When the Trauma Patient Becomes the Stroke Patient- Craniocervical Blunt Trauma

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Objectives

- Identify: Identify common mechanisms of injury as they relate to trauma to the craniocervical region
- Understand: Understand the anatomy of cervical artery dissection
- Describe: Describe the signs & symptoms of cervical artery dissections
- Formulate: Formulate a treatment plan for best possible outcomes
- Discuss: Discuss circumstances, controversies and therapies in the treatment dissections

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Overview of Cervical Artery Dissections

- Cervical artery dissections (CeAD) include both carotid artery dissections (CAD) and vertebral artery dissections (VAD)
- Pathogenesis is not well understood
- Been associated with both major and minor trauma to the cervical region
- Also, atraumatic conditions such as:
  - Genetic factors that alter the vascular structure
  - HTN
  - Migraine HA

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Overview with Facial Trauma

Be aware of the prevalence of carotid artery injury found in asymptomatic blunt facial trauma patients

Can develop devastating ischemic stroke or even death

With improved screening criteria, studies have demonstrated increased detection of blunt carotid injury (BCI)

Lee, et. al (2014). *Craniomaxillofacial Trauma Reconstruction. 7*, 175–189

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So Why Do CeADs Happen?

Patients who sustain CeAD with or without minor trauma likely have an underlying arteriopathy, inflammatory process, or structural instability of the arteries

Volker et.al (2011) showed biopsy-proven structural differences in the arterial walls of patients with spontaneous & trauma CeAD

+ association with underlying kinking and coiling of the ICA and dissection

Some think may be due to inflammation, genetics, infection, or other unknown causes

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Epidemiology

- Blunt cerebrovascular injuries (BCVI) includes:
  - any form of non-penetrating injury to the ICA & vertebral arteries
- Associated with high morbidity/mortality
- Prompt diagnosis and treatment of BCVI
- Blunt carotid injury is observed in 1%- 2.6% of blunt trauma cases and in 2.7% of patients with severe multisystem trauma
  - Blunt carotid injury is associated with a high stroke rate (up to 60%) & mortality rate (19%-43%)

Galyfos G., Filis K., Sigala F. and Sianou A. (2016). Traumatic carotid artery dissection: A different entity without specific guidelines. *Vascular Specialist International, 32*(1), 1-5.

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Epidemiology

CADs can be extracranial (inferior to passage thru the skull) or intracranial

Extracranial segments of the arteries are more mobile and thus more susceptible to injury

CADs outnumber VADs 3 -5x
- ICAD occurring most commonly

CAD occur:
- most frequently 35-50 yo & peak in5th decade
- affect men and women equally

Account for ≈ 2.5% of all 1st strokes & 20% strokes in patients < 45 years of age

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Biomechanics of the Cervical Spine

C-spine-7 vertebral bodies & divided into 4 anatomical sections:
- Atlas & Axis
- Root (C2-3 junction)-secures cervical column to the upper cervical spine.
- Column (C3-C7)

Movements include:
- Flexion, extension, rotation, and lateral flexion
- Dependent on the orientation of the joint facets
- Further restricted by muscles & ligaments surrounding vertebrae

Atlanto-occipital junction- only movement allowed is **nodding**

Due to unique shape of joint articulations between C2-C7, any degree of rotation is always coupled with some lateral flexion and vice versa

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Posterior Circulation

Comprised of:
- Paired vertebral arteries
- Basilar artery
- Paired posterior cerebral arteries

- Vertebrals join to form the basilar
- Basilar divides into 2 posterior cerebral

- Supply:
  - Cerebellum
  - Medulla
  - Pons
  - Midbrain
  - Thalamus
  - Medial temporal and occipital lobes

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Anatomy of the Vertebral Artery

- Brain receives blood supply from vertebral & ICAs
- Interconnects in cranial cavity & produces Circle of Willis
  - Union of vertebral & carotid systems provides collateral circulation
  - Equalizes BP in the brain's blood supply
- Vertebral artery supplies 20% blood to the brain
  - Supplies blood to the brainstem, spinal cord, and vertebrae and their associated ligaments and muscles
- Remaining 80% supplied by the carotid system

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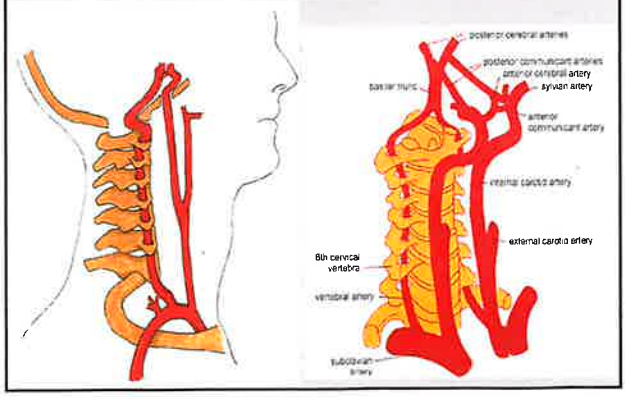
Origin of the Vertebral & Carotid Arteries



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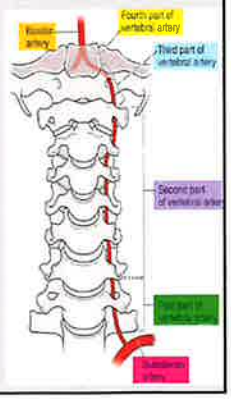
Vertebral Artery

V1 Segment
- Rises from the Subclavian artery to the transverse foramen of C6.

