FETAL CENTRAL NERVOUS SYSTEM

ABNORMALITIES

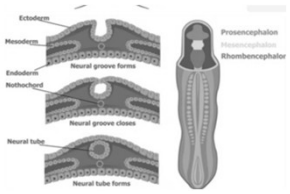
1

DISCLOSURES

I have no actual or potential conflict of interest in relation to this presentation.

2

NEURULATION



- Dorsal ectoderm forms neural plate
- Neural plate folds inward forming neural folds
- Neural folds fuse to form neural tube
- Neural tube closes cranial and caudal
  - Disruption= Neural tube defect

3

3

OBJECTIVES

- Recognize 1st trimester indicators of CNS malformations
- Image optimization
- Updates in fetal surgery for Spina Bifida

4

RISK FACTORS

- Lack of folate in maternal diet
- Medication (Epilepsy)

5

5

NEURAL TUBE DEFECTS- CRANIALLY

Name	Area Involved	Presentation
Anecephaly	Cranium & brain	Lack of cranial vault No cerebral tissue
Acrania	Cranium	Lack of cranial vault
Encephalocele	Herniation of brain & meninges	Occipital or frontal opening Cystic/ solid mass
Iniencephaly	Occipital skull & cervical spine	Fusion of occipital skull to cervical spine Hyperextension of head

6

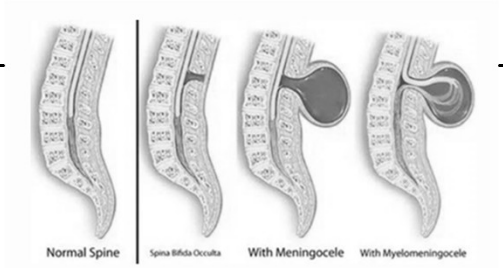
6

NEURAL TUBE DEFECTS CAUDALLY- SPINA BIFIDA

Name	Area Involved	Presentation
Spina bifida occulta	Gap between vertebrae	Dimple (post natally)
Meningocele	Meninges	Sac/cyst
Myelomeningocele	Meninges, spinal cord, nerves	Sac containing cord Chiari malformation Hydrocephalus

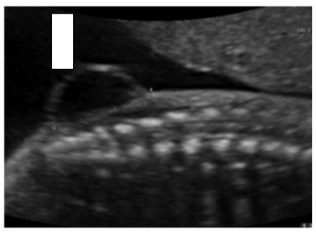
7

7



8

8



MENINGOCELE

9

9

MYELOMENINGOCELE

10

10

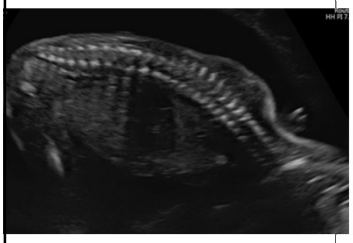
Results	Report
Gest age.	16.4
Gest age based on	Ultrasound
Maternal age at edd	33.8
Race	
Weight	
Multiple gestation	no
AFP Value	84.7
AFP MoM	2.60
OSBR risk 1 in	238

SCREENING TESTS FOR ONTD

- MS AFP
  - Blood test
  - 16-18 weeks
- Ultrasound
  - 1st trimester
  - 2nd trimester

11

11

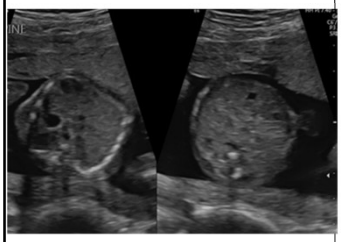


SPINE SAGITTAL

- Parallel arrangement anterior/ posterior vertebral elements
- Curvature cervical and lumbosacral regions
- Sacral tapering
- Integrity of muscle and skin

12

12



SPINE TRANSVERSE

- Configuration of vertebral elements
- Integrity of muscle and skin

13

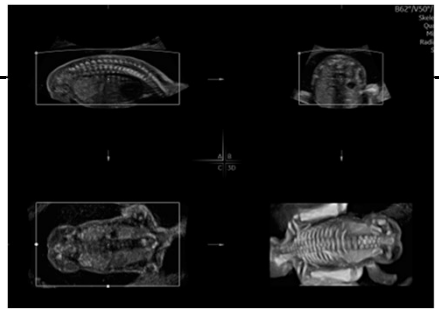
13

3D SPINE- HOW TO

- Acquisition:
  - Spine sagittal plane
  - Volume angle 40-50 degrees
  - Quality- Mid/High
  - Start
  - Save
- Render mode
  - Skeletal setting

