Unusual Carotid Diseases: Dissection, Webs and FMD

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Disclosure

- Consultant & Speaker: Humacyte, Inc.

Uncommon Carotid Pathology

Carotid Dissection

- Spontaneous
- Traumatic

Carotid Pseudoaneurysm

- Traumatic
- Post-intervention (CEA)
- Post-Dissection

Uncommon Carotid Pathology

Carotid Dissection

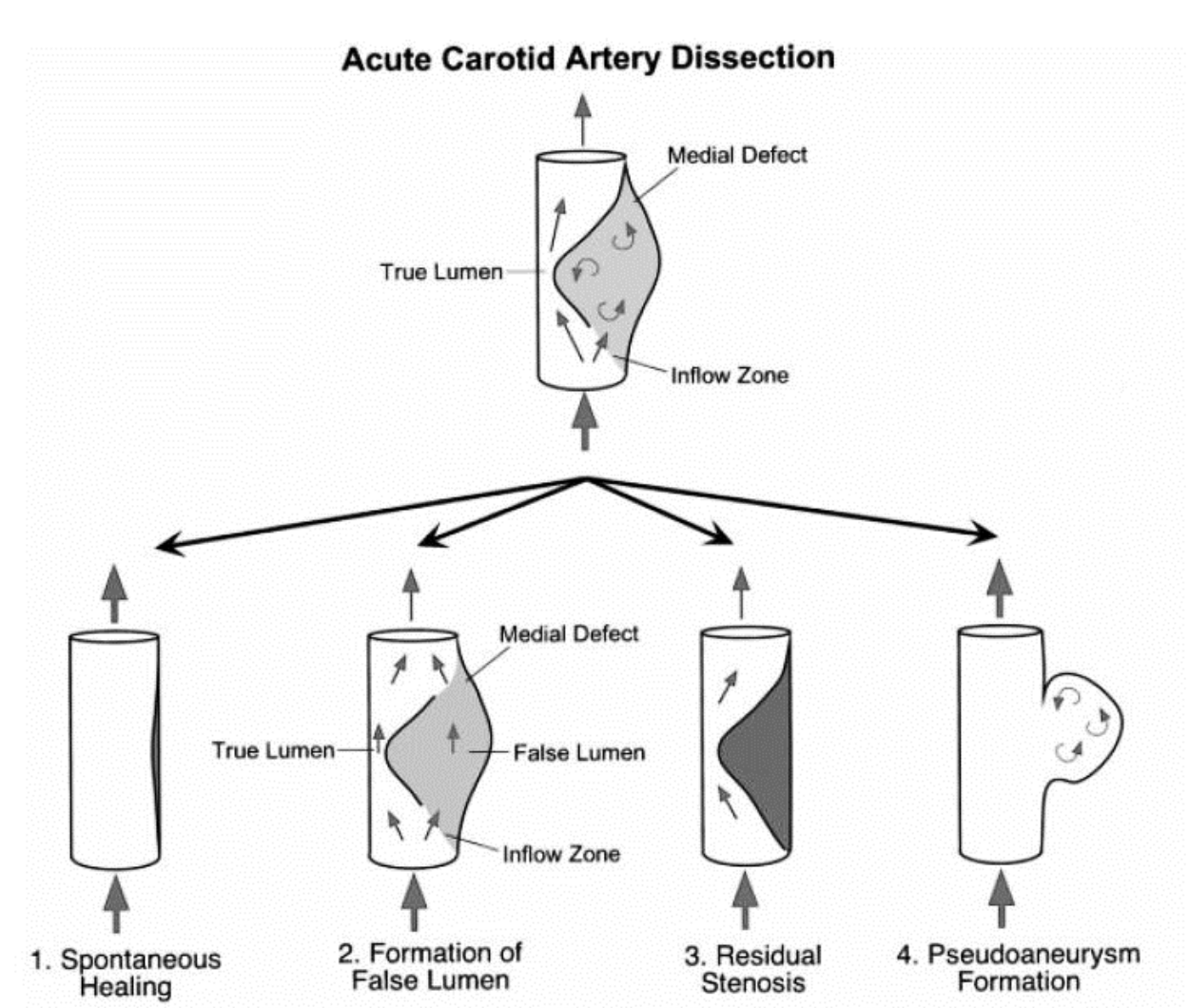
- **Spontaneous:**
  - *HTN, Migraine, Seasonal, Younger patients, Childbirth, FMD, CTD, Familial*
  - *1-3% incidence; 2-3% recurrence*
- **Traumatic:**
  - *Secondary to carotid surgery (rare)*
  - *Other iatrogenia (rare)*
  - *Blunt head and neck injury*
    - *0.5-1% incidence*
    - *Up to 3-4% with altered MS*

Uncommon Carotid Pathology

Carotid PSA

- **Post Dissection**
  - up to 10% after dissection
- **Traumatic**
  - Evolution of blunt or penetrating injury
- **Post-CEA**
  - *Occurs in less than 0.5%*
  - *Suture line failure, patch material, arterial degeneration, infection*

Uncommon Carotid Pathology



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Uncommon Carotid Pathology

Carotid Dissection-Spontaneous

- ***Type I:*** ***Minimal irregularity***
- ***Type II:*** ***> 70% Stenosis/Aneurysm***
- ***Type III:*** ***Occlusion***

Carotid Injury

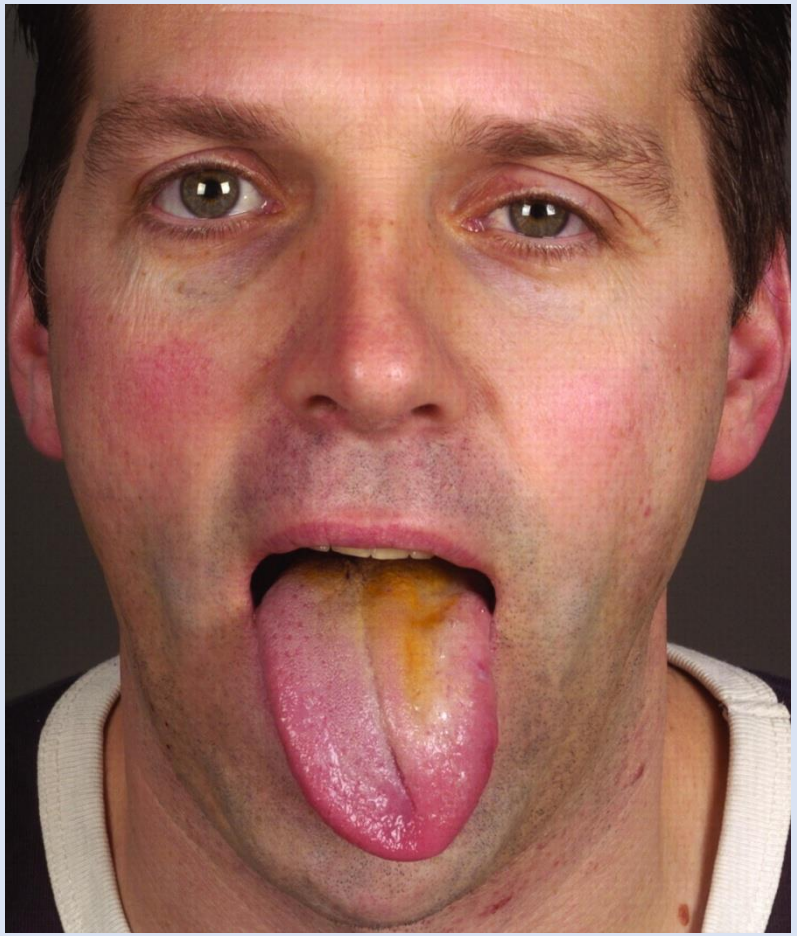
Injury Grade	Description
I	Luminal irregularity or dissection with <25% luminal narrowing
II	Dissection or intramural hematoma with ≥25% luminal narrowing, intraluminal thrombus, or raised intimal flap
III	Pseudoaneurysm
IV	Occlusion
V	Transection with free extravasation

