

# Complications of supra- aortic and renal interventions . Prevention and Management

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# Complications of Carotid Stenting

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- Access site complications
- Hypotension/bradycardia
- Dissection
- Distal ICA spasm
- Slow-flow
- Cerebral embolism, stroke
- Hyperperfusion syndrome



# Features suggested to increase the risk of CAS procedure

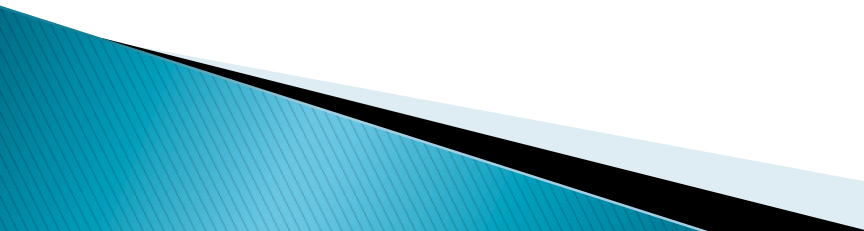
Medical Comorbidity	Anatomic Criteria	Procedural Factor
Elderly (>75/80 yrs)	Type III aortic arch	Inexperienced operator/center
Symptom status	Vessel tortuosity	EPD not used
Bleeding risk/hypercoagulable state	Heavy calcification	Lack of femoral access
Severe aortic stenosis	Lesion related thrombus	Time delay to perform procedure from onset of symptoms
Chronic kidney disease	Echolucent plaque	
Decreased cerebral reserve	Aortic arch atheroma	

EPD = embolic protection device.


# Complications dependent on:

- Duration of catheter in cerebral artery
- Number of catheter exchanges
- Number of vessels cannulated
- Contrast volume, fluoro time

# Hemodynamic Depression

- ▶ Incidence 42%, persistent hemodynamic depression 17%
  - ▶ More common with dilation and stenting of lesion involving carotid bifurcation
  - ▶ Less common in treating post CEA restenosis
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# Management and Prevention of Hemodynamic Depression

- ▶ Hemodynamic depression managed with IVF, vasopressors, Dopamine.
  - ▶ Hypotension should be corrected expeditiously in cases of contralateral ICA occlusion, intracranial stenosis and periprocedural cerebral ischemia
  - ▶ Prophylactic measure includes – Stopping antihypertensive, proper hydration
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# Management of carotid body stimulation: bradycardia

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- Bradycardia is usually transient, even if profound (asystole), and usually resolves quickly with balloon depressurization.
  - *Atropine (up to 2 mg) is occasionally required to support further balloon dilation*
  - *Temporary pacemaker placement---prophylactic or otherwise---is only rarely necessary.*
- Although some operators prefer to pre-treat all patients with atropine, this may occasionally be problematic in the patient with significant coronary disease, and is generally unpleasant.
  - *Clues to the need for atropine therapy can usually be discerned by observing the effects of pre-dilation balloon angioplasty*

# Carotid Dissection and Perforation

- ▶ **Caused by** – severe tortuosity, Poor control of filter position, Post dilatation of distal edge of stent, Manipulation of guide.
- ▶ **Management options** – Balloon inflation, Stent implantation



# Carotid Artery Spasm / slow flow

- ▶ **Spasm** commonly associated with DPD use.
  - responds to DPD removal, intra arterial NTG, low pressure balloon inflation.
- ▶ **Slow flow** may occur when the filter pores of DPD are partially or completely occluded.
  - Managed by aspiration of stagnant blood proximal to filter

# Distal Embolization

- ▶ Extensive use of EPDs significantly reduced the incidence
- ▶ **If changes of neurological status appears**

Monitor patients neurological status after every step

Maintain normal BP and intravascular volume.

Maintain adequate anticoagulation

Conclude the procedure quickly and intracranial angiography and neurorescue procedure maybe done

# Intracranial Hemorrhage

- ▶ **Suspected** when sudden LOC preceded by headache with out intracranial vessel occlusion.
- ▶ **Caused by** – Excessive anticoagulation, poorly controlled hypertension, CAS in the presence of recent ischemic stroke (<2wks), aggressive IC neuro rescue. Berry aneurysm

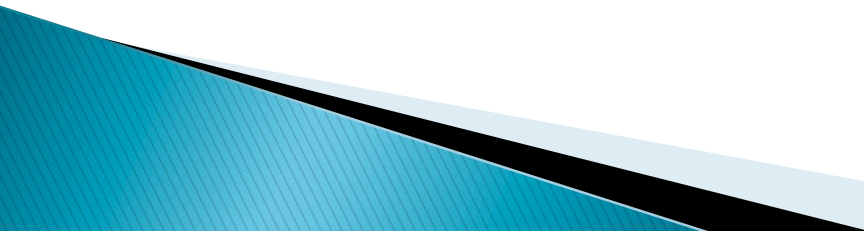
# Stent Complications

- ▶ **Stent Avulsion** – Caused by withdrawal of open DPD across the stent or Inadvertently catching the stent struts during retrieval  
Careful withdrawal of DPD and Neck tilting may help in withdrawal of DPD
- ▶ **Acute Stent thrombosis** is rare. Possibility of plaque prolapse has to be excluded  
Dual antiplatelet therapy lower the rate of AST

