

Patterns of Non-invasive Imaging of Carotid Atherosclerosis

Pranvera Ibrahim

Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för avläggande av medicine doktorsexamen framläggs till offentligt försvar i hörsal B, Unod T9.

Onsdagen den 25 november, kl. 09:00

Avhandlingen kommer att försvaras på engelska.

Fakultetsopponent: Professor Pompilio Faggiano,
Cardiology Division, Azienda Ospedaliera Spedali Civili-Brescia,
Spedali Civili and University of Brescia, Italien.



Department of Public Health and Clinical Medicine

Umeå University

Umeå, 2015

Abstract

Atherosclerosis is an inflammatory disease that can be generalized, affecting more than one arterial bed simultaneously, or localized, manifested in one system. Ultrasound based measurements of plaque textural features, such as low grey scale median (GSM), echolucent (hypoechoic) plaque types and juxtaluminal black (hypoechoic) area (JBA) are manifestation of potentially unstable lesions. Conventional carotid IMT (intima media thickness) and the recently introduced IM-GSM (echogenicity of the intima media complex) are important measures of subclinical atherosclerosis and are used to predict future ischemic events.

The aims of this thesis were to study, in detail, the systemic nature of atherosclerosis by evaluating the carotid disease burden contralateral to symptomatic arteries, determining the relationship between proximal (subclinical atherosclerosis) and distal segments (well established disease) of the same artery and comparing local plaque features with systemic burden of atherosclerosis disease. In addition, the effect of statins on carotid plaque echogenicity was evaluated in a systematic review and meta-analysis.

Methods:

We have measured ultrasound-based textural carotid plaque features (GSM, JBA, entropy, coarseness), surface morphology, as well as IMT and IM-GSM. An in-house custom developed research software package was used for plaque feature extraction. For the meta-analysis we used Comprehensive Meta-Analysis version 3 software.

Results:

Study 1. In 39 patients, the carotid plaques contralateral to symptomatic arteries had similar morphological and textural features to those in the symptomatic arteries and are more vulnerable than those in asymptomatic arteries; more often mildly or markedly irregular with more vulnerable textural plaque features (lower GSM and larger JBA).

Study 2. In 87 asymptomatic patients, an increased IMT in CCA correlated with plaque irregularities in the bifurcation and ICA while IM-GSM was closely related to plaque echogenicity (GSM), and other textural plaque features.

Study 3. In the same cohort in study 2, patients with previous disease in the coronary arteries had higher IMT and lower IM-GSM and those with prior stroke had lower IM-GSM. Neither IMT nor IM-GSM was different between patients with and without previous lower extremity disease. IM-GSM decreases significantly with increasing number of arterial territories $p < 0.001$ (asymptomatic *vs* symptoms in one *vs* multiple arterial systems) but conventional IMT was not different between groups $p = 0.49$.

Study 4. In a meta-analysis of 9/580 identified studies including 566 patients with 7.2 months follow-up, a consistent increase in the carotid plaques echogenicity after statin therapy, was reported. The perpetual (over 12 months) effects of which were shown in a meta-regression analysis to be related to changes in hsCRP.

Conclusion:

Symptomatic patients have similar plaque morphology and textural features of vulnerability in the contralateral carotid system, compared with asymptomatic ones. In the latter, measurements of proximal disease reflect distal pathology and the number of affected arteries. Finally, statin therapy and the drop of LDL cholesterol result in better plaque stability and optimum control of arterial inflammation, shown by arterial wall echogenicity and hsCRP changes, respectively.

Language	ISBN	ISSN	Number of pages
English	978-91-7601-363-2	0346-6612	86 + 4 papers