Monash Health Obstetrics Workshop Fetal Spine

Aaditya Singh

1

Learning Objective

- Anatomy
- Sonographic Techniques
- Pitfalls
- Pathologies
- Case study

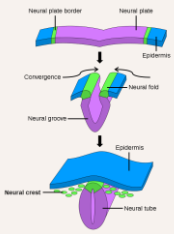
2

01 Anatomy

3

Developmental Biology

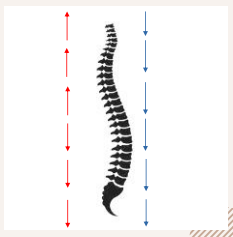
- Neural Plate develops from ectoderm from Day 18
- Neurulation occurs on Day 21
  - Neural plate forms to neural tube
    - The plate first invaginates into the groove – this neural groove begins to fuse along the mid & dorsal aspect of the embryo
    - Fusion continues in a cranial – caudal manner
    - Only small cranial & caudal openings remain as the fusion completes
    - Rostral end of tube – Brain
    - Caudal end – Spinal cord



4

Developmental Biology

- Ossification begins at 10 weeks – 3 ossification centers
  - The centrum – Forms central part of vertebral body
  - Right and Left Neural processes – Forms posterolateral parts of the vertebral body
  - Spinous process – Does not ossify until after birth



5

Spine Anatomy

6

02

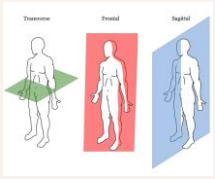
Ultrasound Technique

7

Ultrasound Techniques

- By 20 weeks, we should be able to assess fetal spine from cervical to S2-4 spine
- Three planes are standard procedure to assess spine
  - Axial
  - Sagittal
  - Coronal

Fetal position – Ideally prone for sagittal and axial spine and fetus on the side for coronal views



8

Ultrasound Techniques – Axial Imaging

- Fetal position in prone
- Neural processes should converge towards the midline
- Assess spine to all the way past the sacrum
- 3 ossification centres
- Assess for splaying of neural processes
- Assess skin line
- Assess for masses
- Axial Fetal Kidneys

9

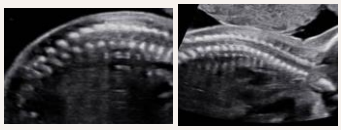
Ultrasound Techniques – Axial Imaging

Cervical | Thoracic | Lumbar | Sacral

10

Ultrasound Techniques – Sagittal Imaging

- Sagittal
  - Centrum
  - Skin line (Fluid between fetus and uterus)
  - Normal curvature of the spine
  - Tapering sacral region
  - Conus level L2-3
  - Sagittal kidneys



11

Ultrasound Techniques – Coronal Imaging

- Alignment of vertebral bodies. Parallel neural processes
- Normal widening in cervical region and lumbar region. Tapering of sacral elements

12

03

Pitfalls

13

Pitfalls

- Most common pitfall is imaging spine in parasagittal plane
- Pedicles should not be visualised
- You will possibly miss small midline defects in parasagittal imaging
- Do not image spine in supine position
- Do not image spine when the fetus is having a stretch!

14

Troubleshoot

Supine Fetus
- Turn patient into Lt or Rt decub position
- Push on belly with the other hand on the opposite side
- Get mother to go for a walk or toilet

For skin line
- Gentle pressure
- Bounce baby
- Turn patient

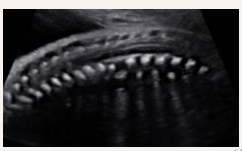
Spine in maternal pelvis
- TV scan

15

16

Case 1

- 24-year-old presented for tertiary scan. GA 24 weeks and 5 days. Querying spinal dysraphism



17

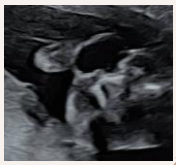
Case 1

- Diagnosis: Hemivertebra at T12 – L1 and at S3 level of spine with associated scoliosis
- Genetic disorder caused by an absence of one of two chondrification centres resulting in half of vertebral body and neural arch on one side.
- Major cause for congenital scoliosis, kyphosis or lordosis

18

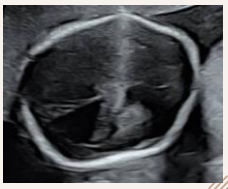
Case 2

- 28 year old presented for tertiary scan. G2P1, GA 22 weeks and 6 days. Low risk FTCS and early diagnosis of GDM

19

Case 2

20

Case 2 – Spina Bifda

Head Signs
- Lemon shaped head
- Narrow CSP.
- Corpus callosum compressed but seen in its' entirety.
- Bilateral ventriculomegaly with the left and right lateral ventricles
- Obliteration of the cisterna magna with posteriorly displaced cerebellum (Banana shaped cerebellum)
- Diagnosis: **Arnold Chiari Malformation II**

