

Abstracts of the poster presentations from the 2020 ESVS Translational Meeting

Neuroprotective Potential of Tetrahydrobiopterin Using a Rat Model

Thoraco-abdominal Aortic Disease

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Introduction: Spinal cord ischaemia (SCI) is a major complication in thoraco-abdominal aortic aneurysm surgery. The identification of neuroprotective substances to prevent this complication is of great interest. Tetrahydrobiopterin (BH4) is one of five essential co-factors of nitric oxide synthase (NOS). Ischaemia reperfusion injury is associated with intracellular BH4 depletion, caused by an uncoupling of NOS with increased production of surrounding radicals. Pre-treatment with BH4 plays a protective role in ischemia reperfusion injury and we therefore wanted to test the neuroprotective potential of this substance.

Methods: SCI was induced in rats by balloon occlusion of the descending thoracic aorta. Animals were subdivided into a sham group ($n = 12$), a treatment group (50 mg/kg BH4 intramuscular 15 minutes before SCI; $n = 11$) and a control group (intramuscular saline injection 15 minutes before SCI; $n = 12$). Blinded neuro-functional testing was performed using the Bassio-Beattie-Breshnahan (BBB) locomotor rating scale.

Harvested spinal cords were further evaluated (H.E. staining and TUNEL assays).

Results: The model was associated with an unexpectedly high peri-operative mortality due to haemodynamic and embolic complications. Within the control group, three animals ($n = 12$; 25%), within the treatment group four animals ($n = 11$; 36%) survived until the defined study endpoint (day 7). Pre-treatment with BH4 led to a significantly better neurological outcome immediately after awakening the animals. The difference of BBB scores showed a trend towards a better outcome after pre-treatment with BH4 at day 7. Histopathological evaluation using H.E. staining to count the number of neurons revealed no difference between the treatment and control group. By using TUNEL assays for detection of vital neurons there was a clear trend towards a benefit of pre-treatment with BH4.

Conclusion: The neuroprotective potential of BH4 as immediate post-operative neurological outcome was significantly better in pre-treated animals. Due to the unexpectedly high post-operative mortality, Results of neurofunctional and histopathological evaluations at day 7 should be taken with caution. However, the observed trend towards a benefit of BH4 pre-treatment urges to repeat the study with a shorter post-operative observation period.

Disclosure: Nothing to disclose

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Morphological and Haemodynamic Implications of Carotid Artery Endarterectomy vs. Stenting

Miscellaneous

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Introduction: The carotid bifurcation is an arterial region that can promote morphology driven disturbed haemodynamic conditions potentially leading to atherosclerotic plaque development [1]. Carotid endarterectomy (CEA) and stenting (CAS) are interventional alternatives for the treatment of carotid stenosis. However, both techniques are associated with notable restenosis rates possibly resulting from persisting disturbed flow conditions after surgery [2,3]. Here, we study the impact of CAS vs. CEA with patch

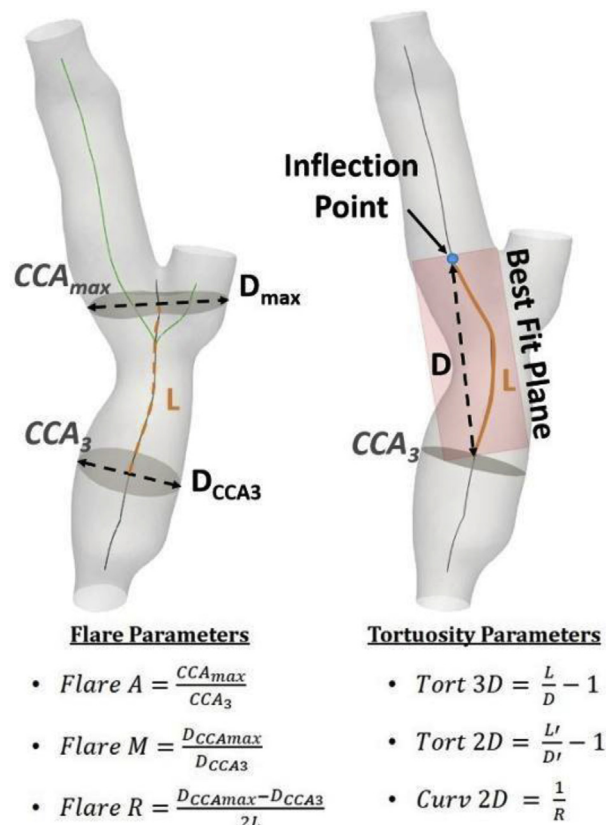


Figure 1. Geometrical variables used in the definition of the flare and tortuosity parameters [2].

plasty in terms of resulting lumen morphology and haemodynamics using patient based computational simulations.

