Comprehensive non-contrast-enhanced MRI of the thoracic aortic dissection: non-contrast-enhanced 3D MRA and time-resolved 3D flow tracking techniques

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Background

Thoracic aortic dissection should be followed up even at a chronic phase to depict any deterioration, because the fatality rate is high in an emergency. Because it is often associated with renal impairment, the use of iodine or gadolinium contrast agent is unfavorable for some patients with renal insufficiency. Recently, non-contrast-enhanced 3D MRA sequences with high vascular signals have been developed, but they lack the flow information of the entry and false lumen. Time-resolved 3D flow tracking may compensate for this disadvantage of the unenhanced 3D MRA. The aim of this study was to evaluate the potential of the comprehensive non-contrast-enhanced MRI techniques of the thoracic aortic dissection: non-contrast-enhanced 3D MRA and time-resolved 3D flow tracking.

Methods

13 patients with thoracic aortic dissection were recruited. A 1.5T imager (Achieva Novadual, Philips) was used for MRI examinations. Non-contrast-enhanced 3D MRA was obtained using 3D turbo spin-echo imaging (TRANCE; n = 6) or 3D steady-state free precession (SSFP; n = 3), both of which utilized cardiac-gating, respiratory-compensation, and fat-suppression techniques. In the remaining 4 patients, breath-hold gadolinium-enhanced 3D MRA was performed for comparison. Thereafter, time-resolved 3D phase-contrast MRI was performed using the following parameters: TR, 4.9 ms; TE, 2.4 ms; FA 8 degrees; temporal resolution, 22 ms; 16 cardiac phases; and the velocity encoding of 200 cm/s. Time-resolved 3D flow tracking was generated from the data acquired by the 3D phase-contrast MRI, using a GT Flow software (Gyrotools, Zurich) offline.

First, the 3D flow tracking was compared with the gadolinium-enhanced 3D MRA, the standard MRA technique for the thoracic aortic dissection. Next, the imaging findings added to non-contrast-enhanced 3D MRA by the time-resolved 3D flow tracking were assessed in this disease.

Results

Comparison between gadolinium-enhanced MRA and time-resolved 3D flow tracking

Time-resolved 3D flow tracking showed high-speed jet at the entry and the blood flow in the false lumen in the 3 patients with double-barrel dissection of the thoracic aorta. In thrombosed dissection, only the slow blood flow of the true lumen was seen by the time-resolved 3D flow tracking.

Time-resolved 3D flow tracking with non-contrast-enhanced 3D MRA

The time-resolved 3D flow tracking visualized the high-speed jet at the entry and the vortex adjacent to the ulcer-like projection (ULP), but did not necessarily show the blood flow in the false lumen.

Discussion

In the non-contrast-enhanced 3D MRA, mural or luminal thrombus can be isointense to blood flow. In addition, the entry could not be confirmed necessarily, because of the signal loss induced by the turbulence or high-speed flow. Time-resolved 3D flow tracking could make up for these disadvantages of the unenhanced 3D MRA techniques, because of its sensitivity to the blood flow. Both morphological MRA and flow-dependent phase-contrast MRI techniques consisted of 3D volume data, and thus the comparison between the two imaging data set was easily made. This allowed for the accurate evaluation of the entry and ULP in the thoracic aortic dissection.

In conclusion, comprehensive evaluation of thoracic aortic dissection was possible without contrast by adding time-resolved 3D flow tracking to non-contrast-enhanced 3D TRANCE or SSFP MRA.

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