



Blunt Cerebrovascular Injuries (BCVIs): Stroke Risk and Management

October 27, 2023
9th annual Greater Cincinnati
Stroke Consortium Symposium



UC Gardner Neuroscience Institute

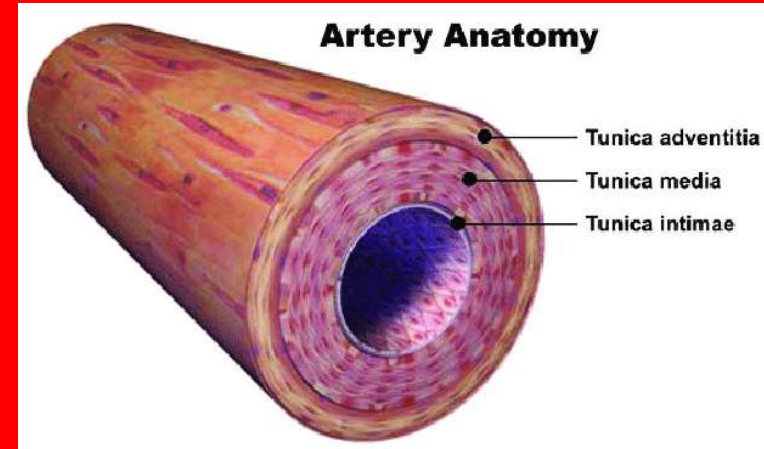
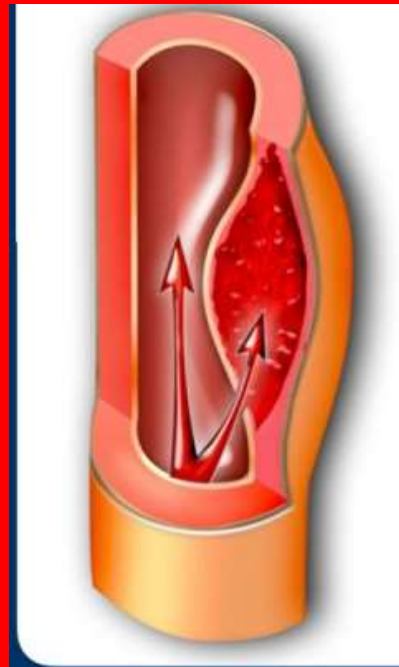
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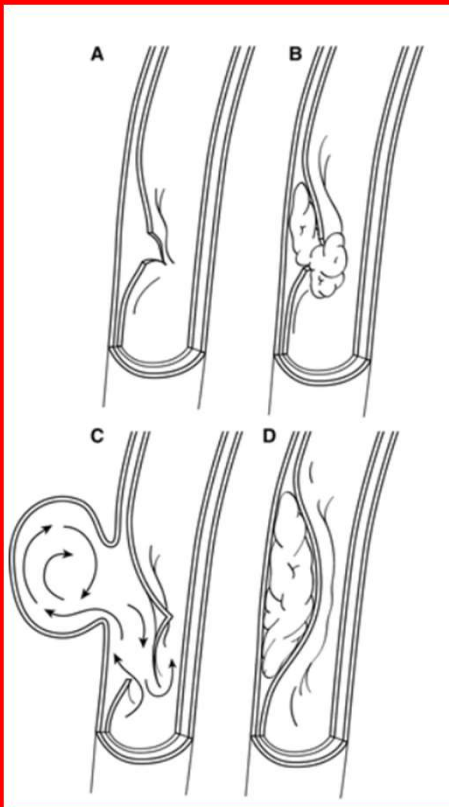
BCVI - Definitions



- 1.) BCVIs are a type of dissection
- 2.) Tear in the intima of artery
- 3.) hematoma formation within tunica media
- 4.) Can cause narrowing or enlargement of artery



BCVI - Pathophysiology



A: Tear in intima wall

B: Thrombus formation due to endothelial damage

C: Dissecting Aneurysm formation from expanding adventitia

D. Thrombus formation within tunica Media causing vessel narrowing

Harrigan, M. "Ischemic stroke due to Blunt Traumatic Cerebrovascular Injury." *Stroke*. 2020;51:353-360

BCVI – Epidemiology



- Account for 2.5% of all strokes
- In young patients (<40) account for 20% of strokes
- About 1% of all trauma patients have a BCVI
- Increases to 8% when cervical trauma suspected

