Stroke in the Young: Extracranial and Intracranial Arterial Dissections

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Arterial dissections

- Pathogenesis?
- Diagnosis and mimics?
- Natural history ?
- Predictors of deterioration?
- Thrombolytic treatment?
- Endovascular treatment?

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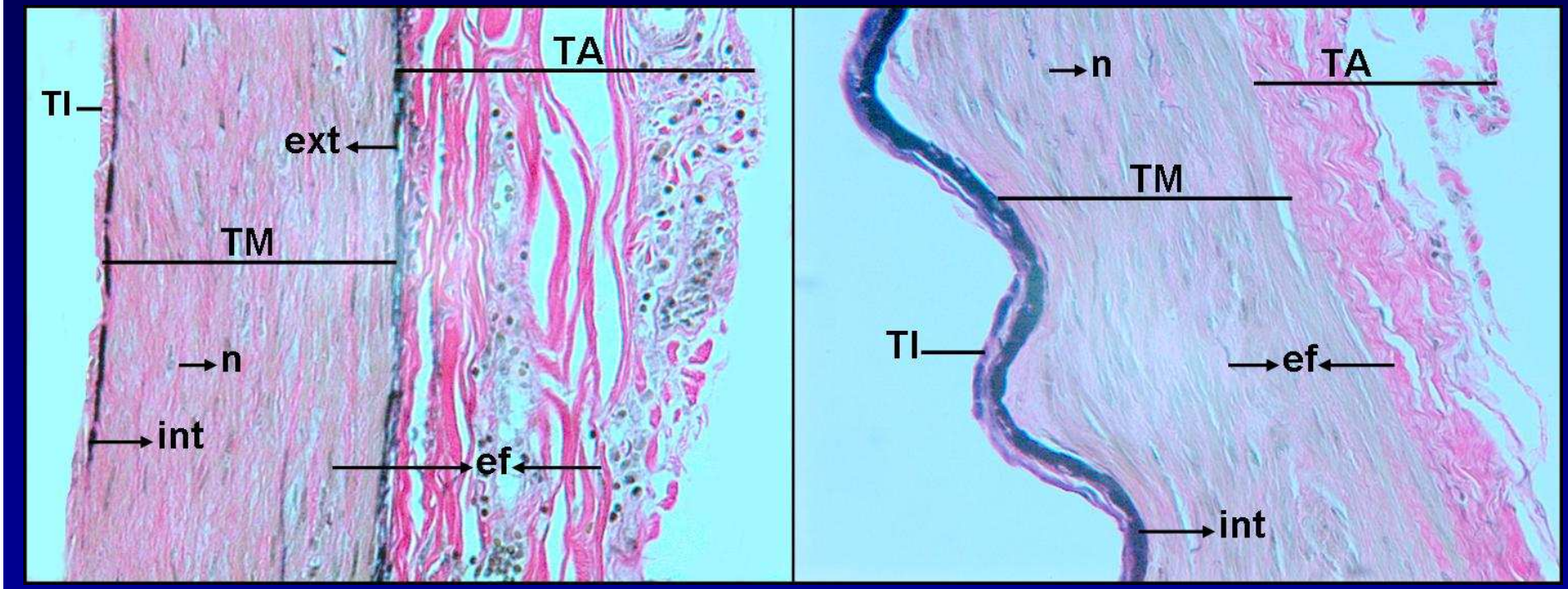
Arterial anatomy

(Re; Miley JT. From eds Qureshi AI, Georgiadis AL. Textbook of Interventional Neurology, Cambridge, UK).

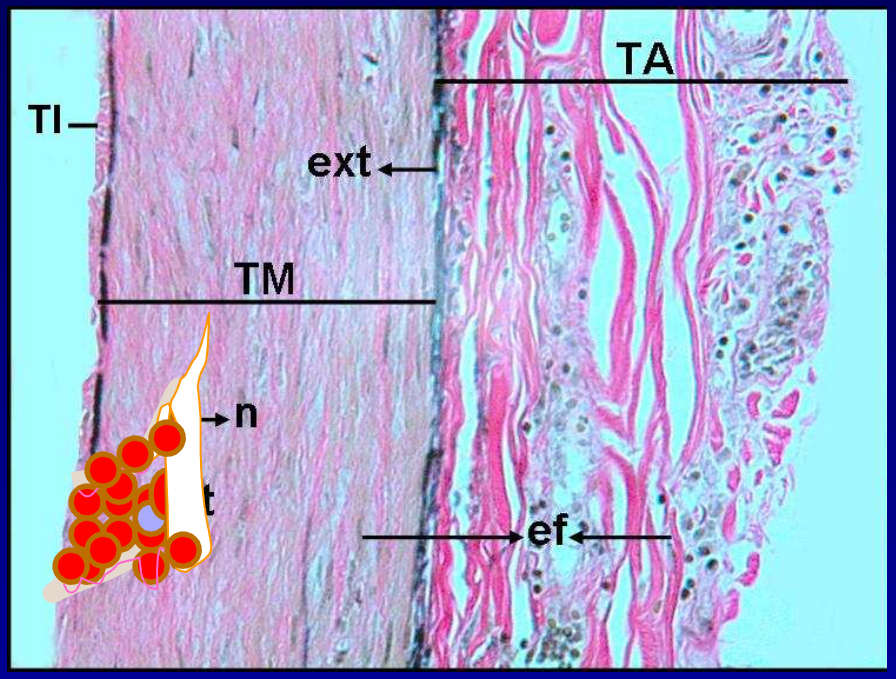


Extracranial artery

Intracranial artery

Dissection- Disruption of layers of arterial layer

- *Lumen narrowing*
- *Intimal flap*
- *Thromb-osis*
- *False lumen*



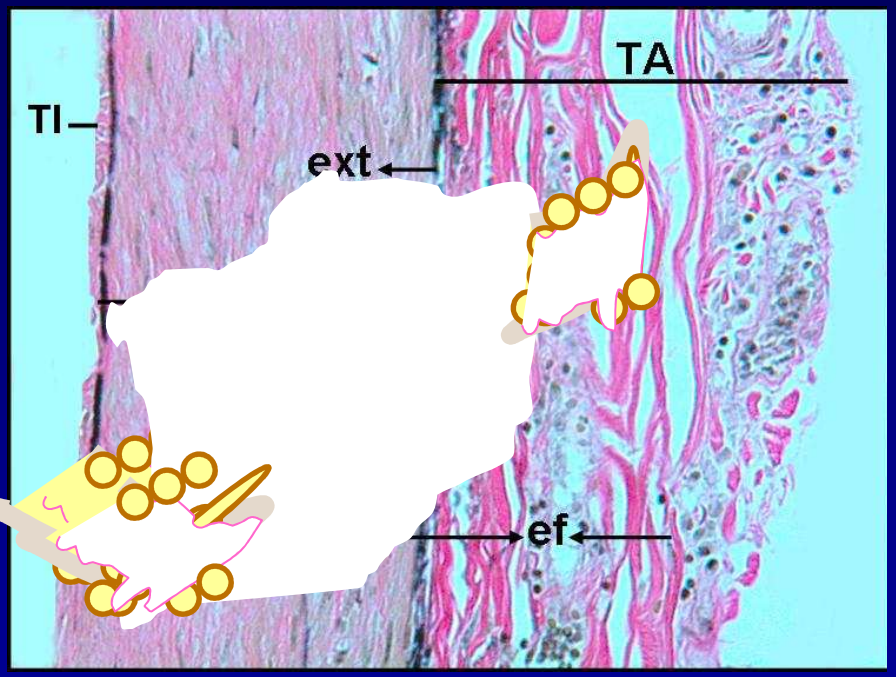
Dissection- Disruption of layers of arterial layer

