Ischemic Infarction in Young Adults

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Ischemic Infarction in Young Adults

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Relevance

- Stroke most common cause of serious disability in US
  - Most CVAs are ischemic
- Incidence is increasing in young adults (18 – 45 or 18 – 55)
- 10 – 14% of ischemic events are in young adults

- Long duration of disability
- Continued risk of complications over many years
Epidemiology

• Frequency increasing with unclear cause

• Possibly better awareness of non-specific symptoms (BE-FAST campaign)

• Better awareness among clinicians leads to more accurate diagnosis
  • More likely to get neuroimaging
  • Increased availability of MRI

• Increasing incidence of diabetes, hypertension, sedentary lifestyle
Diagnosis

- Younger people seek care later after onset of symptoms
- Symptoms tend to be more mild compared to older adults

- Broad range of symptoms (not unique to age)

- Dx can be simple (dissection) or extensive workup (eg, vasculitis)
- Imaging investigates ischemia, hemorrhage, candidacy for intra-arterial therapy
Causes

• Most common classification along 5 broad buckets

• Trial of Org 10172 in Acute Stroke Treatment (TOAST) classification
  • Randomized trial of LMW heparinoid 3 months post acute ischemia 1990-1997

• Discussed in order of frequency in young adult population
Cardioembolic

- As a group accounts for 46% of ischemic infarcts in young adults

- Multiple etiologies and different clot compositions

- Two major patterns:
  - Either single LVO from single embolus
  - Small scattered infarcts in multiple territories from showering emboli
Septic emboli

- Multiple small infectious emboli
- Break off from cardiac valve infectious vegetations

- Septic emboli – most commonly from IV drug use
- Most frequent complication of infective endocarditis
  - Common in asymptomatic patients, 37% have small embolic strokes
Septic emboli
Septic emboli
Other non-septic emboli

- Multiple causes
  - Atrial myxoma
  - Thrombus embolizing via PFO
  - Dilated cardiomyopathy and atrial fibrillation
Atrial myxoma

• Most common adult primary cardiac tumor
• Typically in younger patients
• Of affected, 12 - 46% present with isolated neurological symptoms

• Ischemia caused by
  • surface thrombus embolizing
  • tumor fragments directly detaching (less common)

• Variable pattern
Patent foramen ovale

• In utero structure which fails to close in 25% of adults
• Risk of paradoxical venous thromboembolism from R --> L shunt

• Up to 37% of cardioembolic stroke in young adults
• Controversial association with stroke
  • Closure has high NNT to prevent recurrent stroke (20 – 42)
Atrial myxoma
Cardiac blood stasis

- Dilated cardiomyopathy (17%) and A-fib (14%)
- Risk of ischemic infarcts
- Silent cerebral infarction syndrome (39% of patients dilated CM)
- Leads to --> cognitive defects, vascular dementia
Air emboli

- Rare cause but possible with invasive vascular procedures
  - Central line placement

- If before branching of aorta e.g. venous air going through R --> L shunt
  - Leads to scattered smaller emboli in multiple territories

- If related to carotid or vertebrobasilar procedure
  - Usually in one territory
Fat emboli

• Classically in large displaced fractures or sickle cell
  • Related to displaced fat droplets post fracture
  • In SCD, released fat post bone marrow necrosis

• Can go through R -> L shunt
• Can deform and travel through intact pulmonary capillary beds to CNS
Fat emboli

- CT is usually normal

- On MR
  - "Starfield" pattern throughout brain parenchyma
  - Innumerable tiny foci of restricted diffusion and FLAIR hyperintensity
  - Variable number of lesions --> more lead to worse outcome
Fat emboli

- Other main differential in trauma is diffuse axonal injury

- However, DAI
  - Usually has CT evident hemorrhagic foci
  - Shear injuries typically larger lesions
  - More linear foci evident findings on SWI/GRE
2 – Other demonstrated cause

• Catch all term for multiple causes
• As a group, second most common cause
  • accounts for 34% of infarct cases

• Further broadly subdivided
  • nonatherosclerotic vasculopathies
  • Prothrombotic disorders and states
Dissection

- Cervical carotid or vertebral artery dissection
- About 2% of total strokes but up to 20% of stroke in patients <25
- Spontaneous or traumatic etiology

- Longitudinal subintimal tear in the vessel wall
  - Progressive stenosis or occlusion of the parent vessel
  - Occlusion of perforators arising from the vessel
  - Double lumen, stasis and eventually embolism

- Mechanism of ischemia is
  - embolism 80%
  - hypoperfusion 2/2 stenosis or occlusion 15%
  - mixed 5%
ICA dissection

- Tear of intima with blood entering the media
- happens 2-3 cm above the carotid bulb
Vertebral artery dissection

- Vertebral dissection has similar pathology
  - usually at the C1-C2 level
  - 10% bilateral
Carotid web

- Increasingly recognized, about 10% of ischemic strokes of patients <60 y/o
- Represents variant fibromuscular dysplasia
- Stasis of blood just distal to web leads to thrombus --> infarct

