

Mechanism of early aneurysm formation at compliance zone of intracranial arteries on CTA and MRA

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Purpose: As the signal of brain 3D-TOF MRA depended upon flow volume of systolic phase and the image of brain CTA depended upon time duration of diastolic phase, the transient expansion of arterial bifurcation on cerebral MRA and disappearing on CTA may suggest arterial compliance zone. The transient and periodic expansion of compliance zone on MRA and CTA was compared with CFD and phantom experiments.

Materials and Methods: 3D-TOF brain MRA were obtained from 500 persons who had high risk factors of intracranial aneurysm. When the brain MRA showed broad base expansion of arterial wall at bifurcation area, routine brain CTA and cardiac gated brain CTA were performed for comparison. 3D-TOF brain MRA were taken on a GE Signa 3.0 T system (Signa Excite, GE) with 23/3.6/20 (TR/TE/FA) and brain CTA were taken on MD CT scanner (Somatom Sensation 64, Siemens). Computational flow dynamics (CFD) and phantom experiments using elastic arterial bifurcation model were done for cross comparison with clinical phenomenon.

Results: Twenty-two (4.4%) patients of 500 had 31 intracranial aneurysms. Seven (1.4%) of the 22 patients had 8 broad base expansions of arterial wall at bifurcation area on brain 3D-TOF MRA and which were disappeared on routine brain CTA. Cardiac gated brain CTA showed periodic expansion of arterial bifurcation area synchronizing with cardiac pulse in all of 8 expansions. One DSA, which had taken on combine aneurysm patient, showed good correlation. Pattern analysis of CFD and phantom experiments were well matched with clinical MRA and CTA results.

Conclusion: The difference of images between brain MRA (expansion at arterial bifurcation) and CTA (disappearing expansion) can suggest the presence of compliance zone. Some of compliance zone showed significant expansion during cardiac systolic phase on cardiac gated brain CTA.