V2
- Passes superiorly thru transverse foramina of upper C_6 in ≈ 88% cases
- Can enter as far superior as the transverse foramen of C_{4-5}

V3
- C2 foramen to the dura

V4
- From the dura into the cranium



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Carotid Artery Anatomy

Common carotid artery (CCA) bifurcates into the external carotid artery and ICA

ICA supplies blood to parts within the cranial cavity and the orbital cavity

perfusion to the anterior and middle portion of the brain & eye

sends branches off to the forehead and nose

Originates at the carotid bifurcation and courses, via a number of curvatures, through the base of the skull into the Circle of Willis

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Pathophysiology of Dissections

- Arterial dissections occur when a tear develops in ≥ 1 layer of the vessel wall, allowing blood to enter the wall and split the layers
- Cervical arterial dissection occurs when the intimal wall of an artery is damaged as a result of trauma or defect
- Characterized by a cavity or intramural hematoma (IMH)
- Increased volume of the IMH may narrow or occlude the lumen, and it can also damage the intima and trigger thrombosis

Li Q., et. al. *American Journal of Neuroradiology, 36*, 1769 –75

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Vertebral Dissections- Anatomy

- TVAI tends to occur where vessels are exposed to shearing forces, principally at junctions between fixed and mobile segments
- V2 segment is the most commonly affected in adult TVAI
  - V2 begins from the level of the 5th or 6th cervical vertebra to the 2nd cervical vertebra travelling through the transverse foramina at each vertebral level
  - V3 and V4 segments, artery has greater mobility & may be more resistant to blunt trauma
- Relate to high impact trauma with forced flexion/extension and lateral rotation involving the whole of the c-spine
- Unilateral or bilateral, unilateral in 2/3 cases

deSouza R.M., Crocker M.J., Hallasos N., Rennie A. and Saxena A. (2010). *European Spine Journal, 20*, 1405–1416

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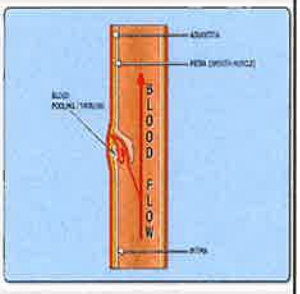
Mechanism of Injury

- May result from a direct blow to anterolateral aspect of the neck
- An extreme extension and rotation of the neck
- TCADs result from Distraction/extension, distraction/flexion or lateral flexion forces of the cervical spine



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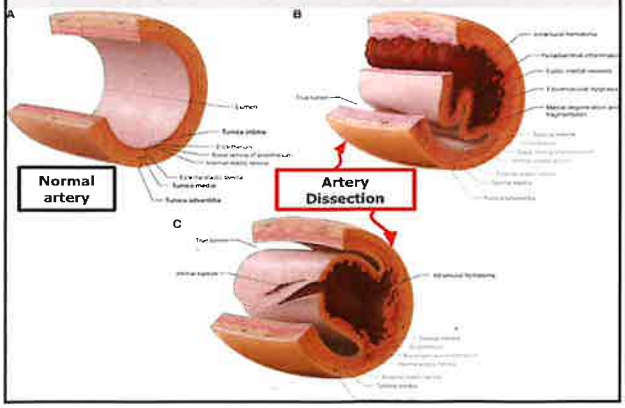
A look at Dissections



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Overview with Facial Trauma

- Be aware of the prevalence of carotid artery injury found in asymptomatic blunt facial trauma patients
- Facial fracture- BCVI is a known sequela of high-energy CMF trauma (Kelts, et al., 2016)
  - Mandible & LeFort II & III fx- most common isolated CMF injury associated with BCVI
- With improved screening criteria, studies have demonstrated increased detection of blunt carotid injury (BCI)

Lee, et. al (2014) *Craniomaxillofacial Trauma Reconstruction. 7*, 175–189

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Blunt Injuries Associated with Vertebral & Carotid Injuries

- DAI with GCS ≤ 8
- Skull base fractures, occipital condyle fx or scalp degloving
- Concurrent TBI & thoracic injury
- Traumatic spinal injuries
  - Subluxations (below C_1- C_2) or fx involving transverse foramen & carotid canal
  - C_1–C_3 fractures- hangings or clothesline

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Those Unhappy Genes

- Similar to other risk factors associated with stroke
  - HTN
  - Carotid artery stiffness
  - Hereditary connective tissue disease
  - Vertebral bone structure changes
- Post-partum
- About 2-10 % of all strokes can be attributed to arterial dissection

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Other Risks

Hx of Migraine

Head position

- Strangulation
- Dental procedure or washing hair
- Ceiling painting
- Resuscitation

Sports

- Wrestling

Leisure activities

- Rollercoaster

Robertson & Koyfman A. (2017)

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Neck Manipulation

- Albuquerque, et al (2011), reported on 13 patients undergoing chiropractic manipulation and then developing symptoms
- Dissections were noted along the vertebral artery, and ICA, as well as the basilar artery
  - Tx involved stenting and thrombolysis
  - 3 patients needed emergency cerebellar decompression
- 6/13 given meds to prevent clotting and stroke
- Others (7) had procedure
- Follow-up revealed:
  - 9 had a complete recovery
  - 3 permanent neurological deficits

death from a cerebellar stroke

sequelae of chiropractic manipulation: Patterns of injury and management. *Journal of Neurosurgery, 115* (6), 197-2005.