Lumen narrowing

Intimal flap

Thromb-osis

False lumen

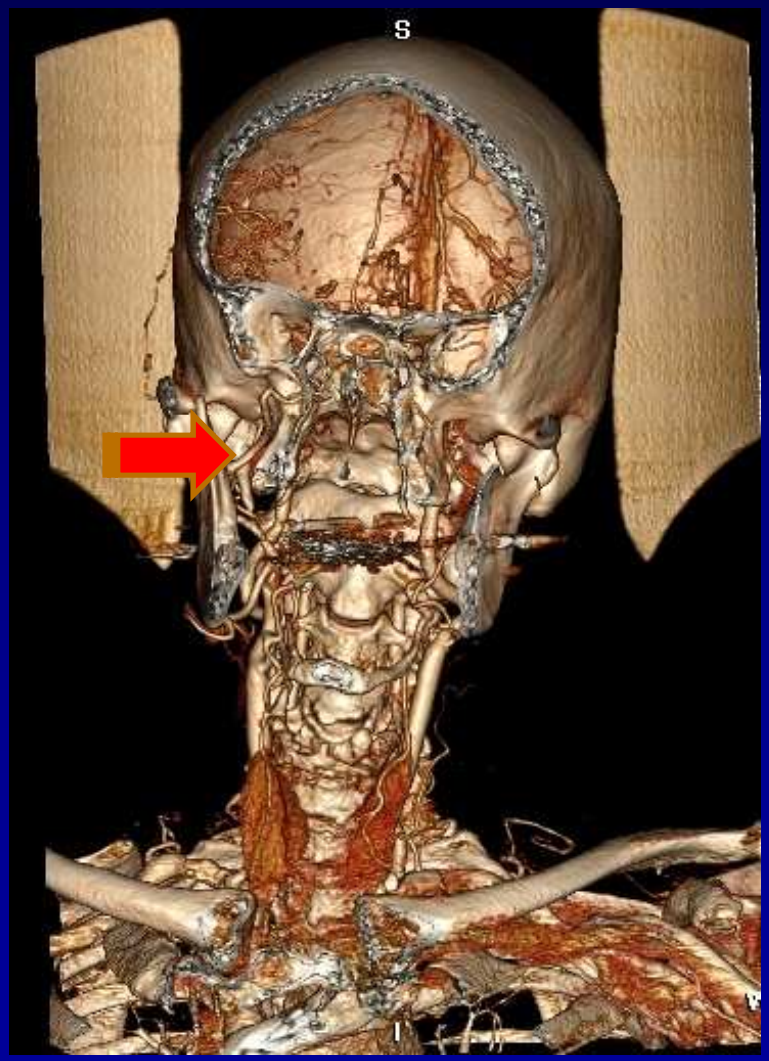


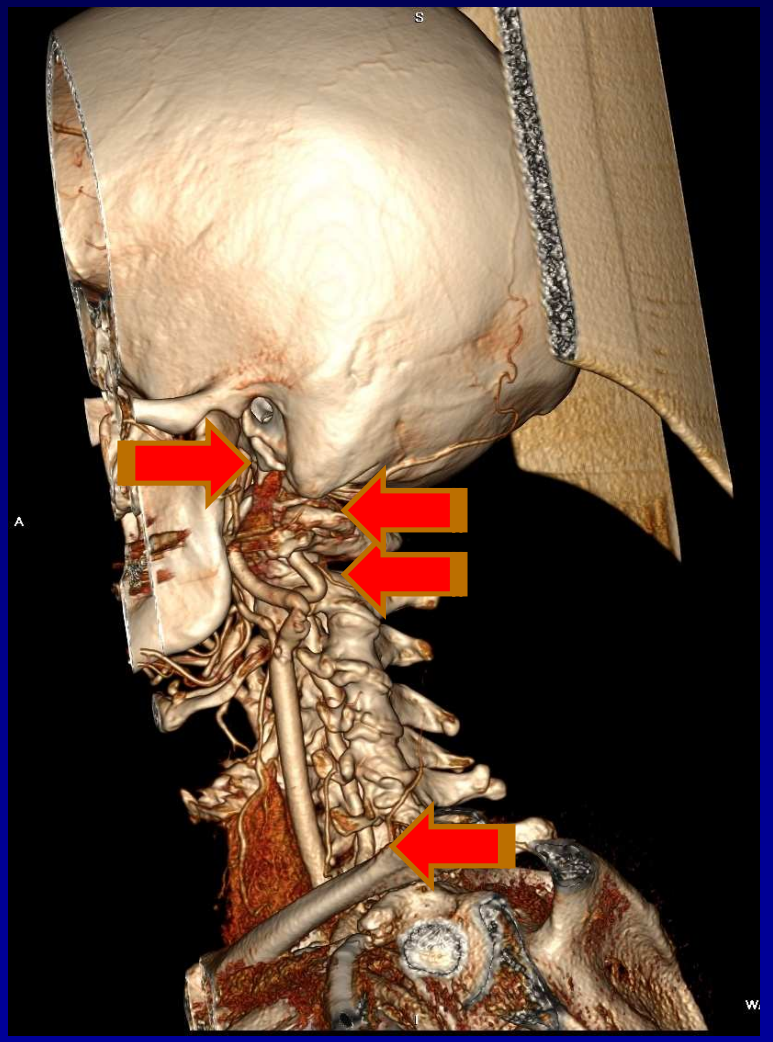
Pseudo-aneurysm

Sub-arachnoid hemorrhage

Arterial vulnerability (mobile-fixed junctions)

(Re; From eds Qureshi AI, Georgiadis AL. Textbook of Interventional Neurology, Cambridge, UK).





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Clinical presentation in population based studies

Head and neck pain	80%
Cerebral ischemia	50%
Horner's syndrome	25%

Lee VH, et al. Neurology. 2006 Nov 28;67(10):1809-12

Diagnostic criteria at ZQSRC

1. Age atypical for stenosis secondary to an atherosclerotic lesion
2. Clinical symptoms such as neck pain or signs of Horner's syndrome suggestive of dissection
3. Disruption of the arterial vessel wall on imaging studies: stenosis, intimal flap, false lumen, mural thrombus, and pseudoaneurysm
4. Location of lesion at high vulnerability arterial junctions
5. Absence of changes suggestive of atherosclerosis such as calcification
6. Exclusion of vessel hypoplasia and pseudo-dissection

Re: Hassan AE: J Neuroimaging 2012;22:384-93.

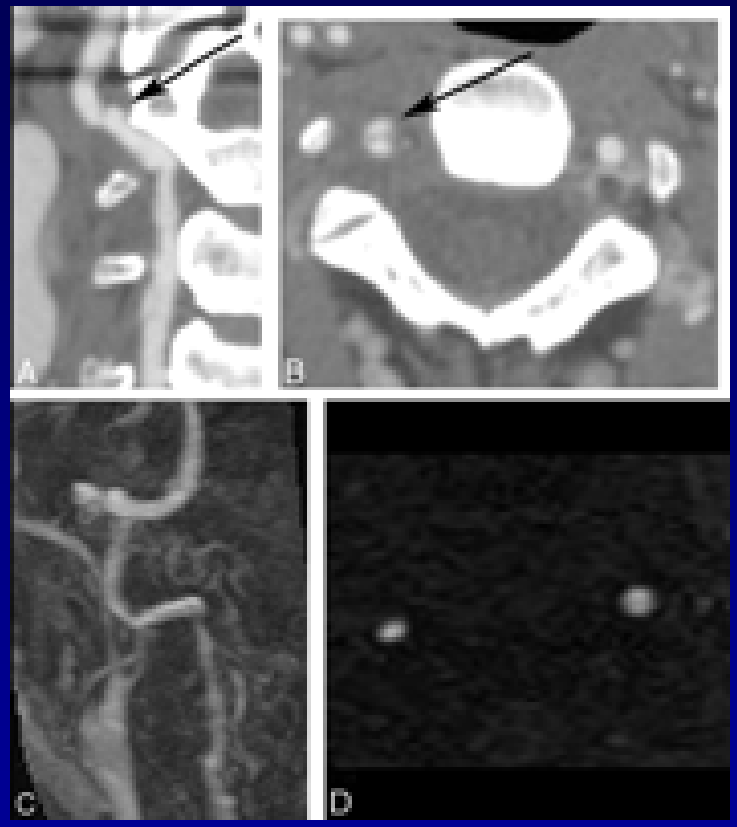
Diagnostic modalities

(From eds Qureshi AI, Georgiadis AL. Textbook of Interventional Neurology, Cambridge, UK).

1. **Clinical history and examination**
2. **Cerebral angiogram, magnetic resonance angiography (MRA) or a computed tomography angiography (CTA). Source images for calcification.**
3. **Fat suppression T1 weighted MRI sequences**

CTA/CT versus MRA/MR

(Vertinsky AT et al. AJNR Am J Neuroradiol. 2008 Oct;29(9):1753-60.)



CT/CTA identified more intimal flaps, pseudoaneurysms, and high-grade stenoses than MR imaging/MRA.

