HEMIPLEGIA IN CHILDREN
HEMIPLEGIA

WEAKNESS OF ONE HALF OF BODY
INVolvement OF Cortico-Spinal Tract ON THE Opposite Side

• Cortex
• Corona radiata
• Internal capsule
• Brain-stem
  • Midbrain
  • Pons
  • Medulla
• Spinal cord
INTERNAL CAPSULE

• Dense hemiplegia
• Hemisensory loss
• Homonymous hemianopia
• Seizures
• Differential involvement - Face + arm > leg in middle cerebral artery infarcts
• Speech – if dominant hemisphere is affected
• Cortical sensory involvement-sensory inattention, astereognosis, hemispatial neglect.
BRAINSTEM

• Crossed hemiplegia
• Ipsilateral CN palsy + opposite hemi
  • Weber syndrome = 3rd N + opp. hemi (midbrain)
  • Millard-Gubler syndr. = 6th /7th + opp. hemi (pons)
  • Jackson syndrome = 10th, 12th + opp. Hemi (medulla)
SPINAL CORD

- Hemicord lesion above C5
- Face spared
- Cranial nerves not affected
- Hemisensory loss (pain and temperature) on the opposite side
CLASSIFICATION

- Congenital
- Acquired
CONGENITAL HEMIPLEGIA

Hemiplegic cerebral palsy

Etiology

- Perinatal vascular insult
  - Hemorrhage or infarct
- Asymmetric periventricular leukomalacia
- Structural malformation
  - Schizencephaly
  - Hemimegalencephaly
CLUES TO CONGENITAL HEMIPLEGIA

- Asymmetric Moro
- Early handedness
- Smaller limb / hand (compare nail size)
- Delayed motor milestones
- Falls to one side
- Cortical thumb
- 20-30 % seizures
- +/- 30 % intellectual disability
MANAGEMENT

• Physiotherapy

• Orthotics - Dynamic splints, Static splints.
  - Ankle foot orthodesis

• Botulinum Toxin - If tone is much increased in one muscle group.

• Almost always walk by about 2 years of age.

• Achieve independence in daily living
ACQUIRED HEMIPLEGIA

• Stroke: acute onset of focal neurological deficit due to presumed vascular cause.
  • Correspond to a vascular territory
  • Arterial or venous thrombosis, embolism or hemorrhage

• Stroke mimics
  • Onset may be subacute or chronic progressive
  • May not follow vascular territories.
## DIFFERENCES BETWEEN CONGENITAL & ACQUIRED HEMIPLEGIA

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<thead>
<tr>
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<th>CONGENITAL</th>
<th>ACQUIRED</th>
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<tr>
<td>APHASIA</td>
<td>RARE</td>
<td>COMMON</td>
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<td>ABDOMINAL REFLEX</td>
<td>RETAINED</td>
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<td>PLANTAR</td>
<td>FLEXOR OR EXTENSOR</td>
<td>EXTENSOR</td>
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<td>SIZE DISCREPANCY OF THE LIMB</td>
<td>COMMON</td>
<td>RARE</td>
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<td>CORTICAL SENSORY LOSS</td>
<td>COMMON</td>
<td>LESS COMMON</td>
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<td>HEMIANOPIA</td>
<td>COMMON</td>
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STROKE MIMICS (OTHER CAUSES OF HEMIPLEGIA)

- Todd’s paralysis - Transient weakness of limb after a seizure
- ADEM (Acute Disseminated Encephalomyelitis)
- Mass lesions, e.g. Neoplasms
- Trauma
- HSV encephalitis
- PRES (Post. Reversible Encephalopathy Syndr.)
- Complicated migraine
- Metabolic e.g. MELAS (Mitochondrial)
DEFINITION OF STROKE

• “A clinical syndrome of rapidly developing focal or global disturbance of brain function lasting >24 hours or leading to death with no obvious nonvascular cause” – WHO definition.

• “A clinical syndrome characterized by acute onset of focal neurological deficit lasting >24 hrs. with evidence of infarct/hemorrhage in the arterial territory
STROKE

• Ischemic stroke
  • Thrombotic
  • Embolic stroke – from heart, from carotid arteries (dissection)
• Hemorrhagic stroke
• Venous sinus thrombosis
DIFFERENCE FROM ADULTS

• In adults the commonest cause of stroke is atherosclerosis, which is very rare in children.

