Doppler of the Ductus Venosus

A Small Vessel with a Big Impact

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Objectives

- Identify the ductus venosus using sonographic techniques.
- Understand the main clinical indications for ductus venosus evaluation.
- Evaluate normal and abnormal Doppler waveforms of the ductus venosus and their clinical significance.

5

What is the Ductus Venosus?

6

What is the Ductus Venosus?

- One of three shunts in the fetal cardiovascular system
- Connection between umbilical vein and sub-diaphragmatic SVC
- Trumpet shaped
- Shunts highly oxygenated blood directly into the heart
- Approximately 20-30% enters through the DV
- Postnatally becomes ligamentum venosum

1, 2, 3, 4, 6, 8, 10, 11, 14, 17, 19, 20, 21, 22

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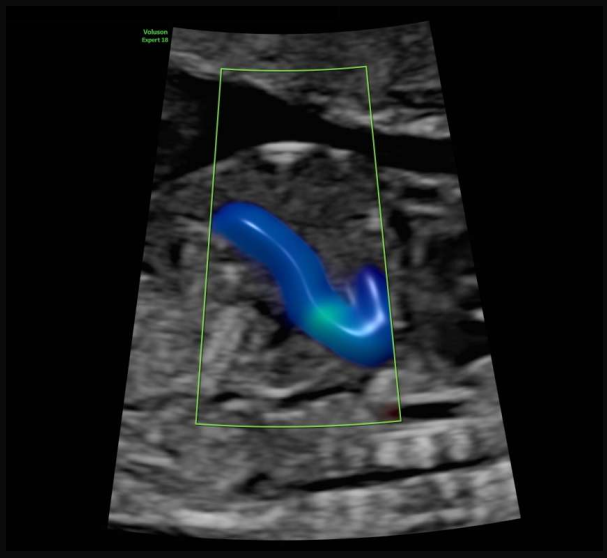
Ductus Venosus



1, 3, 6, 9, 11, 12, 16, 20

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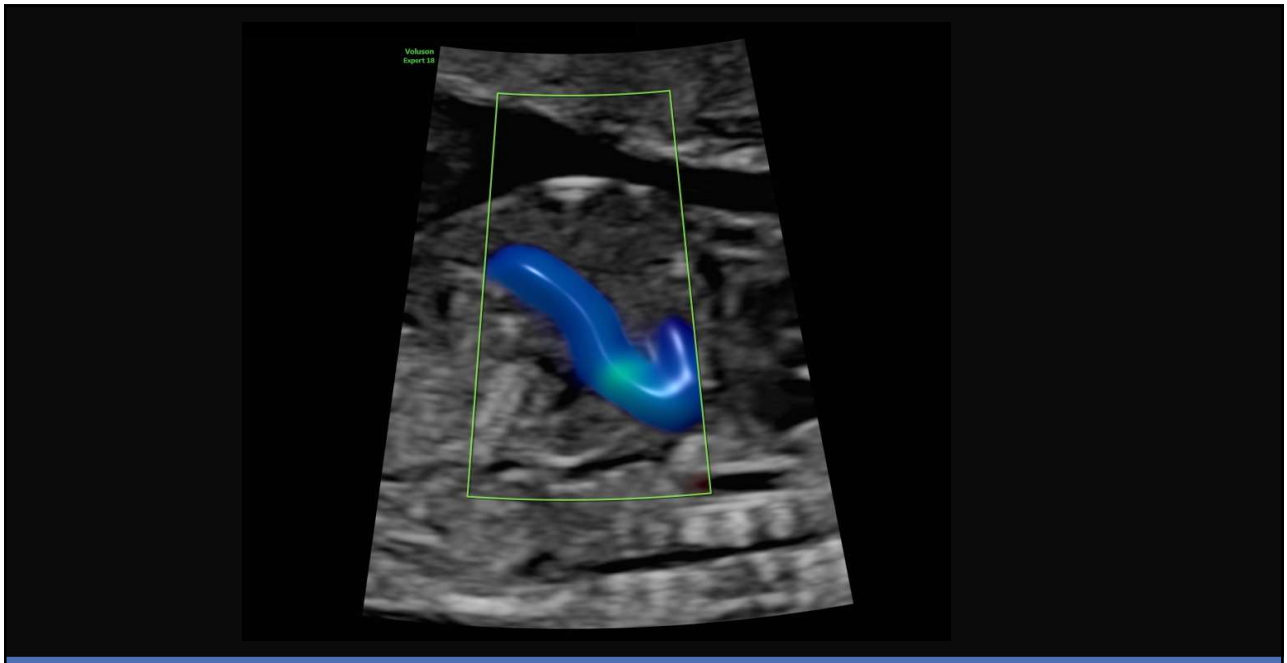
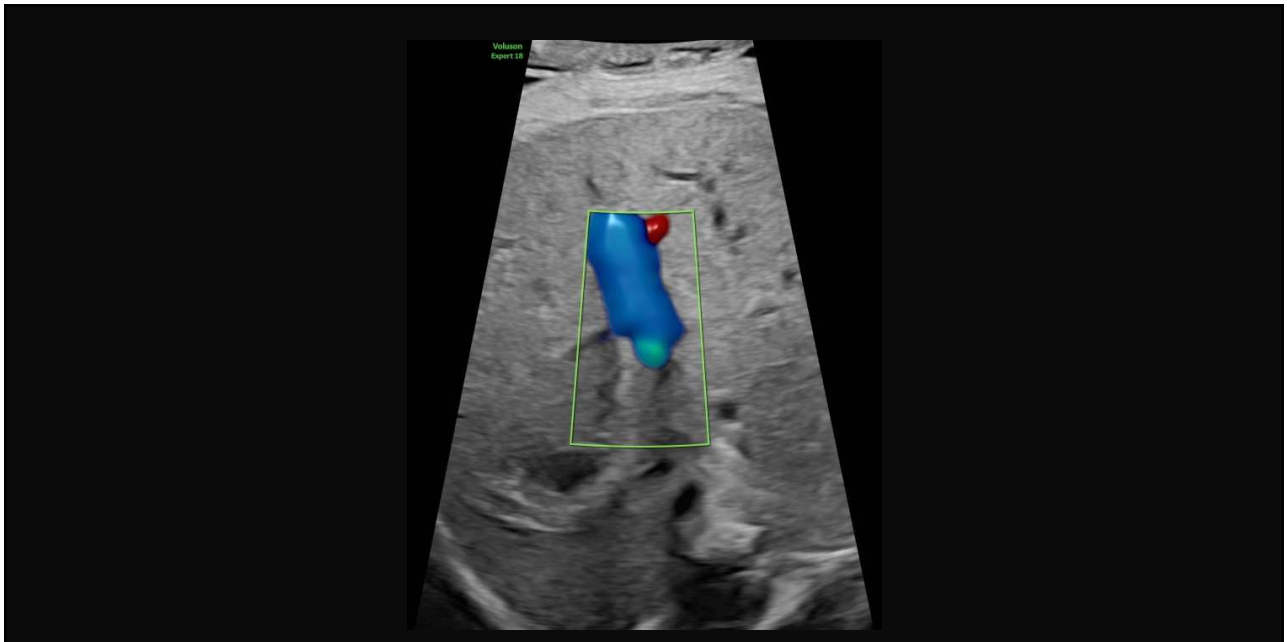