Aneurysmal form of dissection

Touze E et al. Stroke. 2001 Feb;32(2):418-23

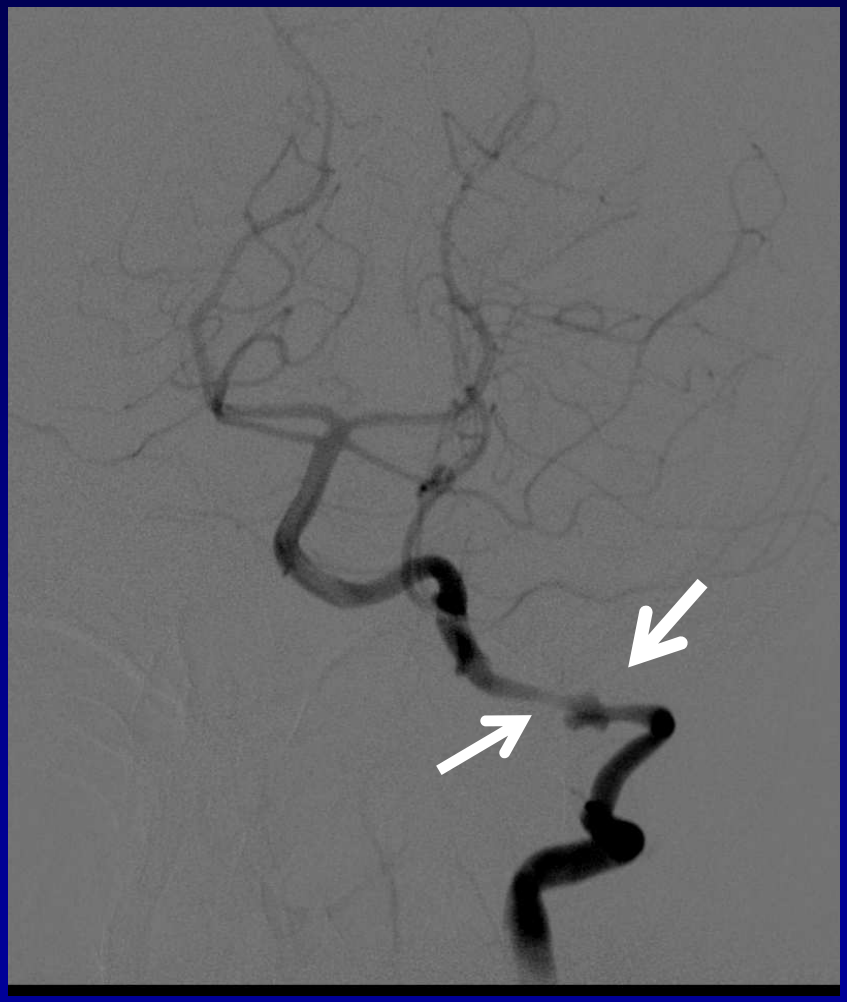
Seen in 50% of dissection patients
30 of 42 aneurysm on symptomatic arteries

3 year follow-up
46% unchanged
54% resolved/decrease
No clinical events

Multi-vessel dissection (1/3rd of cases)

Re: Hassan AE. J Stroke Cerebrovasc Dis 2013;22:42-8

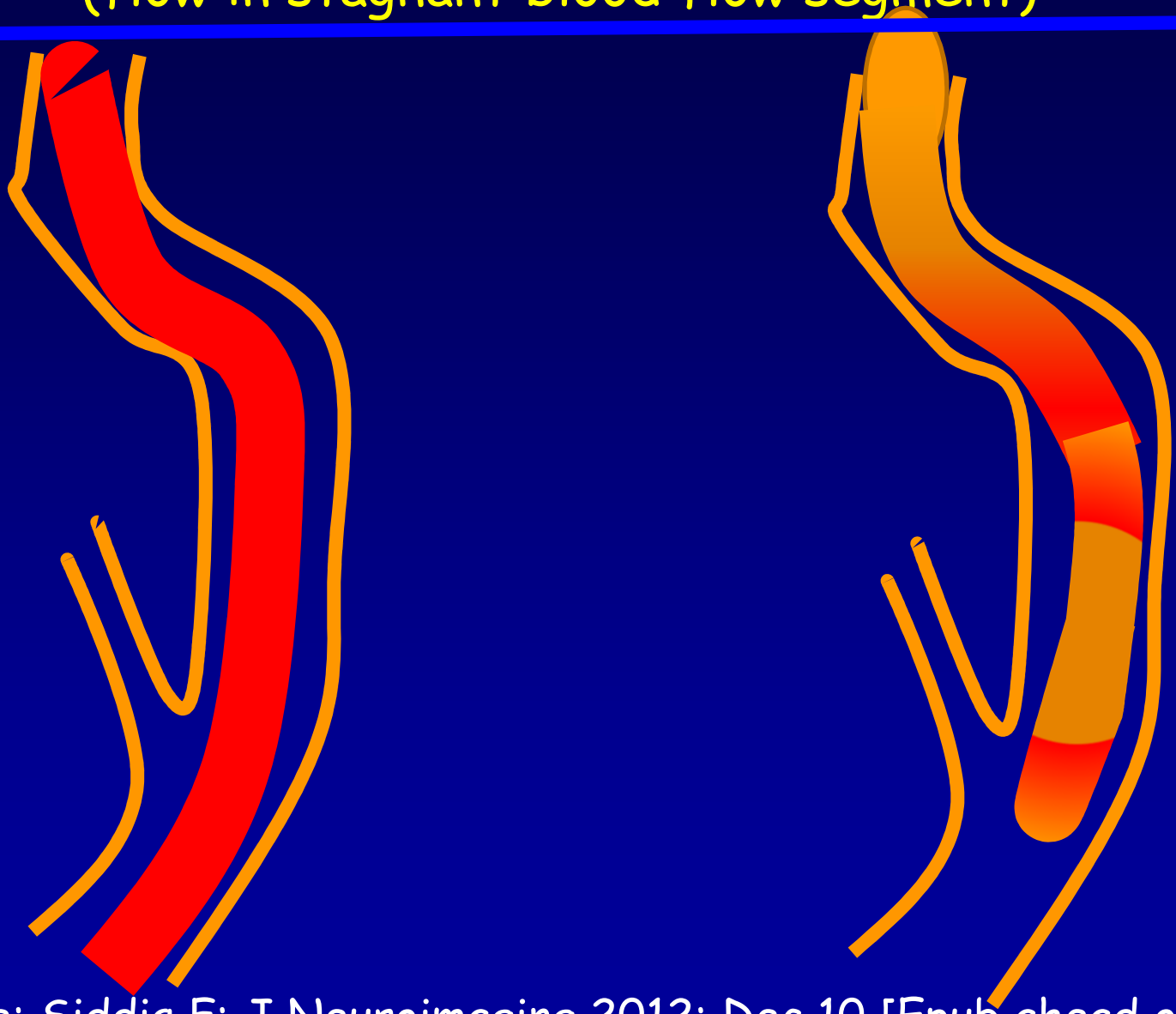
Right vertebral artery



Left vertebral artery

Pseudo-dissection in cervical ICA

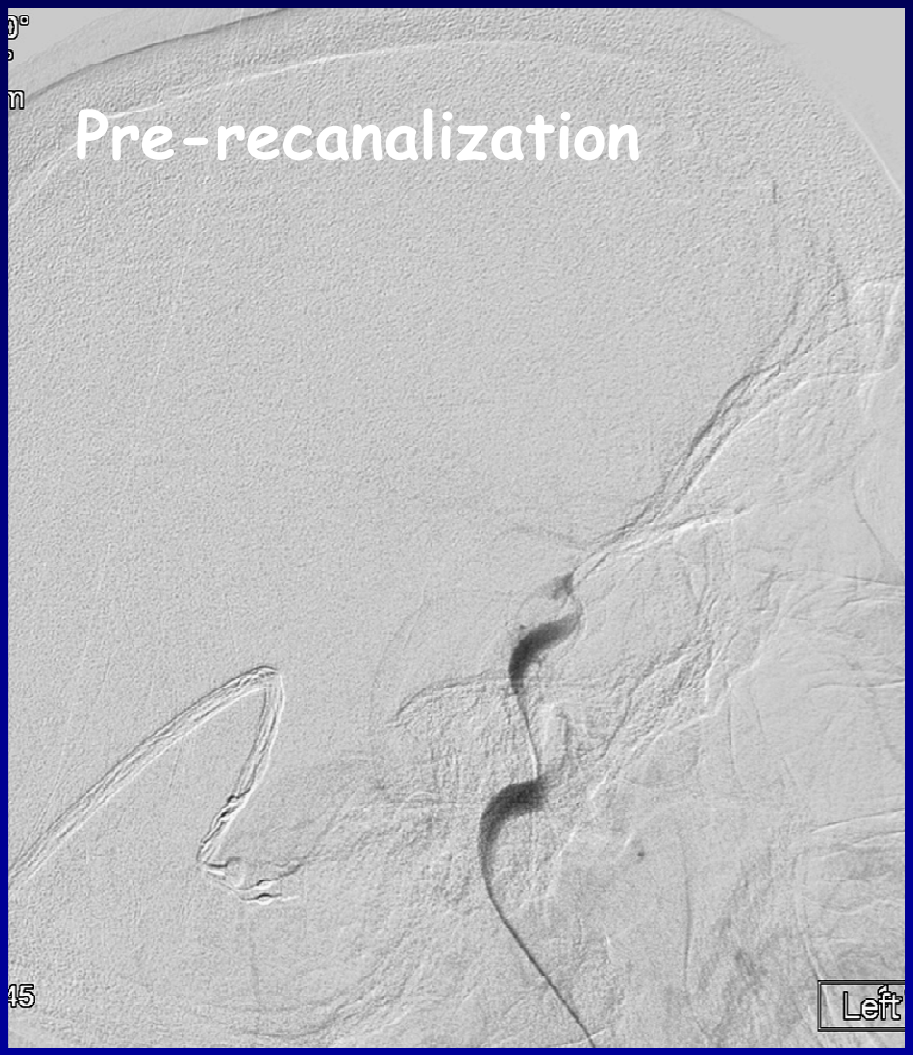
(flow in stagnant blood flow segment)