Carotid Dissection

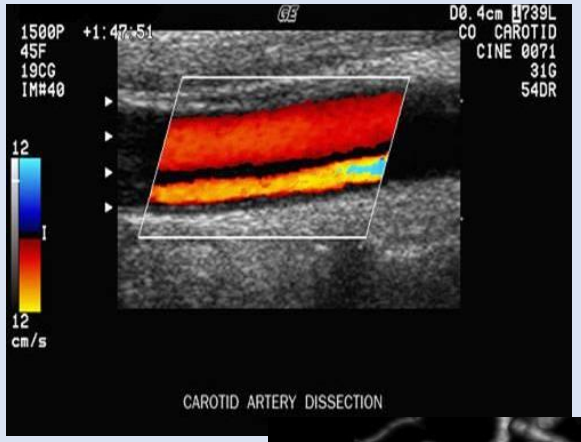
Clinical Signs and Symptoms

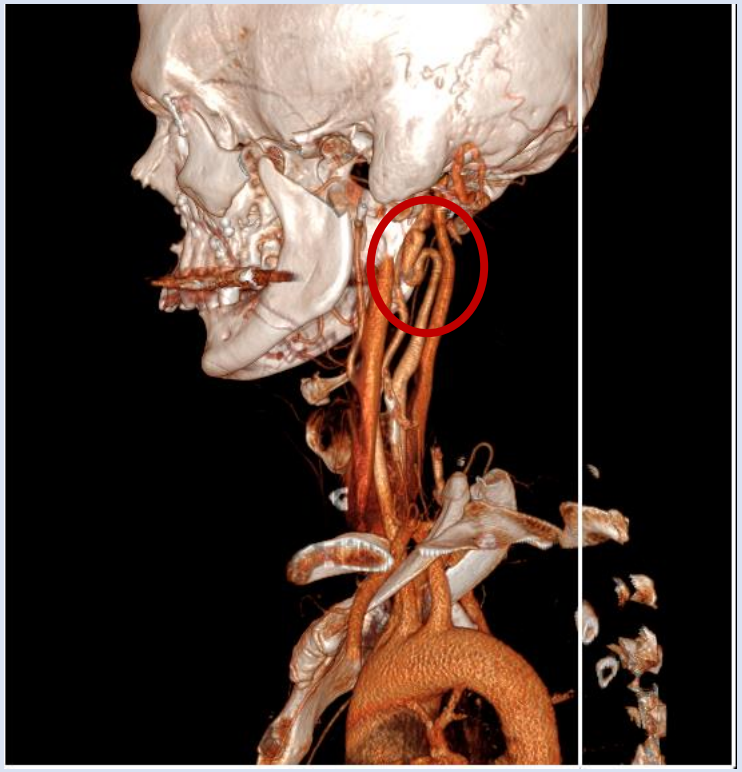
- HA and Neck pain
- CVA/TIA (represents up to 25% of stroke in young)
- Horner's (ptosis, miosis, anhidrosis with ECA)
- CN palsies (IX-XII): XII most common
- Tinnitus-pulsatile
- Pulsatile mass and compression

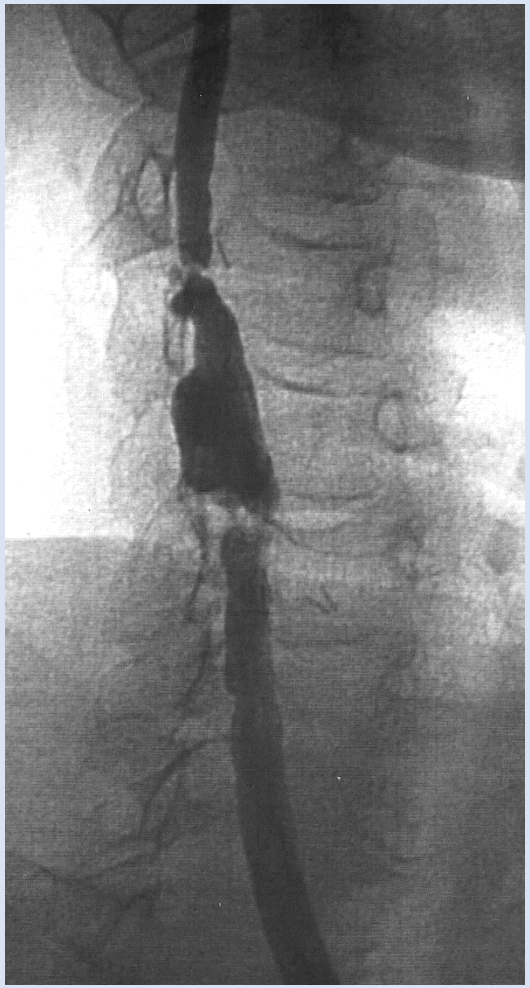
Carotid Dissection



Carotid Dissection







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Carotid Dissection

Neurologic Burden

- **Spontaneous:**

  2% of CVA; 10-20% in young/ middle age

- **Traumatic**

  30% Mortality (5-8% due to CD)

  20% permanent deficit

Carotid Dissection

Management

- ***Antithrombotic Therapy:***

  Anticoagulation/Antiplatelet?

- ***Open Operation***

- ***Endovascular Treatment***

Carotid Dissection

[Intervention Review] 2010

Antithrombotic drugs for carotid artery dissection

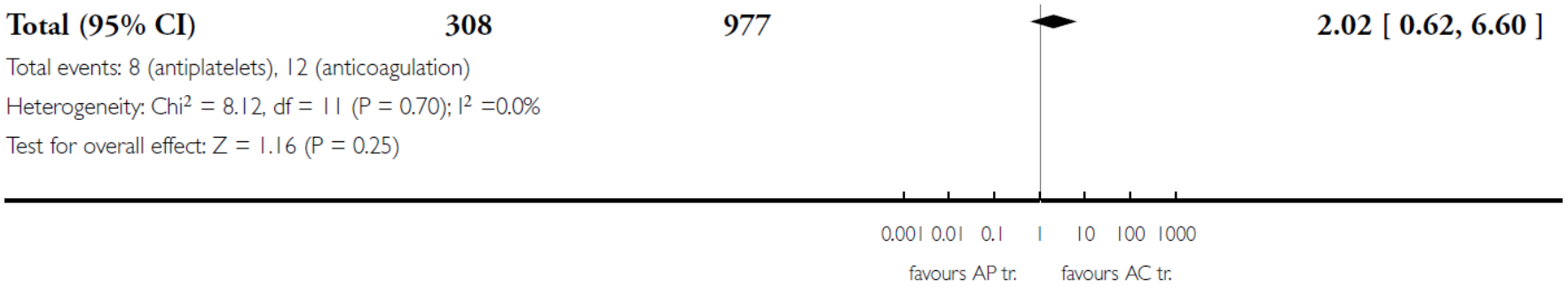
Outcome: 1 Death from all causes

Total (95% CI)	**308**	**977**	**2.02 [0.62, 6.60]**

Total events: 8 (antiplatelets), 12 (anticoagulation)

Heterogeneity: $Chi^2 = 8.12$, df = 11 (P = 0.70); $I^2 = 0.0\%$

Test for overall effect: Z = 1.16 (P = 0.25)



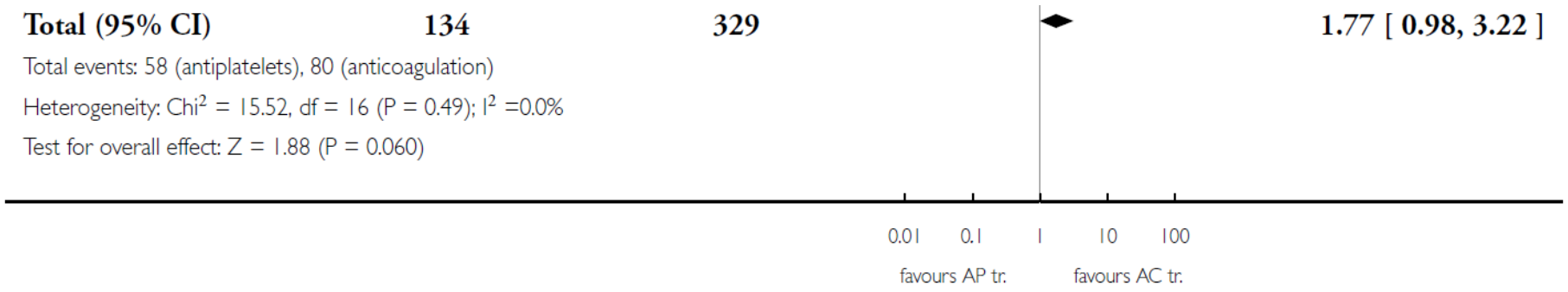
Outcome: 2 Death or disability

Total (95% CI)	**134**	**329**	**1.77 [0.98, 3.22]**

Total events: 58 (antiplatelets), 80 (anticoagulation)

Heterogeneity: $Chi^2 = 15.52$, df = 16 (P = 0.49); $I^2 = 0.0\%$

Test for overall effect: Z = 1.88 (P = 0.060)



