# Identification of basilar plaque components using multicontrast high-resolution 3-tesla MRI

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## Introduction

Rupture of vertebrobasilar plaque with subsequent thrombosis or distal embolization represents the principal pathophysiology of acute atherothrombotic stroke in the posterior circulation [1]. Multicontrast high-resolution MR imaging (HRMRI) has emerged as an effective tool for the assessment of carotid plaque vulnerability because its lipid-rich/necrotic core (LR/NC), intraplaque hemorrhage (IH), calcification and fibrous cap (FC) are distinguishable on the basis of inherent difference in signals on 3-dimensional (3D) time-of-flight (TOF), T1-weighted (T1W), proton density-weighted (PDW) and T2-weighted (T2W) images [2]. We therefore performed this prospective cohort study on 3-tesla multicontrast HRMRI for patients with >70% symptomatic atherosclerotic stenosis of basilar artery (BA).

## Materials and Methods

Patients with >70% atherosclerotic basilar stenosis and symptoms within 90 days were imaged with with an eight-channel phased-array head coil in a 3.0-tesla scanner (Twinspeed, GE Medical Systems). 3D TOF images were obtained using repetition time/echo time (TR/TE)=21 ms/3.2 ms, field of view (FOV)=16 cm×16 cm, thickness=1 mm, matrix=256×256, and number of excitations (NEX)=1. Then, PDW and T2W images of 12-14 slices, and T1W images of 4 slices pre-contrast and post-contrast were acquired, which included images at the stenotic portion of BA. Parameters for PDW and T2W imaging were as follows: fast-spin echo (FSE), TR=3000 ms, TE=12.5 ms for PDW and TE=62.3 ms for T2W, FOV=16 cm×16 cm, thickness=2 mm, matrix=256×320, NEX=2, echo train length [ETL]=10). T1W images were obtained by double inversion recovery FSE with the following parameters: TR/inversion time (TI)/TE=800 ms/650 ms/8.6 ms, FOV=16 cm×16 cm, thickness=2 mm, matrix=256×320 matrix, NEX=4, ETL=12). Fat suppression was used to reduce signalfrom surrounding fatty tissues, and a zip 512 matrix was used to enhance spatial resolution. Plaque compositions of the most stenotic slice were independently evaluated with pre-established criteria by 2 radiologists. Lipid-rich/necrotic core (LR/NC) was identified by iso-signal intensity (SI) on TOF, high- or iso-SI on T1W and PDW; calcification by hypo-SI on all the 4 contrast weightings; recent intraplaque hemorrhage (IH) by high-SI on the 4 contrast weightings.

## Results

Twenty-four consecutive patients were enrolled into this prospective cohort study. LR/NC of basilar atherosclerosis was found in 18 patients (Fig 1), calcification in four (Fig 2), recent IH in one (Fig 3), and both recent IH and calcification in one (Fig 4). Interobserver reproducibility was excellent for LR/NC with $k$ =0.90, calcification with $k$ =0.88, and recent IH with $k$ =1. Intraobserver reproducibility was excellent for LR/NC with $k$ =1, calcification with $k$ = 0.88, and recent IH with $k$ =1.

## Conclusions

Multicontrast high-resolution 3-tesla MRI can be used to study plaque components of severe basilar atherosclerosis with good interobserver and intraobserver agreements for the identification of LR/NC, IH and calcification.

## References

1. Voetsch B, et al. Arch Neurol 2004; 61:471-272.
2. Yuan C, et al. Circulation 2001; 104: 2051- 2056.

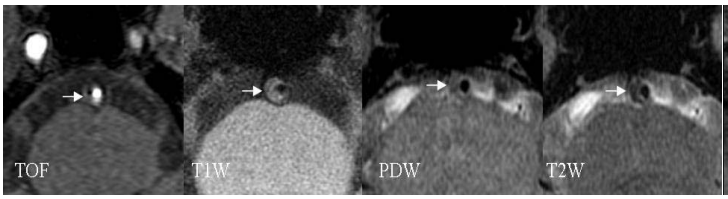


Fig.1 A 71-year-old woman presented with recurrent TIAs of vertigo for two months and right hemiparesis for one month. Lipid-rich/necrotic core (arrows) was identified by isointense on TOF , hyperintense on T1W, isointense on PDW, and hypointense on T2W images.

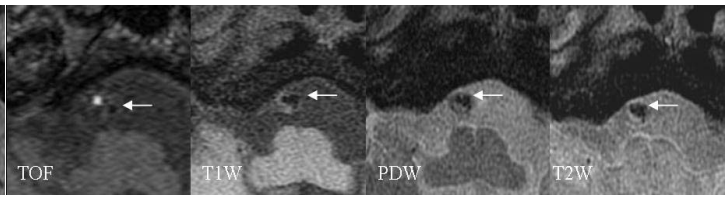


Fig. 2 A 59-year-old man presented with recurrent TIAs of vertigo and tinnitus fortwelve months. Calcification (arrows) was identified by hypointensity on all TOF, T1W, PDW and T2W images.

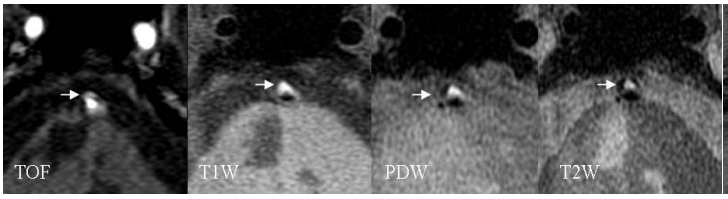


Fig.3 A 55-year-old man presented with a sudden onset of left hemiplasia, vertigo, dysarthria and dysphasia proceeded by headache and left hemiparesis lasting for 28 days. Recent hemorrhage (arrows) was identified by hyperintensity on TOF, T1W, PDW and T2W images.

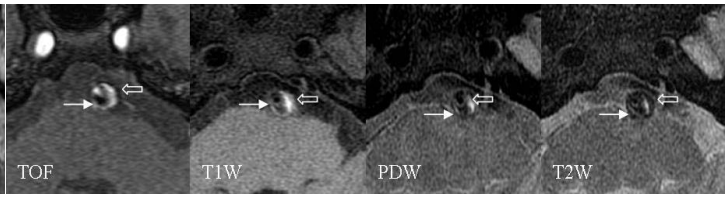


Fig.4. A 47-year-old man presented with recurrent TIAs of vertigo and loss of consciousness for two months. Calcification (arrows) was identified by hypointensity (5 to 8 o'clock) on TOF, T1W, PDW and T2W images. Recent hemorrhage (empty arrows) identified was by hyperintensity from 1 to 5 o'clock on all contrast weightings.