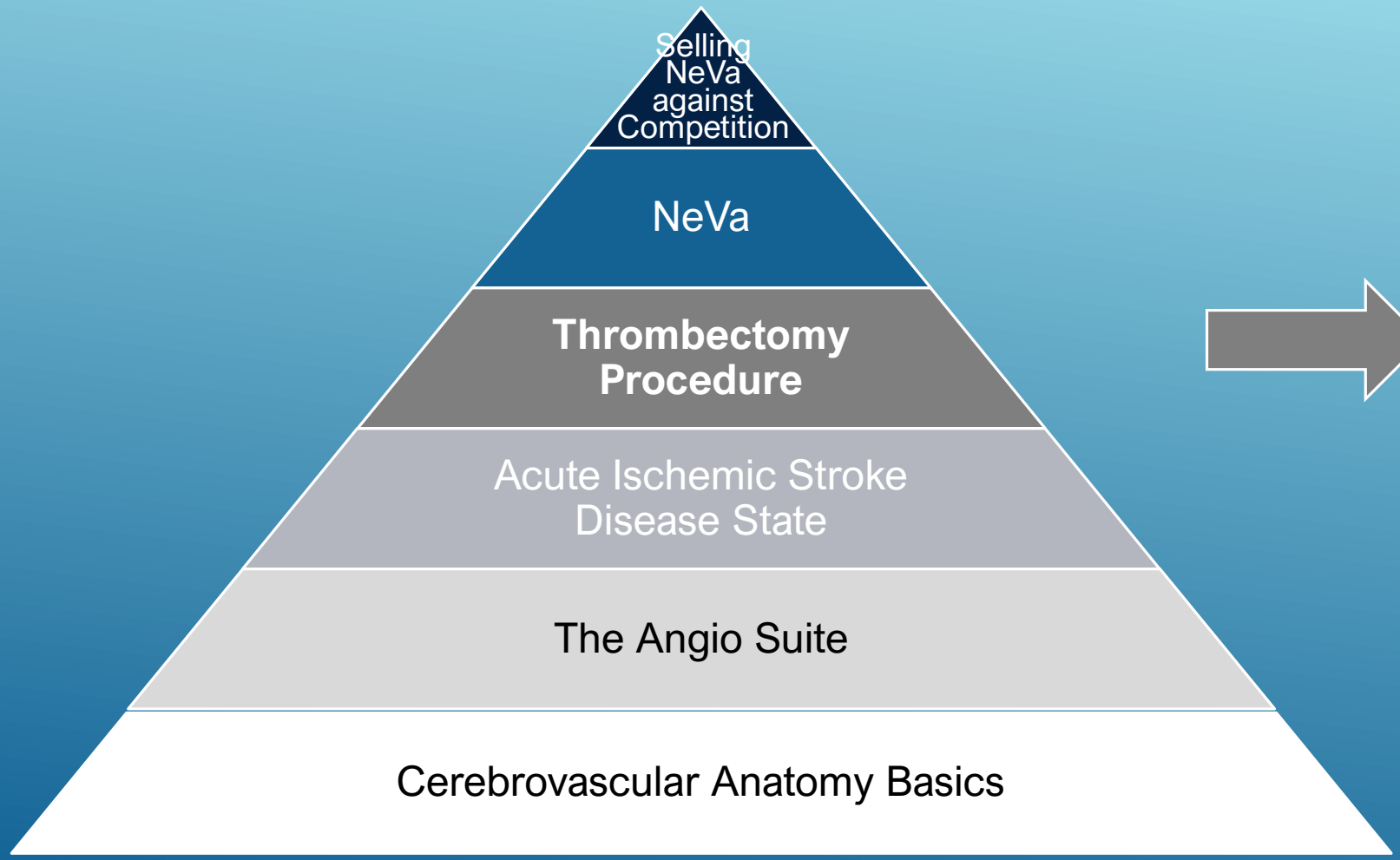
THE VESALIO DISTRIBUTOR TRAINING PROGRAM

Designed to give you confidence & credibility in front of physicians



TODAY

NeVa™

NEXT GENERATION STROKE TREATMENT

Designed for first pass success

MODULE 4: THROMBECTOMY PROCEDURE

THE THROMBECTOMY PROCEDURE

4.1. Stroke Access

- Procedure steps- access
- Access challenges presented by neurovascular anatomy
- Access products
- Access set ups & implications

4.2. The thrombectomy procedure

- Procedure steps
- Clot integration & retrieval techniques
- Cases

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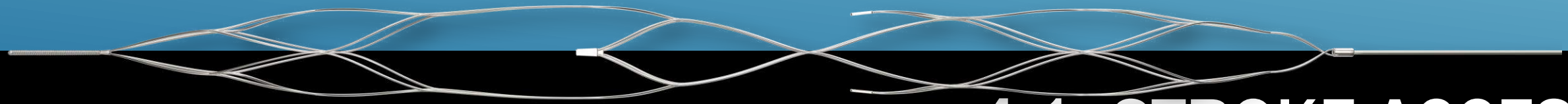


