INTRODUCTION

Contrast-enhanced (CE) MRA has become a widely used method for evaluating vascular disease in the carotid bifurcation. When performed properly, image quality is often excellent, and the exams provide high contrast angiograms in which the vessels are well delineated. However, to date, there has been no published data from a multi-center trial validating the accuracy of stenosis measurements obtained from CE MRA exams.

This work describes an ongoing multi-center trial that is designed to evaluate the performance of CE MRA of the carotid bifurcation and compare stenosis measurements obtained with various CE methods to those obtained with x-ray DSA.

METHODS

Twelve sites acquired images from 100 patients using General Electric, Siemens, and Philips MR scanners. Three-dimensional CE MRA exams were acquired from each site, using various methods including TRICKS (1), fluoro-triggered elliptical centric acquisition order (2), fluoro-triggered centric acquisition order, SmartPrep-triggered centric acquisition (3), partial k-space multi-phase acquisition, and single volume acquisition with a dose timing scan. Each site used parameters to achieve approximately 1 mm x 1 mm in-plane resolution, and approximately 1.5 mm thick slices. The contrast agent was injected at a rate to ensure that it was present during most of the acquisition. In addition to the CE MRA exam, each site acquired a 3D TOF MRA exam and a conventional x-ray DSA exam on each patient.

The 3D MRA data (CE and TOF) were processed to produce images perpendicular to the vessel at the site of the stenosis and approximately 2 cm distal (see Figure 1). The DSA projections and reformatted MRA images were filmed, and stenosis measurements are being obtained from the films using a jeweler's loupe, and the NASCET method. The stenosis grades obtained from CE MRA will be compared with those obtained from 3D TOF and x-ray DSA. The CE MRA data sets also will be used to compare stenosis grades obtained from MIP images with those obtained from the reformatted images.

RESULTS

Patient data has been acquired and quantitative results are being collected. Initial qualitative results indicate that CE MRA compares very favorably with DSA (see Figure 1), in terms of demonstrating the severity of stenoses, and delineating string signs. The CE MRA methods require less scan time than 3D and 2D TOF, and therefore contain fewer motion-induced artifacts. The reduced sensitivity of CE MRA methods to saturation permits the vessels to be oriented within the FOV, allowing better coverage, and higher spatial resolution than TOF MRA methods. The striking contrast and high SNR offered by CE MRA methods leads to improved diagnostic confidence as compare to other MRA methods.

DISCUSSION

It is difficult to compare the results of the measurements because MRA provides cross sections of the vessels, whereas x-ray DSA provides projections. For this reason, it is possible for CE MRA methods to portray a better representation of complicated pathology than x-ray DSA, and thus the quantitative results may not compare favorably. Also, the results may differ because MRA permits measurement across the narrowest diameter of the stenosis, whereas the projection showing the narrowest part of the stenosis may not be acquired in the DSA exam.

This study will provide a quantitative assessment of the accuracy of stenosis measurements of the carotid bifurcation obtained with CE MRA as compared to x-ray DSA. The CE MRA data also will be used to quantitatively compare stenosis grades obtained from MIP data to those obtained from reformatted image data.

REFERENCES


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Figure 1: (a) X-ray and (b) CE MRA images of the carotid bifurcation demonstrating a severe stenosis. Stenosis grades from the DSA exams were measured from the projection showing the tightest stenosis. For CE MRA, the data were reformatted perpendicular to the vessel at the location of the stenosis (c, bottom) and approximately 2 cm distal to the stenosis (c, top), and the grades were determined from these images using the NASCET method.