

Traffic jams in the head

Introduction

Monday morning. You are (happily) driving to work on the highway. Suddenly, your worst nightmare comes true: an accident happened, and as a result, a massive traffic jam, which will prevent you from arriving to your destination in time. The cars are piling one after the other. You, as a smart driver, together with other drivers, decide to take a de-route. This alternative route is not ideal, but due to these unfortunate circumstances, it will do its job. You will get to your classes (almost) in time!

A similar situation can be considered in an acute ischemic stroke onset. An ischemic stroke is caused by the occlusion of a vessel by a thrombus, which restricts blood supply to the brain. The deprivation of blood to the brain rapidly causes brain tissue ischemia, which, if not treated, can end up as an infarction with often fatal consequences or long-term disabilities for the patient.

The human body is also smart and it has developed a compensatory system for these acute situations: the cerebral collateral circulation. The cerebral collateral circulation refers to the subsidiary network of vascular channels that stabilize cerebral blood flow when principal conduits fail. When an artery is occluded, this secondary circulation may provide residual blood flow to the occluded artery territory, distally from the occlusion. These collateral pathways may not completely overcome the deprivation of blood to the tissue (in these acute cases, treatment is always needed), but, they may support patient's chances for successful treatment outcome.

Goal

The goal of this project is to apply the analogy of traffic jams to an acute ischemic stroke setting. You will first get familiar with traffic modelling and simulations. Then, you will use this knowledge to study the occlusion of a vessel by a thrombus and the role of collaterals in this setting.

Tasks

- Research literature of traffic simulation theory (queueing theory, Markov chains or any other model of your choice)
- Adjust these models to ischemic stroke onset: thrombus occlusion, collateral performance, restoration of normal blood flow after treatment, etc.
- Validate the traffic-stroke model with measures in patients
- Write a scientific report

Contact

Nerea Arrarte Terreros
Dept. Biomedical Eng. and Physics
Email: n.arrarteterreros@amc.uva.nl

Henk Marquering
Dept. Biomedical Eng. and Physics
Email: h.a.marquering@amc.uva.nl