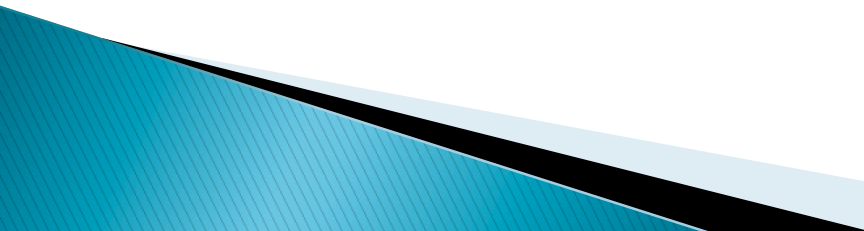
# Post Dilatation

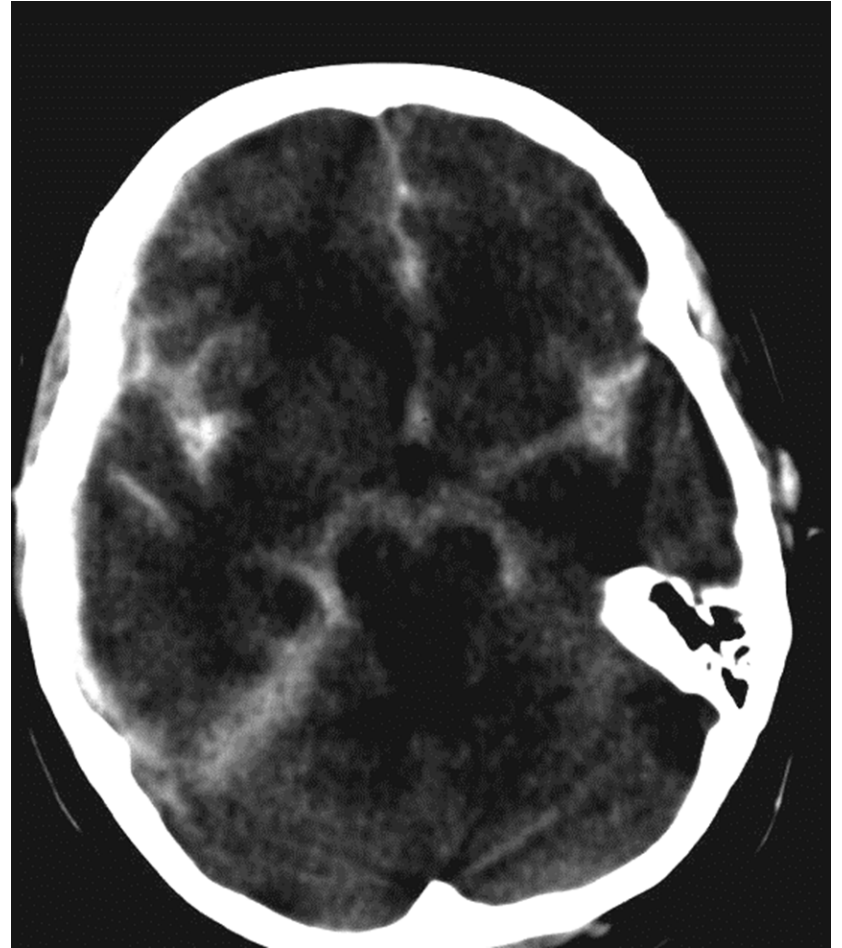
- ▶ Accept up to 30% residual stenosis
- ▶ Size the post dilatation balloon according to distal ICA
- ▶ If plaque prolapses through the stent struts no further dilatation should be performed.  
A second stent with closed cell design may be deployed

# External Carotid Artery Occlusion

- ▶ ECA occlusion is rare and usually asymptomatic
  - ▶ Recanalization is considered if patient is symptomatic.
  - ▶ ECA can supply cerebral flow through collaterals, in such cases it is important to maintain the patency of ECA
  - ▶ TIMI 2 flow may be sufficient
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# Cerebral Hyperperfusion Syndrome

- ▶ Caused by  $>100\%$  increase in cerebral flow following revascularization
  - ▶ Impaired cerebral autoregulation result in transudation, cerebral oedema, ICH, SAH
  - ▶ Incidence 1.3%
  - ▶ Risk factors – HTN, contralateral carotid occlusion, critical ipsilateral carotid stenosis, incomplete Circle of Willis
  - ▶ Occurs within 24 hrs, rare after 2 to 4 days
- 





# Prevention and treatment

- ▶ Diagnosis initially mainly clinical
  - ▶ Aggressive BP control pre and post CAS
  - ▶ Antihypertensive with increased cerebral blood flow are **contraindicated**(NTG, SNP, CCB,ACEI)
  - ▶ Recommended agents – BB, labetalol, clonidine
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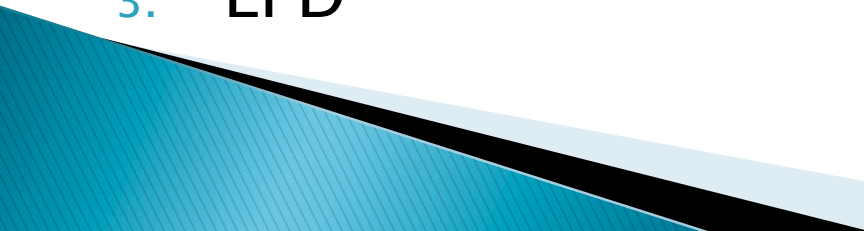
# Subclavian Artery Angioplasty Complication

