

WHAT WOULD YOU DO?

Asymptomatic Carotid Stenosis Prior to Coronary Artery Bypass Grafting

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CASE PRESENTATION

A 69-year-old man presents with known coronary artery disease and stable angina that responds to nitroglycerin. He is a former smoker. Other risk factors include hypertension treated with carvedilol, furosemide, and amlodipine, as well as dyslipidemia treated with rosuvastatin and niacin; both are controlled. He previously had percutaneous coronary intervention and was found to have severe multivessel disease on subsequent catheterization. Coronary artery bypass grafting (CABG) was the preferred treatment for the patient.

The patient denies any cerebrovascular symptoms and is on dual antiplatelet therapy. Duplex ultrasound reveals a right internal carotid artery (ICA) stenosis (Figure 1) with a peak systolic velocity of 367 cm/s and end-diastol-

ic velocity of 134 cm/s. The ICA/common carotid artery (CCA) ratio is 4.8. The left ICA has normal flow velocities. CTA confirms the severity of the stenosis (Figure 2).

? What is your routine workup of patients for carotid disease prior to CABG, and how do you determine the “significance” of the stenosis (flow velocity, NASCET/ECST criteria)?

Dr. Bacharach: In our practice, we typically use ultrasound first to determine the severity of the stenosis. In this particular case, the diastolic flow velocity > 134 cm/s would suggest that this falls into the 80% to 99% category. We would then follow-up with additional imaging. If the patient is determined to be a good candidate for carotid endarterectomy (CEA), we would typically perform confirmatory imaging with a CT scan. This would also hold for the possibility of performing transcarotid artery revascularization (TCAR). On the other hand, when strongly considering carotid artery stenting (CAS) with embolic protection, as in this case, we would likely go directly to digital subtraction angiography.

Dr. Langan: Patients presenting for elective and urgent CABG who are > 50 years are routinely screened with preoperative carotid duplex ultrasound. In our non-invasive laboratory, a peak systolic velocity > 230 cm/s, peak end-diastolic velocity > 100 cm/s, and ICA/CCA ratio > 4 signifies a stenosis of > 70% of the ICA. We sometimes use two out of three criteria to signify a critical stenosis of the ICA. If the velocities are all clearly

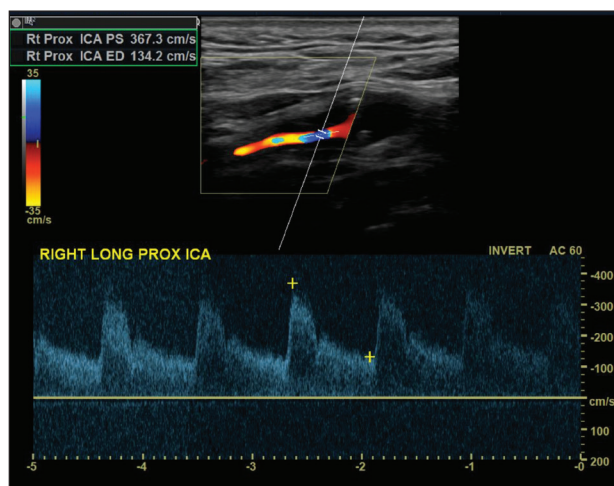


Figure 1. Duplex ultrasound image of the proximal right ICA.

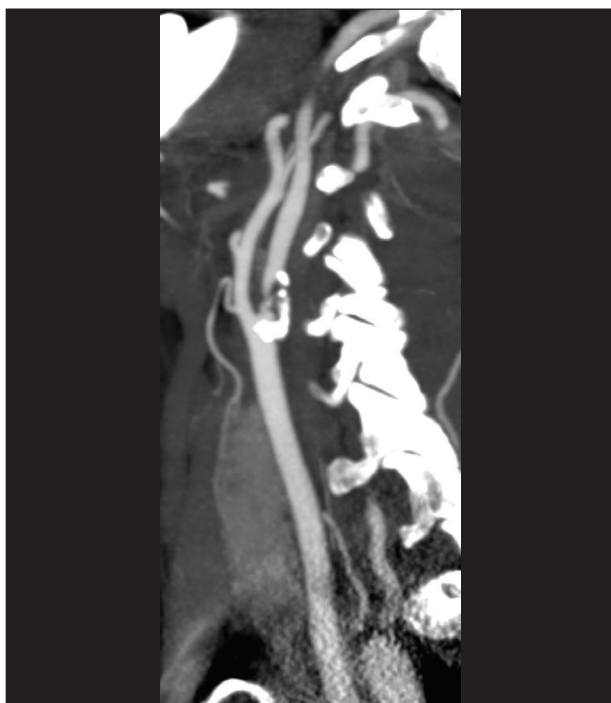


Figure 2. Sagittal view on CTA of the right ICA.