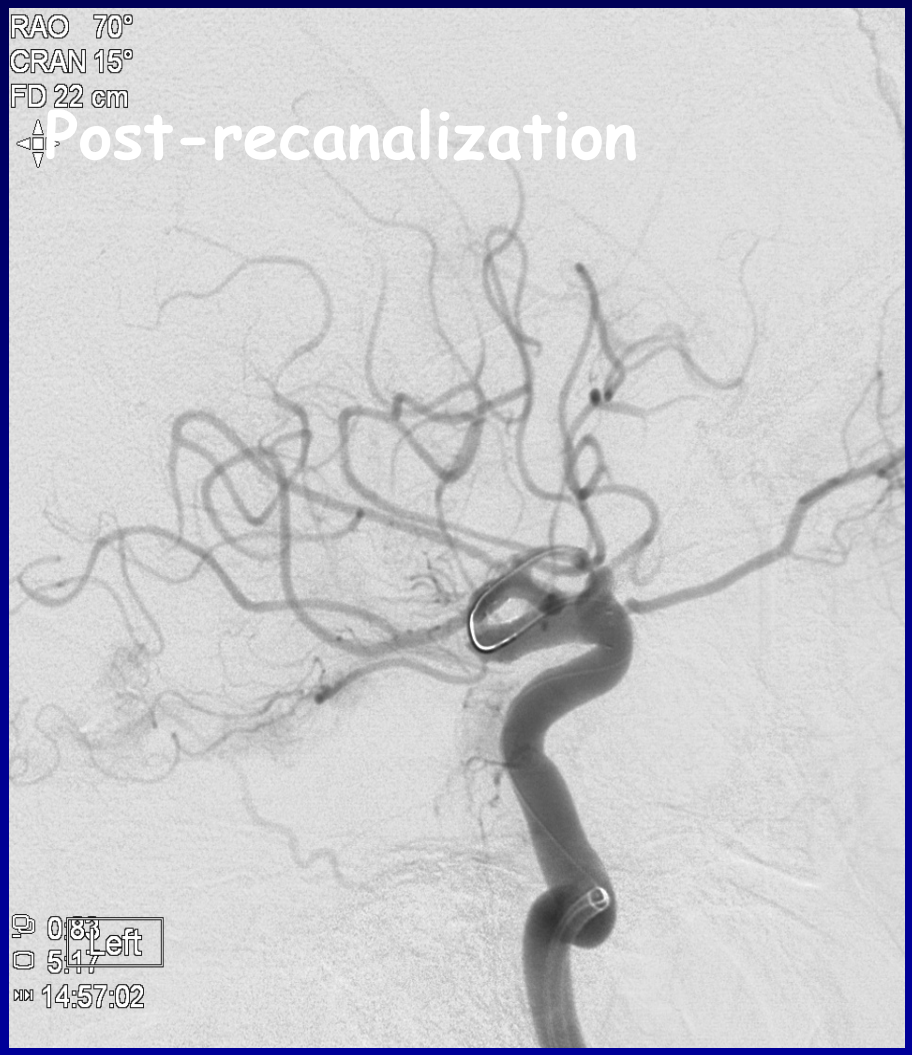


Re: Siddiq F: J Neuroimaging 2012: Dec 10 [Epub ahead of print]

Pseudo-dissection

Intracranial-cervical junction of ICA





Arterial dissections

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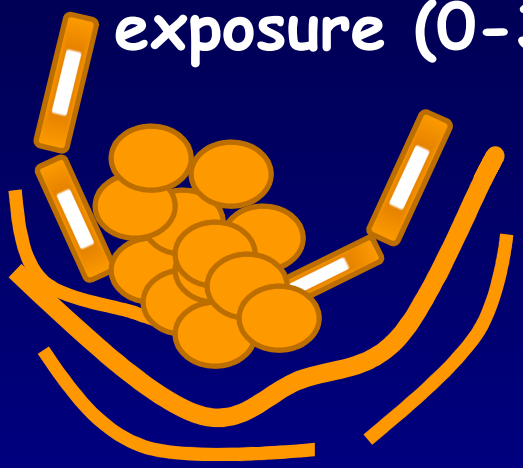
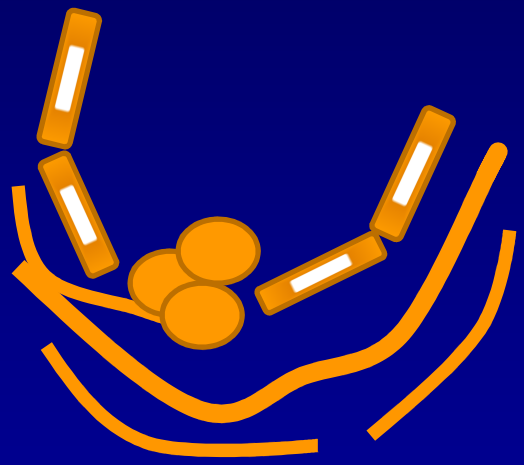
Pathophysiological changes with arterial dissection

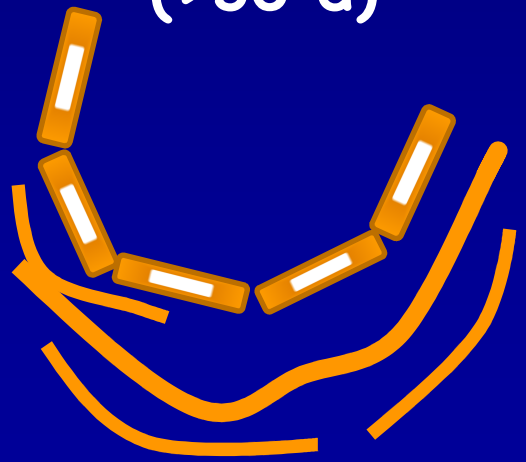
Subintima exposure (0-3d)



Passivation (3-30d)



Re-endo-theliazation (>30 d)