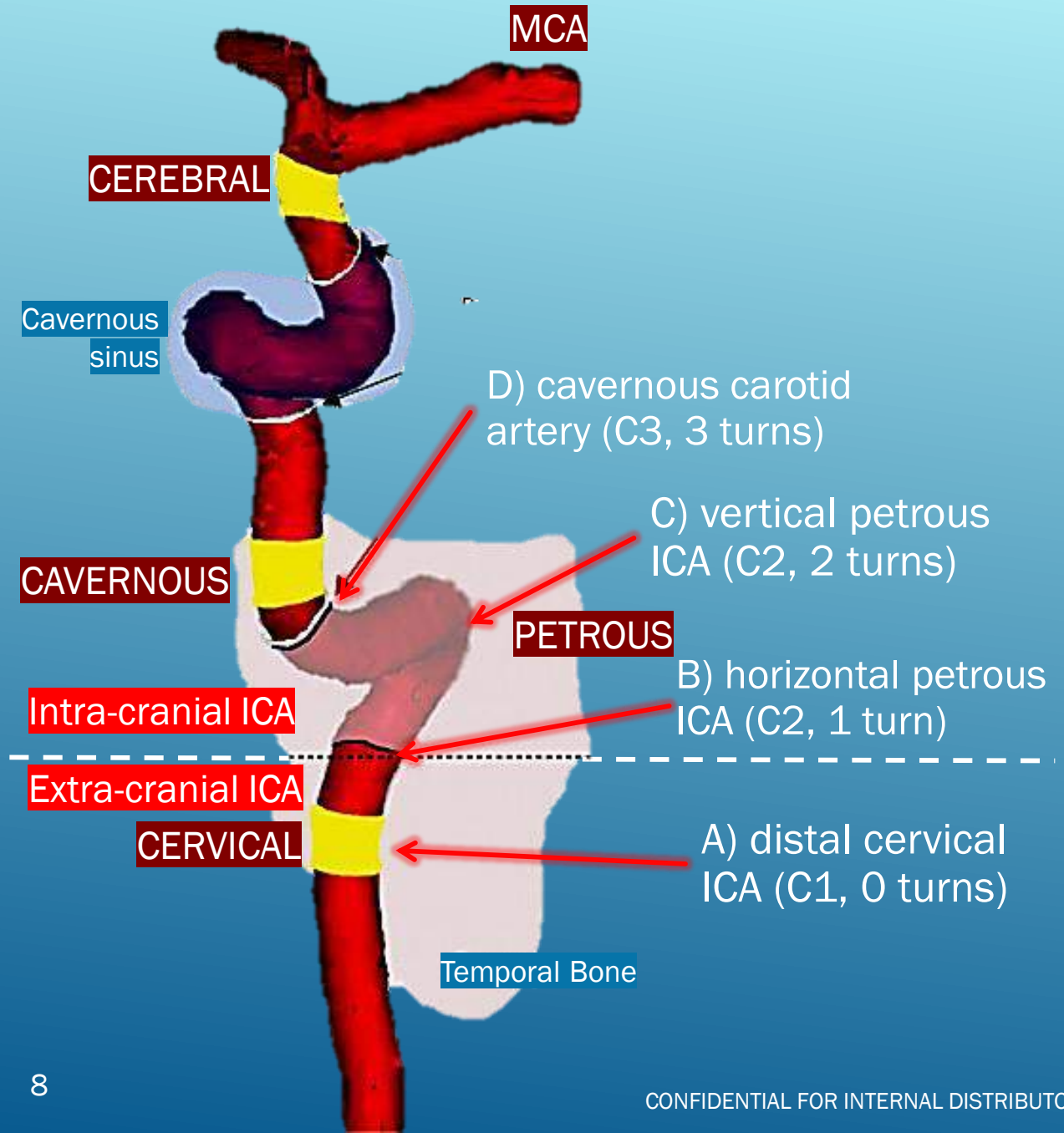
4.1. STROKE ACCESS

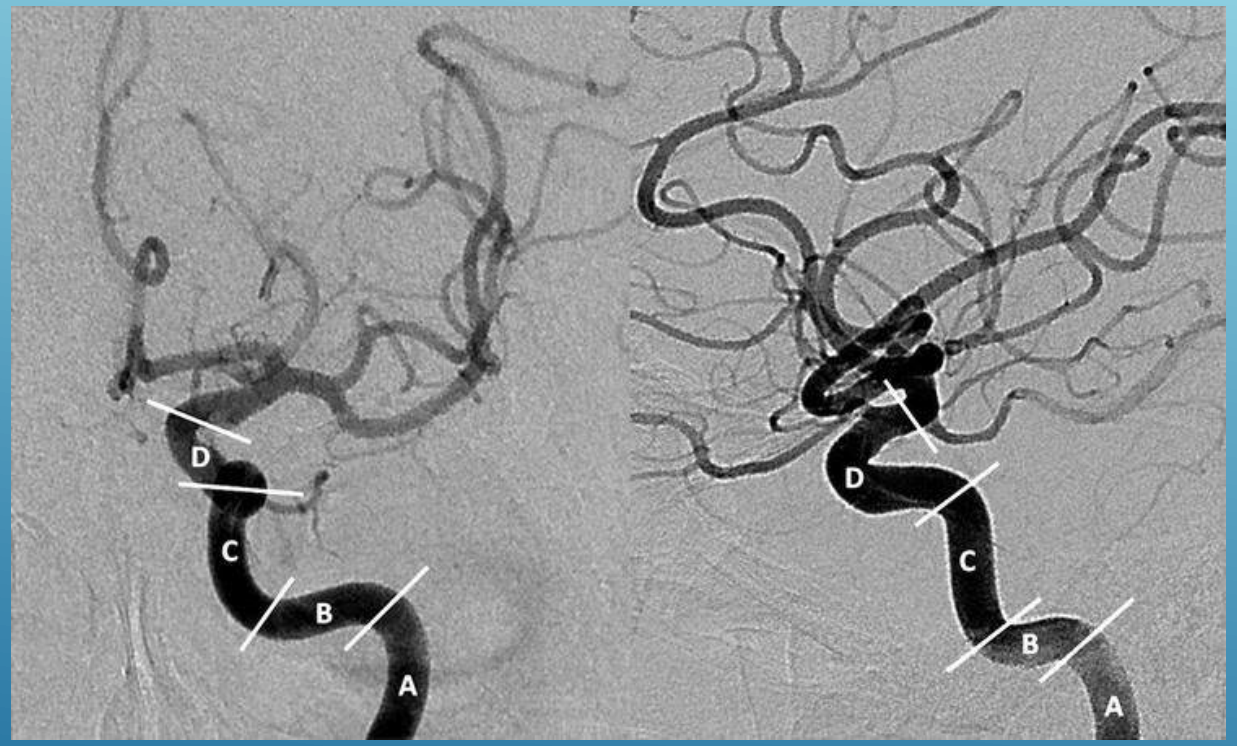
PROCEDURE STEPS

ACCESS CHALLENGES PRESENTED BY NEUROVASCULAR ANATOMY

ANATOMY REVIEW: INTERNAL CAROTID ARTERY

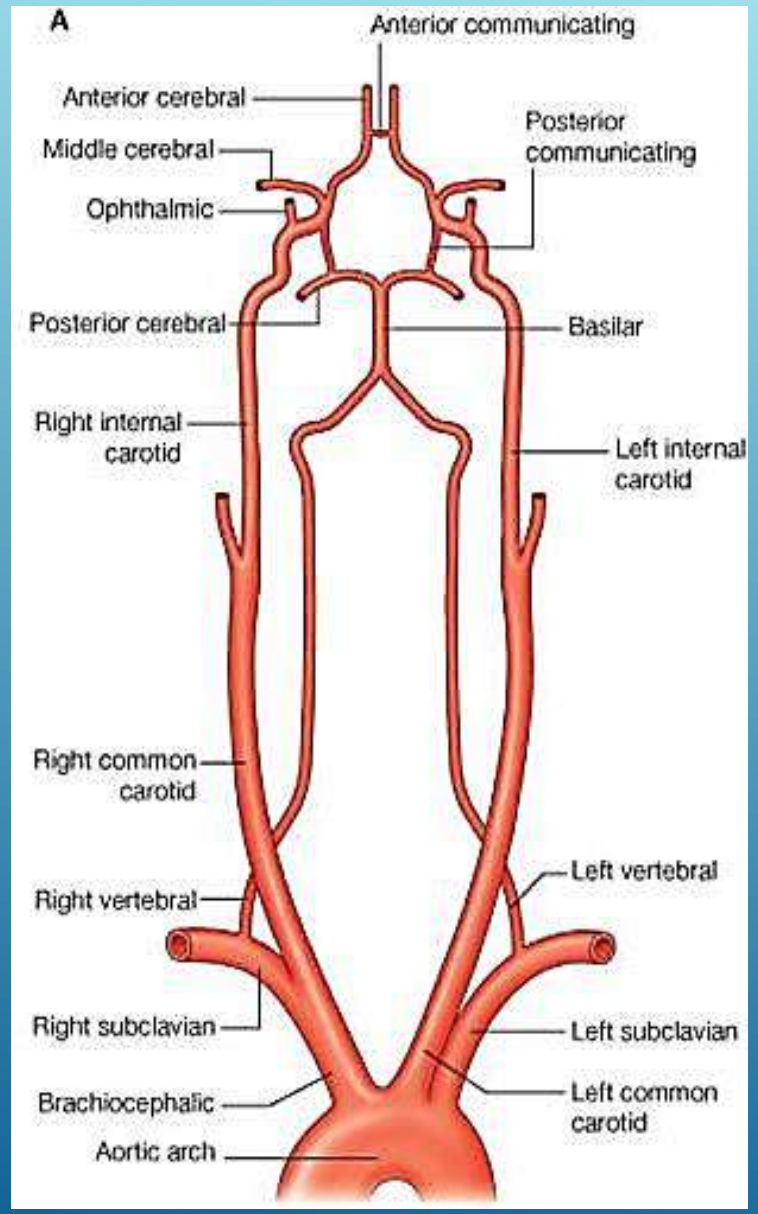
~80% of all neurointerventional procedures are in the anterior anatomy (ICA)

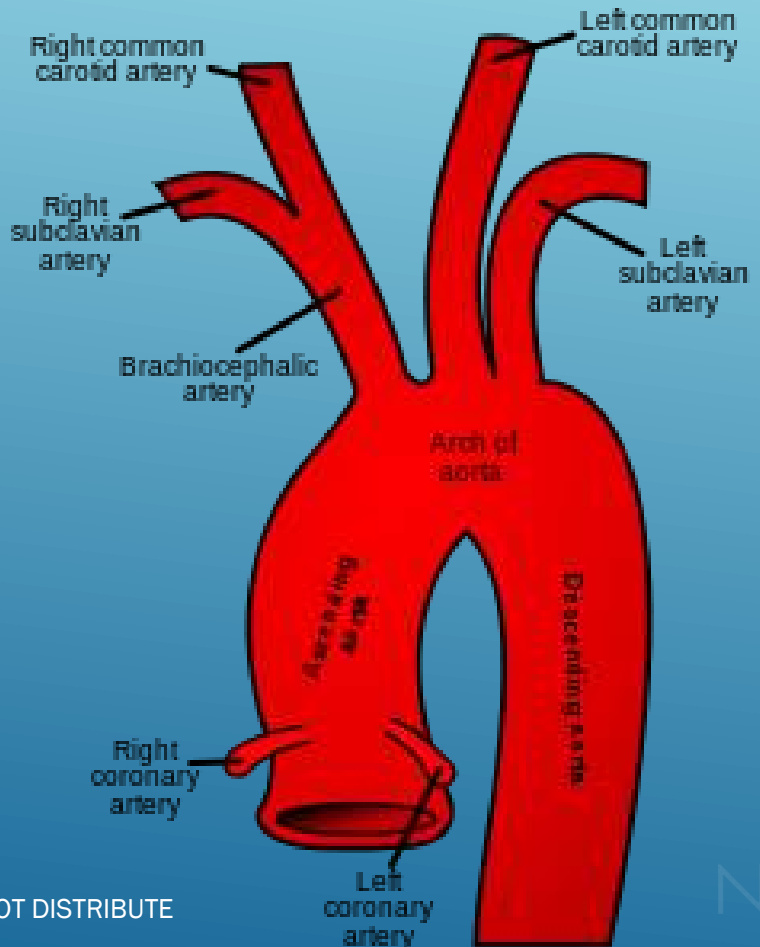




ANATOMY REVIEW: RIGHT VERTEBRAL ARTERY

Posterior circulation is more challenging to access especially in Type 3 (Bovine) arches (10%)



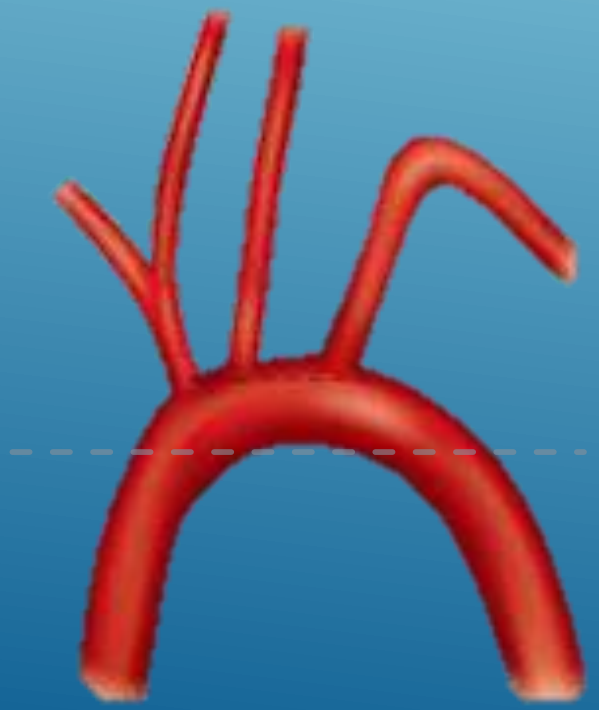


ANATOMY REVIEW AORTIC ARCH TYPES

~Posterior circulation is more challenging to access especially in Bovine arches (10%)

