The ultrasound detection of chromosomal anomalies[1]

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Adapted from "The Ultrasound Detection of Chromosomal Anomalies—A multimedia Lecture" by Philippe Jeanty. ISBN (0-9667878-0-3) available at www.prenataldiagnosis.com and www.TheFetus.net

Second trimester findings.

In this section we will review the sonographic markers that can be used in second and third trimester fetuses.

Gastrointestinal findings

Duodenal atresia

Duodenal atresia occurs in one per 10,000 delivery. It is due to a failure of the recanalization of the gut distal to the ampulla of Vater. Because of the obstruction, the proximal portion the duodenum distends, which creates together with the distended stomach the appearance of a double bubble. Another consequence of the obstruction is that content does not pass through the proximal jejunum and thus the jejunum thins down and this is called disused jejunum.

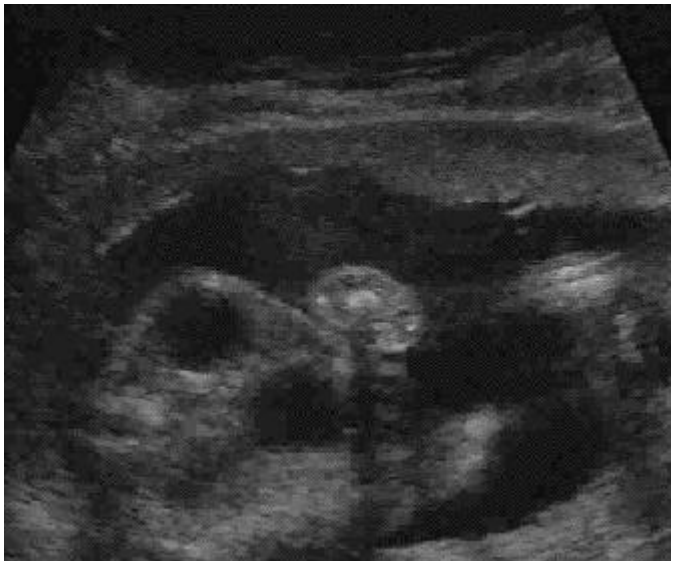


Figure 1: This is the appearance of a double bubble of a fetus with duodenal atresia and triploidy. The distended stomach and the large bubble that compose the proximal portion of the duodenum are clearly visible. Interestingly, this fetus does not have polyhydramnios, yet we expect polyhydramnios in babies that have duodenal atresia because they cannot swallow the fluid. This fetus also had a renal malformation, and thus not only was he not able to swallow the fluid properly, he was not able to produce the fluid in adequate amount.

Forty percent of fetuses that have an isolated duodenal atresia will have an aneuploidy, but if other associated anomalies are present the number rises to 66%. Duodenal atresia is mostly a marker for trisomy 21.

Esophageal atresia or tracheo-esophageal fistulas

Esophageal atresia or tracheo-esophageal fistulas occur in 2:10,000 deliveries. The ultrasound diagnosis is pretty straightforward with a stomach too small for gestational age and in the 3rd trimester an increase in amniotic fluid. A too small stomach is a stomach that is not much greater than the gallbladder. There are however many conditions that can present with the same findings. Esophageal atresia or tracheo-esophageal fistulas are classified in 5 groups (fig. 37). A small stomach will only be present in cases of type B and type C and over 95% of the fetuses have an associated fistula, and therefore the absence of a stomach is rare on ultrasound, and polyhydramnios only develops in the third trimester.