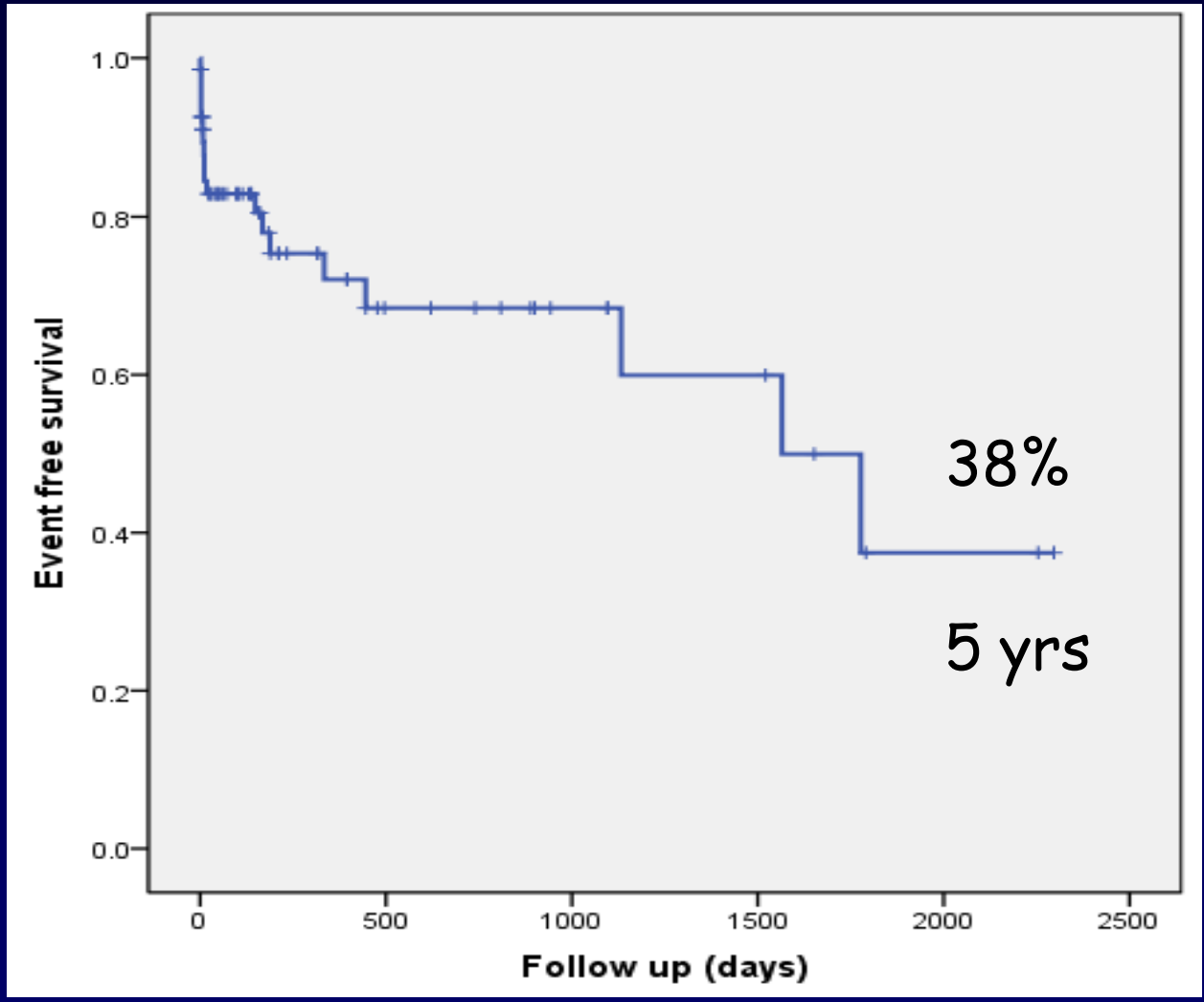


Thrombogenicity

Qureshi AI. Neurosurgery. 2000;46(6):1344-59.

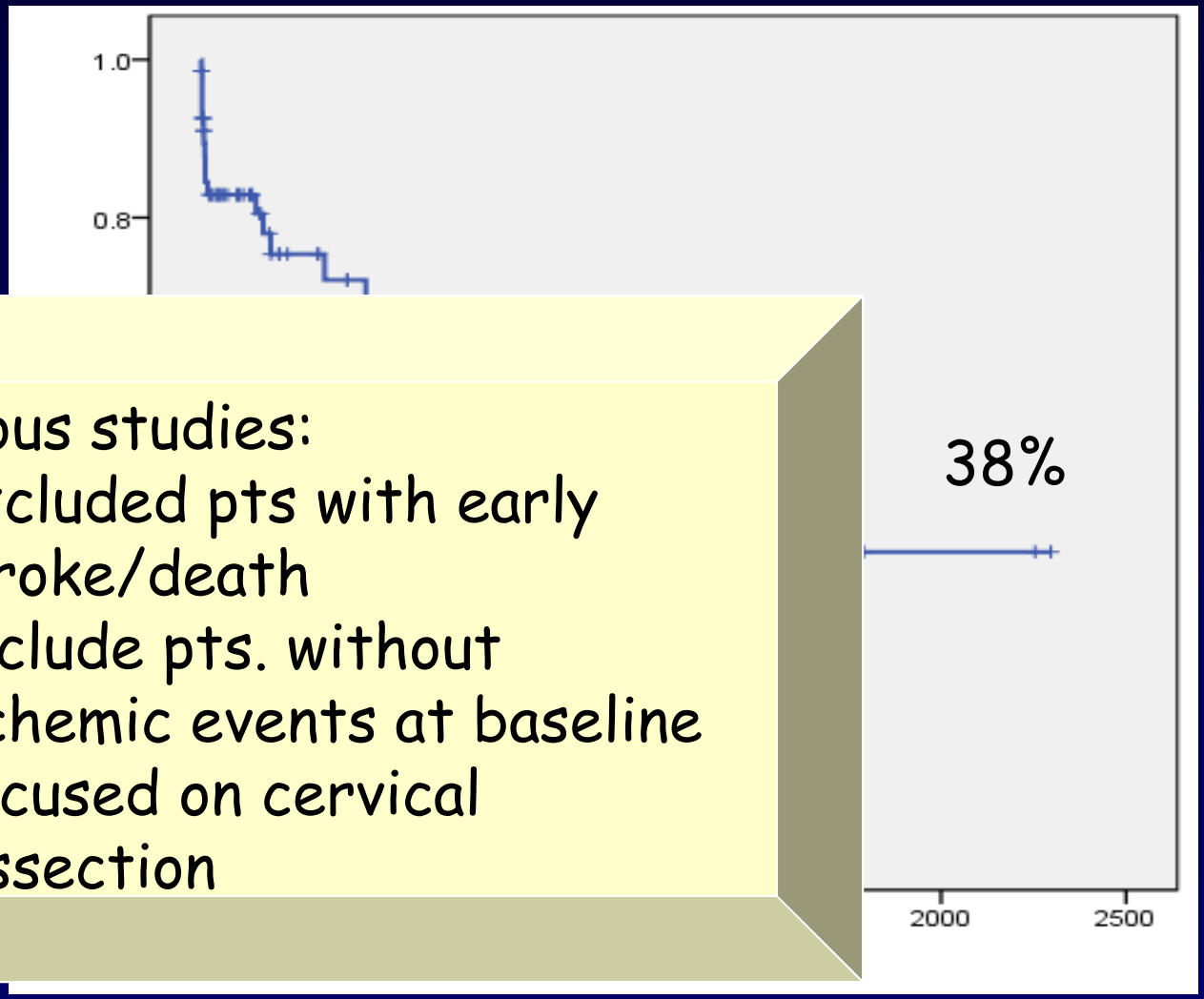
Ischemic event free survival in 69 patients with neurovascular dissection

(Re: Hassan AE. J Stroke Cerebrovasc Dis 2011 Nov 12 [E pub])



Ischemic event free survival in 69 patients with neurovascular dissection

NOT A BENIGN ENTITY

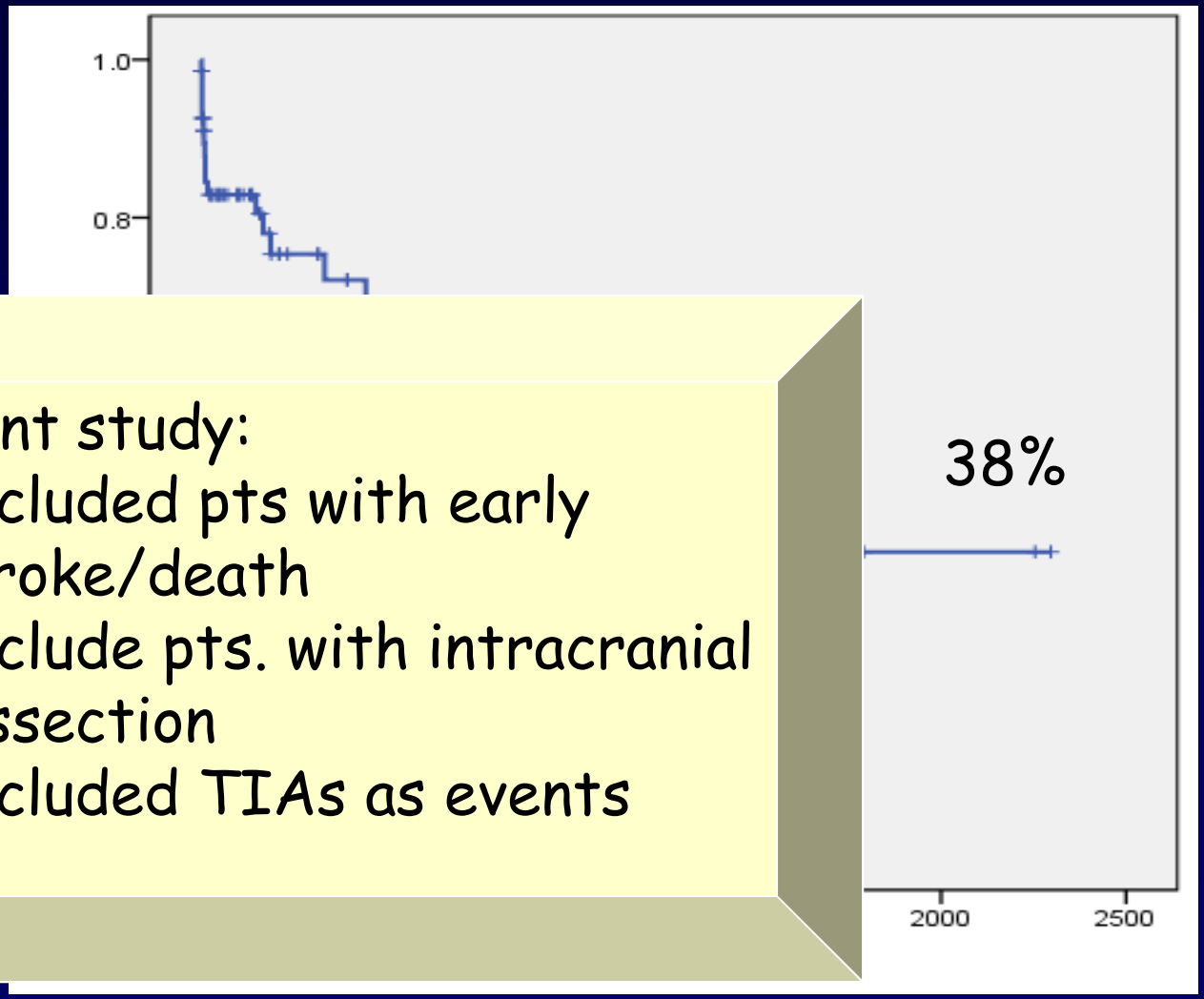


Previous studies:

1. Excluded pts with early stroke/death
2. Include pts. without ischemic events at baseline
3. Focused on cervical dissection

Ischemic event free survival in 69 patients with neurovascular dissection

Which one do you believe?