Hundersmarck et al, "Blunt Cerebrovascular Injury: Incidence and long term followup." *Eur J Trauma Emerg Surg.* 2021 feb;47(1):161-170

BCVI – classification



Biffi injury grade	Angiographic characteristics
I	Luminal irregularity or dissection with < 25% luminal narrowing
II	Dissection or intramural hematoma with $\geq 25\%$ luminal narrowing
III	Pseudoaneurysm
IV	Occlusion
V	Transection with free extravasation

From Biffi et al.: Blunt carotid arterial injuries: implications of a new grading scale (Biffi et al. 1999)

The Biffi injury grading scale for BCVI

Biffi et al "Blunt Carotid arterial injuries: implications of a new grading scale." J trauma, injury, inf, and critical care. 47(5):845

BCVI – classification

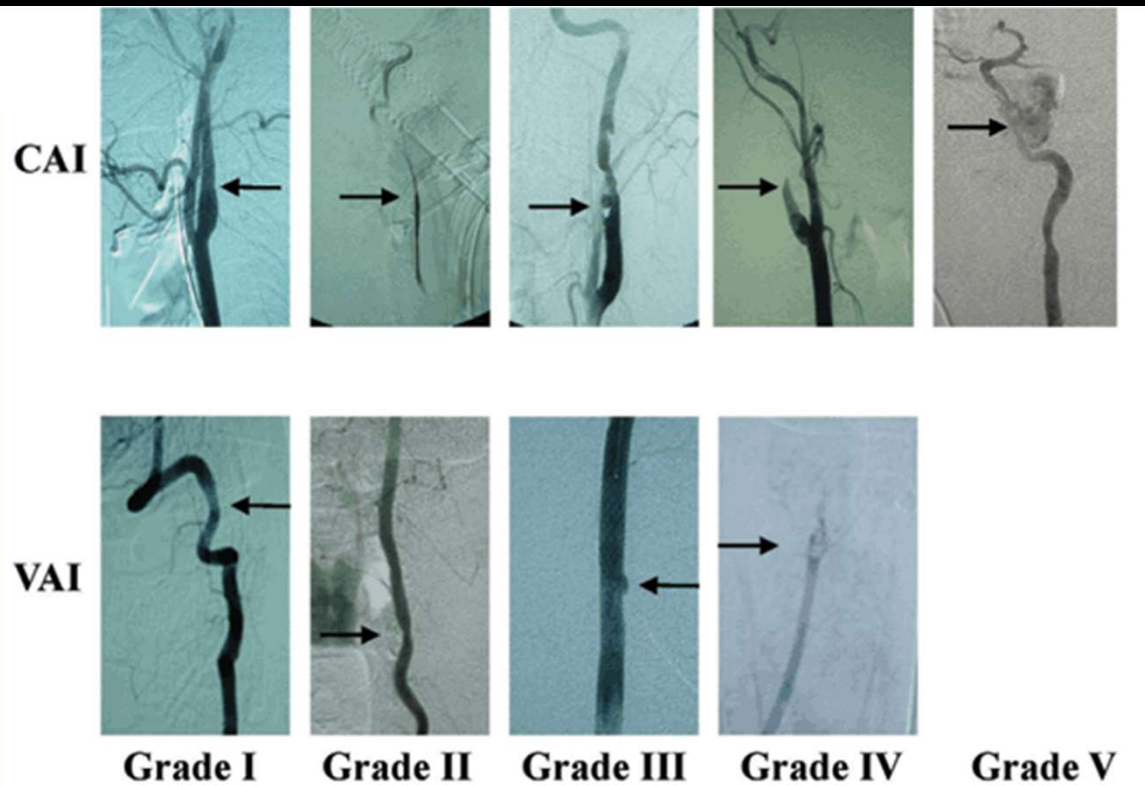


Figure 1 - Representative angiographic images of different grades of BCVI

Injury Grade: Angiographic Finding; Grade I: Intimal Irregularity, <25% Luminal Stenosis; Grade II: Intimal Irregularity, >25% Luminal Stenosis, Intim Flap; Grade III: Pseudoaneurysm; Grade IV: Occlusion; Grade V: Transection with active extravasation.

