

Cerebral Venous Thrombosis (CVT)

Updated: April 17, 2010

ETIOLOGY	1
PATHOPHYSIOLOGY.....	1
CLINICAL FEATURES	1
SUPERIOR SAGITTAL SINUS THROMBOSIS	2
LATERAL SINUS THROMBOSIS	2
CAVERNOUS SINUS THROMBOSIS	2
DIAGNOSIS	2
MRI.....	2
MRV	2
CT	2
CTV.....	3
ARTERIOGRAPHY	3
EEG.....	3
LUMBAR PUNCTURE.....	3
FUNDUSCOPY	3
BLOOD	3
URINE	3
TREATMENT.....	3
PROGNOSIS.....	3

ETIOLOGY

- Infection** extension from **paranasal sinuses, middle ear** (via emissary veins), **face, oropharynx**
→ **SUPPURATIVE INTRACRANIAL THROMBOPHLEBITIS**.
N.B. orbital veins (drain from middle third of face, including paranasal sinuses) have no valves - allow infection passage both *anterograde* and *retrograde*!
 - may be associated with epidural abscess, subdural empyema, meningitis, cranial osteomyelitis.
 - frontal sinuses** are most common source.
 - most commonly - **LATERAL** and **CAVERNOUS SINUSES**.
 - Staphylococcus aureus* is most common.
- Trauma**:
 - mild closed injury ÷ depressed skull fracture (occludes dural sinus)
 - iatrogenic - dural taps, infusions into internal jugular vein.
- Tumors** (e.g. meningioma, neuroblastoma).
- Hypercoagulable states**:
 - antiphospholipid syndrome, protein S and C deficiencies, antithrombin III deficiency, lupus anticoagulant, Leiden factor V mutation.
 - paroxysmal nocturnal hemoglobinuria, thrombotic thrombocytopenic purpura, sickle cell disease, polycythemia.
 - pregnancy and puerperium!!!
 - disseminated malignancies (paraneoplastic hypercoagulation)
 - sarcoidosis, inflammatory bowel diseases, collagenoses (incl. corticosteroids used in treatment)
 - nephrotic syndrome, hepatic cirrhosis
 - dehydration, cachexia ("marantic" thrombosis in infancy) - **SUPERIOR SAGITTAL SINUS** is most common
- Medications**: **oral contraceptives** (incl. 3rd-generation), **corticosteroids**; ε-aminocaproic acid, L-asparaginase, heparin (thrombotic thrombocytopenia with venous sinus thrombosis).

PATHOPHYSIOLOGY

Cerebral venous thrombosis is uncommon cause of cerebral **infarction** (relative to arterial disease).

venous strokes : arterial strokes ≈ 1 : 62.5
--

- venous occlusion → tissue congestion → early severe vasogenic brain edema → **VENOUS INFARCTION**:
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 Labbe) 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 <i>do not conform to arterial territories</i> , are often hemorrhagic and multifocal .
--

Frequency:

- SUPERIOR SAGITTAL SINUS** (70%, but less common site of infective thrombosis) – bilateral parasagittal more or less symmetric infarcts – most severe damage!
- LATERAL SINUSES**
- CAVERNOUS SINUS**
- inferior sagittal sinus, straight sinus, petrosal sinuses, vein of Galen** - usually involved by secondary extension.

CLINICAL FEATURES

- female-to-male ratio** 1.29 : 1
- age distribution**:
 - men** - uniform age distribution;
 - women** - 61% aged 20-35 yrs (may be related to pregnancy or oral contraceptives)
- course is more severe in septic thrombosis.

1. **Signs of ICP↑:**

- headache** - most common symptom!; thunderclap headache (usually indicates SAH) may be seen in sinus thrombosis!!!

- 2) **nausea & vomiting**
 - 3) **normal ÷ decreased level of consciousness** (may progress to coma).
2. **Focal neurological deficit** - depending on area involved as *thrombus extends to cortical veins* (CN syndromes, hemiparesis, facial weakness, aphasia, ataxia, hemianopia, deafness, etc).
N.B. focal neurologic signs may be entirely absent with ICP↑ pressure as only presenting sign!
- **seizures** are more common than in arterial strokes!; can be recurrent.

Clinical patterns:

- a) ISOLATED INTRACRANIAL HYPERTENSION (mimicking pseudotumor cerebri)
- b) FOCAL NEUROLOGICAL SIGNS (simulating arterial strokes or seizures)
- c) CAVERNOUS SINUS SYNDROME.

Symptoms related to AREA of thrombosis:

SUPERIOR SAGITTAL SINUS THROMBOSIS

- **weakness in lower extremity** (unilateral or paraparesis) → **hemiparesis** (secondary to clot extension into cerebral veins).
- *in infants - forehead edema, vein engorgement* in area of anterior or posterior fontanel (caput medusae).
- bilateral involvement can produce *stupor* early in course.
- seizures in > ½ 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 distention of superficial veins.
- **GRIESINGER 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 OTITIC HYDROCEPHALUS.
- most common focal sign – **CN6 palsy**.
- **extension into jugular bulb** → tenderness over jugular vein in neck, **JUGULAR FORAMEN SYNDROME (Vernet)**: CN 9-11

CAVERNOUS SINUS THROMBOSIS

- *septic thrombosis* (*S. aureus* 66%) is associated with **bacterial sinusitis** (sphenoidal or ethmoidal) or **orbital cellulitis**; nonseptic 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; > ½ patients have change in mental status.
- **cranial nerve palsies** (compressive phenomenon) → variable ophthalmoplegia (esp. early CN6 palsy), ptosis, decreased sensation in CN5₁₋₂ divisions.
- **obstruction of ophthalmic veins** → periorbital edema (!), proptosis, chemosis, papilledema with hemorrhages around disc; orbits are painful to pressure.
- *septic thrombosis has high mortality*.