- ▶ Brachial artery access complications are 5 times more common compared to femoral approaches.
- ▶ **Access complication Include** – hematomas, thrombosis, brachial artery dissections, median nerve injury

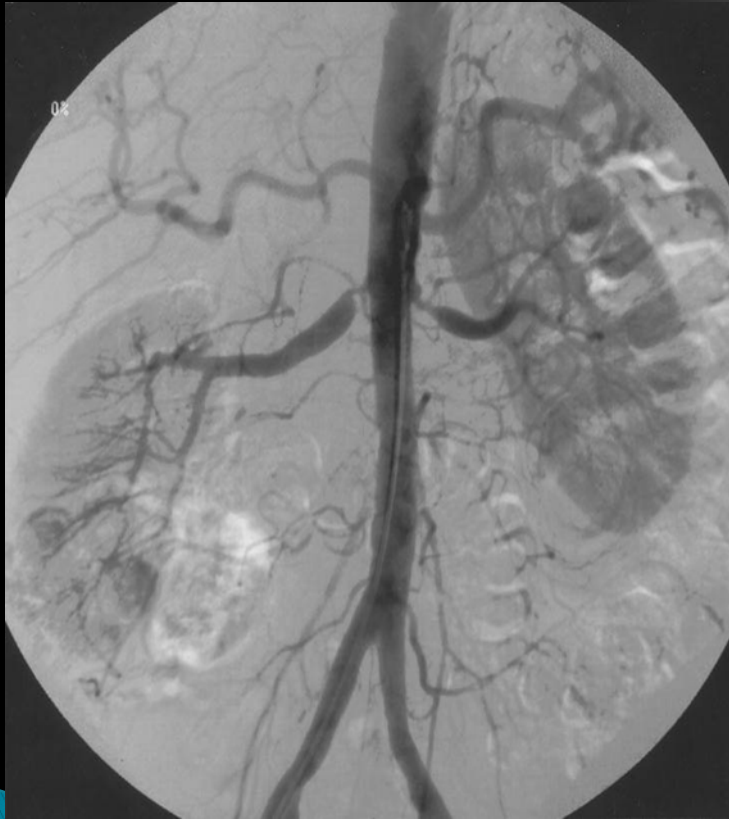
# Subclavian Artery Angioplasty Complication

- ▶ Major complication – 5.8%
- ▶ **Dissection** during wire manipulation can progress to Vertebral artery , LIMA or to aorta.
- ▶ **Stroke** – caused by aortic arch manipulation (right subclavian artery at a higher risk)  
Embolization/dissection of the vertebral artery

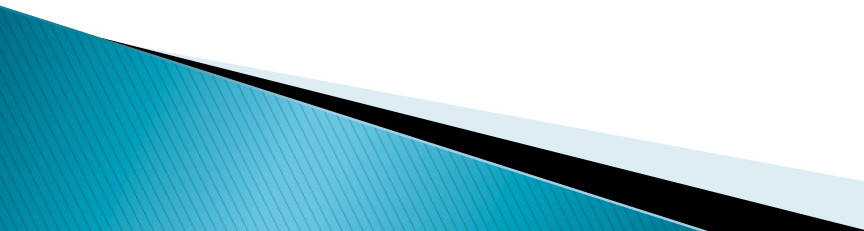
# SCA Angioplasty

- ▶ Once the flow is established in SCA embolization through the vertebral artery can occur.
  - ▶ **Methods to prevent embolic phenomena to the posterior circulation**
    1. Not to predilate, unless necessary, directly stent the lesion.
    2. patient perform repetitive hand squeezes prior to stent placement. This increase perfusion to the arm and 'enhance' reversal of flow in the vertebral artery
    3. EPD
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# Complications and Prevention of Renal intervention



# Complications of Renal Angioplasty

- ▶ Fortunately, Major complications during renal artery stenting are distinctly uncommon
  - ▶ overall incidence of major complications is 6–10%,
  - ▶ Common causes of mortality with renal artery stenting include haemorrhage, acute renal failure, cholesterol embolization, sepsis, and aortic dissection.
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# Complications in 37 prospective studies

- ▶ Death by 30 Days
  - ▶ Transient reduction of GFR
  - ▶ Renal artery or parenchymal injury
  - ▶ Peri-procedural CV event
  - ▶ Distal atheroembolism
- ▶ Up to 3%
  - ▶ 1 – 13%
  - ▶ Up to 5%
  - ▶ Up to 3%
  - ▶ Unknown

# Dissection of Renal Artery


- ▶ Incidence 1–18% of cases. occurs more often in heavily calcified lesions.
- ▶ **Cause for dissection** – sub-intimal passage of the guide wire. Catheter manipulations, pre dilation, oversizing the stent, or aggressive post dilation.
- ▶ **Prevention** –
  1. Reversed-curve catheter, a “soft-tipped” guidewire.
  2. Allow the guidewire to engage the renal artery orifice rather than the tip of the catheter;
  3. “No-touch” technique



