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3D-MR ANGIOGRAPHY OF ATHEROSCLEROTIC CAROTID AND VERTEBRAL ARTERY DISEASE

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INTRODUCTION

Magnetic Resonance Imaging (MRI) is more sensitive than CT for evaluating ischemic brain lesions in cerebrovascular disease (4). Doppler and Duplex Sonography provide functional and morphological assessment of the carotid bifurcation (5). However, there is still need for a noninvasive method to display the peripheral carotid and the vertebral artery. Referred to the term Magnetic Resonance Angiography (MRA), various imaging techniques have been developed to visualize vascular structures based on "time of flight" and "phase-modulation" effects (1,2,3,6,7,8).

Our attempt was to perform MRA as part of a routine brain examination, and to assess the potential of MRA as a noninvasive modality in the diagnosis of cerebrovascular disease.

METHODS AND PATIENTS

All studies were carried out on a 1.5T Magnetom (Siemens), using the standard head coil (FOV=25cm). 2D-MRA is difficult to align along tortuous vessels in arteriosclerotic disease (8), therefore a 3D-gradient-echo-sequence (FISP) was used in our series. 64 contiguus, 1.25mm thick slices were obtained within 13 minutes, containing the carotid as well as the vertebral arteries. TR was 50 ms, TE 12 ms, and the flip angle was set to 25 degrees. Intraluminar vessel enhancement depends on inflow of unsaturated spins and additional gradients, incorporated into the FISP sequence (gradient motion refocussing). Gradient strength and sequence parameters had been optimized during volunteer studies, until consistent enhancement of normal flow within the carotid artery up to the circle of Willis was obtained.

Projectional images of the vessels only were calculated by a ray tracer technique using a maximum intensity algorithm from the original 3D-data. Three-dimensional estimation of the neck vessels is provided when multiple projections are calculated.

Fifteen patients with evidence of carotid or vertebral artery disease were examined (low grade stenosis n=5, high grade stenosis n=5, occlusion n=5). Consent was obtained in all patients. MRA was performed immediately following a routine T1 and T2 weighted brain study, without repositioning of the patient. The overall examination time did not exceed 55 minutes.

RESULTS

MRA was evaluable in all but one patient, who moved during the examination. MRA was a sensitive measure of the vessel pathology in the other 14 patients.

Five cases of low grade stenoses were depicted as a decrease in vessel diameter. Degree of stenosis was best appreciated if different projections of the vessels were calculated (fig. 1).

In 5 patients a high grade stenosis was present, and in all of them MRA tended to overestimate the stenosis, because of signal void due to turbulent flow and acceleration within the stenosis and

peripheral vessel enhancement of the carotid siphon decreased (fig. 2).

No signal enhancement occured in occluded vessels (n=4) (fig.3). The new flow characteristics of blood adjacent to the vessel wall and the spatial resolution (pixel size 1*1*1.25 mm) limited the interpretation of arterosclerotic plaques and ulcers. Vessel overlay and partial volume effects were avoided by adaequate postprocessing.