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Migraine, Stroke, and Cervical Arterial Dissection

Shared Genetics for a Triad of Brain Disorders With Vascular Involvement

Iyas Daghlas, MD,* Muralidharan Sargurupremraj, PhD,* Rebecca Canning, MS, Padhraig Gormley, PhD, Rainer Malik, PhD, Philippe Amouyel, MD, PhD, Tuna Metso, PhD, Alessandro Pezzini, MD, Tobias Kurth, MD, ScD, Stephanie Debette, MD, PhD,† and Daniel I. Chasman, PhD‡

Neurol Genet 2022;8:e653; doi:10.1212/NXG.0000000000000653

- Migraine, stroke, and CeAD represent a triad of cerebrovascular disorders with comorbid relationships &vascular involvement
- Among all pairs of disorders, genome-wide genetic correlation was observed only between CeAD and migraine, particularly migraine without aura
- Local genetic correlations were more extensive between migraine & CeAD than those between migraine & stroke or CeAD & stroke
- Revealed evidence for novel CeAD associations

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History of a Minor Precipitating Event

- Frequently elicited in patients with spontaneous dissection of the carotid or vertebral artery
- Precipitating events associated with hyperextension or rotation of the neck
- Chiropractic manipulation of the neck has been associated with carotid artery dissection &, particularly, vertebral artery dissection
- Hx of a respiratory tract infection

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Cervical Artery Dissection and Sports

- Recommend refraining from any kind of sports for 1 month
- Start with activities at low intensity and gradually increase the pace in an individually tailored
- Circumstances of the occurrences of the CeAD in the individual patient
- The meaning of sports activities for the individual well-being, the
- Presence or absence of comorbidities and of neurological sequela, neurovascular findings
- Signs of an underlying connective tissue alteration.

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Neck Manipulation Associated With Stroke

- Albuquerque, et al (2011), reported on 13 patients undergoing chiropractic manipulation and then developing symptoms
- Dissections were noted along the vertebral artery, and ICA, as well as the basilar artery
  - Tx involved stenting and thrombolysis
  - 3 patients needed emergency cerebellar decompression
- 6/13 given meds to prevent clotting and stroke
- Others (7) had procedure
- Follow-up revealed:
  - 9 had a complete recovery
  - 3 permanent neurological deficits
  - 1 death from a cerebellar stroke.

Albuquerque F, et al. (2011). Craniocervical arterial dissections as sequelae of chiropractic manipulation: Patterns of injury and management. *Journal of Neurosurgery, 115* (6), 197-2005.

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Look, Listen, Ask and Think

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Clinical Pearl

Stop & THINK when you hear ***THIS*** phrase

"I have a pain in my neck and (or) head *unlike anything I have ever had before*"

- Take a step back
- Pay close attention to everything about this patient!

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Making the Diagnosis

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Look and Listen

- Five "**D**'s"
  - Dizziness
  - Drop attacks (vertigo)
  - Diplopia
  - Dysarthria
  - Dysphagia
- **A**nd
  - Ataxia
- 3 "**N**'s"
  - Nausea
  - Numbness
  - Nystagmus

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Signs & Symptoms

- Traumatic vertebral artery injury (TVAI) & CAD present a clinical challenge
  - hard to detect
  - **has a diverse presentation**
  - no widely accepted guidelines of diagnosis and management
- Frequently asymptomatic with disastrous consequences of basilar territory infarction & death with vertebral dissection

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Signs and Symptoms

- BCVIs may be asymptomatic or masked by more significant coexisting traumatic injuries
- Many asymptomatic & remain undetected until symptoms of cerebrovascular ischemia present
- Symptoms of Carotid dissections occur after a mean of 12.5 hours in survivors, and after a mean of 19.5 hours in non-survivors
- Hörner syndrome- pressure from a hematoma, & paralysis of cranial nerve (above T2)

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Classic Horner's Triad

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Carotid Dissection Symptoms

- HA (precedes ischemic event), with neck & facial pain- constant, instantaneous, gradual, throbbing, or sharp
  - HA commonly ipsilateral to the dissected artery
  - HA usually *precedes* cerebral ischemic event
- Transient episodic blindness (painless monocular)
  - caused by decreased blood flow to the retina
- Ptosis with miosis, (partial Horner syndrome)
  - Can be painful
- Neck swelling
- Pulsatile tinnitus- seen in up to 25% of patients
- Decreased taste sensation (hypoageusia)
- Focal weakness

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Pain with Dissections

Pain referral common to Vertebral

Pain referral common to Internal Carotid

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Table 3. Presentation Of Spontaneous Cervical Artery Dissection