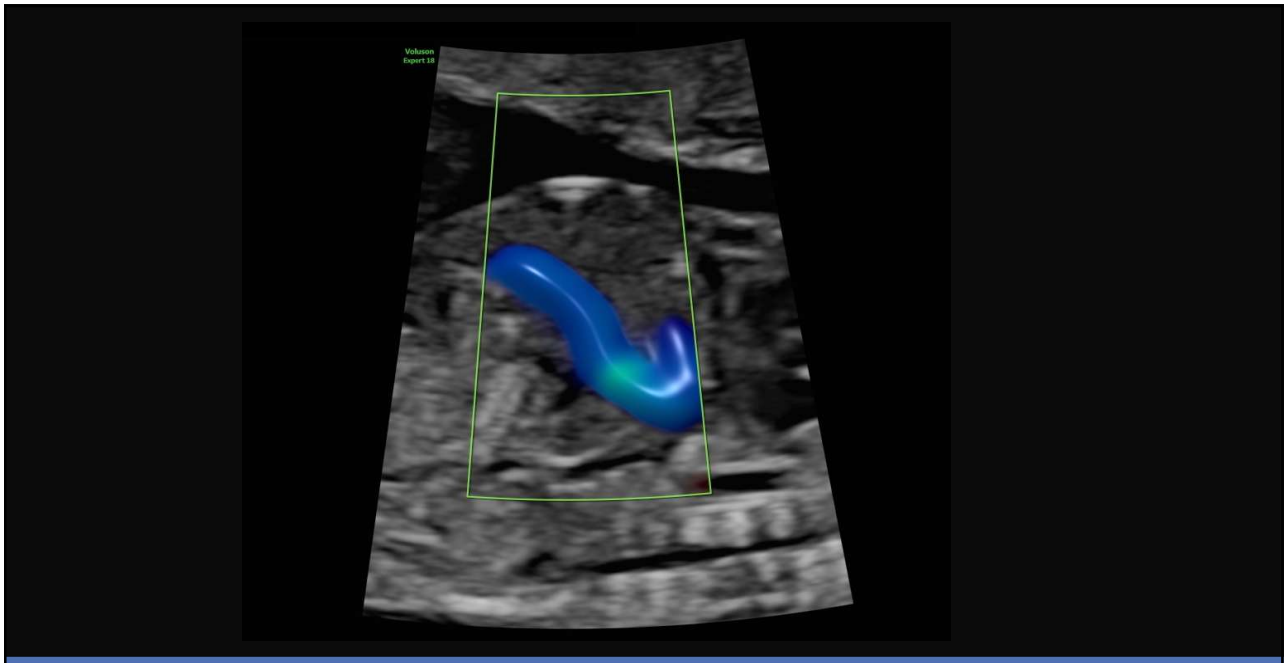
Mid-Sagittal Plane – 2nd Trimester

9



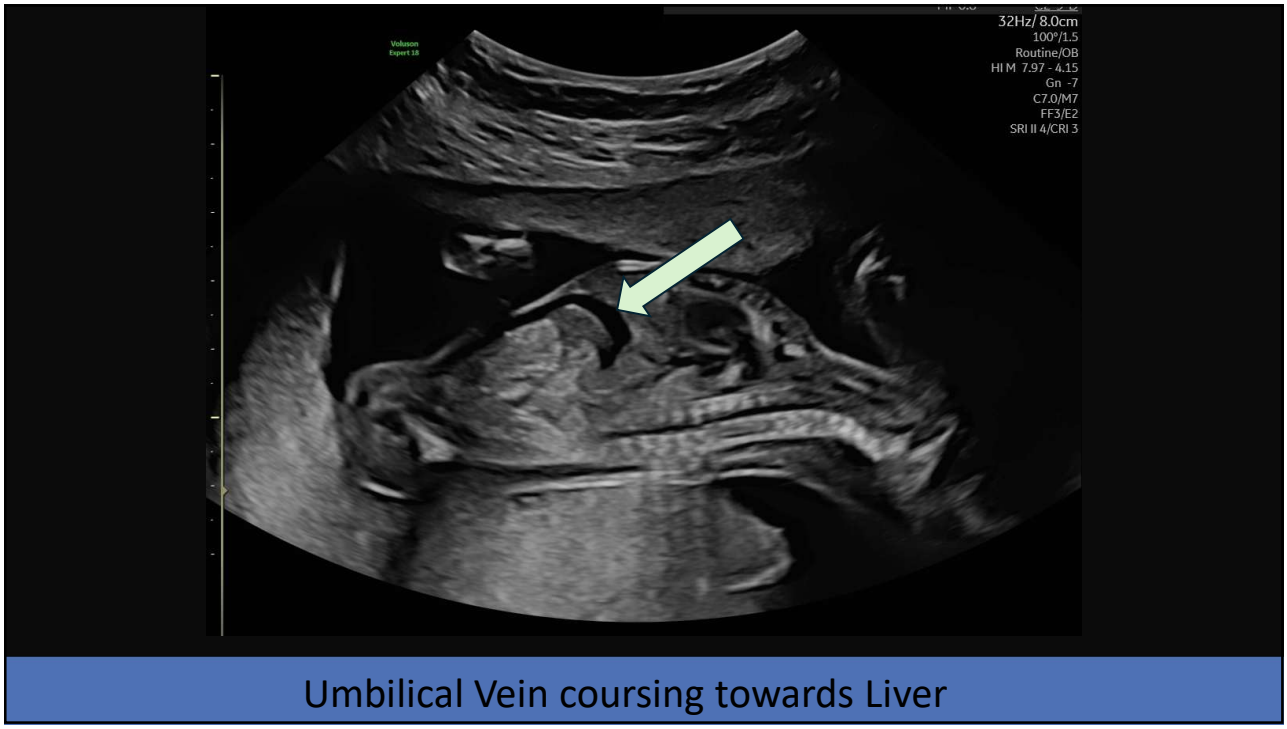
Transverse/Oblique Plane – 2nd Trimester

