Calcium Response to Cardiopulmonary Bypass and Circulatory Arrest in Neonatal Cardiac Myocytes

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Repair of most forms of congenital heart disease requires cardiopulmonary bypass (CPB) for circulatory support. Repair of congenital heart defects often necessitates aortic cross-clamping resulting in a period of myocardial ischemia and dysfunction. Previous studies from this lab demonstrate pre- and intra-operative glucocorticoid therapy protects against intra- and post-operative CPB sequelae. This present study investigates intracellular calcium handling within cardiomyocytes following CPB with or without methylprednisolone treatment using a neonatal piglet model (n=10). Methylprednisolone treatment (30mg/kg) was delivered 6 hours prior and at the time of CPB. Calcium characteristics were anaylzed in electrically-paced, Fluo-3 AM loaded isolated myocytes from non-CPB, CPB, and methylprednisolone-CPB groups using confocal microscopy. Total calcium transient time remained unaltered in methylprednisolone-CPB (368±52.5 msec) compared to non-CPB (434.5±35.3 msec; $p>0.05$). Prolonged total calcium transient time was significant in CPB group (632±83.4 msec; $p<0.01$ vs methylprednisolone-CPB and non-CPB). Calcium transient amplitude was blunted in CPB cells (757±168.8 nM) but not in methylprednisolone-CPB group(1021±155.4 nM; $p<0.05$). Altered calcium transient time to peak was prevented in the methylprednisolone-CPB group (57.4±14.4 msec) compared to CPB group (108.6±42.8 msec; $p<0.05$). Phosphorylated serine-16 and threonine-17 phospholamban, mediators for intracellular calcium handling, were not significant between CPB and methylprednisolone-CPB ($p>0.05$). The data suggest that pre- and intra-operative glucocorticoid therapy provides a protective role in intracellular calcium regulation following CPB.