ACUTE REGULATION OF GLUCOSE METABOLISM IN CARDIAC MUSCLE OF AMERICAN EEL (*Anguilla rostrata*)

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ABSTRACT

Use of exogenous glucose as fuel for energy metabolism is well developed in teleost hearts. However, effective stimuli for the activation of glucose uptake in fish cardiac muscle have not been identified. The purpose of this study was to examine independent effects of anoxia and contractile activity on glucose uptake in isolated ventricular strips of American eel. Ventricular strips, each weighing 20-30 mg, were either 1) incubated in a basal state; 2) exposed to anoxic conditions; or 3) electrically paced at 36 contractions per minute for 10 minutes. Glucose uptake was evaluated by measuring uptake and intracellular phosphorylation of the glucose analogue 2-deoxy-D-glucose (2-DG) and its radio-labeled isotope (2-[^{3}H] deoxy-D-glucose) at 15°C. Cold and radiolabeled mannitol were included in the incubation solution to estimate extracellular space. Preliminary studies demonstrated that uptake of 2-DG in the presence of 5 mM 2-DG was linear between 10-60 minutes there was no difference in the extracellular space over the same time interval. All experimental incubations were subsequently conducted for 20 minutes. Anoxia increased the basal rate of 2-DG uptake 65% (0.90 ± 0.06 µmol/ml/20 min vs. 1.48 ± 0.14 µmol/ml/20 min, $P<0.01$) and contractile activity induced a 71% increase (0.95 ± 0.10 µmol/ml/20 min vs. 1.63 ± 0.17 µmol/ml/20 min, $P<0.01$). Our experiments provide evidence that both anoxia and muscular work promote the use of glucose for energy production in eel ventricles. Primary factors for an increase in glucose uptake in teleost cardiac muscle may include activation of the facilitated glucose transport process, resulting in increased permeability of the cell membrane to glucose, and increasing phosphorylation of intracellular glucose by hexokinase.