Sturge-Weber syndrome comprises of vascular malformations of the central nervous system and the port-wine stain or nevus flammeus of the face in a trigeminal nerve distribution. The syndrome is also known as encephalotrigeminal angiomatosis. The incidence is estimated to be approximately 1 in 50,000.

GENETICS/BASIC DEFECTS
1. Genetics
   a. A sporadic, non-familial disease
   b. Uncertain inheritance: Only a few familial clusters of the syndrome reported; most of these have not exhibited the clear-cut autosomal dominant inheritance pattern
   c. Proposed to represent a genetically mosaic condition. Lesions in the Sturge-Weber syndrome result from somatic mutations in affected areas, such as the port-wine stain or leptomeningeal angioma, but not in blood or normal skin.
   d. A potential role of fibronectin in the pathogenesis of Sturge-Weber syndrome. The gene expression findings in fibroblast supported the hypothesis of a somatic mutation underlying the disorder.
2. Basic defect: caused by residual embryonal blood vessels and their secondary effects on surrounding brain tissue
3. Pathophysiology: Neurologic dysfunction of the syndrome results from secondary effects of residual embryonal blood vessels on surrounding brain tissue.
   a. Hypoxia
   b. Ischemia
   c. Venous occlusion
   d. Thrombosis
   e. Infarction
   f. Vasomotor phenomenon
   g. Seizures

CLINICAL FEATURES
1. Variable natural history of the disease
2. Capillary malformation (port-wine stain, cutaneous angioma)
   a. Involves the ophthalmic branch of the trigeminal nerve, in particular the upper eyelid and supraorbital region
   b. May extend into the maxillary and mandibular regions
   c. May be associated with soft tissue and bony overgrowth
   d. May be hidden in scalp or mouth
   e. May be absent in the forme fruste of Sturge-Weber syndrome
3. Leptomeningeal malformation (angioma)
   a. May be unilateral (more common) or bilateral
   b. Usually ipsilateral to port-wine stain
   c. Capillary and venous anomalies of leptomeninges
   d. No correlation between the size of facial and CNS malformations
4. CNS manifestations
   a. Seizures
   b. Mental retardation present in approximately 50% of cases
   c. Contralateral hemiplegia or hemisensory deficits
   d. Contralateral homonymous hemianopsia (impaired vision in half of the visual field)
   e. Headaches
   f. Developmental delay
   g. Learning disorders
   h. Attention deficit hyperactivity disorder
5. Ocular manifestations
   a. Ipsilateral to the port-wine stain
   b. Can be seen with V1 or V2 involvement
   c. Glaucoma (60%)
   d. Buphthalmos
   e. Vascular malformations of the conjunctiva, epi-sclera, choroids, and retina
6. Long-term outcome
   a. Distribution of port-wine stain
      i. Cranial: 98%
      ii. Extracranial: 52%
   b. Glaucoma (60%)
   c. Seizures (83%)
   d. Developmental delay usually associated with seizures
      i. With seizures: 43%
      ii. Without seizures: 0%
   e. Presence of behavior and emotional problems
      i. With seizures: 85%
      ii. Without seizures: 58%
   f. Require special education
      i. With seizures: 71%
      ii. Without seizures: 0%
   g. Employability
      i. With seizures: 46%
      ii. Without seizures: 78%
   h. Normal fertility
   i. Indications of progressive nature
      i. Increasing duration of seizures and postictal deficits
      ii. Increase in atrophy or of calcified lesions or both

DIAGNOSTIC INVESTIGATIONS
1. Radiography
   a. Asymmetric skull
   b. Double contour “gyriform” patterns of intracranial calcifications
      i. Classic “tram-line”, “tram-track”, or “trolley-track” intracranial calcifications
         a) Considered pathognomonic prior to modern neuroimaging
         b) Often a late finding
         c) May not be present initially
ii. Distribution
   a) In the subcortical region, primarily in the parietal and occipital regions
   b) Unilateral (80%) or bilateral (20%)

2. EEG to evaluate seizure activities

3. Angiographic findings
   a. Lack of superficial cortical veins
   b. Nonfilling dural sinuses
   c. Abnormal, tortuous vessels

4. CT scan findings
   a. “Tram-track” calcifications
   b. Cortical atrophy
   c. Abnormal draining veins
   d. Enlarged ipsilateral choroid plexus
   e. Blood-brain barrier breakdown during seizures

5. MRI findings
   a. Enlarged choroid plexus
   b. Sinovenous occlusion
   c. Abnormal, tortuous vessels
   d. Lack of superficial cortical veins
   e. Blood-brain barrier breakdown during seizures

6. Single-photon emission computed tomography to measure cerebral blood flow
   a. Hyperperfusion early (before 1 year)
   b. Hypoperfusion late (after 1 year)

7. Positron emission tomography (PET) for hypometabolism

8. Histology
   a. Thickened and discolored leptomeninges
   b. Abnormal venous structures
   c. Calcifications
      i. Cerebral vessel walls
      ii. Perivascular tissue
      iii. Rarely within neurons

GENETIC COUNSELING

1. Recurrence risk
   a. Patient’s sib: low
   b. Patient’s offspring: low

2. Prenatal diagnosis: not been reported

3. Management
   a. Medical care
      i. Medications for recurrent headaches
      ii. Management of glaucoma to control the intracranial pressure and prevent progressive visual loss and blindness
      iii. Anticonvulsants for seizure control
      iv. Dermatologic laser therapy for port-wine stain
   b. Surgical care
      i. Surgery for glaucoma if medications fail to lower intraocular pressure
      ii. Option of early surgery for patients with Sturge-Weber syndrome with drug-resistant epilepsy
         a) Focal cortical resection
         b) Hemispherectomy
         c) Corpus callosotomy
         d) Vagal nerve stimulation
      iii. Lesionectomy provided that the pial angioma is unilateral and the resection can be complete

REFERENCES


Fig. 1. An infant with Sturge-Weber syndrome showing port-wine stain primarily affecting right side of the face.

Fig. 2. A girl with typical Sturge-Weber syndrome showing port-wine stain affecting left side of the face.

Fig. 3. Radiographs of the skull in another patient demonstrate the typical gyriform pattern of cortical calcification.