Heart, Skeletal muscle

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High-resolution respirometry: heart, skeletal muscle, and H_2O_2 production

Experimental oxygen concentration influences rates of mitochondrial hydrogen peroxide release from cardiac and skeletal muscle preparations

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Oxygen dependence of oxygen and hydrogen peroxide fluxes in the OXPHOS state in cardiac sample preparations

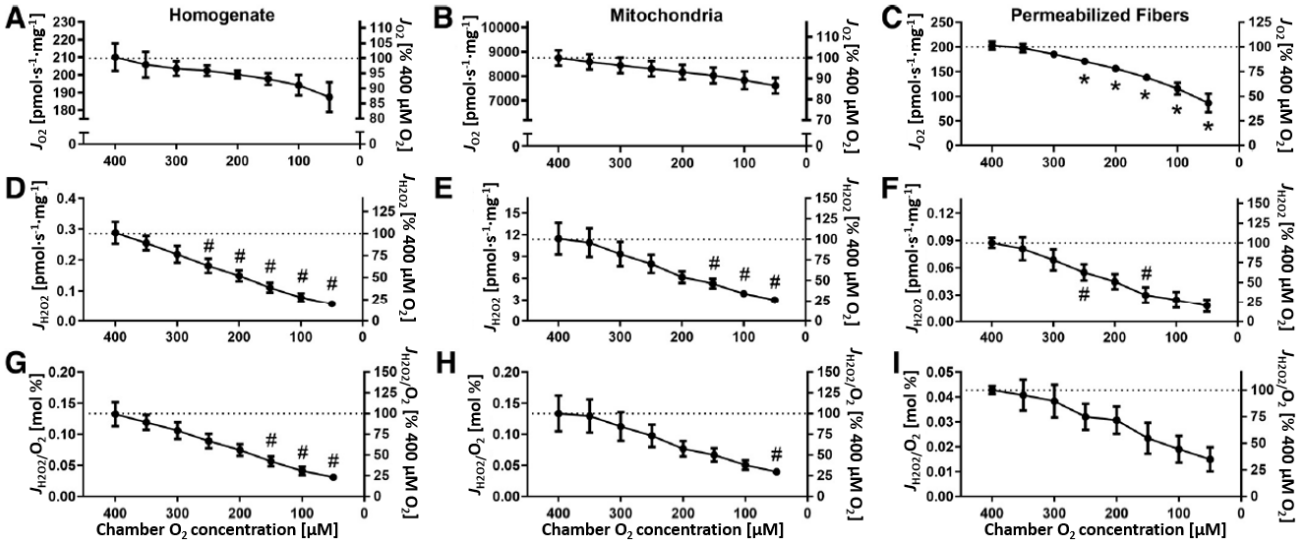

Figure 1. Influence of chamber oxygen concentration [O_2] on oxygen flux (J_{O2}) and hydrogen peroxide flux (J_{H2O2}) in the OXPHOS state in cardiac sample preparations. J_{O2} of homogenates **(A)** and isolated mitochondria **(B)** declined slightly (10–15%) as chamber [O_2] decreased from 400 to 50 µM, whereas J_{O2} of permeabilized fibers **(C)** decreased significantly for every 50 µM decline in chamber [O_2] below 300 µM. J_{H2O2} of all sample preparations declined ~75 % as chamber [O_2] decreased from 400 to 50 µM when expressed as pmol $H_2O_2 \cdot s^{-1} \cdot mg^{-1}$ **(D–F)** or as a proportion of J_{O2} **(G–I)**. Data are means ± SE (N = 4–12/group) presented as absolute flux (left y-axes) and as a percentage of the 400 µM [O_2] value (right y-axes). Statistics: unpaired t test, with $*p < 0.05$ for J_{O2} between 50 µM [O_2] intervals. $\#p < 0.05$ for J_{H2O2} between 100 µM [O_2] intervals.