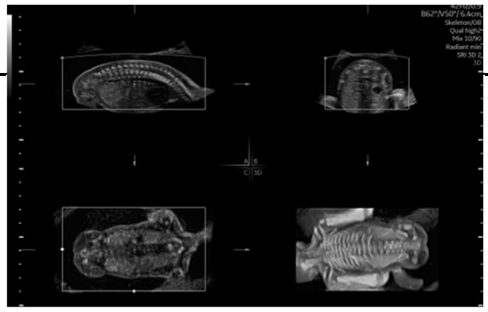
14

14



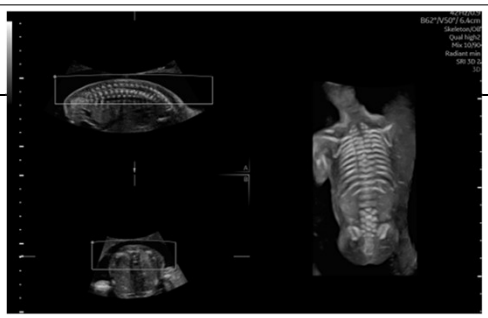
15

15



16

16

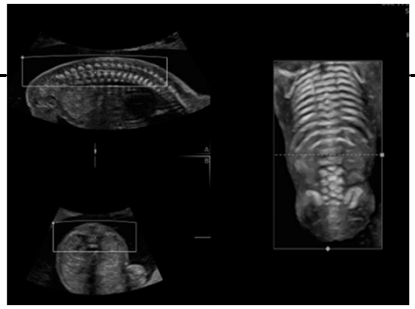


17

17

18

18



19

19

INTRACRANIAL FINDINGS IN SPINA BIFIDA

- Secondary to Arnold Chiari II Malformaiton
- Lemon sign
- Banana sign
- Hydrocephalus

20

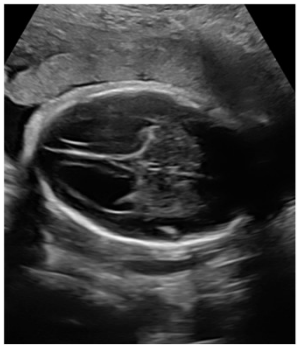
20

INTRACRANIAL FINDINGS IN SPINA BIFIDA

- Secondary to Arnold Chiari II Malformaiton
- Lemon sign
- Banana sign
- Hydrocephalus

21

21

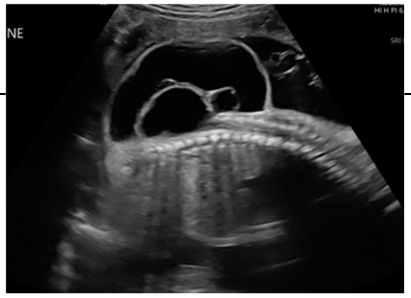


INTRACRANIAL FINDINGS IN SPINA BIFIDA

- Secondary to Arnold Chiari II Malformaiton
- Lemon sign
- Banana sign
- Hydrocephalus

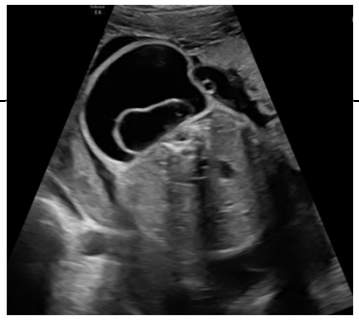
22

22



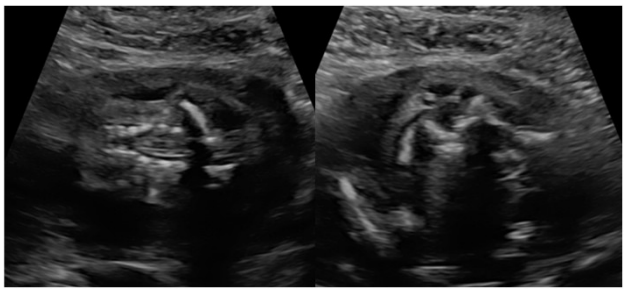
23

23



24

24



25

25

1ST TRIMESTER EVALUATION OF BRAIN 11-13 WEEKS

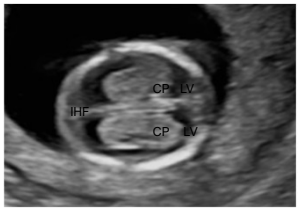
- Cranial bones
- Midline falx
- Choroid plexus filled ventricles

Abnormalities detected:

- Acrania
- Holoprosencephaly
- Cephalocele

26

26

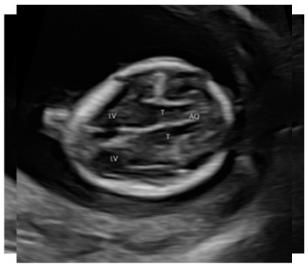


AXIAL VIEWS

- Suprathalmic
  - Interhemispheric fissure (IHF)
  - Lateral ventricles (LV)
  - Choroid plexus (CP)
  - Calvarium

27

27

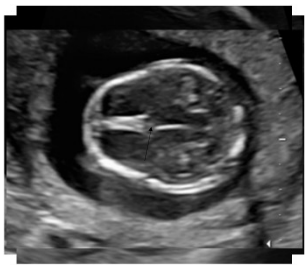


AXIAL VIEWS

- Transthalmic
  - Third Ventricle (3V)
  - Aqueduct of Sylvius (Aq)
  - Thalamus (T)
  - 3rd ventricle (arrow)

28

28



AXIAL VIEWS

- Transthalmic
  - Third Ventricle (3V)
  - Aqueduct of Sylvius (Aq)
  - Thalamus (T)
  - 3rd ventricle (arrow)

29

29

SAGITTAL VIEWS

- Midsagittal brain- Nuchal Translucency view
  - Diencephalon (D)
  - 4th Ventricle (4v)
    - Intracranial translucency
  - Brain stem
    - Mesencephalon (M)
    - Pons (P)
    - Medulla (Md)

30

30

SAGITTAL VIEWS

- Midsagittal brain- Nuchal Translucency view
  - Diencephalon (D)
  - 4th Ventricle (4v)
    - Intracranial translucency
  - Brain stem
    - Mesencephalon (M)
    - Pons (P)
    - Medulla (Md)

31

1ST TRIMESTER EVALUATION OF BRAIN 11-13 WEEKS

- Cranial bones
- Midline falx
- Choroid plexus filled ventricles

Abnormalities detected:

- Acrania
- Holoprosencephaly
- Cephalocele

32

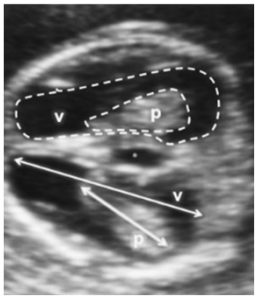
1ST TRIMESTER DETAILED EVALUATION OF BRAIN 11-13 WEEKS

- Cranial bones
- Midline falx
- Choroid plexus filled ventricles
- Suprathalmic section
- Transthalmic section
- Midsagittal (NT/IT) view

Abnormalities detected:

- Acrania
- Holoprosencephaly
- Cephalocele
- Ventriculomegaly
- Open spina bifida
- Dandy Walker Malformation
- Agenesis of Corpus Callosum

33



VENTRICULOMEGALY

- Reduction of Choroid Plexus size
- Too small to reach roof of lateral ventricle

Volpe, N., Dall'Asta, A., Di Pasquo, E., Frusca, T. and Ghi, T. (2021), First-trimester fetal neurosonography: technique and diagnostic potential. Ultrasound Obstet Gynecol, 57: 204-214

34

OPEN SPINA BIFIDA

- Reduced width of cisterna magna
  - Brainstem thicker, displaced posteriorly
  - Compressed 4th ventricle

Volpe, N., Dall'Asta, A., Di Pasquo, E., Frusca, T. and Ghi, T. (2021), First-trimester fetal neurosonography: technique and diagnostic potential. Ultrasound Obstet Gynecol, 57: 204-214

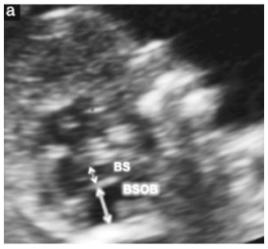
35

OPEN SPINA BIFIDA

- 3rd Ventricle & Aqueduct of Sylvius not seen

Volpe, N., Dall'Asta, A., Di Pasquo, E., Frusca, T. and Ghi, T. (2021), First-trimester fetal neurosonography: technique and diagnostic potential. Ultrasound Obstet Gynecol, 57: 204-214

36

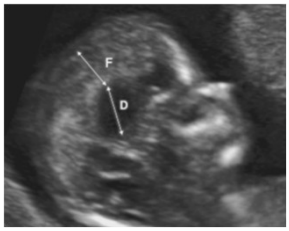


DANDY WALKER MALFORMATION

- Ratio brainstem thickness (BS) and brainstem to occipital bone (BSOB) reduced.
- Only 2 parallel anechoic spaces seen