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Carotid Dissection

[Intervention Review] 2010

Antithrombotic drugs for carotid artery dissection

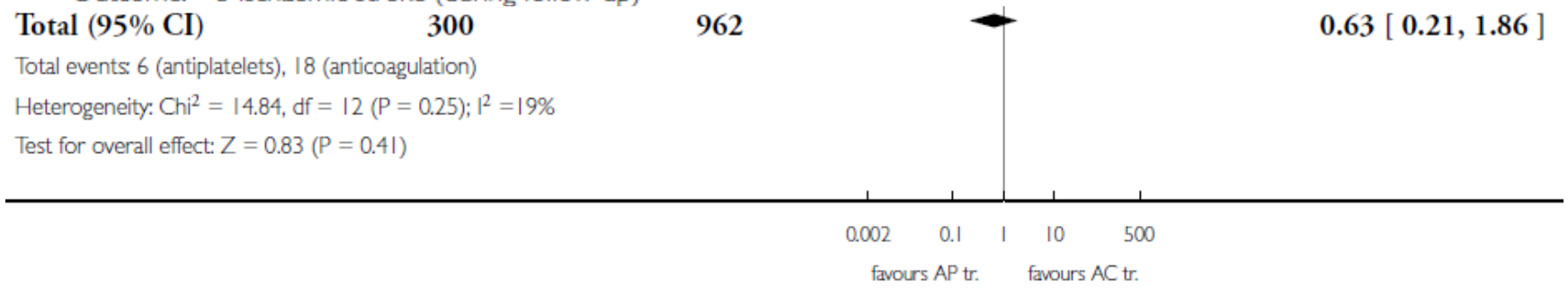
Outcome: 3 Ischaemic stroke (during follow-up)

Total (95% CI) **300** **962** **0.63 [0.21, 1.86]**

Total events: 6 (antiplatelets), 18 (anticoagulation)

Heterogeneity: $Chi^2 = 14.84$, df = 12 (P = 0.25); $I^2 = 19\%$

Test for overall effect: Z = 0.83 (P = 0.41)



Outcome: 4 Symptomatic intracranial haemorrhage

Total (95% CI) **258** **627** **0.25 [0.02, 3.36]**

Total events: 0 (antiplatelets), 5 (anticoagulation)

Heterogeneity: $Chi^2 = 0.02$, df = 2 (P = 0.99); $I^2 = 0.0\%$

Test for overall effect: Z = 1.05 (P = 0.30)

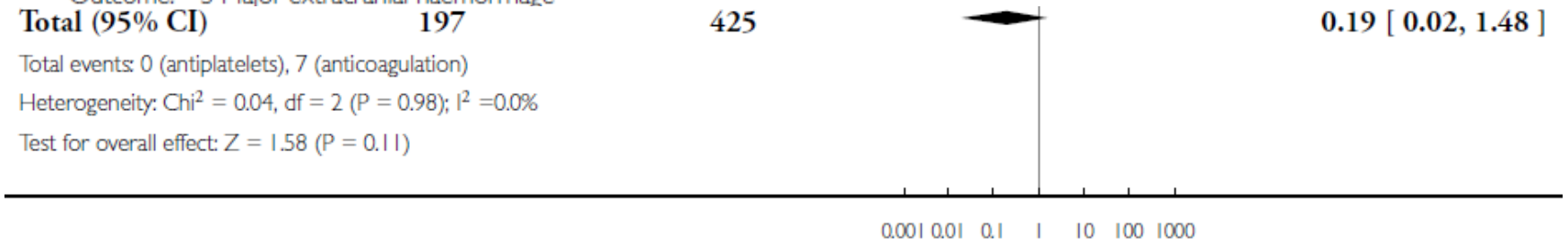
Outcome: 5 Major extracranial haemorrhage

Total (95% CI) **197** **425** **0.19 [0.02, 1.48]**

Total events: 0 (antiplatelets), 7 (anticoagulation)

Heterogeneity: $Chi^2 = 0.04$, df = 2 (P = 0.98); $I^2 = 0.0\%$

Test for overall effect: Z = 1.58 (P = 0.11)



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Carotid Dissection

JAMA Neurology | Original Investigation

Antiplatelet Therapy vs Anticoagulation Therapy in Cervical Artery Dissection

The Cervical Artery Dissection in Stroke Study (CADISS) Randomized Clinical Trial Final Results

Hugh S. Markus, FMedSci; Christopher Levi, MD; Alice King, PhD; Jeremy Madigan, FRCR; John Norris, MD; for the Cervical Artery Dissection in Stroke Study (CADISS) Investigators

	No.							
	Intention-to-Treat Analysis				Per Protocol Analysis			
	Antiplatelets (n = 126)		Anticoagulants (n = 124)		Antiplatelets (n = 101)		Anticoagulants (n = 96)	
Event	0-3 mo	3-12 mo	0-3 mo	3-12 mo	0-3 mo	3-12 mo	0-3 mo	3-12 mo
Ischemic stroke								
Ipsilateral	3	1	1	1	3	1	1	0
Other	0	0	0	0	0	0	0	0
TIA								
Ipsilateral	1	0	4	0	1	0	3	0
Other	1	0	0	1	1	0	0	1
Major bleeding	0	0	1	0	0	0	1	0
Death	0	1[a]	0	0	0	1[a]	0	0

Stroke risk at 1-year 2.5%

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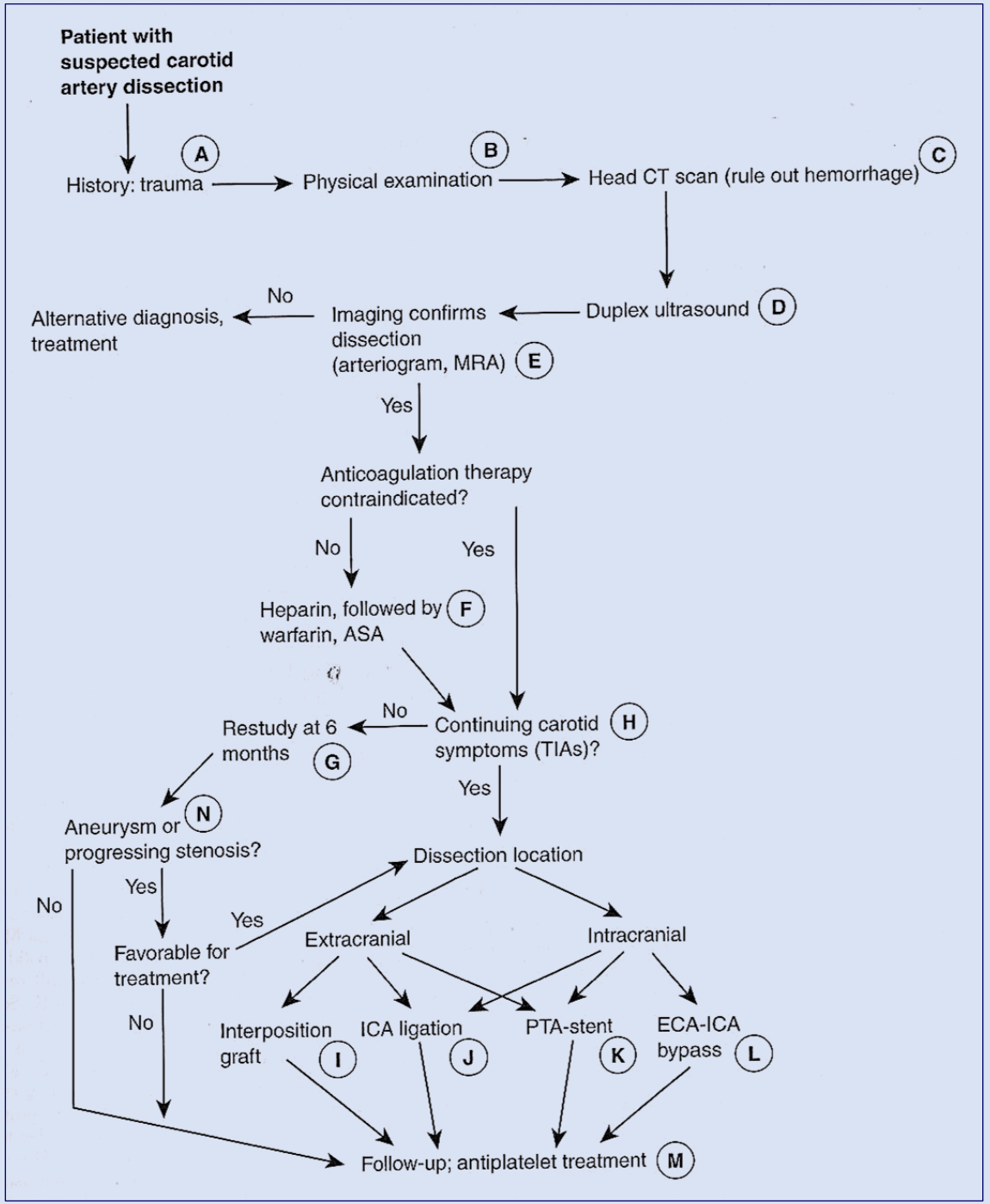

Carotid Dissection

Fate of Distal False Aneurysms Complicating Internal Carotid Artery Dissection: A Systematic Review

Eur J Vasc Endovasc Surg (2016) 52, 281–286

K.I. Paraskevas [a], **A.J. Batchelder** [b], **A.R. Naylor** [b,*]

[a] Department of Vascular Surgery, Southampton University Hospital, Southampton, UK
[b] Department of Vascular Surgery, Vascular Research Group, Division of Cardiovascular Sciences, Clinical Sciences Building, Leicester Royal Infirmary, Leicester, UK

Background: False aneurysm formation occurs in 13–49% of internal carotid artery dissections (ICADs). In light of the uncertainty regarding the clinical course, expansion rates and optimal treatment of post ICAD f… aneurysms, a systematic review of the literature was undertaken to establi… ICA false aneurysm after ICAD.

