

Carotid Artery Stenting

Diagnostic tools and interventional device recommendations, including how best to use distal embolic protection devices.

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ACCESS SITES

- Femoral artery
- Brachial artery if the infrarenal aorta is occluded; it is very difficult to get the wires and sheaths to track into the carotid via the brachial artery (most practical when approaching a left carotid lesion from the right arm via a bovine arch).
- Ipsilateral common carotid artery (CCA) if you are unable to access from the femoral or brachial artery (proximal CCA is usually easily exposed even in redo or radiated neck); if during carotid endarterectomy, the lesion is too high (can avoid mandibular subluxation).



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CONTRAST AGENTS

- Omnipaque (GE Healthcare, Waukesha, WI)
- Visipaque (GE Healthcare)
- A mixture of Visipaque and saline will reduce contrast doses without compromising visibility.

TESTS/MONITORING

- Invasive monitoring (A-line) is not necessary.
- Telemetry and a blood pressure cuff are critical, especially at time of angioplasty.

PHARMACEUTICALS

- Atropine
- Heparin
- Bivalirudin can be used as a substitute for heparin.
- Patients are pretreated with aspirin/clopidogrel for at least 1 week before and maintained on this regimen for 1 month after the procedure; extended-release dipyridamole can be used if clopidogrel is not tolerated.
- Patients with renal dysfunction can be pretreated with acetylcysteine solution and HCO₃ solution.

ANESTHESIA

- Local anesthesia with sedation is ideal (to allow the patient to move his/her head) and is also good for testing neurologic function.
- Oversedation may result in disinhibition and an uncooperative patient.

DIAGNOSTIC DEVICES USED

Sheath Sizes

- 6-F, 7-F

Diagnostic Catheters

- 5-F long pigtail catheter can be used for arch angiograms; power injection.
- 5-F selective catheter can be used for selected carotid angiograms; hand injection.
- Note: all air must be removed to prevent air emboli.

Selective Diagnostic Catheters

- JR4 (Cordis Corporation, Warren, NJ): angled catheter.
- H1 (Cordis): angled catheter with softer and longer tip.
- Vitek (Cook Medical, Bloomington, IN) or SIM1 (Cook Medical): reverse angled catheters; necessary for selecting orifices that originate at a reverse angle but they do not track well.

Diagnostic Guidewires

- .035-inch Bentson wire (Cook Medical)
- Angled hydrophilic wire; if the wire needs to be steered, use a stiff angled hydrophilic wire; useful in tortuous vessels for tracking catheters.

Diagnostic Notes

- Ensure that there is no air or debris in the injection tubing, catheter, syringe, etc.
- Thoracic aortograms are helpful for defining the arch (not necessary with a preoperative arch study [CTA/MRA]); however, there is a risk of stroke with each angiogram obtained.

- Left anterior oblique of 30° to 40° is helpful for splaying out the arch when selecting the artery.
- Be wary of a bovine arch or common origin when selecting the left CCA.
- Image intensifier position may need to be changed (oblique vs anteroposterior [AP]) to splay out the bifurcation and define the lesion.
- Intracranial views need to be in AP and lateral to fully define anatomy.
- Varying obliquities may be needed to splay out the carotid bifurcation.
- Flow-reversal devices, currently in clinical trials, occlude the CCA and external carotid artery to allow flow reversal of the ICA; blood is returned to the venous system after filtration.

INTERVENTIONAL NOTES

- Never lose the wire.
- Minimize arch manipulations because this is a significant source of emboli.
- The DEP, when open, cannot be pulled through the stent or it will get stuck; thus during manipulations, it is important to note the location of the DEP.
- Predilation is usually not necessary unless the stent will not cross the lesion.
- The interventionist should try to limit to one stent to minimize manipulations.
- Postdilation is usually necessary.
- Atropine should be made up and ready to inject if bradycardia or asystole occurs. Some patients may be good candidates for prophylactic atropine (.5 mg; bradycardic, octogenarians).
- Minimize manipulations around the lesion before the DEP is deployed.
- A good road map is necessary for manipulations.
- With each maneuver (DEP deployment, PTA, stenting), a new road map should be generated because the anatomy can become distorted or the patient can move.
- Severe calcification or tortuosity may be a contraindication to carotid artery stenting.
- Completion angiography should be performed before capturing the DEP; this keeps the wire in place in case another manipulation (ie, repeat PTA or additional stenting) is necessary.
- Completion angiogram with an abrupt cutoff at the DEP usually suggests an occluded DEP (debris, thrombus); immediate aspiration followed by capture of the DEP should be performed with repeat angiography.
- Spasm can be treated with intra-arterial nitroglycerine.
- Salvage procedures can be performed with micro-catheters, abciximab, and thrombolytics. ■

INTERVENTIONAL DEVICES USED

Sheaths

- A 6-F or 7-F long sheath is used. It is optimal to have an 80-cm (becomes 90 cm with the Tuohy-Borst adapter [Cook Medical]) length so that a 100-cm catheter can form outside the sheath in case arterial selection needs to be performed through the long sheath.

Wires

- A stiff wire allows introduction of the sheath into the carotid artery and may be needed as a buddy wire to support the sheath in extremely tortuous vessels.
- A device wire is a .014-inch wire that has the distal embolic protection (DEP) device on the end; the interventions are performed over this wire.
- A hydrophilic wire is used as a buddy wire for significant tortuosity and is helpful for introducing the DEP.

PTA Balloons

- Monorail/rapid-exchange
- 4 to 8 mm in diameter, with various lengths (2 to 4 cm)
- Do not inflate the balloon outside the stent (dissection or spasm may result).

Stents

- Usually, we use the stent associated with the DEP; however, sometimes we need to use a different one for trackability, visualization, etc.
- Stent should be self-expanding.
- Tapered stents are ideal because the stent will usually traverse from the internal carotid artery (ICA) to the CCA.
- The benefit of a closed-cell stent is unclear at this time, but it may be better.

Neuroprotection

- DEPs must be prepared properly to remove any air.
- DEPs are usually deployed in the carotid siphon.
- DEPs may need to be sized for the ICA, depending on the manufacturer.
- DEPs at this point should be used in all carotid PTA/stenting procedures that are not part of clinical trials.

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