Available online at www.sciencedirect.com
ScienceDirect
Magnetic Resonance Imaging 28 (2010) 1311 – 1318
MAGNETIC RESONANCE IMAGING

Highly undersampled supraaortic MRA at 3.0 T: initial results with parallel imaging in two directions using a 16-channel neurovascular coil and parallel imaging factors up to 16

Guido M. Kukuk[a,*], Dariusch R. Hadizadeh[a], Jürgen Gieseke[a,b], Marcus von Falkenhausen[a], Ingrid Böhm[a], Renate Semrau[a], Horst Urbach[a], Arne Koscielny[c], Frauke Verrel[c], Kai Wilhelm[a], Hans H. Schild[a], Winfried A. Willinek[a]

[a]*Department of Radiology, University of Bonn, Sigmund-Freud-Strasse 25, 53105 Bonn, Germany*
[b]*Philips Healthcare, 5680 Best, The Netherlands*
[c]*Department of Surgery, University of Bonn, 53105 Bonn, Germany*

Received 30 December 2009; revised 10 March 2010; accepted 10 June 2010

Abstract

Purpose: To present the feasibility of highly undersampled contrast-enhanced MRA (CE-MRA) of the supraaortic arteries with a 16-channel neurovascular coil at 3.0 T using parallel imaging in two directions with parallel imaging factors (PIF) up to 16.
Materials and Methods: Institutional review board approval and informed consent were obtained. In a prospective study, MRA protocols including PIF of 1, 2, 4, 9 and 16 yielding a spatial resolution from 0.81×0.81×1.0 mm^3 to 0.46×.46×0.98 mm^3 were acquired. In 32 examinations, image quality and vascular segments were rated independently by two radiologists. SNR estimations were performed for all MRA protocols.
Results: The use of high PIF allowed to shorten acquisition time from 2:09 min down to 1:13 min and to increase the anatomic coverage while maintaining or even increasing spatial resolution down to 0.46×0.46×0.98 mm^3. The larger anatomic coverage that was achieved with the use of high PIF allowed for visualization of vascular structures that were not covered by the standard protocols. Despite the resulting lower SNR using high PIF, image quality was constantly rated to be adequate for diagnosis or better in all cases.
Conclusion: The use of high PIF yielded diagnostic image quality and allowed to increase the anatomic coverage while maintaining or even improving spatial resolution and shortening the acquisition time.
© 2010 Elsevier Inc. All rights reserved.

Keywords: MRA; 3.0 Tesla; Supraaortic arteries; Parallel imaging; Sensitivity encoding

1. Introduction

Stroke is currently the second most common cause of death and a major cause of disability worldwide, ranking after ischemic heart disease and before cancer [1]. Arterial steno-occlusive disease of the supraaortic circulation is responsible for many ischemic strokes and transient ischemic attacks. According to current meta-analyses, high spatial resolution contrast-enhanced 3D MRA (CE-MRA) has a high sensitivity of about 94% and a high specificity of about 92% for the diagnosis of severe carotid artery stenosis [2,3] and has become a routine application in the assessment of supraaortic steno-occlusive disease. In fact, it has replaced diagnostic digital subtraction angiography (DSA) in many institutions [4–6]. However, spatial resolution is often obtained at the cost of long acquisition times to increase the number of slices, i.e., the anatomic coverage. With parallel imaging, the acquisition time can be reduced while maintaining spatial resolution, but at the expense of signal-to-noise ratio (SNR) [7,8]. The SNR increase at 3.0 T holds promise to use higher acceleration factors in parallel imaging while maintaining image quality and anatomic coverage [9]. For supraaortic CE-MRA, it has previously been shown that parallel imaging techniques with acceleration factors up to 4

* Corresponding author. Tel.: +49 22828715960; fax: +49 22828715598.
E-mail address: guido.kukuk@ukb.uni-bonn.de (G.M. Kukuk).

0730-725X/$ – see front matter © 2010 Elsevier Inc. All rights reserved.
doi:10.1016/j.mri.2010.06.008

can provide good image quality at 3.0 T [10,11]. Even higher parallel imaging factors (PIF) have so far been implemented in cardiovascular applications that use a relatively small field of view like cerebrovascular and heart imaging [12,13].

The purpose of this study was to evaluate the use of parallel imaging in two directions for contrast-enhanced high spatial resolution MRA of the supraaortic arteries at 3.0 T using a 16-channel neurovascular coil and PIF up to 16 with high spatial resolution and increased anatomic coverage.

2. Materials and methods

This prospective study was approved by our institutional review board. Informed consent was given by all participants. CE-MRA of the supraaortic arteries was performed in 32 subjects [six volunteers (mean age 33.3±10.7 years, range 19–52 years) and 26 patients (mean age 66.8±11.0 years, range 40–89 years)]. Volunteer studies were involved in the initial six measurements (PIF 1, n=1; PIF 2, n=2, PIF 4, n=1; PIF 9, n=1, PIF 16, n=1). The clinical indication for CE-MRA in all patients was suspected supraaortic vascular disease. In six of the 26 patients conventional angiography served as the standard of reference. In the other 20 of 26 patients, duplex sonography was performed as the reference standard. Age below 18 years and contraindication to MR imaging (e.g., pacemakers, metallic implants, etc.) were exclusion criteria. Examinations were performed between April 2006 and December 2008.