Volpe, N., Dall'Asta, A., Di Pasquo, E., Frusca, T. and Ghi, T. (2021), First-trimester fetal neurosonography: technique and diagnostic potential. Ultrasound Obstet Gynecol, 57: 204-214

37

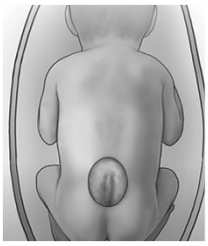


AGENESIS OF THE CORPUS CALLOSUM

- Increased ratio between diencephalon (D) and falx (F)

Volpe, N., Dall'Asta, A., Di Pasquo, E., Frusca, T. and Ghi, T. (2021), First-trimester fetal neurosonography: technique and diagnostic potential. Ultrasound Obstet Gynecol, 57: 204-214

38

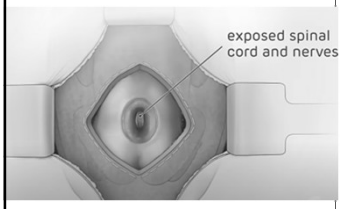


MYELOMENINGOCELE REPAIR

- Goal- protect spinal cord and nerves from damage from amniotic fluid
- Prevent hydrocephalus

Children's Hospital of Philadelphia

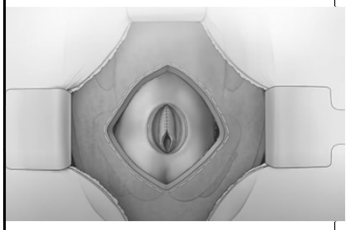
40



MYELOMENINGOCELE REPAIR

- Close dura
- Close muscle
- Close skin

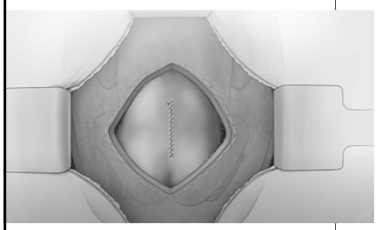
41



MYELOMENINGOCELE REPAIR

- Close dura
- Close muscle
- Close skin

42



MYELOMENINGOCELE REPAIR

- Close dura
- Close muscle
- Close skin

43

CRITERIA FOR ELIGIBILITY (SURGERY)

Eligible:

- Myelomeningocele Level T1- S1 with hindbrain herniation
- Gestational age: < 25w6d
- Maternal age: >18
- Singleton
- Labs: Elevated MSAFP, positive acetylcholinesterase
- Normal Karyotype

Contraindications:

- Insulin dependent diabetes mellitus
- Associated anomalies: cardiac, intracranial hemorrhage
- Fetal kyphosis
- Cervical insufficiency or cerclage
- Placenta previa
- Placental abruption
- BMI >40
- Other

44

SURGERY

Close to protect further damage

- Dura
- Muscle
- Skin

Contraindications:

- Insulin dependent diabetes mellitus
- Associated anomalies: cardiac, intracranial hemorrhage
- Fetal kyphosis
- Cervical insufficiency or cerclage
- Placenta previa
- Placental abruption
- BMI >40
- Other

45

POST SURGERY OUTCOMES- MOMS TRIAL

- Reduced need for ventricular shunting
- Reduced incidence/severity of neurological effects
  - Impaired motor function
  - Sensory function of legs
- Improved mobility and chances child able to walk indedependently
- Reversed hindbrain heniation component of Arnold Chiari II malformation

MOMS2

- Most able to walk by school age
- Better fine/gross motor skills
- Better control of bladder and bowels

46

RESOURCES

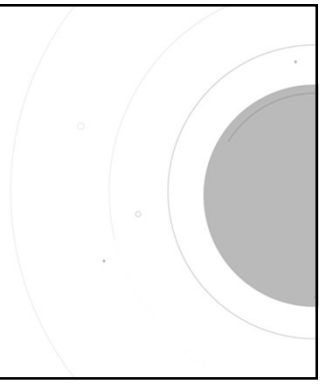
- Volpe, N., Dall'Asta, A., Di Pasquo, E., Frusca, T. and Ghi, T. (2021), First-trimester fetal neurosonography: technique and diagnostic potential. Ultrasound Obstet Gynecol, 57: 204-214
- Children's Hospital of Philadelphia
  - https://gps.chop.edu/condition/spina-bifida-myelomeningocele

47

THANK YOU

Michelle Patterson, BS, RDMS, RDCS

Michelle.rdms@gmail.com



48