# Dissection cont..

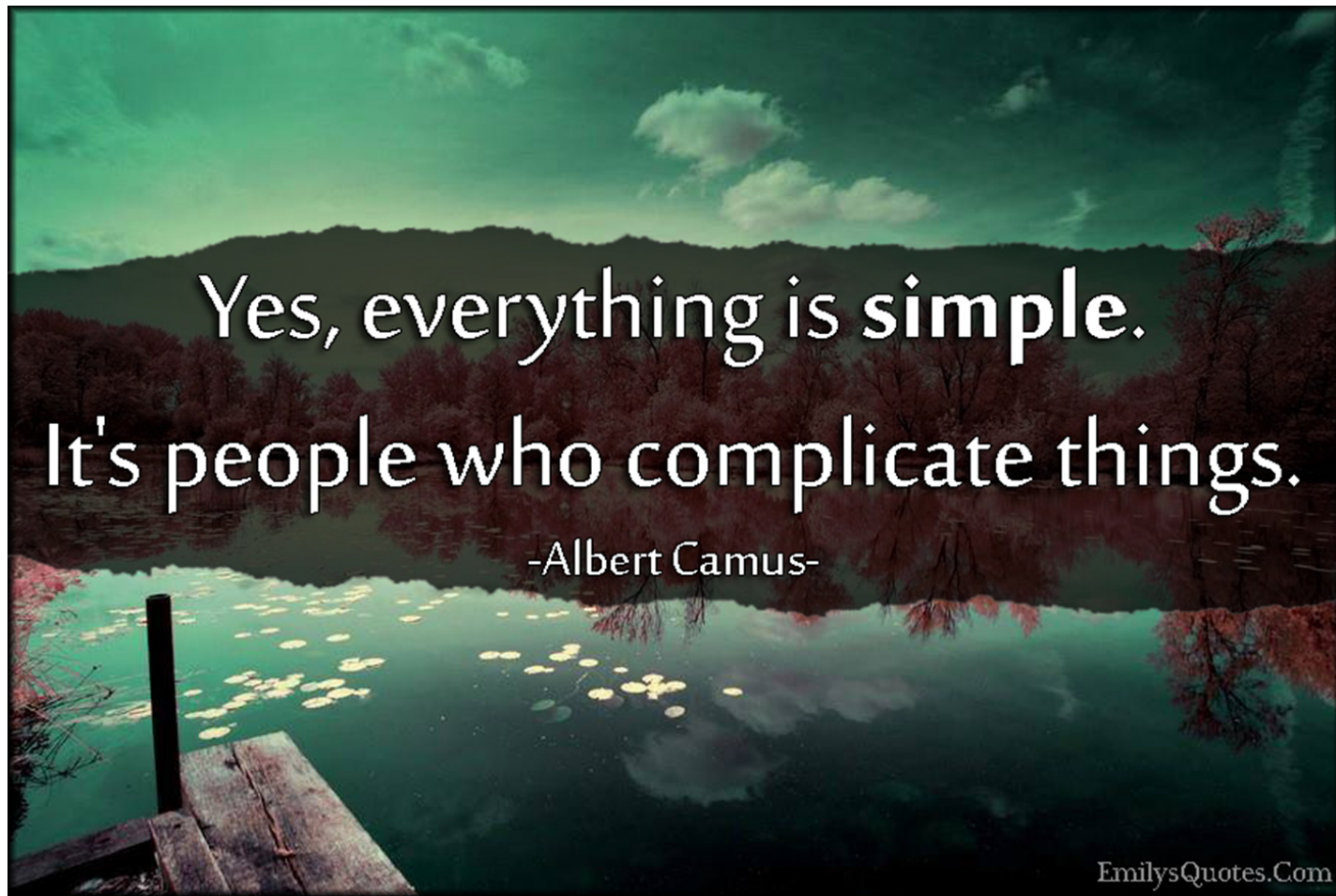
- ▶ Dissection can lead to occlusion of the renal artery .
- ▶ When this complication occurs, renal stenting can restore renal blood flow.

# Embolization

- ▶ **Caused** by manipulation of guide catheter, wire, Balloon and stent
  - ▶ Sequelae of plaque embolization may range from inconsequential to complete renal artery occlusion
  - ▶ **Prevention**
    1. Avoid aggressive manipulations
    2. Low-profile stent delivery platforms.
    3. “No-touch” technique and direct renal artery stenting.
    4. DPD
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# Repture

- ▶ **Incidence** of only 0–1.7%.
- ▶ **Caused by**– balloon dilation in the subintimal plane or balloon dilation of a heavily calcified plaque
- ▶ **Prevention** –
  1. careful selection of balloon size and avoiding aggressive post dilation.
  2. IVUS
  3. Stop dilation when patient complaints of pain




Yes, everything is simple.  
It's people who complicate things.