Methods: PubMed/MEDLINE, Embase, and Cochrane datab… 2015 for studies reporting clinical outcomes and imagi… developed a false aneurysm associated with ICAD, wi… aneurysm.

Results: Eight studies reported on the course/clinic… patients. Of these, five of 166 false aneurysms (3%) … diameter; 35 of 166 (21%) diminished in size; 32 of 16… thrombosed; and five 166 (3%) were repaired surgically. A… 5.0 years later). During the course of surveillance, no… spontaneous ICAD gave rise to any new neurolog… sym…

Conclusions: In this systematic review, >95%… …operated false aneurysms affecting the d… artery that developed after an ICAD did not increase in size and were not associated with any delayed neurological symptoms suggesting that conservative management and serial surveillance is the optimal mode of treatment. As nearly all studies suffered from serious bias, reporting standards for diagnosis and follow-up are needed in order to better define their natural history.

Article history: Received 19 December 2015, Accepted 17 March 2016, Available online 22 April 2016
Keywords: Dissecting aneurysm, False carotid aneurysm, Internal carotid artery dissection

Over **95%** of non-operated false aneurysms…after carotid dissection did not dilate and did not develop neurologic symptoms!!

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Carotid Dissection

Indications for Intervention in CD

Early

- *Symptoms persist/stutter/progress on medical therapy*
- *Contraindication to AC*
- *Enlarging PSA/?extensions*

Late

- *Severe Stenosis*
- *Symptomatic*
- *Aneurysm formation*

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Carotid Dissection

Long-term outcomes of internal carotid artery dissection

Atul S. Rao, MD, Michel S. Makaroun, MD, Luke K. Marone, MD, Jae S. Cho, MD, Robert Rhee, MD, and Rabih A. Chaer, MD, *Pittsburgh, Pa*

Objective: The natural history of acute carotid artery dissection is poorly characterized. The purpose of this study is to report on single institutional long-term outcomes.
Methods: A retrospective review of patients treated for acute spontaneous or posttraumatic carotid artery dissection over a 20-year period from August 1989 to July 2009 was performed.
Results: Twenty-nine patients with a mean age of 47 ± 19.6 years were identified with acute carotid dissection. Six (25%) were related to trauma, while 23 (79%) were spontaneous. Neurologic symptoms included contralateral limb weakness (55%), facial pain (35%), and Horner's syndrome (21%). Eight patients (28%) presented with an acute hemispheric stroke. Diagnostic imaging modalities used included computed tomography angiography (52%), magnetic resonance angiography (41%), and conventional angiography (48%). Twenty percent of patients had complete carotid occlusion and 25% had near occlusion. Most dissections (65%) had intracranial extension, and 35% were limited to the extracranial cervical internal carotid. The majority (96%) of patients were treated conservatively with anticoagulation or antiplatelet therapy or both. One patient underwent stenting for persistent symptoms resulting in complete recovery. There were two deaths, one from unrelated traumatic injuries and the other from unknown causes. Long-term follow-up was available for 20 patients: 14 had complete symptom resolution (70%) and five (25%) had partial clinical symptom resolution. Two patients had initial resolution of symptoms, with subsequent recurrence that was successfully managed conservatively. Follow-up imaging revealed luminal patency in 79% of patients with minimal residual stenosis. Two patients developed a small asymptomatic internal carotid aneurysm that did not require treatment. Mean follow-up was 1133.2 days.
Conclusions: Most cervical carotid dissections can safely be conservatively managed, with the majority achieving anatomic and symptomatic resolution, with low rates of recurrence over long-term follow-up. (J Vasc Surg 2011;54:370-5.)

UPMC CD Experience

- *29 consecutive: 6 trauma, 23 (79%) SCD*
- *8 acute strokes (28%)*
- *18% ICA occlusion/27% near-occlusion*
- *All treated medically(AC 96%; AP 62%)*
- *1 patient CAS for persistent symptoms*
- *70% complete symptom resolution: 25% partial*
- *1 trauma related death; 1 unknown*
- *2 (6.9%) patients post-CD aneurysm*
- *79% luminal patency with minimal narrowing*

Carotid Dissection

Long-term outcome of cervical artery dissection

Mohammed Janquli, MD,[a,b] Logeswaran Selvarajah, MD,[a,b] Michael Anthony Moloney, MD,[a,b] Eamon Kavanagh, MD,[a,b] Damien Christopher O'Neill, MD,[a,b] *and* Mekki Medani, MD,[a,b] *Limerick, Ireland*

ABSTRACT

Objective: The aim of the study is to evaluate the natural history of extracranial cervical artery dissection (CAD) including comorbidities, symptoms at presentation, recurrence of symptoms, and long-term outcome following different treatment approaches.

Methods: A retrospective review of patients treated for acute CAD was performed over a 5-year period from January 2017 to April 2022.

Results: Thirty-nine patients were included in the study, 25 (64.1%) with acute internal carotid artery dissection and 14 (35.9%) with acute vertebral artery dissection. Thirty-four patients (87.1%) had spontaneous CAD, and five patients (12.8%) had traumatic CAD. The mean age of the cohort was 54.2 years. The mean time from symptom onset to presentation was 4.34 days. The most common symptoms in internal carotid artery dissection were unilateral weakness (44%), headache (44%), slurred speech (36%), facial droop (28%), unilateral paraesthesia (24%), neck pain (12%), visual disturbance (8%), and Horner's syndrome (8%). The most common symptoms in vertebral artery dissection were headache (35.7%), neck pain (35.7%), vertigo (28.57%), ataxia (14.28%), and slurred speech (14.28%). The imaging modalities used for diagnosis included computed tomography angiography (48.7%), magnetic resonance angiography (41%), and duplex ultrasound (10.2%). In patients with carotid artery dissection, 57% had severe stenosis, 24% had moderate stenosis, and 20% had mild stenosis. All patients treated were managed conservatively with either anticoagulation or antiplatelets. Long-term clinical follow-up was available for 33 patients (84.6%). Thirty patients (90.9%) reported complete resolution of symptoms, and three patients (9%) reported persistent symptoms. Anatomic follow-up with imaging was available for 17 patients (43.58%). Thirteen patients (76.47%) had complete resolution of dissection, two patients (11.76%) had partial resolution of dissection, and two patients (11.76%) had persistent dissection. There was one death unrelated to CAD in a multi-trauma patient. There were four early recurrent symptoms in the first 3 to 8 weeks post discharge. The mean follow-up time was 308.27 days.

Conclusions: The majority of CADs can be managed conservatively with good clinical and anatomical outcome and low rates of recurrence. (J Vasc Surg 2023;78:158-65.)

Recent Limerick experience: confirms benignity of cervical carotid/vertebral dissection

