

OBSTETRICAL ULTRASOUND CHEST ANOMALY PROTOCOLS CDH, CPAM and BPS

****All exams will be accompanied by either a Detailed Anatomy (UOBC) or Follow Up OB exam (OBF). See separate protocol and image requirements for completion of these exams.**

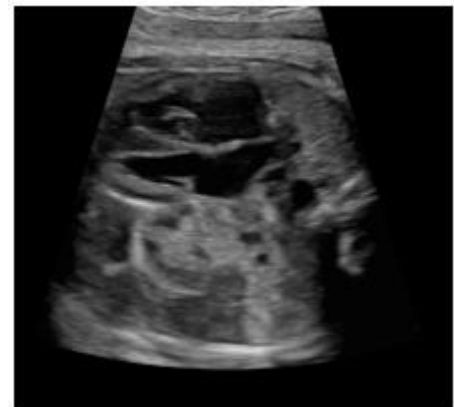
PATIENT PREP: None

Congenital Diaphragmatic Hernia (CDH):

- 15-10% are associated with a syndrome - Donnai-Barrow syndrome, Fryns syndrome, and Pallister-Killian mosaic syndrome. Chromosomal abnormalities 16-37%
- 40-50% are not associated with a known syndrome but also have abnormalities of the heart (35%), CNS (10%), skeleton, intestines, genitals, kidneys, or eyes due to disruption in fetal development.
- 50-60% percent of congenital diaphragmatic hernia cases are isolated findings with no other associated abnormalities.
- **CDH information:**
 - Left (85%), right (13%), bilateral (2%)
 - Bochdalek hernia is a defect in the side or back of the diaphragm. Between 80 and 90% of congenital diaphragmatic hernias are of this type.
 - Morgnani hernia is a defect involving the front part of the diaphragm. This type accounts for approximately 2% of CHD cases and is less likely to cause severe symptoms at birth.
 - Other types of congenital diaphragmatic hernia, such as those affecting the central region of the diaphragm, or those in which the diaphragm muscle is absent with only a thin membrane in its place, are rare.
 - Right CDH may present more as solid mass as stomach remains below diaphragm. Stomach may be displaced more medially in right sided CDH.

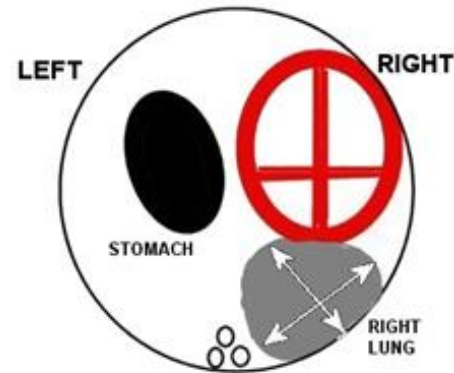
IMAGES TO OBTAIN FOR CDH:

1. **Cine clips of defect** in sagittal, coronal and transverse to include sweeps from upper chest into the abdomen.
2. **Measure the defect** in view best seen, sagittal or transverse
3. **Stomach** - Document the location in abdomen or chest.
4. **Location of heart** -Cine clip showing whether it is displaced by hernia.
5. **Location of Liver** - Targeted liver images to show the location with 2D and cine clip imaging documenting whether it is in abdomen or chest.
6. **Liver Vasculature** -Color Doppler and color cine images to document portal and hepatic vein locations (specially left liver vessels)



Heart displaced to right by bowel in chest.

7. **Measure the lung** on the side opposite of the defect.
8. Measure any lung tissue seen on same side as defect if possible.
9. Calculate the **Lung to Head Ratio (LHR)** using lung measurements from the side opposite of the CDH at the level of the 4-chamber heart.
 - Use lung measurements in a transverse view of the fetal chest at the level of the 4-chamber heart.
 - **$LHR = \text{Lung Width} \times \text{Height (mm)} / \text{HC (mm)}$**
 - *Perinatology.com calculator can also be used*
<https://perinatology.com/calculators/LHR.htm>
 - Include observed vs expected LHR in report
10. Look for additional anomalies if present.
11. Include in the report which structures are located in the chest - stomach, bowel loops, kidney, spleen, liver.
12. Document quantitative **AFI** as polyhydramnios may also occur.



CPAM and BPS Chest Masses:

Congenital Pulmonary Airway Malformation (CPAM) - Congenital cystic malformation of lung tissue during fetal development.

- Can grow rapidly, solid or cystic
- Can impair fetal swallowing, leading to polyhydramnios
- Can result in fetal hydrops due to compression on the heart.
- Not typically associated with chromosomal abnormalities.
- **CPAM classifications:**
 - Type I (Macrocytic): characterized by existence of large cysts > 2 cm
 - Type II (Mixed): characterized by multiple small cysts <2 cm in size within the lesion.
 - Type III (Microcystic): Characterized by the absence of visible cysts

Bronchopulmonary Sequestration (BPS) – Can be distinguished from CPAM by the feeding vessel arising directly from the Aorta, 90% left-sided

