing needs.

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