Cothren and Moore "Blunt Cerebrovascular Injuries."
Clinics. 2005 60(6): 489-496

BCVI – Stroke Risk



- 9% rate (inpatient) for all patients with BCVI
- 12% rate for ICA BCVI
- 7% rate for vertebral BCVI

Observational Study > J Trauma Acute Care Surg. 2022 Feb 1;92(2):347-354.

doi: 10.1097/TA.0000000000003455.

Factors associated with stroke formation in blunt cerebrovascular injury: An EAST multicenter study

Emily C Esposito¹, Joseph A Kufera, Timothy W Wolff, M Chance Spalding, Joshua Simpson, Julie A Dunn, Linda Zier, Sigrid Burruss, Paul Kim, Lewis E Jacobson, Jamie Williams, Jeffrey Nahmias, Areg Grigorian, Laura Harmon, Anna Gergen, Matthew Chatoor, Rishi Rattan, Andrew J Young, Jose L Pascual, Jason Murry, Adrian W Ong, Alison Muller, Rovinder S Sandhu, Rachel Appelbaum, Nikolay Bugaev, Antony Tatar, Khaled Zreik, Leah Hustad, Mark J Lieser, Deborah M Stein, Thomas M Scalea, Margaret H Lauerma

Multicenter Review of 777 BCVIs with inpatient only data.

BCVI – Stroke Risk



Variable	No. of Patients with BCVI Stroke	Percentage	P Value*
No. of injured vessels			
ICA			<.001
0	35/668	5 (4, 7)	...
1	39/407	10 (7, 13)	...
2	28/129	22 (15, 30)	...
VA			<.001
0	49/419	12 (9, 15)	...
1	32/630	5 (3, 7)	...
2	21/155	14 (9, 20)	...
ICA and/or VA			<.001
1	51/870	6 (4, 8)	...
2	40/285	14 (10, 19)	...
3	6/31	19 (7, 37)	...
4	5/18	28 (10, 53)	...

Original Research
Neuroradiology

Free Access

Natural History of Blunt Cerebrovascular Injury: Experience Over a 10-year Period at a Level I Trauma Center

Lei Wu , Diana Christensen , Lindsey Call , Justin Vranic , Charles Colip , Daniel S. Hippe , Cordelie Witt , Robert H. Bonow , Mahmud Mossa-Basha

Author Affiliations

Published Online: Sep 8 2020 | <https://doi.org/10.1148/radiol.2020192866>

1204 patients with 1604 vessel injuries
At least 1 outpatient followup

BCVI – Stroke Risk



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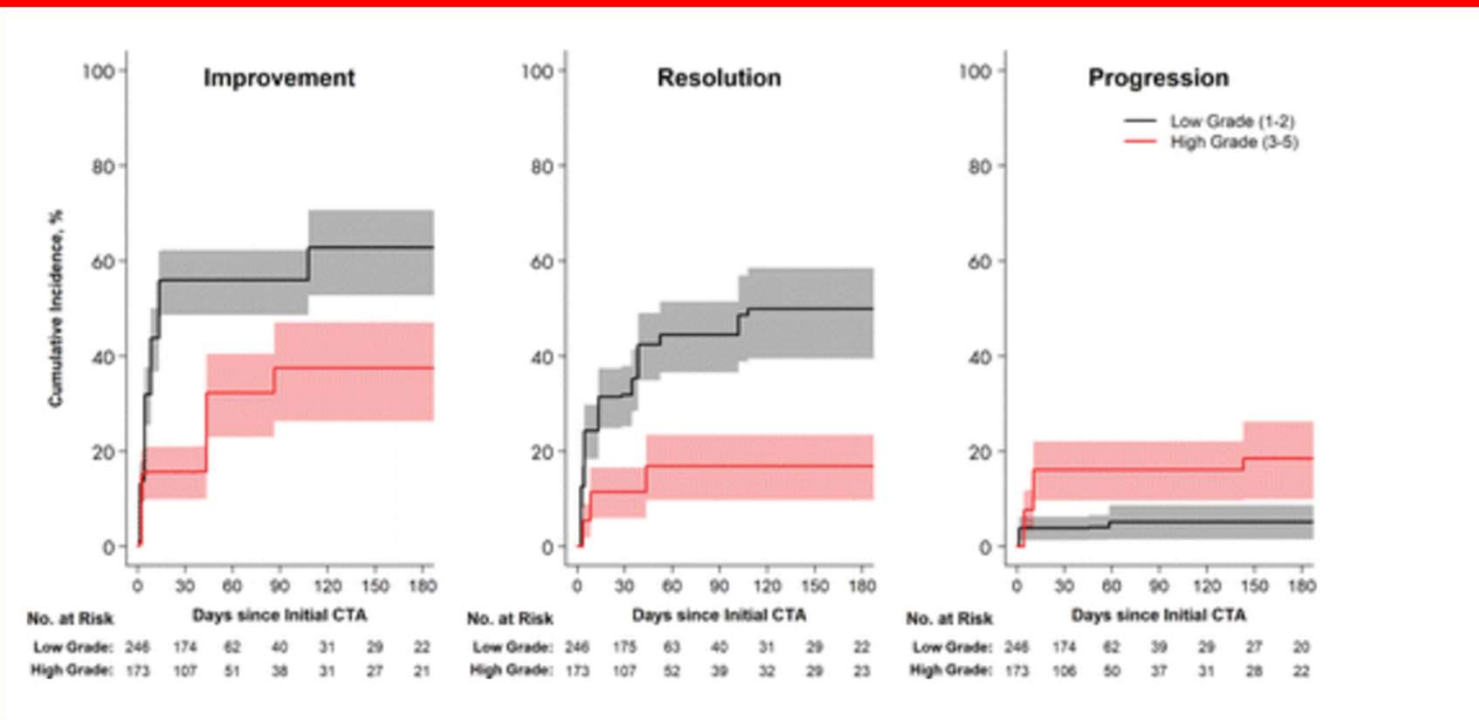
Published Online: Sep 8 2020 | <https://doi.org/10.1148/radiol.2020192866>

