Cerebral Venous Thrombosis (CVT)

Epidemiology

- 1% of all strokes
- female-to-male ratio 1.29:1
- any age (newborn to elderly patients); 80% patients are < 50 yrs; age distribution: men - uniform age distribution; women - 61% aged 20-35 yrs (may be related to pregnancy or oral contraceptives)
- mean age at presentation is nearly 1 decade younger in women compared to men (34 yrs vs. 42 yrs).

Clinical Features

- hypercoagulable states
- tumors
- trauma
- pregnancy and puerperium
- iatrogenic
- mild closed injury ÷ depressed skull fracture
- paraneoplastic hypercoagulation
- anticoagulant
- Leiden factor V mutation.
- 2) sepsis (esp. in septic thrombosis)
- 3) pregnancy and puerperium!!
- 4) disseminated malignancies (paraneoplastic hypercoagulation)
- 5) sarcoidosis, inflammatory bowel diseases (Crohn), collagenoses (incl. corticosteroids used in treatment)
- 6) vasculitis (such as Behçet syndrome).
- 7) nephrotic syndrome, hepatic cirrhosis.
- 8) dehydration, cachexia (“marantic” thrombosis in infancy) - superior sagittal sinus is most common.

5) Medications: oral contraceptives (incl. 3rd-generation), corticosteroids; L-asparaginase, heparin (thrombotic thrombocytopenia with venous sinus thrombosis)

Diagnosis

- ATRIOGRAPHY
- DSA
- CTV
- MRV
- MRI
- EEG
- LUMBAR PUNCTURE
- FUNDOSCOPY
- BLOOD
- URINE
- TREATMENT

Prognosis

- thrombosis of venous sinuses, superficial or deep cerebral veins.

Pathophysiology

- venous occlusion - tissue congestion - early severe VAODICENAL BRAIN EDema - VENOUS INFARCTION - CYTOXOGEN EDema
- venous sinus thrombosis - infarction in cortex and adjacent white matter; deep cerebral vein thrombosis - infarction in basal ganglia, thalamus.
- venous sinus system itself lacks valves, permitting retrograde propagation of clots - thrombosis from dural sinuses may progress (esp. in septic thrombosis) to cortical veins.
- obstruction of cortical veins (e.g. vein of Labbé) can produce significant damage.
- although unusual, cortical vein thrombosis may be seen in absence of dural sinus involvement.
- back-transmission of high pressure into capillary bed usually results in significant hemorrhagic component.
- SAH also may be presenting feature (due to venous hypertension).
- CVT should be considered in workup of SAH, esp. when basilar cisterns are not involved!
- if sinus occlusion occurs gradually (as by neoplastic invasion), collateral drainage routes (incl. scalp veins) are recruited, thus avoiding cerebral edema and ICP!
- venous thrombi are rich in RBCs and fibrin but poor in platelets (“red thrombus”) - replaced by fibrous tissue with time.

VENOUS INFARCTS DO NOT CONFORM TO ARTERIAL TERRITORIES, ARE OFTEN HEMORRHAGIC AND MULTIFOCAL.

Frequency

1) SUPERIOR SAGITTAL SINUS (70%, but less common site of infective thrombosis) - bilateral parasagittal more or less symmetric infarcts - most severe damage!
2) TRANSVERSE (GALLET) SINUSES
3) CAVERNOS SINUS
4) inferior sagittal sinus, straight sinus, petrosal sinuses, vein of Galen - usually involved by secondary extension.
Symptoms related to area of thrombosis

Superior sagittal sinus thrombosis
- weakness in lower extremity (unilateral or paraparesis) \(\rightarrow\) hemiparesis (secondary to clot extension into cerebral veins).
- in infants: forehead edema, vein engorgement in area of anterior or posterior fontanels (caput medusae).
- bilateral involvement can produce stupor early in course.
- seizures in \(\geq\) 1/3 patients.
- course is frequently fulminant and prognosis guarded, although complete recovery may occur.