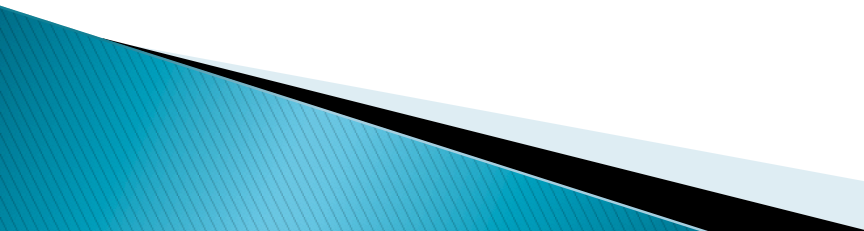
-Albert Camus-

EmilysQuotes.Com

Thank You

- High risk factors for CAS:
- Advanced age
  - Recent symptoms
  - Challenging anatomy
  - Excessive or circumferential calcification of the stenotic lesion
    - Lesions >20 mm in length, sequential lesions, and narrowmouth ulcers
  - Inability to deploy or utilize an FDA-approved Embolic Protection Device (EPD)
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# Proximal Vertebral Artery Intervention

- ▶ Most commonly located at the origin and proximal segment
  - ▶ Complication – TIA, Stroke, Dissection.
  - ▶ Use EPD is limited
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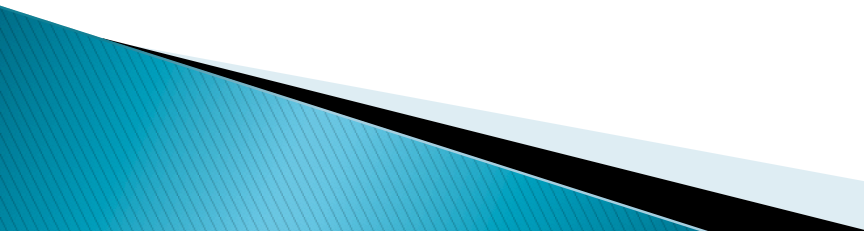
# Mount Kilimanjaro.



. Prevention and management of serious complications can mean the difference between procedural success and possible catastrophe.

