

Vesalius SCALpel™ : Cerebrovascular (see also: vascular folios)

Physiology

internal carotid continuous forward flow (low resistance brain circulation)
EC reversal during diastole
circle of Willis complete in only 18%
nl. ICP 0-15, treat at 20
75% of cerebral ischemia due to surgically accessible lesion
AVM 2-4% hemorrhage/year
fibromuscular dysplasia associated with intracranial aneurysm

Stroke

3rd leading cause of death
25% hemorrhagic, 75% thromboembolic (20% from carotid a., 50% cardiac/atrial thrombus)
echocardiogram has replaced cath for Dx of cardiac source of emboli
carotid disease:
90% atherosclerotic
bifurcation most common source of platelet emboli from ulcerated plaque
other: fibromuscular, stenosis, extracranial dissection, decreased flow, thrombosis,
plaque thrombi, plaque rupture
classification
TIA: completely resolves 24h
many are small cerebral infarcts
amaurosis not as worrisome as hemispheric/contralateral weakness
repeated symptoms, fluid dynamics carry embolus to same vessel
nature of plaque most important, friable
occluded ICA can throw emboli from blind stump
7% stroke rate/year, 36% 5year
highest risk first 6 mo, decreases > 3y
CEA reduces to 1%/y
stroke in evolution: progressing neurologic deficit without resolution between attacks
(as opposed to crescendo TIA's: complete resolution between)
completed stroke: persistent neuro. deficit > 24h
natural hx asymptomatic carotid stenosis
ACAS data:
11% stroke risk @5y with medical management
5% with CEA for > 60% symptomatic stenosis
30-50% of strokes no antecedent symptoms
> 75% stenosis: 18-40% neuro event 1st year, 5% stroke/y (justification for doing
CEA for asymptomatic)
stenosis with large ulcerated plaque: 7.5%/y
CEA reduces stroke rate to 0.3%/y

patterns

anterior/carotid circulation

middle cerebral most common

contralateral hemiplegia and hemianopsia, lat eye deviation, +/- aphasia

anterior cerebral: less common

contralateral leg weakness

posterior circulation:

global symptoms: dizziness, diplopia, vertigo, tinnitus, perioral numbness,
drop attacks, paresthesias

hemodynamic form more common (steal syndrome one cause)

brief symptoms, rare stroke, postural

thromboembolic: less common, 30% of cases

stroke more common, high morbidity

multiple arch vessels: global cerebral ischemia

stroke

15-33% initial mortality, 50% 5y mortality

only 30% of survivors have normal cerebral function, many improve

9% recurrent stroke/y, 40% 5y

CEA reduces stroke risk to 2%.y

NASCET data symptomatic > 70% stenosis

medical management: 26% stroke @ 2y

CEA: 9% stroke @ 2y

stroke in evolution: progressive over hrs to days, 3 patterns

1 repeated atheroemboli from friable lesion

2 thromboembolic from distal end of thrombotic column

3 progression to thrombosis

completed stroke: area of brain infarction

embolization: size, composition, location determine outcome

intracerebral thrombus: lo flo causes brain vessel thrombosis

propagation of thrombus

up to ophthalmic (first branch ICA) may be asymptomatic because of collaterals
beyond ophthalmic progress to middle cerebral

Evaluation

risk

symptoms, degree of stenosis, ulcerated plaque, comorbidities

echocardiogram for atrial thrombus

imaging

duplex/US (main modality), angio (gold standard), CT/MRI

duplex: high sensitivity and specificity, 3 components

gray scale: US image of carotid, not very accurate

15-50% stenosis moderate

50-80% severe

>80 critical

velocity spectral analysis: wave flow, more accurate

contralateral occlusion increases ipsilateral velocities

with 80% stenosis peak systolic velocity (PSV) > 250cm/sec

- end diastolic velocity (most important) > 140cm/sec
 - ratio ICA/CCA > 3.7
 - color flow imaging
- cerebral angio
 - not justified for screening
 - 0.1-1.2 incidence stroke/death
 - indications
 - equivocal duplex
 - confirmation of complete occlusion (duplex may miss)
 - bilateral disease
 - contralateral occlusion
 - recurrent disease
 - arch vessel or intracranial disease
 - if considering for angioplasty or stent
 - NASCET/ACAS reporting convention
 - % stenosis = minimum diameter of stenosis/diameter of normal distal ICA

