A Novel 15-Element SENSE-Compatible Vertical Field PV Array Coil

S. Su[1], F. Robb[1], Y. Guan[1], S. Zhao[1]
[1]USA Instruments - GEMS, Aurora, Ohio, United States

Introduction

Clinical imaging of peripheral vasculature (PV) on a horizontal MRI system is quite limited by patient size. A high performance PV array coil for vertical field open MRI systems has the advantage of accommodating larger patients. However, no vertical field PV coils have been reported to date. The reason is that PV imaging requires large volume coverage. Because the static magnetic field is in vertical direction, the configuration of using small sensitive loop surface coils wrapping around the body and extremities is inefficient for a vertical PV coil. Attempts to use a single solenoid coil for covering a large volume has been proven to be inefficient. Recently, the concept of solenoidal array has been proposed and demonstrated (1). In this work, we have applied solenoidal array concept to design a vertical field PV coil by including mutually decoupled solenoid coils each sensitive to a localized volume to achieve premium performance. A 15-element multi-station vertical open PV coil provides excellent SNR, uniform coverage of the peripheral vasculature and allows for SENSE imaging in S/I and A/P directions.

Methods

The PV array coil consists of 4 stations, A, B, C and D, with D the foot station. A, B and C have same configuration. Figure 1 shows the configuration of station A as an illustration. The complete coil trace of station A is shown as (A) in Figure 1. The station consists of 4 coil elements: an anterior saddle coil (B), a posterior saddle coil (C), an uneven counter-rotational coil (D) and a 2-turn solenoid coil (E). The uneven counter-rotational coil and the 2-turn solenoid coil are inherently decoupled (1) via positioning the later at the null B_1 point of the former. The two saddle coils are decoupled through overlapping (2). The foot station is a smaller station that we found 3 elements, a solenoid and 2 saddle coils, to be sufficient. Each of the four stations is imaged in sequence with automatic patient bed advancement between neighboring stations. Total imaging coverage in head-to-foot direction is >140cm.

Results and Discussion

The 15-element vertical open PV coil was tested using a Hitachi Altaire 0.7T MRI system. Contrast agent was administered and a TOF sequence was used to acquire PV images in 4 stations as shown in Figure 2. The results show that the PV coil provides a uniform coverage of the peripheral vasculature, a comparable SNR to a body coil and good resolution for clinical evaluation. This work demonstrates the first successful vertical field open PV coil and its value in clinical application. This PV coil has the advantage of accommodating large patient size (>300lb) for peripheral vasculature studies. Also, the extended coverage of the coil makes it also ideal for general purpose whole-body imaging. This work also shows that uneven counter-rotational coil and solenoidal array coils in general are valuable in designing high performance array coil for vertical open MRI systems. Solenoidal array coils can be made compatible with SENSE imaging applications.

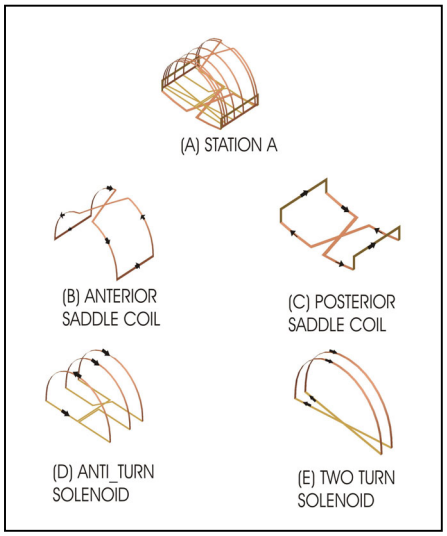

Figure 1. Coil configuration of station A

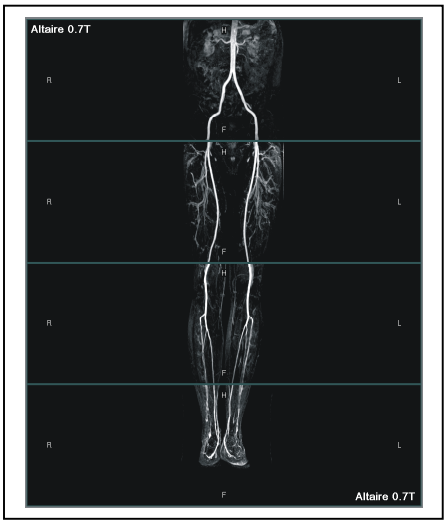

Figure 2. 4-station PV array coil composite image

References:

1. Su et al. Magn. Reson. Med. 47:794, 2002
2. Roemer et al. Magn. Reson. Med. 16:192, 1990

Acknowledgements: Christopher Boyea, Shawn Etheridge and Sandy Woodside, HMSA.