Current study:

1. Included pts with early stroke/death
2. Include pts. with intracranial dissection
3. Included TIAs as events

Arterial dissections

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- Natural history ?
- **Predictors of deterioration?**
- Thrombolytic treatment?
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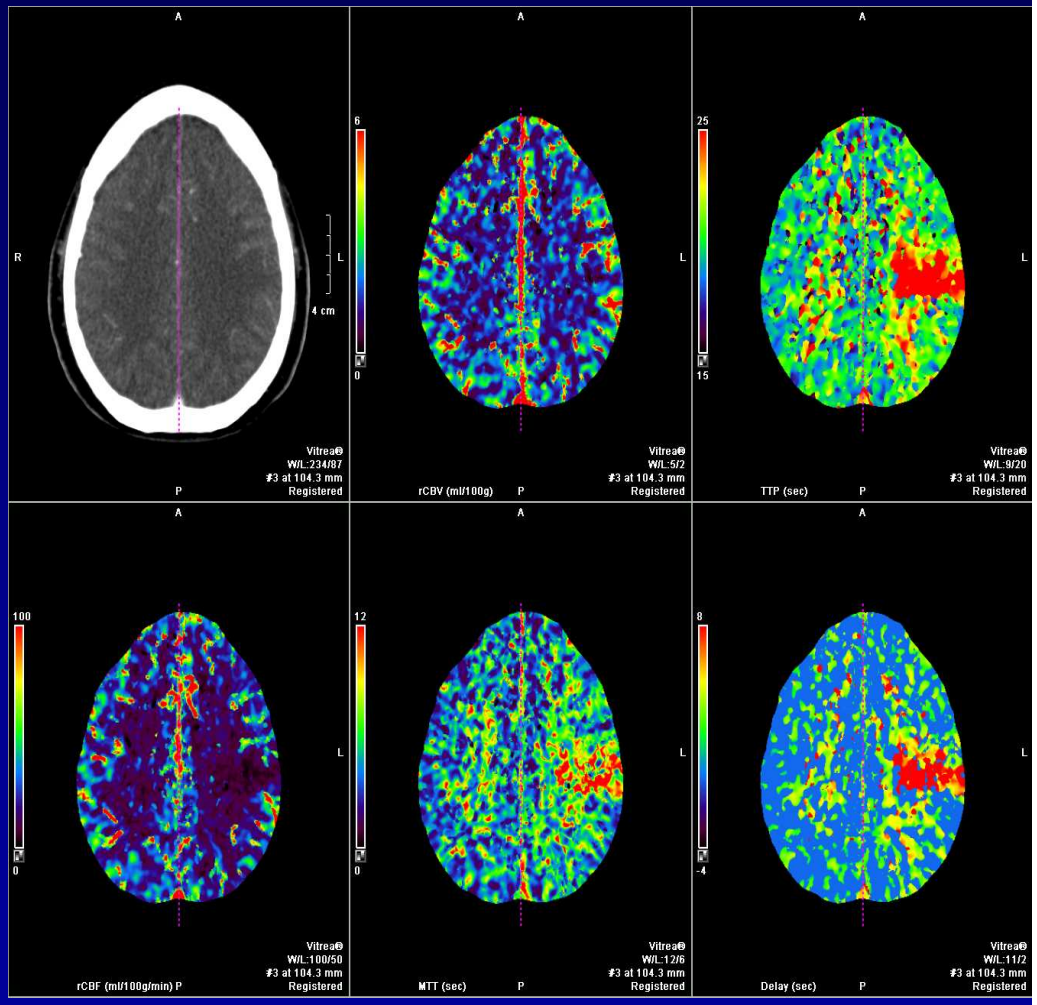
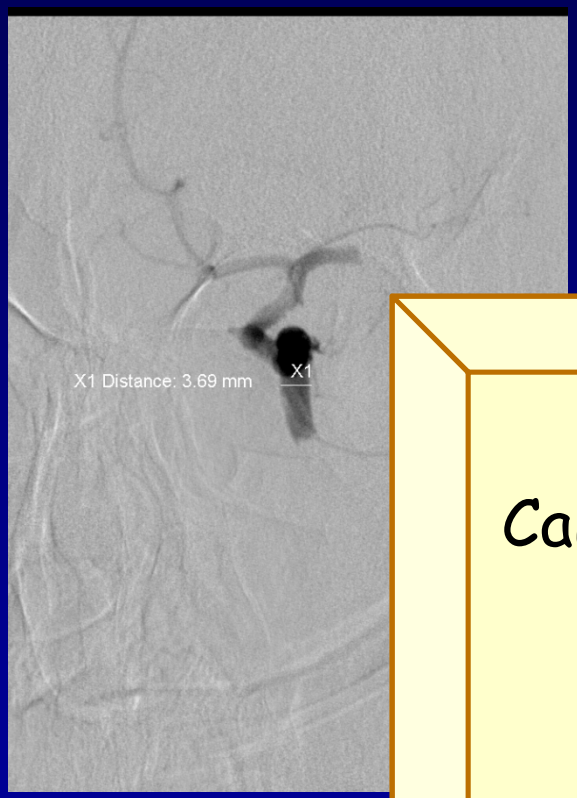
Day 0-NIHSS 2

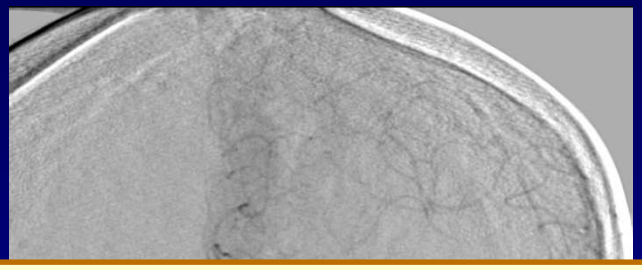
Started on dual antiplatelets

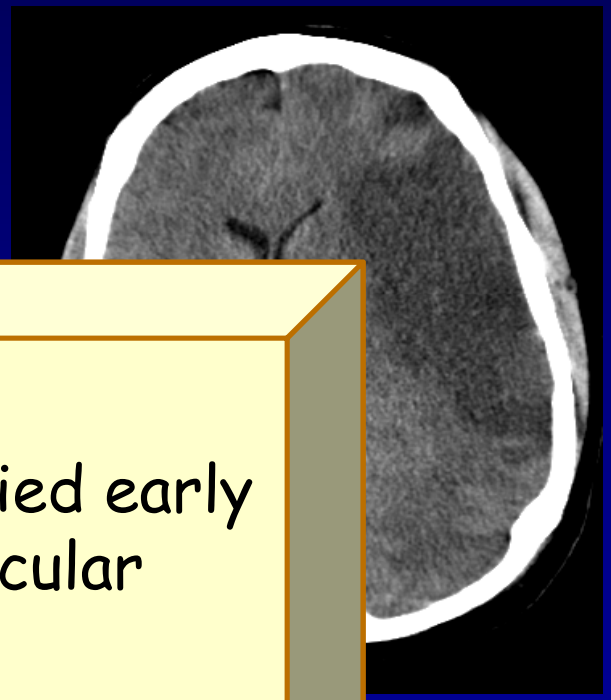


Day 1-NIHSS 20 (deterioration)
Subsequently underwent unsuccessful IA thrombolysis

Day 1-NIHSS 20 (deterioration) Underwent unsuccessful IA thrombolysis







Can these pts be identified early and undergo endovascular treatment?

