Prenatal Prediction of The Neurologically Impaired Neonate By Ultrasound

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Introduction

- Maladaptation of Fetal Brain
- Structural Abnormalities
- Perinatal Infections
- Metabolic Diseases
- Newborn Encephalopathy
- Brain injury of the Very Low Birth Weight Preterm Neonate
- Mechanical in utero injury, compression
Objectives

- Identify most common CNS malformations on prenatal Ultrasound
- Develop an a protocol for Ultrasound of the CNS of a fetus
- Identify normal variant from pathology on prenatal CNS ultrasound
Psychosocial Maladaptation

- Delivery explains < 15% of Neurological injuries
Fetal Brain Development

- Neural tube differentiation
- Cellular differentiation
- Neuronal migration
- Neuroblast differentiation
- Brain growth
  - Dobbings & Sands, 1979
  - Sherman et al., 1985
Structural Abnormalities

- Ventriculomegaly
- Agenesis of Corpus Collosum
- Dandy Walker Cyst
- Syringomelia
- Microcephaly
- Arachnoid Cyst
- Brain destructive lesions
- Choroid Plexus Cyst
Anencephaly.. (A no brainer!)
Transventricular & Transcerebellar Planes
Normal Fetal Brain
Borderline Lateral Ventriculomegaly

- 10-15mm
- 22% abnormal outcome, without MRI
- 4-8% abnormal with normal MRI
- 3.7% perinatal death
- 3.8% Chromosomal abnormality
- 11.5% cognitive +/- motor delay
- 22 v. 4 % abnormal neuro F>M

Pilu et al: Us Obstet Gynecol 2002
Ventriculomegaly

Mild ventriculomegaly

Hydrocephalus

atria

Dangling choroid
Ventriculomegaly

- 1% at 20-23 weeks…>10mm
- 1-2/1000 develop hydrocephalus
- Borderline 10-15mm
- Morbidity related to other problems
- 3% chromosomal
- Syndromic/hemorrhage/infection
- 6-10% mild to moderate delay
- Maldevelopment or destructive lesion
Agenesis of Corpus Callosum

- Complete or partial
- 5/1,000
- Maldevelopment or destructive
- Chromosomal (21/13/18), p deletion syndromes
- Syndromic
- Isolated
Corpus Callosum
Agenesis Of The Corpus Callosum

Absent cavum septi pellucidi

Absent corpus callosum/cavum septi pellucidi

Tear-drop ventricles

3y
Power Angiography
Agenesis of Corpus Callosum

- 90% normal development if isolated
- Early intervention crucial
- Hard to R/O some syndromes (Aicardi)
  - ACC, Epilepsy, Retinal dysplasia
- Developmental delay usually from associated anomalies
- Sporadic / X-linked
Dandy Walker Complex

- 1/30,000 births
- Complete or partial agenesis of vermis with enlarged posterior fossa
- Variant-partial agenesis with normal posterior fossa
- Mega Cisterna Magna
- Aneuploidy/syndromic/isolated
- Warfarin
- Half isolated
Dandy Walker Malformation

<table>
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<tr>
<th>Dandy Walker Malformation</th>
<th>Variant</th>
<th>Megacisternamagna</th>
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[Images of ultrasound scans showing Dandy Walker Malformation with red arrows highlighting the abnormalities.]
Dandy Walker Variant
Dandy Walker Complex

- 20% mortality
- 50% neuro abnormality with syndrome
- Much better prognosis is variant
- Megacisternamagna usually normal outcome
Syringomelia

- Fluid filled cavity in spinal canal
  - Usually cervical in origin
  - Associate with Chiari type II herniation
  - Can be asymptomatic for years
  - Can present with varying degree of neurologic impairment
  - Reported with in utero compression, tumor, arachnoiditis, PPROM, infection
  - Can be idiopathic
Syringomelia

- Mid forceps rotation, no longer done
- Can be developmental from in-utero injury
  - MVA
  - Mal-positioning (common)
  - Myomas with severe compression
- Causes neurogenic atrophy of phrenic, intercostal, and spinothalamic tract
Syringomelia

- Also seen with Spinal muscular atrophy mutation, Williams syndrome
- If no focal hemorrhage, edema, necrosis then likely prenatal injury
- Intrapartum injury usually from head entrapment in breech vaginal attempt
- In utero malposition plays larger role than once thought
  - Found at normal vertex delivery or cesarean section without trauma
Microcephaly

- 1 per 1,000 births
- Chromosomal/syndromic
- Fetal hypoxia
- Congenital infection
- Radiation....>10 rads
- Teratogen..ie warfarin/ETOH
- Need progressive decrease
- > 2sd below mean
- > 50% severe mental retardation
Microcephaly
Microcephaly
Arachnoid Cyst

- Fluid filled cysts in arachnoid space
- Rare..<1 in 30,000
- Cause unknown
- Sonolucent cysts with thin regular outline
- No blood flow
- No ventricular connection
Arachnoid Cyst

- Not associated with loss of tissue
- Most in midline
- Differential
  - Glioeependymal cyst
  - Porencephhalic cyst
Arachnoid Cysts
Arachnoid Cyst
Arachnoid Cysts

- Prognosis
  - Intracranial HTN with large cysts......neuro surgery
  - Normal intellectual development in > 90%
Brain Destructive Lesions

- Hydranencephaly
- Porencephaly
- Schizencephaly

1 in 10,000 births
Hydranencephaly

- Sporadic
  - Bilateral carotid artery occlusion
  - Leukomalacia with confluence
  - Diffuse Hypoxic ischemic necrosis
  - Infection/necrotizing vasculitis
  - Trophoblastic material from twin
Hydranencephaly
Hydranencephaly

Differential
- Extreme hyrocephalus..important!
- Holoprosencephaly
- Porencephaly
  - MRI most helpful

Prognosis
- Universally poor
- Lethal by 1 year
  - Jeanty/Romero/callan
Brain Destructive lesions

- Porencephalic cyst
- Schizencephaly
Porencephaly

- Infarction of cerebral arteries
- Hemorrhage into brain parenchyma
- Cystic areas in cortex communicating with the ventricle
- Within fissures or midline.
- Compresses brain
- Prognosis variable ..size/location..
  - >50% severe handicaps
Schizencephaly

- Bilateral clefts
- Connects lateral ventricles to subarachnoid space
- Associated with absence of cavum septum pellucidum
- Prognosis poor with severe developmental delay and seizures
Choroid Plexus Cysts
Choroid Plexus Cysts

- Found in 2% at Anatomy scan
- All resolve usually by 26 weeks
- Cellular debris occludes capillaries causing cyst during normal development
- Cysts themselves of no pathologic significance
Choroid Plexus Cysts

- Must look for other abnormalities
- Isolated cysts may raise aneuploid risk by a factor of 1.2-1.5 for trisomy 18
- If normal biochemistry, no other markers and less than 35, relative risk is lower than risk of loss from amniocentesis
  - Trisch et al, 2000
Thank You