Can TCAR be helpful in the management of carotid string sign lesions or near occlusion of the internal carotid artery: When is its use justified, advantage and technical tips

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Disclosure

- No relevant disclosures to this talk

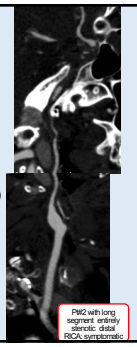
What is a "carotid string sign"

- Also called *atheromatous pseudo-occlusion* and *slim sign*
- Diminished antegrade flow into the ICA which looks like a think string or a hypoplastic artery on angiogram
- Could be related to atherosclerosis, myointimal hyperplasia, low flow, dissection, radiation arteritis, partial thrombosis
- Also, other rare causes of narrowing caused by petrositis,vasospasm, subintimal injection, recanalization of previously occluded ICA, vasa vasorum, "false" diagnosis with ascending pharyngeal artery
- Important to recognize "underfilled artery" vs "long segment disease"

Martin MA, Marotta TR. Vasa vasorum: another cause of the carotid string sign. AJNR Am J Neuroradiol. 1999 Feb;20(2):259-62. PMID: 10094348; PMCID: PMC7056117.

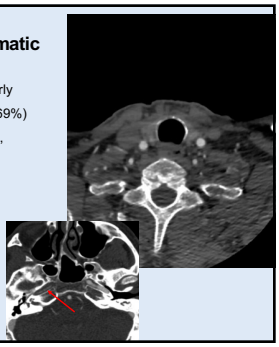
Clinical implications

- Often asymptomatic as the brain is well collateralized
- Treatment needs to be individualized and multi-specialty teams approach is warranted (Neurology, neuro-IR, neurosurgery, vascular surgery) and careful evaluation
- Two separate pathways for symptomatic patients
  - Hypoperfusion (often hypotension depended symptoms)
  - Embolic
- Must evaluate the status of the contralateral carotid disease, vertebral arteries, outflow ICA including the cavernous segment, intracranial segment as well as Circle of Willis on imaging



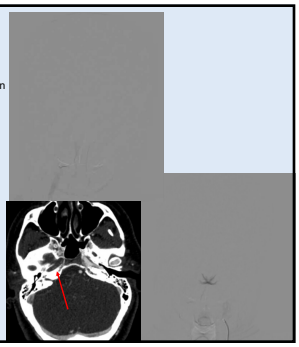
How to decide to intervene: Asymptomatic

- Patient #1: Atherosclerotic RICA stenosis (nearly occluded) with string sign, patent left side (50-69%)
- PMH CAD, CABG 2005, PCI 03/24, HTN, HLD, PAD, new onset A Fib,
- Presented with left hemispheric embolic stroke (expressive aphasia), received TNK → mild improvement. Medical management now with Apixaban, clopidogrel, high intensity statin
- **RICA intervention?**



Symptomatic patient # 2

- Patent right carotid bifurcation but ICA with string sign
- 53 F Type II DM, HTN, morbid obesity, right sided aortic arch
- Recurrent right hemispheric symptoms (left sided weakness)
- Medical management with apixaban, aspirin, high intensity statin
- Incomplete Circle of Willis
- CT perfusion head with deficit in right MCA territory
- Cerebral angiogram: RICA string sign and sluggish flow, normal LICA
- **RICA intervention? CEA/TCAR/TF-CAS/Something else?**

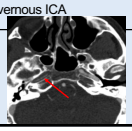


Symptomatic patient # 3

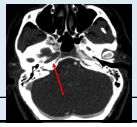
- Bilateral 80-99% stenosis, LICA string sign
- 70 F with CAD, breast ca, COPD, HTN, T2DM, COPD
- Presented with aphasia and right sided weakness which resolved after TNK
- On DAPT and statin
- CT with underfilled ICA (slightly smaller caliber cavernous segment but patent)
- LICA intervention? CEA/ TFCAS/ TCAR/ Something else?