10



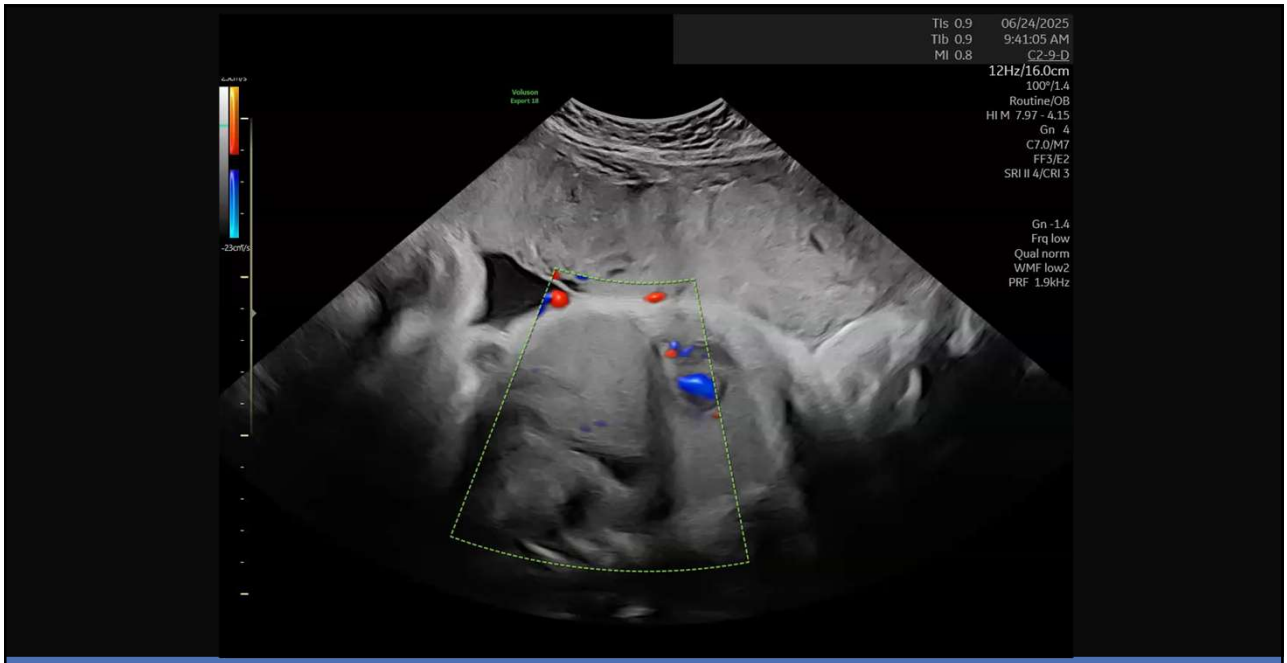
First Trimester

11



Umbilical Vein coursing towards Liver

12



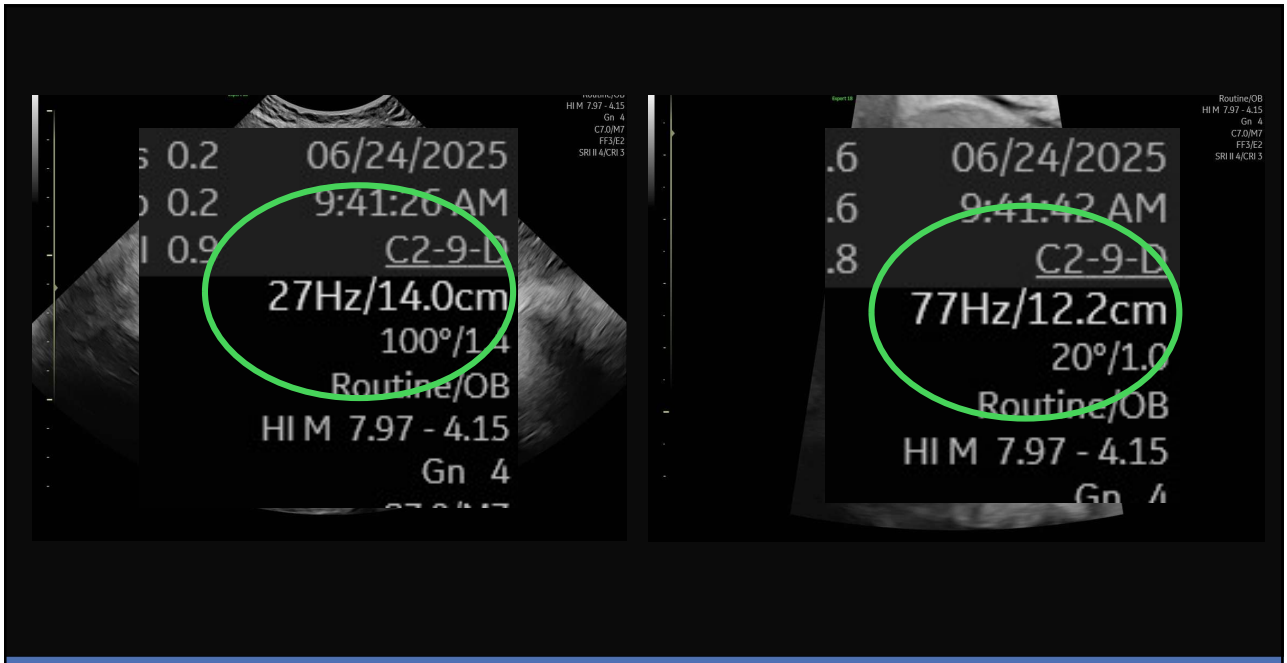
UV vs GB

13

1. Decrease Depth
2. Decrease Width
3. Zoom In

Optimization

14