Methods: After reconstructing pre- and post-operative CT data of patients treated by CAS ($n = 6$) and CEA ($n = 6$), the 3D carotid bifurcation geometries were acquired (24 models in total). Haemodynamics informed geometric descriptors were calculated, i.e., flare (a measure of the carotid bulb expansion) and tortuosity [4], through centreline based geometric analysis (Figure 1). Computational fluid dynamics simulations were additionally performed using the post-operative models to determine indicators of near wall flow disturbances, such as time averaged wall shear stress (TAWSS), oscillatory shear index (OSI) and relative residence time (RRT). Moreover, the extent of luminal surface area exposed to both low and oscillatory WSS, a haemodynamic condition with acknowledged atherogenic [1] and restenosis risk potential [3], was calculated. Parametric (independent and paired t tests) and non-parametric (Welch's test) statistical analyses were employed to compare morphological and haemodynamic quantities between CAS and CEA cases.

Results: From the statistical analysis a marked increase of flare after both types of surgery emerged, which was statistically significant only after CEA (FlareM: $p = .03$, FlareR: $p = .03$). Analysing arterial tortuosity before and after surgery, CEA was associated with a significant increase ($p = .04$), and CAS with a significant

potential for the virtual exploration of personalised post-operative scenarios, providing useful indications on (1) the best interventional treatment strategy, and (2) the stratification of post-intervention restenosis risk.

Disclosure: Nothing to disclose

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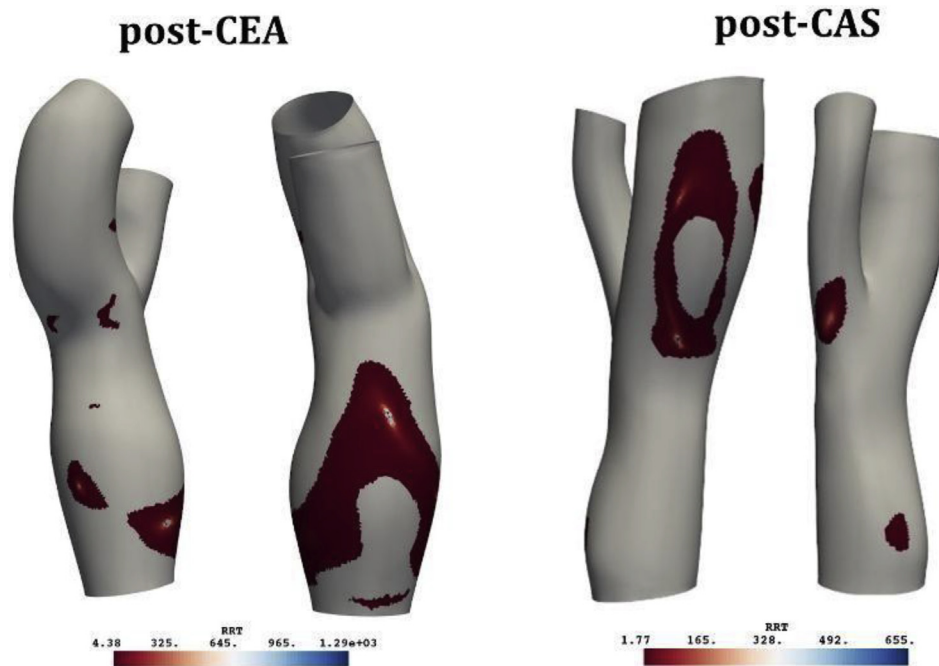


Figure 2. Areas exposed to high RRT values after CAS and CEA with patch-plasty in front and back views.

decrease ($p = .01$). As for haemodynamics, the percentage of the luminal surface area experiencing high RRT values, was lower for CAS in comparison with CEA cases, but the deviation was not statistically significant (Figure 2).

Conclusion: CAS and CEA reshape the carotid bifurcation in a different way, suggesting that different restenosis trajectories are possible in the long term. A tortuous carotid bifurcation can counteract possible flow disturbances. However, stenting causes a decrease of the tortuosity (as expected) while patching seems to increase it. CAS seems to be less susceptible in promoting re-development of atherosclerotic plaque from a haemodynamic point of view. Geometric and haemodynamic analyses hold

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In Situ Fenestration Of Aortic Endografts - (Re)Defining a Problem List And Suggestions for a Solution

Abdominal Aortic Diseases

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