Lateral sinus thrombosis
- usually secondary to pediatric otitis media and mastoiditis (most patients are febrile with earache).
- swelling over mastoid region with distortion of superficial veins.
- CREEDER-NICOLL sign - mastoid emissary vein thrombosis due to thrombus extension from sigmoid sinus.
- PSEUDOTUMOR CEREBRI: like picture (ICP↑) \(-\) more common with right sinus occlusion (in most individuals, right sinus drains greater portion of brain).
- may produce OTIC HYDROCEPHALUS.
- most common focal sign \(-\) tension over jugular vein in neck, JUGULAR FORAMEN SYNDROME (VENOUS CN9-11).

Cavernous sinus thrombosis
- septic thrombosis (S. aureus 66%) is associated with bacterial sinusitis (phoenoidal or ethmoidal) or orbital cellulitis; non-septic thrombosis is rare.
- involves only one sinus at onset but rapidly spreads (via circular sinus) to opposite side.
- onset is usually sudden and dramatic - patient appears acutely ill with fever; \(>\) 1/3 patients have change in mental status.
- cranial nerve palsies (compressive phenomenon) \(-\) variable ophthalmoplegia (esp. early CN6 palsy), ptosis, decreased sensation in CN5,\(\pm\) divisions.
- obstruction of ophthalmic veins \(-\) periorbital edema \(-\), proptosis, chemosis, papilledema with hemorrhages around disc; orbits are painful to pressure.
- septic thrombosis has high mortality.

DIAGNOSIS

MRV
- excellent method of visualizing dural venous sinuses and larger cerebral veins.
- single-shot phase-contrast angiography (SSPCA): takes \(\approx 30\) seconds and provides rapid and reliable information (depicts only flow and not thrombus) \(-\) procedure of choice in diagnosing CVT (specificity and sensitivity 100%).

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N.B. TRANSVERSE SINUS FLOW GAPS (in nondominant or codominant transverse sinus) should not be mistaken for thrombosis.

"empty delta" sign; note prominent sulcal enhancement caused by collateral venous drainage (mimics meningitis).
Late acute DST:

- May be normal!
- May show evidence of infarction (edema) that does not correspond to arterial distribution.
- Useful in ruling out other conditions: neoplasm, subdural empyema, sinusitis.
- Demonstration of infarct may be delayed up to 48-72 hours.
- Hemorrhagic infarction:
  - Parasagittally located - Superior Sagittal Sinus.
  - Centrally located - Straight Sinus.
  - Temporally located - Transverse and Sigmoid Sinuses.
- Dense triangle sign - Fresh coagulated blood in Superior Sagittal Sinus.
- Cord sign - Thrombosed cortical vein.
Axial CT - cavernous sinus (CS) is distended, with abscess (arrowheads); stenosis of intracavernous ICA is response to abscess.

- normal dura and circulating blood are mildly hyperdense compared to brain on CT scans, so subtle increased attenuation of venous thrombi can be difficult to detect.
- venous sinuses lie directly adjacent to skull, so clots can also be obscured by attenuation artifacts.

“empty delta” sign - enhancing dura surrounding nonenhancing thrombus:

CTV
- equivalent to (or better than) MRV in identification of dural sinus thrombosis.

ANGIOGRAPHY
- with delayed filming technique (to visualize venous system) - was procedure of choice prior to advent of MRV.
  - indicated only if MR studies are not diagnostic.
  - intraluminal filling defects, flow absence within dural sinus.
  - delayed-emptying of cortical veins appear as if they are “hanging in space”.
  - narrowing of intracavernous ICA in Cavernous Sinus thrombosis.
  - direct venography - passing catheter from jugular vein into Transverse Sinus.
  - orbital venography is most definitive method for Cavernous Sinus thrombosis.
CEREBRAL VENOUS THROMBOSIS

EEG
- normal or mild generalized slowing or focal abnormalities.

