Phase contrast magnetic resonance angiography

Phase contrast magnetic resonance angiography (PC-MRA) also involves exploiting the motion of blood, although it is not limited by the in-plane flow voids that plague Time-of-flight magnetic resonance angiography (TOF-MRA).

Hsieh et al. examined 24 consecutive patients (mean age 63 years) with stenosis of arteries supplying the brain using PC-MRA and colour-coded duplex (CCD) sonography. Velocities were measured in a total of 209 stenotic and healthy arterial segments (110 extra- and 99 intracranial).

Moderate to good correlation of velocity measurements between both techniques was observed in all six extracranial and five out of seven intracranial segments ($p < 0.05$). Velocities measured with CCD sonography were generally higher than those obtained by PC-MRA. Reversal of flow direction was detected consistently with both methods.

PC-MRA represents a robust, standardised magnetic resonance imaging technique for blood flow measurements within a reasonable acquisition time, potentially evolving as valuable work-up tool for more precise patient stratification for revascularisation therapy. PC-MRA overcomes relevant weaknesses of CCD in being not operator-dependent and not relying on a bone window to assess the intracranial arteries [1)].

Aneurysms

Flow visualization of recurrent aneurysms by 3D PC-MRI is feasible. This technique may be more practical and easier than CFD simulations, and may provide clinically helpful information [2)].

Blood flow in microvessels

Blood flow in microvessels, such as lenticulostriate arteries (LSAs), using PC MRA in eleven healthy subjects were scanned with 7 Tesla (T) MRI. Three velocity encoding (VENC) values of 15, 50, and 100 cm/s were tested for detecting the flow velocity in LSAs. The flow directions in Circle of Willis (CoW) were also examined with images obtained by the proposed method. Three subjects were also scanned with 3T MRI to determine the possibility of velocity measurement in LSAs. Difference between 3T and 7T was quantitatively analyzed in terms of signal-to-noise ratio and velocities in vessels and static tissues.

In 7T MRI, use of VENC = 15 cm/s provided great visualization and velocity measurements in small and slow flowing vessels, such as the LSAs. The mean of peak velocities in LSAs was 9.61 ± 1.78 cm/s. The results obtained with low VENC also clearly depicted the directions of flow in CoW, especially in posterior communicating arteries. However, 3T MRI could not detect the velocity of blood flow in LSAs.

This study demonstrated the potential for measuring the velocity and direction of blood flow in the targeted microvessels using an appropriate VENC and 7T MRI [3)]

[1)], [3)]
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7;145:w14155. doi: 10.4414/smw.2015.14155. eCollection 2015. PubMed PMID: 26151805.

2)

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