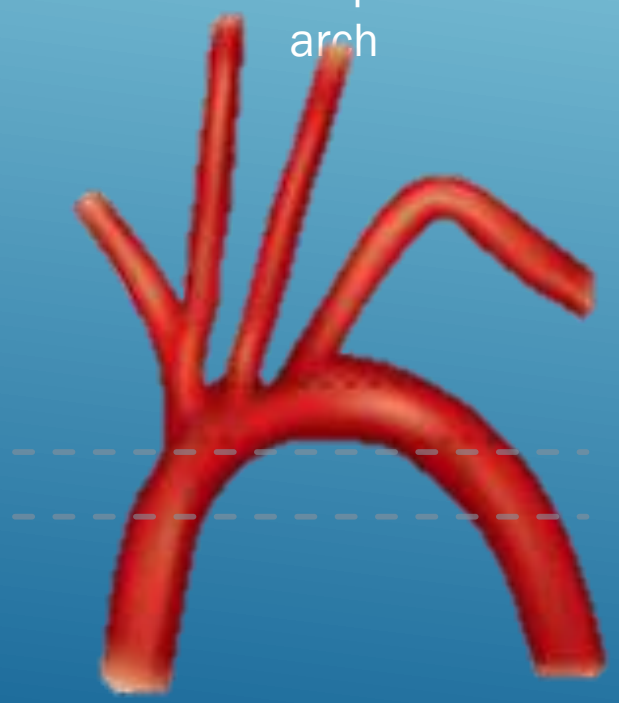
TYPE 1

Great vessels arise at or above the peak of the arch



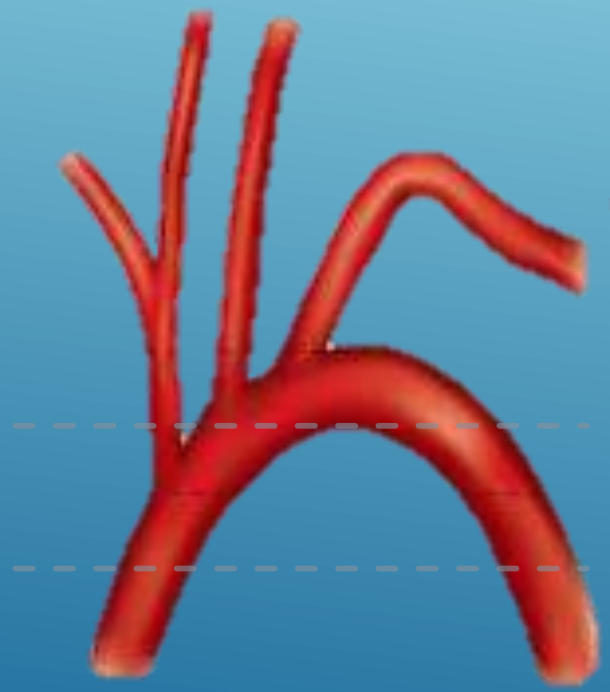
TYPE 2

The BCT & the LCC arise below the horizontal line drawn at the peak of the arch



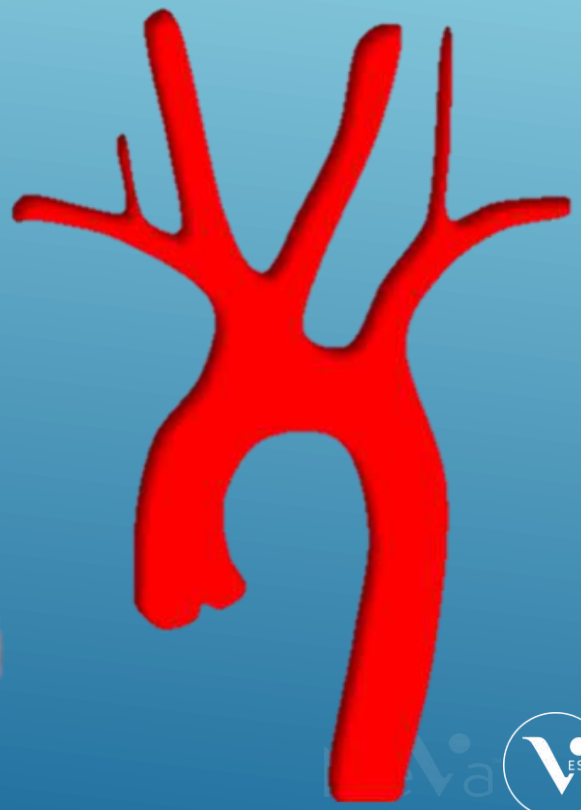
TYPE 3

Great vessels arise well below the peak of the arch



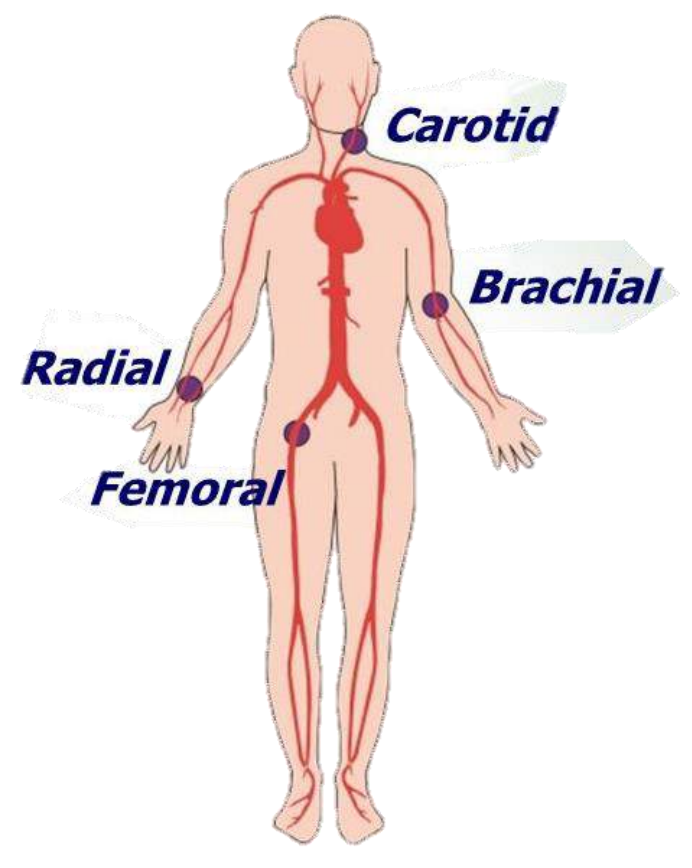
BOVINE

LCC originates from the BCT (10% of patients)

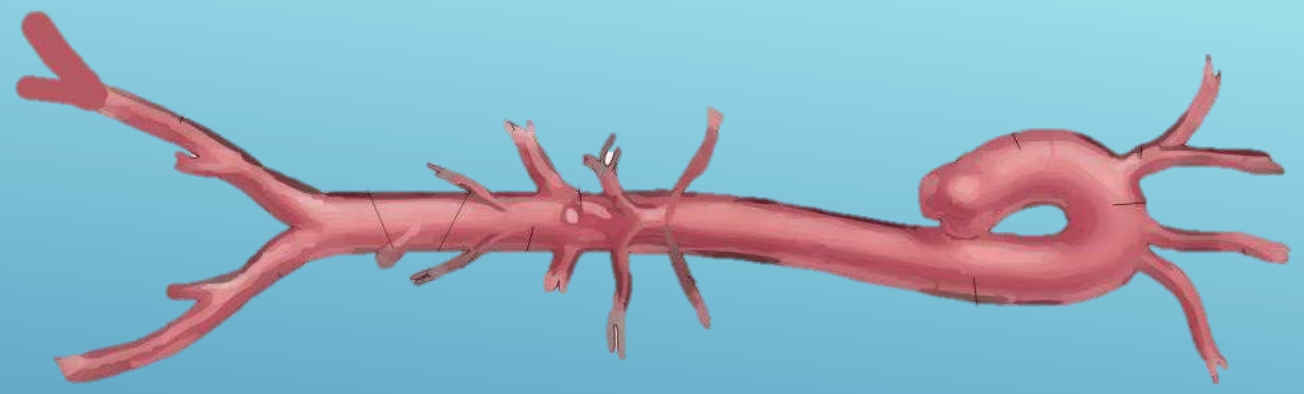


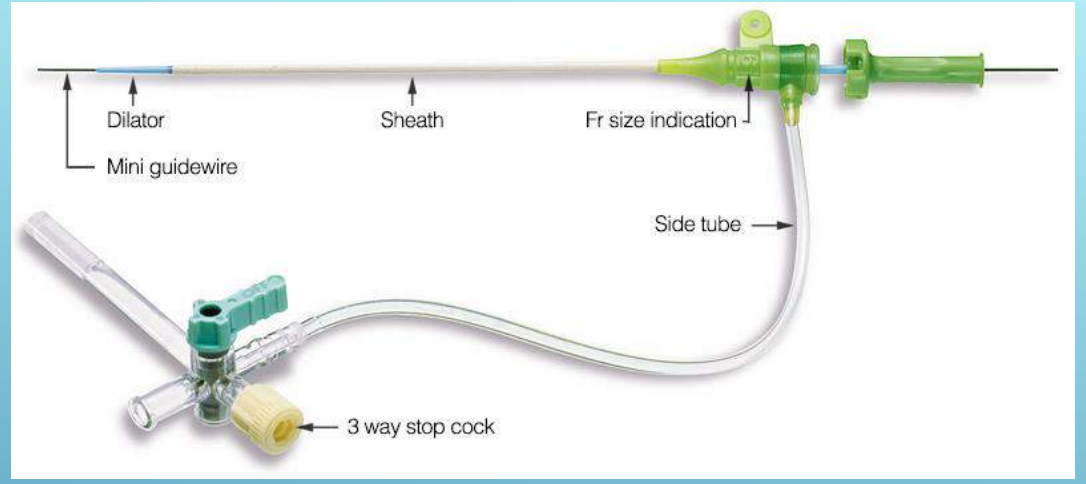
PROCEDURE STEPS

1. Local anesthesia & Conscious sedation or General Anesthesia
2. Puncture of the femoral artery
3. Catheterization of the occluded artery (Guide/Micro/etc.)
4. Deployment of device and retrieval of thrombus



FEMORAL ACCESS & INTRO SHEATH

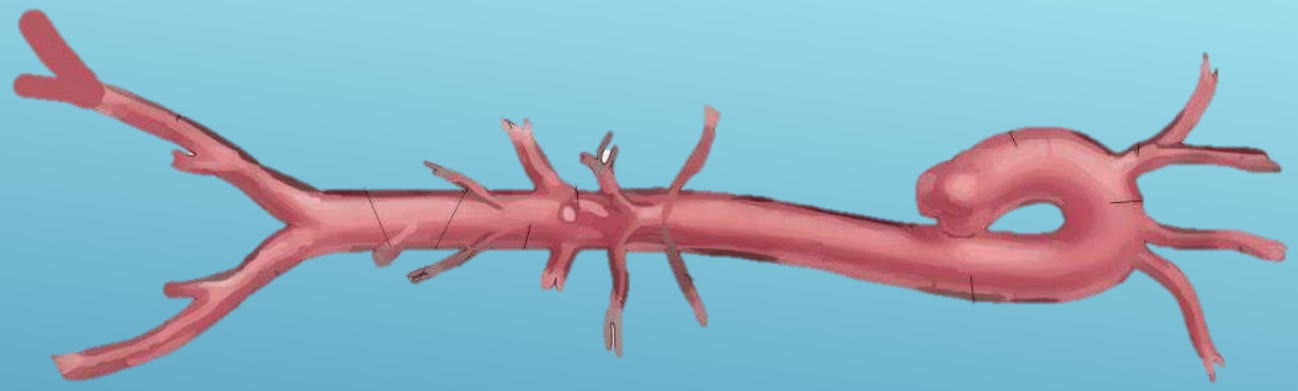




Short Sheath

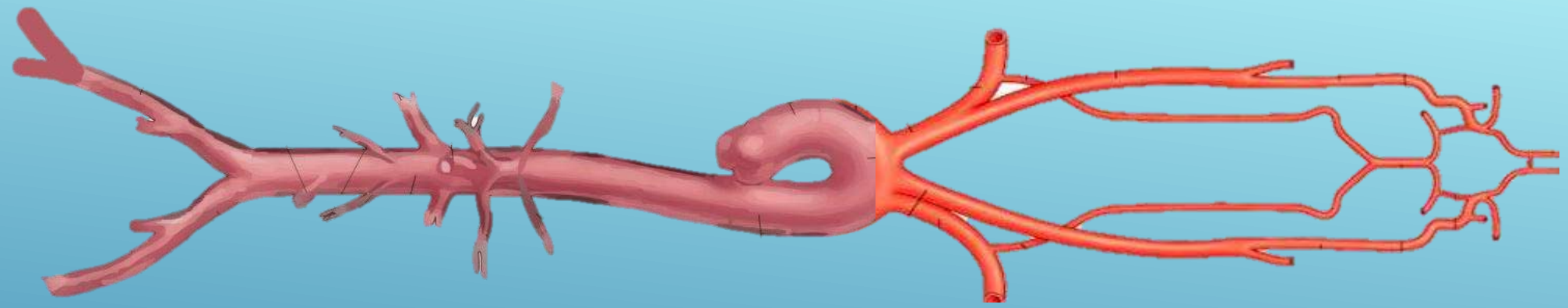
1. Puncture of the femoral artery : IN: a 21-gauge access needle
3. IN: a mini J-tipped guidewire through center of needle, which is advanced gently into the artery and positioned in the iliac artery
4. OUT: the needle, leaving mini-guidewire in place
5. IN: a catheter sheath introducer (CSI) and dilator over the mini-guidewire
6. OUT: the guidewire and dilator leaving the CSI in place
7. CSI is aspirated and flushed to make ready for insertion of other access devices

GUIDE CATHETER



1. IN: a 0.035 inch guidewire
2. IN: a guide catheter over the 0.035 inch guidewire
    1. simple or balloon guide
    2. 6 to 8 Fr
    3. Driven up as far as possible through the neck