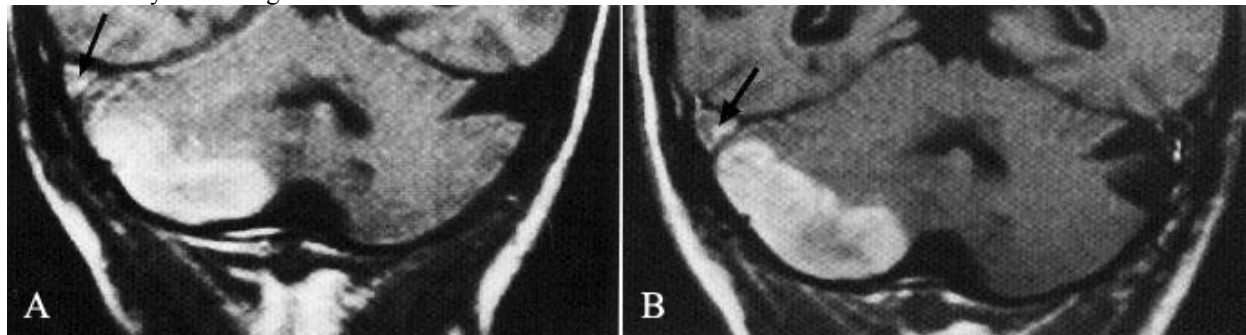
DIAGNOSIS

MRI

- 1) **absence of flow void** in venous channels.
N.B. *acute thrombus* can appear hypointense on spin-echo images (mimics flow void); *slow flowing blood* may appear bright (mimics thrombus); H: MRV
- 2) **infarct** (unilateral or bilateral or single or multifocal) that does not follow distribution of expected arterial occlusion.
- 3) **hemorrhagic infarction** is commonly found (because of increased pressure in draining veins).

Transverse sinus thrombosis:

- A. Unenhanced coronal T1-MRI - high signal in right cerebellar hemisphere due to hemorrhage; absence of flow void and high signal in right transverse sinus (*arrow*).
- B. Enhanced coronal T1-MRI - hemorrhagic infarct better defined and thrombus in right transverse sinus (*arrow*) is demarcated by enhancing walls of sinus.



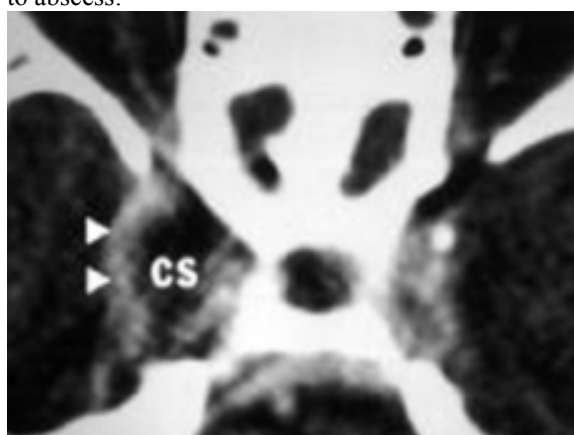
MRV

- **excellent method** of visualizing dural venous sinuses and larger cerebral veins.
- **single-slice phase-contrast angiography (SSPCA)** takes < 30 seconds and provides rapid and reliable information (depicts only flow and not thrombus) - procedure of choice in diagnosing CVT (specificity and sensitivity 100%).
N.B. **TRANSVERSE SINUS** flow gaps (in nondominant or codominant transverse sinus) should not be mistaken for thrombosis.

CT

- may show evidence of **infarction 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**;
temporal located - **TRANSVERSE** and **SIGMOID SINUSES**.
- **empty Δ sign on contrast CT** (most specific CT finding) - nonenhanced thrombus in **SUPERIOR SAGITTAL SINUS** surrounded by enhancement of engorged collateral veins around sinus and in sinus walls.
- **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:



CTV

- equivalent to MRV in identification of dural sinus thrombosis.

ARTERIOGRAPHY

- 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.
- 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.

EEG

- normal ÷ 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↑.

FUNDUSCOPY

- papilledema.

BLOOD

CBC - leukocytosis (sepsis), polycythemia, platelet count↓ (thrombotic thrombocytopenic purpura), antiphospholipid and anticardiolipin antibodies, prothrombin gene mutation, factor V Leiden mutation, sickle cell preparation / Hb electrophoresis (individuals of African decent), ESR & antinuclear antibody, liver function tests (cirrhosis).

- tests for hypercoagulable states should not be made while patient is on anticoagulants.
- **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%.

URINE

- nephrotic syndrome.

TREATMENT

MEDICAL

1. **ANTICOAGULATION ASAP** (**HEPARIN** → **WARFARIN**) even if hemorrhagic infarction is present!!!!!!
 - continue for at least 3-6 months.
 - may be followed with **ASPIRIN**.
2. **ANTIBIOTICS** for *septic thrombosis* (empirically start with antistaphylococcal a/b).
 - for **CAVERNOUS SINUS** thrombosis - **NAFCILLIN** 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.

- 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** – 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%.

- 59% developed **recurrent thrombotic events**.
- prognosis is worse in **septic** thrombosis.

BIBLIOGRAPHY for ch. “Neurovascular Disorders” → follow this [LINK >>](#)