Optimization

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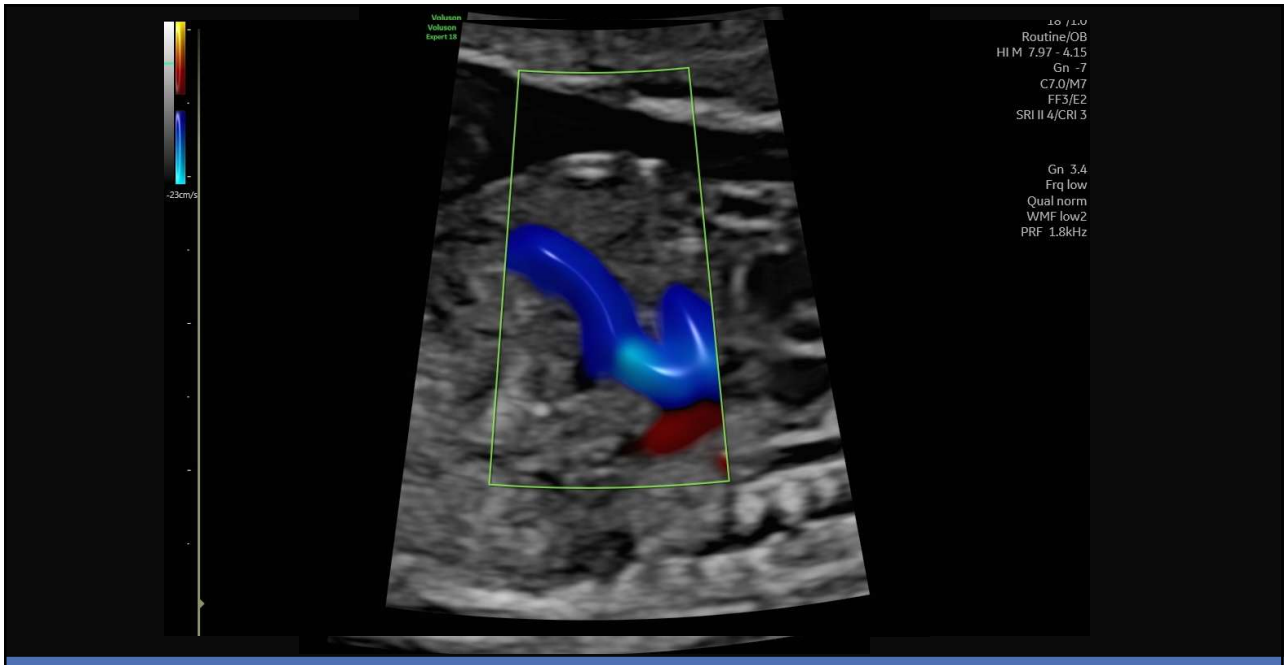

Color Doppler 12, 16, 20, 21

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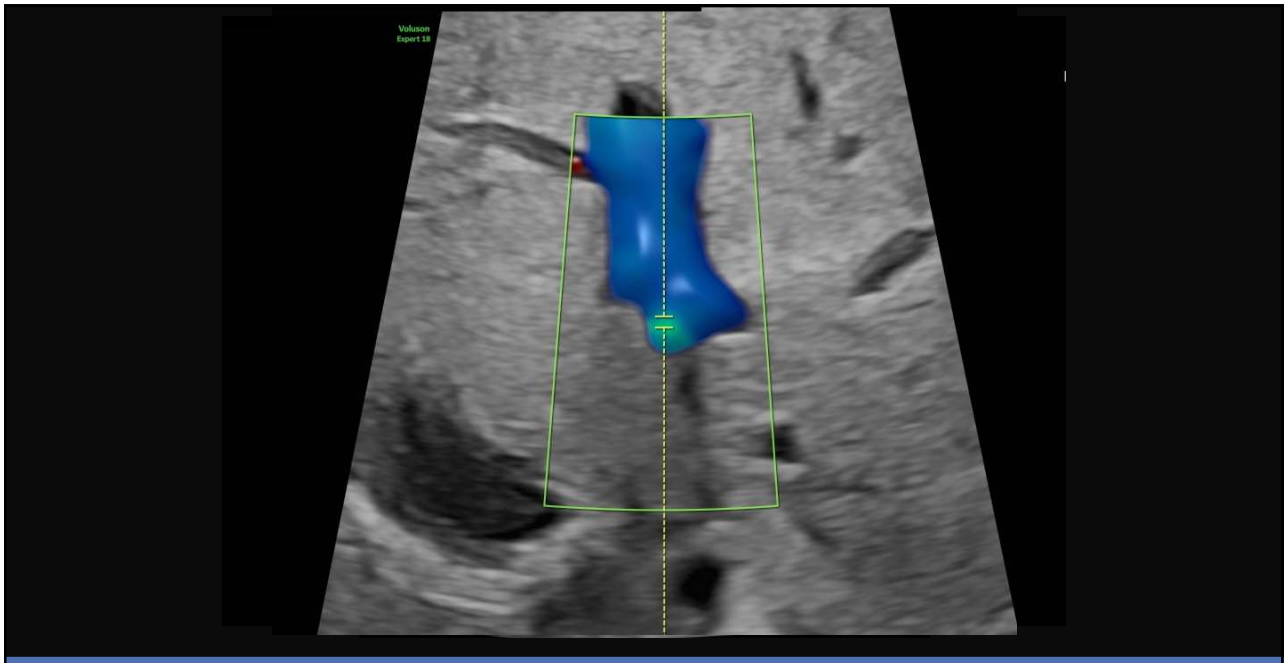