1204 patients with 1604 vessel injuries
At least 1 outpatient followup

Maximum Denver grade

ICA				<.001
0 (no injury)	35/668	5 (4, 7)	...	
1	5/204	2 (1, 6)	...	
2	16/166	10 (6, 15)	...	
3	24/124	19 (13, 27)	...	
4	19/37	51 (34, 68)	...	
5	3/5	60 (15, 95)	...	
VA				<.001
0 (no injury)	49/419	12 (9, 15)	...	
1	7/299	2 (1, 5)	...	
2	15/215	7 (4, 11)	...	
3	3/45	7 (1, 18)	...	
4	25/215	12 (8, 17)	...	
5	3/11	27 (6, 61)	...	

BCVI – Progression



BCVI – Denver Criteria for Screening



Criteria Categories	Signs and Findings Present
Clinical signs and symptoms of BCVI	<ul style="list-style-type: none">• Arterial hemorrhage• Cervical bruit• Expanding cervical hematoma• Focal neurological deficit• Neurologic findings unexplained by intracranial findings• Ischemic stroke on secondary CT scan
Clinical risk factors that mandate radiologic screening for BCVI	<ul style="list-style-type: none">• High-energy mechanism• Horner's syndrome• Neck soft tissue injury• Near hanging• Direct blow to the neck
Injuries of concern associated with possible BCVI	<ul style="list-style-type: none">• LeFort II or III fracture• Cervical spine fractures• Basilar skull fracture with or without carotid canal involvement• Diffuse axonal injury

Management – Grade 1 asymptomatic



- ASA 81mg
- Repeat CTA in 7 days
- If CTA stable continue ASA for 90 days and then discontinue

Management – Grade 2 asymptomatic



- ASA 325mg
- Repeat CTA in 7 days
- If CTA stable continue ASA for 90 days and then discontinue if 3 months CTA is improved.
- Consider perfusion imaging +/- cerebral angiography if stenosis > 70%

Management – Grade 3 asymptomatic



- Heparin gtt vs ASA 325
- Repeat CTA in 7 days
- If CTA stable continue anticoagulation/AP for 90 days and then discontinue if 3 months CTA is improved.
- If pseudoaneurysm enlarges consider endovascular flow diversion