3 scenarios

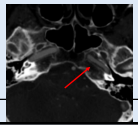
Patient # 1
RICA string sign, but asymptomatic (had a contralateral hemispheric CVA, likely cardioembolic), complete COW, hypoplastic/underfilled cavernous ICA



Patient # 2
RICA string sign, symptomatic from hypoperfusion, incomplete COW, underfilled/ hypoplastic cavernous ICA



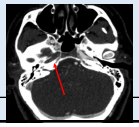
Patient # 3
LICA string sign, symptomatic, complete COW, underfilled ICA



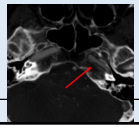
3 scenarios

Patient # 1
Medical management only
Apixaban (new A fib), Clopidogrel, Statin
Intervene if new embolic CVA (most likely ligation)

Patient # 2
NSx consult → Perfusion CT scan with acetazolamide challenge, cerebral angiogram → EC-IC bypass
Aspirin and Statin (postop)



Patient # 3
Left TCAR
Aspirin, Clopidogrel, Statin

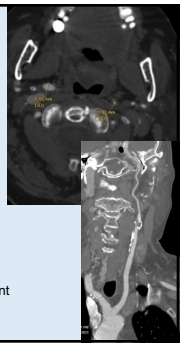


Patient # 3: Case for TCAR

CEA
Outflow ICA ~ 1.5 mm makes CEA technically challenging (exposure, vessel too small for shunting, risk of dissection with coronary dilator, patch)

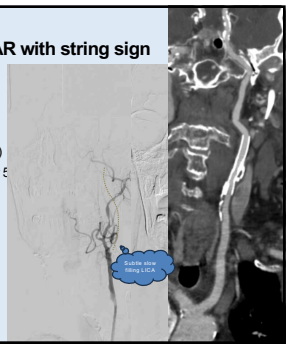
TF-CAS
Much higher risk of stroke. ICA too small to place an embolic protection device **PLUS** additional pitfalls of TCAR.

TCAR
Safer to cross the lesion with flow reversal. Pitfalls of significant size mismatch between CCA, bulb and ICA. Consider tapered stent vs overlap 2 stents. Discussion on distal landing zone

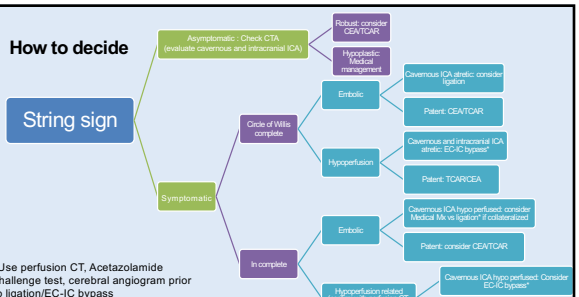


Patient # 3: Technical tips for TCAR with string sign

Be ready to change plan as necessary
Might not see the ICA well on angiogram on flow reversal with 8 Fr sheath in place.
Confirm cannulation (avoid Asc pharyngeal branch)
May need angiogram after predilation with 4 mm or 5 mm balloon
Avoid PTA for the underfilled section of ICA
Tapered stent vs 2 stents overlap
Expect vasospasm
May need post dilation
Anticipate nice remodelling of the outflow ICA



How to decide



*Use perfusion CT, Acetazolamide challenge test, cerebral angiogram prior to ligation/EC-IC bypass
Multidisciplinary team management

Conclusions

- Carotid string sign is an angiographic finding related to diminished antegrade flow into the ICA
- Traditionally considered to be a predictor for high risk for stroke, but it is multifactorial
- Management involves careful assessment of the distal ICA, including the cavernous and intracranial section as well as collateralization via Circle of Willis
- A small minority of patient might need ligation vs EC-IC bypass, but it requires a multidisciplinary evaluation with neurology, Neruo-IR, Neurosurgery as well
- TCAR is likely safer than CEA and TF-CAS but robust clinical evidence is missing
- Operator should be aware of the pitfalls during carotid revascularization
- Call for multi-institutional registry/rare disease consortium to evaluate management and outcomes of “carotid string sign”

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Questions?

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