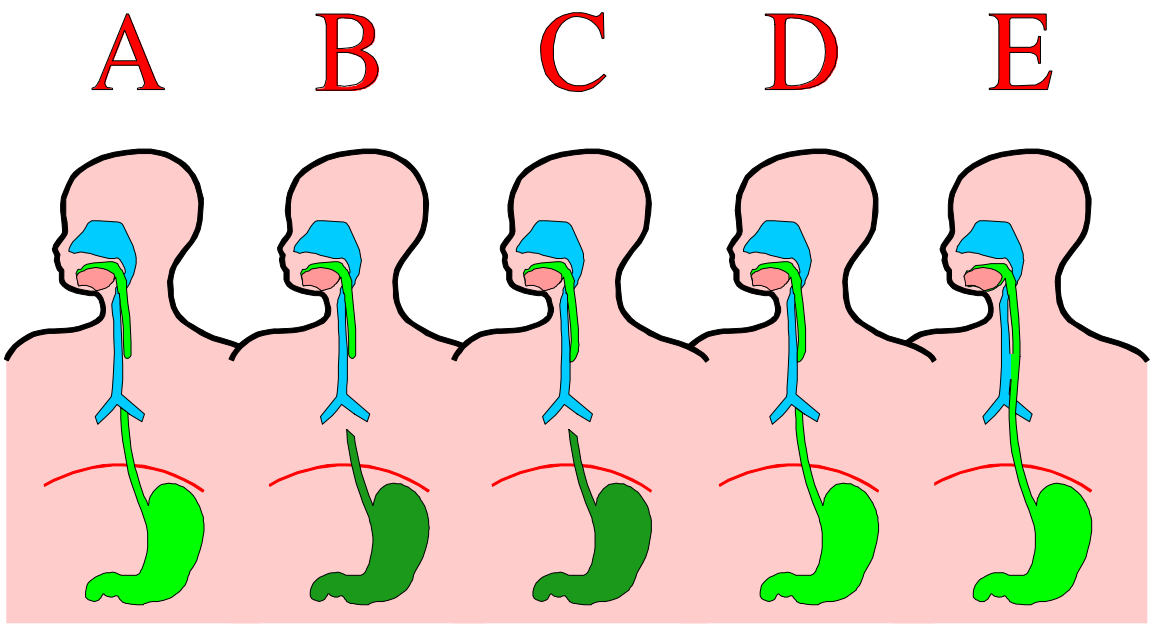


Figure 2: The type A, which is the most common, occurs in 85 to 93% of the cases. In a type A the proximal esophagus terminates into a blind pouch. However the distal esophagus is connected to the tracheobronchial tree, and therefore some fluid will pass into the stomach. Type B is the second most common, it occurs in 3-10% of the cases. Again the proximal esophagus terminates into a blind pouch but the distal esophagus is not connected to the tracheobronchial tree, and therefore no fluid will pass into the stomach and the stomach will appear too small. In type C there is a connection of the distal part of the proximal portion of the esophagus, but again, no connection of the distal portion, and therefore again, no fluid will pass into the stomach and the stomach will not be full. In type D that occurs in 1-1.5% of the cases, both the proximal and the distal portion of the esophagus are connected to the tracheobronchial tree and therefore the ultrasound appearance of the stomach will be essentially normal. And finally in type E that occurs in 1.8 to 4% of the cases the esophagus is continuous, but has an H connection to the tracheobronchial tree, and therefore the stomach will also appear normally full.

A recent paper has addressed the association of tracheo-esophageal fistula and aneuploidy[4]. In the presence of a combined esophageal atresia and tracheo-esophageal fistula, 7% of these fetuses will have an

aneuploidy. If there is only a tracheo-esophageal fistula the number varies between 3 and 10%. However, in cases of pure esophageal atresia without associated tracheo-esophageal fistula 20-25% of these fetuses have an aneuploidy and the most likely one is trisomy 18.

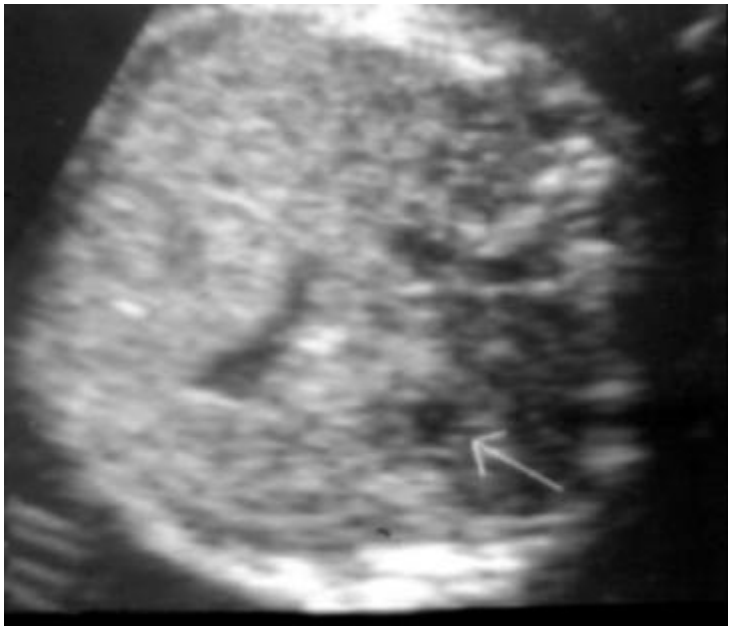


Figure 3: This is a fetus that has a Klinefelter/trisomy 18 mosaic, and presents with a tracheoesophageal fistula with a small stomach.