ACCESSING THE OCCLUSION



Balloon Guide Catheter

Large Bore Aspiration Catheter

Microcatheter

Device

1. IN: a DAC (Local Aspiration Catheter)
2. OUT: the 0.035 inch guidewire
3. In a 0.018 inch guidewire
4. IN: a 0.021 inch Microcatheter

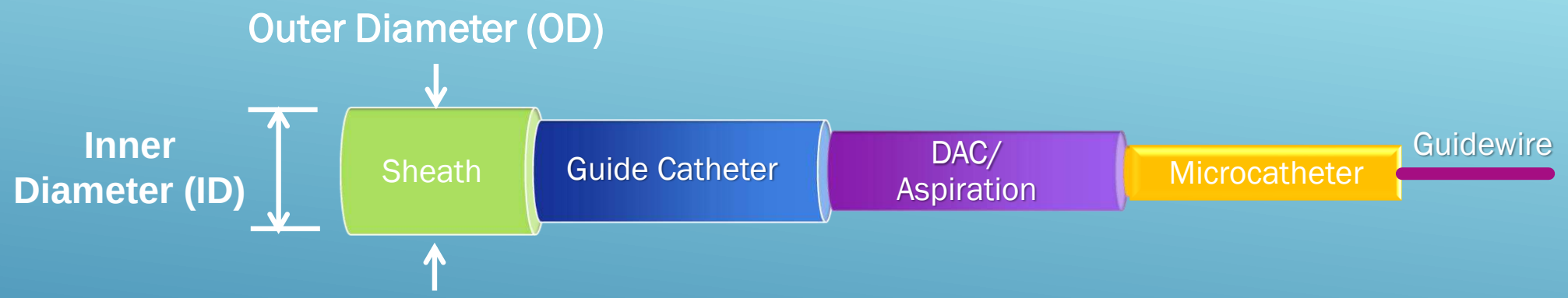
1. Out: the 0.018 inch guidewire
2. IN: the Stent retriever

ACCESS PRODUCTS

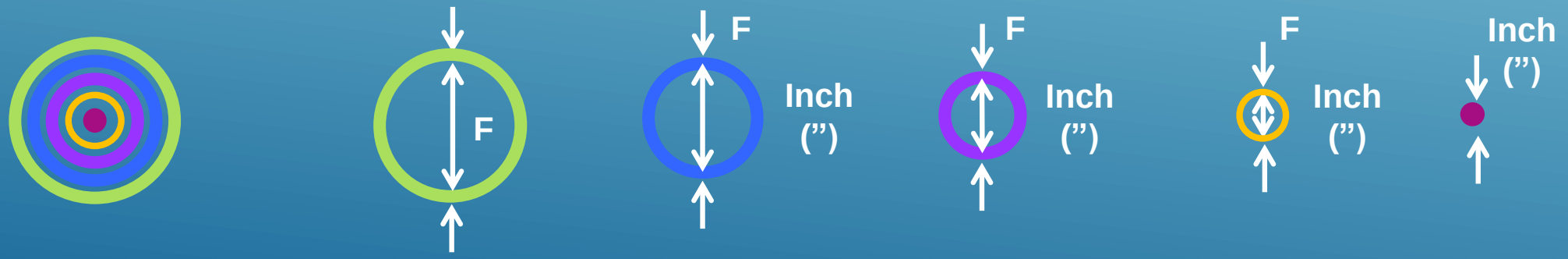
UNDERSTANDING ACCESS DEVICES

Conversion
1.0F = 0.013” = 0.33mm

ACCESS SET UP



CROSS-SECTIONAL VIEW

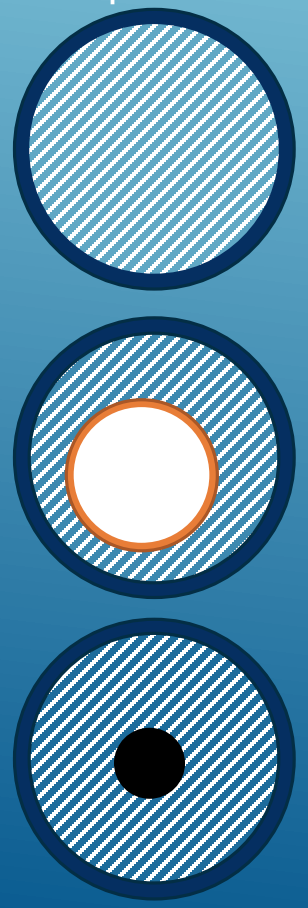


UNDERSTANDING ACCESS DEVICES

Conversion
1.0F = 0.013” = 0.33mm

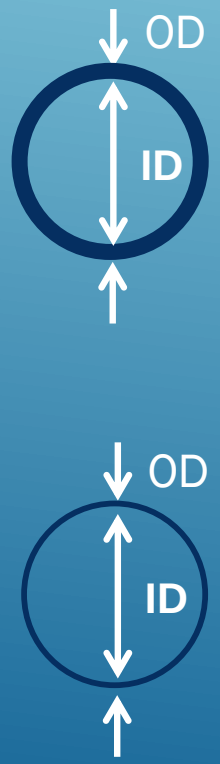
SPACE WITHIN

Will affect efficiency of fluoro injections and aspiration



WALL THICKNESS

Will affect distal support and navigability



TAPER

Will affect how far a catheter will go, distal support and navigability

TIP SHAPE

Will affect navigation & device delivery

LONG SHEATHS VS REGULAR GUIDE CATHETERS

SHEATH

GUIDE

Inch (”)

- Label size refers to inner diameter (I.D.)
- Label size refers to outer diameter (O.D.)

6F Sheath ≠ 6F Guiding Catheter

6F Sheath is approximately equivalent in OD to an 8F Guiding Catheter

- Often comes with a haemostatic valve
- Inserted directly into body using a dialator
- Benefit:
  - Large ID, more room for devices and contrast injection
  - Aspiration devices fit in

- No haemostatic valve
- Requires a sheath prior to inserting it
- Benefit:
  - May reach further vasculature
  - May be preferable for posterior circulation

UNDERSTANDING ACCESS DEVICES

Conversion
1.0F = 0.013” = 0.33mm

- Any 3 of these 4 categories may be used to create a tri-axial set-up
- EX: Neuron Max / Navien .058 / Marksman – common for flow diversion cases
- EX: Neuron Max / Sofia Plus / Trevo PV 18 – for a thrombectomy case using ASPIRATION & STENT RETRIEVER together

- In thrombectomy, more and more KOLs are starting to recommend use of balloon guide AND local aspiration, therefore one set up could be:
- EX: Short sheath / FLOWGATE 2/ Sofia Plus/ Rebar 18

CATHETER CHOICE: CATHETERS TRY TO STRIKE A BALANCE AND PHYSICIANS CHOOSE ACCORIND TO NEED

- Inner diameter (ID)
  - What device do I need to put into this?
- Outer diameter (OD)
  - What size catheter will I need to put this into?
  - How much space will be left within what it will go through (for aspiration)?
  - How far up will I be able to navigate with this?
  - How much will I worry about fiddling about and deranging the artery inner walls?
- Distal Support vs Conformability
  - Catheter size → bigger is more stable but also less easy to navigate more distally
  - Bigger distal OD or distal thickness of catheter wall → same as above
  - Catheter build : braided & braid angles, versus coiled structure
  - Catheter material

ACCESS DEVICE CATEGORIES

Conversion
1.0F = 0.013” = 0.33mm

	SHEATH	GUIDE	ASPIRATION	MICRO
Notes	• Short (10-25 cm) • Long (47-55cm) • Several sizes exist but ones used in neuro-intervention are usually the bigger sizes (8-9 Fr)	• Traditional and Balloon guides exist • Lengths vary between 50-110cm • Shorter ones have larger ID/OD,	• Used to be called intermediate catheters and were smaller • ID and OD could differ from proximal to distal end • The bigger the distal ID, the stronger the aspiration power	• 10, 14, 17, 21, 27 inch sizes exist • ID same throughout • OD could differ from proximal to distal end • In thrombectomy tip shape is straight
OD	• -	• 5 F – 8 F	• Proximal: 6.0 – 6.4 F • Distal: 5.0 – 6.4 F	• Proximal: 2.4 – 3.0 F • Distal: 2.0 – 2.6 F
ID	• 4 – 11 F	• .056” – .098” (traditional) • .075” – .085” (balloon)	• Proximal:.054” – .070” • Distal: .054” – .070”	• .010” – .027”

SHEATHS & GUIDES

Conversion
1.0F = 0.013” = 0.33mm

SHEATH

Long Sheaths

- Cook Flexsor Shuttle 6F (.087), 7F (.100)
- NeuronMax .088
- Super Arrow Flex

GUIDE

Traditional Guides

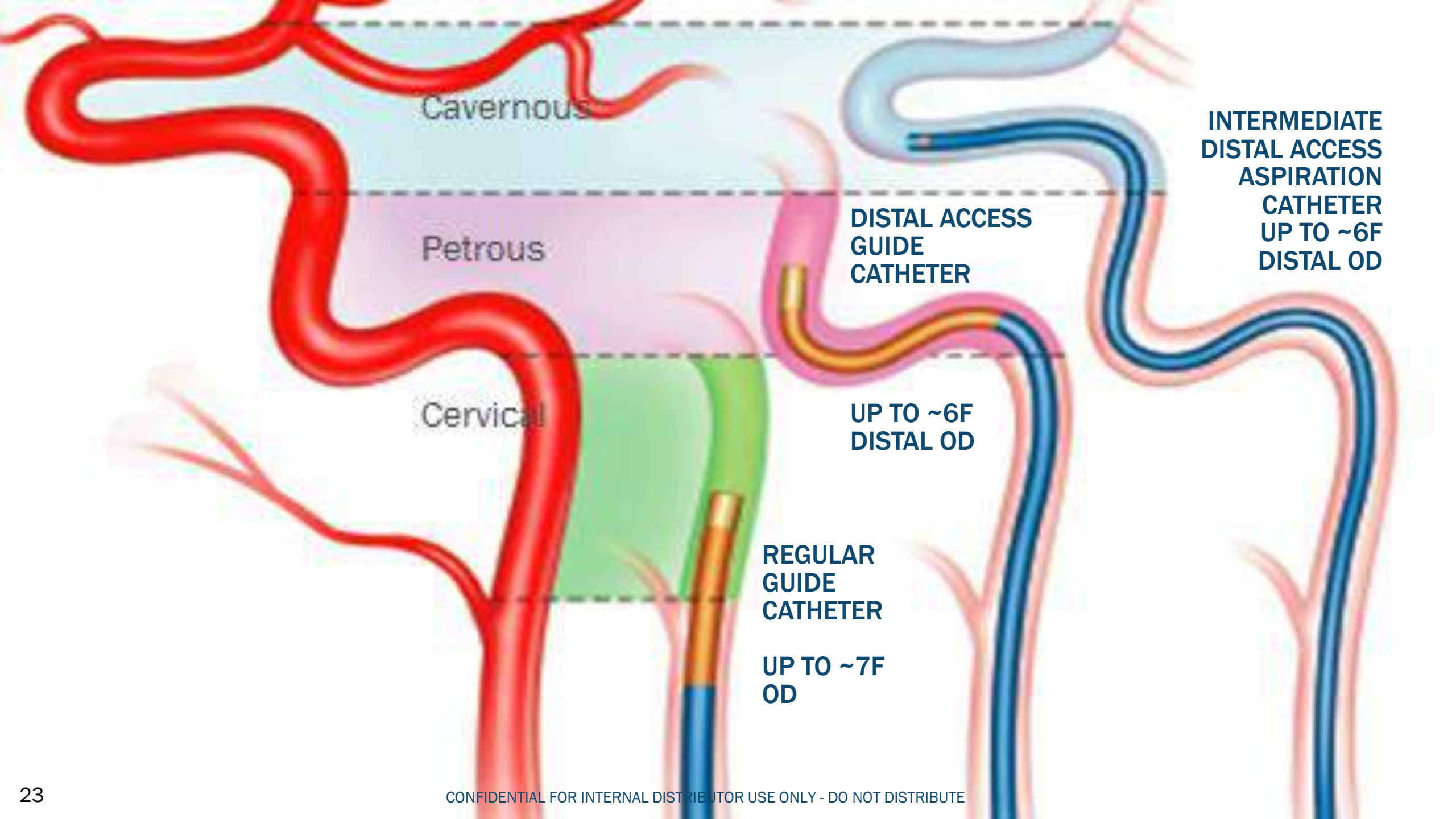
- Envoy & Envoy XB (5F, 6F, 7F)
- Vista Brite Tip
- Guider Soft Tip