Pulsed Wave Doppler 3, 6, 9, 12, 16, 20, 21

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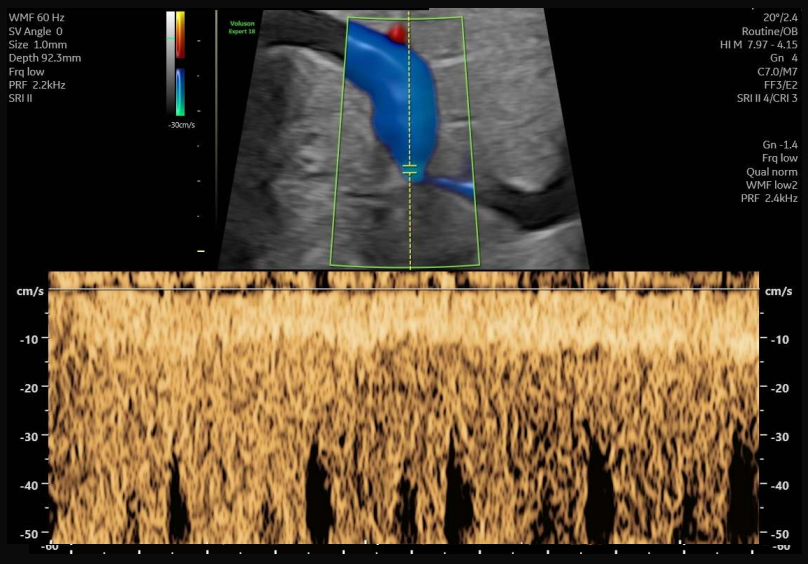
1. Wall Filter

2. Sweep Speed

3. Scale



PW Doppler Optimization 5, 6 , 12, 16

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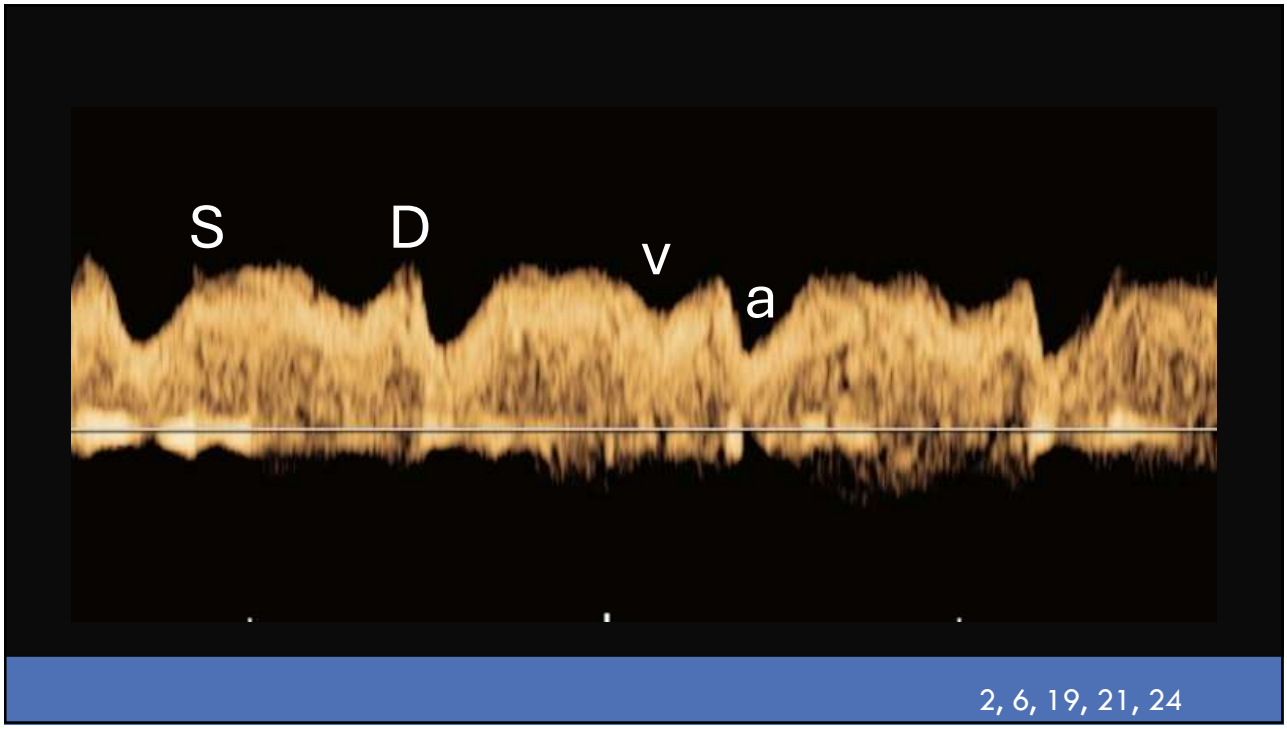