• Ischemic stroke (55%) and hemorrhagic stroke (45%) are almost equal in incidence in children. Ischemic stroke is very common in adults (80% vs. 20%).

• Seizures are more common as the presenting symptom of stroke in children.
### AETIOLOGY OF ISCHEMIC STROKE

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<tr>
<th>Intravascular</th>
<th>Vascular</th>
<th>Embolic</th>
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<tr>
<td>Haematologic</td>
<td>Vascularopathies</td>
<td>Congenital heart disease</td>
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<tr>
<td>eg. Sickle cell disease</td>
<td>eg. Post-varicella (TCAC)</td>
<td>eg. Complex CHD</td>
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<tr>
<td><strong>Prothrombotic states</strong></td>
<td>Moyamoya</td>
<td><strong>Acquired Heart Disease</strong></td>
</tr>
<tr>
<td>Congenital:</td>
<td><strong>Vasculitis</strong></td>
<td>eg. Rheumatic HD</td>
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<tr>
<td>eg. Protein S,C deficiency</td>
<td>eg. Meningitis, SLE</td>
<td>Infective endocard.</td>
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<tr>
<td>Acquired:</td>
<td>Takayasu</td>
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<tr>
<td>eg. L-asparaginase</td>
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<tr>
<td>Anticardiolipin</td>
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SICKLE CELL DISEASE AND STROKE

Stroke a major complication of sickle cell disease.
Rates of stroke in SCD are much higher than stroke in children in general.
  • The deformed RBC will block the blood vessels → thrombosis
Rates of both ischemic and hemorrhagic stroke are higher in children with SCD.
Depends on the level of Hb S - Hb S > 30% associated with increased risk.
Transcranial Doppler - flow velocity > 200 m/s
COAGULATION ABNORMALITIES AND STROKE

• Anti-thrombin

• Protein C or protein S deficiencies

• Activated protein C resistance

• Factor V Leiden mutation

• Prothrombin gene mutation (G20210A)

• Anti phospholipid antibody syndrome (APAS)
HEART DISEASE AND STROKE IN CHILDREN

Cyanotic heart disease

- Right to left shunt
- Venous emboli → systemic circulation
- Polycythemia

Mitral stenosis, prosthetic valves, LA Myxoma

- Vegetations, tumor may embolize
- Arrhythmias

Patent foramen ovale
OTHER CAUSES OF STROKE

• Transient cerebral arteriopathy – transient narrowing of vessels after chicken pox or viral infection. Good prognosis and low chance of recurrence.
• Infections – meningitis, TBM – vasculitis and infarct.
• Vasculitis – primary and secondary – infarct.
• Fibromuscular dysplasia, Ehler Danlos syndrome - dissection.
• Trauma – diving, manipulation of neck – dissection and stroke.
• Iron deficiency anemia – increased incidence of stroke.
ASSESSMENT

- Vital signs, GCS
- Fever, headache, vomiting, meningeal signs
- Anaemia - iron deficiency, sickle cell, Leukemia etc.
- Trauma - Hemorrhage, dissection,
- Hemangioma, - Sturge Weber, angiokeratoma in Fabry’s
- Dysmorphism - Down’s, Marfan, homocystinuria
- Dislocated lens - Marfan, homocystinuria
- Short stature - ataxia, developmental delay –MELAS
- vasculitis - rash, hypertension, renal
- Cardiac - cyanotic, acyanotic, PFO
INVESTIGATIONS IN STROKE

Imaging as early as possible

- CT SCAN – can exclude hemorrhage, can be normal in the initial 12 hours or so

- MRI including diffusion weighted imaging is the procedure of choice, diffusion restriction will be picked up early.