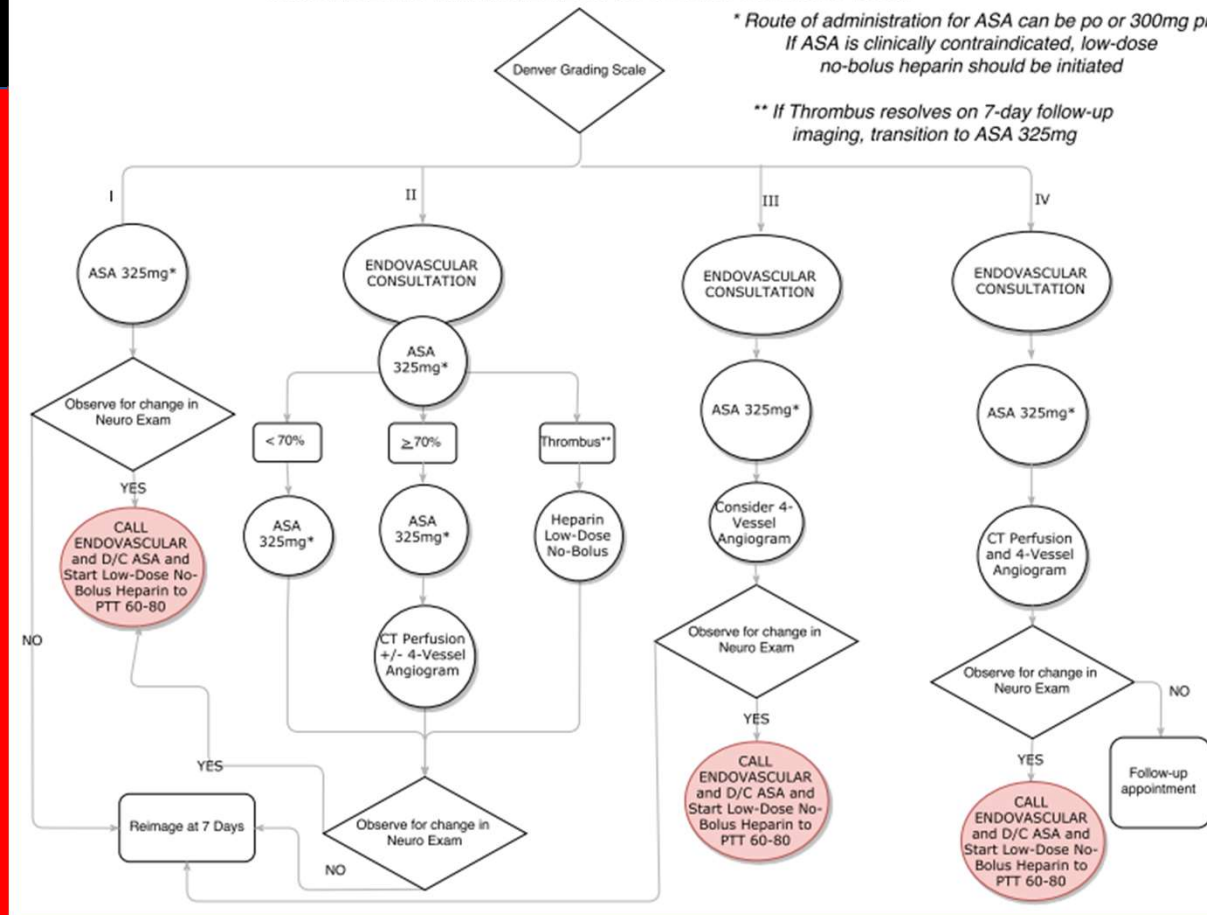
Management – Grade 4 asymptomatic



- Heparin gtt vs ASA 325
- Repeat CTA in 7 days (vessel may reopen)
- If CTA stable continue anticoagulation/AP for 90 days and then discontinue if 3 months CTA is improved.
- Consider CT perfusion +/- cerebral angiogram to determine reserve.

