

PHYSICAL MATHEMATICS SEMINAR

Image-based modeling of blood flow and oxygen transfer in feto-placental capillaries

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ABSTRACT:

During pregnancy, oxygen diffuses from maternal to fetal blood through villous trees in the placenta. At the smallest scale of the feto-placental vasculature are the “terminal villi”, bulbous structures that are thought to be the main sites for oxygen transfer in the final trimester of pregnancy. The objective of this study is to investigate blood flow and oxygen transfer in the terminal villi of the placenta. Three-dimensional representations of villous and capillary surfaces, obtained from confocal laser scanning microscopy, are converted to finite-element meshes. Simulations of blood flow and oxygen transfer are performed to calculate the vascular flow resistance of the capillaries and the total oxygen transfer rate from the maternal blood. Scaling arguments, which predict the oxygen transfer across a range of Peclet numbers, are shown to be an efficient tool for quantifying the effect of structural variability. Finally, the increase in oxygen transfer due to commonly observed localised dilations in the fetal vasculature is quantified using an idealised model in a simplified geometry.

TUESDAY, NOVEMBER 29, 2016

2:30 PM

Building 4, Room 257

*Reception following in Building 2, Room 290
(Math Dept. Common Room)*

<http://math.mit.edu/seminars/pms/>