Symptoms	Location of Dissection	
	Carotid	Vertebral
Pain distribution	• Headache or migraine, 36%, 68%,[6] 65%[7,8] • Occipital headache, 1%[7] • Frontal headache, 33%[8] • Facial or orbital pain, 52%[7] • Neck pain, 16%,[3] 26%[7] • Chest pain[7]	• Headache or migraine • Neck pain • Neck pain posteriorly • Chest pain[7]
Neurological deficits, by occlusion	• Hemiparesis and sensory loss • Monocular blindness • Hemineglect • Aphasia (if dominant hemisphere)	• Locked in syndrome • Respiratory failure • Hemianopsia or bilateral visual field loss
Neurological deficits, by emboli	Anterior circulation deficits • Amaurosis fugax (monocular blindness), 17%[5] • Hemineglect • Hemiparesis, 23%[7] • Aphasia • Dysarthria • Hemisensory loss, 7%[7]	Posterior circulation deficits • Hemianopsia or unilateral field defect • Ataxia, 20%[4] • Diplopia • Dysarthria • Upside-down vision • Lateral medullary syndrome (Wallenberg syndrome), 32%[4] dysphagia, hemiparesis, diplopia, facial weakness, unilateral tinnitus
Neurological deficits by compressive aneurysmal dilatation and disruption of adventitia	Horner syndrome, unilateral miosis, ptosis, anhidrosis, 35%, 29%–58%[9] Dysgeusia, 0.5%[10] Pulsatile tinnitus, 15%[10] Ocular motor palsy, CN III, IV, VI, 2.6%[11] Palsy of CN V, 3.7%[11] Palsy of CN VII, IX-XII, 7.5%, 12%[11]	• Pulsatile tinnitus, 5% • Unilateral radicular weakness (C5-C6 most common), 1%[2,12,13]

April 2012 - www.ebmedicine.net

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SCREENING TOOLS

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Incidence of traumatic carotid and vertebral artery dissections: results of cervical vessel computed tomography angiogram as a mandatory scan component in severely injured patients

Purpose: The aim of this study was to evaluate the true incidence of cervical artery dissections (CeADs) in trauma patients with an Injury Severity Score (ISS) of ≥16, since head-and-neck computed tomography angiogram (CTA) is not a compulsory component of whole-body trauma computed tomography (CT) protocols.

Patients and methods: A total of 230 consecutive trauma patients with an ISS of ≥16 admitted to our Level I trauma center during a 24-month period were prospectively included. Standardized whole body CT in a 256-detector row scanner included a head-and-neck CTA. Incidence, mortality, patient and trauma characteristics, and concomitant injuries were recorded and analyzed retrospectively in patients with carotid artery dissection (CAD) and vertebral artery dissection (VAD).

Results: Of the 230 patients included, 6.5% had a CeAD, 5.2% had a CAD, and 1.7% had a VAD. One patient had both CAD and VAD. For both, CAD and VAD, mortality is 25%. One death was caused by fatal cerebral ischemia due to high-grade CAD. A total of 41.6% of the patients with traumatic CAD and 25% of the patients with VAD had neurological sequelae.

Conclusion: Mandatory head-and-neck CTA yields higher CeAD incidence than reported before. We highly recommend the compulsory inclusion of a head-and-neck CTA to whole-body CT routines for severely injured patients.

Schicho A, et. al (2018). Incidence of traumatic carotid and vertebral artery dissections: Results of cervical vessel computed tomography angiogram as a mandatory scan component in severely injured patients. *Therapeutics and Clinical Risk Management, 14*, 173—178

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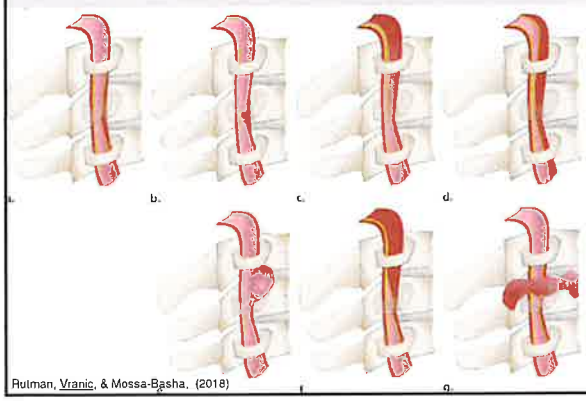
BCVI Grading Scale



Rutman, Vranic, & Mossa-Basha, (2018)

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Denver Screening Criteria

Screening criteria

- The screening protocol criteria for BCVI are divided into signs and symptoms of BCVI and risk factors:

Signs and symptoms

- arterial hemorrhage
- cervical bruit in patient <50 years of age
- expanding cervical hematoma
- focal neurologic deficit
- neurologic exam incongruous with head CT scan findings
- Stroke on secondary CT scan

Risk factors include high-energy transfer mechanism with

- Le Fort fracture: type 2 or 3
- base of skull fractures involving the carotid canal
- diffuse axonal injury with a GCS <6
- cervical spine fractures that involve C1-3, and/or the transverse foramen
- cervical spine subluxation

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Modified Denver Criteria

- Basilar skull fractures with carotid canal involvement
- C-spine fx through transverse foramina
- C- spine fractures involving C1-3
- Expanding neck hematoma
- Cervical bruit in patients<50 years of age
- Focal neurological deficits
- Evidence of brain infarct on CT
- DAI with GCS<6 or less
- Presence of Lefort II or III fx
- Near hanging injuries with anoxic brain injury
- Neurological examination inconsistent with head CT
  - Arterial hemorrhage

