High resolution non-contrast lymphangiography of the head and neck at 3Tesla

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Objective

The aim of this work is to evaluate a state of the art high resolution non-contrast MR lymphangiographic method for isolated visualization of head and neck lymph nodes.

Introduction

Accurate detection of metastasis in lymph nodes is now possible with the recent development of iron oxide based nano-particle enhanced imaging [1]. After injection of iron oxide based contrast agent, benign lymph nodes can be identified on positive contrast using off resonance imaging techniques [2]. However, malignant lymph nodes remain undetected with this method due to the absence of macrophages that are lymphotropic to the iron oxide. Conventional 2D multi-contrast techniques provide neither enough contrast nor spatial resolution to depict lymph nodes which may be ~5mm or smaller. We demonstrate the use of a new T2 weighted 3D turbo spin echo sequence (SPACE) [3] that improves visualization of the lymph nodes. We show in healthy volunteers at 3.0 Tesla utilizing a dedicated 8-channel neck array coil, the combination of field strength, RF array coil and 3D technique can enhance the conspicuity of lymph nodes in the head and neck region.

Methods

Four subjects male and female ranging in age from 38 to 75 participated upon giving informed consent with all studies conducted according to institutional IRB guidelines. All subjects were imaged on a 3.0T Siemens Tim TRIO using an in-house constructed bilateral eight-channel array receiver coil [4].

Sequence

The new technique has the following features: 1) variable flip angle refocusing pulse train that optimizes contrast; 2) nonselective refocusing pulses to improve sampling efficiency; 3) linear reordering and long echo train to give T2 contrast. 4) Coronal imaging to improve spatial coverage. The 3D TSE based SPACE sequence that uses flip angle evolution was optimized for head and neck with the following parameters: TR=2000ms, TE=179ms, NEX=2, ETL=47, BW=780Hz/pixel and FA=120. The 3D images had isotropic voxel dimensions of 0.7mm. The images for this experiment were acquired in the region of the carotid artery. Parallel acceleration with GRAPPA=2 was also applied.

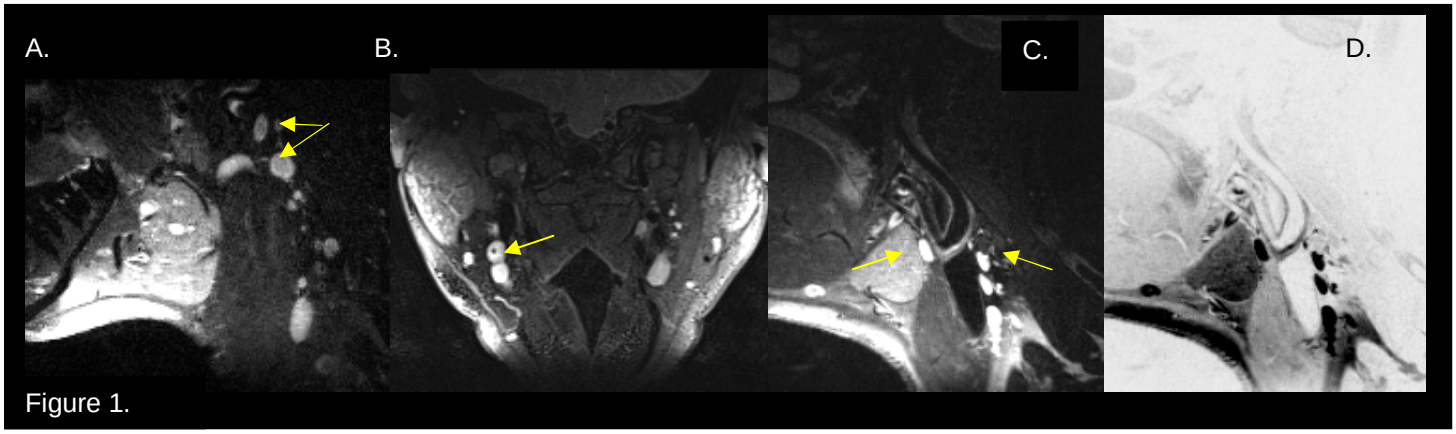

Figure 1. 3.0 Tesla Images of Head and Neck Lymph nodes (yellow arrows) shown distinctly bright with high CNR in (A) Sagittal view (b) Coronal view and (c) Axial along the carotid artery and (D) inverted contrast to produce PET like image of the nodes all acquired with the 3D SPACE sequence.

Results

Figure 1 displays a set of lymph node images obtained in the region above and below the carotid artery bifurcation. In 1A, superficial nodes are displayed in a sagittal image acquired with the 3D SPACE sequence with the preauricular nodes (yellow arrow) as well as nodes in the cervical region well visualized. The extended coverage of the sequence provides the option for coronal acquisition and in this view (Figure 1B) the sub-mandibular nodes are well elucidated. Deeper nodes in the cervical region are displayed in the sagittal view of Figure 1C and in 1D the image grey scale is inverted to produce a PET like image contrast currently the standard representation of diffusion weighted images of lymph nodes. In the inverted contrast image, the lymph nodes are the most distinct structures. This method clearly enables non contrast MR lymphangiography of the head and neck with high resolution. Even without using a metastasis sensitive contrast agent this method allows for the evaluation of the lymph nodes based on size criterion alone and both deep and superficial nodes between 2-7 mm were well visualized.

Conclusion

The combination of high signal to noise generated with a dedicated array coil at 3.0T and the 3D SPACE sequence provides the opportunity to generate high contrast sub-millimeter isotropic resolution images of the head and neck lymph nodes. The sequence applied with novel and newer lymphangiographic contrast agents will allow for accurate nodal detection and characterization, and this method is predicted to provide the nodal metastases status. The high resolution of this technique may provide the opportunity to resolve the subtle variations involved in a host of diseases that impact the lymphatic system.

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