LUMBAR PUNCTURE
1) evaluation for meningitis
2) compression of jugular vein unilaterally with pressure measurement (now rarely used) → pressure ↑ if contralateral TRANSVERSE SINUS is thrombosed (collateral circulation or incomplete compression of jugular vein may yield false-negative result), elevation of intracranial venous pressure may precipitate herniation!
- CSF may be bloody or xanthochromic with parameningeal inflammatory profile and pressure ↑.

FUNDOSCOPY
- papilledema.

BLOOD
CRC - leukocytosis (sepsis), polycythemia, platelet count ↓ (thrombotic thrombocytopenic purpura).
- D-dimer > 500 ng/mL may be beneficial in screening headache patients in ED.
  - D-dimers are positively correlated with thrombosis extent and negatively correlated with symptom duration
  - sensitivity = 97.1%, negative predictive value = 99.6%, specificity = 91.2%, positive predictive value = 55.7%.

Hypercoagulable workup:
1) antithrombin
2) protein C, protein S
3) factor V Leiden
4) prothrombin gene G20210A mutation
5) lupus anticoagulant
6) anticardiolipin antibodies
7) anti beta2 glycoprotein-1 antibodies
8) sickle cell preparation / Hb electrophoresis (individuals of African descent), ESR & antinuclear antibody, liver function tests (cirrhosis).
- tests for hypercoagulable states should not be made while patient is on anticoagulants.

URINE
- nephrotic syndrome.

DIFFERENTIAL
1) hypoplastic or absent sinus segment
2) giant arachnoid granulation

TREATMENT

MEDICAL
1. ANTICOAGULATION in therapeutic doses ASAP (HEPARIN → WARFARIN INR goal of 2-3) even if hemorrhagic infarction is present!!
   - LMWH may be preferable to unfractionated heparin.
   - duration: for unprovoked thromboses - 6-12 months → reimage and decide for continued anticoagulation; if patient is prothrombotic, duration is indefinite
   - may be followed with ASPIRIN.

2. ANTIBIOTICS for septic thrombosis (empirically start with antistaphylococcal a/b).
   for CAVERNOUS SINUS thrombosis - NAPCILLIN OR VANCOMYCIN + METRONIDAZOLE + 3rd-generation cephalosporin.

3. Supportive treatment similar to arterial stroke (esp. reducing ICP, anticonvulsants).

THROMBOLYSIS at present is limited to specialized centers but should be considered for patients with significant deteriorating deficits.
CEREBRAL VENOUS THROMBOSIS

- All studies concerning use of thrombolytics in CVT involve intrasinus administration - either direct instillation into sinus (at time of surgery) or use of microcatheters to reach venous sinus; i.e. no data about systemic IV effects for CVT.

- Recent report describes use of rheolytic catheter device - delivers 6 high-velocity saline jets through halo device at catheter tip → Bernoulli effect breaks up thrombus; particulate debris is directed into effluent lumen for collection into disposable bag.

SURGICAL

OPEN THROMBECTOMY and LOCAL THROMBOLYTIC THERAPY - salvage therapy only for severe neurological deterioration* (despite adequate anticoagulation).

- Surgery is indicated for septic thrombosis if no response to antibiotics in 24 h - remove infected bone (e.g. mastoidectomy), expose and drain sinus; ligate jugular vein (for LATERAL SINUS thrombosis).

PROGNOSIS

Mortality:
untreated cases – 13.8-48%;
treated cases – 12.5% (7% in acute phase, 1% during one year follow-up).

Full recovery:
untreated cases – 29%;
treated cases – 62.5%.

Morbidity:
episodic headaches 11-30%
seizures 8.8-10%
pyramidal signs 11.7%
visual deficits 5.9%
aphasia 9%
memory deficit and depression 17.6%.

- Some spontaneously recanalize.
- Some form dural AVF.
- 59% (esp. males, polycythemia) developed recurrent thrombotic events.
- Prognosis is worse in septic thrombosis.

BIBLIOGRAPHY for ch. “Neurovascular Disorders” → follow this LINK >>