How to do carotid artery stenting safely

George Joseph
Professor of Cardiology
Christian Medical College , Vellore

Carotid Angioplasty

1980 Angioplasty during CEA

Kerber et al AJNR 1980;1:348

1983 Percutaneous carotid angioplasty

Bockenheimer & Mathias AJNR 1983;4:791

Wiggli & Gratzl AJNR 1983;4:793

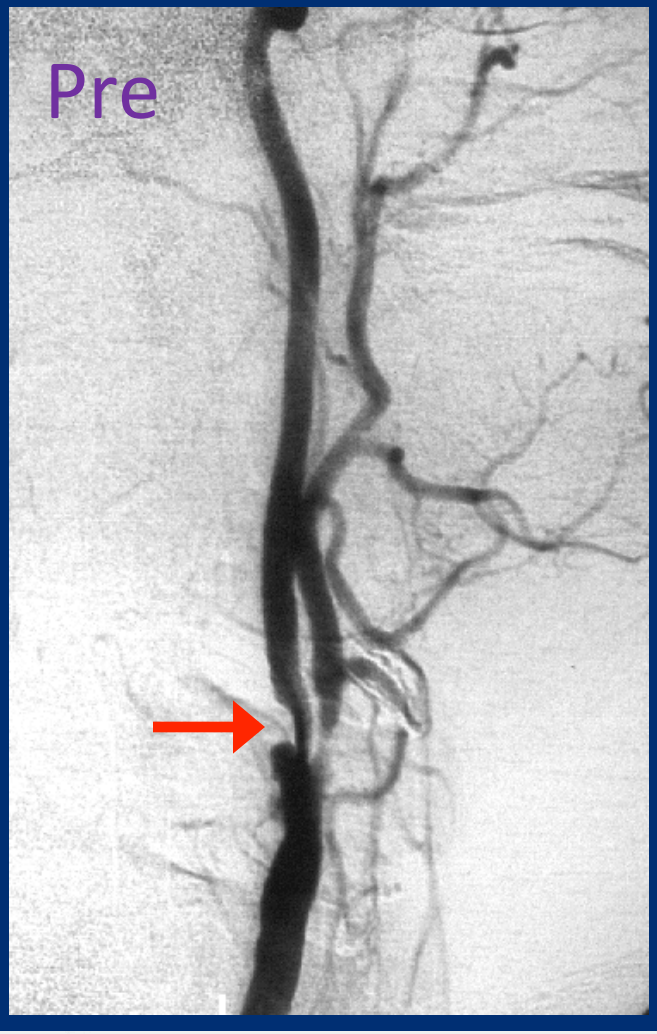
Tievsky et al AJNR 1983;4:800

1991 Carotid artery stenting

Mathias K

Theron J

Diethrich EB

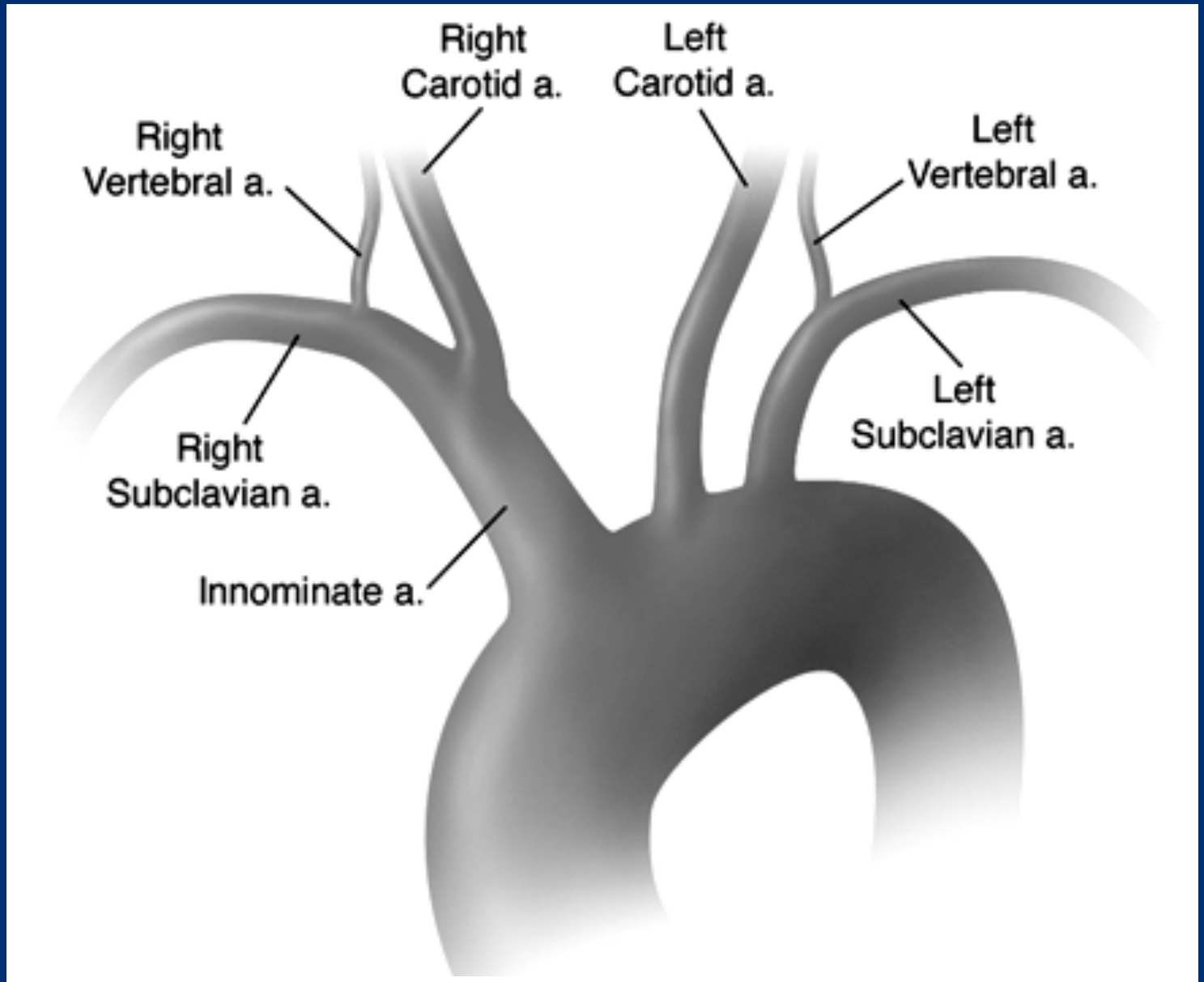


April 1996

Indian Heart J 1996; 48: 412-414

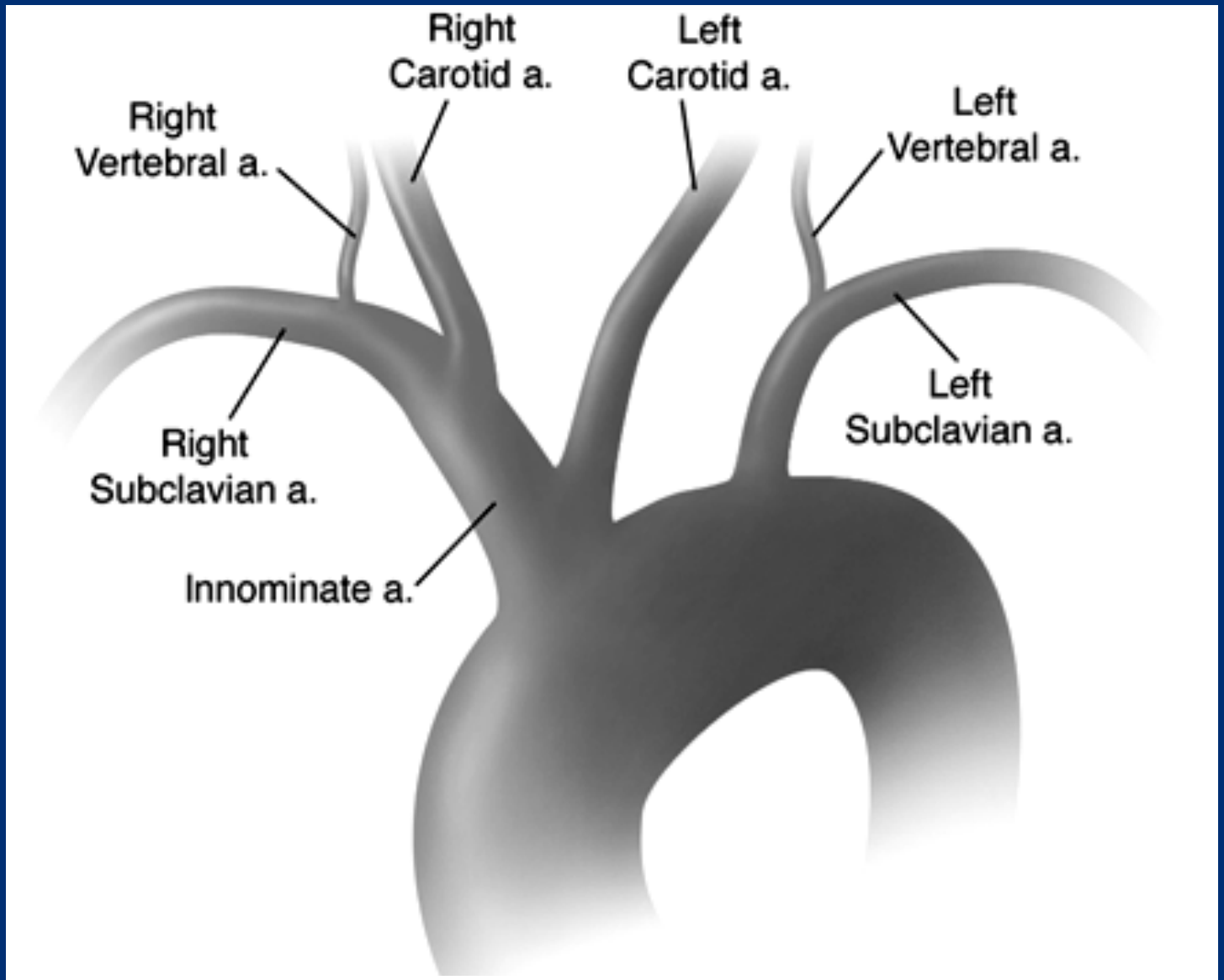
Treatment of Ulcerated Atherosclerotic Carotid Artery Bifurcation Stenosis Using a Self-Expanding Mesh Stent

George Joseph, S Krishnaswami, SK Trivedi
Department of Cardiology, Christian Medical College Hospital, Vellore



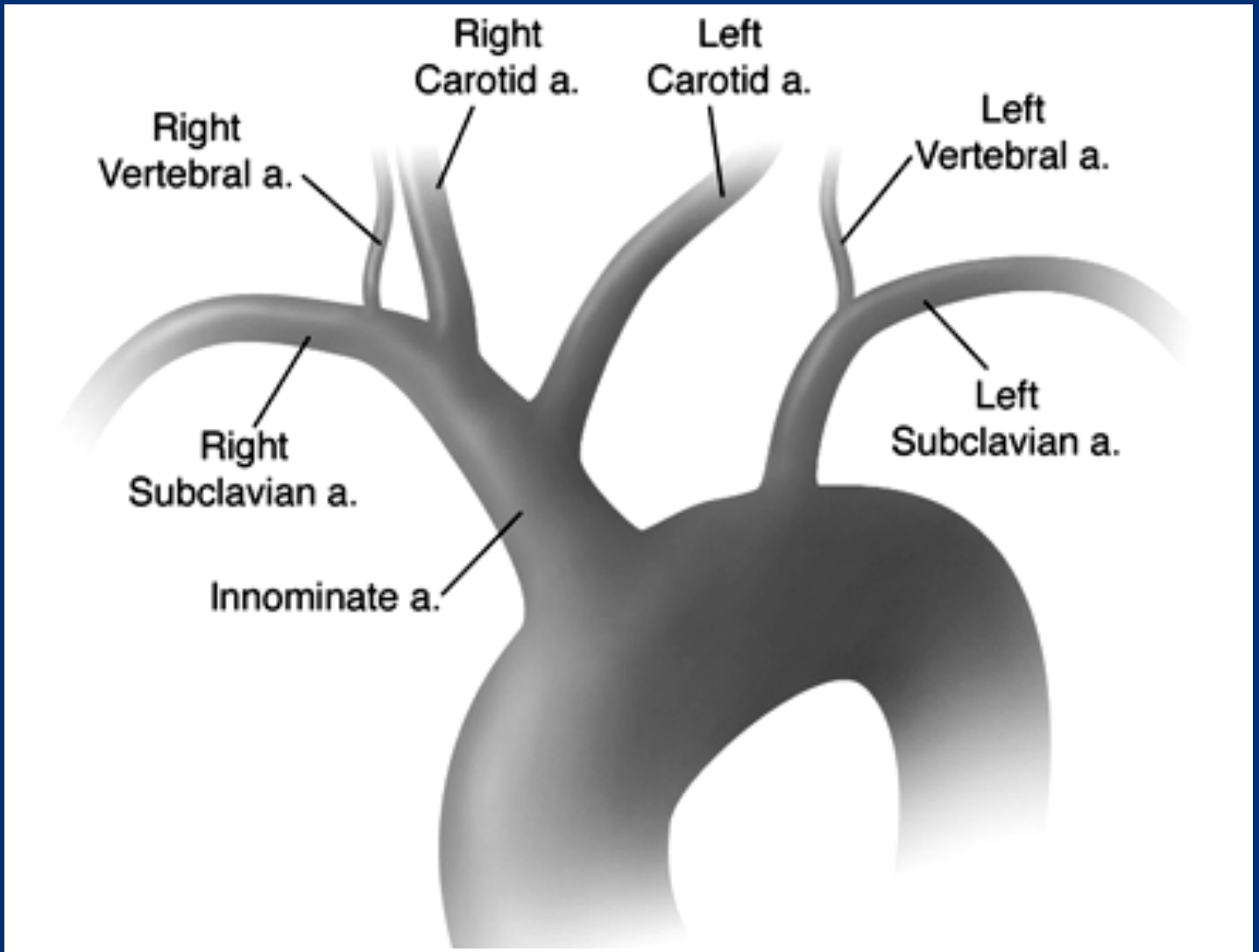
Standard Aortic Arch 70%

Layton KF, et al. AJNR 2006;27:1541-2



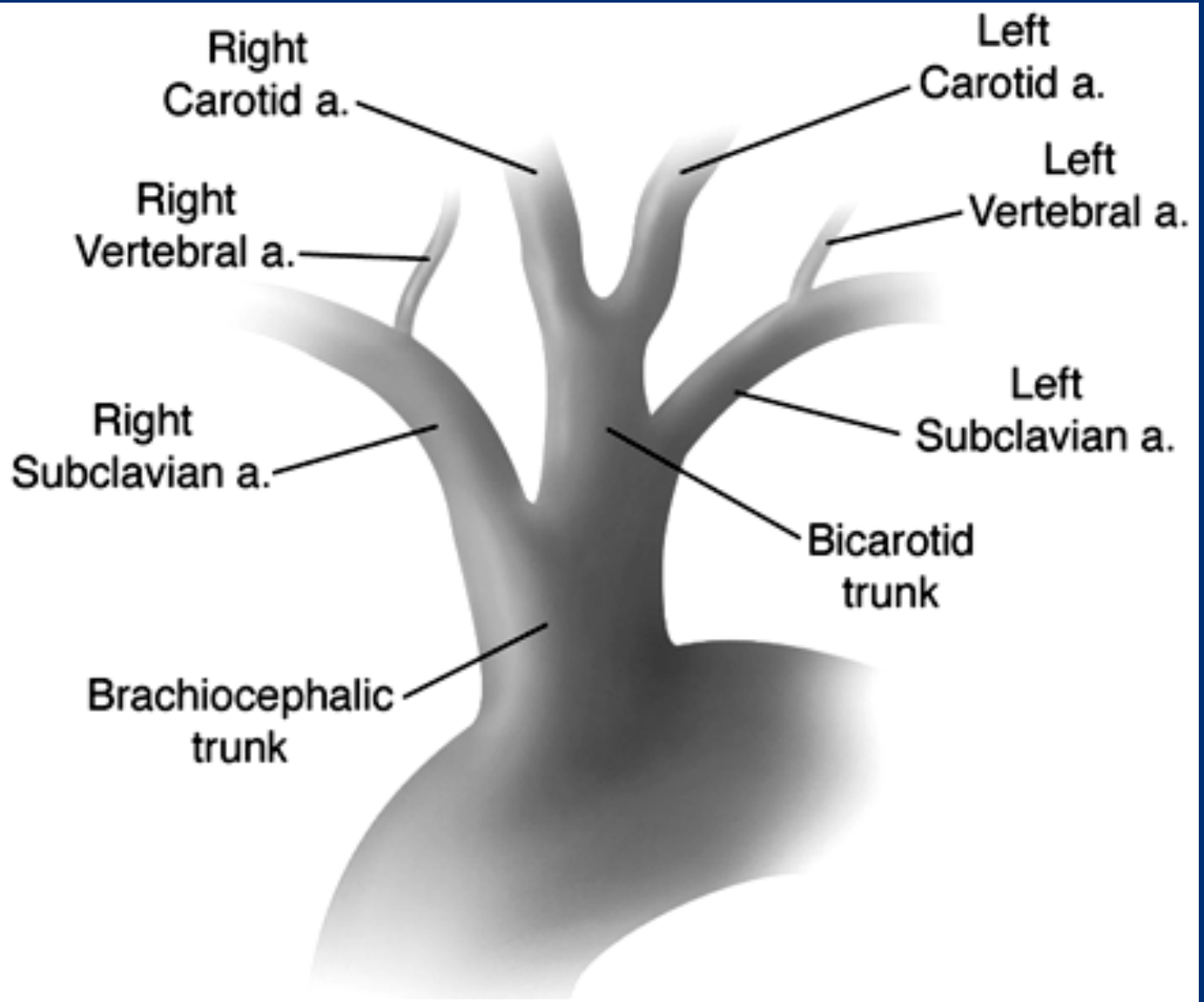
Common Origin of the Innominate Artery and Left Common Carotid Artery 13%

Layton KF, et al. AJNR 2006;27:1541-2



Origin of the Left Common Carotid Artery from the Innominate Artery 9%

Layton KF, et al. AJNR 2006;27:1541-2



Aortic arch branching pattern found in cattle

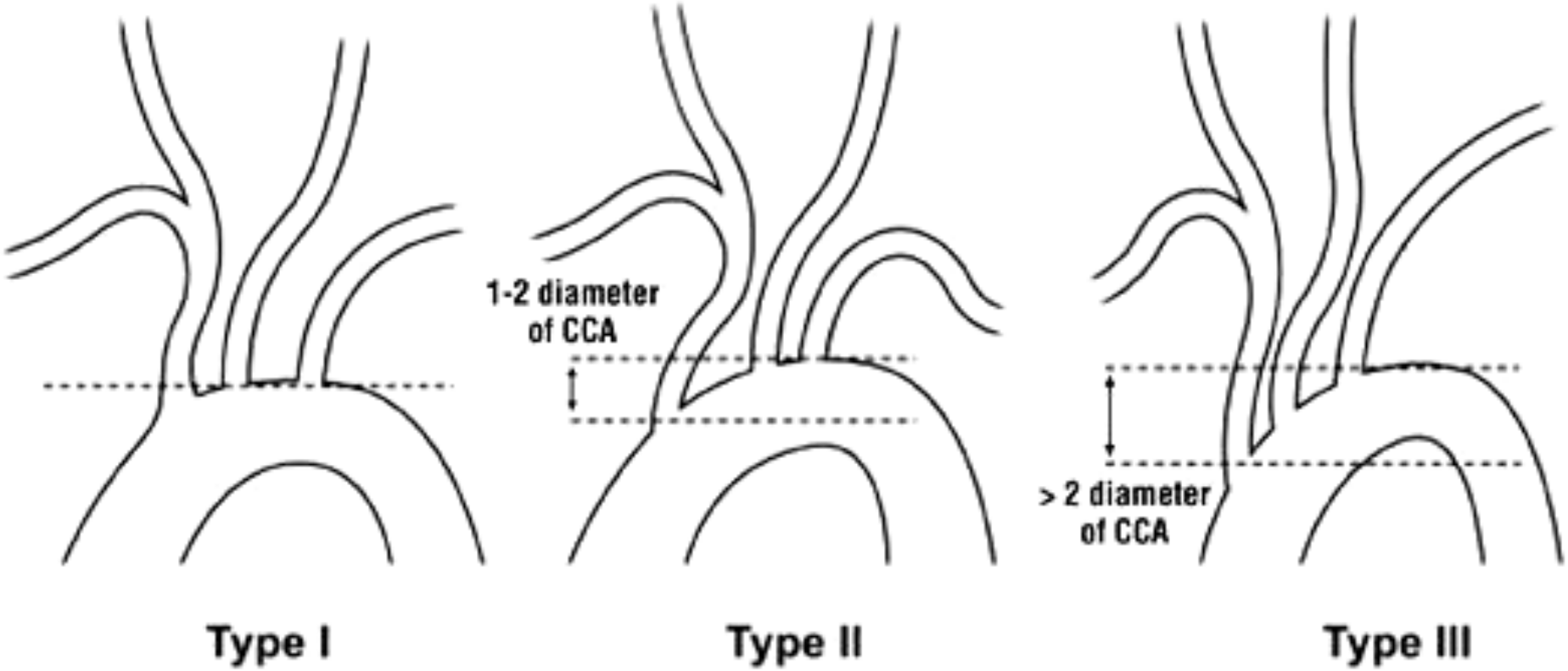
Layton KF, et al. AJNR 2006;27:1541-2

Access Strategy

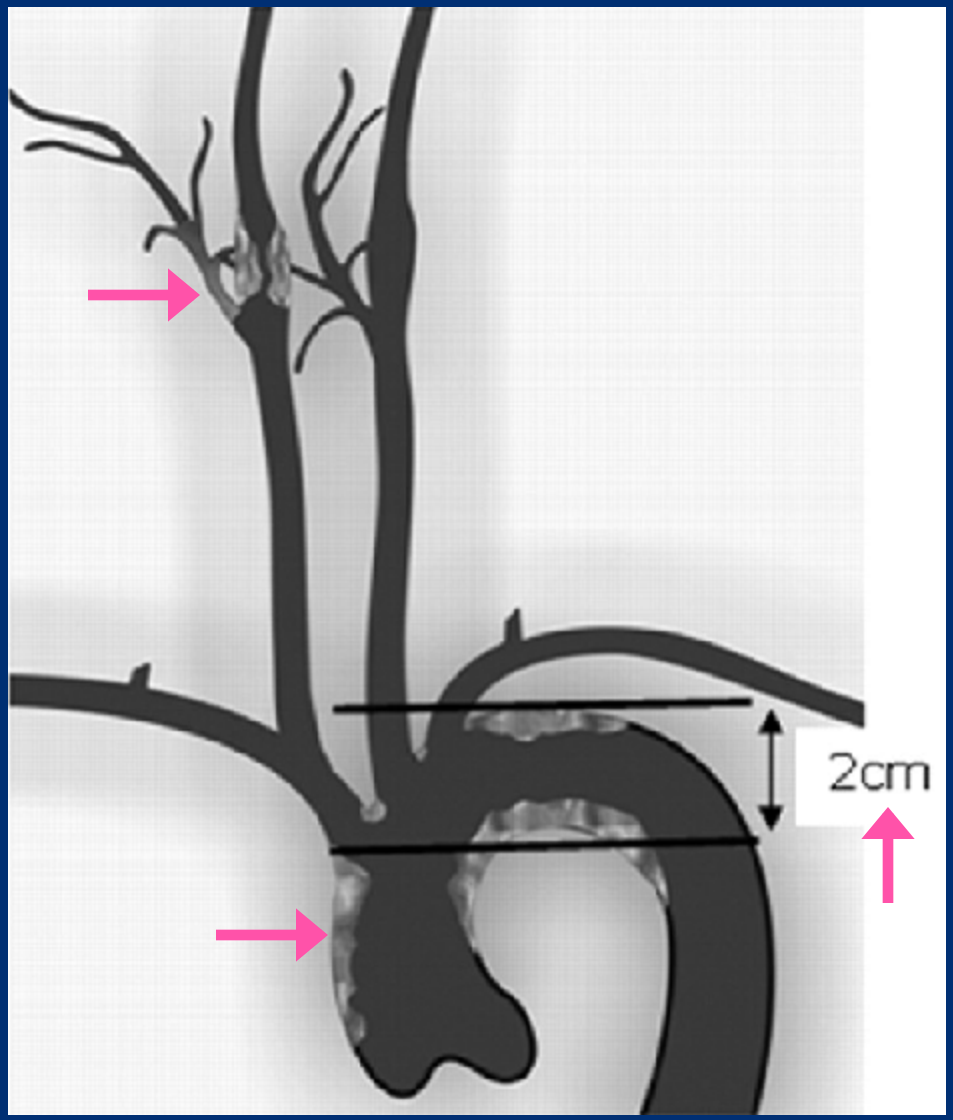
Determined by:

- Arch Anatomy
- Common carotid anatomy
- Anatomy of the lesion
- Patency of external carotid artery
- Anatomy of internal carotid distal to the lesion

Types of aortic arch

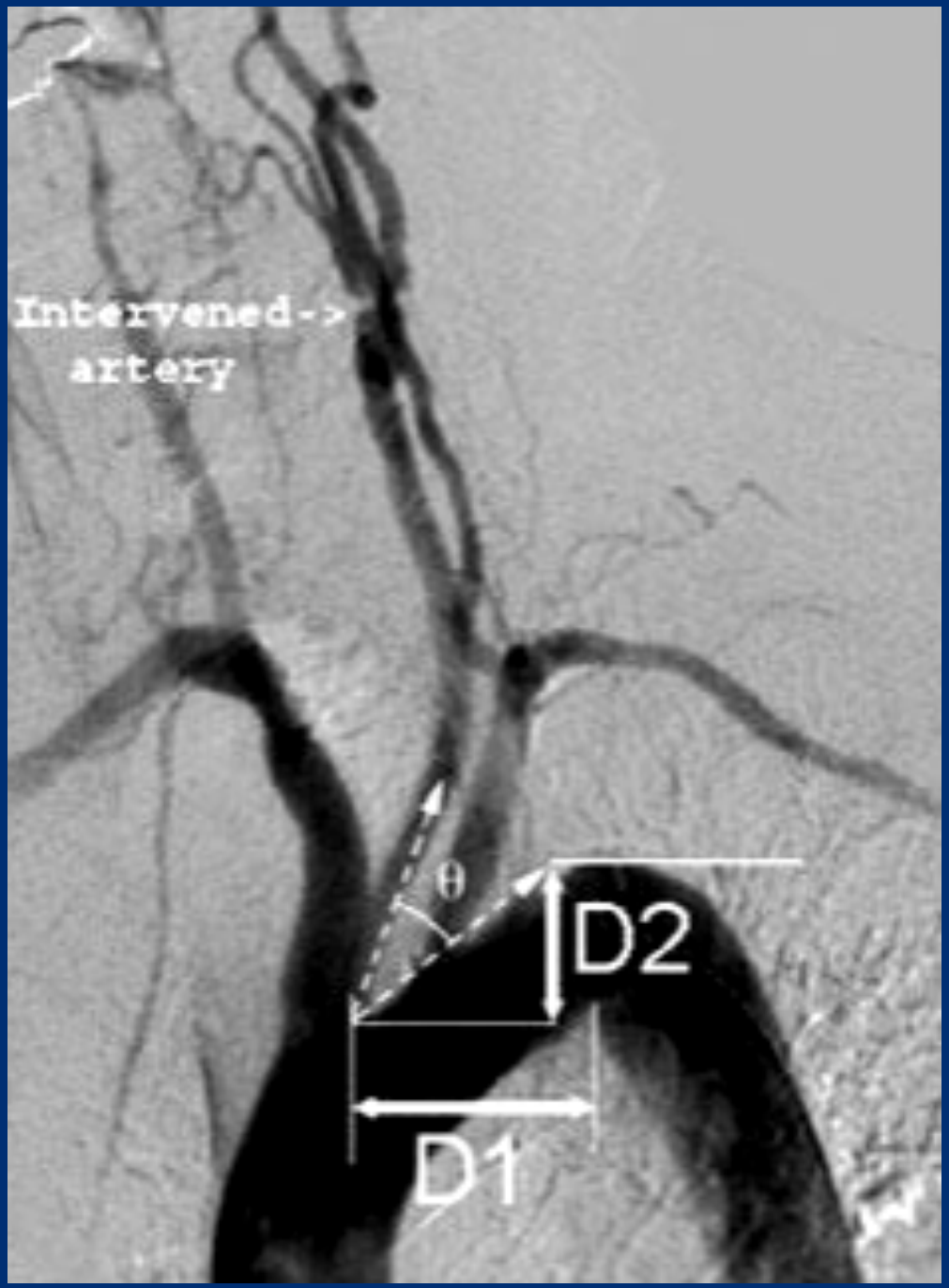


Madhwal S et al. J Invas Cardiol: 5 (May 2008)



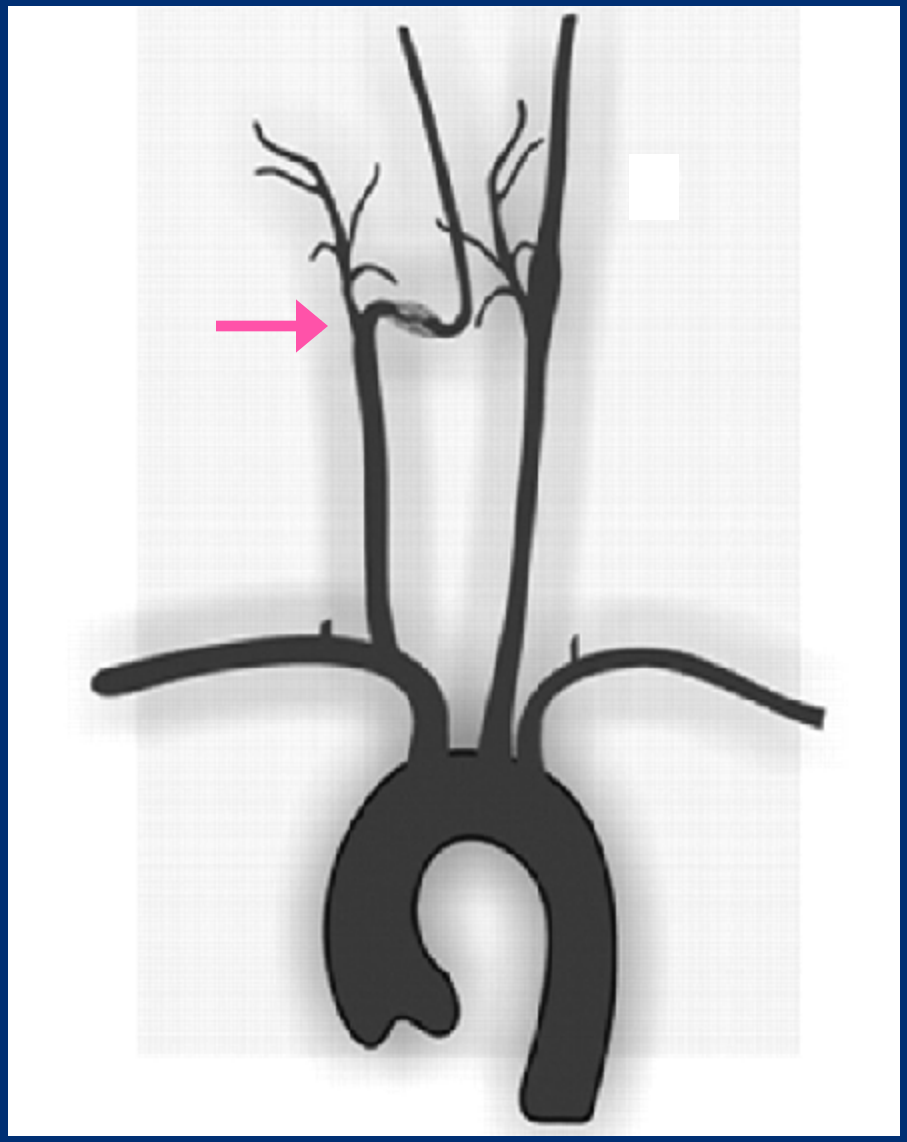
Adverse Anatomy

- Arch atheroma
- Occluded ECA
- Type III arch (i.e. >2cm between highest point of the arch and the origin of the vessel to be catheterized)



Adverse Anatomy

- Angulated CCA take-off (small angle θ)
- Long D1
- Long D2 (Type III arch)



Adverse Anatomy

- Angulated ICA origin

Carotid Stent Technique

Fundamental Steps

- Femoral access
- Arch angiography
- Selective catheterization of target CCA
- Wire placement in ECA
- Sheath or GC placement in distal CCA
- Placement of embolic protection device
- Pre-dilation of lesion
- Stent placement
- Post-dilation of stent
- Removal of EPD
- Final angiography

Carotid Stent Technique

Basic Equipment

- Angiography (pigtail, access catheter)
- Stiff hydrophilic guide wire (0.035”)
- Long interventional sheath or guide catheter
- Embolic protection device
- Appropriate size balloon catheter
- Self-expanding carotid stent
- Closure device (optional)

Arch Aortogram

- 30-40 LAO view
- Field of view should include origin of great vessels and extend to include the carotid bifurcation
- Patient's head should be straight with chin turned upward

V 730164B

Carotid Angiography

- Ipsilateral oblique and lateral views (additional views may be necessary)
- Contralateral carotid (Circle of Willis, collaterals, etc)
- 5 or 6 F with appropriate curve
- Intracranial angiography also important

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5.9.2013

Carotid Angiography

Key features

- Site of stenosis
- Bifurcation involvement
- Landing zone for EPD
- Patency of ECA
- Presence of ICA tortuosity
- Presence of ulceration
- Severity of stenosis
- Lesion length
- Degree of calcification
- Presence of thrombus

Intracerebral Angiography

- Anterior cerebral circulation viewed by PA cranial (15-20 degrees) and lateral views
- Important to visualize both arterial and venous phases:
  - Intra-cerebral disease
  - Collateral circulation
  - Presence of AVM, aneurysm, isolated hemisphere
  - Missing arterial phase vessels
    (allows identification of embolization post CAS)

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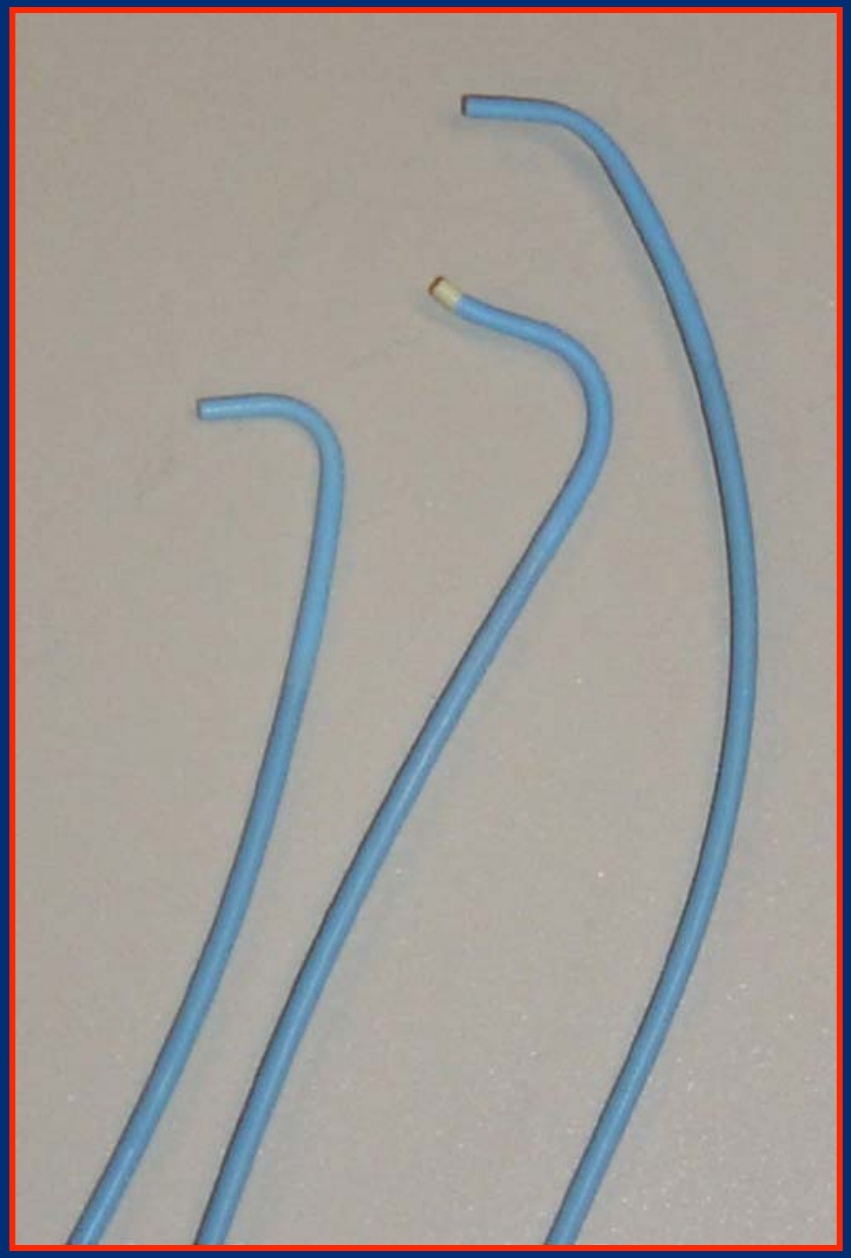
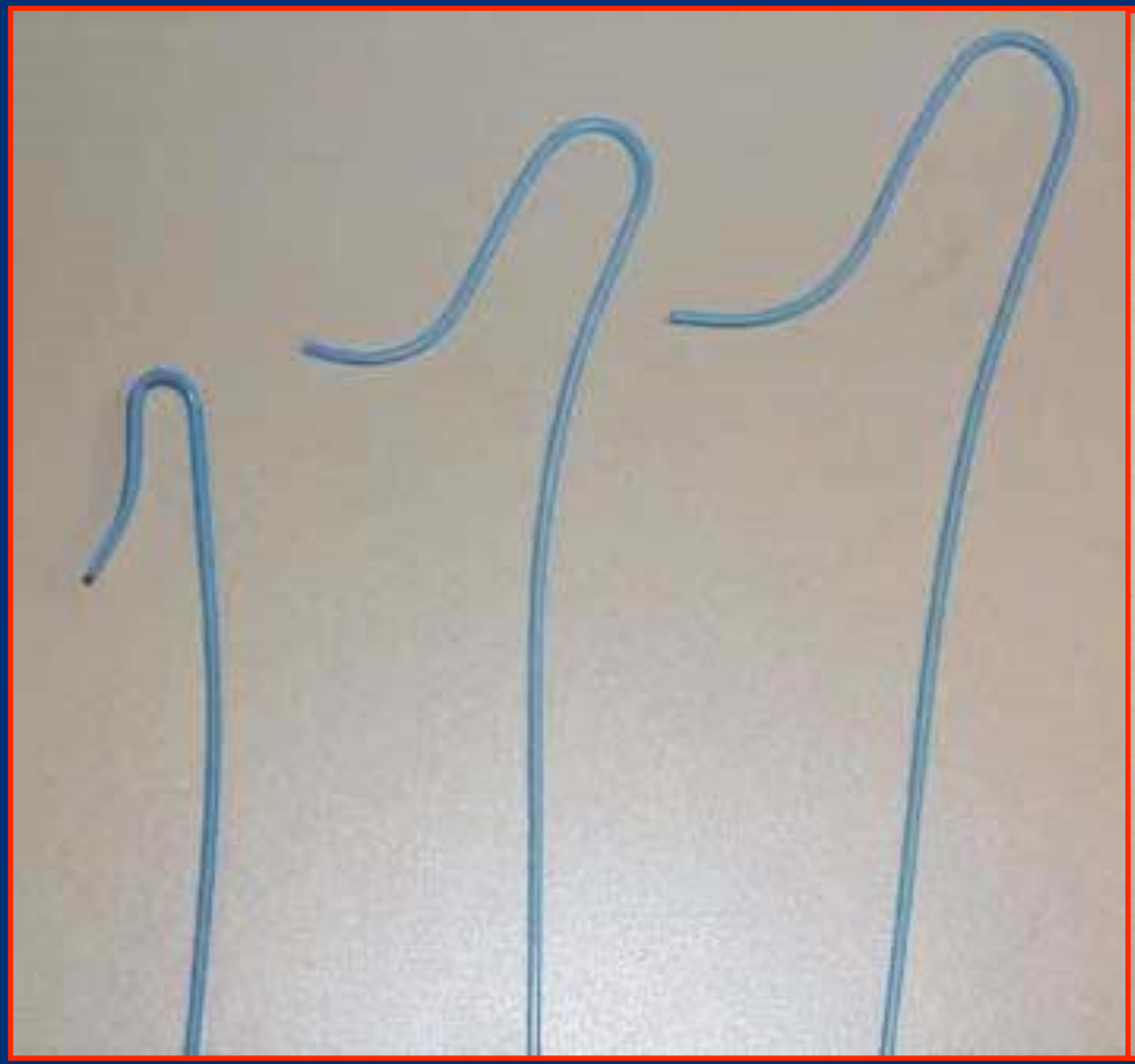
5.9.2013



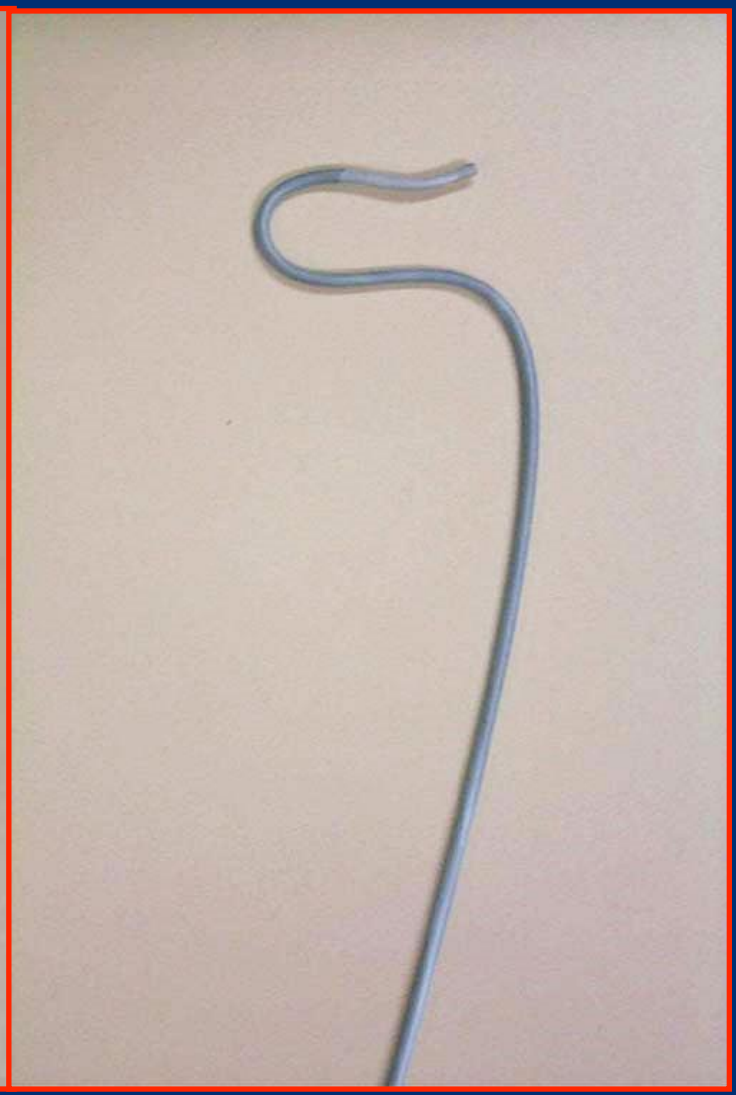
Simple curved Catheters used for Carotid Access