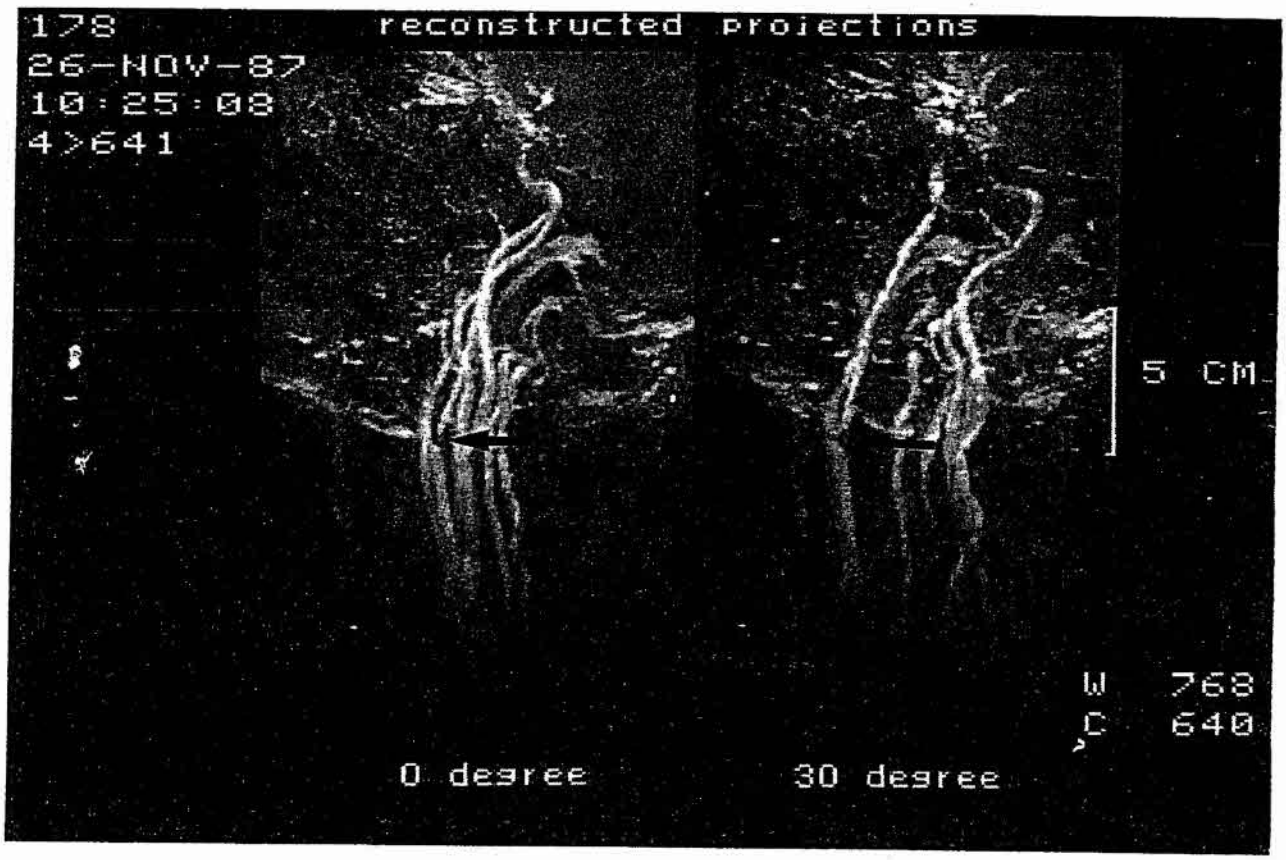

Figure 1 60% stenosis of the left internal carotid artery (aarow). Projections calculated from 0° and 30° to avoid vessel overlay and more precise estimation of the stenosis.

DISCUSSION

It has been demonstrated that high quality MR-Angiograms of the neck vessels can be obtained in short examination times.

MRA does not display vessel morphology but visualizes intraluminar blood flow dynamics. The method is sensitive to altered flow conditions secondary to vessel pathology. Reduction of inflow and secondary flow result in signal void, if the capacity of the refocussing gradients is exceeded; high grade stenoses tend therefore to be overestimated.

MRA may add important information about the peripheral carotid and the vertebral artery in patients with arteriosclerotic cerebrovascular disease. The method is absolutely noninvasive and the short examination time indicate the potential of MRA as a new