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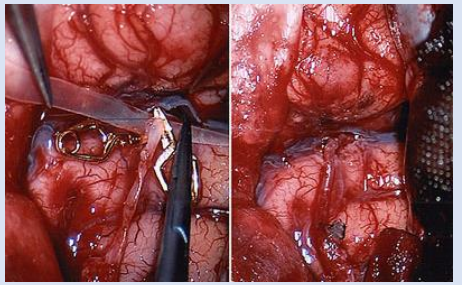
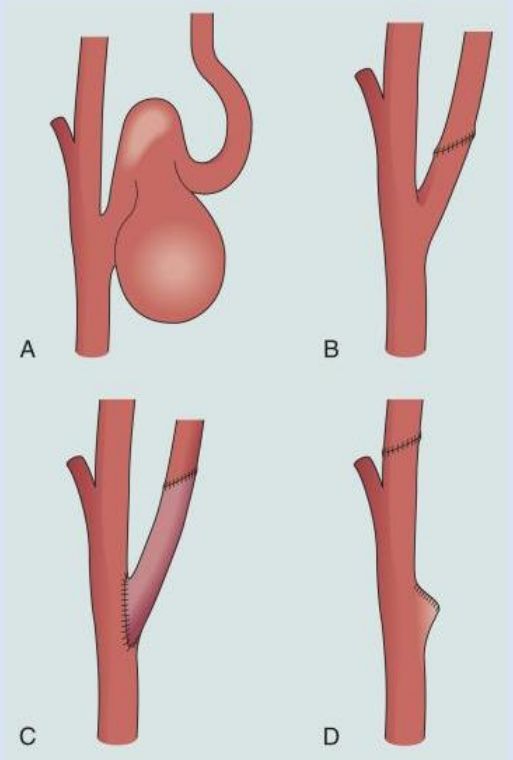
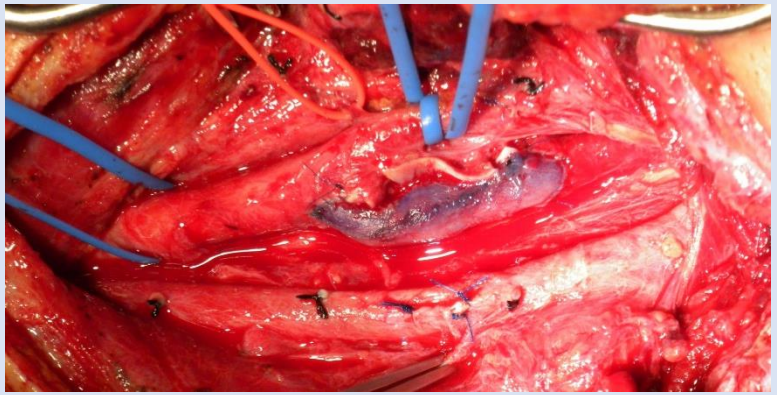
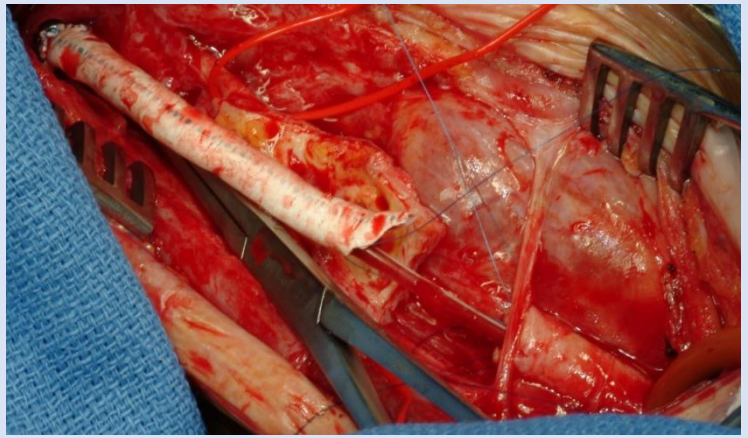
Carotid Dissection

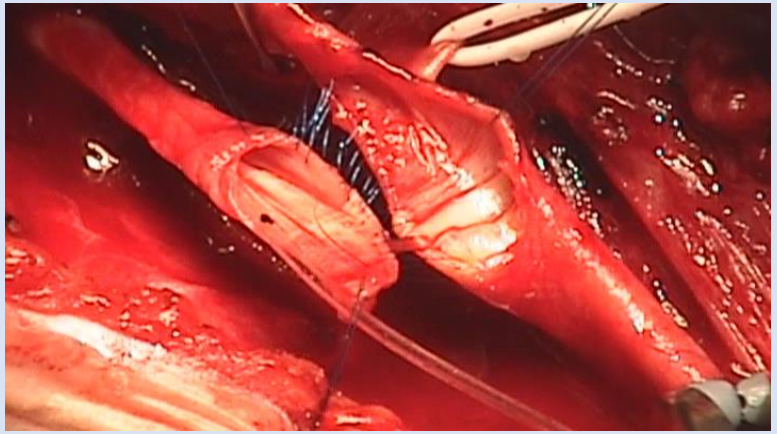
Open Repair











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Carotid Dissection

Open Repair

Surgical treatment of 50 carotid dissections: Indications and results

Barbara Theresia Müller, MD, Bernd Luther, MD, Waldemar Hort, MD, Tobias Neumann-Haefelin, MD, Albrecht Aulich, MD, and Wilhelm Sandmann, MD, *Düsseldorf, Germany*

J Vasc Surg 2000;31:980-8.

Table III. Indication for operative intervention

Cause	*No. of operations (%)*
Aneurysm	27 (54)
Stenosis	13 (26)
Aneurysm and stenosis	9 (18)
Acute intervention	1 (2)

Table IV. Operative technique

Technique	*No. of operations (%)*
Resection, vein interposition graft	40 (80)
Ligation or clip	5 (10)
Thromboendarterectomy + patch angioplasty	3 (6)
Dilatation	2 (4)

Table V. Early results of therapy

	No. of operations (%)	*No. of patients (%)*
Reconstruction patent	35 (70)	
Ligation or clip	5 (10)	
Early occlusion	10 (20)	
Perioperative death (intracranial bleeding)		1 (2)
Perioperative minor recurrent stroke		5 (10)
Perioperative cranial nerve damage		29 (58)

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Carotid Dissection

Endovascular Repair

- *Bare-metal stenting*
- *Coiling with stenting*
- *Covered stenting*
- *Flow diversion*

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Carotid Dissection

Endovascular Repair

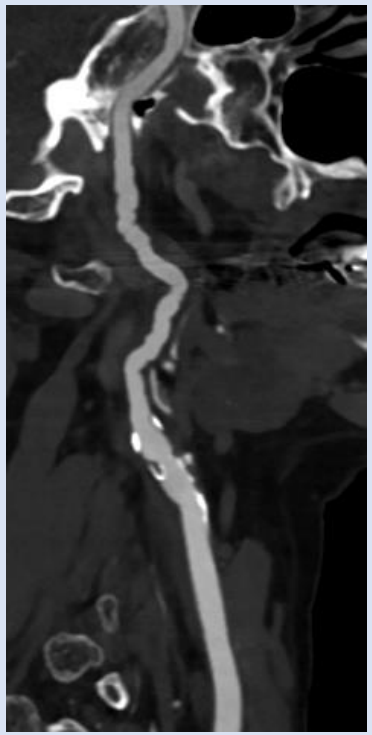
Endovascular Repair of Extracranial Carotid Artery Dissection: Current Status and Level of Evidence

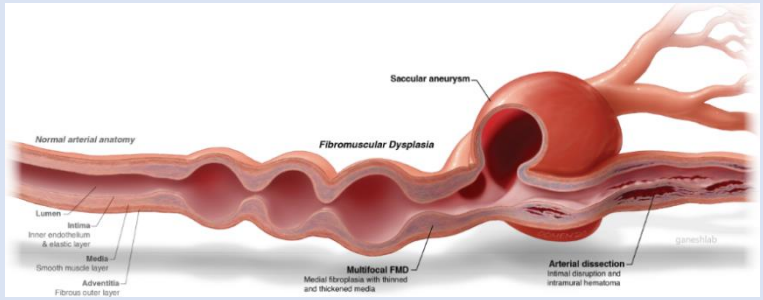
J Vasc Interv Radiol 2008; 19:1693–1698

Konstantinos P. Donas, MD, Dieter Mayer, MD, Ivo Guber, MD, Ralf Baumgartner, MD, Michele Genoni, MD, and Mario Lachat, MD

Cause of Carotid Dissection	No. of Patients	No. of Studies*	Mean Follow-up (mo)	Central Neurologic Deficit†	Local Signs or Asymptomatic‡	Clinical Outcome	
						Complete Recovery§	Permanent Neurologic Deficit
Spontaneous	12	4	12.8	8/12	4/12	12/12	0
Trauma	22	5	14	7/22	15/22	20/22	2/22
Spontaneous and trauma	28	4	20.2	0/28	28/28	22/28	6/28
Total	62	13	15.7	15/62	47/62	54/62	8/62

Carotid Artery Fibromuscular Dysplasia





- 0.4-3% of population
- Idiopathic; affecting medium-sized arteries - Theories
  - Hormonal
  - Genetic
  - Developmental
  - Vasa vasorum abnormality
- Poly-arterial: renal, carotid, mesenteric, extremity
  - 75 % Carotid Involvement
  - 55% Multivessel
- Women, 5th decade, Caucasian
- Cerebral Aneurysms/Carotid Dissection
- Medial Fibroplasia 85%
  - perimedial dysplasia 10%
  - intimal fibroplasia 5%
  - medial hyperplasia rare