Predictors of neurological deterioration

	Subjects	In hospital neurological deterioration	Neurological deterioration within 1 year	Log-Rank (p value)
	(n=69)	(n=11)	(n=15)	
Gender				3.9 (0.04)
Men	45	5 (11%)	7 (16%)	
Women	24	6 (25%)	8 (33%)	
Involve both vertebral arteries				4.8 (0.02)
Yes	5	2 (40%)	2 (40%)	
No	64	9 (14%)	13 (20%)	
Intracranial vs. extracranial				4.9 (0.02)
Intracranial	23	6(27%)	8 (35%)	
Extracranial	44	5(11%)	7 (16%)	

(Re: Hassan AE. J Stroke Cerebrovasc Dis 2011 Nov 12 [E pub])

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The effect of underlying arterial dissections on outcomes in thrombolytic treated ischemic stroke patients (Nationwide Inpatient Sample 2005-2008)

Re: Qureshi AI. Arch Neurol 2011;68:1536-42

Outcomes	Un-adjusted		Adjusted for age, gender, risk factors and hospital teaching status	
	OR (95% C.I.)	P value	OR (95% C.I.)	P value
Minimal disability	0.7 (0.4 - 1.1)	0.16	0.3 (0.2 - 0.5)	< .001
Moderate to severe disability	1.3 (0.8 - 2.1)	0.2	2.1 (1.3 - 3.4)	0.001
In-hospital mortality	1.0 (0.5- 2.0)	0.8	1.7 (0.9 - 3.5)	0.09

Ischemic stroke patients with underlying arterial dissection ARE LESS LIKELY TO RESPOND to IV thrombolytic treatment

Re: Qureshi AI. Arch Neurol 2011;68:1536-42

- Higher rate of flow limiting non-thrombotic lesions
- Higher levels of platelet activation and aggregation resulting in platelet rich thrombo-embolisms
- Involve multiple segments or arteries- limit the potential to develop collateral flow.

Ischemic stroke patients with underlying arterial dissection ARE LESS LIKELY TO RESPOND to IV thrombolytic treatment

Re: Qureshi AI. Arch Neurol 2011;68:1536-42

- Additional treatment modalities after thrombolytic treatment to reduce the rate of poor outcomes.
- Similar to endovascular treatment following intravenous thrombolytic treatment in patients with ≥NIHSS score of 10 or hyperdense middle cerebral artery sign.

Arterial dissections

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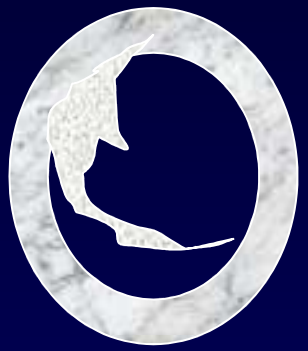
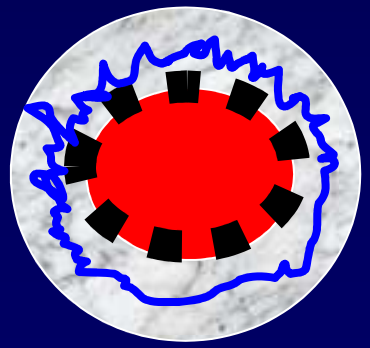
Mechanism of beneficial effect of stent

Distal embolization

Superimposed thrombus



Hypoperfusion

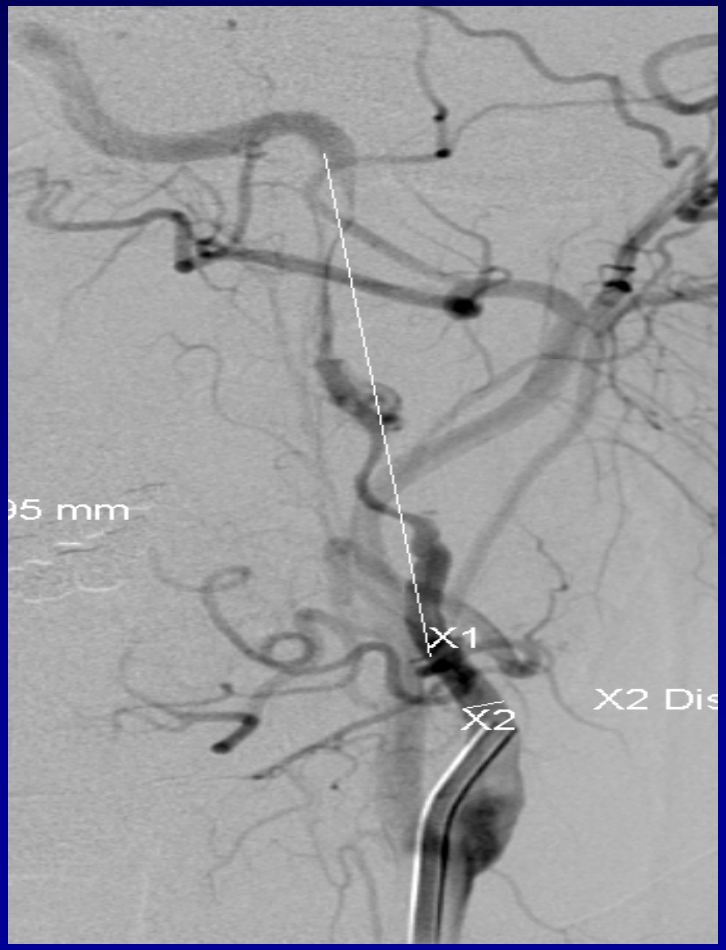


Remodeling reduces thrombogenecity

Restore diameter of vessel to improve perfusion

Endovascular treatment of spontaneous extracranial internal carotid artery dissection

(Re: Hassan AE. J Neuroimaging 2012;22:384-93)

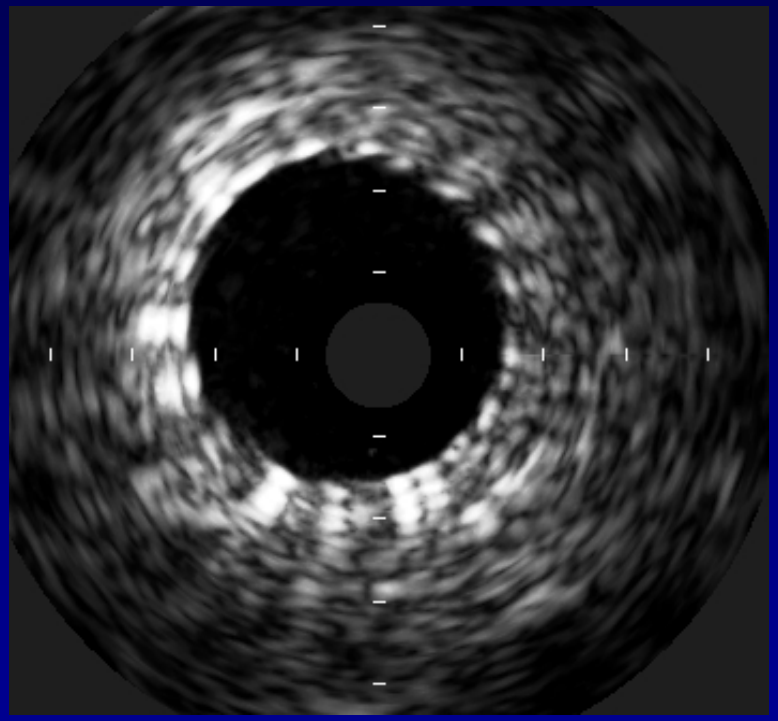


Pre Stent

Post Stent

One year follow up-Results are sustainable

(Re: Hassan AE. J Neuroimaging 2012;22:384-93)



Intravascular ultrasound

Systematic review (4 studies) –stent placement for dissection

(Re: Hassan AE. J Neurotrauma 2012;29:1342-53)

Etiology	Pre-procedure stenosis	Post-procedure stenosis	Adverse events during follow-up
28 spontaneous	71%	6%	11%
11 traumatic			
7 iatrogenic			

ASA/AHA Council guidelines: Candidates for endovascular treatment

Re: Sacco RL, et al. Circulation 2006;113:e409-449.

- Symptomatic patients refractory to medical management;

or

- Asymptomatic dissections with persisting hemodynamically (> 70%) significant stenoses, unstable intimal flaps, or enlarging pseudoaneurysm.

Conclusions

- Neurovascular dissection remains an understudied and less understood cause of cerebral ischemic and hemorrhagic events.

- The natural history of extracranial and intracranial dissections may be worse than initially thought.

- The management of dissections need to revisited in the current era of thrombolytics and stents.