Management

medical

- antiplatelet: ASA, ticlopidine, clopedogrel
- anticoagulation: warfarin
- stop smoking
- lower cholesterol (statin)
- control hypertension
- surveillance imaging

interventional

- thrombolysis
- angioplasty
- stent

- 30d combined stroke and mort < 5%

- potential indications: inaccessible lesion, recurrence, radiation induced

- stenosis, fibromuscular disease, hi risk (SAPPHIRE trial: stent with

- embolic filter can be done safely in hi risk, not inferior to CEA)

- lower incidence MI than CEA

surgery

- carotid endarterectomy (CEA)

- eversion endarterectomy

- carotid bypass

- extracranial/intracranial (EC/IC) bypass

- ACAS (NIH '95) asymptomatic > 60% stenosis CEA v medical management

- 5y incidence ipsilateral stroke 5.1 surgery v 11% medical

- recommended CEA if reasonable surgery risk, expected long term survival

- NASCET: symptomatic, 50 centers w < 5% M & M after CEA, NEJM '91

- symptoms: TIA or minor stroke within 3mo

ASA alone v CEA and ASA
 lesions classified 30-69% and 70-99%
 stopped after 18mo because of significant advantage of CEA
 65% relative reduction cumulative strokes
 81% relative reduction fatal strokes
 for > 70% stenosis in symptomatic pts. TWO year risk of stroke: 9% for treated,
 26% untreated, dramatic difference
 moderate benefit with 50-69% stenosis
 no benefit women, men with diabetes or pts < 50
 less benefit pts with retinal symptoms
 most benefit symptomatic older male with severe or critical stenosis

carotid endarterectomy (CEA)
 contraindications
 acute stroke within 2-6w
 primary concern: avoid reperfusion injury to ischemic penumbra
 theoretical concern: convert non-hemorrhagic to hemorrhagic
 large fixed dense stroke (limited residual brain tissue to protect)
 total occlusion
 meticulous technique
 monitor cerebral perfusion
 no difference general v regional
 shunt
 only 10-15% lack adequate collaterals and require shunt
 routine shunt does not decrease perioperative neuro events
 ICA back pressure < 25-40mm need shunt
 3min. test occlusion with local, observe for symptoms, EEG changes with
 general: shunt will reverse
 air embolus potential complication

patch
 Dacron most common, no difference v autologous saphenous v, PTFE,
 bovine pericardium
 indications: all patients
 advantages: decrease stenosis, restenosis, restore bulb hemodynamics
 decreases incidence of periop stroke
 disadvantages: thrombogenic surface, aneurysm/rupture, infection, time

complications
 ICA occlusion: 2-18%, 0.8% symptomatic
 only 20% require reoperation
 must determine patency of ICA immediately (US, angio,
 whichever quickest)
 if neuro deficit in recovery room, return to OR immediately
 urgent < 4h reoperation for thrombosis
 > 60% improve after thrombectomy, 17% mortality
 anticoagulate once hemorrhage excluded
 cerebral edema/hemorrhage (late)
 deficit often presents after period of normal function

BP instability

carotid sinus stimulation: baroreceptor in bulb to N of Herring to brain stem to bradycardia, decrease BP

associated with stroke and mortality

Rx: atropine, lidocaine for bradycardia, correct volume, pressor

cranial nerve dysfunction

10-15% incidence, 1/3 asymptomatic

speech pathologist can detect more, 35%

most resolve by 3 mo

evaluate cranial nerves before do contralateral

vagus/recurrent laryngeal

6-8% incidence, ipsilateral cord paramedian, hoarse

hypoglossal: 4-6%, ipsilateral deviation of tongue

superior laryngeal: 1-2% (when passing clamp around ECA)

