# Hemodynamic characteristics of leptomeningeal collaterals in patients with asymptomatic high-grade internal carotid artery stenosis

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## Background

- Internal carotid artery stenosis (ICAS) accounts for 10-20% of strokes[1]
- Secondary collateral flow in chronic hypo-perfusion however is not understood
- Coefficient of variance (CoV) of a dynamic susceptibility contrast (DSC) time series as a proxy of pial collaterals[2]

## Methods

3T MRI Philips Ingenia

29 ICAS — 70.1 ± 4.8 y — Asymptomatic unilateral NASCET > 70%

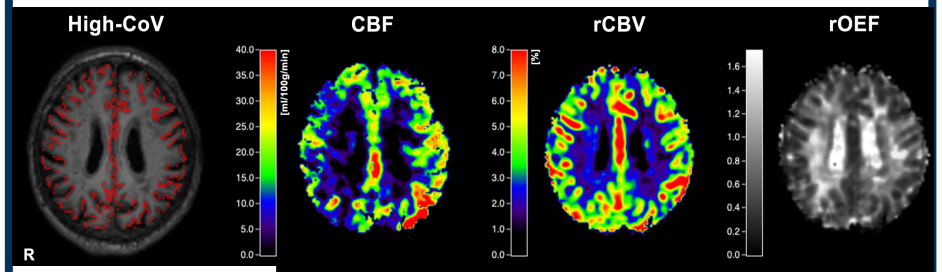
30 HC — 70.3 ± 4.9 y — No stroke or injuries



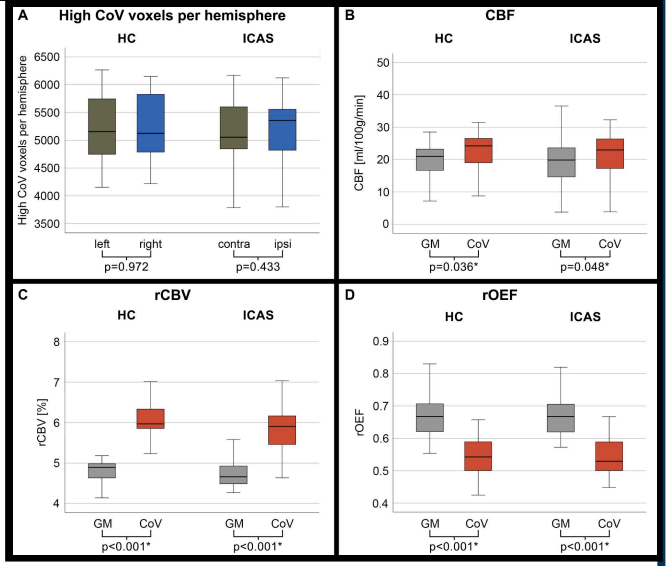
| Structural | Perfusion | | $T_2$ & $T_2$* Relaxation | |
|---|---|---|---|---|
| MP-RAGE | pCASL | DSC | $T_2$ GraSE | $T_2$* GRE |
| 1x1x1 mm3, TE=4 ms, TR=9 ms, TI=1000 ms, α=8°, 5:59 min | Segmented 3D GraSE, 2.7x2.8x6 mm³, TE=7.4 ms, TR=4403 ms, 16 slices, D=1800 ms, PLD=2000 ms, 3 dynamics, PDw, 5:43 min | GE-EPI, 2x2x3.5 mm³, TE=-30 ms, TR=1.5 s, α=60°, 80 dyn, 2:01 min, 15 ml Gd-DOTA bolus-injection,4 ml/s | 2D GraSE, 2x2x3 mm³, 30 slices, 8 echoes, $TE_1$=ΔTE=16 ms, TR=8596 ms, 2:23 min | 2x2x3 mm³, 30 slices, 12 echoes, $TE_1$=ΔTE=5 ms, TR=1950 ms, α=30°, 6:08 min |
| WM, GM | CBF | CoV, rCBV | $T_2$ | $T_2$* |

mq-BOLD $rOEF \propto \frac{R_2'}{rCBV}$ $\quad R_2' = \frac{1}{T_2^*} - \frac{1}{T_2}$

## Results




- Symmetric distribution of CoV voxels in both groups, indicating no collateral recruitment
- Elevated CBF and rCBV within CoV
- In contrast, rOEF was about 20% lower in CoV compared to grey matter.




## Discussion

- The hemodynamics within CoV voxels imply a high density of arteriols.[3]
- Pial collateral recruitment limited to severely deteriorated hemodynamics [4,5]
- Hemodynamic impairment might still be compensated, possibly also by primary collateral pathways via the Circle of Willis [6]

## Conclusion

Absence of secondary collateral flow in our group of asymptomatic patients

High potential to detect future pial collateral flow and to determine status of arterial vessels

**References**

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3: Brozici et al.,*Stroke,* 2003
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5: Kunieda et al.,*InternMed*, 2017
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