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Other Screening Tooks

- Modified Memphis
- Combined Denver & Memphis
- Boston Screening tool

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DIAGNOSIS MADE BY IMAGING

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Importance of Dx BCVI

- It can lead to severe neurological deficits and even death related to a major stroke
- The hallmark of injury to the internal carotid artery *is* ***a change in the caliber of the vessel***
- CTA is nearly always sufficient to confirm the diagnosis of carotid artery dissection
- Even early studies (1996) with CTA achieved 100% sensitivity and specificity with arterial angiography

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> Eur J Trauma Emerg Surg. 2021 Feb;47(1):141-170. doi: 10.1007/s00068-019-01171-9. Epub 2019 Jun 13.

Blunt cerebrovascular injury: incidence and long-term follow-up

Dennis Hundersmarck [1 2], Willem-Bart M Slooff [3], Jelle F Homans [4], Quirine M J van der Vliet [1], Nizar Moayeri [5], Falco Hietbrink [1], Gert J de Borst [2], Fetullah Cumhur Oner [4], Sander P J Muijs [4], Luke P H Leenen [1]

- 71 BVI patients identified among the 12.122 (0.59%) blunt trauma patients
- Ischemic stroke as a result of BCVI was found in 20 patients (28%). In-hospital stroke rate was lower in patients receiving antiplatelet therapy ($p < 0.01$).
- Improved CTA diagnostic modalities have increased BCVI incidence. Furthermore, BCVI patients reported significant functional impairment at long-term follow-up. Antiplatelet therapy showed a significant effect on in-hospital stroke rate reduction.

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MRI/MRA Carotid Dissection

- MRI scans with fat saturation can show intramural blood, and mural expansion, pathological hallmark of dissection
- MRA may fail to detect intramural hematoma within the 1st 24-48 hours after occurrence of CAD
- Other MRA signs of dissection include
  - irregular vessel margins
  - filling defects
  - extravasation of contrast
  - vascular occlusion
  - caliber changes of the vessel

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Doppler Ultrasound- Carotid

- DUS **lowest cost and highest safety** profile of all the imaging
- **Sensitivities as high as 96%** in dx carotid artery dissections in stroke
- **Abnormal blood flow pattern seen in up to 90%** of patients with carotid artery dissection
- **Most common DUS finding in carotid artery dissection is high resistance flow pattern** or absence of signal in a totally occluded artery.
- DUS has a **relatively high false-negative** rate in patients with carotid artery dissection **presenting with Horner syndrome**
- **Abnormalities with DUS should always be followed up** with another imaging modality

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Clin Neuroradiol. 2018 Jan 26. doi: 10.1007/s00062-018-0666-4. [Epub ahead of print]

Imaging of Spontaneous and Traumatic Cervical Artery Dissection : Comparison of Typical CT Angiographic Features.

Sporns PB[1], Naggvslaff T[2], Heindel W[2], Rasschke M.J[2], Hartensuer R[2], Dittrich R[3], Hanning U[2,3]

+ Author Information

Abstract

INTRODUCTION: Cervical artery dissection (CAD) is an important etiology of ischemic stroke and early recognition is vital to protect patients from the major complication of cerebral embolization by administration of anticoagulants. The etiology of arterial dissections differ and can be either spontaneous or traumatic. Even though the historical gold standard is still catheter angiography, recent studies suggest a good performance of computed tomography angiography (CTA) for detection of CAD. We conducted this research to evaluate the variety and frequency of possible imaging signs of spontaneous and traumatic CAD and to guide neuroradiologists' decision making.

METHODS: Retrospective review of the database of our multiple injured patients admitted to the Department of Trauma, Hand, and Reconstructive Surgery of the University Hospital Münster in Germany (a level 1 trauma center) for patients with traumatic CAD (tCAD) and of our stroke database (2006-2015) for patients with spontaneous CAD (sCAD) and CT/CTA on initial clinical work-up. All images were evaluated concerning specific and sensitive radiological features for dissection by two experienced neuroradiologists. Imaging features were compared between the two etiologies.

RESULTS: This study included 145 patients (99 male, 46 female, 45 ± 18.8 years of age), consisting of 126 dissected arteries with a traumatic and 43 with spontaneous etiology. Intimal flaps were more frequently observed after traumatic etiology (58.1% tCADs, 6.9% sCADs, $p < 0.001$), additionally, multivessel dissections were much more frequent in trauma patients (3 sCADs, 21 tCADs) and only less than half (42%) of the patients with traumatic dissections showed cervical spine fractures.

CONCLUSION: Neuroradiologists should be aware that intimal flaps and multivessel dissections are more common after a traumatic etiology. In addition, it seems important to conduct a CTA in a trauma setting, even if no cervical spine fracture is detected.

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Neuroimaging. 2017 Nov;27(6):607-612. doi: 10.1111/jon.12451. Epub 2017 Jun 2.

CT versus MR Techniques in the Detection of Cervical Artery Dissection.