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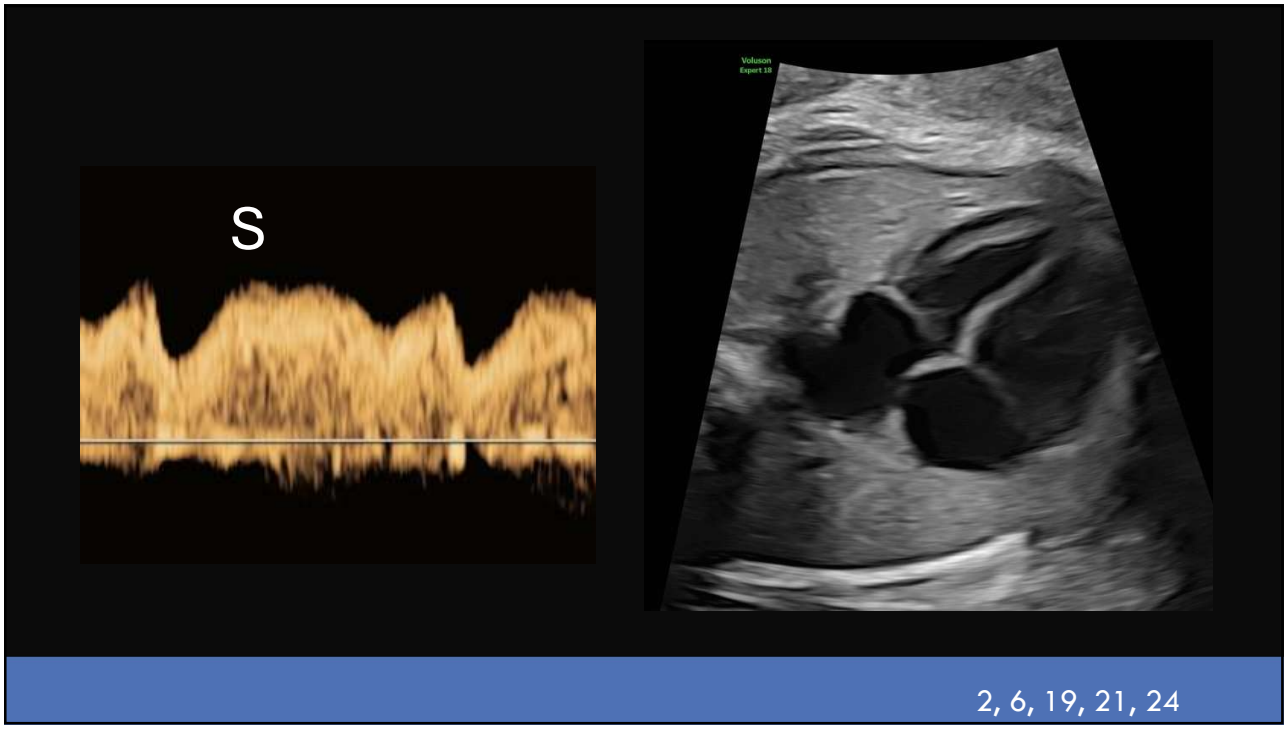

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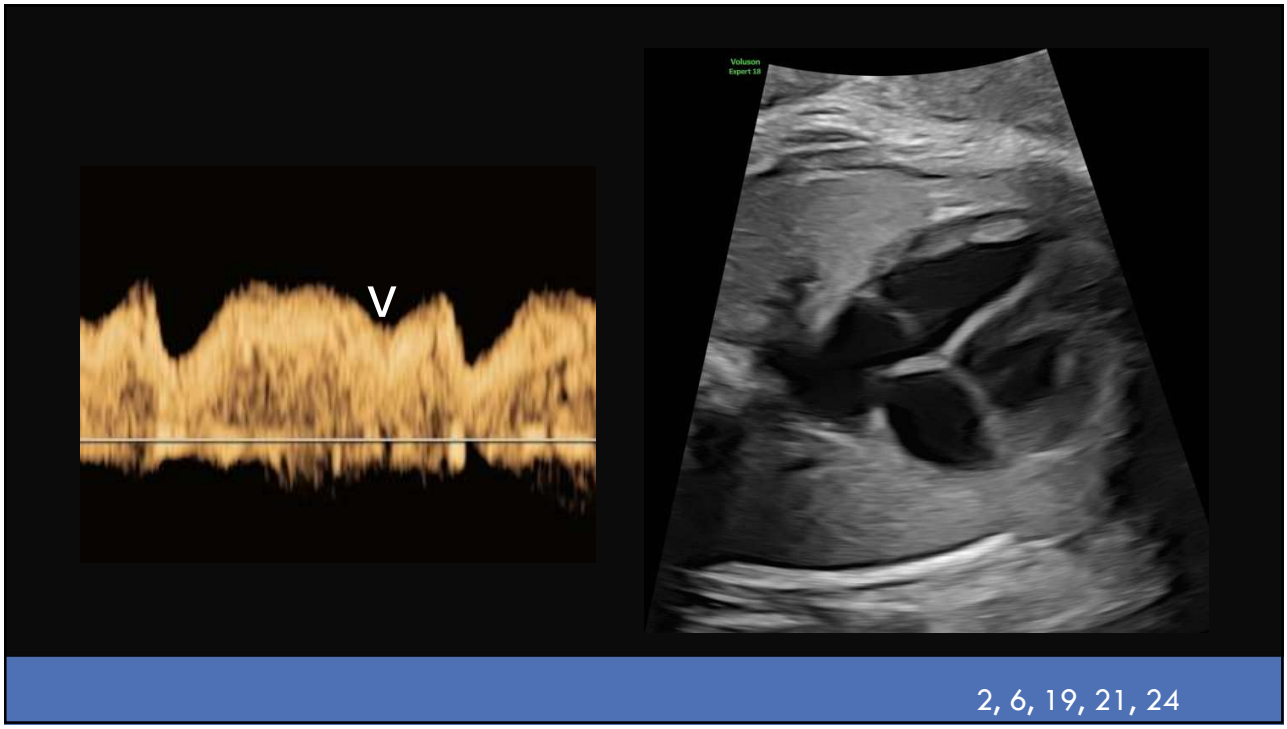