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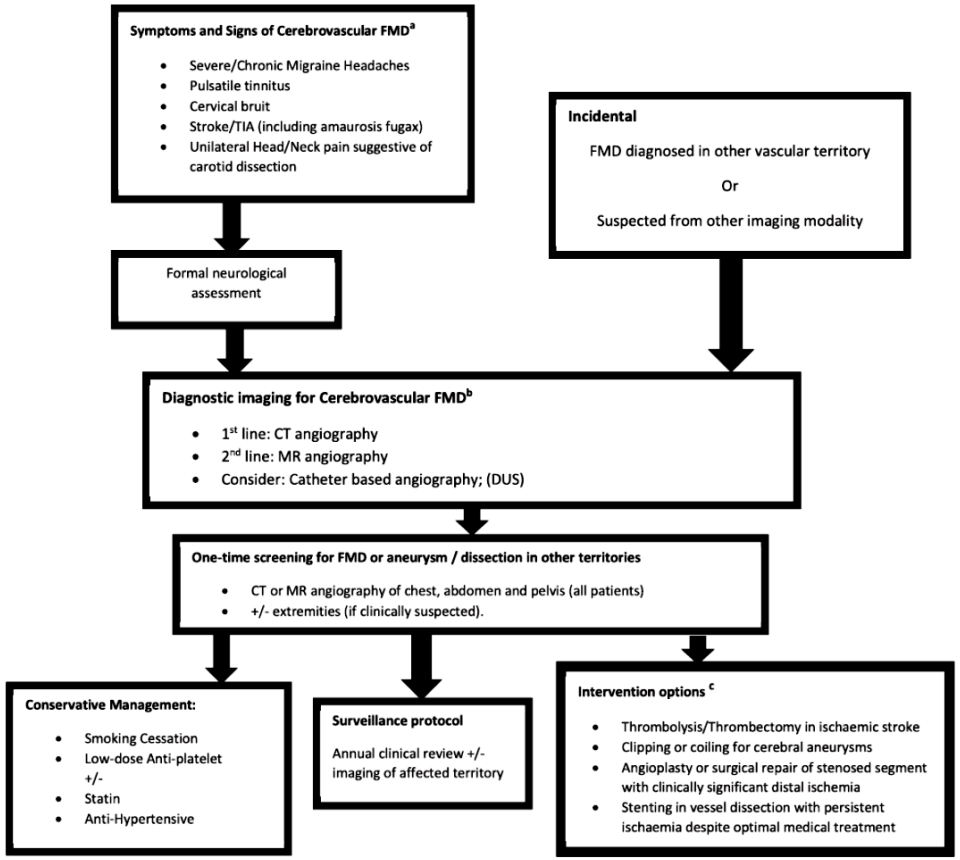
Carotid Artery Fibromuscular Dysplasia

A Retrospective Cohort Study of Cerebrovascular Fibromuscular Dysplasia

Anthousa Kythreotou,[1] Ruwan A. Weerakkody,[1,2] Kantida Koysombat,[1] Natalie Marzouqa,[2] and Daryll M. Baker,[1,2,3] London, United Kingdom

Ann Vasc Surg 2023; 92: 104–110



CAS for symptomatic lesions with stenting reserved for poor response or CD

Resection/bypass if focal

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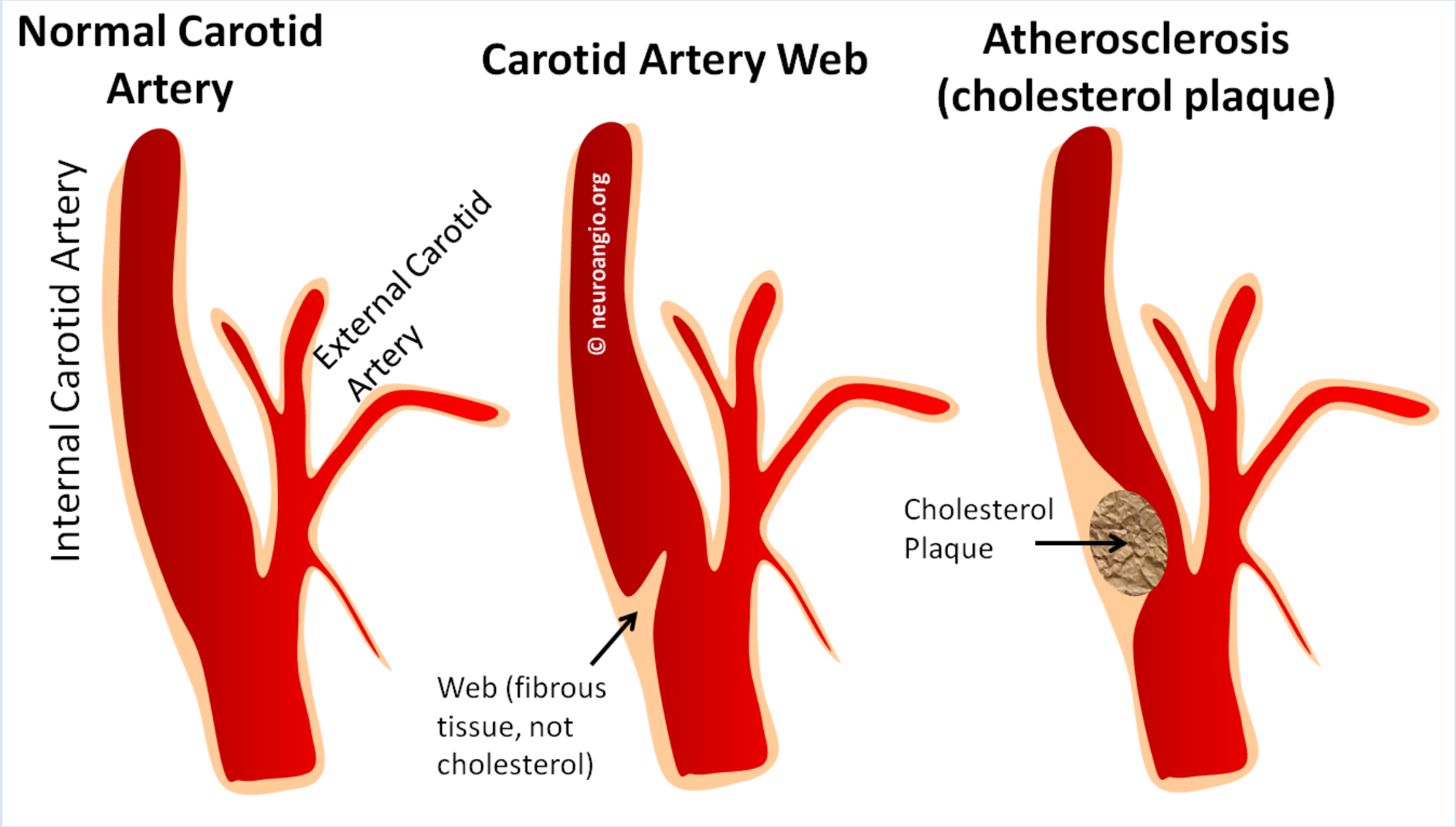
Carotid Web



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Carotid Web

A Systematic Literature Review of Patients With Carotid Web and Acute Ischemic Stroke

Andrew J. Zhang, BA; Parth Dhruv, MD; Philip Choi, MBChB; Caitlin Bakker, MLIS, AHIP; Jonathan Koffel, MSI; David Anderson, MD; Jae Kim, MD; Bharathi Jagadeesan, MD; Bijoy K. Menon, MD; Christopher Streib, MD, MS

Stroke. 2018;49:2872-2876

Morphological characteristics of symptomatic and asymptomatic carotid webs

Borna Ethan Tabibian, MD, Matthew Parr, MD, Arsalaan Salehani, MD, Anil Mahavadi, MD, Sage Rahm, MD, Manmeet Kaur, MD, Sasha Howell, MD, Jesse G. Jones, MD, Elizabeth Liptrap, MD, and Mark R. Harrigan, MD

J Neurosurg 137:1727–1732, 2022

Carotid webs management in symptomatic patients

Sébastien Multon, MD,[a] Christian Denier, MD, PhD,[b] Phillippe Charbonneau, MD,[a] Mariana Sarov, MD,[b] David Boulate, MD,[a] Delphine Mitilian, MD,[a] Justine Mougin, MD,[a] Olivier Chassin, MD,[b] Nicolas Legris, MD,[b] Elie Fadel, MD, PhD,[a] Stephan Haulon, MD, PhD,[a] *and* Dominique Fabre, MD, PhD,[a] *Paris, France*

J Vasc Surg 2021;73:1290-7

Symptomatic carotid webs require aggressive intervention

Clayton J. Brinster, MD,[a] James O'Leary, MD,[a] Aaron Hayson, MD,[a] Andrew Steven, MD,[b] Charles Leithead, MD,[a] W. Charles Sternbergh III, MD,[a] Samuel R. Money, MD, MBA,[a] *and* Gabriel Vidal, MD,[c] *New Orleans, LA*

J Vasc Surg 2024;79:62-70

Clinical, imaging, and management features of symptomatic carotid web: Insight from CAROWEB registry

International Journal of Stroke
2024, Vol. 19(2) 180–188

DOI: 10.1177/17474930231204343
journals.sagepub.com/home/wso
Sage

Carotid webs: a review of pathophysiology, diagnostic findings, and treatment options