voice fatigue, loss of high pitch

marginal mandibular (incision too far anterior), droop corner of mouth

glossopharyngeal: 1% (with high exposure), significant swallowing morbidity

cerebral hyperperfusion syndrome: 0.7-5% incidence, 36% mortality

increased cerebral blood flow, edema, seizure, hemorrhage, death

ipsilateral frontoparietal headache, hypertension

disturbed autoregulation

risk factors: correction of very hi grade stenosis, especially with contralateral occlusion, hypertension, old/new infarct, poor collateral circ., anticoagulation

cerebral imaging: CT shows hemorrhage, MRI/gadolinium more sensitive

Rx: antihypertensives, anticonvulsants, D/C anticoagulation, treat cerebral edema

recurrent stenosis

early: technical defect

2y: intimal hyperplasia, smooth surface, less thrombogenic, more common in women, usually asymptomatic

9-20y, 2-4% need reoperation

indications for reoperation: neuro symptoms, hi-grade (80%), especially recurrent atherosclerosis

must patch if reoperate

may need interposition

consider PTA/stent

eversion endarterectomy

standard longitudinal incision

don't see endpoint

combo CABG and CEA

only in severe carotid disease (> 80%) or symptomatic carotid disease with

coronary artery disease that can't wait (3 vessel symptomatic disease)

2X stroke and death rate (5% v 2%)

Other cerebrovascular disorders

fibromuscular dysplasia (FMD)

string of beads, bilat, women more common

associated with other lesions: atherosclerosis, carotid aneurysm, dissection,

intracranial aneurysm, renal FMD

50% asymptomatic

natural history relatively benign

operate only for symptomatic and severe stenosis in asymptomatic (3% of CEAs)

dilatation/PTA

periop stroke 1-3%, late 1-4%

tortuous/kinked carotid

congenital or associated with atherosclerosis in adult, 25% bilateral

may have symptoms with head turning

only have to deal with if doing CEA

surgery only for symptoms

resect and reanastomose

extrinsic compression

mostly vertebral in bony canals

tumor

radiation-induced stricture: 3 patterns

1 intimal damage leads to thrombosis within 5y

2 fibrotic occlusion 10y

3 accelerated atherosclerosis 20y

different from atherosclerosis, long narrowing, early age, less associated vascular disease

endarterectomy more difficult, may need interposition

consider PTA/stent

vasculitis/giant cell arteritis

elderly women, medium to large arteries (arch, extracranial)

flu-like symptoms, headache, jaw claudication, visual changes

Dx temporal a bx

Rx: immediate steroids

surgery only indicated after disease quiesces

Takayasu arteritis

young (<40) women

arch and great vessels

3 phases: prodromal, inflammation, burned out

complications: stenosis, embolization, occlusion

carotid aneurysm (rare)

dissection, atherosclerosis, trauma, prior carotid surgery

rarely rupture unless infected

embolization common, surgical indication

resect and reconstruct

consider endovascular
carotid body tumor, neural crest origin
chemoreceptor responsive to hypoxia, hypercarbia, acidosis
stimulation results in incr respir, tidal vol., heart rate, increase BP
2-5% malignant, 5% bilateral
asymptomatic neck mass which is mobile laterally but not cranio-caudally
splaying IC/EC, angle of mandible
highly vascular, blood supply from ECA
pre-op angio +/- embolization (makes surgery easier)
high exposure for excision
5% perioperative stroke, 20-40% cranial nerve injury
external carotid AVM
total excision; pre-op embolization may reduce blood loss, but not definitive Rx
high flow may result in congestive heart failure

Carotid trauma

blunt or sudden neck extension causes intimal tear
spontaneous dissection with FMD, Marfans/connective tissue disorders
symptoms
unilateral headache, delayed cerebral symptoms
incomplete Horner's (oculosympathetic paresis)
cranial nerve palsies
most recover, treat with anticoagulation (coumidin 3-4mo) of symptomatic
penetrating trauma, ABCs
med Rx: small defect on angio
surgery: primary repair (best option), graft, ligate
ligate with massive hemorrhage, coma, severe cerebral injury, no back-
bleeding after thrombectomy

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