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

David M. Plank, Kelly M. McLean, Connie J. Wagner, Jody Y. Duffy, Jeffrey M. Pearl
Pediatric Cardiothoracic Surgery, Cincinnati Children’s Hospital Medical Center

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 analyzed 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.