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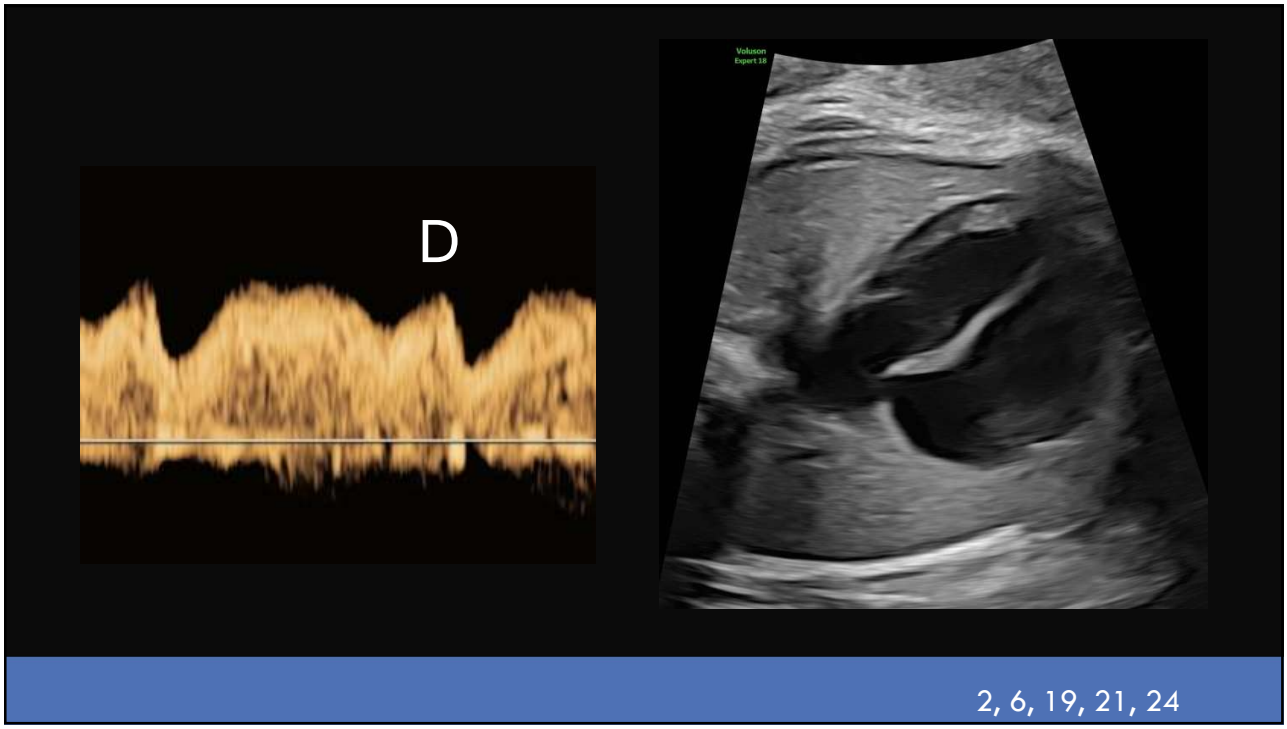

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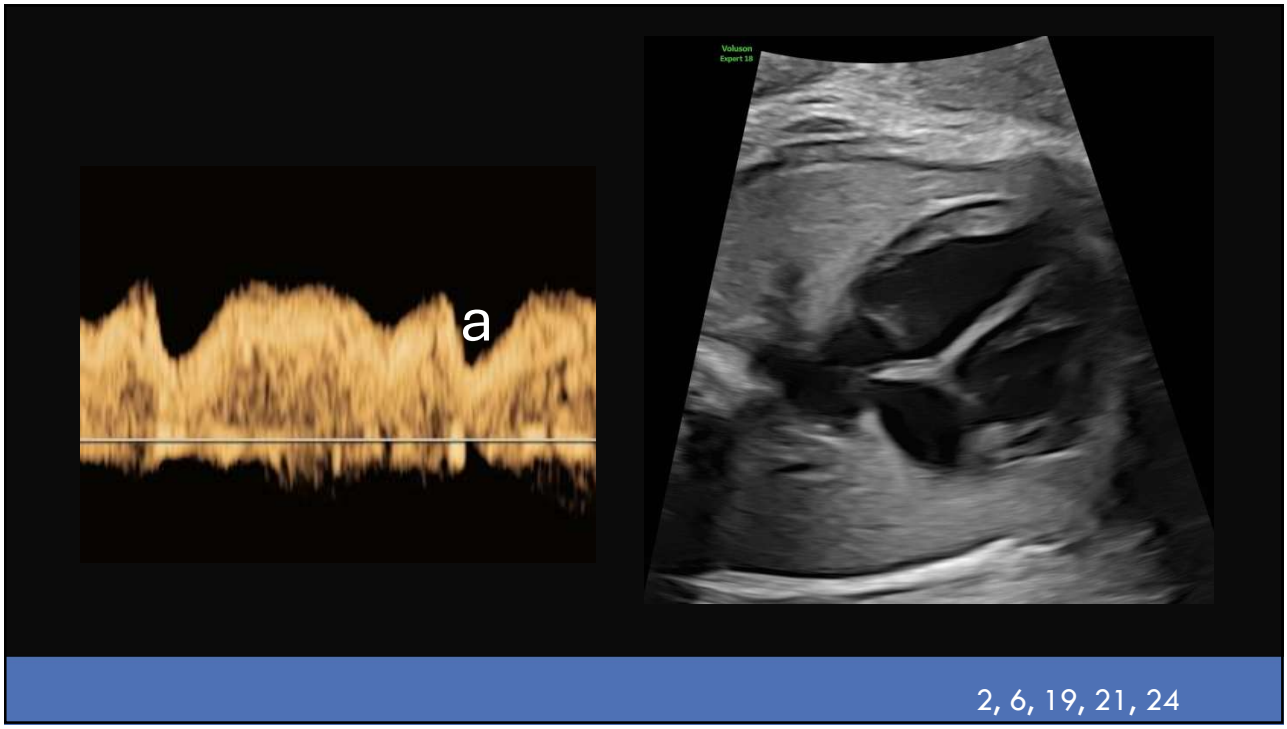