Omphalocele

Omphalocele occur in 1 per 10,000 delivery. 20-60% percent of these fetuses have an aneuploidy. The risk of aneuploidy increases if the fetus has either oligo- or polyhydramnios. David Nyberg has also demonstrated that if the omphalocele contains liver and bowel, the risk of aneuploidy is 16 percent, while if only bowel are present the risk of aneuploidy increases to 66 percent[5]. Thirteen percent of fetuses that have just an omphalocele have an aneuploidy, but with an associated anomaly the risk increases to 46%. And trisomy 18 and 13 are the most likely aneuploidies.

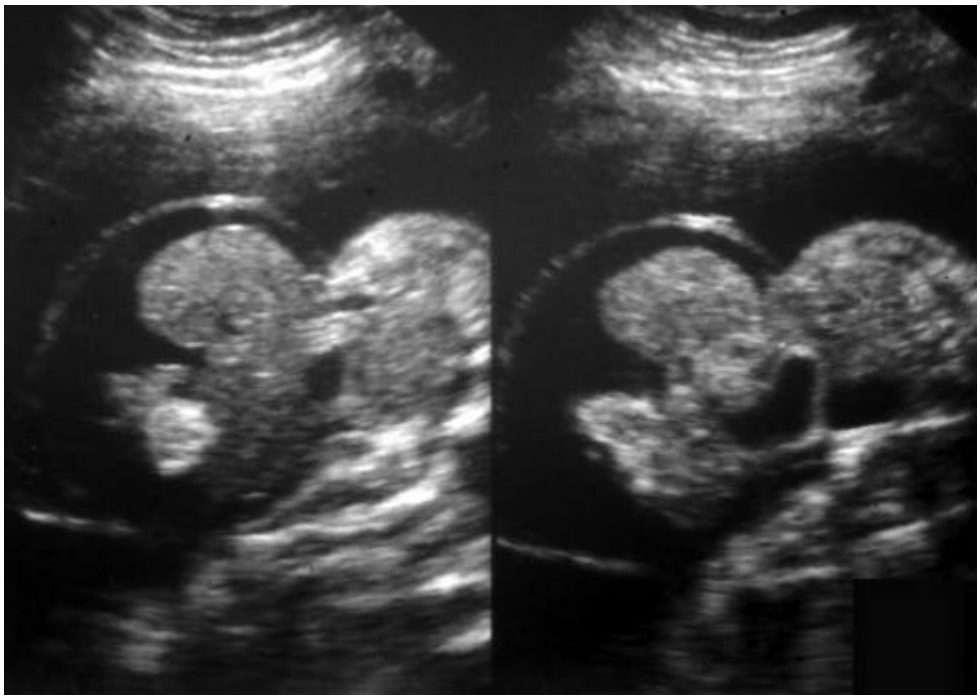


Figure 4: Large omphalocele in a trisomy 18 fetus.

Diaphragmatic hernia occurs in three to four per 10,000 deliveries. This is a fairly easy diagnosis by ultrasound, because the position of the stomach alongside the heart is characteristic. Although isolated diaphragmatic hernia, are uncommonly associated with aneuploidy, the presence of diaphragmatic hernia and associated anomalies is associated with aneuploidy in about 30 percent of the cases, and the most likely aneuploidy is trisomy 18.

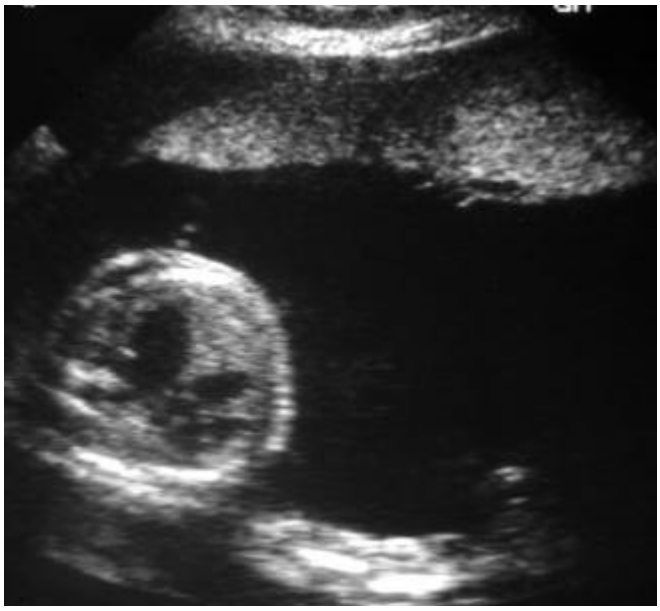
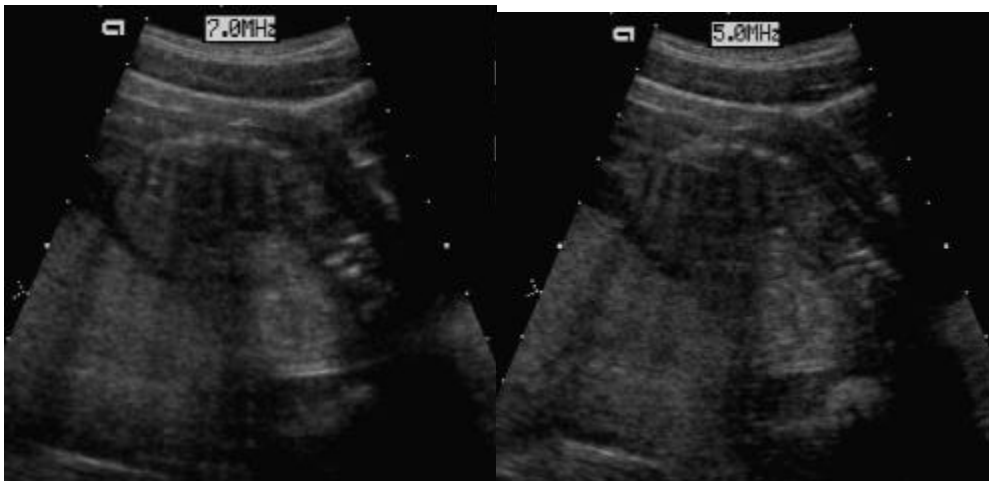


