Carotid Intervention

Carlos Mena, MD. F.A.C.C., F.S.C.A.I
Associate Professor - Cardiology
Director Cardiac Catheterization Laboratories
Director Vascular Medicine
Section of Cardiovascular Medicine
Yale University School of Medicine
Diagnostic & Interventional Procedure Requirements

• Required Angiographic Skills
• Vascular Access
• Interventional Skills
• Intraprocedural Management Skills
• Neurological/Non-neurological Management
• Vascular Management
Diagnostic and Interventional Procedure Requirements

Required Skills

• Stroke is a risk of diagnostic and cerebral angiography.
  • Make good decisions
  • Be meticulous and time efficient

• Required angiographic skills include:
  • Vascular access methods
  • Use of “closed system” manifold
  • Knowledge of aortic arch, cerebrovascular anatomy and common variants
  • Familiarity with angulated view angiography

• Required interventional skills include:
  • Shuttle sheath or guide catheter selection and use
  • Guide wire selection and use
  • Embolic protection device selection and use
  • Pre- and post-dilatation techniques
  • Stent placement and deployment techniques
Intraprocedural Management Skills

- Anticoagulant therapy
- ECG interpretation
- Neurological assessment
- Blood pressure management
- Neurological, non-neurological, and vascular or device complication management
Diagnostic and Interventional Procedure Requirements
Neurological/Non-neurological Management

• **Neurological complications include:**
  • Stroke or cerebrovascular ischemia
  • Acute onset severe headache
  • Seizure and loss of consciousness
  • Hyperperfusion

• **Non-neurological complications include:**
  • Arrhythmia
  • Hypotension
  • Hypertension
  • Myocardial infarction
Diagnostic Angiography
Aortic Arch Angiography

• The LAO view is the preferred method for defining aortic arch anatomy.
• Digital subtraction angiography (DSA) of the aortic arch is useful in that it removes bony structures to improve the visualization of the arch anatomy.
• Aortic arch type is defined with consideration to potential difficulty in gaining sheath or guide catheter positioning to begin the carotid intervention.
• Patients with severe aortic arch or common carotid artery (CCA) disease and tortuosity are not suitable for carotid interventions.

Type III Arch
Image courtesy of Mahmood Razavi, M.D.
Aortic arch imaging:
- Identifies complex anatomy
  - Arch type & tortuosity
  - Proximal great vessels
  - Variants
- Subclavian & vertebral dominance/flow
- Degree of calcification
- Arch imaging is essential to procedural planning

Image courtesy of Mark Wholey, M.D.
Diagnostic Angiography
Aortic Arch Angiography

4-5F pigtail
LAO 30° - 60°
• Degree of angulation depends on steepness of arch
• Digital subtraction angiography (DSA)
• 4-6 frames/sec

Contrast Injection
• 15-20 cc/sec
• 30 to 40 cc total

Image Courtesy of Mark Wholey, M.D.
An right anterior oblique (RAO) 20-degree/caudal 20-degree projection is useful in separating the bifurcation of the right common carotid artery (RCCA) and right subclavian artery.
Carotid Arteries

Optimal Angiographic Views of the CCA – AP and Lateral Views

AP and lateral views should be obtained to identify and grade the severity of CCA and carotid bifurcation stenoses.

A steep oblique view will provide the best images of the carotid bifurcation.

Images courtesy of Rajesh Dave, M.D.
**Target Lesion Angiography**

- Use ipsilateral oblique and lateral views to define target lesions. Considerations include:
  - Advance the 4-5F diagnostic catheter to the origin of the artery
  - Do not advance the guide wire into the target artery or across the lesion
  - At least two projections should be obtained for the index lesion
  - Views should have no vessel overlap

*Index Lesion at Left Internal Carotid Artery (LICA)*

Image courtesy of Rajesh Dave, M.D.
Equipment for CAS

- Arterial access kit
- Selective diagnostic catheters
- Guide wires
- Guide catheter or sheath
- Rotating Hemostatic Valve (RHV) recommended
- Manifold system
- Coronary and peripheral balloons
- Embolic Protection System (EPS) (see product modules)
- Self-expanding carotid stent (see product modules)
- Supplementary supplies
Selective Diagnostic Catheters
Simple Curves

Used for selective access of arch vessels

- 4-5F, 100 cm - 125 cm long
- H1, JB1, JR4
  - Type I-II arches
  - Not preferred for extreme angulations or bovine arches

Image courtesy of William Gray, M.D.
Selective Diagnostic Catheters
Complex Curves

Used for selective access of arch vessels

- 4-5F, 100 cm - 125 cm long
- Simmons, HN2, HN5, Vitek
  - Type III arches
  - Variant and bovine anatomy

Images courtesy of William Gray, M.D.
Guide Wires
Selective and Stiff Support

Selective for CCA and ECA access:
- 0.035” and 0.038” diameters
- ~ 150 cm long
- Floppy tip
- Steerable
- Examples
  - Angled tip Glidewire®
  - Wholey Hi-Torque® Floppy
  - TAD® wire
    - 0.018” tip transitioning to 0.035” core

Stiff Support for placement of guide catheter or sheath into CCA
- 0.035” or 0.038” diameters
- Exchange length (~300 cm)
- Examples:
  - Amplatz
    - Straight and J tip
  - Stiff angled Glidewire®
  - SUPRACORE™
  - Wholey Hi-Torque® Plus
Guide Catheter Selection and Use
Choosing a Guide Catheter or Sheath