Management

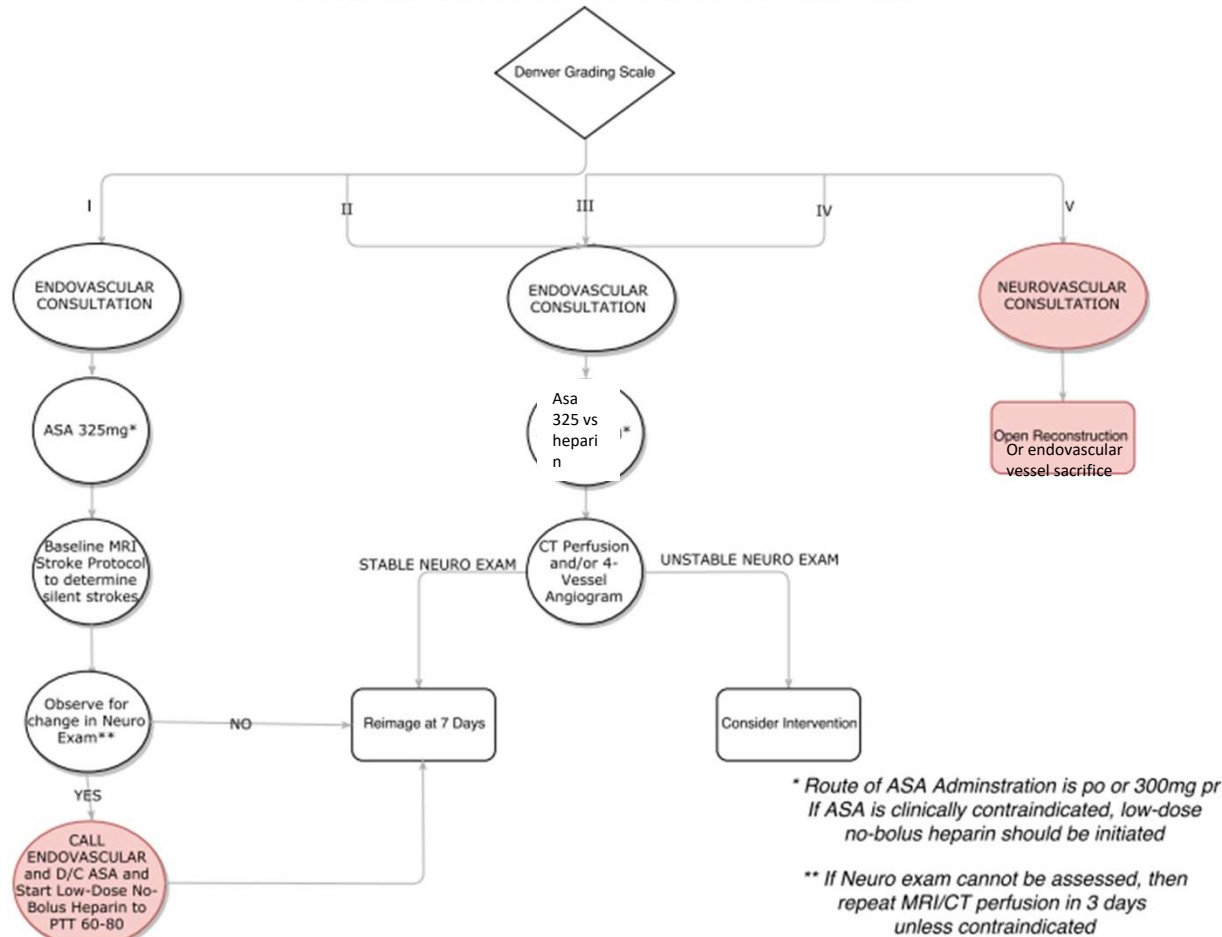
FIGURE 2.1.A MANAGEMENT OF ASYMPTOMATIC BCVI



Management



FIGURE 2.2.A MANAGEMENT OF SYMPTOMATIC BCVI



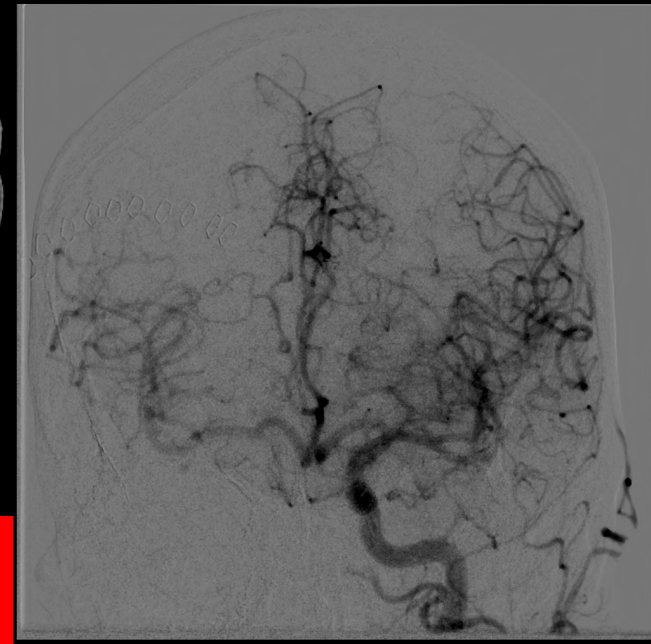
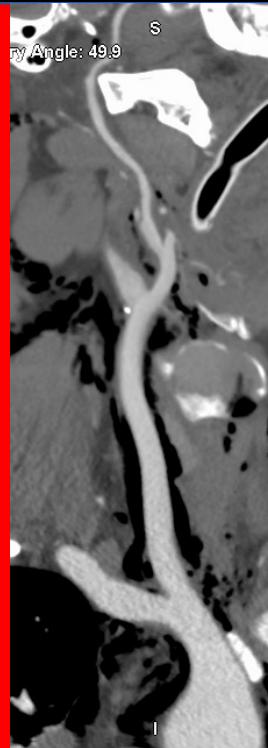
Case # 1