- IMA
- AR
- JR

Compex curved catheters used for carotid access



Simmons 1,2,3



Vitek

Catheters used for Carotid Access

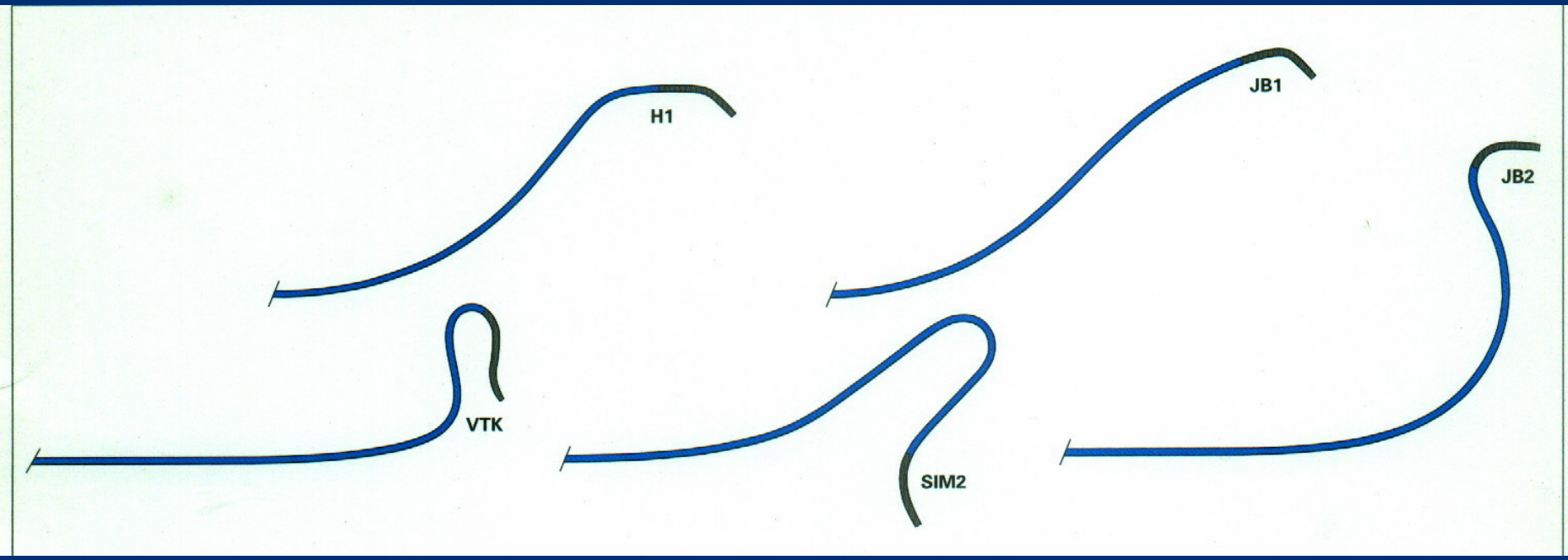


TABLE 1. COMPARISON OF DIAGNOSTIC CAROTID ACCESS CATHETERS

Features	Catheter Shapes			
	Headhunter	Simmons	VTK	Judkins Right
Size	5–7 F	5–7 F	5 F	5–7 F
Ease of use	Easy	Difficult	Moderate ease	Easy
Success in cannulation	50%–70%	90%	70%–90%	50%
Type of arch	Type I	Type I, II, III	Type I, II	Type I
Risk of emboli	Minimal	Moderate	Minimal	Minimal
Anomalous left CCA	Not useful	Highly useful	Somewhat useful	Not useful
Ease of advancement into CCA after cannulation	Very easy	Somewhat difficult (need to bury the shoulder into the CCA before it can be advanced further)	Moderately easy	Easy in type I arch
Potential for catheter prolapse into arch during advancement	Minimal except in type II, III arch	Moderate unless the shoulder is advanced into the CCA	Minimal	Minimal
Amount of expertise needed	Minimal	Significant skill level needed, need ability to shape the reverse curve	Minimal to moderate	Minimal

Myla S. Endovascular Today 2009 Nov 59-66

Carotid Stent Technique

Guide Catheter Placement

- Dx catheter engages innominate / LCCA and angiography of carotid bifurcation done
- Stiff angled 0.035’ guide wire advanced into distal CCA or ECA under roadmap / reference image guidance
- Diagnostic catheter exchanged for guide catheter
- Guidewire removed
- Alternatively, an 8F GC can be railroaded over a 125cm diagnostic catheter into the CCA

Carotid Stent Technique

Sheath Placement in CCA

- Diagnostic catheter engaged in innominate or LCCA
- Angiography done (preferably lateral) to visualize bifurcation of ECA and ICA
- Stiff, angled 0.035 hydrophilic wire advanced into ECA
- Dx catheter advanced over wire into the ECA
- Guide wire exchanged for super stiff (1cm soft tip)
- 6F sheath advanced into CCA over guidewire
- Guidewire removed

Carotid Stent Technique

Guide Catheters

Advantages

- Better torque control
- More rigid; better support
- Better for tortuousity
- Many pre-formed curves available to fit anatomy

Disadvantages

- 8 Fr sheath size
- Uneven transition with inner catheter

Carotid Stent Technique

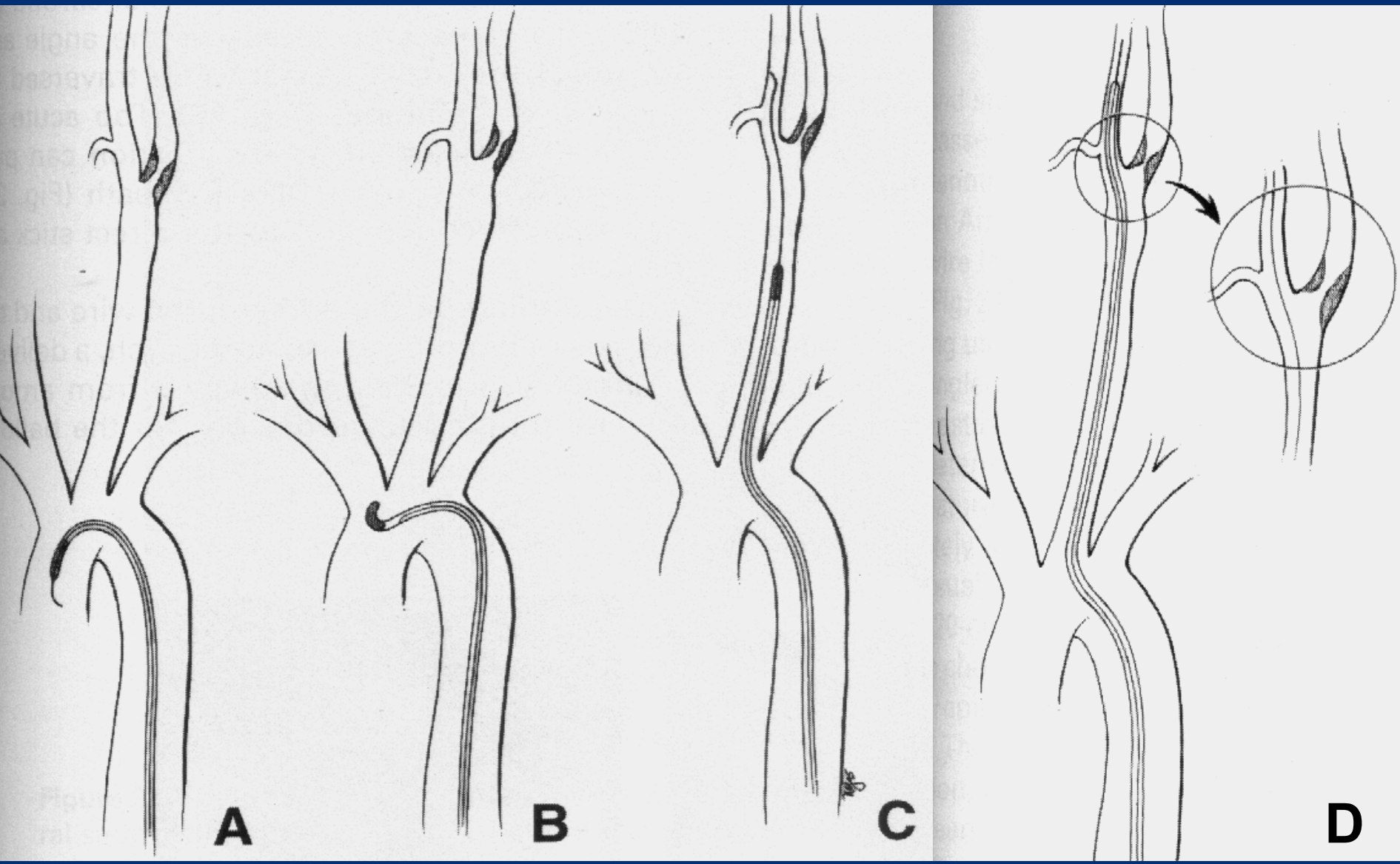
Long Sheath System

Advantages

- 6 Fr sheath size
- Integrated dilator provides smooth transition

Disadvantages

- No torque control
- Less rigid; less support
- Less favorable for tortuous anatomy
- More likely to slip back during EPD or stent delivery

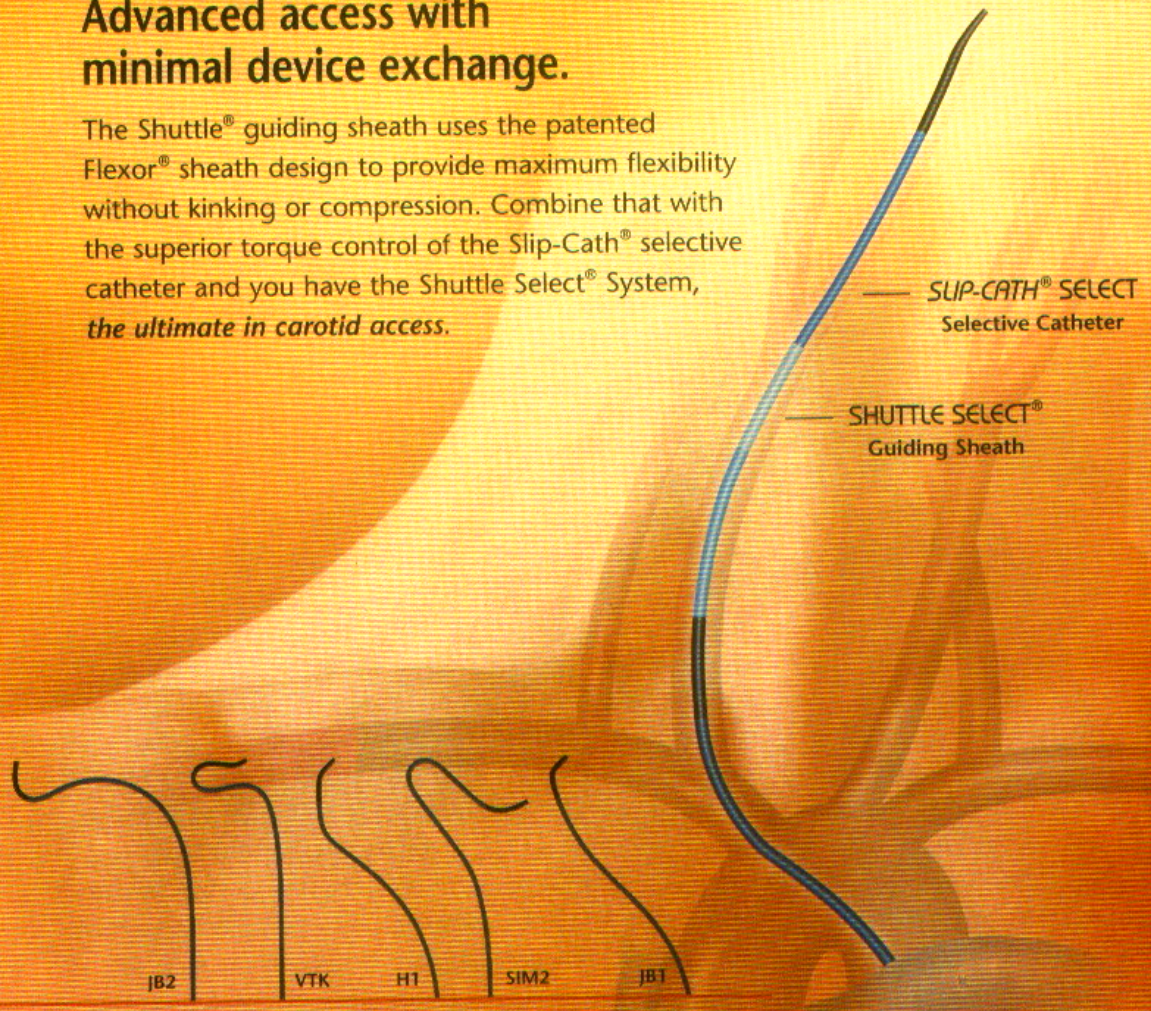

A
B
C
D

SHUTTLE SELECT® SYSTEM

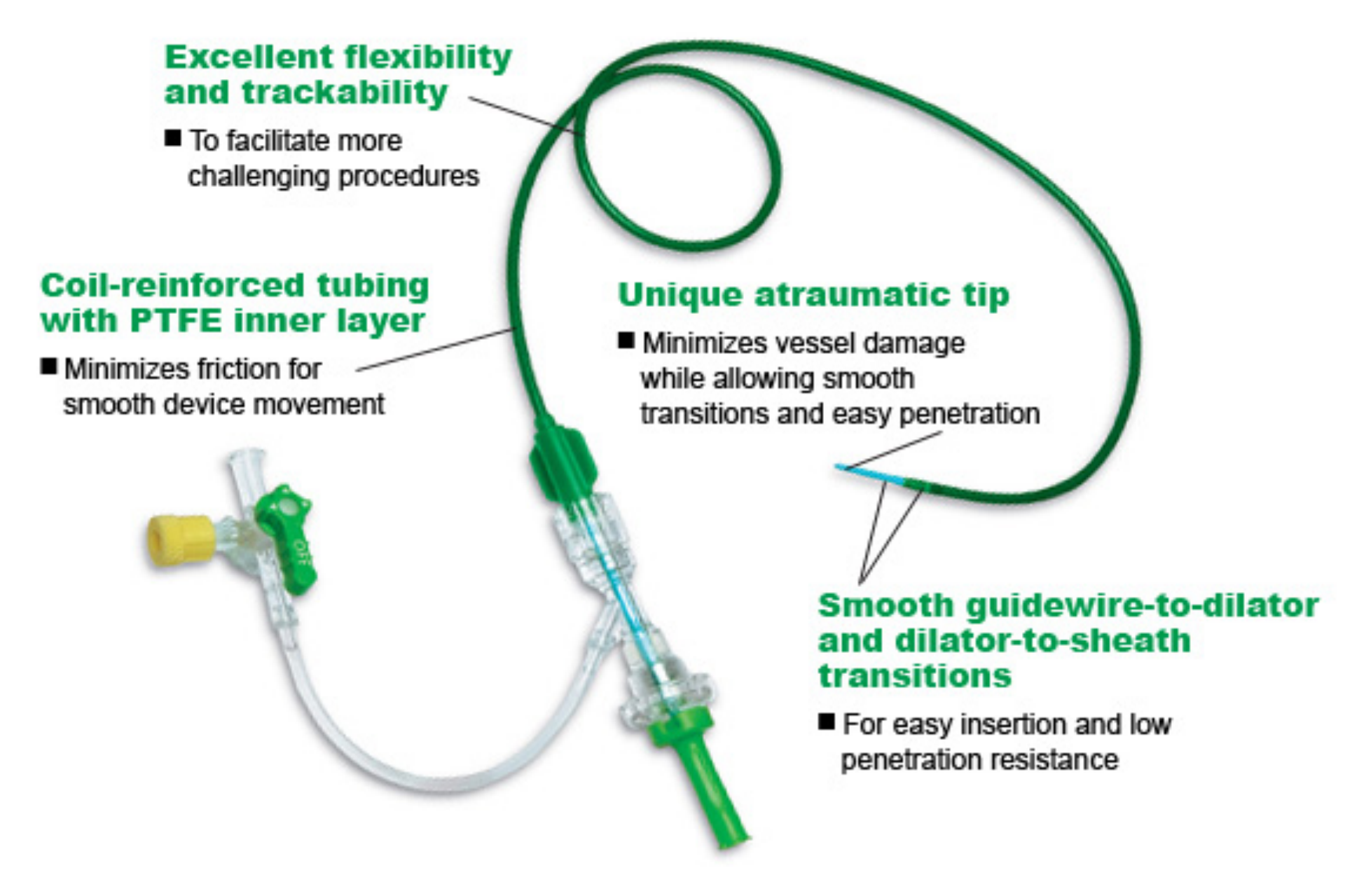
for carotid artery access

Advanced access with minimal device exchange.

The Shuttle® guiding sheath uses the patented Flexor® sheath design to provide maximum flexibility without kinking or compression. Combine that with the superior torque control of the Slip-Cath® selective catheter and you have the Shuttle Select® System, ***the ultimate in carotid access.***

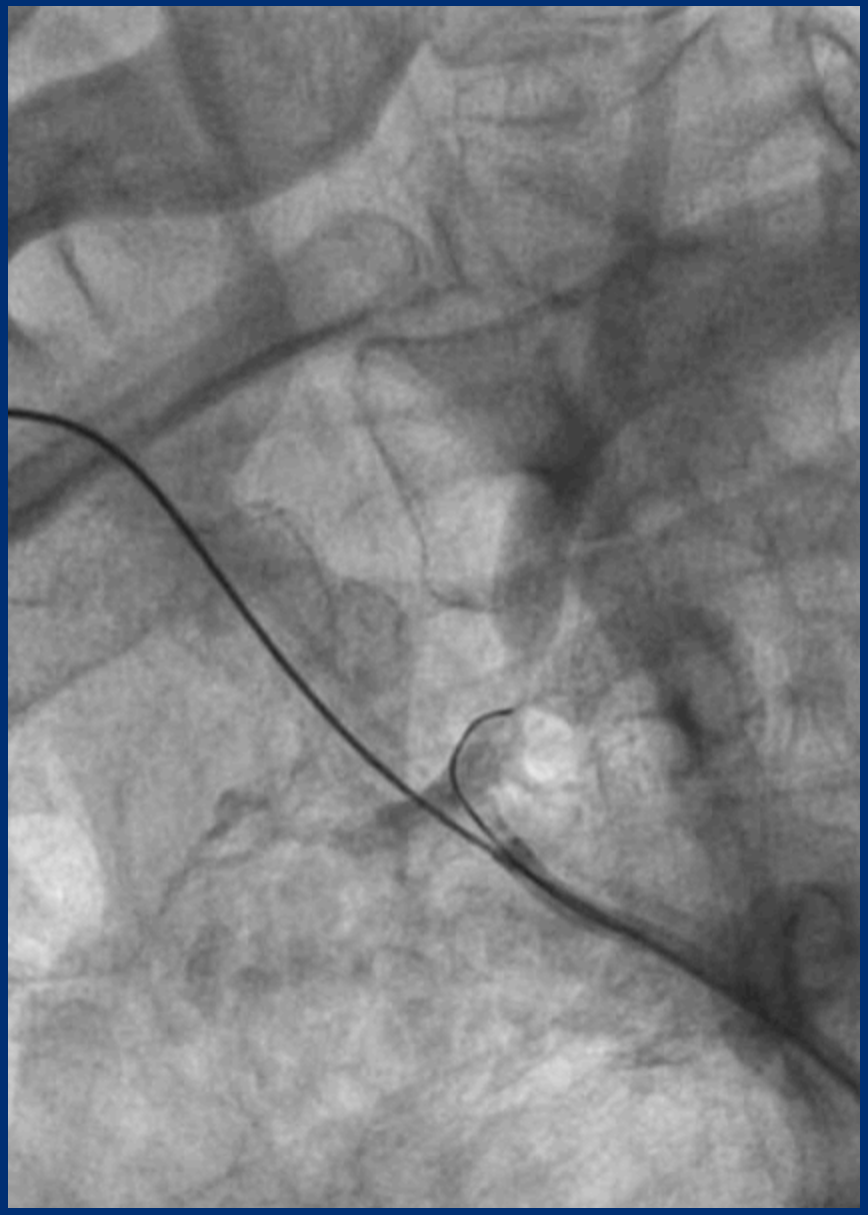


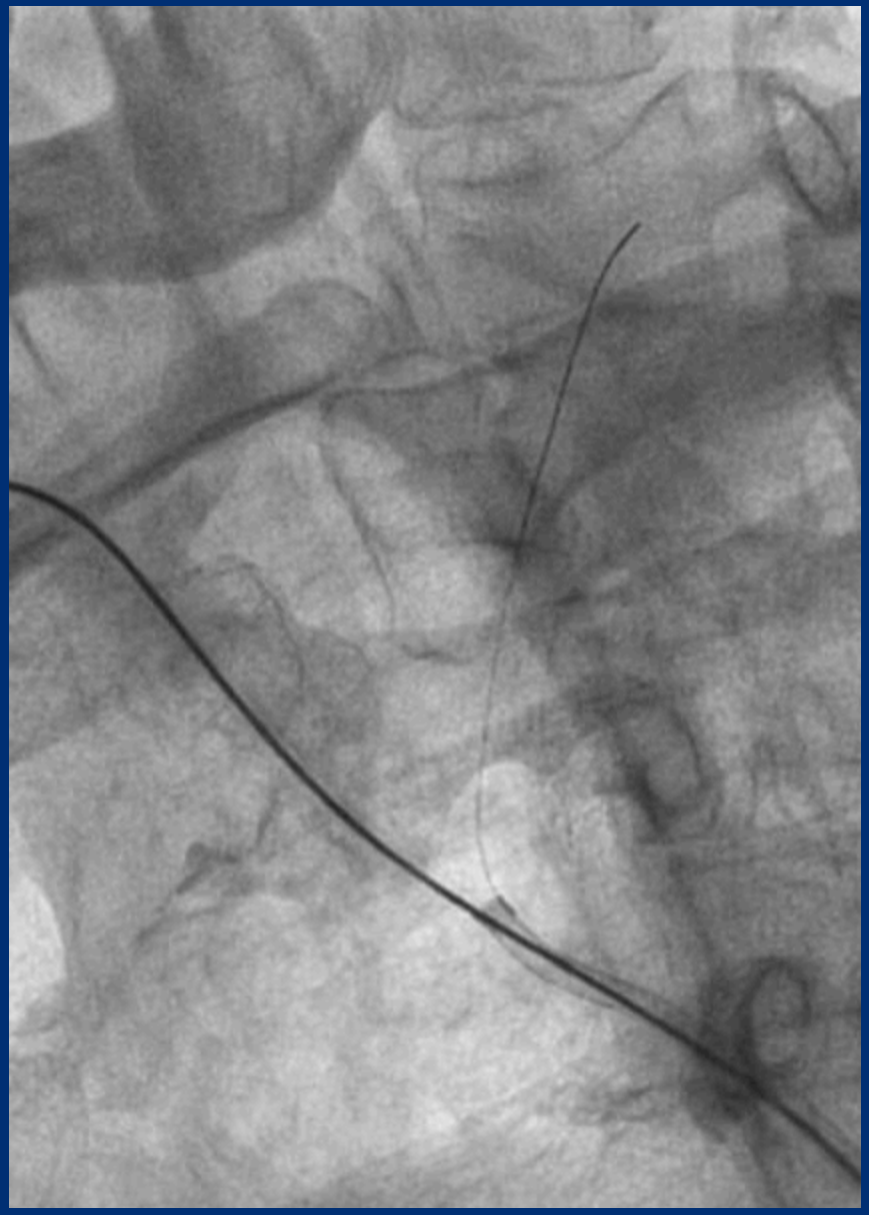
Now available in 5 selective catheter configurations.