Balloon Guides

- Merci
- Cello
- Flowgate

Distal Access Guides (not popular in aspiration)

- Envoy DA .071
- Envoy DA XB
- Neuron .070
- Navien .072
- DAC .070
- FargoMax .070
- Chaperon .071
- TransGate .071
- Benchmark .071



ASPIRATION CATHETERS

Conversion
1.0F = 0.013” = 0.33mm

- Aspiration catheters are usually used with a long sheath (8F – 9F OD; .087 – .088 ID)

Company	Penumbra				Medtronic	TerumoMV	Stryker
Product	5MAX DDC	5MAX ACE / ACE 60	ACE 64	ACE 68	ARC	SOFIA Plus	Catalyst 6
OD Proximal (F)	6.1F	6F	6F	6.4	6.1	6.3F	6F
OD Distal (F)	5.0F	5.4F	5.75F	6,4	5F	6F	5.4F
ID Proximal (inch")	.064 / .054	0.068	0.068	0.068	0.069	0.070	0.060
ID Distal (inch")		0.060	0.064	0.068	0.061	0.070	0.060

21 INCH MICROCATHETERS

ALL RECOMMENDED WITH 0.018 INCH GUIDEWIRES

Conversion

1.0F = 0.013” = 0.33mm

COMPANY NAME	PRODUCT NAME	TYPE OF CATHETER CONSTRUCTION	ID (INCHES)	PROXIMAL OD (F)	DISTAL OD (F)	TOTAL LENGTH (CM)
Boston Scientific	Renegade	Vortec fiber braiding	0.021	3.00	2.50	130, 150
J&J	Transit	Braid/coil design	0.021	2.80	2.50	135, 150
Cook Medical	Cantata 2.5	Braided stainless steel, PTFE, Pebax	0.021	2.50	2.50	100, 110, 135, 150
Stryker	Renegade 18	Braided, hydrophilic	0.021	3.00	2.50	150
Boston Scientific	Direxion Transend	Slotted nitinol shaft design	0.021	2.70	2.40	105, 130, 155
Boston Scientific	Renegade STC 18	Vortec fiber & stainless steel braid	0.021	3.00	2.40	105, 130, 150
Medtronic	Rebar 18	–	0.021	2.70	2.40	153
Stryker	Trevo Pro 18	Braided	0.021	2.70	2.40	150
J&J	Prowler Plus	Braid/coil design	0.021	2.80	2.30	110, 135, 150
J&J	Prowler Select Plus	Braid/coil design	0.021	2.30	2.30	150
J&J	Rapidtransit	Braid/coil design	0.021	2.30	2.30	75, 100, 135, 155, 175
MicroVention	Headway	Tapered PTFE with coil wind	0.021	2.50	2.00	150

27 INCH MICROCATHETERS

Conversion
1.0F = 0.013” = 0.33mm

Company Name	Product Name	Type of Catheter Construction	ID (inches)	Proximal OD (F)	Distal OD (F)	Total Length (cm)	Recommended GW (inch)
Roxwood Medical	Micro 18	Variable pitch braid, PTFE liner, tapered tip	0.022	2.9	1.9	155	0.018
Baylis Medical	ProTrack	Coiled stainless steel, PTFE, Pebax	0.022	2.7	2.7	145	Up to 0.021
Terumo	Progreat	Tungsten coil, PTFE liner	0.022	2.9	2.4	110, 130, 150	0.018
Baylis Medical	ProTrack	Coiled stainless steel, PTFE, Pebax	0.025	2.9	2.9	145	Up to 0.024
Cook Medical	Cantata 2.8	Braided stainless steel, PTFE, Pebax	0.025	2.8	2.8	100, 110, 135, 150	0.021 (maximum)
Penumbra	Velocity	Nitinol coil reinforced; eight extrusion zones	0.025	2.95	2.6	160	0.014
Surefire Medical	Surefire	Braided stainless steel, PTFE, multiple polymers	0.025	3.7	3.4	120, 150	0.018 (maximum)
Terumo	Progreat	Tungsten coil, PTFE liner	0.025	2.9	2.7	110, 130	Up to 0.021
Boston Scientific	Direxion Hi-Flo	Slotted nitinol shaft design	0.027	3	2.8	105, 130, 155	0.021 (maximum)
Boston Scientific	Renegade Hi-Flo	Vortec plus braiding: fiber and platinum braid	0.027	3	2.8	105, 115, 135, 150	0.018 (maximum)
Johnson & Johnson	Prowler 27	Braid/coil design	0.027	3	2.6	150	0.018 (maximum)
Cook Medical	Cantata 2.9	Braided stainless steel, PTFE, Pebax	0.027	2.9	2.9	100, 110, 135, 150	0.025 (maximum)
Medtronic	Marksman	–	0.027	3.2	2.8	105, 135, 150, 160	0.021
Medtronic	Rebar 27	–	0.027	2.8	2.8	130	0.021
Stryker	Excelsior XT-27	Braided, hydrophilic	0.027	2.9	2.7	135, 150	0.018 (maximum)
Stryker	Neuro Renegade Hi-Flo	Braided, hydrophilic	0.027	3	2.8	135, 150	0.018 (maximum)
Terumo	Progreat	Tungsten coil, PTFE liner	0.027	3	2.8	110, 130, 150	Up to 0.025
Merit Medical	EmboCath Plus	Stainless steel braid	0.028	3	2.9	100, 135	0.025
Merit Medical	Maestro	Nylon ribbon braiding	0.024, 0.027	2.8, 2.9	2.4, 2.8, 2.9	110, 130, 150	0.021

ACCESS SET UPS & IMPLICATIONS

CO-AXIAL
GUIDE CATHETER + MICRO-CATHETER

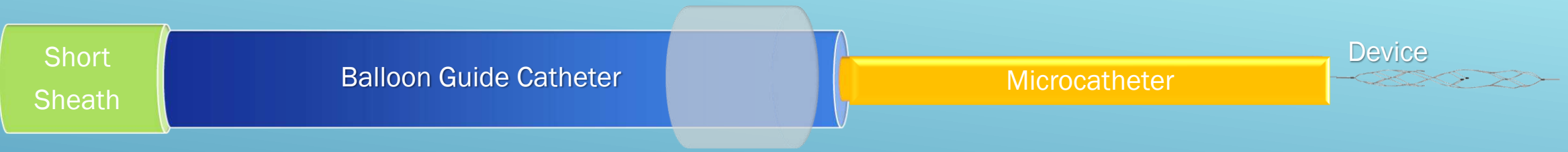
ADVANTAGES

1. Easy and fast access
2. Good technique for severe carotid stenosis (small diameter of MC)
3. May be preferred for posterior circulation

DISADVANTAGES

1. Not effective for aspiration (GC too far and MC inner diameter too small)
2. Loss of thrombus during retrieval is a risk as there is no neutralization of blood flow

FLOW ARREST
BALLOON GUIDE + MICRO-CATHETER



ADVANTAGES

1. Arresting flow proximal to the lesion, thrombus loss risk is minimized
2. Easier placement in proximal ICA *(compared to the struggle to drive a large bore catheter above the Siphon)*
3. Larger ID to collapse clotted device