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High-resolution respirometry: heart, skeletal muscle, and H_2O_2 production

Oxygen dependence of oxygen and hydrogen peroxide fluxes in the OXPHOS state in skeletal muscle sample preparations

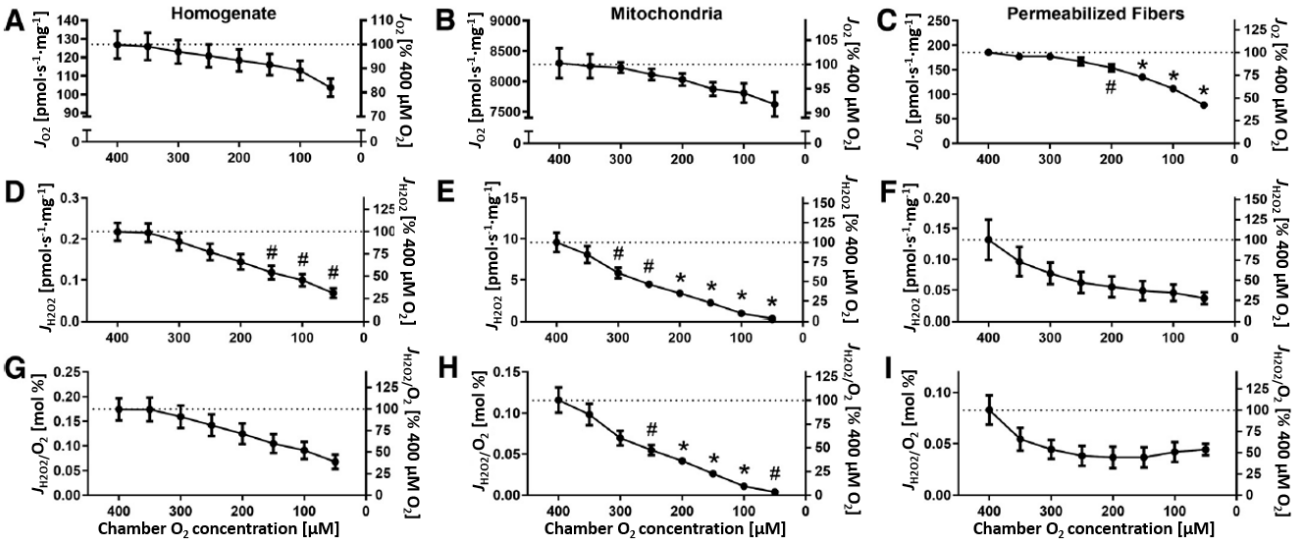

Figure 2. Influence of chamber oxygen concentration on oxygen flux (J_{O2}) and hydrogen peroxide flux (J_{H2O2}) during oxidative phosphorylation (OXPHOS) in skeletal muscle sample preparations. J_{O2} of homogenates **(A)** and isolated mitochondria **(B)** declined slightly as chamber [O_2] decreased from 400 to 50 µM, whereas J_{O2} of permeabilized fibers **(C)** declined significantly for every 50 µM decrease in chamber [O_2] below 250 µM. J_{H2O2} of all sample preparations declined markedly as chamber [O_2] decreased from 400 to 50 µM when expressed as pmol $H_2O_2 \cdot s^{-1} \cdot mg^{-1}$ **(D–F)** or as a proportion of J_{O2} **(G–I)**. Data are means ± SE (N = 4–12/group) presented as absolute flux (left y-axes) and as a percentage of the 400-µM O_2 value (right y-axes).
Statistics: unpaired Student´s t test, with *$p < 0.05$ for J_{O2} between 50 µM [O_2] intervals. #$p < 0.05$ for J_{H2O2} between 100 µM [O_2] intervals.

H_2O_2 flux declined by ~75% from 400 µM to 50 µM O_2 in all cardiac and skeletal muscle sample preparations in NS-OXPHOS state. In contrast, decline in the O_2 flux was more pronounced in permeabilized fibers (~70%) and negligible in isolated mitochondria and tissue homogenate (~10-15%) in the range of 400 µM to 50 µM O_2.

The linear dependence of H_2O_2 flux on O_2 concentrations from 400 µM to 50 µM O_2 in all sample preparations indicates that mtROS-production sites are significantly sensitive to changes in O_2 concentration. Furthermore, this study demonstrates negligible O_2 sensitivity of O_2 flux in isolated mitochondria and tissue homogenate, while O_2 flux of permeabilized fibers declines linearly with O_2 concentrations below ~ 250 µM.

Reference: Li Puma LC, Hedges M, Heckman JM, Mathias AB, Engstrom MR, Brown AB, Chicco AJ (2020) Experimental oxygen concentration influences rates of mitochondrial hydrogen peroxide release from cardiac and skeletal muscle preparations. Am J Physiol Regul Integr Comp Physiol 318:R972-80.

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