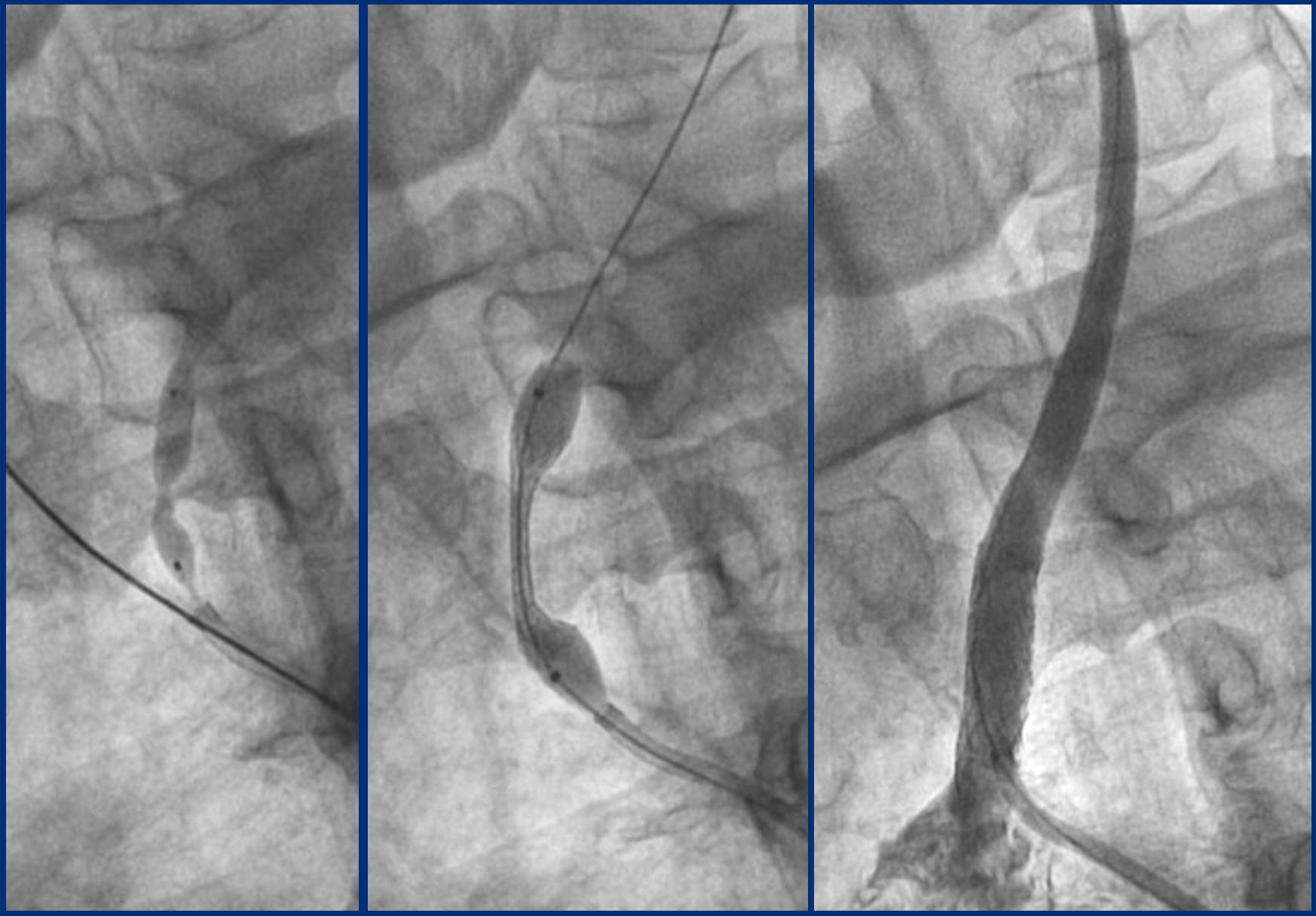


Pinnacle Destination guiding sheaths (Terumo)

63 male, smoker, DM, CAD-TVD







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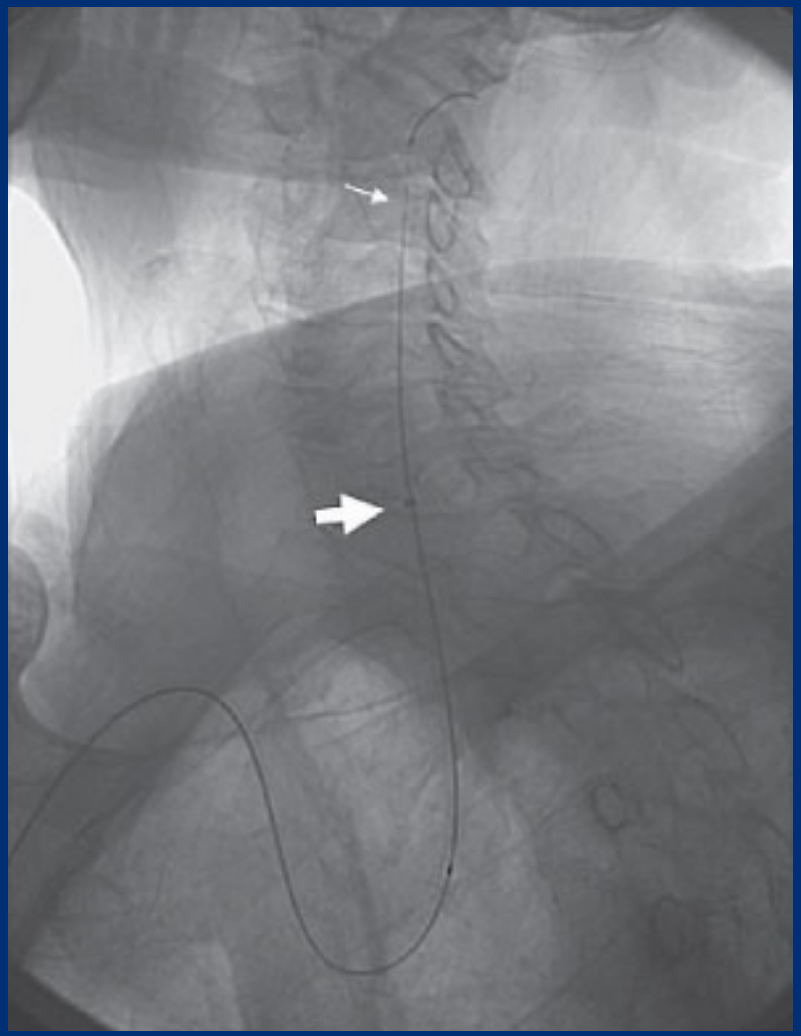
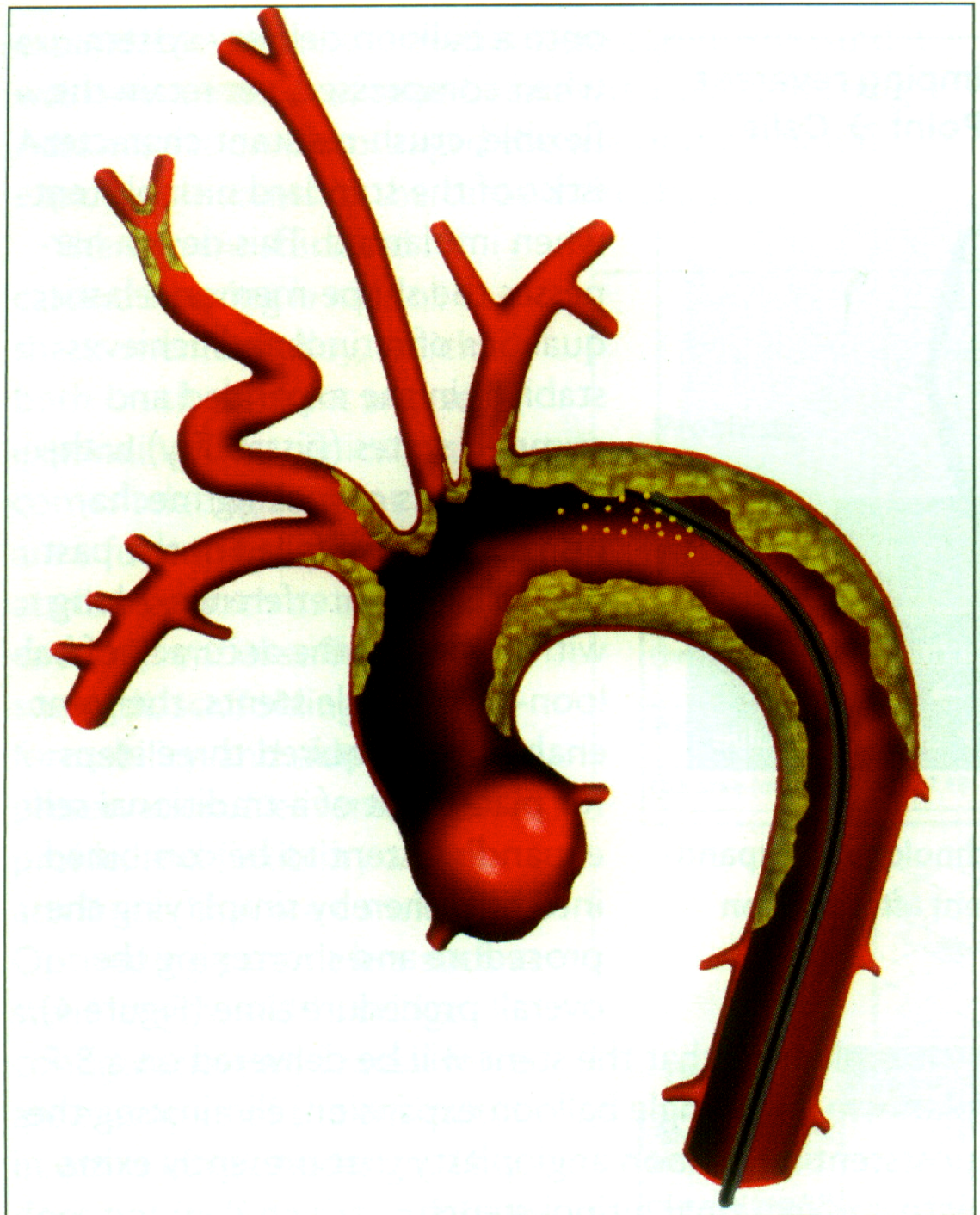
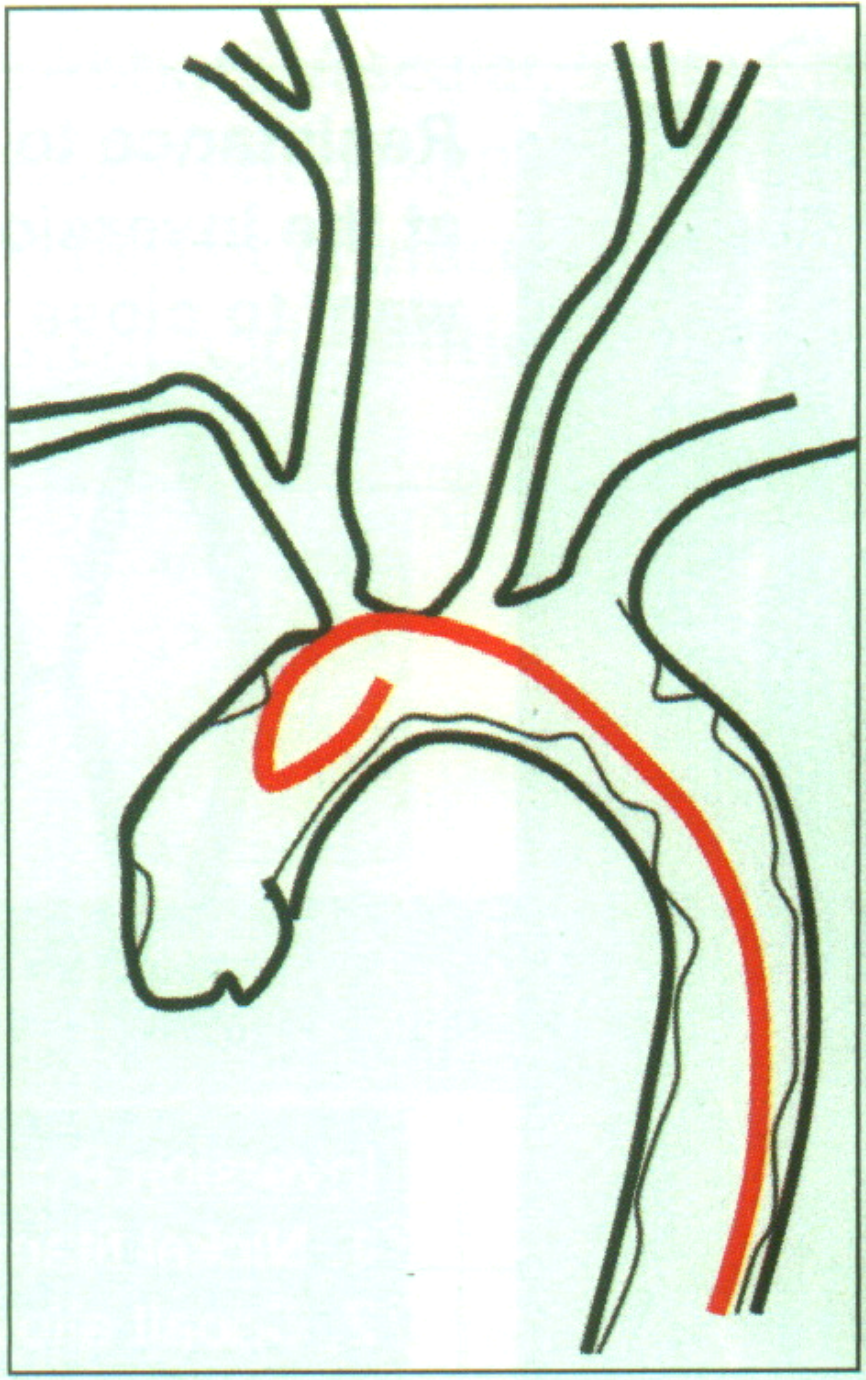
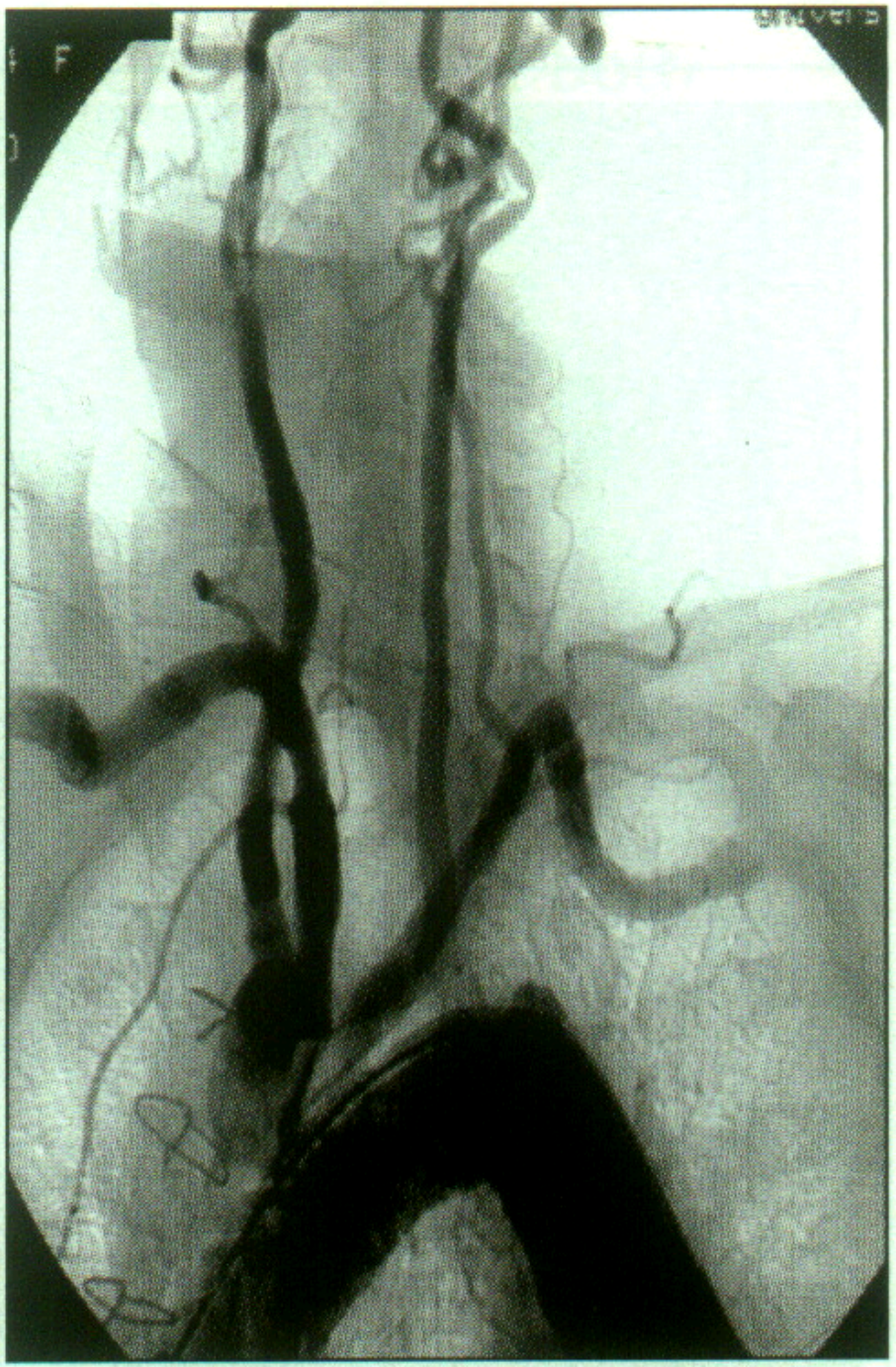


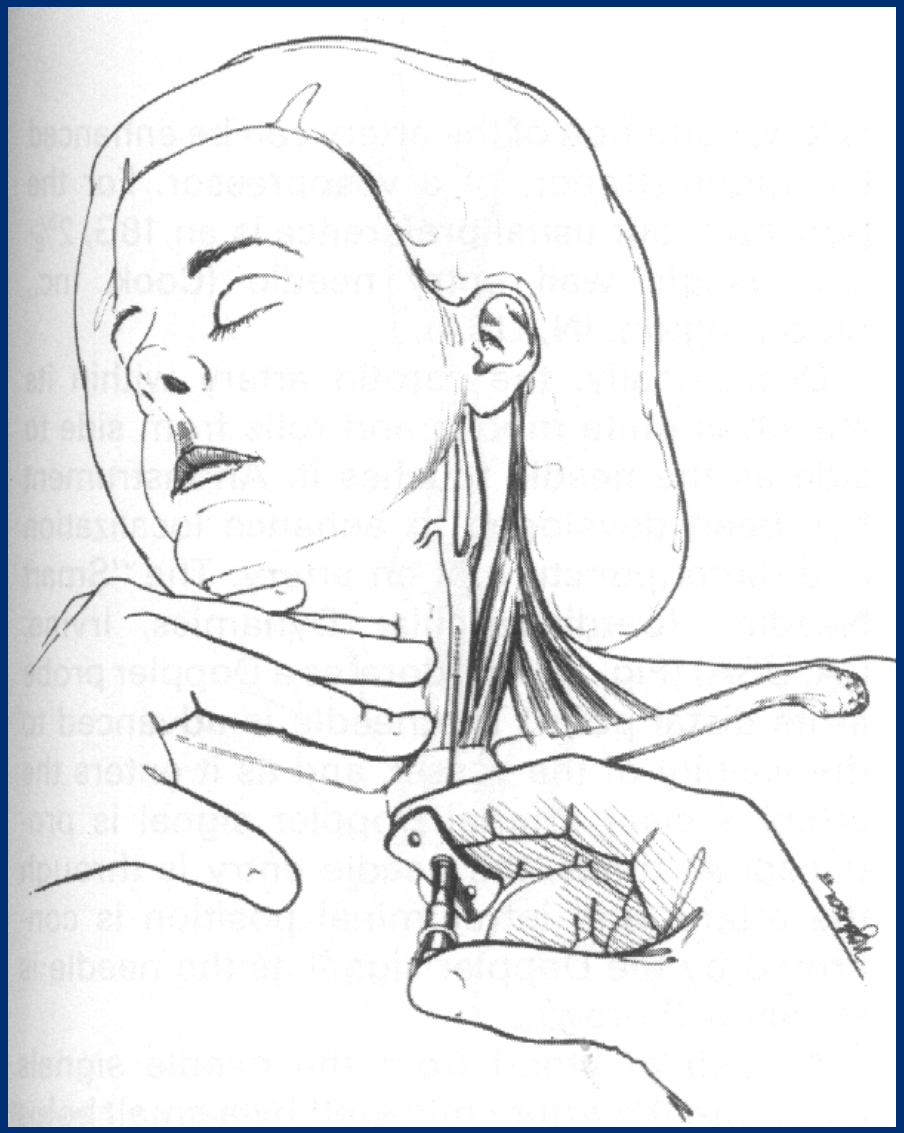
Left carotid artery stenting using right radial artery approach. A TAD wire has been advanced to the left external carotid artery (thin arrow), and a 6 F Shuttle sheath (thick arrow) is positioned in the left common carotid artery.