- Does not typically grow faster than the rest of the lung and rarely causes compression problems seen with CPAM.
- Can develop fetal hydrops or pleural effusion due to high blood flow through the lesion, not because of compression as in CPAM.
- Not typically associated with chromosomal abnormalities.
- May also have hybrid lesions (both CPAM and BPS on histology)
- Can also have abdominal BPS below the hemidiaphragm

IMAGES TO OBTAIN FOR CPAM and BPS:

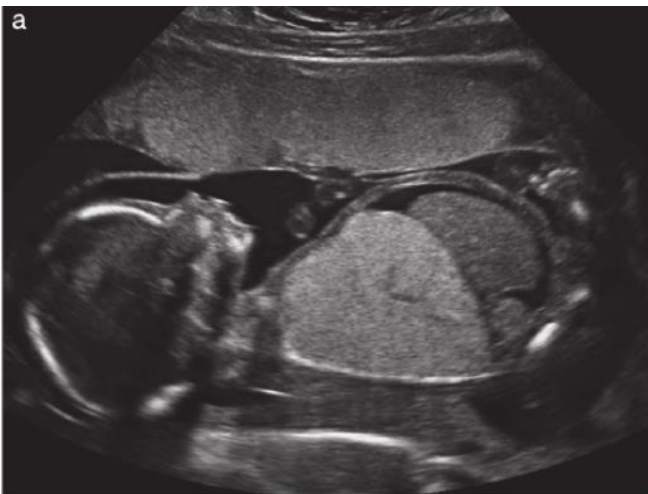
1. Cine clips of mass in sagittal and transverse.
2. Color doppler cine sweep to document the vascularity within the mass.
3. Color doppler cine sweep of the vascular origin to determine if it originates from the aorta (BPS) or pulmonary vasculature (CPAM).
4. Cine clip-showing the location of the heart and whether the heart is displaced by the mass.

5. Document presence or absence of fetal hydrops.

Evaluate for:

- Ascites
- Edema of extremities and scalp
- Pericardial effusion or pleural effusion
- Placentomegaly
- Polyhydramnios

6. Evaluate for diaphragm eversion.



Example of diaphragmatic eversion with abnormal outward bulging away from chest.



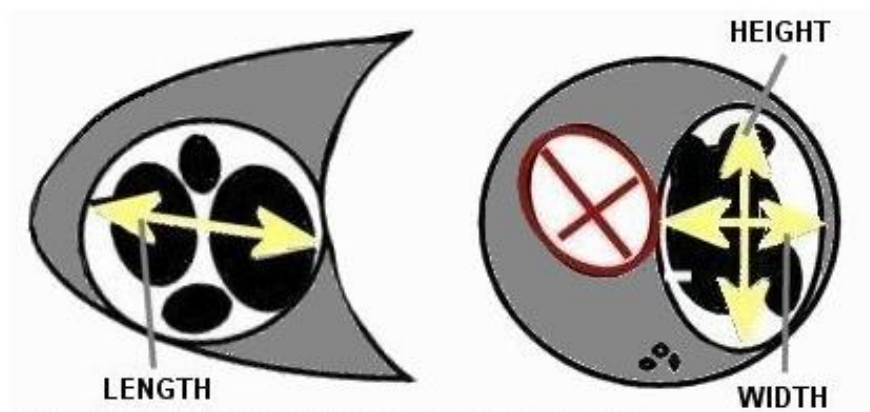
Normal diaphragm with inward orientation toward chest and lungs.

7. Calculate the CVR (CPAM/BPS volume ratio) at every ultrasound between 16-28 weeks. After 28 weeks, the provider should specifically request it.

$$\text{CVR} = \frac{\text{Mass Volume (length} \times \text{height} \times \text{width} \times 0.52)}{\text{HC}}$$

Perinatology.com calculator can also be used:

<https://perinatology.com/calculators/CVR.htm>



Chest Mass Differentials:

CHOAS (CONGENITAL HIGH AIRWAY OBSTRUCTION SYNDROME)

- Consider if **BILATERAL** lungs look enlarged
- Blockage of the fetus's trachea or larynx due to narrowing or atresia of the airway
- The fluid produced by the lungs cannot escape and the lungs and airways become distended
- Diaphragm is often inverted
- Heart appears small and anteriorly placed in chest
- Hydrops can occur from congenital heart failure
- Very poor prognosis.

CLO (CONGENITAL LOBAR OVERINFLATION)

- Consider as a differential to CPAM if unilateral lung enlargement seen.
- Result of bronchial airway obstruction in a portion of airway tree
- Hypervascularity with color flow extending to periphery of lung distinguishes from a CPAM

OTHER LUNG CYSTS & MASSES

- Bronchogenic cyst
- Esophageal duplication cyst
- Neurenteric cyst
- Thymus
- Pericardial Teratoma
- Mediastinum Teratoma

OB CHEST ANOMALY PROTOCOL HISTORY

	Date	Changes made	By whom
Created	8/2022	-Separate protocol made -Info on anomalies added	Manjiri Dighe, Renee Betit Fitzgerald, Kathia Sakamoto Reynolds
Added	9/20/22	Additional anomaly info and required ultrasound images added	Kim Ma and Shani Delaney
Removed	1/11/23	Removed Chest Circumference from CDH image requirements	Renee Betit Fitzgerald
Added	11/26/24	Differentials	Renee Betit Fitzgerald