Thank you

Zeenat Qureshi Stroke Research Center 2012

Characteristics of patients with multivessel dissection

Re: Hassan AE. AAN annual meeting. 2010; Toronto, CA

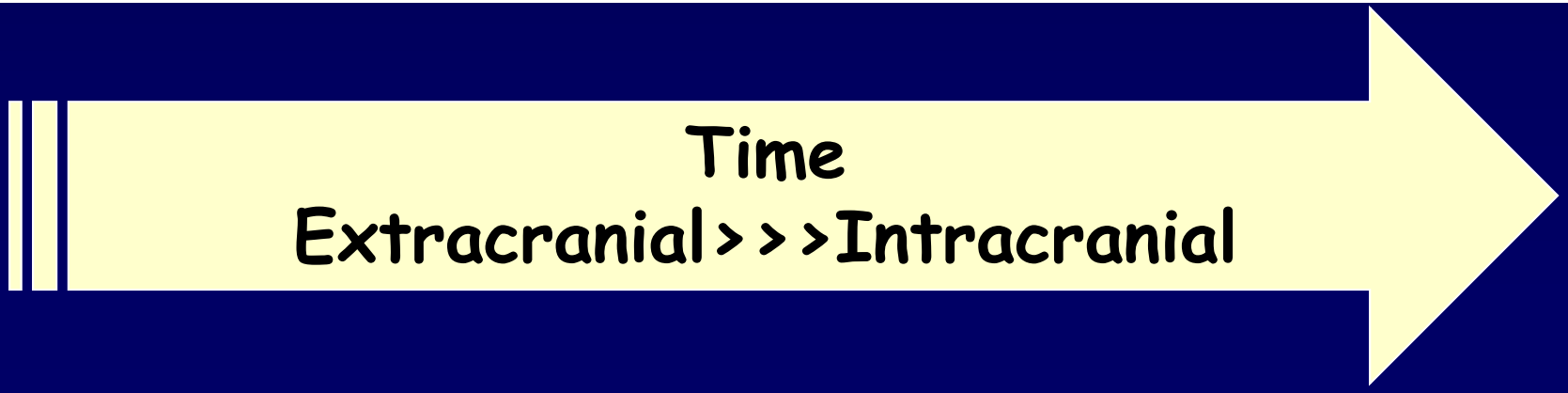
	Pts with single dissection (n = 37)	Pts with multiple dissections (n=9)	p – value
Angiographic severity of stenosis	63 ± 28%	71 ± 21%	0.44
Presence of pseudoaneurysm	12 (33%)	8 (89%)	0.003
Fibromuscular dysplasia (FMD)	3 (8%)	3 (33%)	0.04

Patients treated with thrombolytics according to presence or absence of underlying arterial dissection (Nationwide Inpatient Sample 2005-2008)

	Patients treated with thrombolytics without underlying arterial dissection	Patients treated with thrombolytics with underlying arterial dissection	p-value
Characteristics	(n=47411)	(n=488)	
Mean age (±SD)	69.01±14.6	50.13±13.01	< .001
Medical complications			
ICH (%)	6.4	6.9	0.7987
Procedures			
Cerebral angiography (%)	23.4	64.1	< .0001
Carotid stent (%)	3.0	19.3	0.0015
Intracranial stent (%)	1.5	4.1	0.1727
Hospital outcomes			
Mean hospital charges (±SD)	$62,431±63,479	$101,203±85,875	< .001

Categories of dissection (ZQSRC criteria)

Stage I	*Stage II*	*Stage III*
Inbound *Lumen compromise*	*Mixed*	*Outbound* *Protruding lesions*



Predictors of neurological deterioration

	Subjects	In hospital neurological deterioration	Neurological deterioration within 1 year	Log-Rank (p value)
	(n=69)	(n=11)	(n=15)	
Multivessel involvement				3.01 (0.0832)
Single	60	9 (15%)	11 (18%)	
Multi	9	2 (22%)	4 (40%)	
Severity of stenosis				1.59 (0.2069)
<50 %	18	2 (11%)	2 (11%)	
≥50 %	46	9 (20%)	12 (26%)	
Pseudoaneurysm				0.16 (0.6903)
Yes	20	2 (10%)	4 (20%)	
No	46	9 (20%)	10 (21%)	

Endovascular treatment of arterial dissection-Questions

- Does angiographic success result in clinical benefit?
- Who are the patients most likely to benefit from endovascular treatment?
- Is waiting for medical treatment failure a valid approach?

Rates of various outcomes following arterial dissection

Events	Total number of pts.	Pts. with events (%)
3 month death and disability	463	138 (30%)
Recurrent ischemic events	632	30 (5%)
Symptomatic intracranial hemorrhage	627	5 (0.8%)

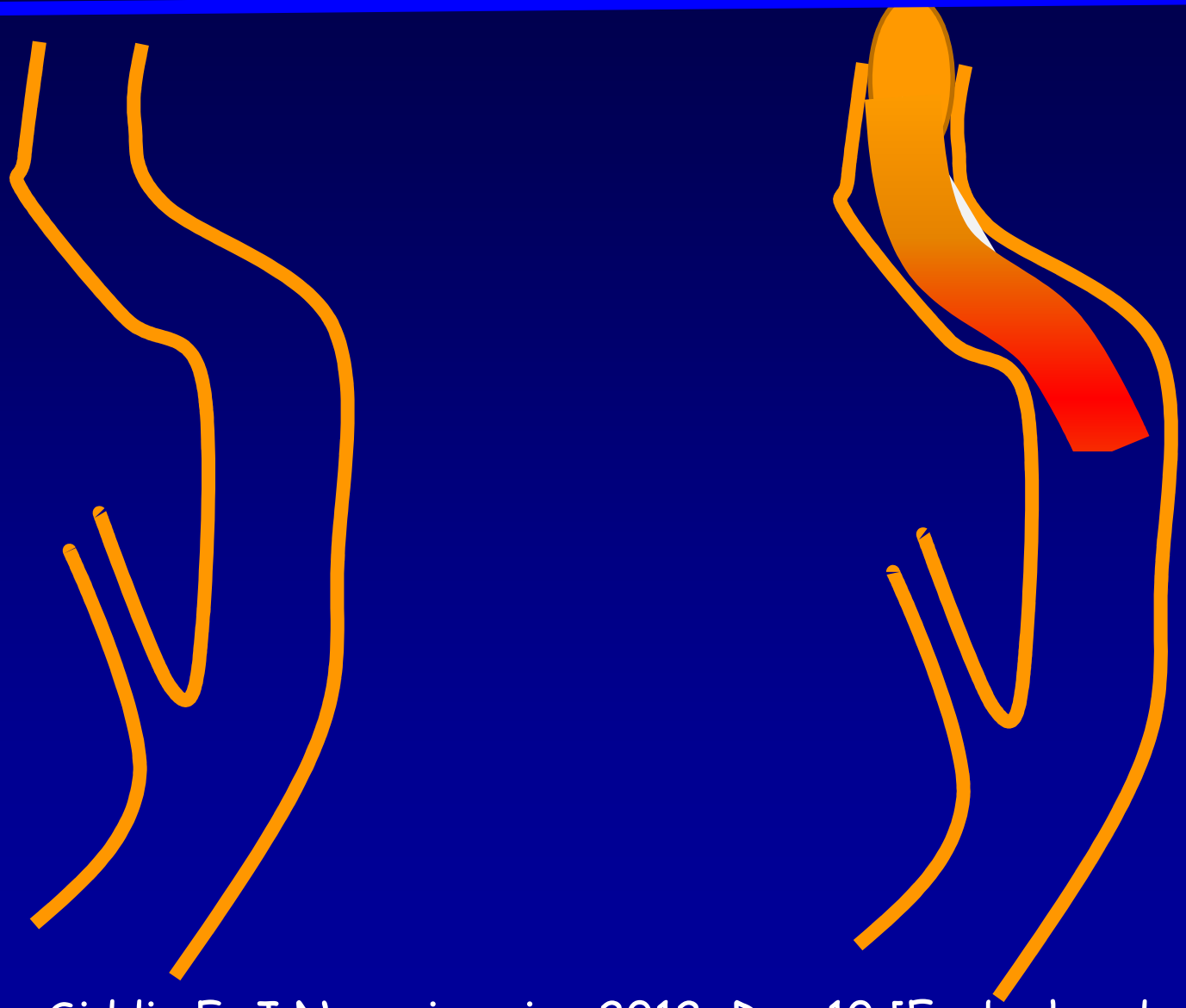
(Cochrane Database Syst Rev. 2010 Oct 6;(10):CD000255—
J Neurol Neurosurg Psychiatry 2008;**79**:1122-1127)

Rates of various outcomes following arterial dissection

Events	Proportion of pts.
Resolution of stenosis 3-6 m	90%
Recanalization of occluded segment 3-6 m	50%
Resolution/ decrease aneurysm	40%
Unchanged aneurysm	50%

(Re: Redekon GJ. Can J Neurol Sci. 2008 May;35(2):146-52)

Pseudo-dissection



Re: Siddiq F: J Neuroimaging 2012: Dec 10 [Epub ahead of print]