Comparison between the blood pool agent Vasovist and conventional gadolinium agents for dynamic moving table peripheral CE-MRA – a preliminary study

J. H. Maki[1,2], M. Wang[3], G. J. Wilson[4], and T. Leiner[5]

[1]Radiology, University of Washington/PSVAHCS, Seattle, WA, United States, [2]Radiology, Puget Sound VAHCS, Seattle, WA, United States, [3]Bioengineering, University of Washington, Seattle, WA, United States, [4]Philips Medical, Cleveland, OH, United States, [5]Radiology, University of Maastricht, Maastricht, Netherlands

Introduction

The Blood Pool agent gadofosveset (Vasovist, Schering AG, Berlin, Germany) reversibly binds albumin, giving it a R_1 relaxivity approximately five times that of conventional extracellular (ECF) Gd agents. Although Vasovist was initially conceived for equilibrium phase vascular imaging, it can be used for dynamic imaging as well. It is, however, not well understood how well it performs as compared to conventional ECF Gd agents for dynamic contrast-enhanced MRA (CE-MRA). This work examines Vasovist vs. conventional ECF agents for moving table, peripheral dynamic 3D CE-MRA (pMRA).

Methods

Using a Philips Intera 1.5T system (Philips Medical Systems, Best, the Netherlands) and a protoype 18 channel peripheral vascular coil [1], pMRA was performed on 16 clinical patients grouped as follows: 6 with Vasovist dosed at 0.05 mmol/kg (13-19 cc), 5 with Vasovist dosed at 0.03 mmol/kg (6–11 cc), and 5 with a fixed dose of 40 cc Magnevist (Schering AG, Berlin, Germany). The entire dose of Vasovist was injected at 0.7 cc/sec in all cases, while a split bolus of Magnevist (20 cc @ 1.8 cc/sec followed by 20 cc @ 1.4 cc/sec) was used per established clinical protocol. Typical acquisition parameters were: TR = 4.5/4.5/5.1 ms, TE = 1.3/1.4/1.6 ms, L/R Sense Factor = 3.5/3.5/4.0, Scan Time = 10/8/49 s, and Spatial Resolution = 1.2x2.1x2.6 / 1.2x2.1x2.0 / 1.0x1.0x1.0 mm^3 for the upper/middle/lower stations respectively. The lower station was acquired with a centric profile order. Arterial signal intensity as well as artery-muscle and artery-fat contrast ratios $[(SI_{artery}-SI_{muscle/fat})/SI_{artery}]$ were calculated for each station of each exam. Statistical analysis was performed using a paired t-test.

Findings

All 16 studies were well-tolerated and diagnostically successful. Figure 1 demonstrates typical pMRA exams for each agent/dose. Average artery-muscle contrast ratios for each agent/dose/station are shown in Figure 2. As can be seen, artery-muscle contrast decreased for more distal stations. Image quality of Vasovist 0.05mmol/kg was superior to Vasovist 0.03 mmol/kg, achieving statistical significance for the upper and lower stations and near significance for the middle station (p=0.005, 0.01, 0.06 respectively). Vasovist 0.05 mmol/kg and Magnevist 40 cc were very similar in contrast (see Figure 2) with no statistical difference. Subjectively, Vasovist images were well-received by the interpreting radiologists. Results of artery-to-fat contrast ratios were similar. No significantly different degree of lower station venous enhancement was appreciated between agents.