Huanwen Chen ,[1,2] Marco Colasurdo ,[3] Matias Costa,[4] Erez Nossek,[5] Peter Kan [4]

J NeuroIntervent Surg 2024;**0**:1–6. doi:10.1136/jnis-2023-021243

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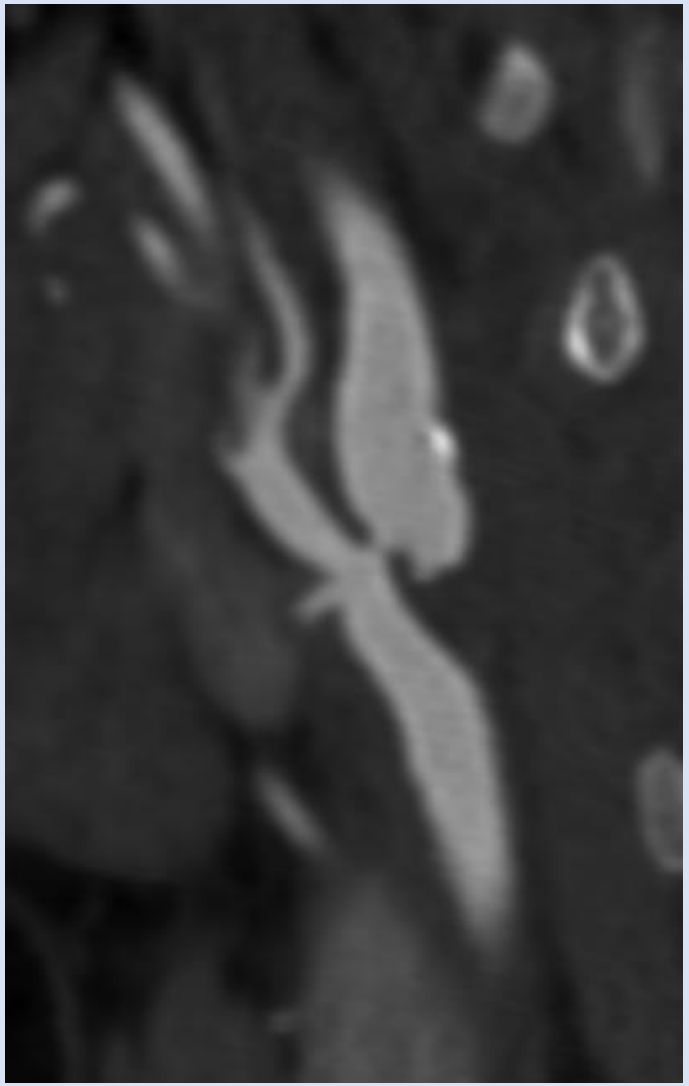
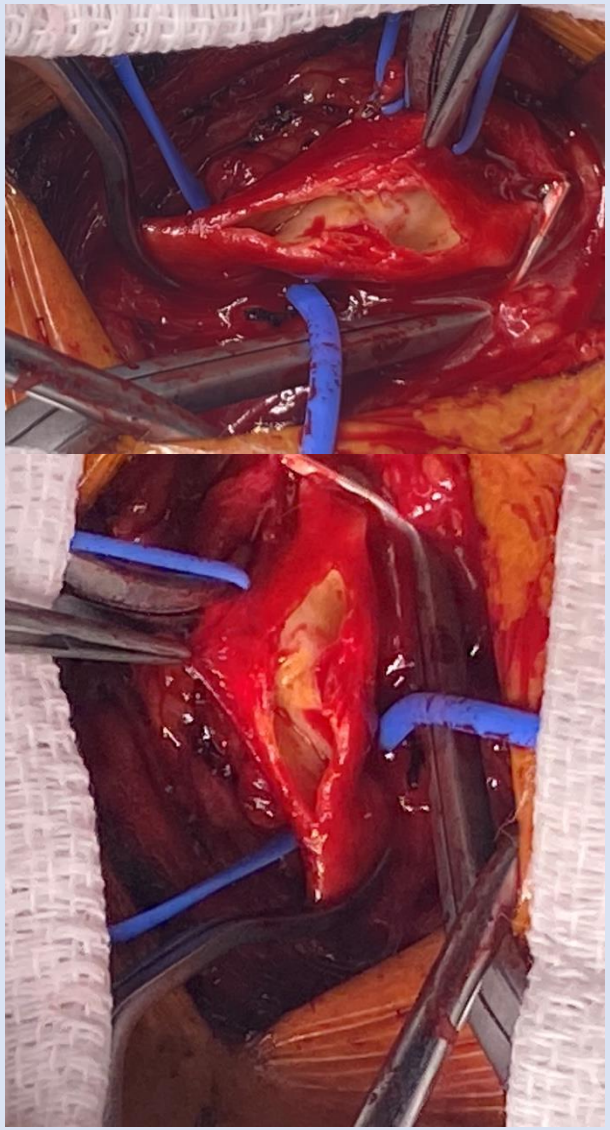
Carotid Web





- Atypical, focal FMD
- Those with “cryptogenic stroke”
- Symptomatic lesions are malignant
  - Carry a very high recurrence
  - Intervention (CEA/CAS)
- Asymptomatic Lesions
  - Aggressive antiplatelet (DAPT?)
  - Careful close surveillance
  - Intervention with significant stenosis
- Frequently Bilateral
- Imaging tricky
  - Duplex
  - CTA
  - MRA
  - Careful inspection of axial imaging when suspected

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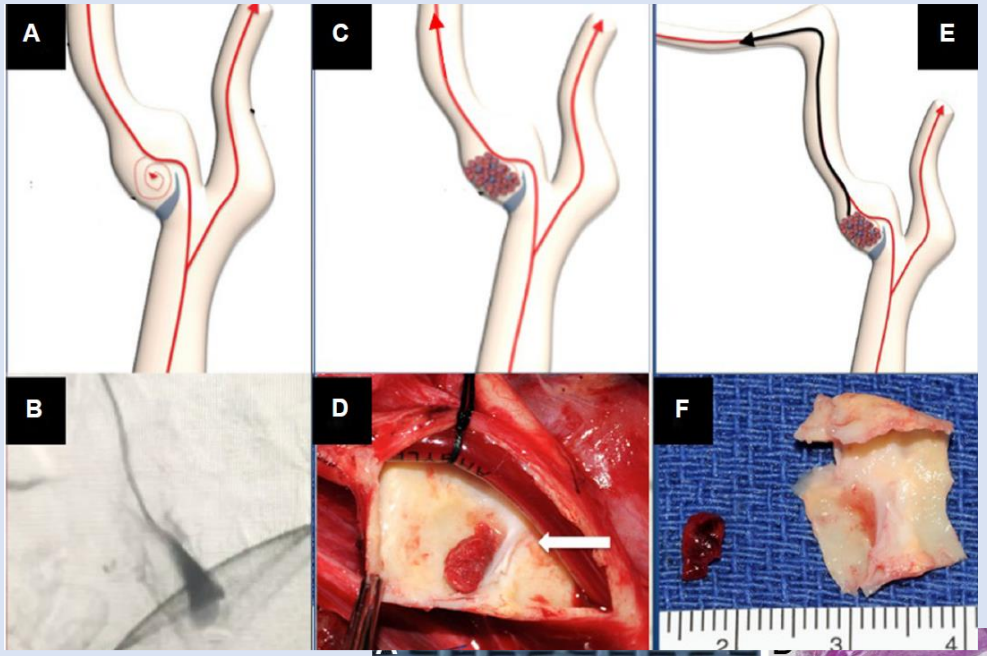
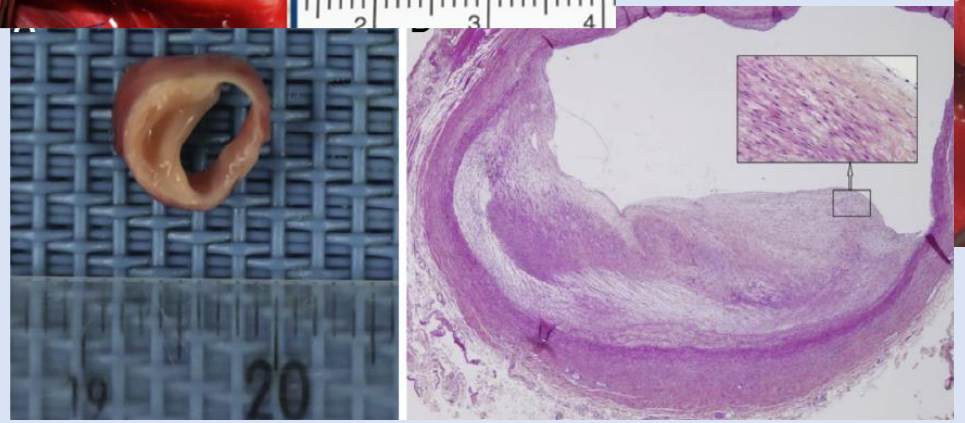
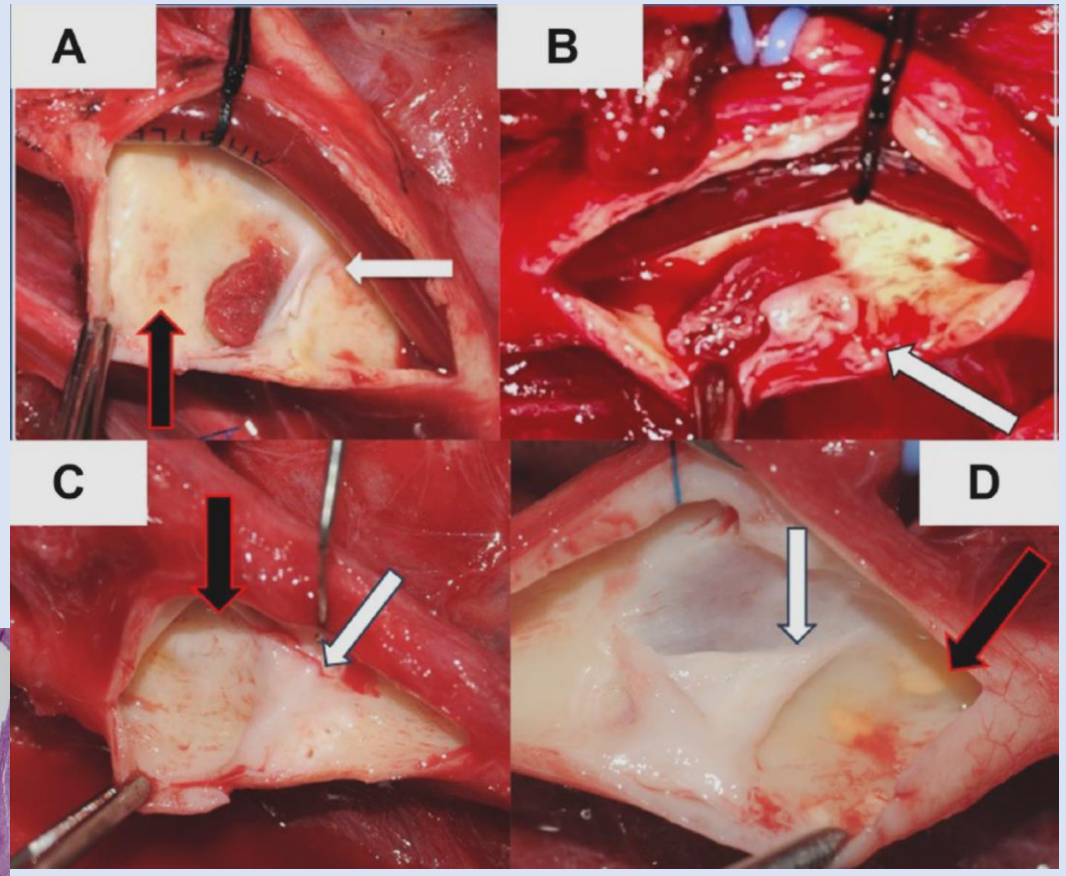
Carotid Web