DISADVANTAGES

1. More difficult to use in posterior circulation
2. Belief that "vessel collapse“ is less likely vs. flow reversal

LOCAL ASPIRATION OR TRI-AXIAL
LONG SHEATH + LARGE BORE ASPIRATION + MICRO-CATHETER

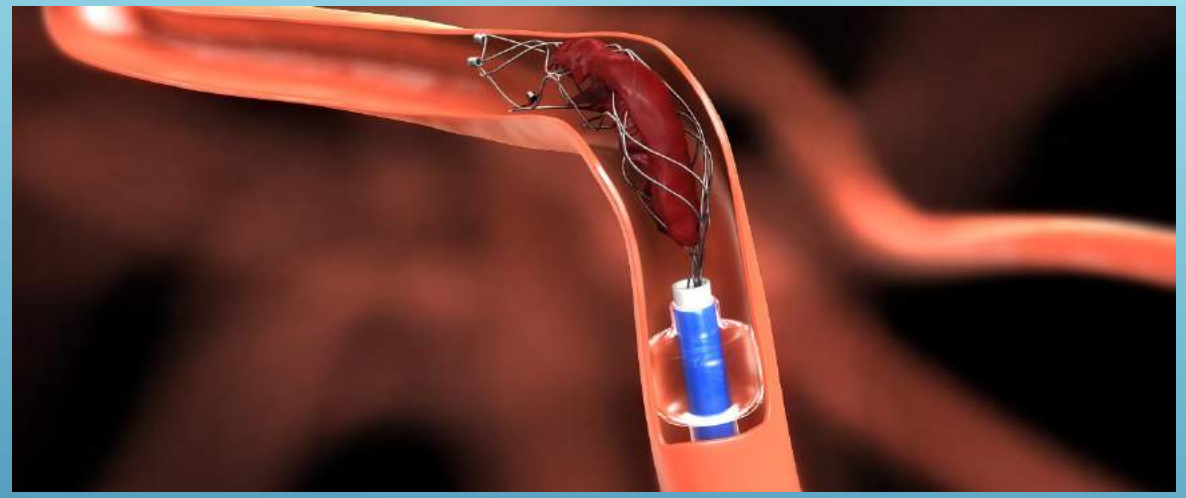
ADVANTAGES

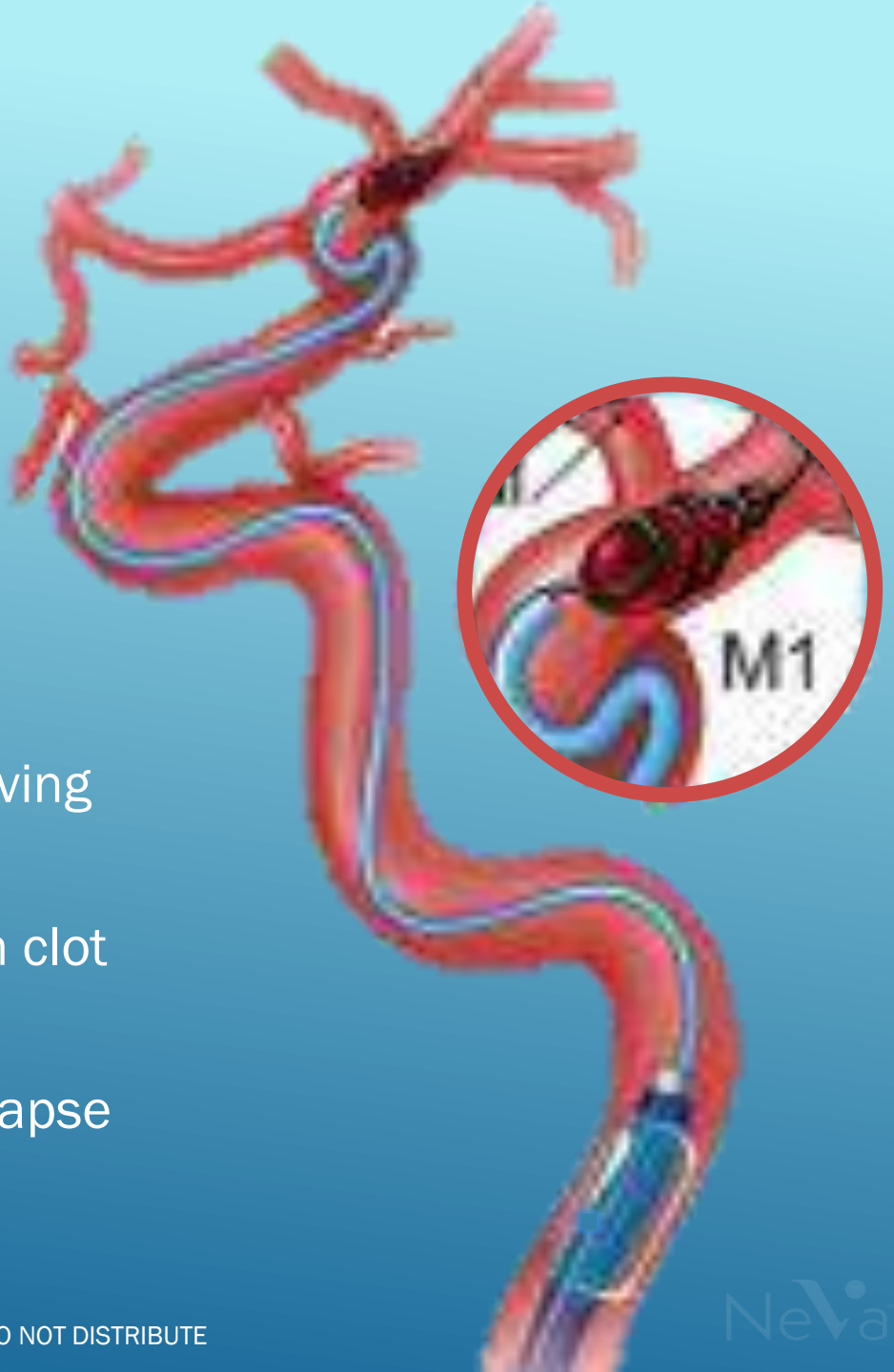
1. Aspiration at occluded vessel *(vs. ~20 cm away with balloon guide)*
2. Re-constraining of clot in occluded vessel *(no risk of "dislocated" clot in previously unaffected territory)*
3. "Straightens out" the anatomy - *thus leading to both easier delivery and retrieval of the stent retriever*

DISADVANTAGES

1. Placement of the IC above the siphon may need more effort (and time)
2. Dissection & vasospasm risk
3. Difficult in posterior circulation

FLOW ARREST TECHNIQUE





Use of a **balloon guide catheter** to arrest flow while retrieving the clot with a stent retriever

- Reassured the INR during retrieval (no pressure on clot meant less risk of losing it)
- Large ID of the balloon guide was ideal for clot collapse

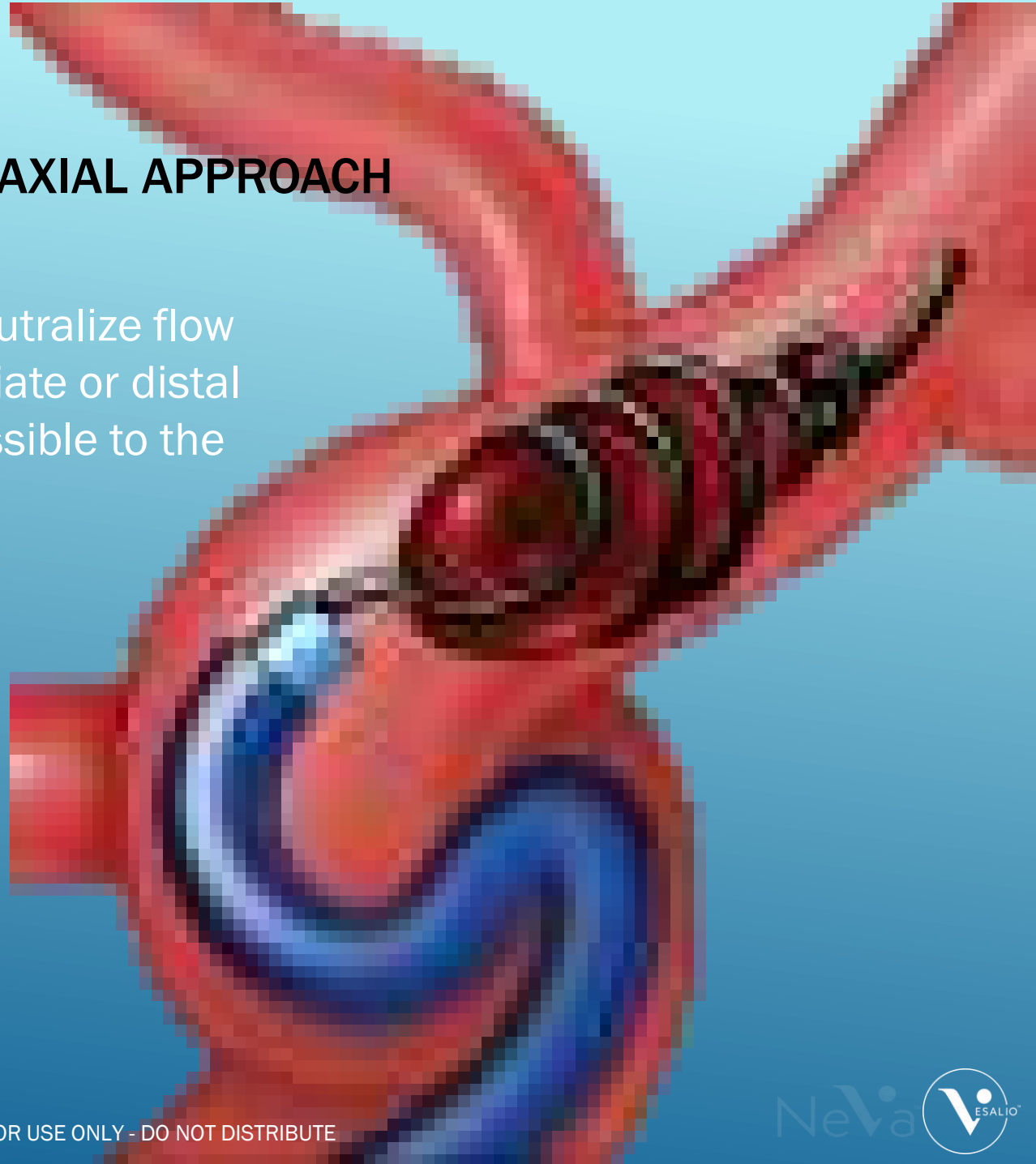
LOCAL ASPIRATION TECHNIQUE

ALSO CALLED FLOW REVERSAL, DAC OR TRIAXIAL APPROACH

Instead of arresting flow with a balloon guide, neutralize flow by withdrawing fluid (blood) through an intermediate or distal access catheter that is navigated as close as possible to the occlusion site.

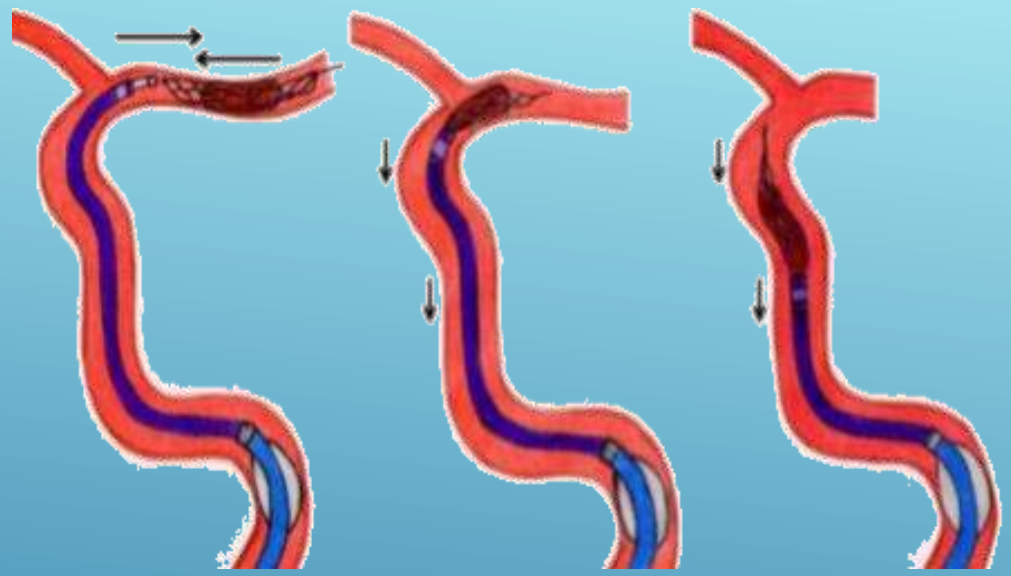
The “goal” of this technique when used in stent retrieving was not to aspirate clot into the catheter but:

1. Have good support during stent retrieval
2. Ensure clot retention in the device thanks to neutralized flow condition



ADAPT: A DIRECT ASPIRATION FIRST PASS TECHNIQUE

Aspiration alone as an alternative to stent retrieving started coming back with new generation, easier to navigate large bore catheters.



