PETRA

Time of flight magnetic resonance angiography, though widely used after coil embolization, is associated with limitations owing to magnetic susceptibility and radiofrequency shielding following stent assisted coil embolization.

Grodzki et al. presented a sequence that achieves the shortest possible encoding time for each k-space point, limited by pulse length, hardware switching times, and gradient performance of the scanner. In pointwise encoding time reduction with radial acquisition (PETRA), outer k-space is filled with radial half-projections, whereas the center is measured single pointwise on a Cartesian trajectory. This hybrid sequence combines the features of single-point imaging with radial projection imaging. No hardware changes are required. Using this method, 3D images with an isotropic resolution of 1 mm can be obtained in less than 3 minutes. The differences between PETRA and the ultrashort echo time (UTE) sequence are evaluated by simulation and phantom measurements. Advantages of pointwise encoding time reduction with radial acquisition are shown for tissue with a T(2) below 1 ms. The signal-to-noise ratio and Contrast-to-noise ratio (CNR) performance, as well as possible limitations of the approach, are investigated. In-vivo head, knee, ankle, and wrist examples are presented to prove the feasibility of the sequence. In summary, fast imaging with ultrashort echo time is enabled by PETRA and may help to establish new routine clinical applications of ultrashort echo time sequences [1)].

Nishikawa et al. presented the 141 intracranial arterial branches' visibilities near the 72 cerebral aneurysms in postoperative 58 patients treated with titanium or cobalt-chromium-nickel-molybdenum (CCNM) alloy clips. The visibilities were evaluated using time-of-flight magnetic resonance angiography (TOF-MRA), pointwise encoding time reduction with radial acquisition (PETRA)-MRA, which uses MRA with ultrashort echo time (UTE-MRA) and subtraction technique between saturated and non-saturated images, and three-dimensional computed tomography angiography (3DCTA). We retrospectively acquired the data from the medical records of Suwa Red Cross Hospital. Each method's appearance was compared, and associations between visibility on PETRA-MRA, arterial diameter, clip numbers, clip shapes, clip materials, and amounts of hematoma were summarized. Our article on PETRA-MRA's usefulness for proximal and branched arteries evaluation after cerebral aneurysm clipping [1] was based on these data. This dataset would be useful for reference value for other neurosurgeons or radiologists for further analysis on PETRA-MRA and another UTE-MRA like SILENT-MRA after cerebral aneurysm clipping [2)].

Heo et al. evaluated the pointwise encoding time reduction with radial acquisition (PETRA) sequence in subtraction-based MRA (qMRA) using an ultrashort TE relative to TOF-MRA during the follow-up of stent-assisted coil embolization for anterior circulation aneurysms.

Materials and methods: Twenty-five patients (3 men and 22 women; mean age, 59.1 ± 14.0 years) underwent stent-assisted coil embolization for anterior circulation aneurysms and were retrospectively evaluated using TOF-MRA and PETRA qMRA data from the same follow-up session. Two neuroradiologists independently reviewed both MRA findings and subjectively graded flow within the stents (relative to the latest DSA findings) and occlusion status (complete occlusion or neck/aneurysm remnant). Interobserver and intermodality agreement for TOF-MRA and PETRA qMRA were evaluated.

Results: The mean score for flow visualization within the stents was significantly higher in PETRA qMRA than in TOF-MRA (P < .001 for both observers), and good interobserver agreement was reported (κ = 0.63). The aneurysm occlusion status of PETRA qMRA (observer 1, 92.0%; observer 2, 88.0%) was more consistent with DSA than with TOF-MRA (observer 1, 76.0%; observer 2, 80.0%), and there was a better intermodality agreement between DSA and PETRA qMRA than between DSA and TOF-MRA.

Conclusions: These findings indicate that PETRA qMRA is a useful follow-up technique for patients who have undergone stent-assisted coil embolization for anterior circulation aneurysms [3].

1)
Grodzki DM, Jakob PM, Heismann B. Ultrashort echo time imaging using pointwise encoding time reduction with radial acquisition (PETRA). Magn Reson Med. 2012 Feb;67(2):510-8. doi: 10.1002/mrm.23017. Epub 2011 Jun 30. PMID: 21721039.
2)
Nishikawa A, Katsuki M, Kakizawa Y, Wada N, Yamamoto Y, Uchiyama T. The dataset on the clipped cerebral aneurysm and their radiological findings in three-dimensional computed tomography, time-of-flight magnetic resonance angiography (TOF-MRA), and Pointwise Encoding Time Reduction with Radial Acquisition (PETRA)-MRA. Data Brief. 2021 Feb 13;35:106874. doi: 10.1016/j.dib.2021.106874. PMID: 33665265; PMCID: PMC7907704.
3)
Heo YJ, Jeong HW, Baek JW, Kim ST, Jeong YG, Lee JY, Jin SC. Pointwise Encoding Time Reduction with Radial Acquisition with Subtraction-Based MRA during the Follow-Up of Stent-Assisted Coil Embolization of Anterior Circulation Aneurysms. AJNR Am J Neuroradiol. 2019 May;40(5):815-819. doi: 10.3174/ajnr.A6035. Epub 2019 Apr 11. PMID: 30975655; PMCID: PMC7053916.