Metabolic Imaging of Mouse Embryos to Determine Safety of 1-Photon FLIM for Clinical Applications in In Vitro Fertilization

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Mitochondrial dysfunction has long been associated with reduced reproductive potential. More than 200 publications link mitochondrial function with in vitro fertilization (IVF) success. 67% of all IVF cycles fail, making the process economically and emotionally costly to patients and the health system. Developing an effective and accurate embryo selection tool has long been a primary goal in clinical reproductive research, as it would have a dramatic impact on IVF success rates. Non-invasive assessment of mitochondrial health could provide the means to such a tool.

We have established that we can non-invasively assess mitochondrial function of oocytes by measuring NADH and FAD fluorescence using Fluorescence Lifetime Imaging Microscopy (FLIM). Experiments thus far have been performed on a 2-photon system in the Needleman Lab, and we have demonstrated the safety of 2-photon FLIM for use in oocytes and embryos.

The aim of this proposed research is to assess the safety and feasibility of a 1-photon FLIM system for generating FLIM measurements of NADH and FAD. To accelerate translation of our research to the clinical realm, we must better understand phototoxicity of 1-photon microscopy systems to determine whether they are clinically viable. We will achieve this aim by varying photodosage for mouse oocytes and mouse embryos, and by measuring Reactive Oxygen Species levels, potential DNA damage, and live birth outcomes.