**A HERO CAN BECOME ZERO**

# Aortic Dissection During Renal Angioplasty

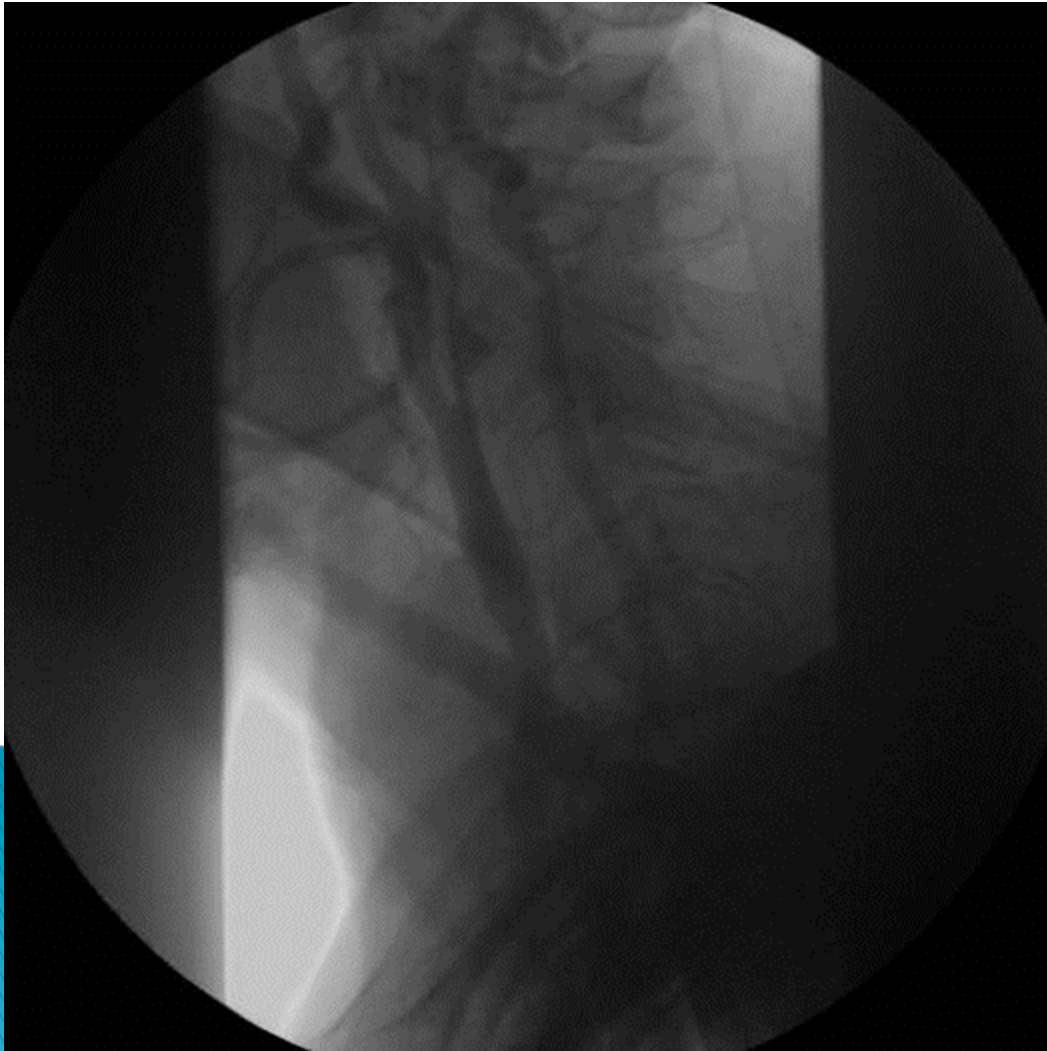
- ▶ **Incidence** of up to 2.2%
  - ▶ **Caused by** – over dilating a stent within the renal artery orifice
  - ▶ **Prevention** –
    1. Avoid over aggressive post dilation
    2. Stop dilation when patient complaints of pain
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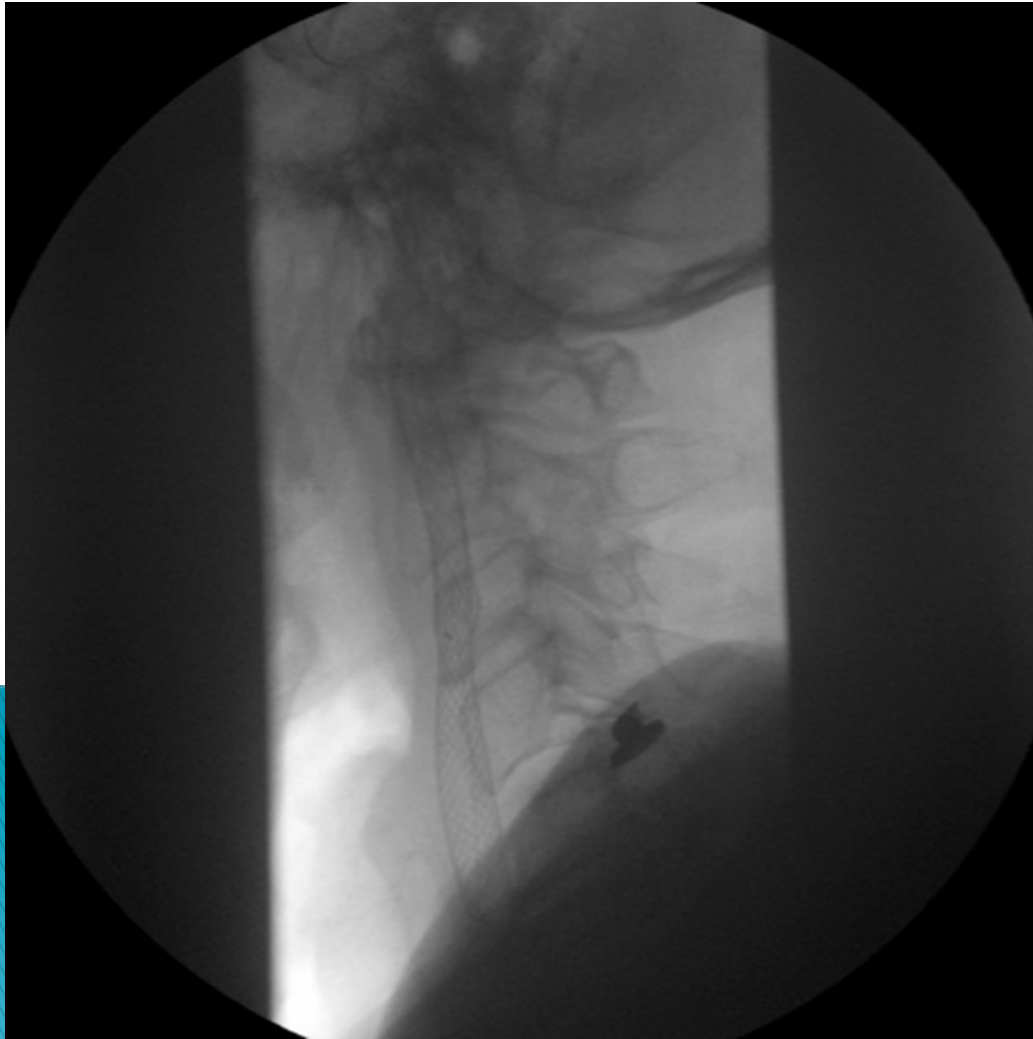
# Complications of CAS

- Stroke
- Stretching of the carotid sinus can cause bradycardia in 28% to 32% and hypotension in 22% to 26% of cases.
- Occasionally occlusion of the external carotid artery can cause jaw claudication.
- Lastly, spasm, dissection, perforation, and acute stent thrombosis may occur.

# RICA Stenosis



# Post Stent Deployment





# Medication.

- ASA 81 mg and Plavix 75 mg are begun 5 days pre procedure.
- Heparin during procedure
- Continued on ASA and Plavix minimum 4 to 6 weeks.
- ASA lifelong.
- Hold Beta Blockers on day of procedure.

# What is the problem with octagenarians?

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- Poor cerebrovascular reserve?
  - Atrophy, small vessel disease, cerebral autoregulation
  - Microembolization?, “silent” emboli on MRI
- Higher incidence of risky stenting anatomy.
  - Carotid tortuosity, bad arch, diffuse calcification
- More hemodynamic instability.