- If MRI is suggestive of ischemic stroke, MR angiography of cervical and intracranial vessels should be done within 48 hrs. – can detect dissection, Moya, transient cerebral arteriopathy, arteritis etc..
MCA INFARCT – SHOWING DIFFUSION RESTRICTION
INVESTIGATIONS IN ACUTE ISCHEMIC STROKE

• Blood – CBC, platelet count,, peripheral smear, sickling test, serum iron, ferritin ,PT, APTT
• ESR, ANA, dsDNA, APLA
• Lipid profile
• CSF study – intracranial infections
• ECG,CXR,ECHO ? Trans-esophageal echo
• Urine for homocysteine
• Sr. Lactate, pyruvate
• Stroke panel – identification of prothrombotic factors –Protein C, Protein S, Factor 5 Leyden, MTHFR,
MANAGEMENT

Neuroprotective strategies: Critically important: can decrease size of infarct and improve outcome

1) Rapid diagnosis and stabilization

2) Minimize size of infarct by controlling
   - Fever
   - Seizures
   - Blood pressure-upper limit of normal – maintain CPP
   - Blood glucose

3) Identify early evidence of ICT and manage
SPECIFIC TREATMENT

• ASPIRIN -3-5 mg/kg/d for 6-12 months
• Anticoagulants
• Thrombolysis
• Specific treatment for different etiologies
  • Exchange transfusion (to reduce HBs to <30%) and hydroxyurea in sickle cell disease.
  • Management of iron deficiency anemia
  • Revascularization in Moya Moya disease
ANTICOAGULANTS IN STROKE

Class I Recommendation

1. Anticoagulation with LMWH is useful for long-term anticoagulation of children with a substantial risk of cervicocephalic arterial dissection, venous sinus thrombosis, recurrent cardiac embolism and selected hypercoagulable states. (Class I, Level of Evidence C)

2. The administration of LMWH or UFH may be considered in children for up to 1 week after an ischemic stroke pending further evaluation to determine the stroke’s etiology. (Class IIb, Level of Evidence C)

AAN recommendations 2008
THROMBOLYSIS

• tPA – tissue plasminogen activator
• Only few open label trials
• Risk of hemorrhage is higher
• Stroke in children is often diagnosed late beyond the 6hr window
• Not recommended as a treatment option in children. (Class III, Level of Evidence C)
5-7 DAYS OF LOW MOLECULAR WEIGHT HEPARIN

IDIOPATHIC STROKE
CEREBRAL ARTERIOPATHY
INTRACRANIAL DISSECTION
VASCULITIS

ASPIRIN

CERVICAL DISSECTION
CARDIOEMBOLIC STROKE
(WITH INTRACARDIAC THROMBUS)
PROTHROMBOTIC STATES
STROKE WHILE ON ASPIRIN

WARFARIN 6-12 M
HEMORRHAGIC STROKE IN CHILDREN

• Hematologic abnormalities
  • ITP
  • Leukemia
  • Hemophilia
• Arteriovenous malformations
• Aneurysm
• Vascular tumours

Acute headache, vomiting and rapid deterioration of neurological function. In children the presentation may be subtler
INVESTIGATIONS IN HEMORRHAGIC STROKE

• CT scan
• MR angiogram/CT angiogram
• Coagulation Profile
• Platelet Count
• Peripheral Smear
• DSA
AVM
• Replacement of coagulation factors in factor deficiencies

• Platelet transfusion and IVIG in ITP

• AVM – surgical/embolization

• Aneurysm -coiling
SUPPORTIVE MEASURES

• Control fever
• Avoid vigorous suction, straining at stools,
• Control of hypertension
• Fluid balance
• Evacuation not indicated in supratentorial lesions unless they produce impending coning
• Infratentorial hematoma – evacuate
• Anticonvulsants - prophylactic
CEREBRAL VENOUS SINUS THROMBOSIS

PREDISPOSING FACTORS
• Dehydration
• Shock
• Nephrotic syndrome
• Prothrombotic states
• Under recognized in newborns
• Otitis media/sinusitis

CLINICAL FEATURES
• Seizures
• Coma
• Raised ICT
• SAH/SDH
• Hemorrhagic infarction – not obeying vascular territory
• MRI+MRV

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MANAGEMENT OF NON VASCULAR CAUSES OF ACQUIRED HEMIPLEGIA

- Depend on the specific etiology
  - Todd’s paralysis improves by itself over 6-12 hours
  - Steroids/immunosuppressants in ADEM
  - Removal of the tumor
  - Management of hypertension in Posterior reversible encephalopathy
  - Mitochondrial cocktail and arginine infusion in MELAS
RECURREN HEMIPLEGIA

- Cardio-embolic stroke – weakness in different territories
- Cervical dissection – weakness recurs in the same territory
- Sickle cell anemia
- Moya Moya disease
- Hereditary thrombophilia's
- MELAS
- Alternating hemiplegia of childhood
THANK YOU