

Press release

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Basic information

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Department of: Clinical Medicine

Main supervisor: Sune Nørhøj Jespersen

Title of dissertation: The role of capillary transit time heterogeneity (CTH) on oxygen and glucose extraction in the brain

Date for defence: 15th of May at (time of day): 12:30 Place: The Lake Side Auditoriums (Søauditorierne) - Jeppe Vontillius Auditorium (Building 1252, room 310), Aarhus University, Aarhus

Press release (Danish)

The role of capillary transit time heterogeneity on oxygen and glucose extraction in the brain

Et nyt ph.d.-projekt fra Aarhus Universitet, Health, undersøger de mekanismer, hvormed ilt bliver ekstraheret fra kapillærer til væv i hjernen ved hjælp af biofysisk modellering. Det viser, at fordelingen af blodgennemstrømningen (flow) over kapillærene (dvs. homogenisering af flow) er en vigtig mekanisme til at udtrække ilt nok under funktionel aktivering. Projektet peger på, at forringelse af denne kapacitet kan være forbundet med patogenesen af visse sygdomme, som stadig ikke er velforståede, såsom Alzheimers sygdom. Projektet er gennemført af Hugo Angleys, der forsvarede det d. 15/05/2017.

Hjernens overraskende høje stofskifte er næsten udelukkende drevet af oxidativ fosforylering af glukose, og normal hjernefunktion er derfor betinget af en stabil forsyning af både ilt og glukose. Det er derfor meget vigtigt at opnå en bedre forståelse af de mekanismer, der kontrollerer ilt og glukoseekstraktionen, samt stofskiftet.

For 25 år siden foreslog Kuschinsky og Paulson, at blodgennemstrømningen samt dens fordeling over kapillærene spiller en vigtig rolle i reguleringen af vævsiltningen. Denne hypotese er siden blevet støttet af flere eksperimentelle studier, som også indikerer, at flowet aktivt omfordeles i kapillærene.

Afhandlingen undersøger ved hjælp af biofysisk modellering den rolle kapillære flowmønstre spiller for ilt og glukoseforsyningen. Vi viser at homogenisering af kapillær flow er en effektiv måde at øge ilt-tilgængeligheden på. Når den bruges til at forudsige det såkaldte blood-oxygenation-level dependent (BOLD) MR signal, uddyber vores model forståelsen af den neurokapillære kobling, dvs. de mekanismer som tilpasser ekstraktionen af oxygen ved aktiv omfordeling af flowet.

Sammenlagt understreger resultaterne i disse tre studier vigtigheden af kapillære strømningsmønstre for ilt og glukoseforsyningen til cerebralt væv. De giver også en ramme til at vurdere, hvilken rolle mikrocirkulation spiller for både raskt og sygt væv. Forsvaret af ph.d.-projektet er offentligt og finder sted den 15/05/2017 kl.12:30 i (Søauditorierne) - Jeppe Vontillius Auditorium (Building 1252, room 310), Aarhus University, Aarhus. Titlen på projektet er "The role of capillary transit time heterogeneity on oxygen and glucose extraction in the brain". Yderligere oplysninger: Ph.d.-studerende Hugo Angleys, e-mail: hugo.angleys@cfon.au.dk, tlf. +4578464402.

Press release (English)

The role of capillary transit time heterogeneity on oxygen and glucose extraction in the brain

This project is based on biophysical modeling and investigates the mechanisms by which oxygen is extracted from capillaries to the tissue in the brain. It shows in particular that redistribution of the blood flow in capillaries (i.e. blood flow homogenization) is an important means for cerebral tissue to extract enough oxygen during functional activation. The project suggests that the impairment of this capacity to homogenize the blood flow might be related to the pathogenesis of some diseases which remain poorly understood, such as Alzheimer's disease. The project was carried out by Hugo Angleys, who is defending his dissertation on 15/05/2017

The brain's high resting metabolism is fueled almost entirely by oxidative phosphorylation of glucose, and normal brain function is therefore contingent on a steady supply of oxygen and glucose. Getting a better understanding of the mechanisms controlling this supply is therefore of foremost importance.

It was proposed 25 years ago that not only the blood flow, but also its pattern plays an important role to regulate tissue oxygenation. This hypothesis was supported by several experimental studies suggesting that the blood flow is actively redistributed at the capillary level.

In this thesis, based on biophysical modeling, we further examine the effects of capillary flow pattern on oxygen and glucose delivery. We show that homogenization of capillary flow is an effective means to increase oxygen availability. Employing our model to predict the blood-oxygen-level dependent (BOLD) signal, we show that our predictions are consistent with neuro-capillary coupling mechanisms, i.e. homogenization of capillary flows to increase oxygen availability.

Overall, this project emphasizes the importance of capillary flow patterns on oxygen and glucose delivery to cerebral tissues, and provides a framework to evaluate the role of the microcirculation in health and disease. The defence is public and takes place on 15/05/2017 at 12:30 in The lake Side Auditoriums (Søauditorierne) - Jeppe Vontilius Auditorium (Building 1252, room 310), Aarhus University, Aarhus. The title of the project is "The role of capillary transit time heterogeneity on oxygen and glucose extraction in the brain". For more information, please contact PhD student Hugo Angleys, email: hugo.angleys@cfm.au.dk, Phone +4578464402

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