Maastricht University

Non-Invasive Imaging of the Carotid Artery

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Valorization

Relevance

Ischemic stroke is a major burden of morbidity and mortality. In 2018, a total of 29,419 patients were admitted to the hospital for ischemic stroke in the Netherlands, of which 5,365 patients died.[1] Besides the devastating effect of ischemic stroke on a patient's personal life, stroke also has a significant impact on health care expenses. Direct health care costs associated with (all-cause) stroke in the Netherlands in 2017 were 1.48 billion euro, being 1.8% of the total Dutch health care budget, which is in line with estimates from other Western countries.[2, 3] Total costs are even higher because indirect societal costs are not accounted for, such as loss of productivity of patients and caregivers. Thus, reducing the impact that stroke has on society is of great importance.

Carotid atherosclerosis is an importance cause for ischemic stroke. Selecting patients for carotid revascularization treatment needs improvement. Increasing our understanding in the process of plaque destabilization resulting in plaque rupture will help to improve treatment stratification. This thesis aims to contribute by using carotid ultrasonography as a non-invasive imaging technique to gain more insight in the pathophysiology of plaque development and plaque rupture. We developed and validated techniques for assessment of structural and functional vessel wall and plaque properties.

Target groups

The results of this thesis may be of interest for several target groups. First, clinicians involved in the care for patients with recent ischemic stroke are an important target group. This includes neurologists, vascular surgeons and radiologists, amongst others. Currently, patients with mild to moderate degree of luminal stenosis will not undergo carotid surgery, while some patients may have a stroke in the (near) future. Moreover, asymptomatic subjects will rarely undergo surgery in the Netherlands, while in some of these subjects disabling strokes may be prevented. Improving risk stratification means that patients who will benefit most from revascularization are more likely to be selected for such interventions, whereas subjects who will not benefit or who may even be harmed from surgery will not be referred. This will involve both patients with recent ischemic stroke as well as subjects with asymptomatic carotid artery disease. Second, an important target group will be manufacturers of ultrasonography devices. If simultaneous assessment of structural and functional plaque properties would result in improved risk stratification, this will lead to an increased interest of ultrasonography investigations for patients with carotid artery disease.

Innovation, products and implementation

The main result of this thesis are that simultaneously investigating structural and functional vessel wall and plaque properties in patients with recent ischemic stroke is

feasible and reproducible. Moreover, assessment of plaque properties can be used to reliably identify patients with carotid intraplaque hemorrhage. The developed algorithm used to analyze carotid ultrasonography is currently not protected by a patent. The algorithm may however be further improved, e.g. automatic region-of-interest selection instead of manual drawing, before such a patent may be of value.

To result in clinical implementation, several important steps need to be taken. First, results of the PARISK-US score will need to be externally validated in another population of patients with recent stroke, such as the CAPIAS study. Second, the results from the PARISK longitudinal study will need to demonstrate that non-invasive imaging can help to predict future stroke recurrence. More importantly, these results will clarify whether ultrasonography can directly contribute to improved risk stratification, or just through improved selection of patients eligible for carotid MRI. Third, manufacturers of ultrasonography devices may be approached to incorporate data analysis during data acquisition as to facilitate interpretation. Last, to include such approaches in clinical guidelines, trial data need to underline the value of image-based patient selection for carotid revascularization. This will ultimately result in accurate, individualized risk assessment and improved use of carotid revascularization compared to current clinical practice.

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