59 yo M polytrauma MVC
Concurrent epidural
hematoma

Angiogram with decreased
watershed perfusion

Treated with heparin gtt 60-
80ptt 48 hours after
craniotomy



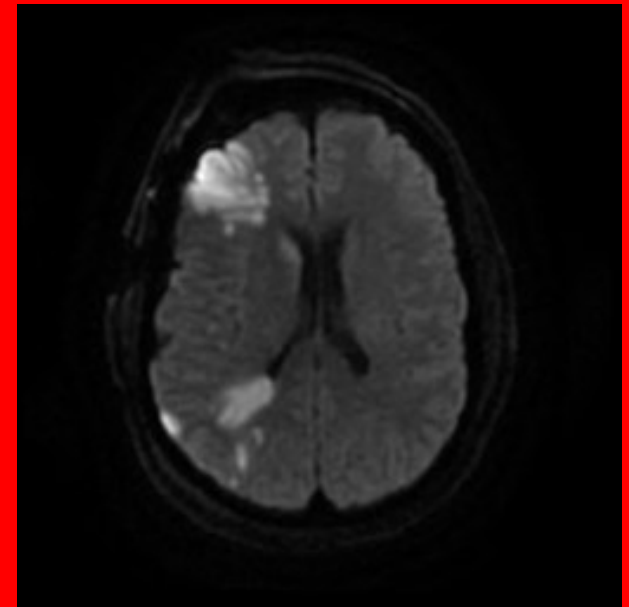
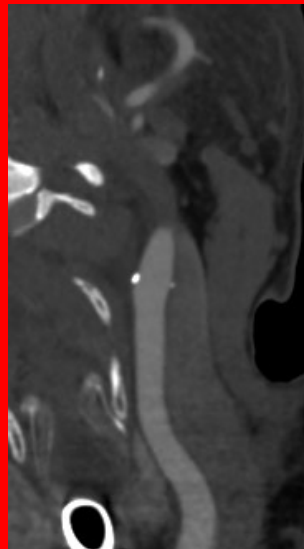
Case # 1



59 yo M polytrauma MVC
Concurrent epidural
hematoma

Angiogram with decreased
watershed perfusion

Treated with heparin gtt 60-
80ptt 48 hours after
craniotomy



Case # 2

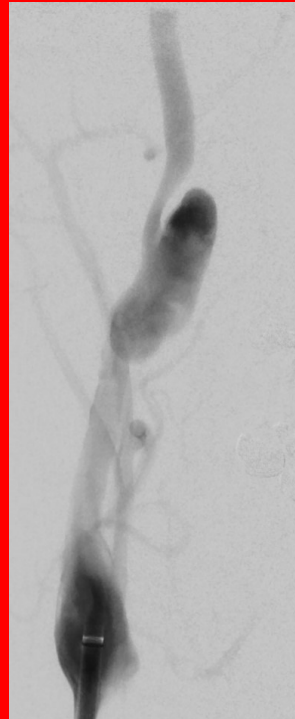


38 yo M with MVC vs pedestrian and polytrauma.

7 day repeat CTA with enlarging pseudoaneurysm, discharged on AC

3 month CTA pseudoaneurysm continues to enlarge

Flow diverting stent placed



Summary



- BCVIs are a cause of stroke in trauma patients
- Screen patients with positive Denver criteria using CTA neck
- Consider ASA for all dissections or heparin if thrombus or pseudoaneurysm present
- Consider endovascular consult for BCVI grade II (if > 70% stenosis) or all grade III and above.
- Reimage BCVIs at 7 days and then +/- again in 3 months if de-escalation of therapy needed

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Questions?



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