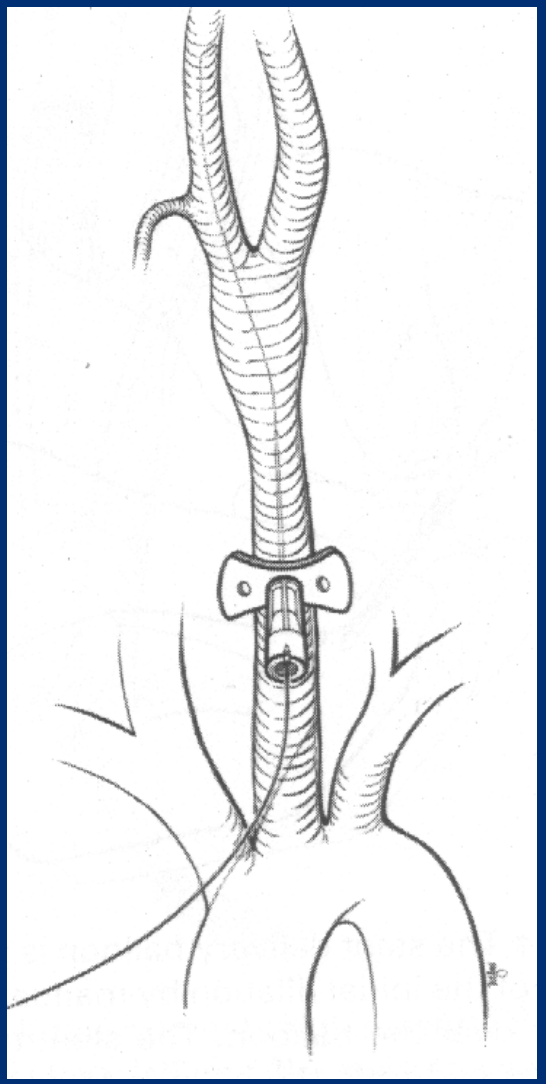
Narins CR. Cardiol J. 2009;16(1):88-97

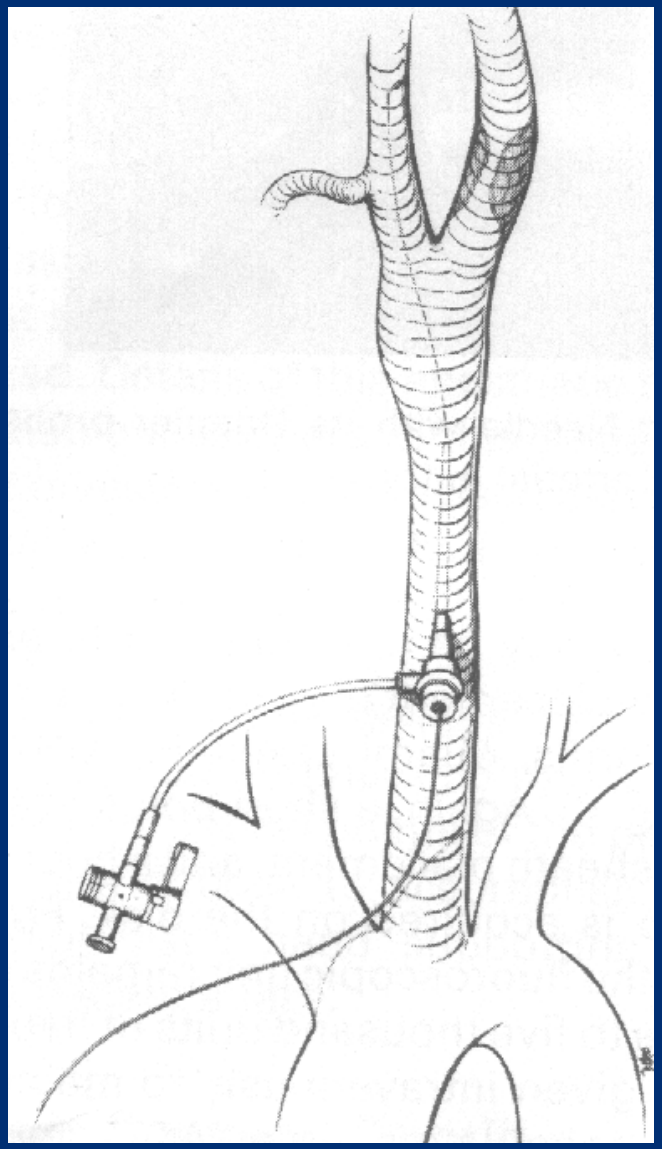


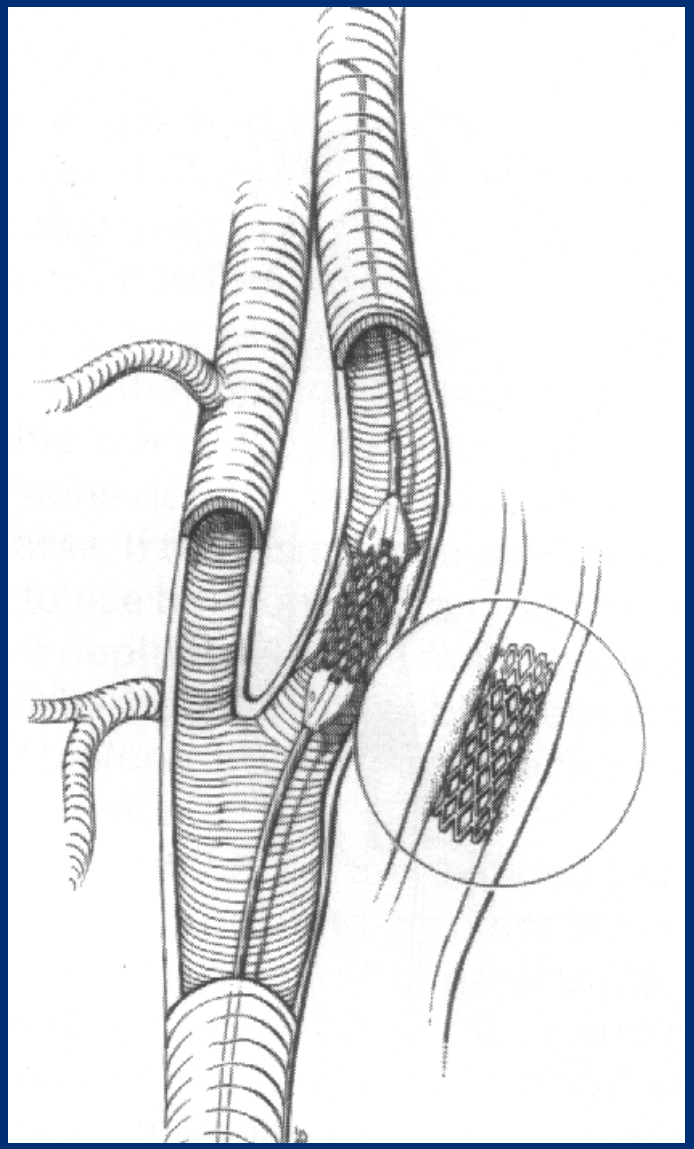


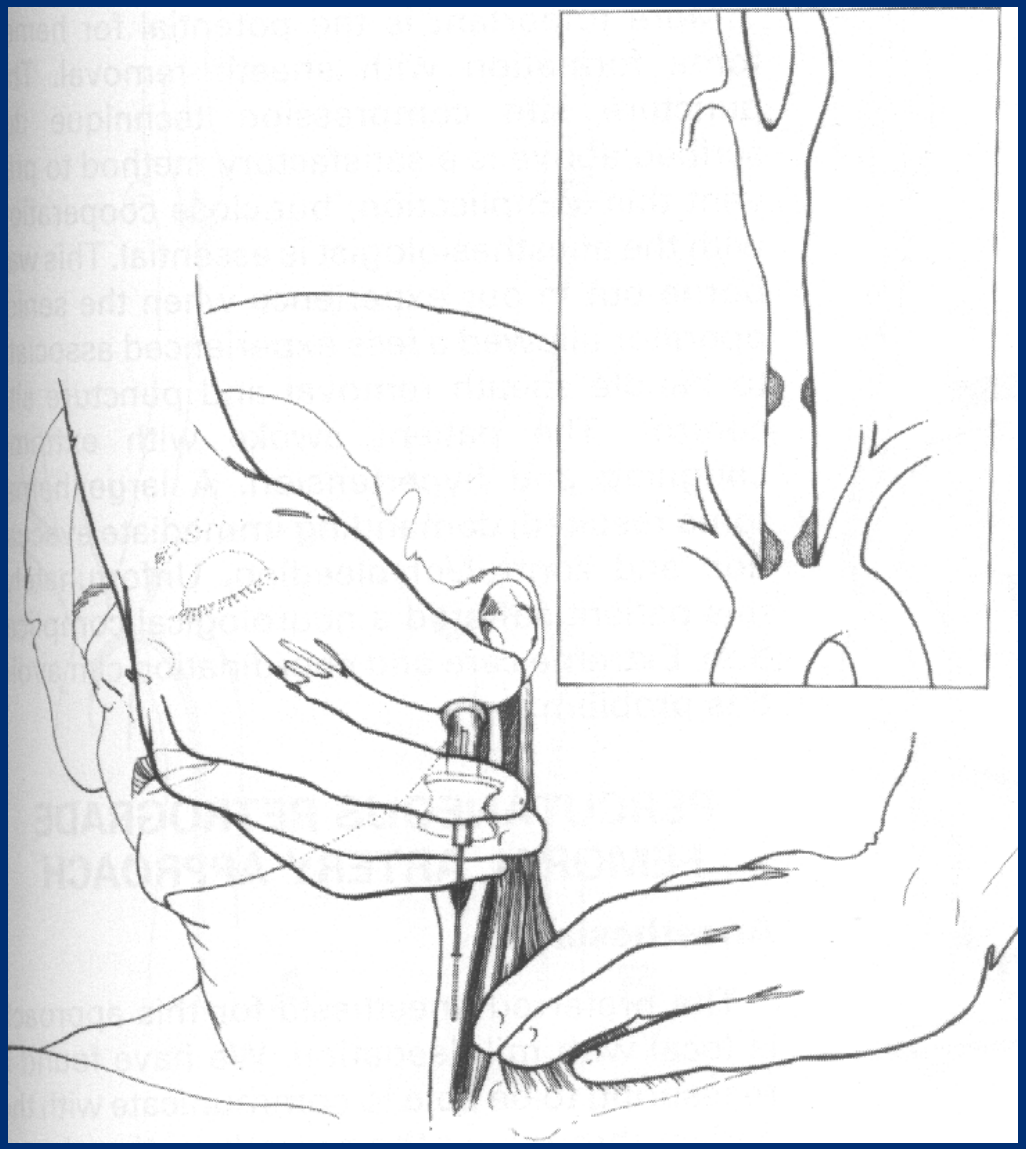


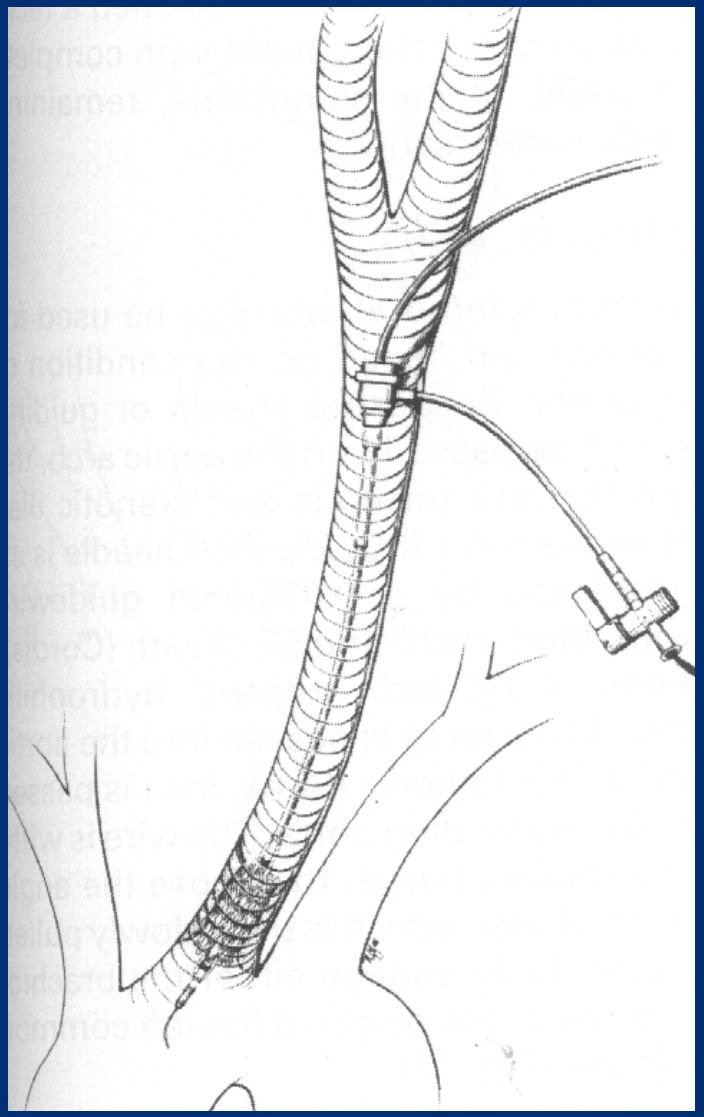


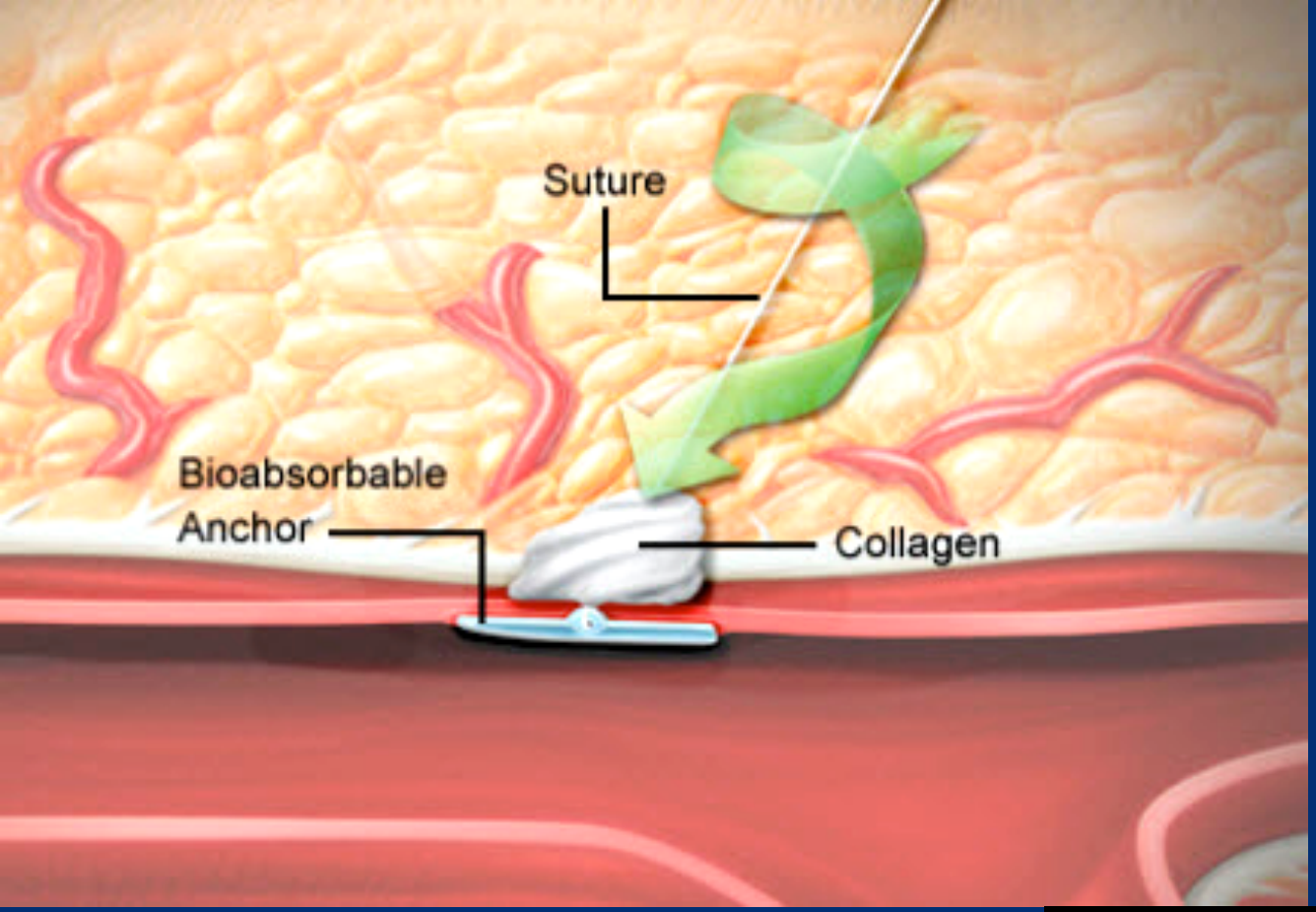




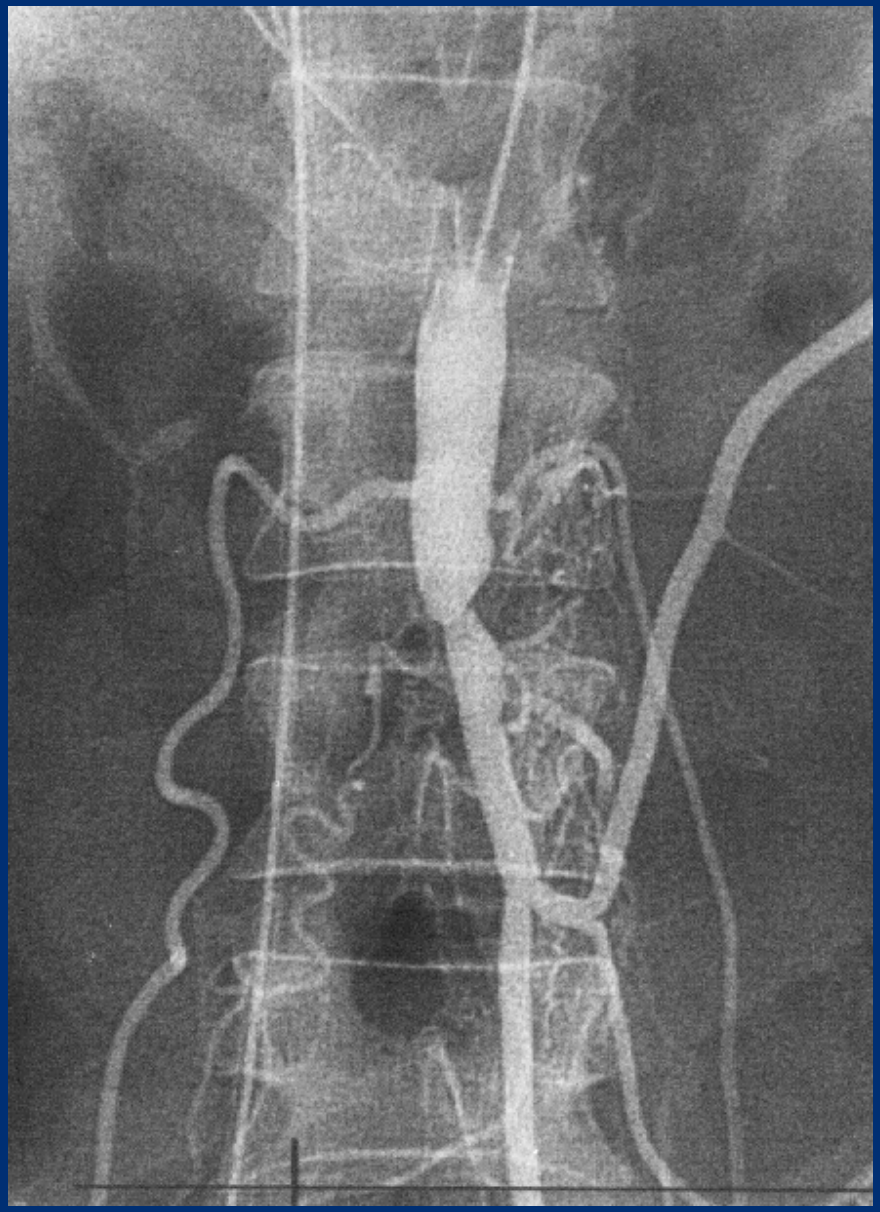


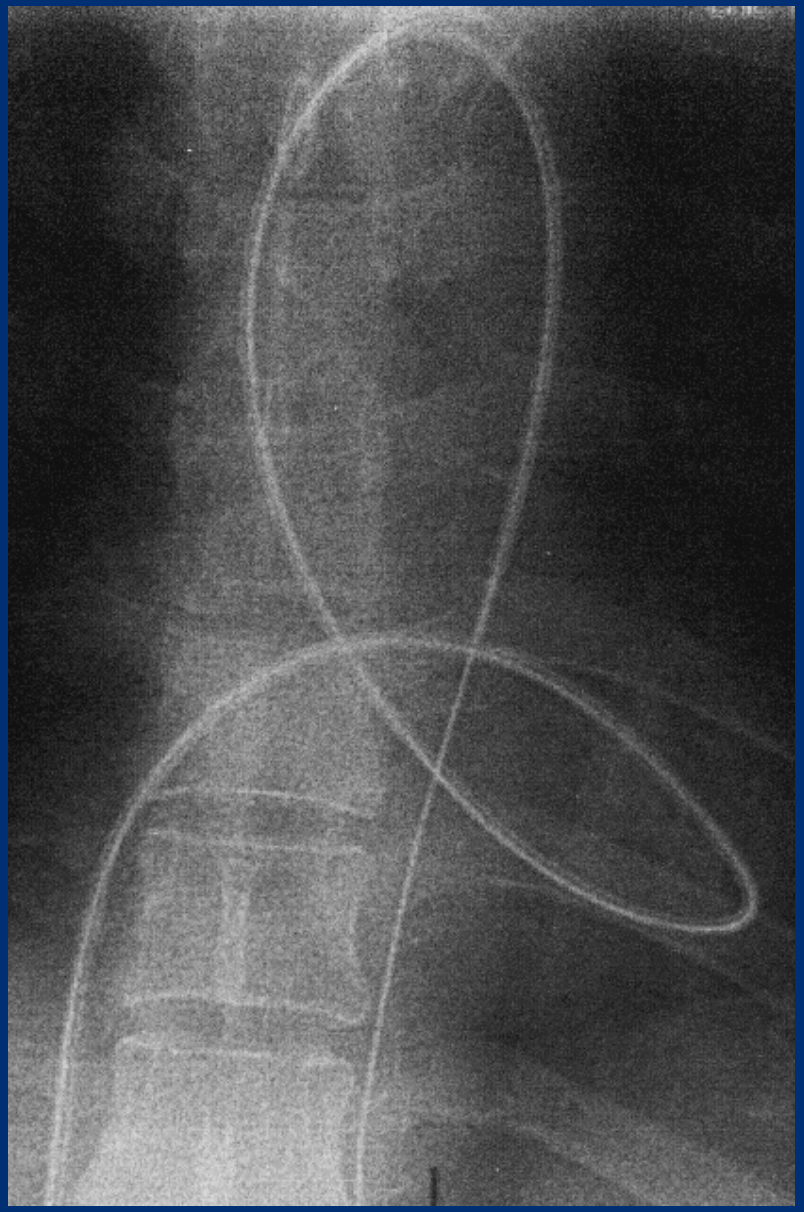




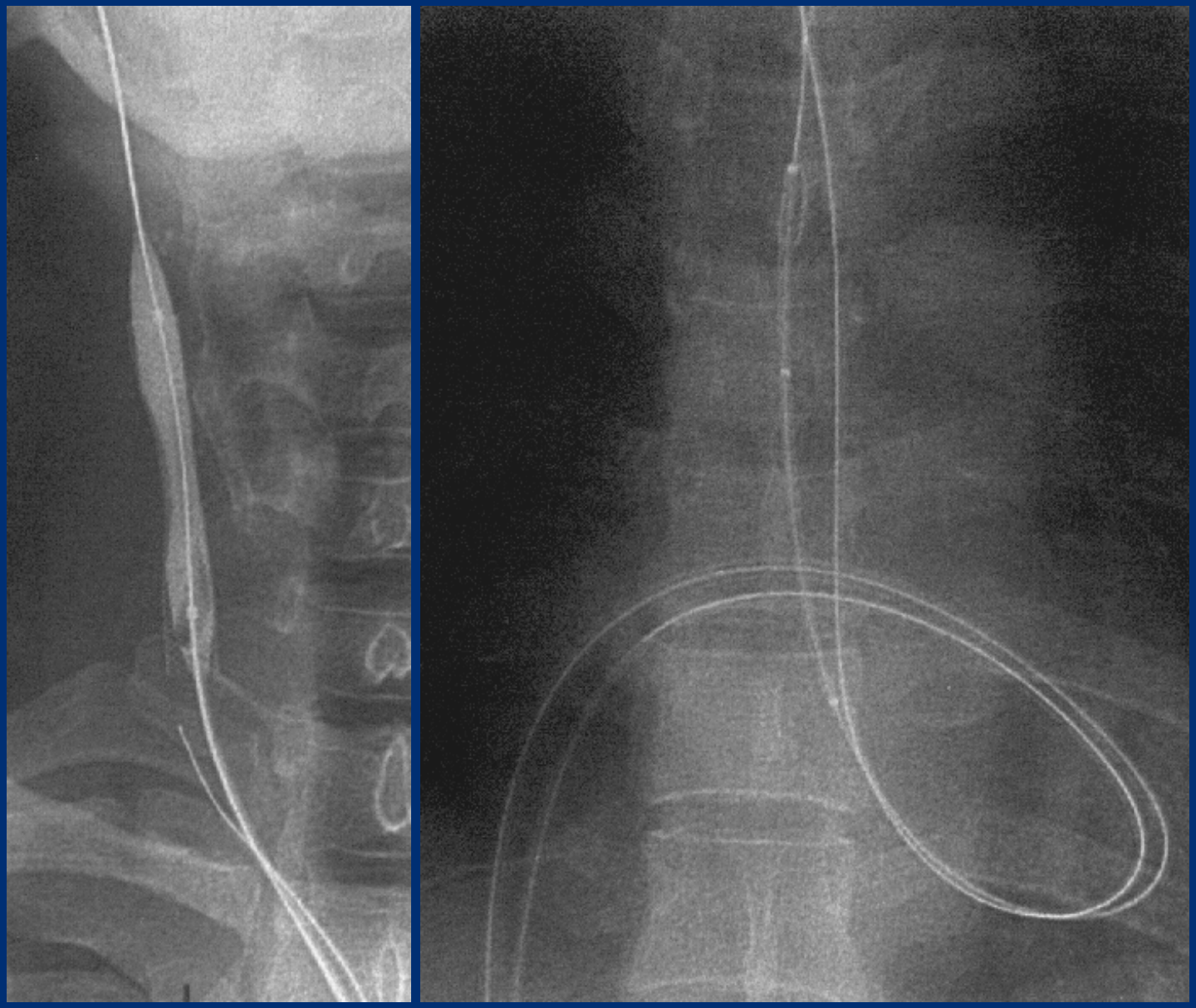

Suture
Bioabsorbable
Anchor
Collagen


ANGIO-SEAL





1996



1996

1996

Transseptal Approach to Aortography and Carotid Artery Stenting in Pulseless Disease

George Joseph,[1*] MD, DM, S. Krishnaswami,[1] MD, DM, Dibya K. Baruah,[1] MD, DM, Sajy V. Kuruttukulam,[1] MD, DM, and O.C. Abraham,[2] MD

We report on a patient with pulseless disease (Takayasu's arteritis) in whom access to the central circulation by extremity arterial cannulation was not possible due to absent pulses in all four limbs. The transseptal approach was used for