Hanning U[1], Sporns PB[2], Schmiedel M[3], Rangelkian EB[3], Heindel W[3], Wiendl H[3], Niederstadt T[3], Dittrich R[3]

› Author information

Abstract

BACKGROUND: Spontaneous cervical artery dissection (sCAD) is an important etiology of juvenile stroke. The gold standard for the diagnosis of sCAD is convential angiography. However, magnetic resonance imaging (MRI)/MR angiography (MRA) and computed tomography (CT)/CT angiography (CTA) are frequently used alternatives. New developments such as multislice CT/CTA have enabled routine acquisition of thinner sections with rapid imaging times. The goal of this study was to compare the capability of recent developed 128-slice CT/CTA to MRI/MRA to detect radiologic features of sCAD.

METHODS: Retrospective review of patients with suspected sCAD (n = 188) in a database of our Stroke center (2008-2014) who underwent CT/CTA and MRI/MRA on initial clinical work-up. A control group of 26 patients was added. All images were evaluated concerning specific and sensitive radiological features for dissection by two experienced neuroradiologists. Imaging features were compared between the two modalities.

RESULTS: Forty patients with 43 dissected arteries received both modalities (29 internal carotid arteries [ICAs] and 14 vertebral arteries [VAs]). All CADs were identified in CT/CTA and MRI/MRA. The features intimal flap, stenosis, and lumen irregularity appeared in both modalities. One high-grade stenosis was identified by CT/CTA that was expected occluded on MRI/MRA. Two MRI/MRA-confirmed pseudoaneurysms were missed by CT/CTA. None of the controls evidenced specific imaging signs for dissection.

CONCLUSIONS: CT/CTA is a reliable and better available alternative to MRI/MRA for diagnosis of sCAD. CT/CTA should be used to complement MRI/MRA in cases where MRI/MRA suggests occlusion.

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Antiplatelet treatment compared with anticoagulation treatment for cervical artery dissection (CADISS): a randomised trial

Lancet Neurol 2015; 14: 361–67

Summary

Background Extracranial carotid and vertebral artery dissection is an important cause of stroke, especially in young people. In some observational studies it has been associated with a high risk of recurrent stroke. Both antiplatelet drugs and anticoagulant drugs are used to reduce risk of stroke but whether one treatment strategy is more effective than the other is unknown. We compared their efficacy in the Cervical Artery Dissection in Stroke Study (CADISS) with the additional aim of establishing the true risk of recurrent stroke.

Methods We did this randomised trial at hospitals with specialised stroke or neurology services (39 in the UK and seven in Australia). We included patients with extracranial carotid and vertebral dissection with onset of symptoms within the past 7 days. Patients were randomly assigned (1:1) by an automated telephone randomisation service to receive antiplatelet drugs or anticoagulant drugs (specific treatment decided by the local clinician) for 3 months. Patients and clinicians were not masked to allocation, but investigators assessing endpoints were. The primary endpoint was ipsilateral stroke or death in the intention-to-treat population. The trial was registered with EUDract (2006-002827-18) and ISRN (CTN:44555237).

Findings We enrolled 250 participants (118 carotid, 132 vertebral). Mean time to randomisation was 3·65 days (SD 1·91). The major presenting symptoms were stroke or transient ischaemic attack (n=224) and local symptoms (headache, neck pain, or Horner's syndrome; n=26). 126 participants were assigned to antiplatelet treatment versus 124 to anticoagulant treatment. Overall, four (2%) of 250 patients had stroke recurrence (all ipsilateral). Stroke or death occurred in three (2%) of 126 patients versus one (1%) of 124 (odds ratio [OR] 0·335, 95% CI 0·006–4·232; p=0·63). There were no deaths, but one major bleeding (subarachnoid haemorrhage) in the anticoagulant group. Central review of imaging failed to confirm dissection in 52 patients. Preplanned per-protocol analysis excluding these patients showed stroke or death in three (3%) of 101 patients in the antiplatelet group versus one (1%) of 96 patients in the anticoagulant group (OR 0·346, 95% CI 0·006–4·390; p=0·66).

Interpretation We found no difference in efficacy of antiplatelet and anticoagulant drugs at preventing stroke and death in patients with symptomatic carotid and vertebral artery dissection but stroke was rare in both groups, and much rarer than reported in some observational studies. Diagnosis of dissection was not confirmed after review in many cases, suggesting that radiographic criteria are not always correctly applied in routine clinical practice.

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Biomarkers and Antithrombotic Treatment in Cervical Artery Dissection (TREAT-CAD) trial

- Designed before the results of CADISS published
- 194 in TREAT-CAD trial randomly assigned (within 2 wks of symptomatic MRI-verified CAD) to 90-day aspirin 300 mg daily (n=100) or vitamin K antagonists (n=94), to test the non-inferiority of aspirin rather than the superiority of either treatment
- Why the difference in this trial vs CADISS
- The benefit of dual antiplatelet therapy appears particularly robust in individuals with large vessel disease, which might share some common pathophysiological features with arterial dissection, including intimal disruption.

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Society for Vascular Surgery Guidelines

- CEA as the first-line treatment for symptomatic low-risk surgical patients with stenosis of 50% to 99% and asymptomatic patients with stenosis of 70% to 99%
- The perioperative risk of stroke and death in asymptomatic patients must be 50% stenosis and should be performed as soon as the patient is neurologically stable after 48 hours but definitely, ≤ 14 days after symptom onset
- clinically asymptomatic carotid artery stenosis in patients without cerebrovascular symptoms or significant risk factors for carotid artery disease is not recommended

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› Injury. 2018 Jan;49(1):67-74. doi: 10.1016/j.injury.2017.07.036. Epub 2017 Jul 31.

