

Developmental changes in the relation between phosphate metabolites and oxygen consumption in the sheep heart in vivo.

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This study examines the role of phosphate metabolites in the regulation of mitochondrial oxygen consumption of the heart in vivo as a function of development. We used an open chest lamb/sheep preparation in which myocardial oxygen consumption (MVO₂) was monitored via an extracorporeal shunt from the coronary sinus. Phosphate metabolites were monitored simultaneously using ³¹P nuclear magnetic resonance with a surface coil overlying the left ventricle. Graded infusions of epinephrine were used to increase MVO₂ in both neonatal lambs (age 5-12 d, n = 8), and mature sheep (26-86 d, n = 6). The maximal increase in MVO₂ achieved was 220 +/- 38% in the newborns and 350 +/- 66% in the mature animals. Associated with these increases in MVO₂ in the newborn lambs are significant (P less than 0.001) decreases in PCr/ATP, and increases in calculated ADP and intracellular Pi. This was in contrast to the mature sheep, in which there were no significant changes in PCr/ATP, ADP, or Pi. In conclusion, we find that (a) there are changes in PCr/ATP, Pi, and ADP in newborn animals with moderate increases in work that are not apparent in mature animals of the same species and (b) that these changes suggest that cytosolic ATP hydrolysis products may be more important in regulation of myocardial energy metabolism in the newborn than in the adult..