aortography, bilateral selective carotid angiography, and successful elective stent deployment in the right common carotid artery. *Cathet. Cardiovasc. Diagn. 40:416–420, 1997.*

Key words: angiography; carotid stenosis; angioplasty

Editorial Comment

Transseptal Approach to Aortography and Carotid Artery Stenting in Pulseless Disease

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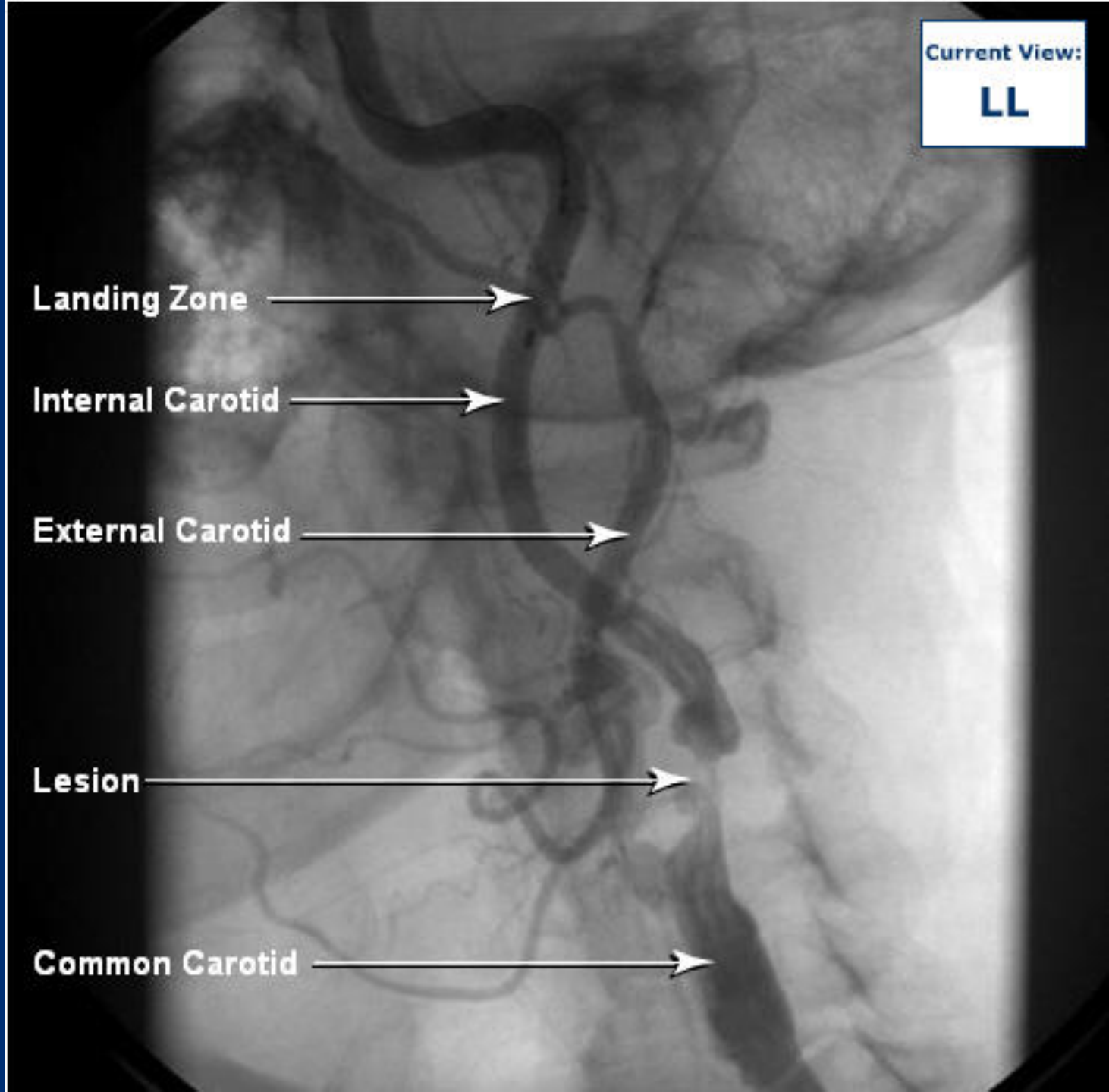
Division of Cardiology
Washington Hospital Center
Washington, D.C.

Carotid Stent Technique

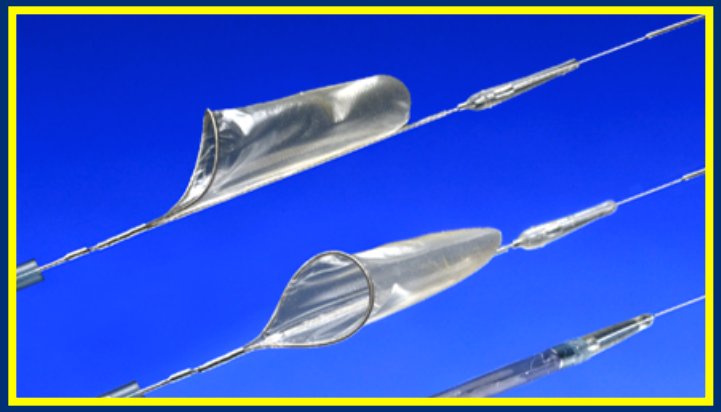
Working View



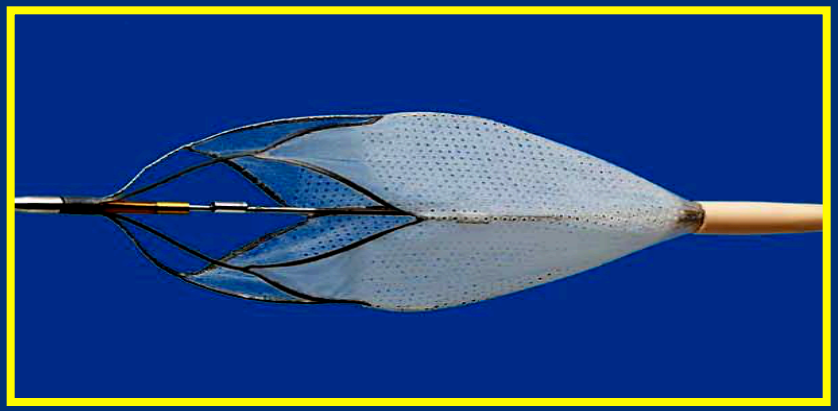
Filters

AngioGuard XP
100μ pore size

Filter Wire EX
80-110μ pore size



ACCUNET
≤150 μ pore size



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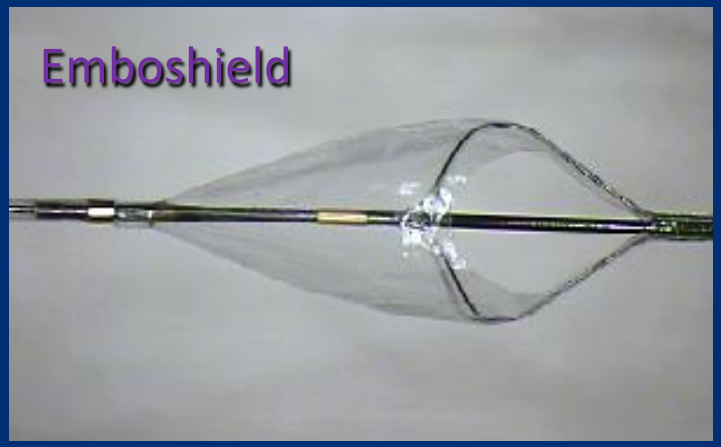
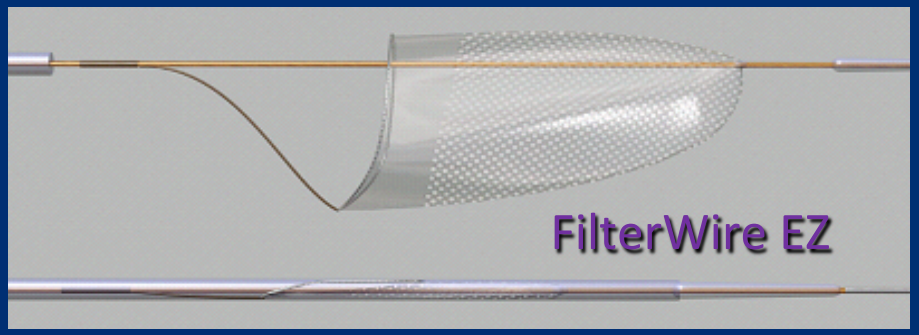
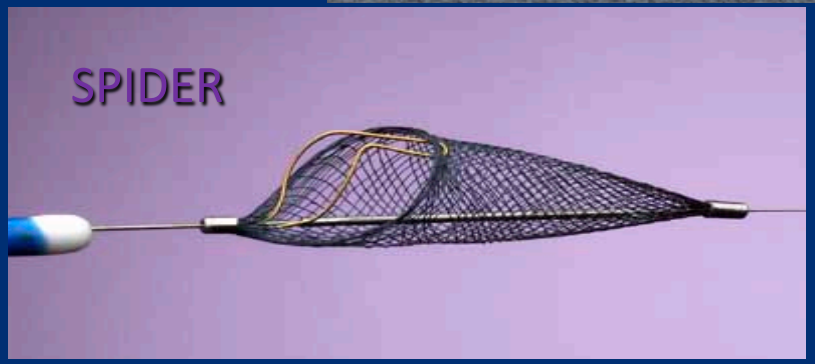
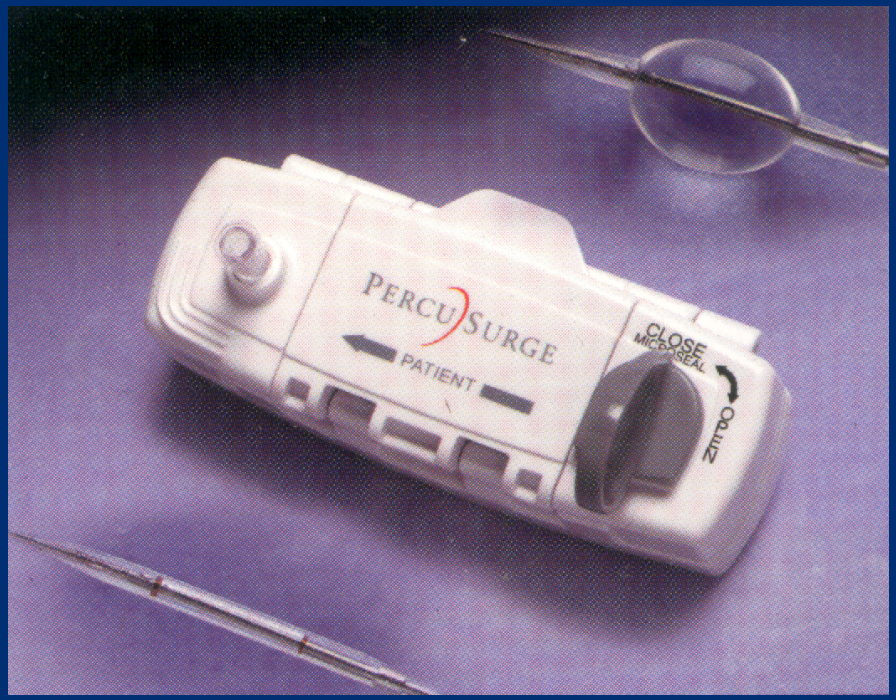
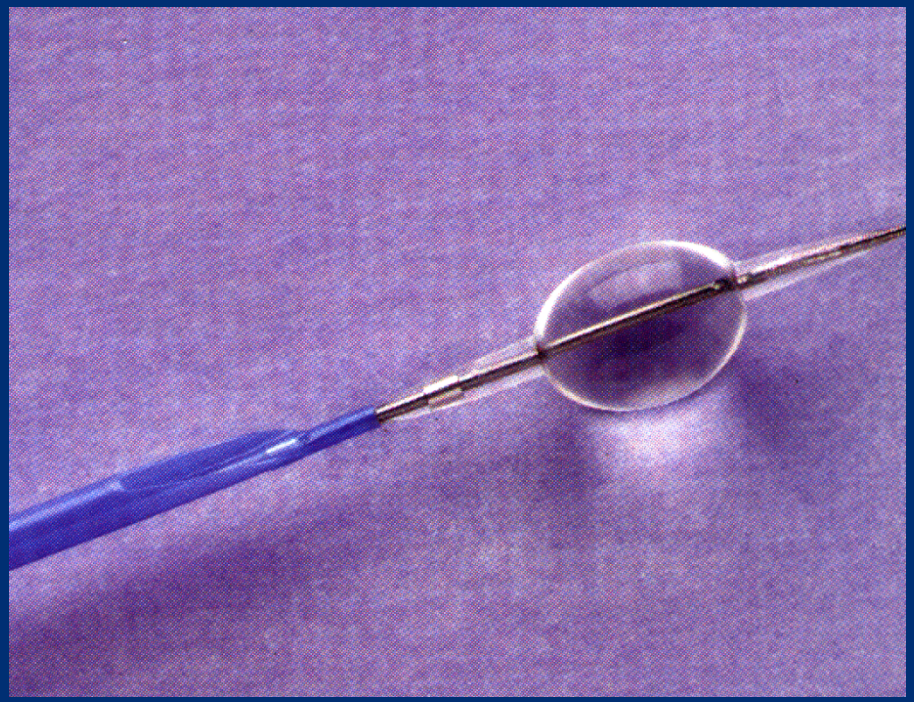