2.1. MR Angiography

CE-MRA was performed on a 3.0-T Achieva MR scanner (Philips Healthcare, Best, Netherlands; maximum gradient amplitude 80 mT/m; 0.2 ms rise time; maximum slew rate 200 T/m per second) equipped with a 16-channel neurovascular coil that covers the regions of the upper chest, head, neck and brain.

A standardized, automatic bolus injection (Spectris MR injection system, Medrad Europe) of 0.1 mmol/kg body weight of gadopentetate dimeglumine (Magnevist, Bayer Schering Pharma AG, Berlin, Germany) was used at a flow rate of 1.5 ml/s, followed by a saline flush of 25 ml.

When real-time fluoroscopy revealed that the bolus of contrast material had reached the aortic arch, the actual angiographic pulse sequence was started manually with a delay of 1 s. To minimize motion artifacts, patients were asked to hold their breath during the initial 15 s of data acquisition.

CE-MRA protocols were based on a 3D gradient-echo pulse sequence with parallel imaging (sensitivity encoding,

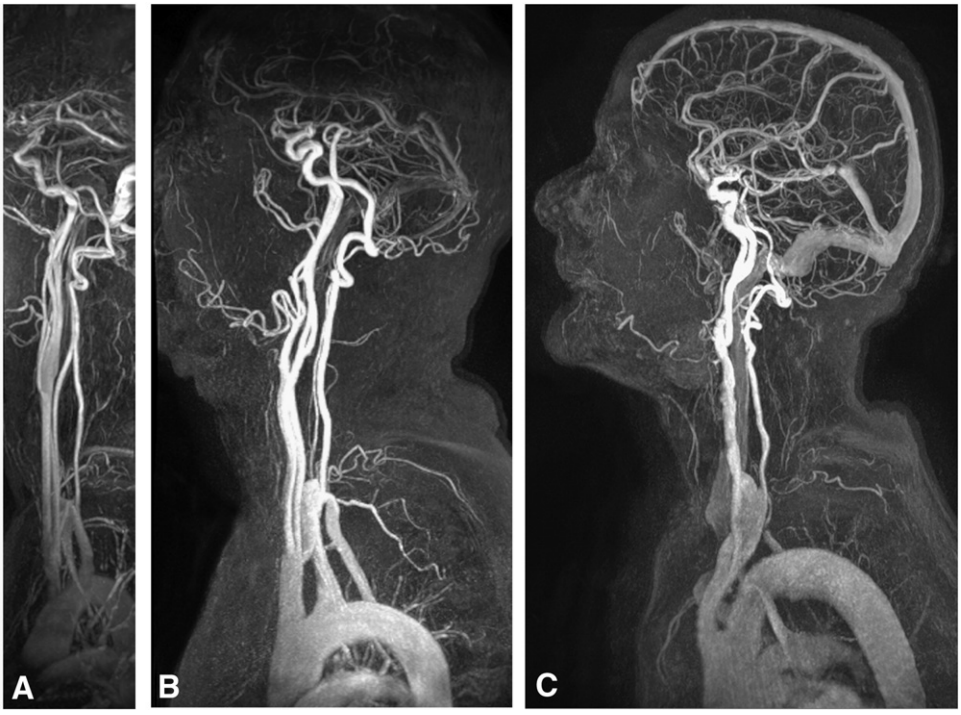

Fig. 1. (A) Supraaortic MRA images of a 30-year-old female healthy volunteer: sagittal maximum intensity projection from T1-weighted GRE sequence (5.1/1.5/30°) using a parallel imaging factor of 1 (without undersampling). The acquired spatial resolution was 0.81×0.81×1.0 mm^3. (B) Supraaortic MRA images of a 63-year old male patient: sagittal maximum intensity projection from T1-weighted GRE sequence (5.1/1.9/30°) with a parallel imaging factor of 4. The acquired spatial resolution was 0.68×0.68×0.98 mm^3. Note the visualization of the peripheral segments of the intracranial arteries as well as of the facial and suprascapular arteries which is caused by the extended anatomic coverage. (C) Supraaortic MRA images of a 75-year-old female patient with a minor stenosis (<50%) of the left internal carotid artery: sagittal maximum intensity projection from T1-weighted GRE sequence (4.9/1.9/25°) using a parallel imaging factor of 16. The acquired spatial resolution was 0.46×0.46×0.98 mm^3. Venous enhancement does not interfere with image interpretation.

Download English Version:

https://daneshyari.com/en/article/1806998

Download Persian Version:

https://daneshyari.com/article/1806998

Daneshyari.com