increased and the entire lesion/bifurcation is clearly visualized, then intervention will be planned without further imaging. Most of the time, CTA is performed, and the lesion is assessed using NASCET criteria to measure ICA stenosis. We currently utilize computer diagnostic software that calculates the degree of stenosis, but clinician overread is critically important.

Dr. Perl: Coronary artery disease is a significant marker for concomitant carotid disease, with the presence of significant carotid artery disease substantially higher (in some series as high as 40%) than the general population; thus, screening should be performed in all patients. I typically use duplex ultrasound as the initial screening tool due to its excellent sensitivity, specificity, and lower cost, as long as it is performed in a dynamic accredited ultrasound lab. Other modalities such as MRA and CTA may play a role in locations where an accredited vascular lab is not available. However, if significant disease is present and a proximal ICA stenosis > 70% is detected with duplex ultrasound, then further workup is performed, including an evaluation of the intracranial circulation with MRA or CTA.

Because I typically use duplex ultrasound as my initial screening tool, a significant stenosis is determined by flow velocity, as long as it is seen with concomitant morphologic changes on ultrasonography. However, if

other modalities are used, I typically use NASCET criteria—although there are other criteria, such as ECST—because there is a close-to-linear relationship between the measurements.



What variables do you take into account to determine which asymptomatic patients are at heightened risk of stroke?

Dr. Langan: There are clinical and anatomic features to take into account to assess patient risk. Clinically, patients who have unstable cardiac disease without critical carotid stenosis should proceed with CABG first. Those with semielective cardiac surgical needs should be prioritized as to the perceived risk of carotid disease. For instance, patients with a history of contralateral transient ischemic attack/stroke or ipsilateral silent cerebral infarction are at heightened risk, and we treat their carotid stenosis first. Patients who have documented carotid disease progression (> 20%), contralateral ICA occlusion, impaired cerebral vascular reserve, large plaque volume, or echolucent plaques may also be considered “high-risk” asymptomatic patients. The joint consensus of cardiac and vascular surgery at our program is that if there is a critical ICA stenosis > 70%, carotid intervention or surgery will precede CABG. We think it is better to manage an urgent cardiac event after carotid repair than a carotid-based neurologic event after CABG.

Dr. Perl: There are multiple variables to consider when determining which asymptomatic patients are at higher risk. The most obvious—which is not the case in this example—is appropriate use of contemporary medical therapy, including the use of statins, antiplatelet agents, antihypertensive agents, and lifestyle risk reductions. However, there is significant mounting evidence that plaque morphology and plaque burden play a significant role in assessing the risk of individual stenoses beyond the severity of narrowing. The presence of interplaque hemorrhage, plaque burden, and composition are likely to affect the risk of embolization and overall prognosis. Lastly, the burden of bilateral disease should be strongly considered, as well as whether the patient has an intact circle of Willis or isolated hemisphere. A patient with a high-grade stenosis and an isolated hemisphere would be at higher risk of a hemodynamic clinical event associated with surgery in the event of hypotension.

Dr. Bacharach: The advantage of obtaining additional CT or angiographic information is that it allows

determination of cerebral reserve. This would take into account whether the patient has contralateral disease that may be present or significant vertebral disease. It also determines possible collateral flow through the posterior communicating artery or anterior communicating flow. We would consider patients who have significant contralateral disease or poor intracranial reserve to be in a higher-risk category. Additional variables include the presence of valvular heart disease, such as aortic stenosis. All of this is then evaluated within the context of the planned procedure. In this case, the plan for CABG subjects the patient to a period of potential hemodynamic compromise, which we would consider in the risk stratification.



What is your treatment algorithm for patients with asymptomatic carotid stenosis undergoing CABG, and what device or treatment technique would you use?

