Aortic Arch to Intracranial 3D MRA with t-SLIT 3D-SSFP using a Neurovascular-Attached QD head SPEEDER Coil

M. Yui[1], M. Miyazaki[1], H. Kanazawa[1], K. Okamoto[1]

[1]MRI Department, Toshiba Medical Systems Corporation, Ohtawara, Tochigi, Japan

ABSTRACT

Observation of aortic arch to intracranial MRA is clinically desired. An ASL technique, ECG-triggered 3D t-SLIT SSFP, is developed to selectively depict fast flow arteries. The technique allows a coronal plane acquisition to cover the aortic arch to intracranial arteries and permits remarkable scan time reduction using a neurovascular-attached QD SPEEDER coil.

INTRODUCTION

In clinical studies, observation of aortic arch to intracranial vessels is desired. As a non-contrast-enhanced MRA technique, multi-slab 3D TOF acquisitions are wildly used for this purpose. However, using a normal multi-slab 3D TOF technique, acquisition time is about 15 to 20 min to cover from aortic arch to intracranial arteries. Because of the long acquisition time, it is sometimes hindered to use in clinical examinations. Recently, time-spatial labeling tag (t-SLIT) half-Fourier FSE, as an arterial spin labeling (ASL) technique, has been reported in studies of pulmonary and carotid MRA [1,2]. Another TOF method using spatially selective inversion recovery pulse has been reported to gain inflow effects [3]. The FSE-based t-SLIT has a merit of less susceptibility effect, which works well in pulmonary MRA. Even though short echo-train spacing (ETS) was used in half-Fourier FSE, signal loss was prominent during systolic-triggered images due to fast flow. Therefore, 3D SSFP-type sequence is appropriate to combine with t-SLIT to overcome this problem. In this study, we have developed a method, using ECG-triggered 3D t-SLIT SSFP, which does not affected by fast flow and enables marked reduction of scan time by acquiring in a coronal direction using a neurovascular-attached QD head SPEEDER coil [4].

MATERIALS and METHODS

Figure 1 shows a sequence diagram of t-SLIT-SSFP. Both non-selective (tag-off) and spatially selective (tag-on) pulses can be placed simultaneously and tag-on pulse can be placed in any orientation as a free-hand pulse. In order to depict a full coverage of aortic arch to intracranial arteries, a coronal acquisition method was used to reduce scan time. After blood in myocardium are marked by a tag-on pulse to cover a whole heart, the marked blood travels to the intracranial region through during an inversion time (TI), and followed by 3D-SSFP imaging to depict the blood vessels. All experiments were performed on a 1.5-T clinical imager (EXCELART/Vantage, Toshiba, Japan) equipped with a neurovascular-attached QD head SPEEDER coil. A total acquisition time of the tag-on and tag-off images were around 2-3 min. Typical acquisition parameters were as follows: TR/TE=5.2/2.6 ms, FA=50 deg, 16 slice partitions with a 6-mm thick slice, 2 segments, matrix=192x256, FOV=40x40 cm, and TI=1000-1300 ms. Five healthy volunteers underwent the 3D t-SLIT-SSFP experiments.

RESULTS

Figure 2 shows an MIP image of ECG-triggered 3D t-SLIT-SSFP, after subtraction of tag-on from tag-off images. Note that the aortic arch, common carotid artery, carotid bifurcation, internal carotid artery, and basilar artery are delineated in high signal intensity. The image was acquired using only tag-on and tag-off scans without a non-spatial pulse, since stationary background signals are anyway subtracted from tag-on from tag-off images.

DISCUSSION

The SSFP-type t-SLIT sequence allows not only fine depiction of fast flow arteries but gains tremendous reduction of scan time also. Furthermore, the carotid bifurcation is well defined in detail without flow void, which is often seen in 3D TOF images. It is worth notified that the technique allows separation of arteries from veins. Thus contamination of veins is not observed. However, blood-traveling time differs from patient to patient so that TI time may vary to obtain the certain length. With using a long TI, signal intensity becomes lower.

In conclusion, ECG-triggered 3D t-SLIT-SSFP is appropriate to depict fast flow arteries from aortic arch to intracranial arteries in a short time using a neurovascular-attached QD head SPEEDER coil. This may be useful for screening purposes.

REFERENCES

[1] Kanazawa H, et al, ISMRM p140, 2002. [2] Kurihara Y, et al, ISMRM 1781, 2002. [3] Leupold J, et al, ISMRM p138, 2002. [4] Okamoto K, et al, ISMRM submitted, 2004.

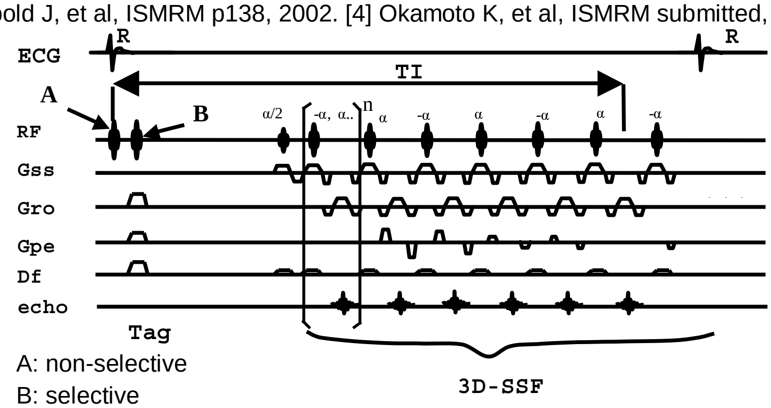

Figure 1 ECG-triggered 3D t-SLIT-SSFP

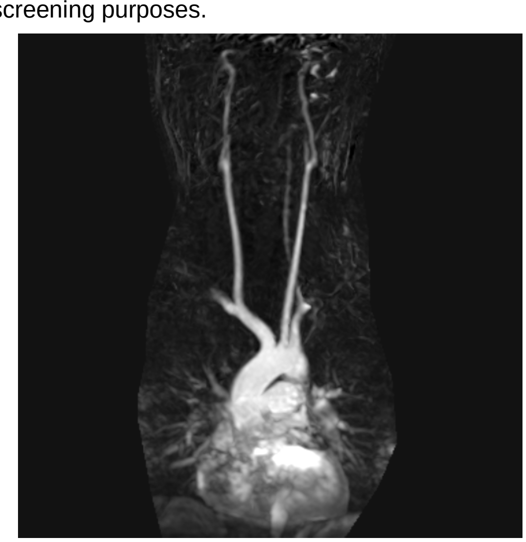

Figure 2 an MIP image after subtraction