Management of blunt cerebrovascular injury (BCVI) in the multisystem injury patient with contraindications to immediate anti-thrombotic therapy

Michelle K McNutt [1], A Cozette Kale [2], Ryan S Kitagawa [3], Ali H Turkmani [4], David W Fields [5], Sarah Baraniuk [6], Brijesh S Gill [7], Bryan A Cotton [8], Laura J Moore [9], Charles E Wade [10], Arthur Day [11], John B Holcomb [12]

- Total of 28,305 blunt trauma - 323 (1.1%) had 481 BCEVIs
- Isolated BCVI was reported in 111 (34.4%) & 212 (65.6%) patients had accompanying multisystem injuries (TBI, solid organ, or spinal cord injury) that contraindicated immediate antithrombotic therapy
- Lack of bleeding complications and equivalent stroke rates between groups suggests that the presence of TBI, solid organ injury, and spinal cord injury are not contraindications to anti-thrombotic therapy for stroke prevention in patients with BCVI

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Early antithrombotic therapy is safe and effective in patients with blunt cerebrovascular injury and solid organ injury or traumatic brain injury

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- 119 patients (74 with TBI, 26 with SOI, and 19 with both) were identified
- 71% were treated with heparin infusion & 29% received antiplatelet therapy alone
- Initiation of early AT for patients with BCVI and concomitant TBI or SOI does not increase risk of worsening TBI or SOI above baseline

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World Neurosurg. 2020 Jan;133:e985-e990. doi: 10.1016/j.wneu.2019.09.015. Epub 2019 Sep 12.

Management of Extracranial Blunt Cerebrovascular Injuries: Experience with an Aspirin-Based Approach

Joshua S Catapano [1], Sharjeel Israr [1], Alexander C Whiting [1], Omar M Hussain [1], Laura A Snyder [1], Felipe C Albuquerque [1], Andrew F Ducruet [1], Peter Nakaji [1], Michael T Lawton [1], Jordan A Weinberg [1], Joseph M Zabramski [2]

- 13,578 patients admitted following blunt trauma
- 94 (0.7%) with confirmed BCVI (mean age, 42 yrs; 72% male). Mean Injury Severity Score and Glasgow Coma Score were 27 and 10, respectively
- BCVI was identified in 130 vessels
- An ASA-based management strategy for BCVI was efficacious and relatively safe in this study. This approach may be the preferred treatment for BCVI, but confirmation is needed.

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Observational Study > J Trauma Acute Care Surg. 2022 Feb 1;92(2):347-354.
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Factors associated with stroke formation in blunt cerebrovascular injury: An EAST multicenter study

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- 777 BCVIs included
- Stroke rate 8.9% for all BCVIs, with 11.7% rate of stroke for ICA BCVI and 6.7% rate for VA BCV
- Protocol-driven management by the trauma service, antiplatelet therapy (specifically Aspirin), and lower % luminal stenosis were associated with lower stroke rates
- Resolution & development of intraluminal thrombus were associated with higher stroke rates

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ESO guideline for the management of extracranial and intracranial artery dissection

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SAGE

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Abstract

The aim of the present European Stroke Organisation guideline is to provide clinically useful evidence-based recommendations on the management of extracranial artery dissection (EAD) and intracranial artery dissection (IAD). EAD and IAD represent leading causes of stroke in the young, but are uncommon in the general population, thus making it challenging to conduct clinical trials and large observational studies. The guidelines were prepared following the Standard Operational Procedure for European Stroke Organisation guidelines and according to GRADE methodology. Our four recommendations result from a thorough analysis of the literature comprising two randomized controlled trials (RCTs) comparing anticoagulants to antiplatelets in the acute phase of ischemic stroke and twenty-six comparative observational studies. In EAD patients with acute ischemic stroke, we recommend using intravenous thrombolysis (IVT) with alteplase within 4.5 hours of onset if standard inclusion/exclusion criteria are met, and mechanical thrombectomy in patients with large vessel occlusion of the anterior circulation. We further recommend early endovascular or surgical intervention for IAD patients with subarachnoid hemorrhage (SAH). Based on evidence from two phase 2 RCTs that have shown no difference between the benefits and risks of anticoagulants versus antiplatelets in the acute phase of symptomatic EAD, we strongly recommend that clinicians can prescribe either option. In post-acute EAD patients with residual stenosis or

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Treatment of Carotid Dissections

- Asymptomatic with low-grade dissections typically tx conservatively with medical management & close imaging observation
- According to the guidelines, antithrombotic or antiplatelet treatment is recommended in patients with neurological symptoms (Class IIa, Level B recommendation)
  - Anticoagulants or antiplatelets are usually recommended in the acute phase of CAD to prevent primary or recurrent ischemic events
- Endovascular intervention is suggested only when neurological status of a patient deteriorates under conservative medical treatment

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Denver Radiologic Grading Scale for BCVI & Tx