Uneventful recovery up to 5 days post CAS  
Sudden deterioration with hypertension  
and focal seizures

Deteriorating conscious level

Doppler U/S – widely patent stents but very  
high flow velocities in ICA and MCA

CT – diffuse basal SAH

Died 36 hours post CT

Diagnosis – ?

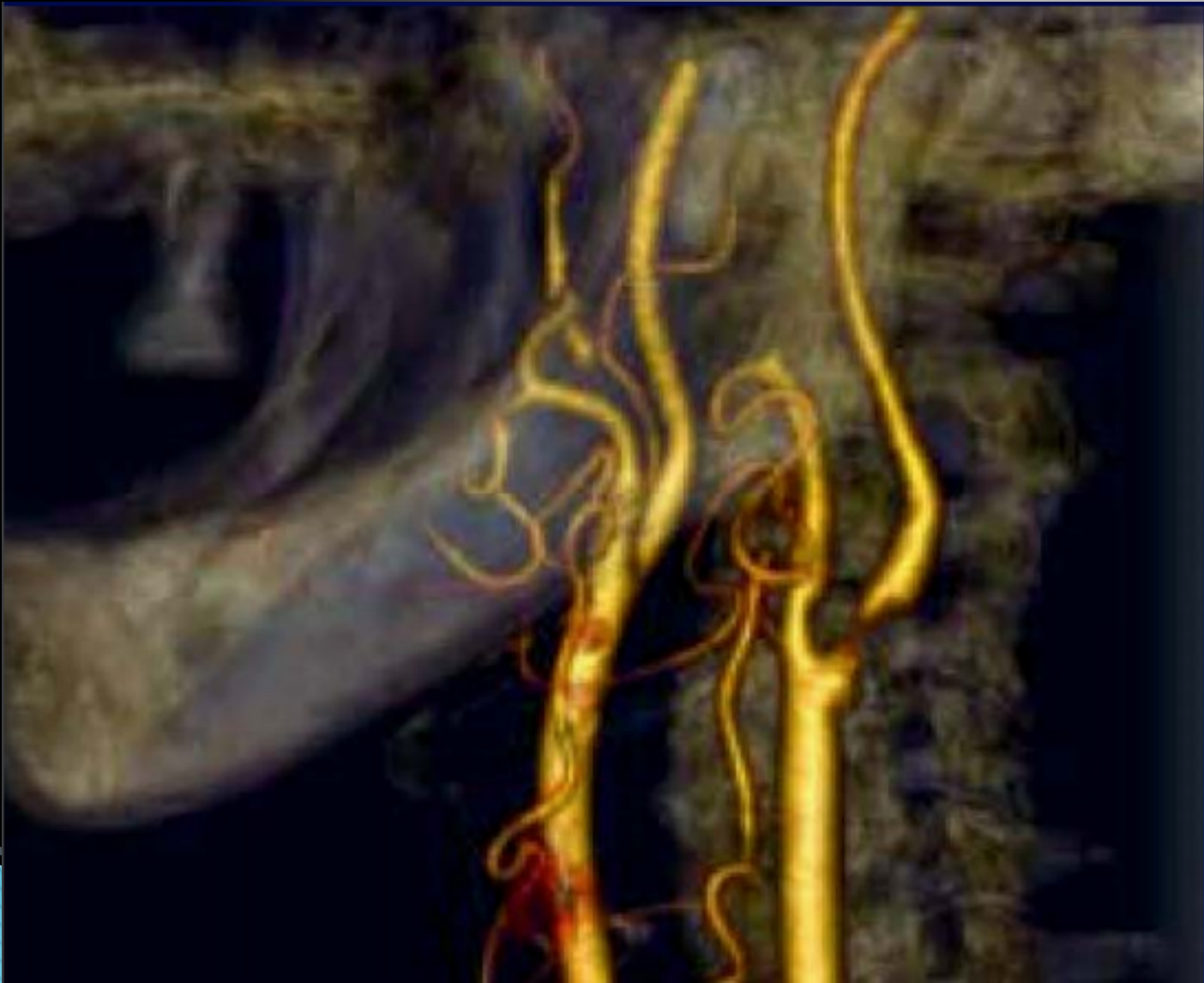
# Cerebral Hyperperfusion Syndrome

- Failure of cerebral autoregulation post revascularisation
  - 2.7% of CEA's
- Presenting symptoms
  - Self-limiting headache to fatal ICH (0.3-0.7%)
- 6 previous reports of ICH
- 1 previous report of SAH (J Neurol 1997; 244: 101-4)
- Differential diagnosis
  - Spasm
  - Dissection
    - Angio; no dissection in previously reported case
  - SAH from pre-existing aneurysm
    - Not detected on pre-procedure MRA

