# In vivo MR quantification of the lipid-rich necrotic core

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## Introduction

A large lipid-rich necrotic core (LRNC) is regarded as one of the key indicators of atherosclerotic plaque vulnerability. However, the amount of LRNC associated with increased risk for thrombo-embolic events is unknown and therefore quantification may aid better risk assessment. The aim of this study was to determine the accuracy of quantification of the relative amount of LRNC in carotid atherosclerotic plaques with MRI.

## Materials and Methods

Sixty-four symptomatic patients with carotid stenosis ≥70% were included. Multisequence MRI was performed shortly before endarterectomy. Two MRI readers classified relative signal intensities in regions of interest (ROIs) in the vessel wall around the carotid bifurcation. The relative amount of LRNC was quantified using an algorithm[1] based on fixed combinations of five MR pulse sequences (T1w TFE (TR/TI/TE 10.3/900/4.0 ms, FA 15º), PDw TSE (TR/TE 2RR/20 ms, T2w TSE (TR/TE 2RR/50 ms), T1w TSE (double inversion-recovery black blood technique, TR/TI/TE 570/255/14 ms), partial T2w TSE (TR/TE 2RR/30 ms), as well as solely based on T1w turbo field echo (TFE) images; in-plane resolution 0.39x0.39 mm for T1, T2, partial T2 and PDw images and 0.39x0.49 mm for T1w TFE images (Figure 1). Interreader agreement was expressed by intraclass correlation coefficients (ICC). Histology served as reference standard. Agreement between MRI and histology was determined by linear regression analysis.

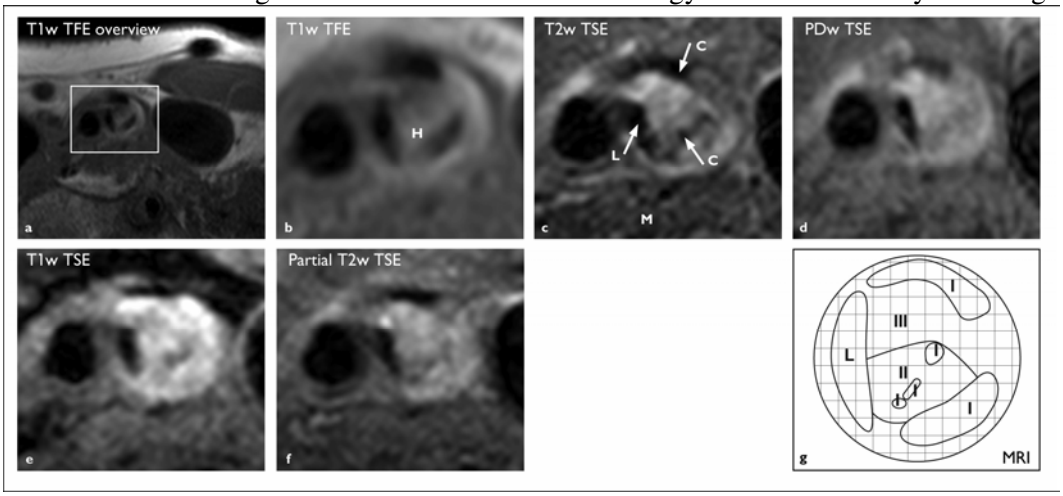


Fig 1. Five MR images of the same carotid cross-sectional level, together representing an MR image set. Also shown is the corresponding grid on which one of the MR readers assigned ROIs using information of the five MR images. MR images are all in transverse plane a) T1w TFE image at carotid bifurcation level, b) T1w TFE image, c) PDw TSE image, e) T1w TSE image, f) Partial T2w TSE image, g) grid on which one of the MR readers traced the vessel wall and the ROIs with homogeneous relative signal intensity (rSI) based on the information of this particular MR image set. Signal intensity was scored relatively to adjacent muscle tissue (rSI). Percentages of the ROIs compared to the whole vessel wall were calculated with the grid (number of pixels of ROI / number of pixels of vessel wall). An algorithm[1] based on five MR pulse sequences determined the plaque components: I=calcification, II=intra-plaque hemorrhage, and III=fibrous tissue, which are indicated on the MR images: H=intra-plaque hemorrhage, C (+ arrow)=calcification, L (+ arrow)=lumen and M=muscle.
(analysis of solely T1w TFE images was performed similarly but with information based solely on these T1w TFE images)

## Results

Interreader reproducibility for quantification of LRNC based on multi- as well as single sequence (T1w TFE) MRI was high (ICC, 95% CI): 0.86 (0.77-0.94) and 0.91 (0.85-0.95), respectively. Good agreement between MRI and histology was found for both MR readers for quantification based on multisequence as well as single sequence MRI, with linear regression coefficients ≥0.80 ($p<0.0001$).

**Conclusion** The amount of LRNC as assessed by single sequence T1w TFE MRI is a reproducible, accurate, and fast way to quantify LRNC in vivo in carotid atherosclerotic plaque.

## References

[1]Cappendijk et al. Assessment of human atherosclerotic carotid plaque components with multisequence MR imaging: initial experience. Radiology 2005;234:487-492.