IDENTIFICATION OF THE ARTERY OF ADAMKIEWICZ ARTERY: THE ROLE OF HIGH SPATIAL AND TEMPORAL RESOLUTION MR ANGIOGRAPHY IN PATIENTS WITH INDISTINCT DEPICTION BY MDCT ANGIOGRAPHY.

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Target audience: Researchers, radiologists, and clinicians imaging/treating patients with aortic disease.

Introduction: Postoperative spinal cord ischemia is a serious complication of descending and thoracoabdominal aortic replacement. The main feeder of the anterior spinal artery in the thoraco-lumber levels is the artery of Adamkiewicz (the great anterior radiculomedullary artery). Identification of the artery of Adamkiewicz is important to reduce a risk of postoperative paraparesis or paraplegia. There is a high degree of variability in its origin although it mostly arises between the Th8 and L1 neuroforamina[1]. Its diameter is approximately 0.5-1.5 mm [2].

Multidetector CT (MDCT) is widely used for planning of surgical or endovascular procedure in patients with aortic dissection or aneurysm for the following reasons: it demonstrates not only details of the aorta and its main branches but also those of other organs such as lungs, spine and ribs; volume rendering images of the body give useful information to vascular surgeon. Reported detectability of the artery of Adamkiewicz by MDCT is 80-90%[2,3]. However, potential drawbacks of MDCT for depiction of the artery of Adamkiewicz are: (1) interruption or obscuration of the artery by the osseus structure through the course of intervertebral foramen, (2) high dose of iodine contrast media that may induce nephropathy and (3) difficulty in estimating appropriate scan delay in case of aortic dissection or occlusion of the intercostal artery.

Current MR angiography technique can provide vascular visualization with high spatial and temporal resolution. Combined with little artifact from bones, time-resolved MR angiography has a potential to overcome drawbacks of MDCT for depiction of the artery of Adamkiewicz.

Purpose: The purpose of this study was to evaluate whether time-resolved MR angiography at 3.0T is superior to MDCT angiography in the depiction of the artery of Adamkiewicz. Confidence in its localization was compared between MDCT and MR angiography.

Materials and Methods: We retrospectively evaluated MDCT and MR images. Between April 2011 and October 2012, sixty-two consecutive patients scheduled for surgical or endovascular repair of the thoracic or thoracoabdominal aorta underwent MDCT angiography for preoperative evaluation including identification of the artery of Adamkiewicz. By MDCT angiography, the artery of Adamkiewicz arising from intercostal arteries of the lower thoracic or lumbar vertebra and supplying the anterior spinal artery was clearly identified in 41 of the 62 patients. Those patients did not undergo additional MR angiography examination. The remaining 21 patients whose MDCT angiography demonstrated partially obscured or unidentifiable Adamkiewicz artery underwent time-resolved MR angiography. Another two patients with a history of anaphylaxis to iodine contrast media and with a high risk of iodine contrast nephropathy also underwent MR angiography. Therefore, a total of 62 MDCT and 23 MR data sets were included.

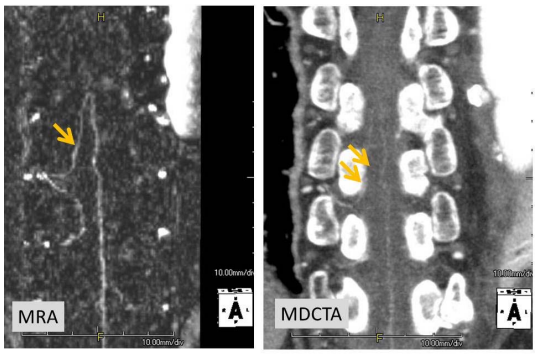
MR angiography was performed on a 3.0T whole body scanner. Time resolved TWIST (Time-resolved Imaging with Stochastic Trajectories) technique was used. Parallel imaging was used in one or two phase encoding directions. Following the acquisition of an entire non-enhanced dataset, injection of 20ml of gadopentetate dimeglumine at a rate of 2ml/sec was started and consecutive 14-19 sagittal 3D T1W undersampled data sets (TR/TE 2.4-2.9/1.2 ms; FA18°; slices 80; FOV 400 x 263-275 mm^2; image matrix 240-252 x 384; spatial resolution 1.0-1.1 x 1.0-1.1 x 1.0 mm^3, temporal resolution 5.7-7.1s) were acquired.

Each CT and MR data set was retrospectively reviewed on a commercially available workstation. In patients who underwent both examinations, each image analysis was performed blinded to the findings of the other modality. For image analysis, a 4-point confidence index was used: grade 1, the artery of Adamkiewicz was not depicted; grade 2, intradural segment was partially depicted but the continuity to extradural segment was not recognized; grade 3, characteristic hairpin turn is depicted, but other substantial intradural venous enhancement obscured the continuity to the extradural segment; grade 4, characteristic hairpin turn is depicted and the vessel clearly continues through the intervertebral foramen to the extradural segment. A grade 3 or 4 was regarded as diagnostic for detection of the artery of Adamkiewicz. We calculated the detectability of the artery of Adamkiewicz for each modality. Statistical differences between each modality were calculated using binomial test for dichotomous data and Wilcoxon Signed Ranks test for quantitative data. $P<0.05$ was used to designate statistical significance.

Results: MDCT angiography detected the artery of Adamkiewicz in 53 of 62 patients (85%). In 23 patients who underwent MR angiography, detectability of MR angiography was significantly higher than that of MDCT angiography (78% vs. 52%, $p=0.038$). Mean consensus grade of MR angiography was also significantly higher than that of MDCT (3.2 vs. 2.5, $p=0.01$). In ten patients, diagnostic images of both MR and MDCT angiography were obtained. The vertebral levels and sides where the artery of Adamkiewicz originates were consistent between both modalities in all the patients.

Discussion: In this study, several advantages of MR angiography brought the higher confidence grades for detection of the artery of Adamkiewicz than MDCT: MR angiography demonstrated no obscuration by the spine; higher temporal and spatial resolution of the protocol provided vessel continuity with less venous contamination.

In the clinical setting, MDCT angiography is widely used for treatment planning of aortic diseases and it is difficult to replace MDCT angiography with MR angiography. Our MDCT angiography reached comparable success rates (85%) to previous reports regarding identification of the artery of Adamkiewicz. Therefore, additional MR angiography was not necessary for almost of patients from the perspective of medical resources and cost. MR angiography is useful for patients whose MDCT angiography failed in localization of the artery of Adamkiewicz.



The artery of Adamkiewicz originates from the right 9th intercostal artery. The arterial course is obscured by the Th 9th on MDCTA. MRA demonstrates the entire course.

Conclusions: High spatial and temporal resolution MR angiography technique can increase the confidence in localization of the artery of Adamkiewicz. MR angiography is a useful tool that can compensate for the limitation of MDCT angiography.

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