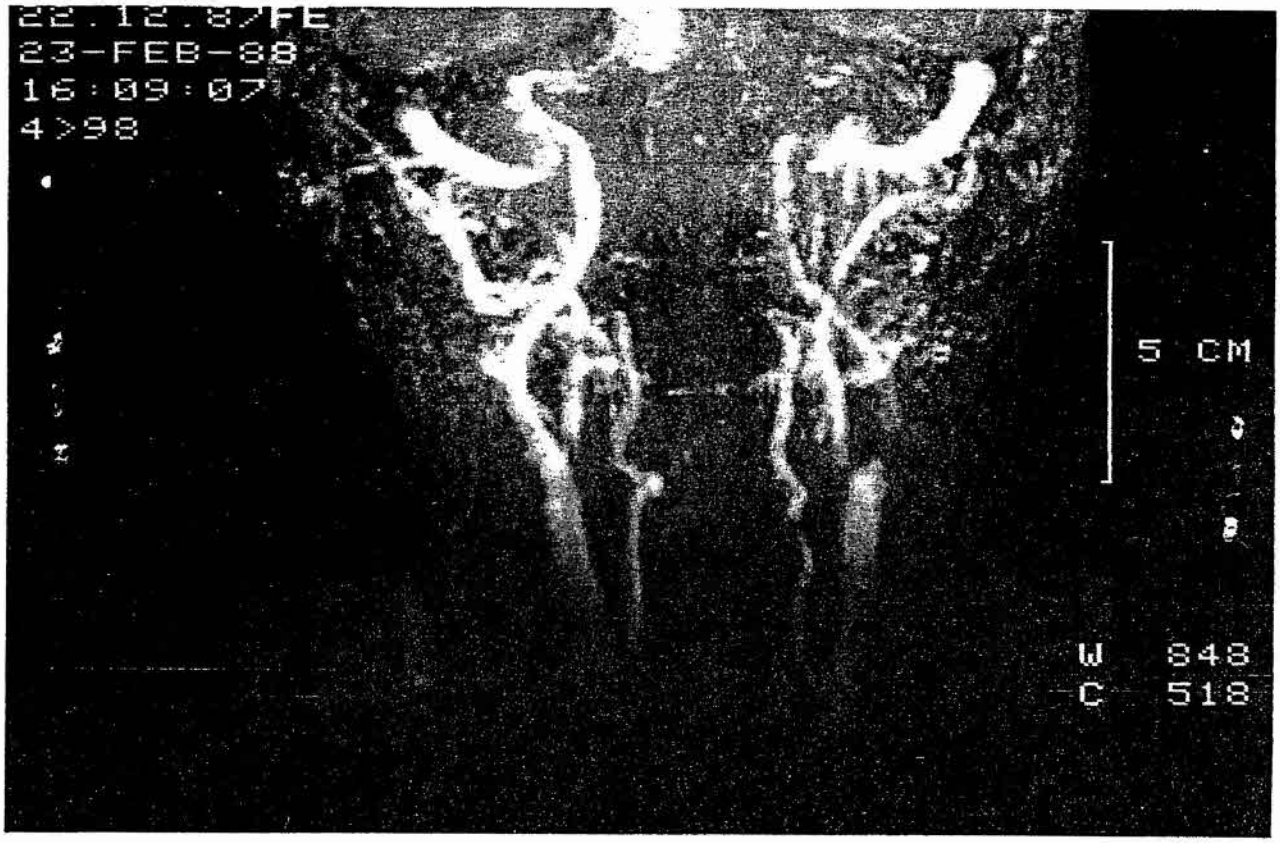

Figure 2. High grade stenosis of the left internal (90%) and the left external (95%) carotid artery. Reduced inflow decreases enhancement of the carotid siphon on the left.