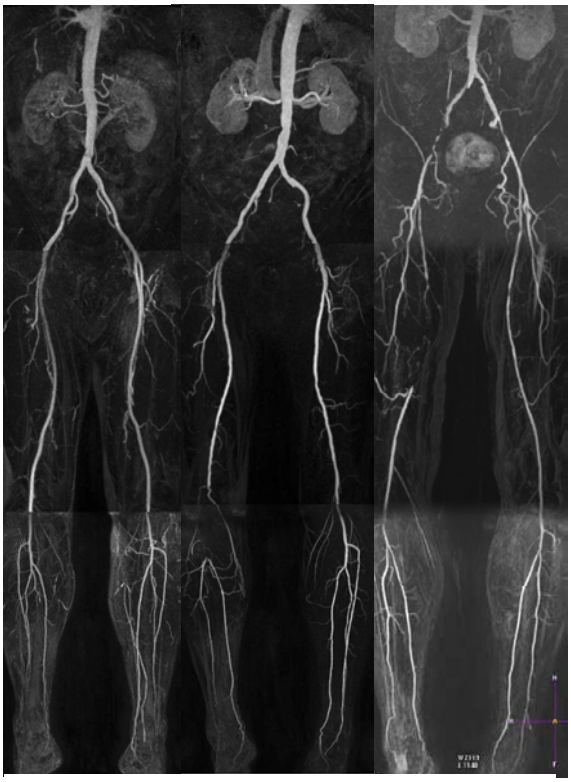

Figure 1. Representative pMRA studies for Vasovist 0.03, Vasovist 0.05, and Magnevist 40cc (L to R).

Discussion

Vasovist performs well for dynamic moving table peripheral CE-MRA. In this preliminary study using the approved dosage of 0.03 mmol/kg and a single-phase injection profile, arterial contrast falls short of a conventional ECF Gd examination using 40 cc of contrast. Increasing the dose to 0.05 mmol/kg, however, yields arterial contrast equal to the ECF study. This occurs despite the molarity of Vasovist being half (0.25M vs. 0.5M), the administered volume of contrast being less than half, and the initial rate of infusion being less than 40% that of the ECF study. The equality of these two exams is precisely as predicted by first principles, given that signal intensity scales as sqrt(R_1* IR) where $R_1$is the T_1 relaxivity and IR is the molar infusion rate. The R_1 of Vasovist is known to be approximately 5 times that of conventional ECF agents (R_1 of 20 L $mmol^{-1}$ sec^{-1} for Vasovist vs. 3.9 L $mmol^{-1}$ sec^{-1} for Magnevist). Thus, we expect the 0.05 mmol/kg Vasovist dose to have a signal intensity approximately sqrt(5 * 0.4 * 0.5) = 1, which is consistent with the data presented here (Figure 2). The 0.03 mmol/kg Vasovist dose likely falls short of this due to the much shorter total injection duration (8.5 – 16 sec).

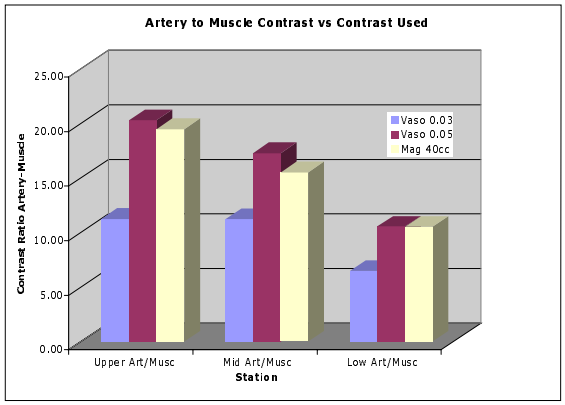

Figure 2. Artery to muscle contrast for 2 doses of Vasovist and 40cc dose Magnevist for all three stations.

In conclusion, Vasovist performs for CE-MRA precisely as expected based on its much higher molar relaxivity. The smaller volume dosages for Vasovist translate to slower infusion rates, which are in turn counteracted by its greater relaxivity. In future studies, the image quality of Vasovist exams may be further improved by using a biphasic injection profile as in the Magnevist exams. In this preliminary study using a single-phase Vasovist injection, a greater than approved dosage (0.05 mmol/kg) appears beneficial, producing image quality equivalent to 40 cc of an ECF contrast agent.

Bibliography

1.) JH Maki, CE Hayes, GJ Wilson, CM Mathis, RM Hoogeveen. Proceedings of ISMRM 13th Scientific Meeting, Miami Beach, FL, May 2005.