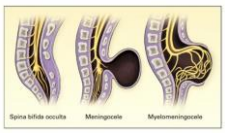
Spine
- Neural tube defect seen in sacral region originating at S1
- Splaying of the vertebral pedicles at the level of S1 as the spine reaches the level of the pelvis.
- The defect extends into a closed cystic sac containing neural elements
- Diagnosis: **Myelomeningocele.**

21

Case 2 – Spina Bifda

•*Neural Tube Defect:* abnormality of the head or spine due to failure of the neural tube to close properly during embryonic development
- Open: not covered by skin (↑ alpha fetoprotein)
- Closed: covered by skin

•*Spina Bifida:* The arches (made of lamina and spinous processes) fail to fuse and enclose the spinal canal
- Spina Bifida Occulta
- Meningocele
- Myelomeningocele
- *Myeloschisis*



22

Case 2 – Spina Bifda – 1st Trimester features

Before 18 weeks, the pedicles and lamina are not ossified
Sonographic signs of Open Neural Tube Defect are:
- Absent Intracranial Translucency
- Compressed aqueduct of Sylvius
- Elevated posterior brain stem diameter

Interesting Article (Lachmann et al., 2010)
- Distance between Brainstem and Occipital Bone (BSOB) (Line B&C)
- Brainstem (Line A&B)
- Normal Patients: Brainstem < BSOB
- Open Spina Bifida: Brainstem > BSOB
- Caudal displacement of brainstem and compression of 4V/cisterna magna complex.


23

Case 3

20-year-old presented for tertiary scan at GA 25 weeks and 4 days for suspected neural tube defect at mid – trimester morphology ultrasound.


24

Case 3

What are the Ultrasound Features?

- Predominantly cystic mass which appears to have a small intrapelvic origin that is pre-sacral
- The majority of the cystic lesion is extra-pelvic.
- It is avascular with anechoic fluid content.
- Thi represents a **sacro-coccygeal teratoma**

25

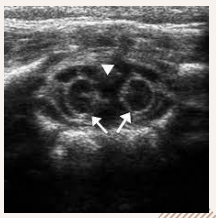
Case 3

Teratoma	MMC
Situated at lower level to sacral ala	Situated at higher level to sacral ala
Usually deficits in motor power do not exist	Usually deficits in motor power do exist
Anterior fontanelle in usually normal	Anterior fontanelle in may be abnormal and bulging
Sacrum may be displaced anteriorly	Sacral agenesis usually occurs
On MRI lesion lesion is usually more dense	Density matches that of water
Associated anomalies of other systems, for example, CVS or urogenital system are common	Associated anomalies such as hydrocephalus or Arnold-Chiari or split cord malformation are common

26

Rare Spine Pathologies

- Sacral Agenesis
  - Absent sacral vertebrae
- Diastematomyelia
  - Split spinal cord in the presence bony septum
- VACTERL
  - Vertebral defects, anal atresia, cardiac defects, tracheo – oesophageal fistula, renal anomalies and limb abnormalities



27

Questions

28

References

- Basude, S., McDermott, L., Newell, S., Wreyford, B., Denbow, M., Hutchinson, J., & Abdel-Fattah, S. (2015). Fetal hemivertebra: associations and perinatal outcome. *Ultrasound In Obstetrics &Amp; Gynecology*, *45*(4), 434-438. doi: 10.1002/uog.13401
- Lachmann, R., Chaoui, R., Moratalla, J., Picciarelli, G., & Nicolaides, K. (2010). Posterior brain in fetuses with open spina bifida at 11 to 13 weeks. *Prenatal Diagnosis*, *31*(1), 103-106. doi: 10.1002/pd.263
- Rumack C, Wilson S, and Charboneau J, 2005, "Diagnostic Ultrasound – Volume 1 (3rd Edition)," Mosby, St Louis.
- Vidyadhar U et al, 2016, Prenatal diagnosis and assessment of congenital spinal anomalies: Review for prenatal counselling, World Journal of Orthopedics, 7(7): 406-417
- Paoletti D et al, 2014, A sonographic approach to prenatal classification of congenital spine anomalies, AJUM, Feb, 17: 20-36
- Fin M et al, 2011, The aqueduct of Sylvius: a sonographic landmark for neural tube defects in the first trimester, Obstet Gynecol, 38:640-645.
- Srivastava, A., Singh, S., Sardhara, J., Sharma, P., Das, K., & Bhaisora, K. et al. (2017). Is it the monster "teratoma" or simply meningomyelocele: Our experience of "histological surprise". Journal Of Pediatric Neurosciences, 12(2), 192. doi: 10.4103/jpn.jpn_188_16

29