

Developmental adaptations in cytosolic phosphate content and pH regulation in the sheep heart in vivo.

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This study examines adaptations in myocardial cytosolic phosphate content and buffering capacity that occur in vivo as a function of development. Phosphate metabolites were monitored in an open chest sheep preparation using a ^{31}P magnetic resonance surface coil over the left ventricle. Newborn lambs (aged 4-9 d, n = 5) underwent exchange transfusion with adult blood to reduce blood-borne 2,3-diphosphoglycerate contamination of the heart monophosphate and phosphomonoester resonances, thus allowing determination of these phosphate concentrations. The blood-exchanged newborns and mature controls (aged 30-60 d, n = 5) were infused with 0.4 N hydrochloric acid to decrease pH from greater than 7.35 to less than 7.00. Simultaneously, intracellular and extracellular pH were determined from the chemical shifts of the respective phosphate peaks and compared to arterial blood pH. Findings were as follows: (a) diphosphoglycerate contribution to the cardiac spectrum was found to be negligible, (b) significant decreases in cytosolic phosphate (P less than 0.03) and phosphomonoester (P less than 0.01) content occurred with maturation, and (c) large decreases in extracellular pH (greater than 0.5 U) in both groups were similarly associated with only small changes in intracellular pH (less than 0.1 U). Change in cytosolic phosphate content implies that alterations occur in the phosphorylation potential with resulting effects on regulation of myocardial respiration, and cardiac energetics.