- **Grade I**: Irregularity of the vessel wall or dissection/intramural hematoma with less than 25% stenosis
  - **Management**: Anticoagulation or antiplatelet therapy, endovascular repair for symptomatic patients who are not candidates for anticoagulation or antiplatelet therapy
- **Grade II**: Intramural thrombus or raised intimal flap or dissection/intramural hematoma with greater than 25% stenosis
  - **Management**: endovascular therapy if symptomatic, anticoagulation, antiplatelet therapy, deferred endovascular repair in high-risk asymptomatic patients
- **Grade III**: Pseudoaneurysm
  - **Management**: endovascular therapy if symptomatic, anticoagulation, antiplatelet therapy, deferred endovascular repair in high-risk asymptomatic patients
- **Grade IV**: Vessel Occlusion
  - **Management**: endovascular therapy if symptomatic, anticoagulation, antiplatelet therapy, deferred endovascular repair in high-risk asymptomatic patients
- **Grade V**: Vessel transection
  - **Management**: Vascular sacrifice, either open or endovascular if symptomatic followed by anticoagulation or antiplatelet therapy. Asymptomatic patients may be managed with observation, operative or endovascular treatment for ongoing hemorrhage.

Biffl WL, Moore EE, Offner PJ et al. (1999) Blunt carotid arterial injuries: implications of a new grading scale. J Trauma ;47 (5): 845-53

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ENDOVASCULAR TREATMENT

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Observational Study > Am Surg

Endovascular Intervention in Internal Carotid Artery Blunt Cerebrovascular Injury: An EAST Multicenter Study

Margaret Lauerman, Emily Esposito, Chance Spalding, Joshua Simpson, Julie A Dunn, Linda Zielinski, Sigrid Burruss, Paul Kim, Lewis L Jacobson, Jamie Williams, Jeffry Nahmias, Areg Grigorian, Laura Harmon, Anna Gergen, Matthew Chatoor, Richi 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, Mark J Lieser, Thomas M Scalea, Deborah M Stein

- Use of endovascular intervention (EI) for blunt cerebrovascular injury (BCVI) is without consensus guidelines Rates of EI use and radiographic characteristics of BCVI undergoing EI nationally are unknown
- 332 ICA BCVI included, 21 (6.3%) underwent EI
- seudoaneurysm size is associated with use of EI for ICA BCVI. Stroke is more common in ICA BCVI with EI but did not occur after EI use

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Surgical & Endovascular Repair

- Data limited on surgical therapy limited
- AHA/ASA recommends that angioplasty and stenting be considered when ischemic neurologic symptoms have not responded to medical therapy
  - **only for ICAD and not VAD!**
- Candidates for procedural therapy include:
  - those with recurrent ischemia despite medical treatment
  - patients with contraindications to anticoagulants or antiplatelet medications
  - patients with significantly compromised cerebral blood flow or with severe occlusion
  - luminal narrowing, and those with enlarging pseudoaneurysms

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Endovascular Management of Cervical Carotid and Vertebral Artery Dissection: Indications, Techniques, and Outcomes From a 20-Year Experience

- 116 patients, including 93 in the CAD cohort and 23 in the VAD cohort, with a mean age of 44.9 years (range 5-76)
- In a long-term experience, endovascular management of CAD and VAD is highly effective in specific indications, with an acceptable complication profile. CAD requiring intervention is more likely than VAD to have failed medical therapy, present with thromboembolic events and pseudoaneurysms, and undergo primary stent placement, whereas VAD is more likely to undergo treatment for traumatic occlusions with recanalization

Moon K., Albuquerque F., Cole T.S., et al. (2016). Endovascular management of cervical carotid and vertebral artery dissection: indications, techniques, and outcomes from a 20-year experience. Neurosurgery, 63, 205

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Endovascular Tx of ICA Dissections

- High rates of favorable outcome and reperfusion noted, **BUT** most of the studies retrospective case reports or case series with a high sensitivity to bias and low number of cases
- Data in the included studies was not always consistently described
- Time to treatment in the reviewed studies was relatively long, which could be due to procedural time needed to stent the ICA increases the onset-to reperfusion time
- Studies that describe results of 2nd generation (Solitaire & Penumbra) treatment methods are not widely available yet

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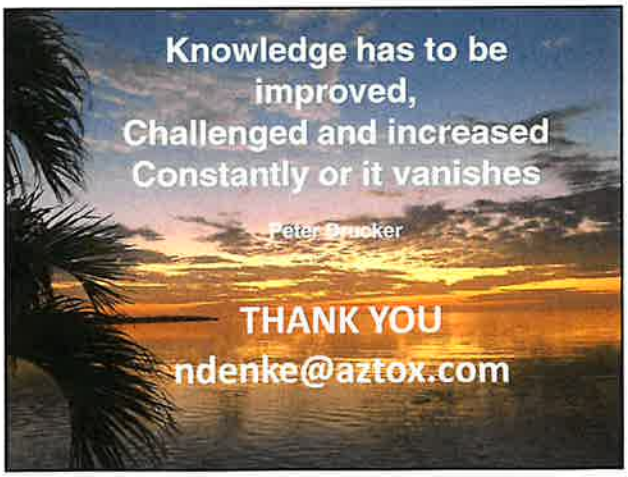

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