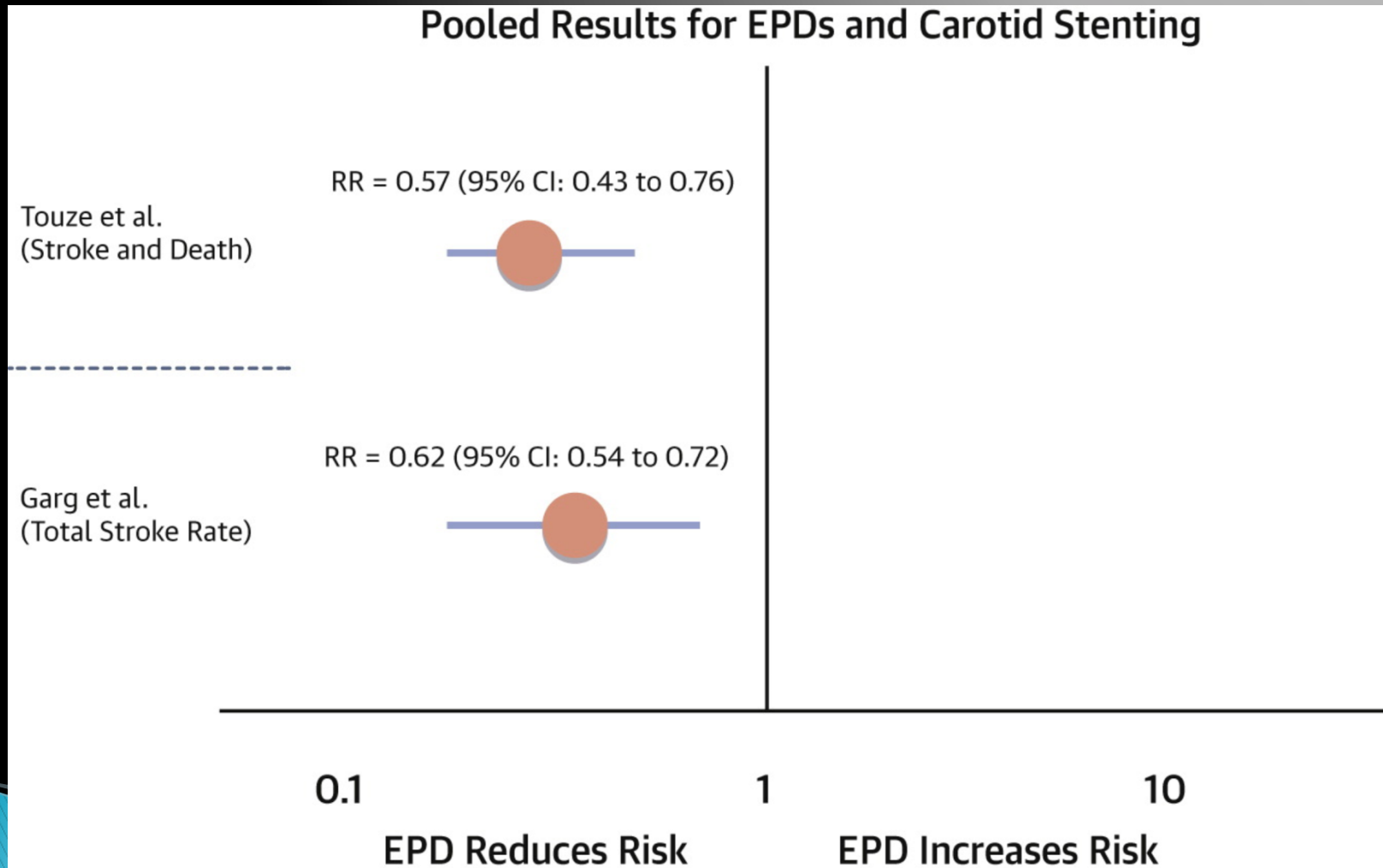
# Carotid Mesh Stent Designs

Design		  	
Aperture Size	500 $\mu$	375-500 $\mu$	150-180 $\mu$
Materials	PTFE mesh (Heparin coated) on nitinol stent	nitinol on nitinol	PET MicroNet™ on nitinol stent





# Meta-analysis data supporting the use of EPD



# My Worst Complication

- 75 year old male
- 3 minor left sided anterior circulation strokes in previous 5 months and hospitalised since first event
  - CHD – previous MI
  - Chronic Cl.diff infection
  - Chronic alcohol abuse
- CT brain – diffuse ischaemic change/moderate atrophy
- Doppler U/S
  - > 70% RICA stenosis; 50-69% LICA
- MRA – confirmed severe RICA stenosis with ulceration
- Turned down for CEA
- Referred for CAS

# Renal Angioplasty

- ▶ complications of angioplasty include hematoma at the puncture site; azotemia, caused by the dye load; and cholesterol emboli.
- ▶ These complications tend to be more common in old patients with diffuse atheromatous disease than in others
- ▶ patients with elevated creatinine levels, alternative contrast agents such as carbon dioxide and gadolinium-based contrast may be used to minimize the risk of azotemia
- ▶ Gadolinium have been linked to the development of nephrogenic systemic fibrosis (NSF) or nephrogenic fibrosing dermopathy (NFD)

- ▶ Manipulations with the initial catheterization can lead to dissections of the renal artery or segmental branches, which may be a cause for acute renal artery occlusion. Renal artery rupture, renal artery dissection or aortic dissection may follow stent deployment. Cholesterol embolization resulting in renal artery occlusion may occur with either the initial catheterization or the stent deployment. With meticulous technique, many of these complications can be avoided. Prevention and management of these serious complications can mean the difference between procedural success and possible catastrophe.