Histological Analysis of the Carotid Plaque Post-endarterectomy: A Waste of Time or a Wasted Piece of Information?

In the United Kingdom (UK) more than 100,000 people annually suffer a stroke with significant associated morbidity and mortality. According to the recently published UK audit of vascular surgical services and carotid endarterectomy (CEA), 4500 operations per year are performed in the UK. In other countries many more CEAs are performed; Australia does 10 times, Canada 8 times and the United States up to 30 times as many CEAs per 100 000 population. Currently, the majority of the extracted atherosclerotic plaque specimens from these procedures are wasted, generally without standardized histological analysis of their composition.

The recent advances in vascular imaging have introduced novel, in vivo markers of carotid plaque instability apart from the traditional degree of carotid artery stenosis. Better cerebrovascular risk stratification is possible using a combination of clinical and ultrasound features (i.e. thin fibrous cap, surface ulceration, lipid rich core) for both asymptomatic and symptomatic patients. However, a number of recently published studies provide preliminary evidence which indicates that the composition of the extracted atherosclerotic plaque specimens after a CEA may provide us with further insight to the ongoing atherosclerotic process of the entire vascular system and the future cardiovascular risk of these patients.

In a recent study, 818 patients were followed-up for a mean of 2.3 years post-CEA. The primary endpoint was the composite of a vascular event (vascular death, nonfatal stroke, nonfatal myocardial infarction) and vascular intervention. It was shown that the composition of the extracted atherosclerotic plaque was independently associated with the clinical outcome and was independent of other traditional clinical factors or concurrent medication. More specifically plaque hemorrhage and intraplaque vessel formation were associated with increased risk of adverse outcome [Hazard Ratio and 95% confidence interval (95% CI): 1.7 (1.2–2.5) and 1.4 (1.1–1.9), respectively].

In addition, similar studies have shown that the expression of certain markers such as the adipocyte fatty acid binding protein and the osteopontin levels within the atherosclerotic carotid plaque may have predictive value for the occurrence of future adverse cardiovascular events.

Furthermore the Athero-Express study investigated the relationship between carotid plaque histology after CEA and the occurrence of local restenosis. In this study patients who had plaques with a large lipid core (>40%) had a lower risk of developing ≥50% restenosis than those with small lipid core (<10%) with a risk difference of 11.3% vs. 25.5%, respectively (Odds Ratio: 0.40, 95% CI: 0.19–0.81). Interestingly, similar were the conclusions of a study which assessed the predictive value of histological plaque characteristics for the occurrence of restenosis after femoral artery endarterectomy in 217 patients. Plaque characteristics such as high collagen and smooth muscle cell content were positively associated with the occurrence of restenosis.

The identification of the individual with high cardiovascular risk remains a challenging task. Especially for those patients who had a cerebrovascular event and underwent a CEA this task becomes even more crucial. Traditional screening methods based on established Framingham risk factors do not always allow an individualized approach. The use of the extracted atherosclerotic plaque in order to evaluate the underlying atherosclerotic process locally but also elsewhere in the vascular tree to estimate the cardiovascular risk, seems to hold some promise for the future.

The data in the presented reports is encouraging and suggests that certain markers that can be obtained after histological analysis post-CEA, such as intraplaque neoangiogenesis and hemorrhage, may have strong predictive value for future cardiovascular events. Maybe it is time to investigate further if routine post-operative histological analysis can contribute to the identification of the high risk individuals and their improved management. Prospective, national biobanks similar to those created for the Oxford...
or the Athero-Express studies\textsuperscript{10,11} and common, standardized methods of histological analysis may provide us with the power to study the effectiveness of this approach in the identification of the individuals with high cardiovascular risk.

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**Conflict of Interest**

All authors have no conflict of interest to disclose.

**References**

1 UK audit of vascular surgical services and carotid endarterectomy. The Clinical Standards Department Royal College of Physicians of London; July 2010. Public report.

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