Figure 5: The typical appearance of diaphragmatic hernia, with the stomach alongside the heart, the shift of the heart and polyhydramnios.

Hyperechoic bowel is a common finding, and occurs in about 0.5% of second trimester pregnancies. In order to be called hyperechoic, bowel has to be whiter than any other abdominal structure and it is usually as white as bone but without the shadowing. Why it occurs is unknown, it might be a normal variant, or represent swallowed blood that persist undigested in the gut of the fetus, or later in the gestation might represent either a meconium ileus or meconium peritonitis, (this is rarely the case in the early second trimester), or it might represent varicella infection or it might be a marker for trisomy 21?

The problem with the echogenic bowel is that this is a ill-defined criteria. And there is marked variability between manufacturers and between transducers. Some manufacturers have scanners they will commonly demonstrate echogenic bowel while other will almost never demonstrate echogenic bowels.



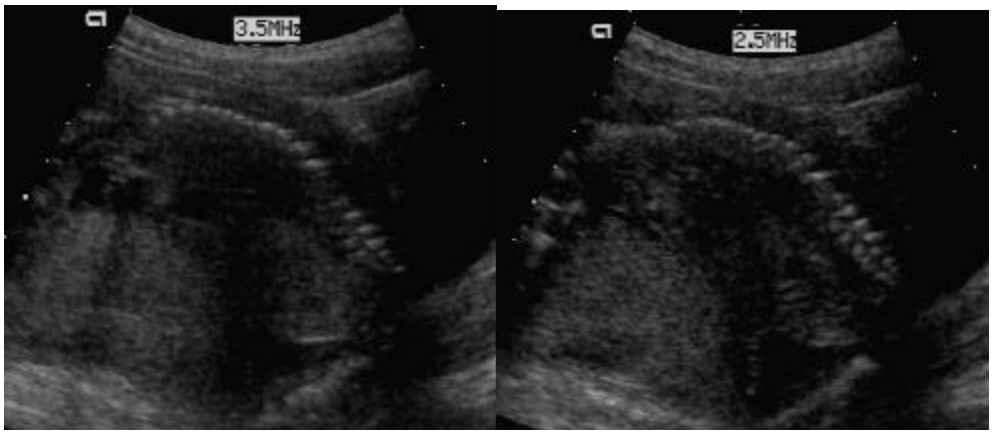


Figure 6: This is a series of images obtained in the same fetus a few seconds apart. The first image is obtained at 7 MHz and there is clearly a big white blob of echogenic bowel in this fetus. When the frequency is dropped down to 5 MHz the echogenicity is still quite noticeable, but not quite as brilliant as at 7 MHz. Dropping further down to 3.5 MHz, noticed that these bowel don't look so much hyperechoic anymore. Compare the echogenicity of the bowel to that of the placenta which is adjacent to this fetus, and observe the big difference between the 7 MHz and three and a half MHz image of this fetus. Finally when the frequency is drop down to 2.5 MHz, the hyperechogenicity has completed disappeared. Because of this variability I have big problems in making clinical decision based on echogenic bowel.

To karyotype or not to karyotype?

