PULSED DOPPLER FROM THE SUPRASTERNAL NOTCH SYSTEMATICALLY UNDERESTIMATES MEAN BLOOD FLOW VELOCITY IN THE ASCENDING AORTA COMPARED TO PHASE CONTRAST MRI

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Background

Continuous pulsed-wave Doppler readings of flow velocity in the ascending aorta from the suprasternal position (sCD) are widely used in estimating stroke volume, particularly during physiological challenge maneuvers such as head-up tilt testing. Stroke volume is derived from velocity time integrals and vessel area. We compared the sCD against an established gold standard.

Methods

In 12 healthy women and men, we obtained 2D cross sectional, velocity encoded phase contrast MRI of the ascending aorta (2DMRI) and sCD to measure mean blood flow velocity (Vmean) at the ascending aorta. We compared sCD insonation depth to the distance between Doppler probe and sinotubular junction measured by MRI. Within an aortic 4D-Flow dataset, allowing flow measurements in every anatomical point along the ascending aorta, Vmean was determined at the sCD measurement point for comparison.

Results

sCD significantly underestimated Vmean compared with 2DMRI at the sinotubular junction (Vmean 2DMRI – Vmean sCD = 24.42 cm/s ± 12.55 cm/s, p = <0.001). Moreover, sCD sampled flow velocities 21.8 mm ± 7mm (p = <0.001) or 26% off the sinotubular junction. Yet, depth and velocity differences between sCD and 2DMRI were not correlated with each other (Pearson r = -0.147; p = 0.648). When we applied 4DMRI to assess flow velocity at the sCD measurement site, the Vmean difference between methodologies was reduced to 9.1 cm/s ± 12.38 cm/s (p = 0.035).

Conclusion

sCD profoundly underestimates Vmean in the ascending aorta compared to 4DMRI. The methodology has important limitations in accessing the ideal position for aortic flow measurements and precise information regarding the position of data acquisition for vessel area quantification cannot be ascertained. Overall, sCD is of limited utility in measuring absolute stroke volume.