- On MR VWI, thin non-enhancing fibrous band
- No intramural hemorrhage or lipid core (which suggests atherosclerosis)
Reversible Cerebral Vasoconstriction Syndrome

• Combined radiological AND clinical diagnosis, unknown pathophysiology  
  • Medications, illicit drugs, vasoactive medication, pregnancy, etc

• Long list of diagnostic criteria, including:
  • Thunderclap headache
  • Multifocal vasoconstriction
  • Reverses within 12 weeks
  • No aneurysm
  • Uniphasic course with no recurrence
Reversible Cerebral Vasoconstriction Syndrome

• Common imaging findings:
  • No evidence of aneurysm – nonaneurysmal distribution of subarachnoid blood
  • SAH usually near high convexities (when present)
  • Hemorrhage not necessarily where constriction is worse
  • Multifocal beaded large intracranial vessels in multiple territories (diagnostic but not specific)
  • Constriction may not be seen in first week post symptoms
Vasculitis

• Inflammation of the vessel, with or without necrosis

• Long list of causes
  • Systemic inflammatory process (Sjogrens, SLE)
  • Infection
  • Malignancy
  • Radiation
  • Medication
Vasculitis

- Usually more subacute headache, but hard to differentiate clinically from RCVS
- Vessel wall imaging used to differentiate from RCVS
- Enhancement pattern:
  - Usually concentric, focal intense enhancement of affected vessels
Drug use

• Long list of illicit and recreational drugs
• 7x risk of ischemic CVA

• Cocaine in particular
• vasospasm, thrombosis, cerebral vasculitis and thromboembolism 2/2 dysrhythmia or CM

• Typically multifocal vasospasm:
  • Can be across multiple vascular territories
  • Distal cortical branch and subcortical location

• Focal large vessel spasm can mimick large territorial ischemia

• Stimulants: MDMA and methamphetamine with similar effects related to adrenergic release
CADASIL

- Cerebral Autosomal Dominant Arteriopathy with Subcortical Infarcts and Leukoencephalopathy
  - Also CARASIL, same but worse
- Genetic disease, mutation in NOTCH3, protein involved in neuronal development
- Fibrotic thickening of arterioles --> small vessel disease
- Presents in adulthood
- 30s – migraines
- 40 – 50s – recurrent TIA or ischemia, vascular dementia or neuro deficits
Moyamoya

• Refers to numerous lenticulostriate collaterals on angiography
• Grow due to chronic occlusive disease of CoW
• Either idiopathic disease or syndrome secondary to other cause
  • Sickle cell, radiation, Down syndrome, NF1
• Cerebral infarcts in 57%
  • Usually watershed infarcts 2/2 stenosis/occlusion at ICA terminus and involving ACA and MCA origins
• Can see tiny T2 flow voids of collaterals sometimes
Prothrombotic disorders

• Varied presentation

• Can be venous, arterial, or microvascular thrombosis
  • Arterial is non-specific pattern, matches other subtypes

• Note: can't use gadolinium in pregnancy
Prothrombotic disorders

• Factor V Leiden mutation
  • Most common prothrombotic disorder

• Antiphospholipid syndrome
  • Accounts for about 17% of infarcts in < 50 patients

• Abs common in autoimmune disease in general, eg. SLE 20-30% have antiphospholipid antibodies
Prothrombotic disorders

- High estrogen and progesterone levels
  - Most commonly pregnancy and OCPs
  - Accounts for ~20% of young female ischemic infarcts
  - Classically increased risk with smoking

- Pregnancy and ~6 weeks post delivery
- Associations with both ischemia and hemorrhage, arterial and venous
- Highest risk in 2 weeks post delivery
3 – Undetermined cause

• Catch-all for causes that are unknown or unclear

• In order of frequency in cohort:
  • Indeterminate cause
  • two or more causes
  • incomplete evaluation
4 – Small vessel occlusion

• Lacunar infarcts
  • < 1.5 cm, in the deep cerebral white matter, basal ganglia, internal capsule, thalamus, and pons/brainstem

• Occlusion of distal perforating arteries
  • fibrinoid material occluding distal vessels
  • possibly embolic cause as well (explain 10-15% of lacunar)
  • same imaging features as commonly seen in older adults

• 7 – 14% of ischemic infarcts in young adults

• No concurrent atherosclerosis in the relevant vessel
• Usually clinically silent (?up to 30% left with disability)
5 – Large vessel atherosclerosis

- Accounts for 2 – 8% of ischemic infarcts, least common (vs older adults)
- One study of 215 patients with infarct found no patients younger than 36
  - Associated risk factors of sedentary lifestyle and hypertension

- Can be attributed if there is
  - Infarct in cerebral cortex, brainstem, cerebellum
  - AND symptomatic athero elsewhere (coronaries, aorta) OR risk factors

Supporting findings include stenosis usually at proximal ICAs, carotid siphons, V4 segments
Large vessel atherosclerosis
Conclusion

• Increasing incidence
• Prolonged period of disability
• Most commonly cardioembolic cause
• Followed by dissection

• Workup and differential should reflect special circumstances
Attributions

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