

Three- and Four-Dimensional Vessel Cast in the Evaluation of Carotid Artery Stenosis

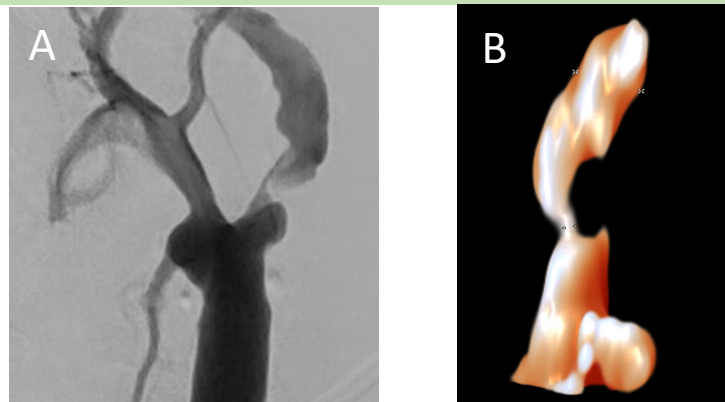
Background

- Precise determination of carotid artery stenosis (CAS) is limited in carotid duplex ultrasonography (DUS), CT angiography (CTA), and MR angiography (MRA).
- The current reference standard for determining the exact percentage of stenosis is catheter angiography (CA). Though effective, this procedure is invasive.
- 3D/4D vessel cast is an ultrasound technique that provides an accurate map of the carotid artery lumen.
- The purpose of this study is to validate 3D/4D vessel cast as a useful tool in the evaluation of CAS and compare its accuracy to CA, MRA, and CTA.

Methods

- Single-center retrospective cohort study consisted of 63 events among 36 patients with CAS from 2018 to 2022.
- Inclusion Criteria: Patients with a carotid DUS, associated 3D/4D vessel cast, and a carotid CA, CTA, or MRA within a 1-year time frame.
- All vessel casts were obtained with the XL14-3 workflow (Philips, Amsterdam, Netherlands).
- Primary endpoint: absolute difference in percent stenosis determined by vessel cast between that of CA, CTA, and MRA.
- Statistical analysis included paired t-tests and Spearman correlation coefficients.

Results



Corresponding (A) catheter angiogram and (B) 4D vessel cast indicating carotid artery stenosis. Stenosis measurements are 94% and 89% respectively. Note the irregular plaque in the proximal ICA leading to stenosis. DUS range demonstrated between 80-99% stenosis.

- The 63 events were composed of 18 CAs, 29 CTAs, and 16 MRAs.
- Mean stenosis for vessel cast was $73.8 \pm 6.7\%$ and in CA was $77.8 \pm 10.1\%$ ($p=0.2$), mean difference was $7.4 \pm 2.5\%$, and the correlation coefficient was 0.55 ($p=0.02$).
- Mean stenosis for vessel cast was $64.3 \pm 20.1\%$ and in CTA $65.4 \pm 21.7\%$ ($p=0.8$), mean difference was $17 \pm 5.9\%$ and the correlation coefficient was 0.39 ($p=0.04$).
- Mean stenosis in vessel cast was $55.8 \pm 24.7\%$ and in MRA $69.0 \pm 13.9\%$ ($p=0.07$), mean difference was $20 \pm 11\%$ and the correlation coefficient of 0.31 ($p=0.2$).

Vessel Cast v. CA N=18	
Mean Stenosis	VC: $73.8 \pm 6.7\%$ CA: $77.8 \pm 10.1\%$ ($p=0.2$)
Mean Difference	$7.4 \pm 2.5\%$
Correlation Coefficient (ρ)	0.55 ($p=0.02$)

Vessel Cast v. CTA N=29	
Mean Stenosis	VC: $64.3 \pm 20.1\%$ CTA: $65.4 \pm 21.7\%$ ($p=0.8$)
Mean Difference	$17 \pm 5.9\%$
Correlation Coefficient (ρ)	0.39 ($p=0.04$)

Vessel Cast v. MRA N=16	
Mean Stenosis	VC: $55.8 \pm 24.7\%$ MRA: $69.0 \pm 13.9\%$ ($p=0.07$)
Mean Difference	$20 \pm 11\%$
Correlation Coefficient (ρ)	0.31 ($p=0.2$)

VC = Contrast Enhanced Ultrasound, CA = Conventional Angiography, CTA = CT Angiography, MRA = MR Angiography

Conclusions

3D/4D vessel cast demonstrates moderate correlation to carotid CA. Further studies with larger sample sizes are needed to assess the clinical validity of vessel cast in comparison to CTA and MRA. Given that it is a safe and effective technique, 3D/4D vessel cast should be considered in the diagnostic armamentarium to obtain estimates of stenosis.