Developmental changes in sarcoplasmic reticulum (SR) dependency of contraction and relaxation mechanisms in the mouse ventricular myocardium

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Developmental changes in contraction and relaxation mechanisms were examined in the ventricular myocardium from fetal, neonatal, and 1, 2 and 4 week-old mice. In isolated tissue, the negative inotropy by ryanodine increased with age, while that by nifedipine decreased with age. The prolonging effect on the relaxation by cyclopiazonic acid, a SR Ca^{2+} ATPase (SERCA) inhibitor, increased with age, while that by SEA0400, a Na^{+}/Ca^{2+} exchanger inhibitor, decreased with age. Carboxyeosin, a plasma membrane Ca^{2+} ATPase (PMCA) inhibitor, had no effect on the relaxation in all developmental stages. In the presence of cyclopiazonic acid and SEA0400, carboxyeosin slightly prolonged the relaxation, and its prolonging effect decreased with age. In cardiomyocytes, fluorescence imaging revealed that the SR increases with age. t-Tubules, which were absent in the cell center region until 1 week, were present throughout the cytoplasm after 2 weeks. Until 1 week, Ca^{2+} at the cell center showed slower rise than the subsarcolemmal region, but after 2 weeks, Ca^{2+} increased simultaneously across the entire width of the cell. Ca^{2+} decay time decreased with age. These results indicate that the contraction and relaxation mechanisms in the mouse ventricular myocardium convert from membrane dependent to SR dependent during the postnatal development.