Dr. Bacharach: I do not advocate for routine treatment of asymptomatic carotid artery stenosis for every patient who undergoes CABG. Patients who fall into a higher-risk category have decreased cerebral reserve. For instance, in patients with contralateral occlusions, we would be more aggressive about carotid revascularization before CABG. We have extensive experience with CAS, which has worked very well and can be done safely without the need for general anesthesia or subjecting the patient to significant hemodynamic compromise. Care during the carotid stenting procedure is critical in maintaining blood pressure and avoiding periprocedural hypotension or heart block. Pretreatment with atropine, holding blood pressure medication, and ensuring that the patient is well hydrated before the procedure can mitigate the potential adverse bradycardia and/or hypotension seen during CAS. In our practice, we commonly use the Mo.Ma device (Medtronic) because we believe it affords proximal protection and does not require a filter crossing the lesion prior to stenting. The data suggest very low rates of major adverse events or stroke associated with CAS when using the Mo.Ma device.

Dr. Langan: We either proceed with CEA or TCAR because we do not have access to a trial that covers transfemoral CAS. To date, we have more experience with CEA because this has been in our protocol longer. The carotid intervention/surgery is performed before the CABG; this is usually done during the same admission, when possible, or scheduled for as soon as possible. Dedicated cardiac anesthesia also adds to the safety of this approach.

The TCAR procedure is performed with local anesthesia under conscious sedation. A small incision is made

at the base of the CCA. Using the Enroute transcrotid neuroprotection system (Silk Road Medical), the sheaths are placed and the neuroprotection retrograde flow/filter is established. We use the 95-cm Enroute guidewire to traverse the lesion. Tight lesions are predilated with a 4-mm Rx Viatrac 14 Plus balloon (Abbott Vascular) and a Precise stent (Cordis, a Cardinal Health company) is deployed. We prefer to use a stent that is 1 mm larger in diameter than the CCA and 40-mm long to avoid geographic miss. We routinely postdilate with a 5-mm Rx Viatrac 14 Plus balloon. After completion arteriography, we remove the sheaths, close the arteriotomy with a previously placed purse-string suture, and close the skin incision. The patient remains on dual antiplatelet therapy for 30 days before undergoing CABG on aspirin alone.

Dr. Perl: Our approach to treating patients with asymptomatic carotid disease who are undergoing a planned CABG reflects the institutional expertise available. The patient is screened with duplex ultrasound, and if velocity suggests a stenosis > 70%, the patient will undergo CTA of the head and neck. The presence of other concerning vascular features, such as lipid-laden plaque or possible intraplaque hemorrhage, is also evaluated and may lead to additional imaging. At our institution, we do not yet have the ability to image the vessel wall with MRI, but this not only determines the extent of the disease but also the relative position of the stenosis to other anatomic structures. It also establishes the presence or absence of collateral flow at the level of the circle of Willis.

If the patient is low risk but has > 70% (or more typically 80%) stenosis, then revascularization is offered. If the patient is high risk for CEA due to anatomic features or previous radiation, for example, the patient will undergo stent-assisted angioplasty. If this patient is normal risk, we would perform CEA. Appropriate maximal medical treatment is employed in all patients. Antiplatelet therapy is utilized in all patients, irrespective of the treatment, and continued through the CABG procedure.



If you offered this patient CAS, what equipment do you prefer to use and how would you do it?

Dr. Langan: Our transfemoral CAS procedure is performed by placing a 6-F Shuttle sheath (Cook Medical) into the CCA over a 0.035-inch Hi-Torque Versacore modified J wire (Abbott Vascular). We use an Emboshield Nav6 filter (4–7 mm, 190-cm shaft; Abbott Vascular). We predilate with the Rx Viatrac 14 Plus 4-mm balloon, place a stent, and postdilate with a



Figure 3. Preintervention arteriogram of the right ICA stenosis (A). Postdilation of the right ICA stent (B). Completion arteriogram after stent placement (C).

5-mm Rx Viatrac 14 Plus. We use an RX Acculink stent (Abbott Vascular) with a 132-cm shaft for tortuous arteries and the tapered Xact stent (Abbott Vascular) with a 136-cm shaft for bifurcation lesions that have significant size discrepancy from ICA to CCA and minimal tortuosity. The Precise stent with a 135-cm shaft is an excellent all-purpose stent that works well with any variable.

