Title: Cerebral blood flow response to CO2 in healthy individual and hemodialysis patients.

Trainee Name: Marat Slessarev

Supervisor(s): Christopher McIntyre and Christopher Ellis

Structured Abstract:

BACKGROUND: Hemodialysis (HD) patients experience higher rates of cerebrovascular disease and cognitive decline compared to the general population. These changes may be related to impairment in cerebrovascular function. In this study we assessed cerebrovascular function by measuring the magnitude and dynamics of the cerebral blood flow (CBF) response to step changes in carbon dioxide (CO2) in a cohort of healthy volunteers and HD patients.

OBJECTIVE: To compare the magnitude and dynamics of CBF response to CO2 in healthy volunteers and HD patients.

HYPOTHESIS: HD patients will have impaired CBF response to CO2 compared to healthy volunteers.

METHODS: We used RespirActTM to induce square wave changes in end-tidal PCO2 (PETCO2) from normocapnia to hypercapnia and back to normocapnia, with each isocapnic stage lasting 5 minutes. We used transcranial Doppler to monitor CBF velocity in one or both middle cerebral arteries, and Finapres NOVA to monitor blood pressure and heart rate. For both increase and decrease in CO2, we calculated the magnitude of CBF response as percent change in CBF per mmHg change in CO2, and the dynamics of CBF response as an exponential time constant of change. Comparisons between groups was done using Mann-Whitney tests with statistical significance assumed if p < 0.05.

RESULTS: Data from fourteen healthy volunteers (9 males, median [IQR] age 30 [14] years) and six HD patients (6 males, age 69 [18] years) were analyzed (study is still enrolling HD patients). In healthy volunteers, the CO2 increased by a median of 9.7 [1.2] mmHg from baseline of 38.0 [5.4] mmHg, followed by a median decrease of 9.7 [1.7] mmHg back to baseline. The corresponding changes in HD patients were 8.9 [1.9] mmHg and 9.8 [1.8] mmHg, and these were not statistically different from healthy volunteers (p=0.179 and p=0.589). The changes in CO2 had no clinically significant effect on blood pressure or heart rate in either group. The magnitude of CBF response to increase in CO2 was similar between HD and healthy groups (2.66 vs 2.79 %/mmHg, p=0.546), but HD group had attenuated response to decrease in CO2 (2.07 vs 2.62 %/mmHg, p=0.0049). Although the dynamics of CBF response appeared slower in HD patients (56.01 vs 24.5 sec for increase and 20.7 vs12.3 sec for decrease in CO2), these differences did not reach statistical significance (p=0.1093 and p=0.1528 respectively). Patterns of CBF response to CO2 varied between HD patients.

CONCLUSIONS: Our preliminary results suggest that HD patients have altered CBF response to CO2. These findings may explain higher rates of cerebrovascular disease and cognitive decline in this population.