RELATION BETWEEN CEREBRAL PERFUSION TERRITORIES AND LOCATION OF CEREBRAL INFARCTS

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Introduction The perfusion territories of the brain feeding arteries are difficult to assess in-vivo and therefore standard cerebral perfusion territory templates are often used to determine the relation between cerebral infarcts and the feeding vasculature.(1,2) In the present study we compared this infarct classification, using standard templates, with the individualized depiction of cerebral perfusion territories on MRI in 159 stroke patients.

Methods The ethics committee of our institution approved the study protocol. A total of 159 patients with clinical symptoms of cerebral ischemia lasting for more than 24 hours and no history of previous cerebro-vascular disease were included in the study. All MRI studies were performed on a 3.0 T Philips Achieva System. For ASL perfusion territory MRI we used the recently developed QUAntitative STAR labeling of Arterial Regions (QUASAR) pulse sequence.(3) Scan parameters: 7 slices; thickness = 8 mm; gap = 1 mm; matrix = 64×64; FOV = 240 mm; α = 35°; TR/TE = 4000/23 ms; TI1/ΔTI = 50/390 ms; time points = 10, SENSE = 3; 96 averages (32 for each territory); scan time 6:40 min.The number of infarcts located in a specific perfusion territory (left ICA, right ICA and posterior circulation) were counted for the evaluation of the DWI images alone using standard textbook perfusion territory templates (*step 1*) and the evaluation of the DWI images in combination with the TASL MRI perfusion territory images of each patient (*step 2*). The number and percentage of discrepancies between *step 1* and *step 2* were calculated.

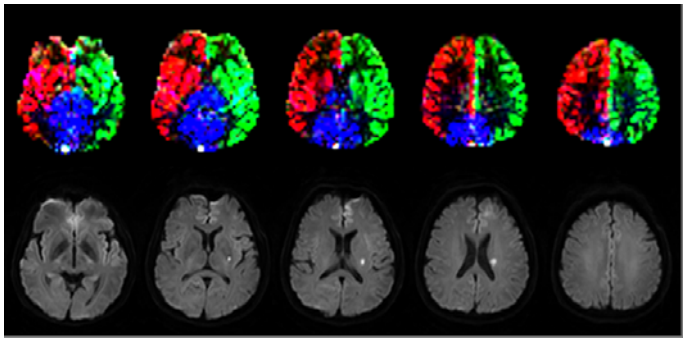

Fig. 1. Perfusion territory images and corresponding diffusion weighted images (DWI) in a patient with a lacunar infarct on the left side. Colors represent the perfusion territory of the right ICA (red), left ICA (green) and the vertebrobasilar arteries (blue). As expected the area of lacunar ischemia is within the perfusion territory of the left internal carotid artery.

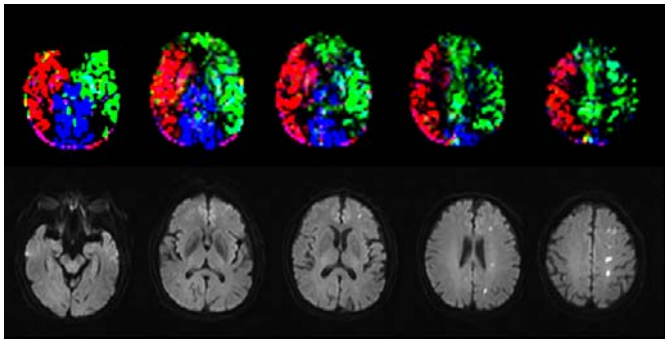

Fig 2. Perfusion territory images and corresponding diffusion weighted images (DWI) in a patient with internal border zone ischemia on the left side. As expected the area of border zone ischemia is within the perfusion territory of the left internal carotid artery.

Results Based on the hyperintense regions on the DWI scans and standard textbook perfusion territory maps, 52 infarcts were classified as posterior circulation infarcts. Furthermore, 98 infarcts were classified as anterior circulation infarcts, of which 55 were classified to the left ICA and 43 to the right ICA. Fourteen patients showed infarcts in multiple (two or more) territories. The additional knowledge of the perfusion territory images changed the classification in 11% of cortical or border zone infarcts (6 out of 56) whereas no territorial change was observed in the infarcts classified as lacunar, periventricular, cerebellar and brainstem.

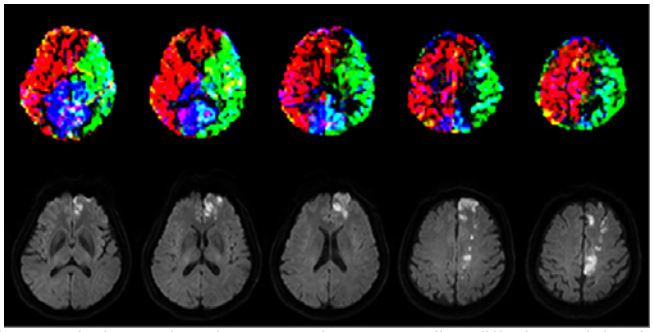

Fig 3. Perfusion territory images and corresponding diffusion weighted images (DWI) in a patient with ischemia in an area corresponding to the left anterior cerebral artery perfusion territory. Unexpectedly, the area of ischemia is within the perfusion territory of the right internal carotid artery. Most of the DWI lesions in slices 4 and 5 are clearly located at the border of the right and left internal carotid artery perfusion territories.

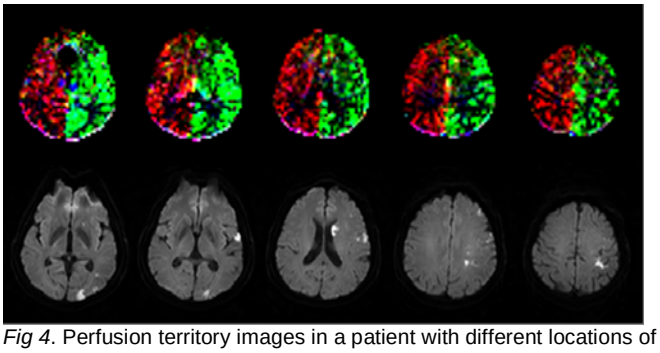

Fig 4. Perfusion territory images in a patient with different locations of ischemia in the left hemisphere. From the DWI images alone ischemia was judged to be located within the left internal carotid artery (middle cerebral artery) and vertebrobasilar (posterior cerebral artery) territories. However, perfusion territory images show that all the areas of ischemia are within the perfusion territory of the left internal carotid artery.

Conclusion The diagnostic information provided by perfusion territory imaging is valuable for the classification of cortical and border zone infarcts whereas no change of the textbook-based classification was observed for other infarct types.

References: 1. Osborn AG. Diagnostic imaging: brain. First edition. 2005 I:4-4 to I:4-7. 2. Grossman RI, Yousem DM. Neuroradiology: the requisites. 2003, 84-92. 3. Petersen ET, Lim T, Golay X. MRM 2006;55:219-32.