- The choice of either a guide catheter or a sheath depends on the tortuosity of the aortic arch and the CCA ipsilateral to the target lesion, patency of the external carotid artery, anatomy of the internal carotid artery (ICA) distal to the lesion, and physician preference. There are pros and cons for each approach.
- For most carotid artery stenting procedures a 6F (or larger) long sheath or 8F (or larger) guiding catheter is used, with the sheath being most common.
- Placement of the guiding catheter or sheath into the CCA requires meticulous technique to avoid arterial injury or athero-embolization.
Guide Catheter Selection and Use
Using a Guide Catheter

The choice of a sheath or guide catheter is usually dependent on physician preference and may also depend on anatomical factors. Considerations include:

• Several different guiding catheter shapes are excellent for CAS, including Multipurpose, Amplatz 1, Judkins Right, Hockey Stick, and Mammary Artery.

• With the guide wire in the CCA, advance the guide catheter over the guide wire and position it within the proximal CCA.
Guide Catheter Selection and Use
Advantages/Disadvantages of Using Guide Catheters

Advantages
• Better image control and pre-shaped guide catheters that may be beneficial in certain anatomies
• Better support during advancement of interventional devices

Disadvantages
• Positioned low in the CCA; may make subsequent guide wire advancement into the target artery more difficult, especially with severely stenotic lesions or target arteries having acute take-off angles from the CCA
• The larger size guide catheter requires a larger arteriotomy to accommodate an 8F guide catheter compatible short sheath
Sheath Selection and Use

The choice of a sheath or guide catheter is dependent on:

• Physician preference
• Anatomical factors
Sheath Selection and Use - Considerations

• The sheath introducer technique uses a diagnostic catheter and support guide wire at the start of the procedure, with cannulation of the external carotid artery with a 0.035” or 0.038” guide wire preceding the exchange to the sheath introducer.

• A 6F or larger long sheath is advanced into the CCA with the radiopaque marker positioned below the origin of the ICA. Guiding sheaths are 80-90 cm in length.
Sheath Selection and Use - Considerations

- A Shuttle SELECT (Cook), Destination (Terumo) or Strada (St. Jude) sheath can be used for carotid artery stenting procedures.
- When a carotid guide sheath is used in tortuous anatomy, advance the sheath deep enough into the CCA so that the transition point is positioned beyond any arch angulations (usually 10 cm).
Sheath Selection and Use

Use of a Slip-Cath Sheath system eliminates the need for a separate diagnostic catheter and facilitates placement of the sheath in the CCA without any additional catheter exchange.
Standard Sheath Placement Method

- Advance an 0.035” or 0.038” guide wire through the diagnostic catheter and into the ipsilateral ECA. Position the diagnostic catheter in ECA.
- Avoid the ICA. Use Roadmap overlay images to facilitate correct placements.
- Remove the selective guide wire and place a stiff support wire through the diagnostic catheter into the ECA.
- Remove the diagnostic catheter, leaving the stiff guide wire in the ECA.
- Advance the sheath over the stiff guide wire into the CCA and position it proximal to the ICA.
- Remove the sheath dilator and guide wire.
- Place the 0.014” EPS wire in the target artery per Instructions for Use.

Image courtesy of Rajesh Dave, M.D.
Modified Sheath Placement Method

• In the presence of a severely diseased or occluded external carotid artery (ECA), first introduce a diagnostic catheter into the CCA with the aid of an 0.035” guide wire. (Do not advance the wire or catheter into the ECA.)

• Remove the selective wire leaving the diagnostic catheter in the CCA

• Advance a stiff wire such as a Superstiff Amplatz with a 1 cm tip through the diagnostic catheter. Make a large J-tip bend on the wire before placement in the CCA. This action may avoid injury to the bifurcation, as well as prevent the wire from crossing the lesion.

• When the stiff wire is in place, remove the diagnostic catheter and advance the sheath into the CCA over the stiff wire. Do not engage or cross the ICA lesion.
Telescoping Sheath Placement Method

- Insert a 5F x 125 cm diagnostic catheter through the lumen of a 90 cm sheath before the diagnostic catheter is inserted.
- Load an 0.035” or 0.038” guide wire into the lumen of the diagnostic catheter.
- Advance the guide wire/diagnostic catheter and sheath into the aortic arch as one unit.
- Access the CCA with the selective diagnostic catheter for roadmap images.
- Advance the guidewire into the ECA.
- Position the diagnostic catheter in the CCA.
- Advance guide/sheath over the diagnostic catheter into the CCA. Remove the guidewire and diagnostic catheter.
Spasm

- Arterial spasm can be caused by aggressive guide wire or delivery system movement.
- Straightening of a tortuous segment is frequently associated with spasm and development of pseudostenosis (kinking).
- Spasm is usually benign and is resolved with device repositioning.
- Persistent spasm can be treated with intra-arterial nitroglycerin. Severe spasm may interfere with safe advancement of the stent delivery catheter.
Disclosures

**Stockholder:**
- Insert Company Name
- Insert Company Name

**Grant/Research Support:**
- Insert Company Name
- Insert Company Name

**Medical/Scientific Boards:**
- Insert Company Name
- Insert Company Name

**Speaker’s Bureau:**
- Insert Company Name
- Insert Company Name

**Honorarium:**
- Insert Company Name
- Insert Company Name

**Consultant:**
- Insert Company Name
- Insert Company Name