Success rates:

~ 60-70% according to Penumbra research (2016)

~ 40-50% according to non-company funded studies

Rescue with stent retrievers if fails

"In the minority of cases in which aspiration alone is unsuccessful in achieving complete revascularization, the platform is versatile, allowing the rapid incorporation of adjunctive devices (such as stent retrievers)"

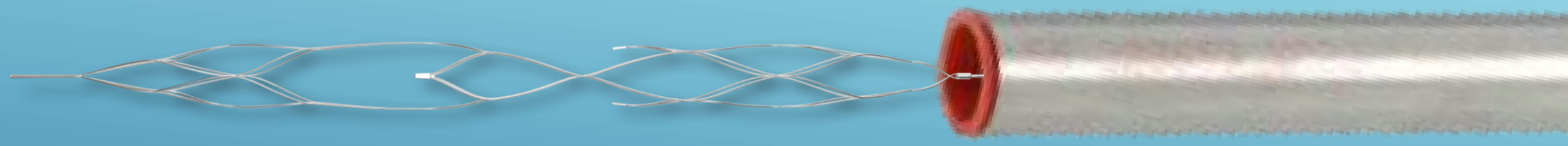
FROM ADAPT
TO COMBINATION OR SOLUMBRA OR NEVUMBRA

For higher first pass rate: use stent-retriever and aspiration catheter together rather than doing ADAPT

+ Balloon Guide: also recommended by some KOLs

PARTIAL RETRIEVAL INTO THE DAC: WITHDRAWING THE SR WITH THE AC RATHER THAN COLLAPSING SR INTO THE AC TO AVOID CLOT SHEARING

- NeVa deployment
- Bring the DAC tip up to the proximal marker



- Remove excess tension from the DAC
- Retrieve NeVa into the DAC up to the 1st Drop Zone markers

- Tighten the RHV of DAC around the MC and retrieve the whole system together (DAC+MC+NeVa) while gently aspirating

THE THROMBECTOMY PROCEDURE

4.1. Stroke Access

- Procedure steps- access
- Access challenges presented by neurovascular anatomy
- Access products
- Access set ups & implications

4.2. The thrombectomy procedure

- Procedure steps
- Clot integration & retrieval techniques
- Cases

NeVa™

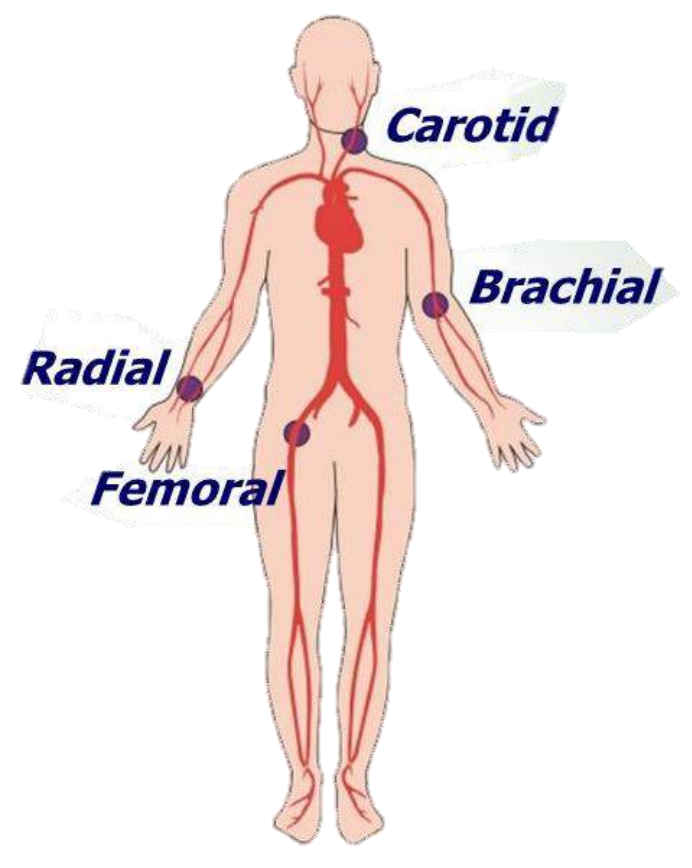
NEXT GENERATION STROKE TREATMENT

Designed for first pass success

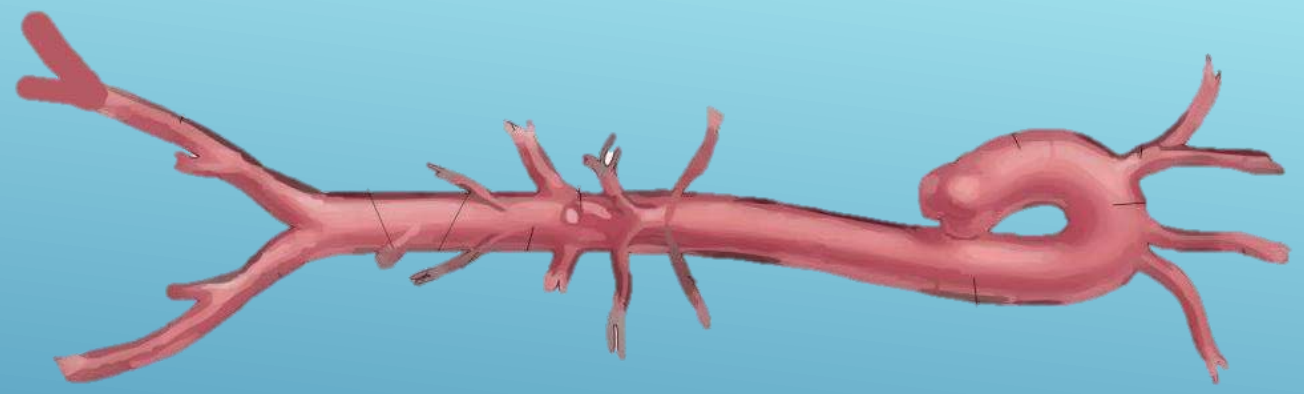
4.2. THE THROMBECTOMY PROCEDURE

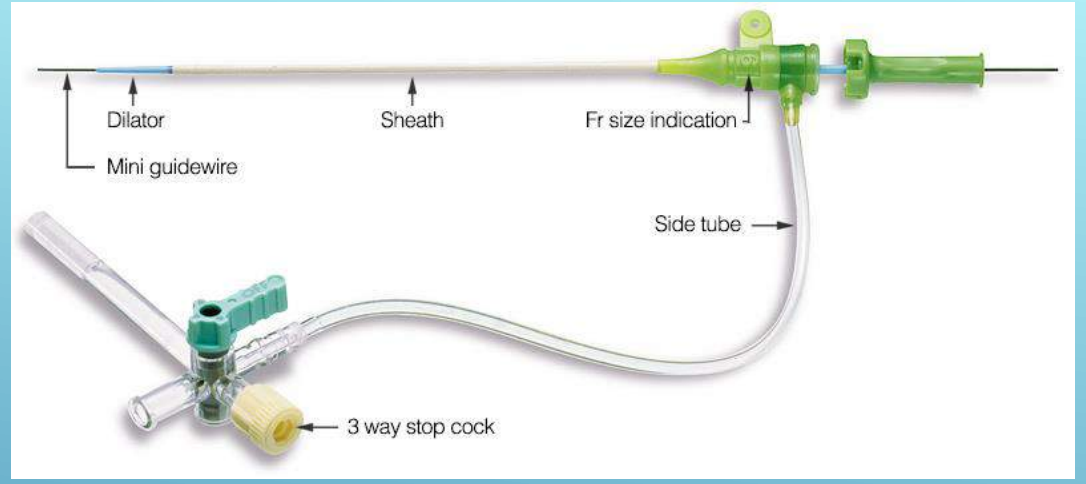
PROCEDURE STEPS

1. Local anesthesia & Conscious sedation or General Anesthesia
2. Puncture of the femoral artery
3. Catheterization of the occluded artery (Guide/Micro/etc.)
4. Deployment of device and retrieval of thrombus



FEMORAL ACCESS & INTRO SHEATH

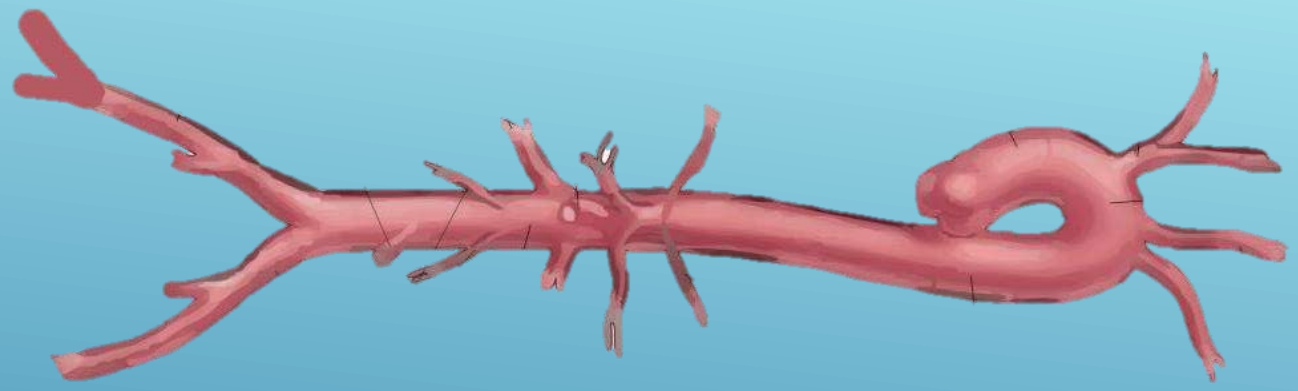




Short Sheath

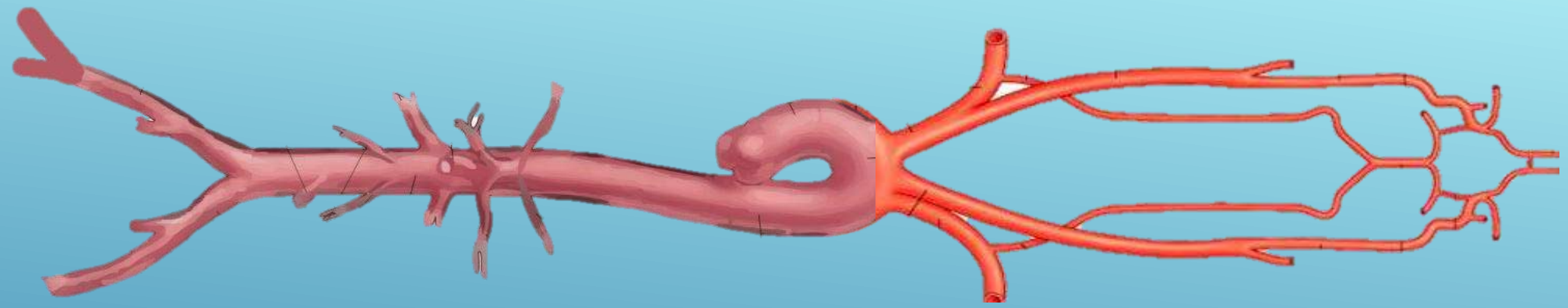
1. Puncture of the femoral artery : IN: a 21-gauge access needle
3. IN: a mini J-tipped guidewire through center of needle, which is advanced gently into the artery and positioned in the iliac artery
4. OUT: the needle, leaving mini-guidewire in place
5. IN: a catheter sheath introducer (CSI) and dilator over the mini-guidewire
6. OUT: the guidewire and dilator leaving the CSI in place
7. CSI is aspirated and flushed to make ready for insertion of other access devices