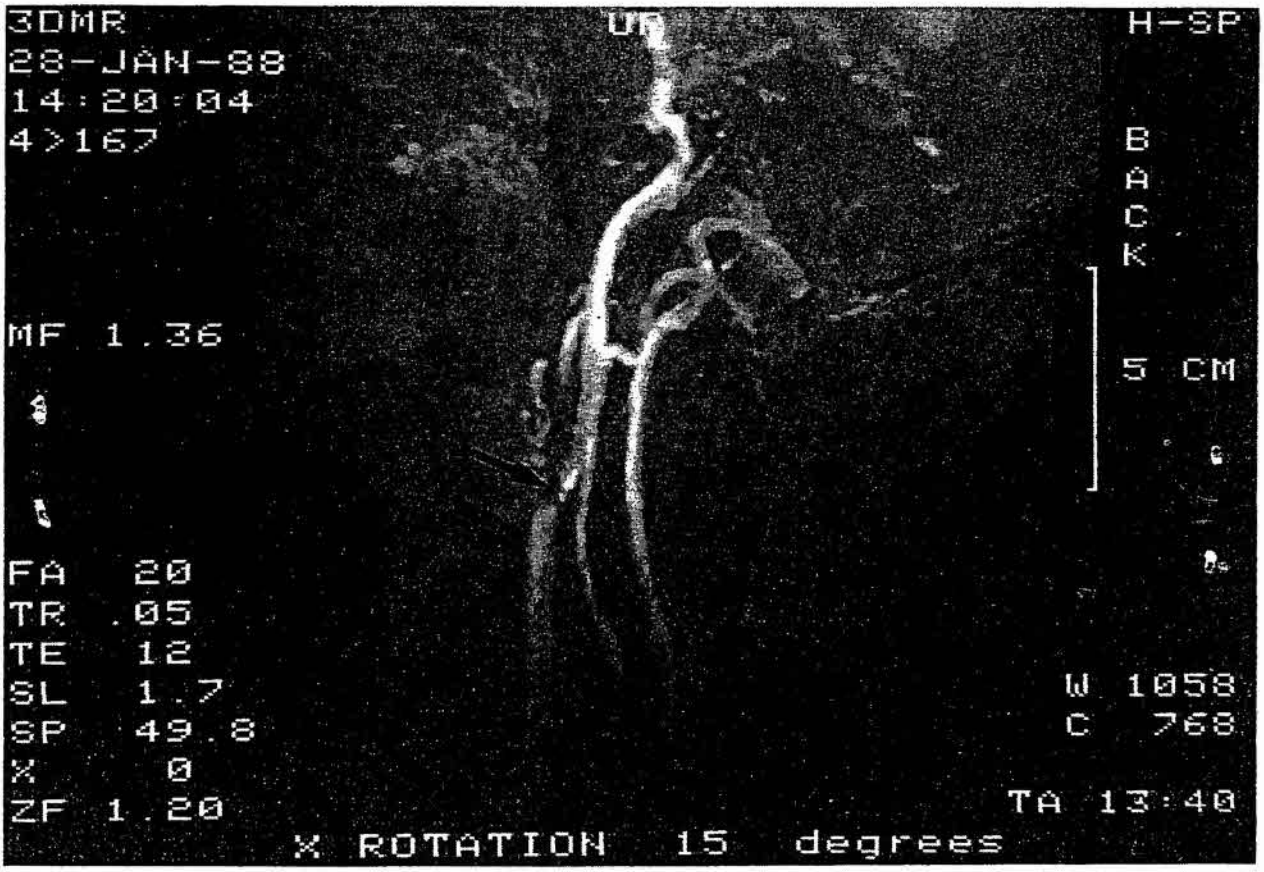

Figure 3. Occlusion of the left common carotid artery. The right internal carotid artery shows a 75% stenosis (arrow).

screening modality.
However, the limited number of patients in this series does not allow conclusions about the specifity of MRA as this remains to be evaluated in further studies.

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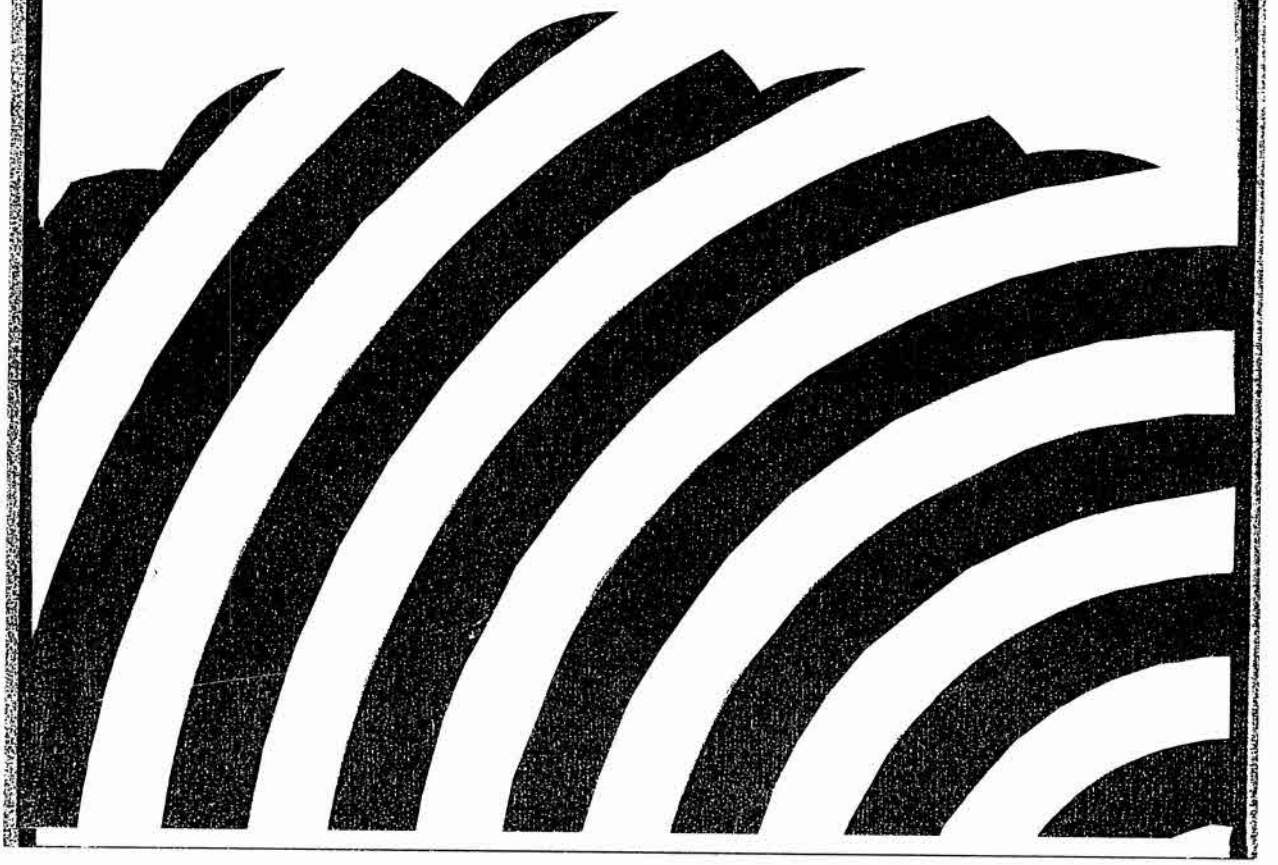

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