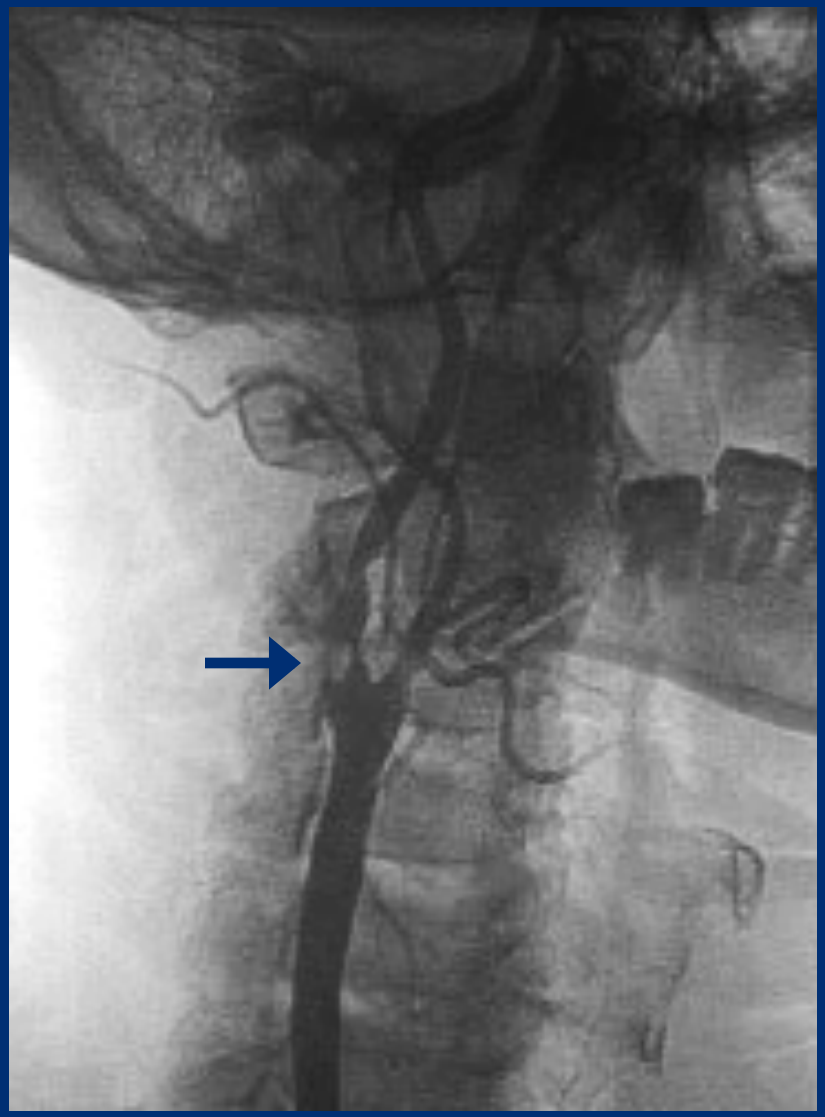


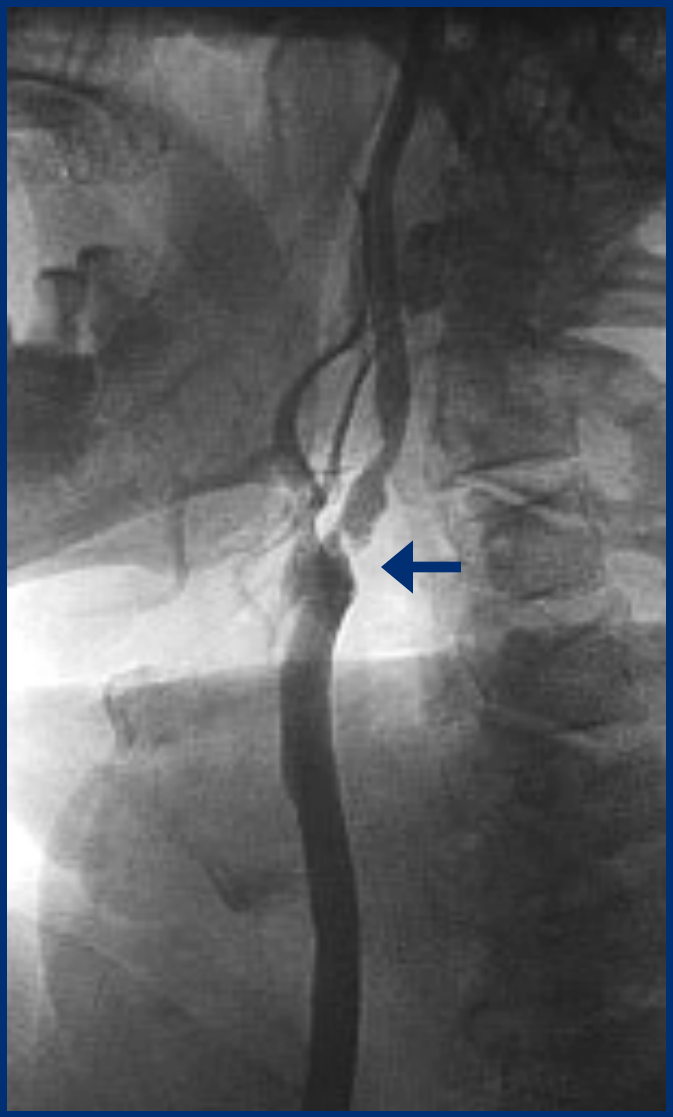


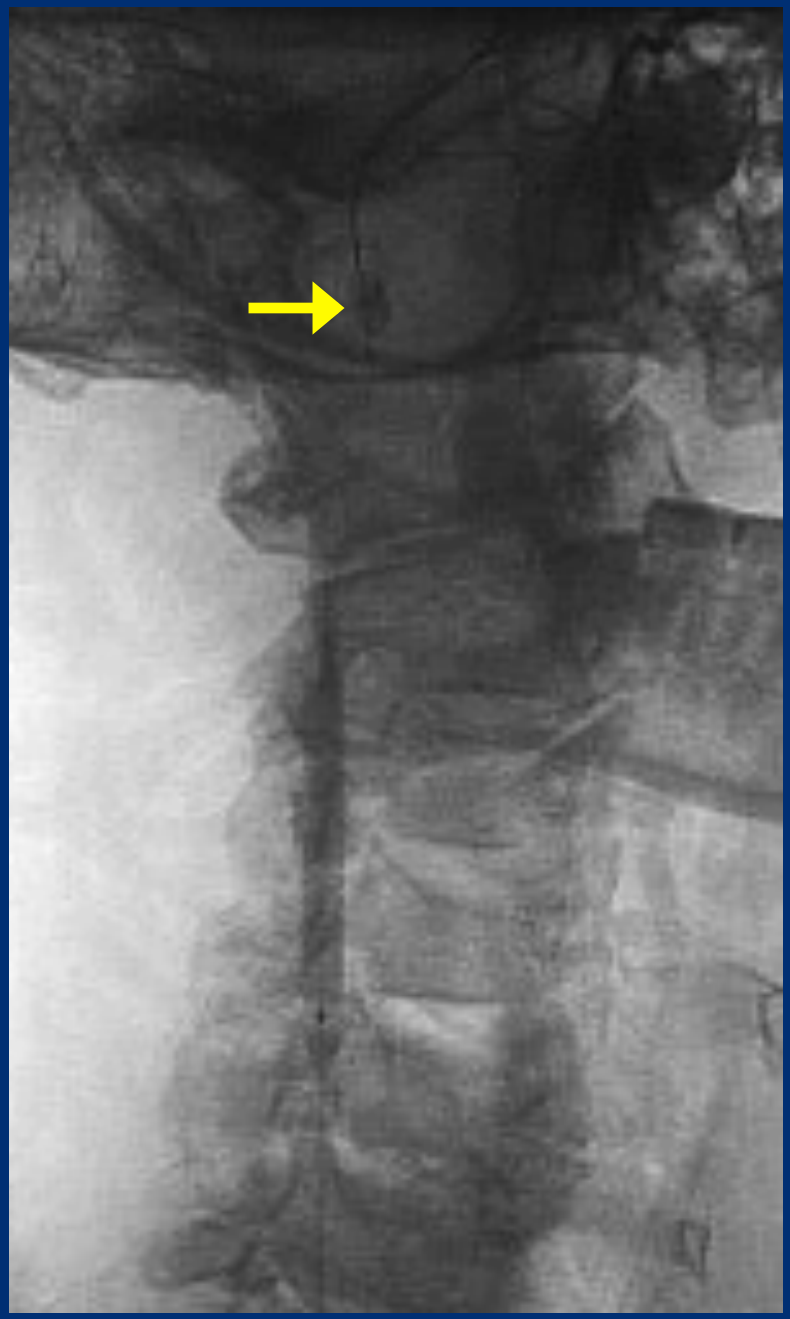
Percusurge Cerebral Protection System

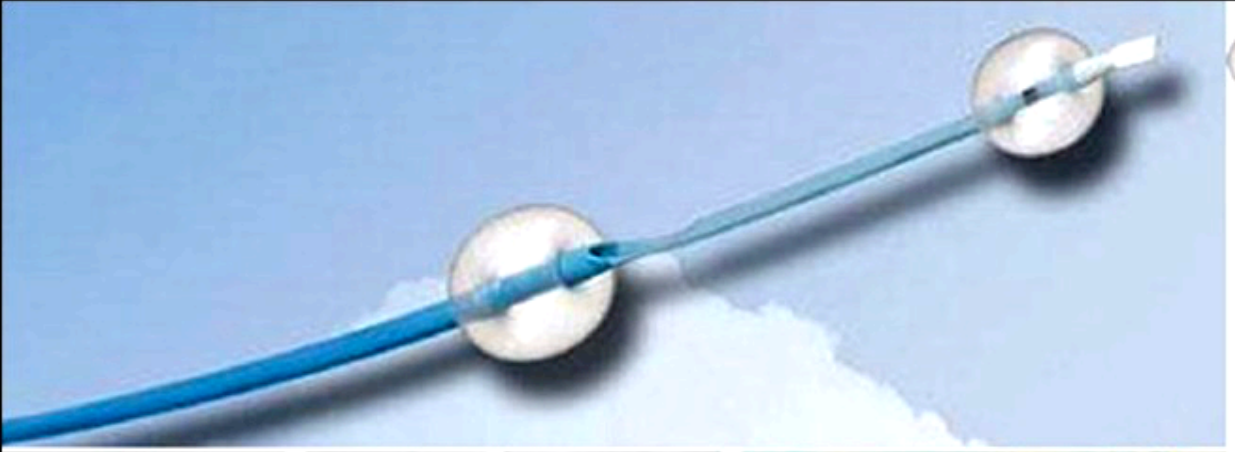


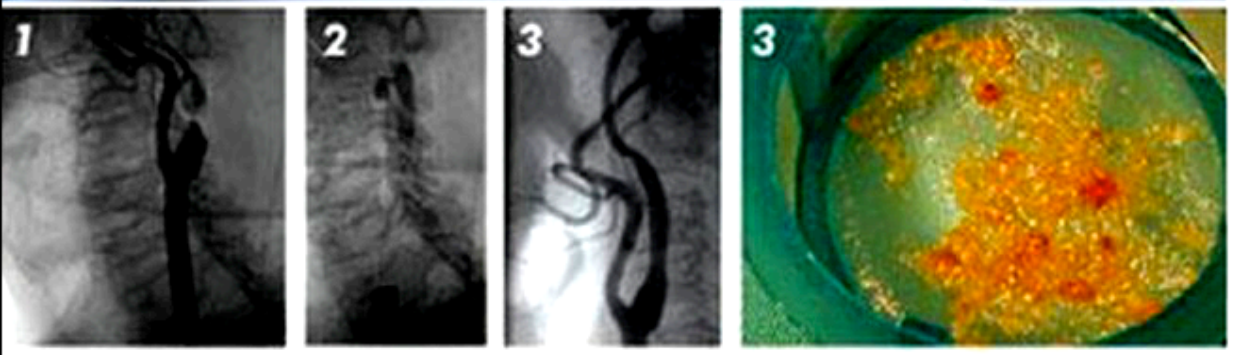




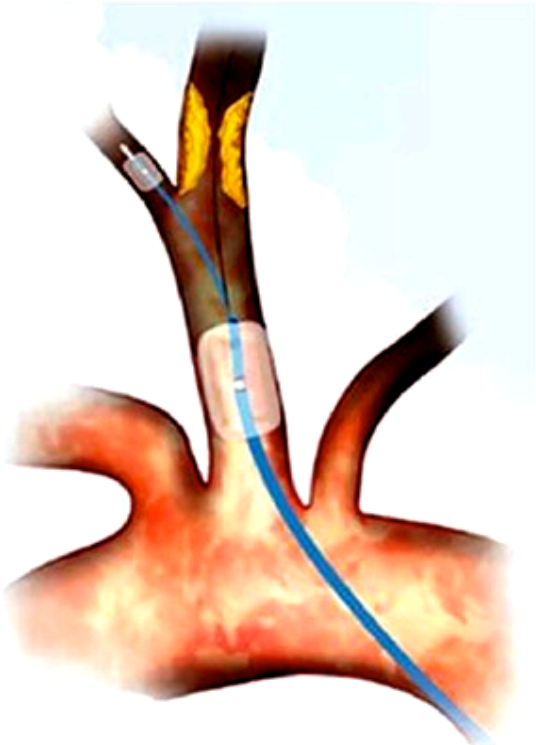








1. Protect & Control | 2. Treat | 3. Capture all sizes of debris



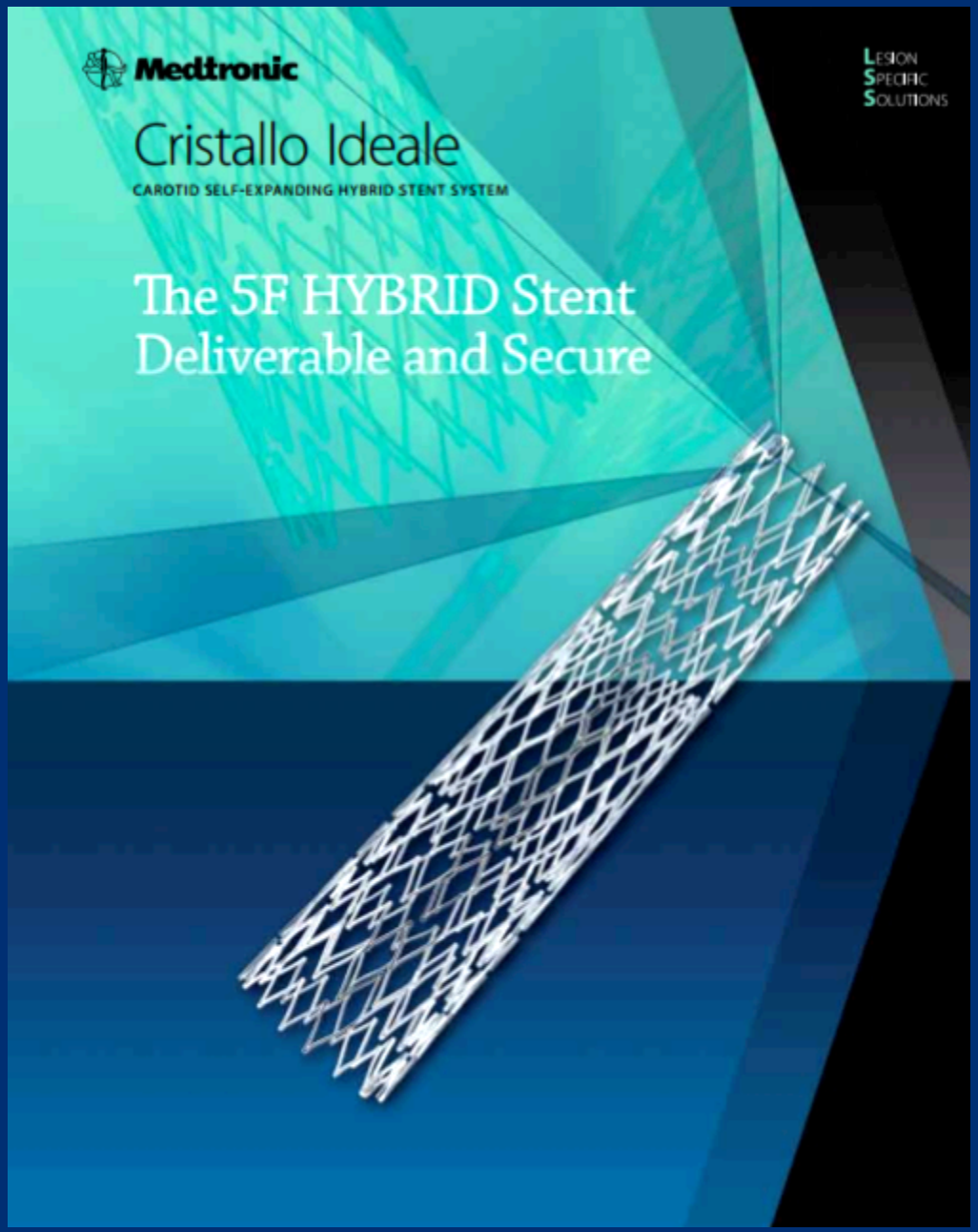
Mo.Ma Ultra

PROXIMAL CEREBRAL PROTECTION DEVICE

Medtronic

Carotid stent systems

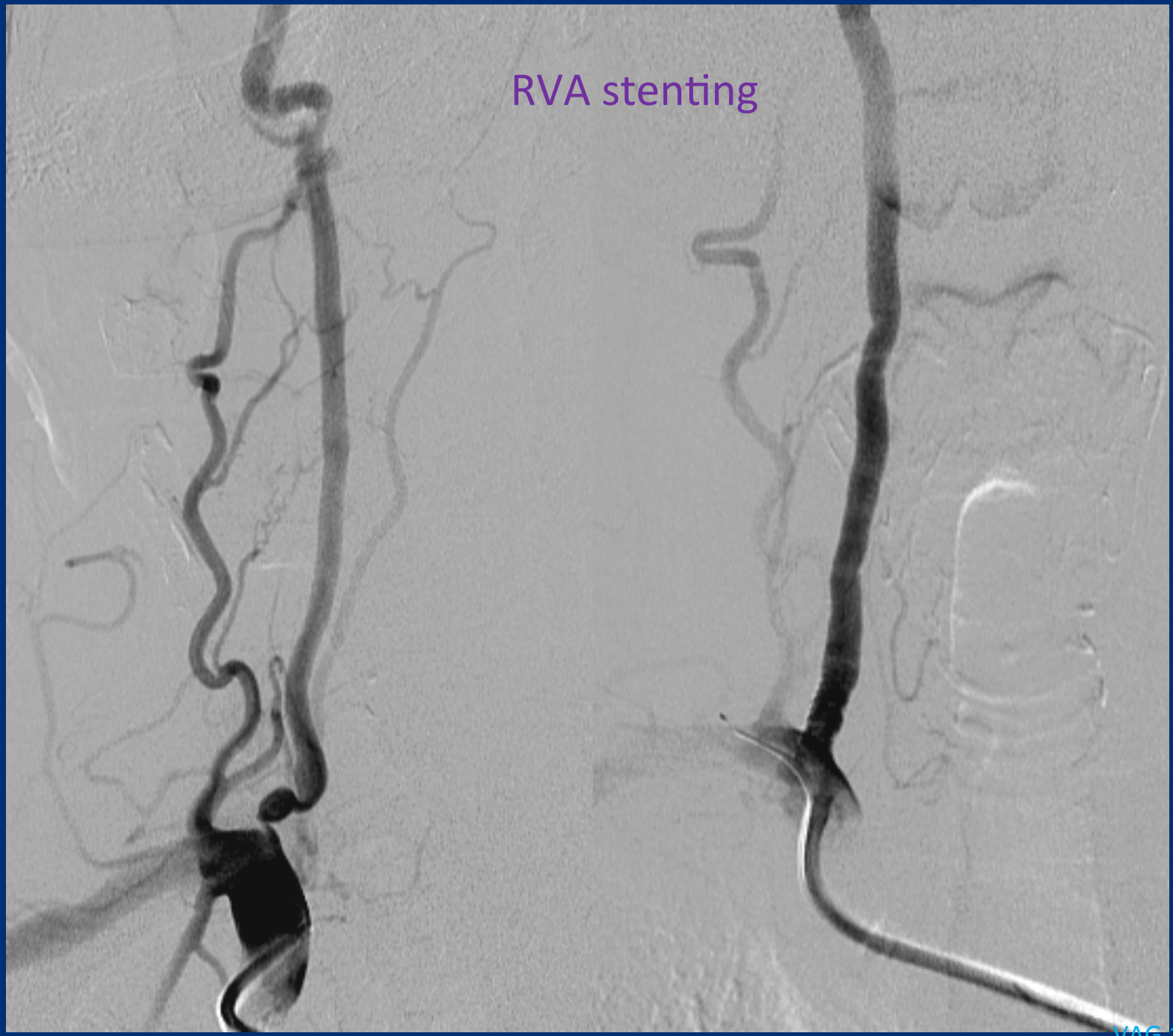
Stent	Manufacturer	Cell type	Free cell area (mm2)
Acculink	Abbott	Open	11.48
Carotid Wallstent	Boston Scientific	Closed	1.08
Cristallo Ideale	Invatec	Hybrid	15.17-3.24-11.78
Exponent	Medtronic	Open	6.51
Precise	Cordis	Open	5.89
Protege	ev3	Open	10.71
NexStent	Boston Scientific	Closed	4.07
Vivexx	Bard	Open	10.44
X-act	Abbott	Closed	2.74