We do not consider hyperechoic bowel with no associated findings to be justification for amniocentesis. The indication when it exists is usually related to other findings and the hyperechoic bowel rarely affects the decision one way or another. Some authors disagree and recommend an amniocentesis on the sole finding of hyperechoic bowel[6,7,8,9,10,11], while other do not recommend karyotyping[12,13,14].

Malrotation of the bowel is another nonspecific finding that may be part of many aneuploidies[15,16,17,18,19,20,21,22].

Bowel obstructions. Although bowel obstructions are uncommonly associated with aneuploidies, about 1 percent of trisomy 21 will present with a bowel obstruction[23,24].

Urinary tract anomalies

Urinary tract anomalies are common and occurred in 20-30 per 10,000 deliveries. The presence of mild hydronephrosis (> 4 mm), is suggestive in some cases of trisomy 21. When the hydronephrosis is moderate to severe it could be part of trisomy 13 or trisomy 18. Multicystic dysplasia is also associated with trisomy 13 and 18 as is renal agenesis.

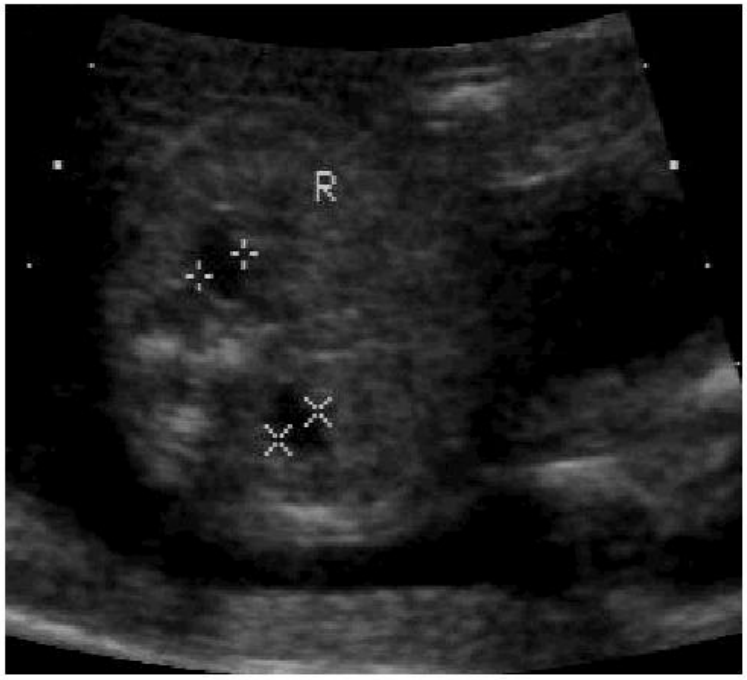


Figure 7: This is a fetus with trisomy 21 and mild bilateral pyelectasis.

The risk of aneuploidy is not really influenced by the type of urinary tract anomalies, by the fact that it is unilateral or bilateral, or by the amniotic fluid levels. When associated anomalies are present only 25% of these fetuses will have an aneuploidy.

Genital findings

Ambiguous genitalia or clitoromegaly are common in triploidy, and in many other sex chromosome anomalies such as XXY, XXYY, XYYY. They may also occasionally be present in trisomy 18, 4p-deletion and many others.

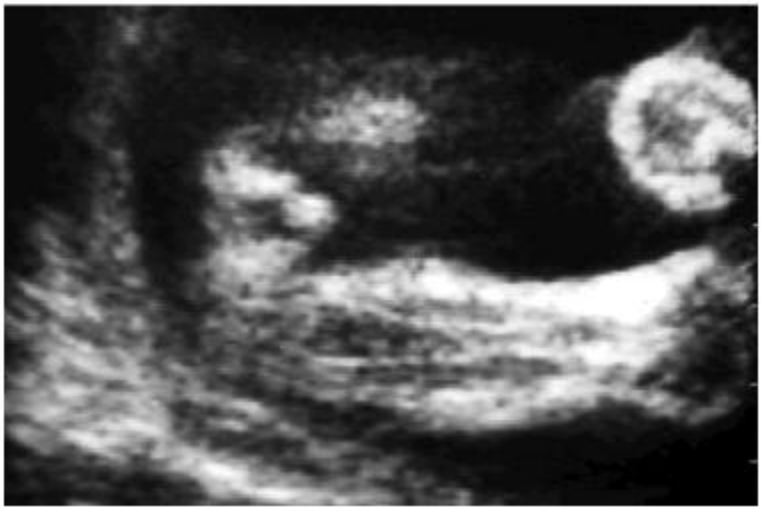


Figure 8: This is clitoromegaly in a fetus with trisomy 18

References

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