Perfusion Preservation versus Static Preservation for Cardiac Transplantation: Effects on Myocardial Function and Metabolism

Rosenbaum DH, Peltz M, DiMaio JM, Meyer DM, Wait MA, Merritt ME, Ring WS, Jessen ME. 
Department of Cardiovascular and Thoracic Surgery, University of Texas Southwestern Medical Center, Dallas, Texas 75390-8879, USA.

INTRODUCTION: Continuous perfusion of donor hearts for transplantation has received increasing interest, but the effects on cellular metabolism, myocyte necrosis, and myocardial edema are not well defined.

METHODS: Pig hearts were instrumented with sonomicrometry crystals and left ventricular catheters. Left ventricular function was quantified by the pre-load-recruitable stroke work (PRSW) relationship. Hearts were arrested with Celsior solution with 5.5 mM 13C-glucose added, and removed and stored in cold solution (n = 4) or placed in a device providing continuous perfusion of this solution at 10 ml/100 g/min (n = 4). After 4 hours of storage, left atrial samples were frozen, extracted, and analyzed by magnetic resonance spectroscopy. Hearts were then transplanted into recipient pigs and reperfused for 6 hours, with function measured hourly. At the end of the experiment, left ventricular water content and serum creatine kinase-MB isoenzyme levels were measured.

RESULTS: Baseline left ventricular function was similar in both groups. During reperfusion, the volume-axis intercept of the PRSW relationship was significantly lower in hearts stored with continuous perfusion (p < 0.05), suggesting reduced contractile impairment. Magnetic resonance spectroscopy revealed a decrease in tissue lactate in hearts that received continuous perfusion. Serum creatine kinase-MB isoenzyme levels were higher hearts that had static storage (30.8 +/- 9.0 vs 13.2 +/- 2.7 ng/ml; p < 0.05). Left ventricular water content was similar in both groups (0.797 +/- 0.012 vs 0.796 +/- 0.014; p = 0.45).

CONCLUSIONS: Donor hearts sustain less functional impairment after storage with continuous perfusion. This technique reduces tissue lactate accumulation and myocardial necrosis without increasing myocardial edema and appears promising as a method to improve results of cardiac transplantation.