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Carotid Stenosis in Women

TOPICAL REVIEW

Section Editors: Alison Halliday, MS, and Giuseppe Lanzino, MD

Carotid Interventions for Women: The Hazards and Benefits

Caron Rockman, MD; Valeria Caso, MD; Peter A. Schneider, MD

Stroke. 2022;53:611–623. DOI: 10.1161/STROKEAHA.121.035386

ABSTRACT: The goal of the current review is to examine the hazards and benefits of carotid interventions in women and to provide recommendations for the indications for carotid intervention in female patients. Stroke and cerebrovascular disease are prevalent in women. There are inherent biological and other differences in men and women, which affect the manifestations and outcome of stroke, with women experiencing worse disability and higher mortality following ischemic stroke than men. Due to the underrepresentation of female patients in most clinical trials, the ability to make firm but alternative recommendations for women specifically on the management of carotid stenosis is challenging. Although some data suggest that women might have worse periprocedural outcomes as compared to men following all carotid revascularization procedures, there is also an abundance of data to support a similar risk for carotid procedures in men and women, especially with carotid endarterectomy and transcarotid artery revascularization. Therefore, the indications for carotid revascularization are the same in women as they are in men. The choice of a carotid revascularization procedure in women is based upon the same factors as in men and requires careful evaluation of a particular patient's risk profile, anatomic criteria, plaque morphology, and medical comorbidities that might favor one technique over the other. When performing carotid revascularization procedures in women, tailored techniques and procedures to address the small diameter of the female artery are warranted.

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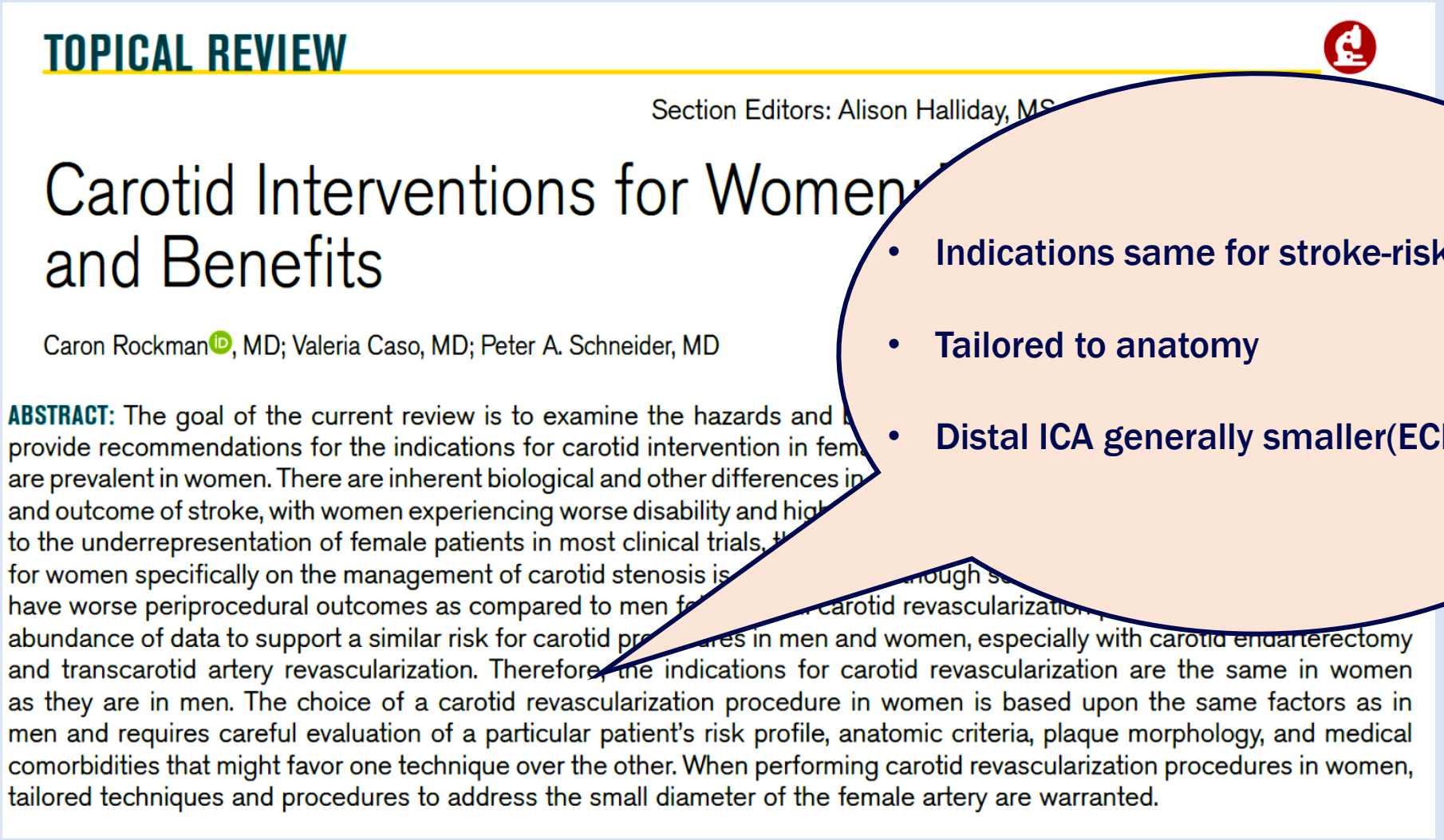
Carotid Stenosis in Women



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- Indications same for stroke-risk reduction
- Tailored to anatomy
- Distal ICA generally smaller(ECEA/patch)

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