Addressing Calcified Carotid Lesions With TCAR

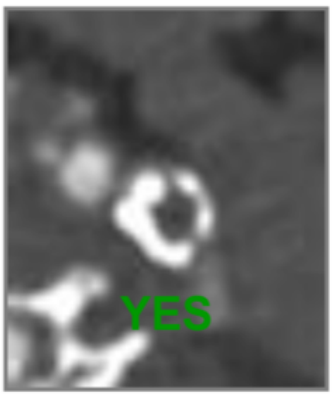
Peter Schneider, MD

Calcification is a frequent finding in advanced atherosclerotic carotid lesions. We sat down and spoke with Dr. Peter Schneider about factors that influence the endovascular management of carotid lesions.

When addressing a calcified carotid lesion, what are some of the factors which influence your treatment decision?

The calcific burden poses a challenge to carotid stenting. Circumferential calcium in particular, needs to be approached with careful planning. The main concern with stenting calcified lesions is whether adequate stent expansion is possible with a given degree of calcification. It may not be possible for the stent to generate the amount of outward force that is needed to expand a circumferentially calcified vessel. In most settings, circumferential calcium will rule a patient out for a carotid stent.

Patients with non-circumferential or interruptions in a nearly circumferential pattern of the calcification (e.g. 270° to 300° of calcium) may respond well to a thorough and expansive pre-dilatation followed by stent placement. This should be considered on a case-by-case basis. If the calcium rim is thin and less than 3mm, it is a lot more likely to be treatable with a stent.

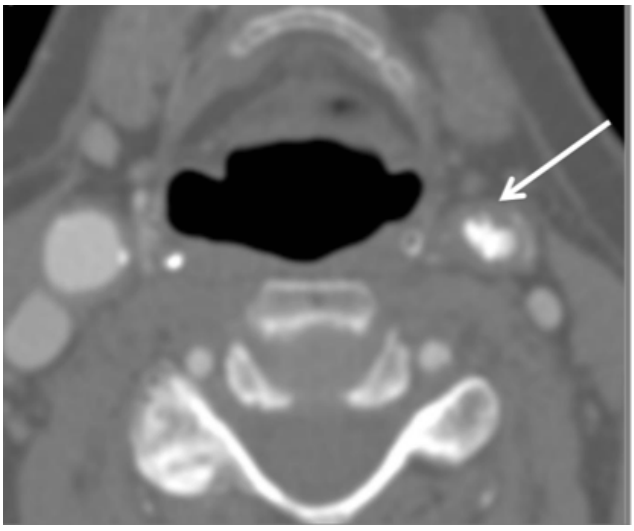


Lesion length is also an important consideration. If a lesion is covering most of the circumference of the artery and is quite lengthy (>3cm), then a pre-dilatation may not be successful in establishing an adequate lumen for stent placement. Another factor that influences my treatment decision is the width or thickness of the calcium, which can be measured approximately via CTA. A bone window must be used so that the thickness of the calcium plate is not confused with contrast in the carotid artery lumen. Slice thickness on CTA from the arch origin to the Circle of Willis is also an important consideration. For example, 3mm slices may significantly underestimate the calcium burden.

What, in your opinion, is the calcium threshold for stenting a lesion in the carotid artery?

If the calcification is more than 3 mm thick, it may not dilate well. In this setting, if the lesion is focal and limited to one side of the artery, stent treatment is still an option. If the lesion also covers a significant circumference of the vessel and is more than 3 mm thick it may not respond well to angioplasty.

If calcium extends beyond the lesion in a curved segment of the internal carotid artery, it will not respond to stenting in the same way that a non-calcified artery may respond. Additionally, it is worth evaluating whether the point of maximal calcification is also at the point of maximal stenosis. If this is the case, the likelihood of successful stent placement is decreased.



Here is an example of a solid mass of calcification within the lumen of the distal left common carotid artery (white arrow). This occlusive/sub-occlusive pattern of calcification is often termed “exophytic” calcification and can be challenging to manage by endovascular means.

When deciding to perform TCAR on a lesion with appropriate calcium burden, what general guidance would you give to physicians?

When dilating a calcified lesion, the pre-dilatation balloon may have to be expanded at a higher than usual atmospheric pressure in order to reach the intended size. This advanced knowledge is critical to the management of blood pressure changes. When the calcific lesion gives way under high pressure, bradycardia usually occurs, and occasionally asystole. Pre-treatment for the potential of bradycardia should be considered. In the calcified artery, a pre-dilation which is consistent with the intended size of the vessel is warranted.

If the potential for residual stenosis, especially in the presence of a focal thick segment of calcium is concerning, I would strongly recommend at least two views of the stent. If there is more than 30 or 40% residual stenosis, I would recommend post dilatation of the stent with a balloon that is sized to the reference vessel diameter. This is more likely to be required when treating calcified lesions.

The key to managing calcium is to understand that stent placement is not indicated in the most heavily calcified lesions. I also suggest being vigilant for circumferential calcification, and non-circumferential calcium that is thicker than 3 mm.

Key Points to Keep in Mind

- Patients with non-circumferential or interruptions in a nearly circumferential pattern of the calcification may respond well to a thorough pre-dilatation followed by stent placement
- Lesions with completely circumferential calcium may rule a patient out for carotid stenting
- Be mindful of lesion thickness:
    - If the calcium ring is <3mm it is much more likely to be able to be treated by a stent
    - If calcium is >3mm and covers a significant circumference of the vessel, it may not dilate well
    - Thick slice CTA (e.g. 3mm slices) may underestimate calcium burden, 0.625mm slices are optimal
- Pre-dilation which is consistent with the intended size of the vessel is warranted
- Pre-treatment for the potential of bradycardia should be considered when pre-dilating at a higher than usual atmospheric pressure
- Post dilatation is recommended if there is more than 30-40% residual stenosis

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Dr. Peter Schneider is a world-renowned vascular surgeon, who practiced at Kaiser Permanente Clinic in Honolulu, Hawaii. He has been the Principal Investigator in numerous U.S. trials and is most recently the National Co-Principal Investigator of our ROADSTER 2 trial. As an early adopter of endovascular techniques, he has authored multiple scientific publications and books, including Endovascular Skills, Critical Limb Ischemia and Carotid Interventions.