Dr. Perl: In general, my preference for embolic protection is proximal protection first. Proximal protection offers better protection because the volume and type of embolic material do not affect the performance or overwhelm the device. There are challenges with flow occlusion, especially if the patient has an isolated hemisphere. The circle of Willis is only intact in 40% of patients, and some patients derive the entire blood supply from the affected artery. Distal emboli protection is my second choice. I choose this if there is an isolated hemisphere or the external carotid artery anatomy is not well suited for proximal protection. If I am using distal protection devices, I like Emboshield because it is centered in the vessel with good apposition to the vessel wall. I occasionally use the SpiderFX embolic protection device (Medtronic) because

of its crossing profile, although it is often eccentric in the vessel. In this case, both options would work well because of the favorable anatomy. There is an adequate external carotid artery and landing zone, so a distal protection device is appropriate, but a Mo.Ma device would also work well here. I typically use tapered stents most frequently and jail the external carotid artery.

I tend to use the tapered Abbott Vascular or Medtronic stents because of the deliverability and compliance to the vessel wall. I will gravitate toward a membrane stent when they become available.

My general technique for CAS is as follows:

- **Step 1.** Place a 9-F, 25-cm Pinnacle sheath (Terumo Interventional Systems).
- **Step 2.** Catheterize the CCA. I tend to use the 5-F Vitek catheter (Cook Medical).
- **Step 3.** Place the exchange wire in the external carotid artery. I use either a Storq or Jindo wire (Cordis, a Cardinal Health company).
- **Step 4.** Place a proximal protection device (I would likely use Mo.Ma in this case), inflate the external carotid artery balloon, and ensure the external carotid artery is occluded.
- **Step 5.** Inflate the CCA balloon and ensure that the carotid is occluded. Cross the lesion with a

Choice PT wire (Boston Scientific Corporation) mounted with a Sterling 4- X 20-mm balloon (Boston Scientific Corporation), unless sizing of the lesion and the adjacent carotid indicates a different balloon size. If so, select a balloon that is just less than the lumen of the normal vessel beyond the stenosis. Inflate the balloon to its nominal 6 atm.

- **Step 6.** Spin down the insufflator on the Sterling balloon. To avoid cavitation, I do not pop it down.
- **Step 7.** Aspirate the Mo.Ma until it is clear.
- **Step 8.** Deploy a stent of choice.
- **Step 9.** Aspirate the Mo.Ma until it is clear.
- **Step 10.** Inflate the balloons.
- **Step 11.** Perform control angiography to ensure there is good apposition of the stent and no technical abnormalities. At this point, only perform angioplasty if there is poor stent apposition, significant wall recoil, or significant residual stenosis. If postdilating, inflate the Mo.Ma balloons.

Dr. Bacharach: TCAR is an appropriate technique for this patient, and initial data suggest that TCAR can be performed safely and with a very low periprocedural stroke rate. Additionally, it has the advantage of avoiding complex arch disease or arch tortuosity that would make transfemoral CAS more difficult. The disadvantages are that it still requires a surgical incision at the common carotid level, and the typical time required in the operating room is longer than the transfemoral procedure performed in a catheterization lab. There is also a significant cost difference, as TCAR is more expensive than transfemoral CAS. An additional disadvantage of using TCAR is that in some patient circumstances, particularly the left carotid, the length of the common carotid is not long enough to allow safe positioning of the reverse flow system. In this case, it was a right carotid and the CCA clearly was long enough to gain surgical access to place the TCAR device. It has been my experience that, from an access standpoint, right carotid arteries tend to be easier when performing transfemoral CAS.

This case is a nice example of using a less invasive method to revascularize a carotid artery before CABG. I think the transfemoral CAS approach could also have been performed very safely, particularly using the Mo.Ma device. My standard approach is to advance the Mo.Ma device over a 0.035-inch Supra Core wire (Abbott Vascular). My go-to wire for stenting is the 0.014-inch Prowater (Asahi Intecc USA, Inc.). I prefer to predilate with a 4- X 20-mm Rx Viatrac 14 Plus and postdilate with

a 5- X 20-mm Rx Viatrac 14 Plus. I prefer the tapered RX Acculink stent that is 6 to 8 mm in diameter and 40 mm long. Both TCAR and transfemoral CAS have the disadvantage of requiring antiplatelet therapy, typically clopidogrel, both periprocedurally and after the procedure. This may impact the timing of CABG, depending on the surgeon's comfort level in proceeding on aggressive antiplatelet therapy.

CASE CONCLUSION

The patient is treated with angioplasty and stenting via TCAR before the CABG procedure (Figure 3). He then undergoes successful CABG 30 days later and remains asymptomatic from a cerebrovascular and cardiovascular standpoint 1 year later. ■

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