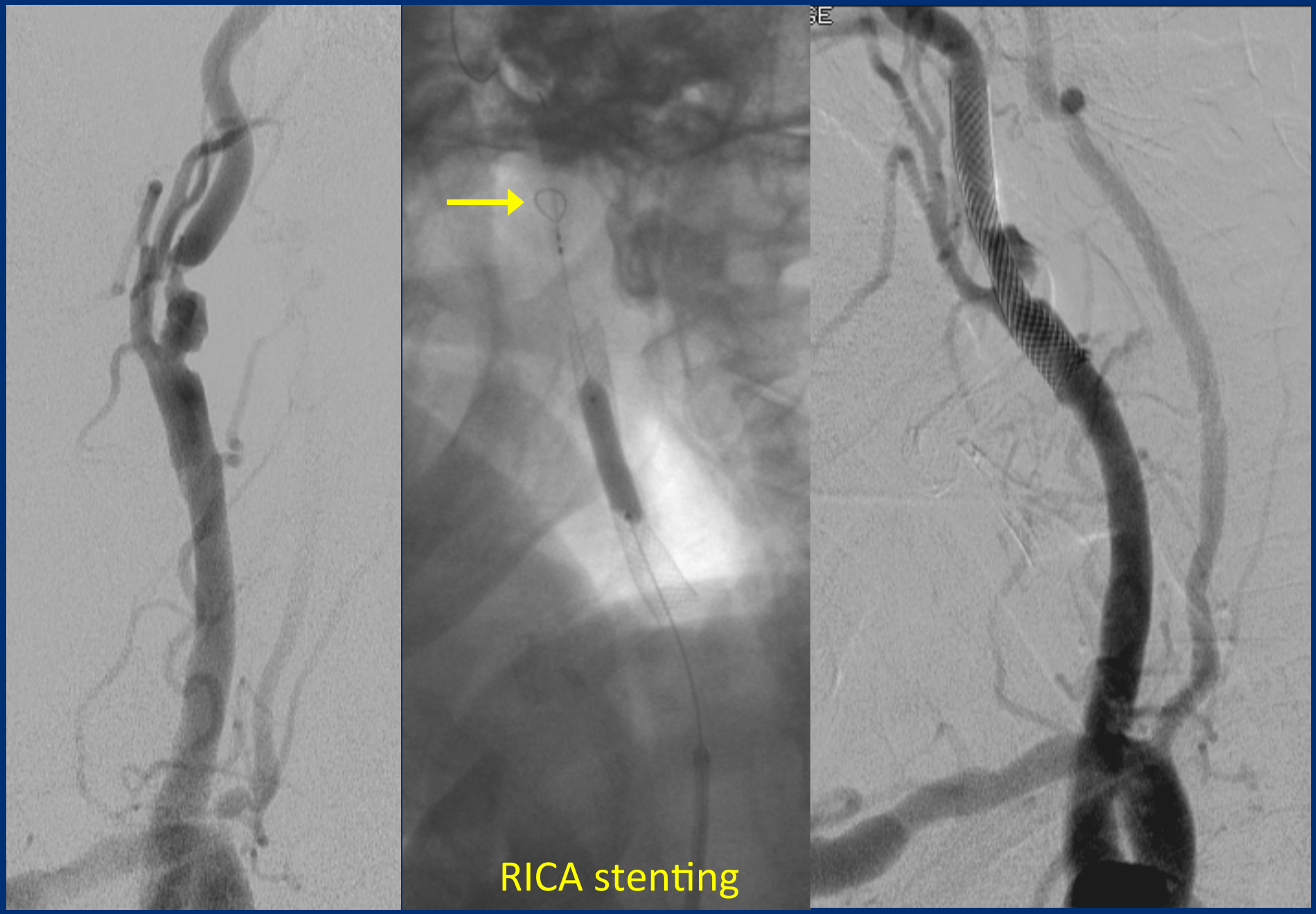
Boston Scientific

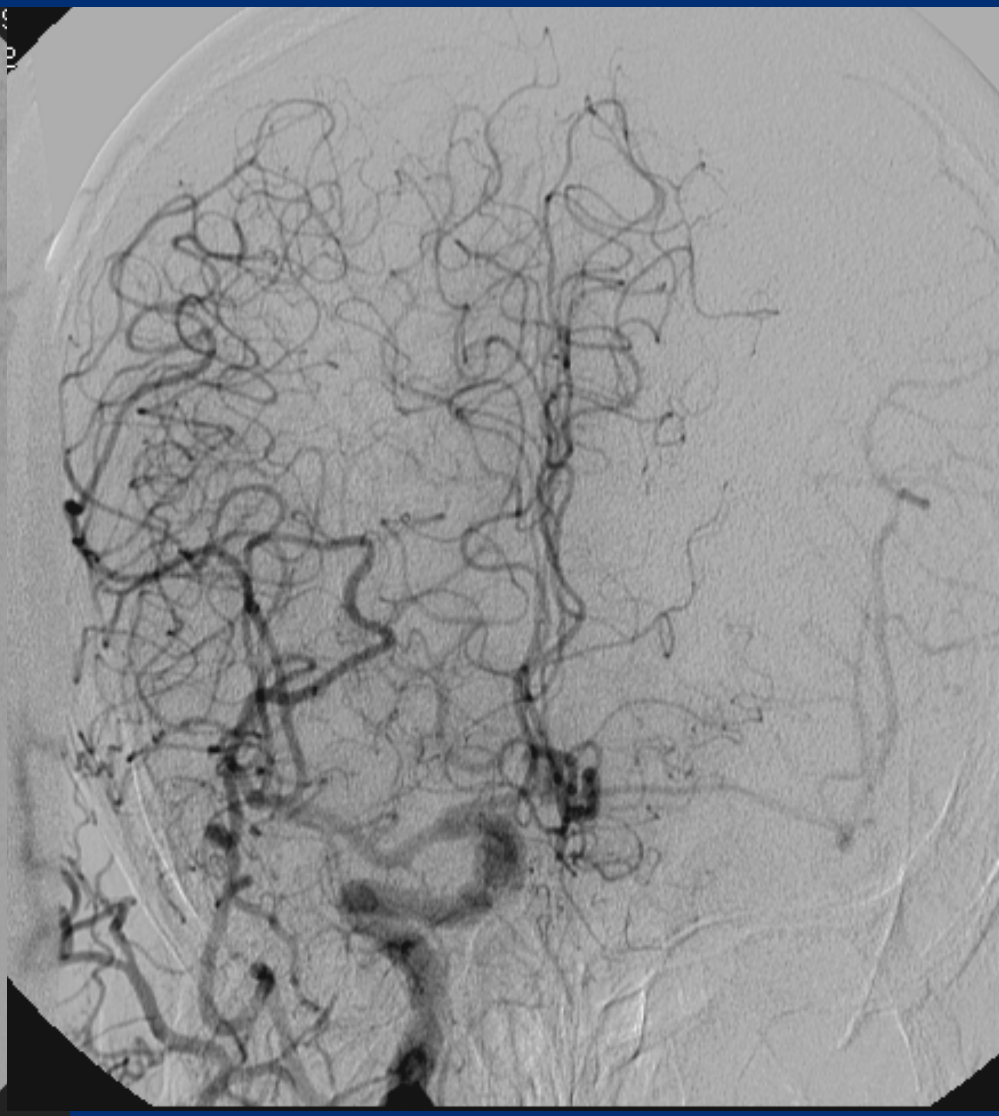
Carotid Wallstent

VAG 175016B


RVA stenting
VAG 175016B

VAG 175016B


RICA stenting



VAG 175016B

Tips on carotid stent selection

- Challenging aortic arch: use low-profile highly flexible systems - Carotid Wallstent (BSC), Crystallo Ideale (Invatec).
- Soft, long, inhomogenous lesions prone to embolization: Cobalt alloy braided mesh (Carotid Wallstent), and closed-cell stents - Crystallo ideale and X-act (Abbot)

Tips on carotid stent selection

- Tortuous vessel with severely angled carotid take-off: Use conformable nitinol open-cell stents – Precise stent (Cordis)
- Focal, concentric lesions, esp. if resistant or calcified – use nitinol closed-cell stent – X-act (Abbot)
- Marked mismatch between ICA and CCA diameter: Use a shouldered tapered stent – Protégé (ev3)

Tips on carotid stent selection

- Multiple problems: the hybrid nitinol stent (Crystallo Ideale –Invatec). Open cells in the proximal and distal segments enhance flexibility and adaptability; closed cells in the middle segment provides high plaque prolapse prevention.

Carotid Stent Technique

- Post dilate to achieve adequate lumen (5 mm balloon)
- Assess final result and distal flow
- Remove EPD if satisfactory flow
- If slow flow, determine cause:
  - spasm, dissection, full filter
- Aspiration with Export catheter before removal if filter full

Carotid Stent Technique

Final Angiography

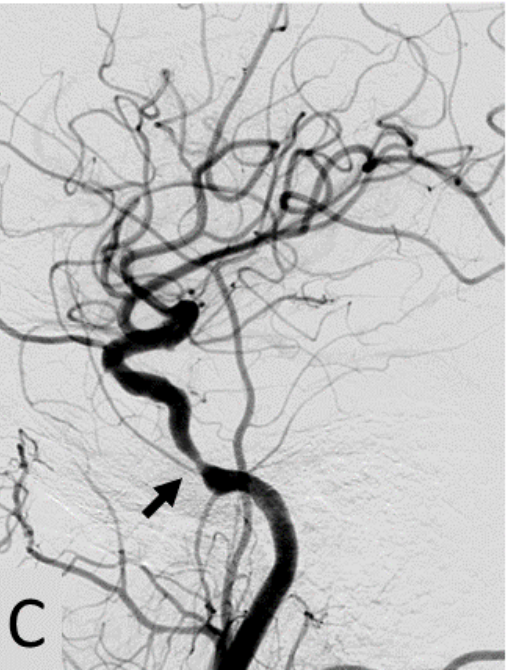
- Carotid Angiography:
  - evaluate target lesion status
  - stent expansion
  - distal runoff
  - evidence of spasm or dissection
- PA and lateral intracranial views
  - exclude evidence of embolization

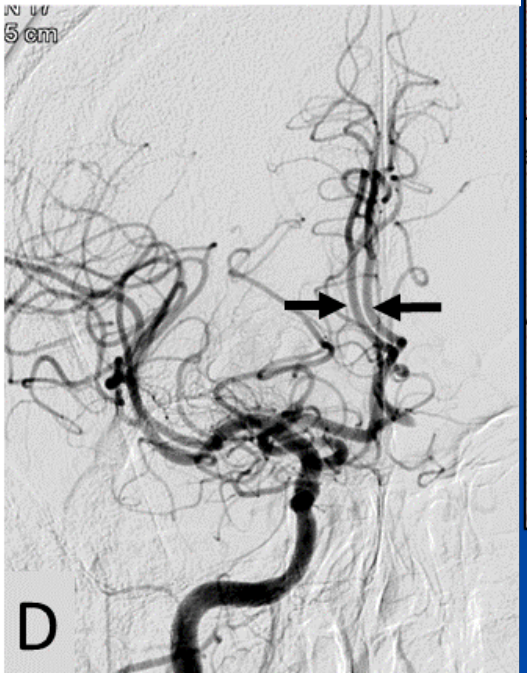
Special Precautions

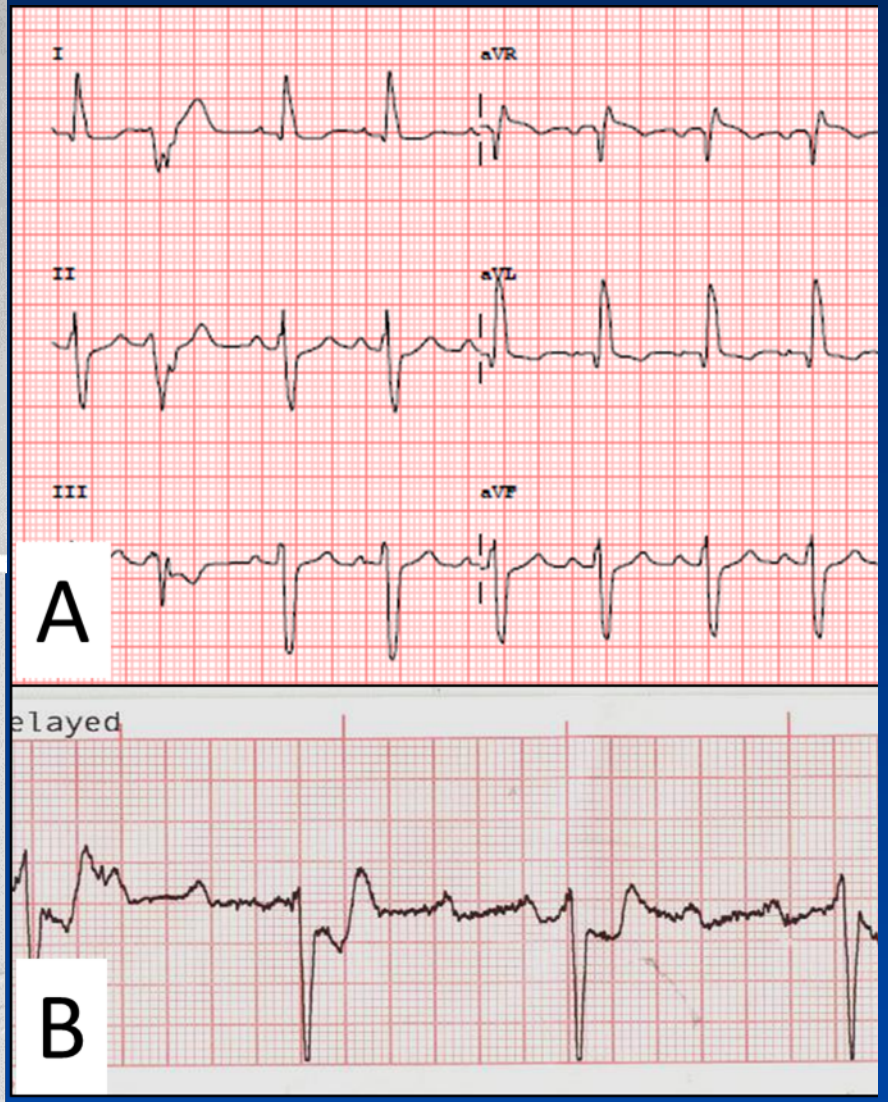
- Hemodynamic depression
  - LV dysfunction
  - Atropine
  - Pacing
  - Pressors
- Cerebral hyperperfusion
- Cerbral embolization
  - Adequate heparinization
  - MOMA device


A


B


C


5 cm
D


I
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INDIAN HEART JOURNAL 66 (2014) 696–699

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Case Report

Fatal delayed hemodynamic depression after carotid artery stenting

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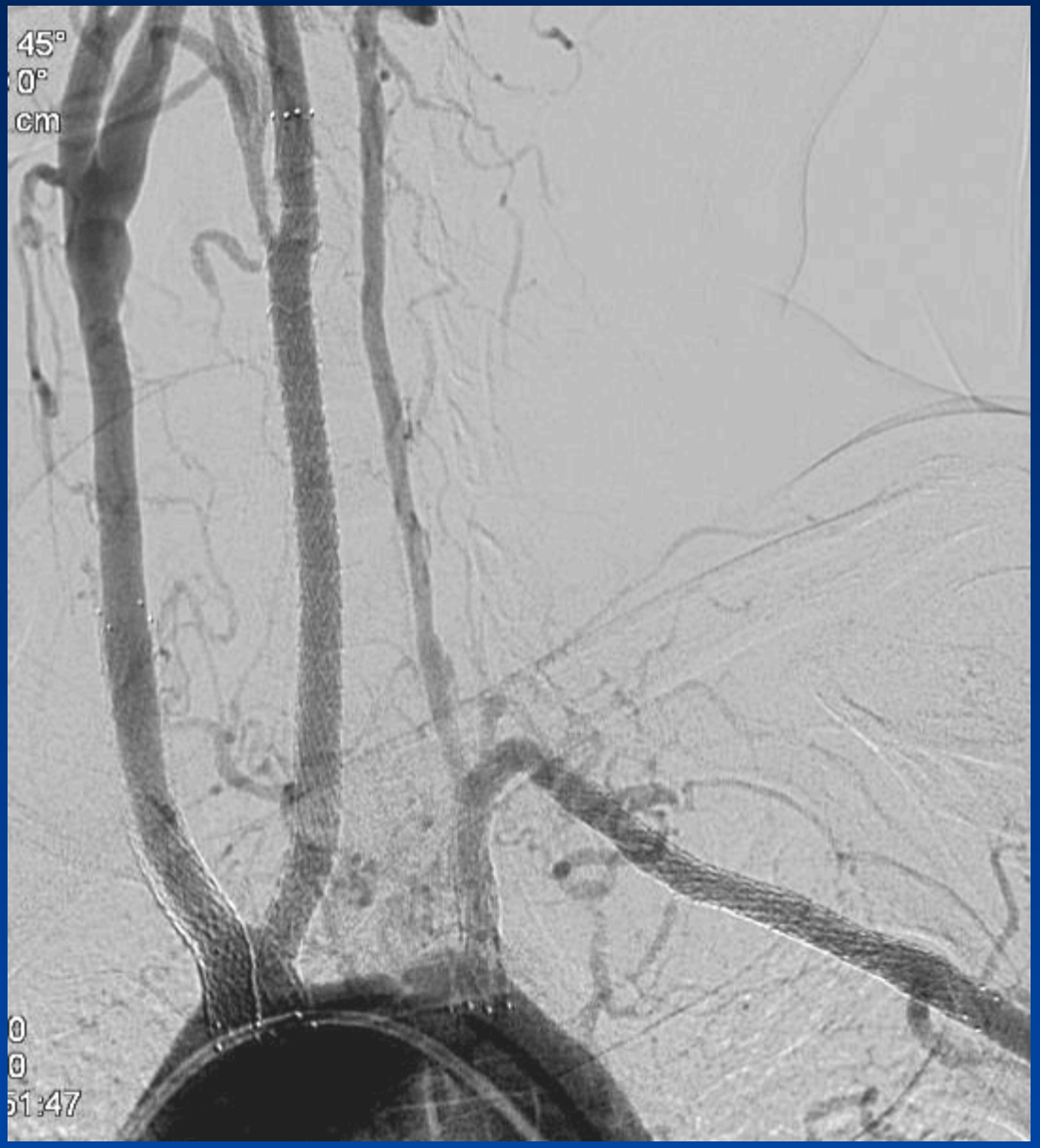
ARTICLE INFO

Article history:
Received 2 June 2014
Accepted 9 October 2014
Available online 29 October 2014

Keywords:

ABSTRACT

Refractory and fatal hemodynamic depression remarkably occurred eight hours after left carotid artery stenting in a 62-year-old male who had no hemodynamic instability till then; possible contributory factors were pre-existing moderate left ventricular systolic dysfunction and new-onset complete heart block caused by vasopressor-induced sympathetic stimulation in the presence of covert distal conduction system disease.



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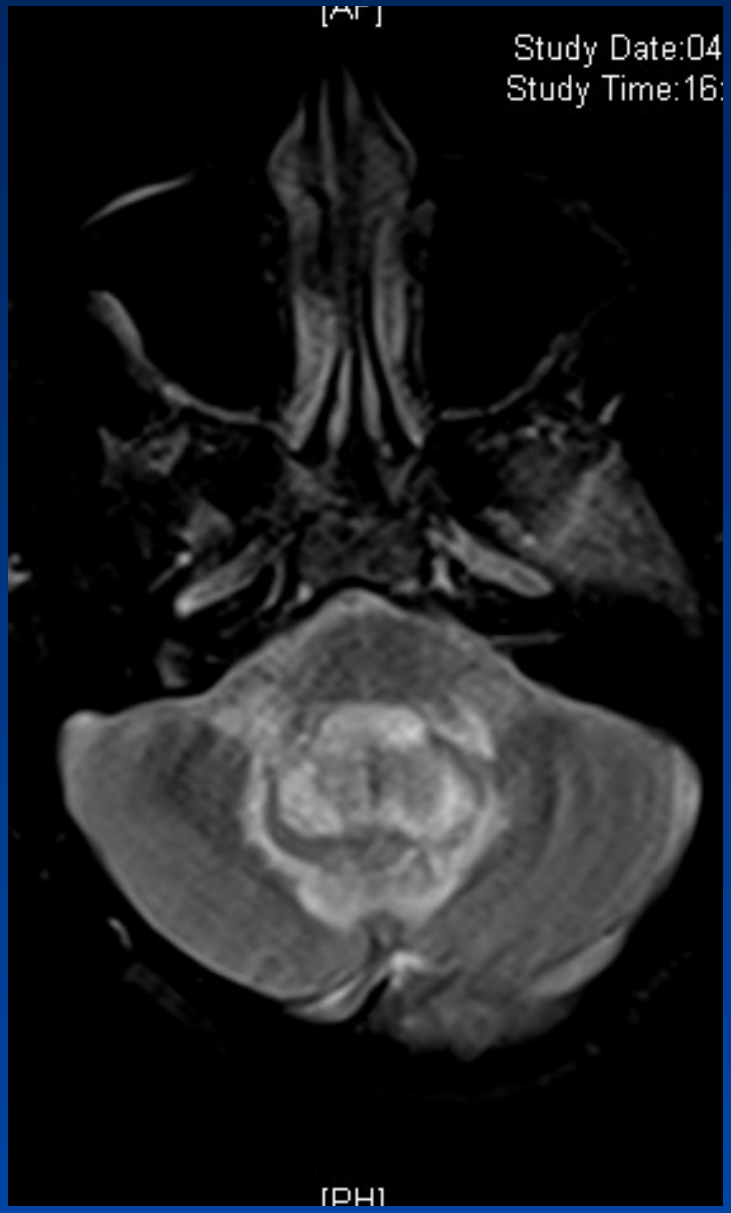

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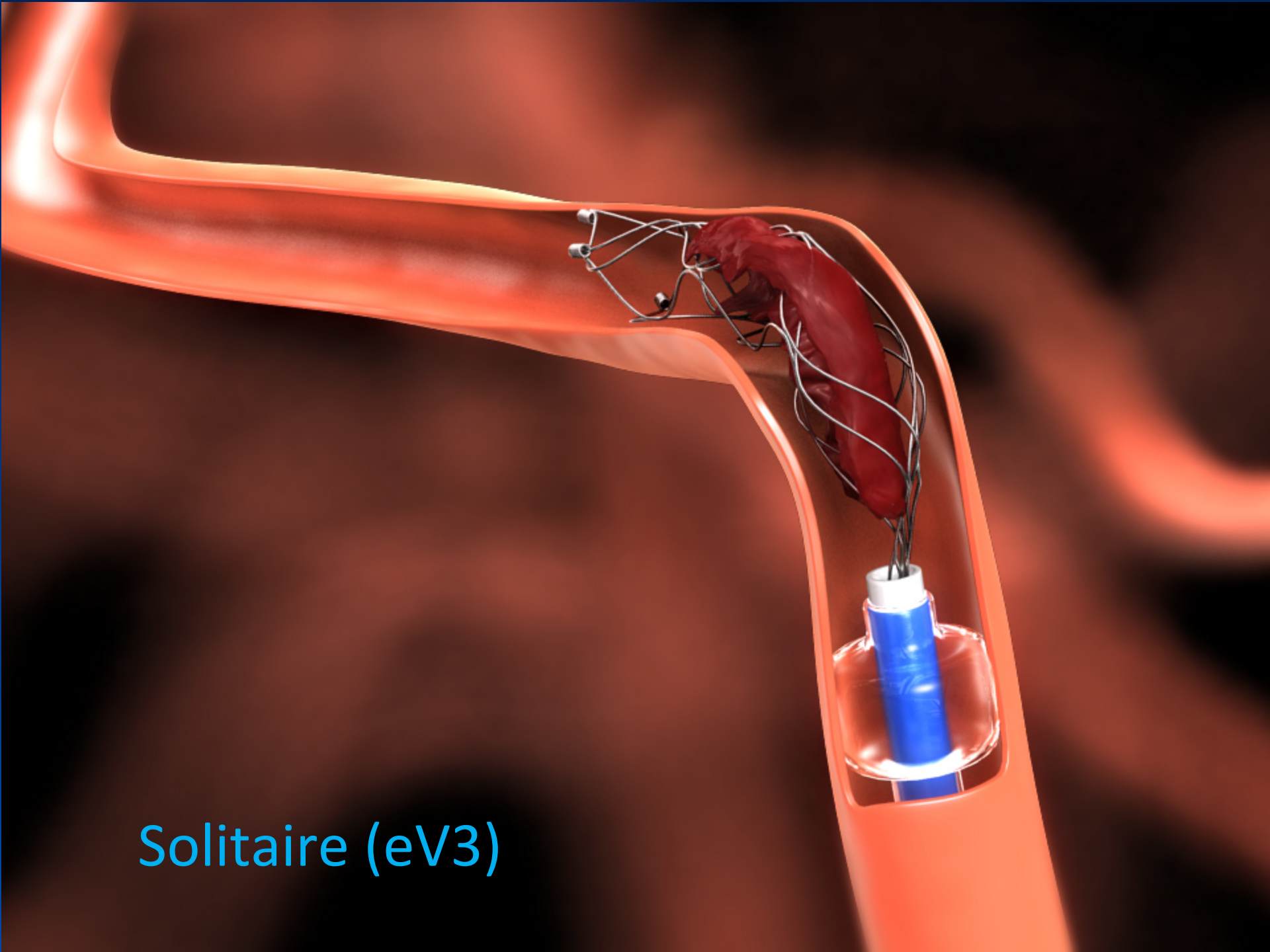
Solitaire (eV3)

Thank you for your attention