GUIDE CATHETER



1. IN: a 0.035 inch guidewire
2. IN: a guide catheter over the 0.035 inch guidewire
    1. simple or balloon guide
    2. 6 to 8 Fr
    3. Driven up as far as possible through the neck

ACCESSING THE OCCLUSION



Balloon Guide Catheter

Large Bore Aspiration Catheter

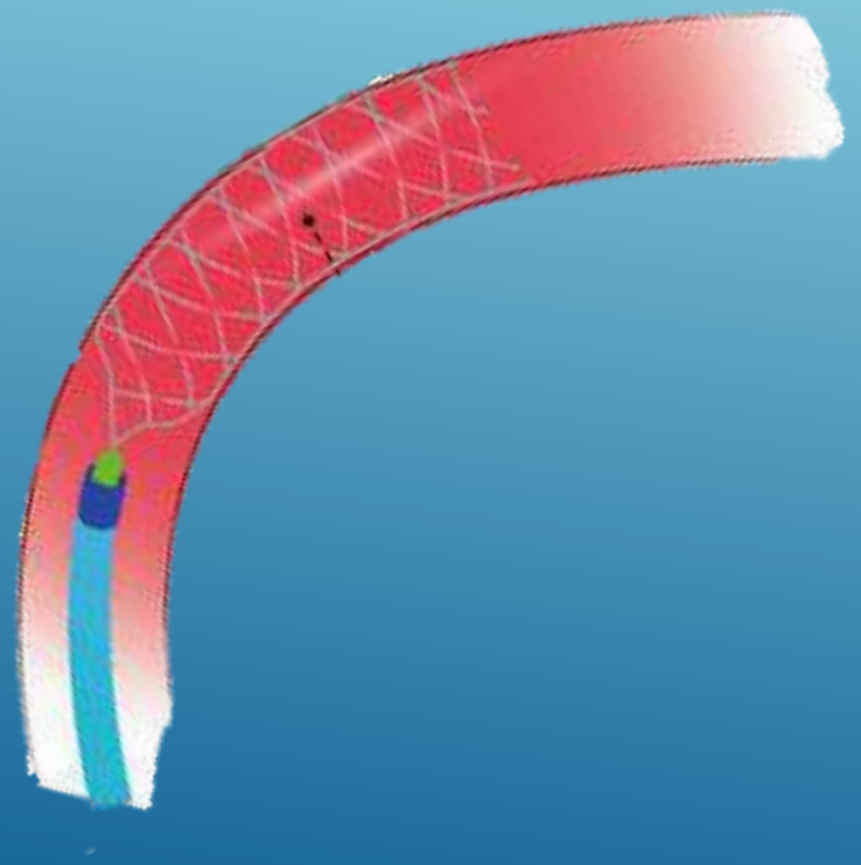
Microcatheter

Device

1. IN: a DAC (Local Aspiration Catheter)
2. OUT: the 0.035 inch guidewire
3. In a 0.018 inch guidewire
4. IN: a 0.021 inch Microcatheter

1. Out: the 0.018 inch guidewire
2. IN: the Stent retriever

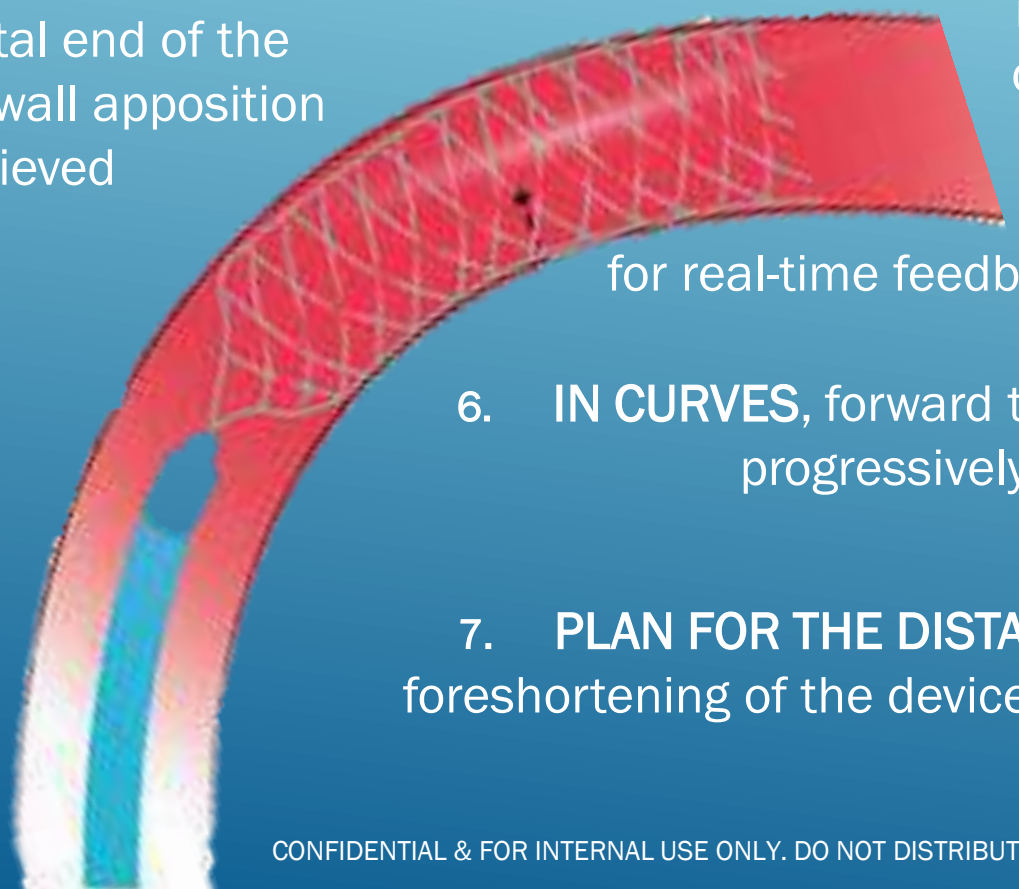
CLOT INTEGRATION & RETRIEVAL TECHNIQUE: STANDARD UNSHEATHING – APPLIES TO ALL DEVICES



1. Position the device across the occluded segment
2. Un-sheath the device by retracting the microcatheter while immobilizing the wire of the stent retriever device
3. Wait for 5-7 minutes for device to engage clot
4. Retrieve device and microcatheter with slow & stable pull till clot is collapsed into the guide catheter

CLOT INTEGRATION & RETRIEVAL TECHNIQUE: PUSH & FLUFF: APPLIES MORE TO BRAIDED STRUCTURES

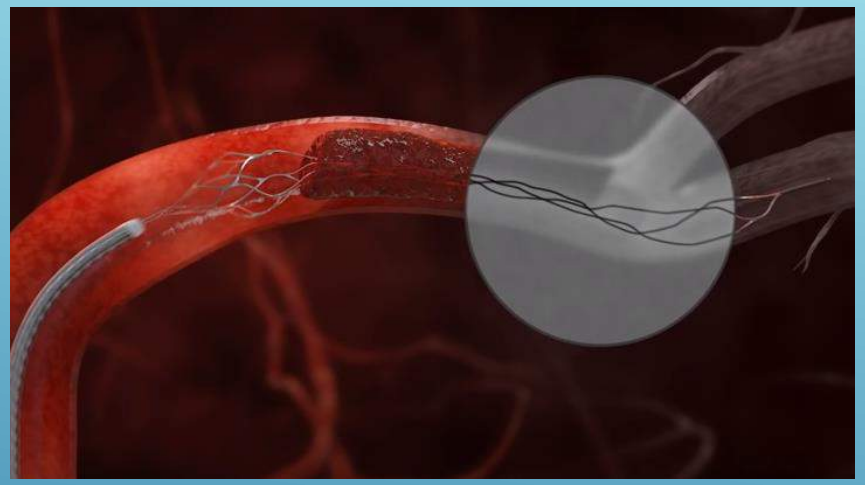
1. **POSITION** the device across the occluded segment
2. **BRIEF UNSHEATHING STEP:** Un-sheath the distal end of the device until good wall apposition (anchoring) is achieved
3. **PUSHING STEP:** After this, apply forward force into the device wire, which will generate spontaneous retraction of the microcatheter



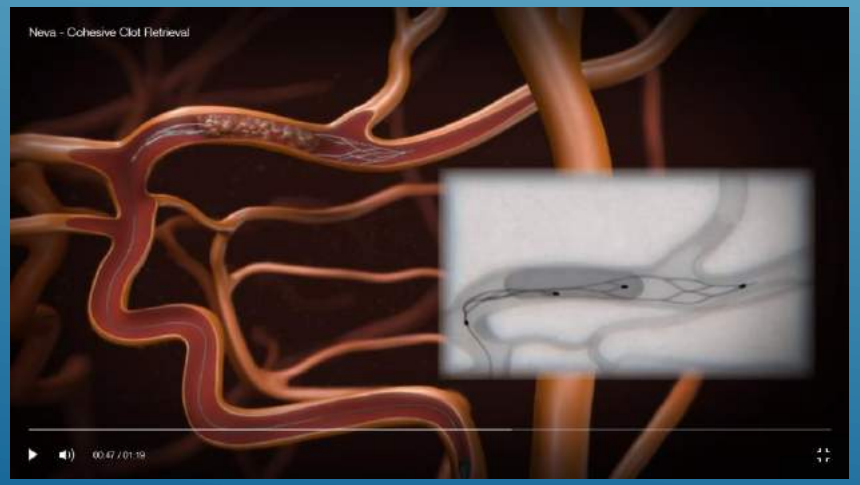
4. **FLUFFING STEP:** At the main targeted area (where clot is located), apply forward tension to the microcatheter while continuing to push the delivery wire to maximize device expansion
5. **USE RADIO-OPAQUE PROPERTIES** for real-time feedback on amount of fluffing & wall apposition
6. **IN CURVES**, forward tension of the microcatheter may have to be progressively decreased if the device is seen to collapse & lose apposition to the inner wall
7. **PLAN FOR THE DISTAL LANDING ZONE** considering the expected foreshortening of the device that typically happens with this technique.

STANDARD UNSHEATHING

Trevo Animation



NeVa Animations



PUSH & FLUFF

Trevo Push & Fluff Demo in Flow Model

Fred Deployment in Flow Model

STROKE CASE WITH STENT RETRIEVER TECHNIQUE FROM BICÊTRE HOSPITAL TEAM, PRESENTED AT LINNC

- You may need to subscribe to LINNC in order to view this case
- Trevo and AxsCat6 – Stent retriever with flow reversal
- Expert panel discussion on the case

STROKE CASE WITH ADAPT TECHNIQUE FROM CHU MONTPELLIER, FRANCE, PRESENTED AT SLICE

STROKE CASE WITH ASPIRATION TECHNIQUE FROM MEDICAL UNIVERSITY OF SOUTH CAROLINA, US