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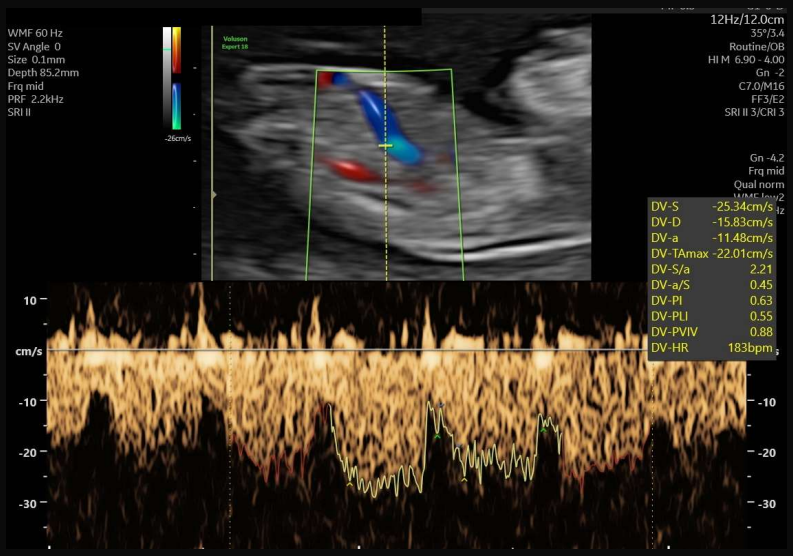
First Trimester



2, 6, 19, 21, 24

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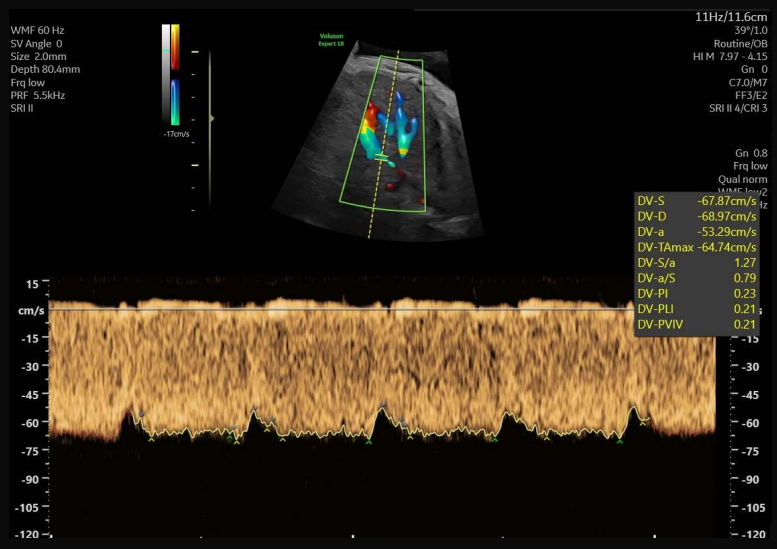
2nd/3rd Trimester



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Why do we look at this vessel?

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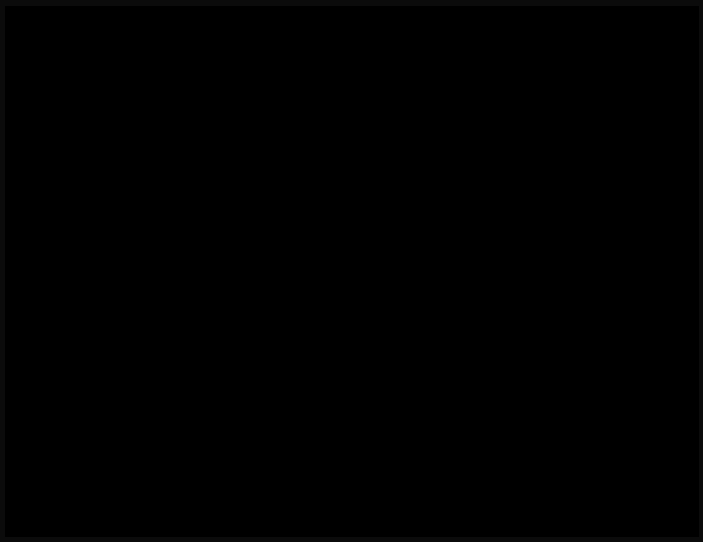
First Trimester

Increased Risk for Aneuploidy



20, 23

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First Trimester

Abnormal NIPT

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2nd/3rd Trimester

CHD/Risk of CHD

30

2nd/3rd Trimester

FGR

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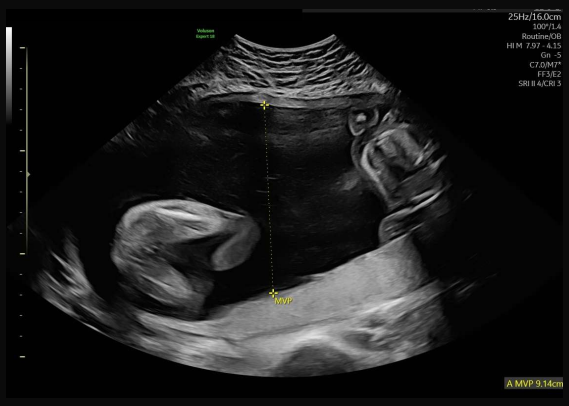
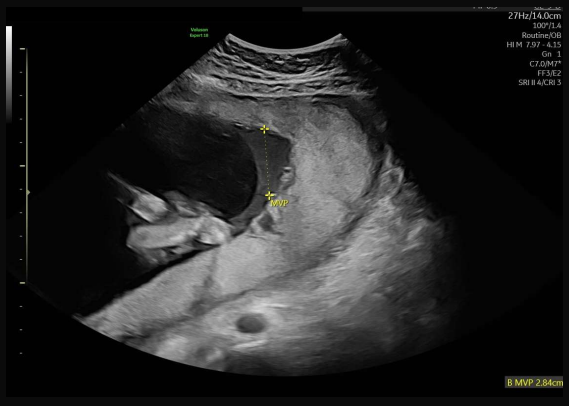
2nd/3rd Trimester

TTTS





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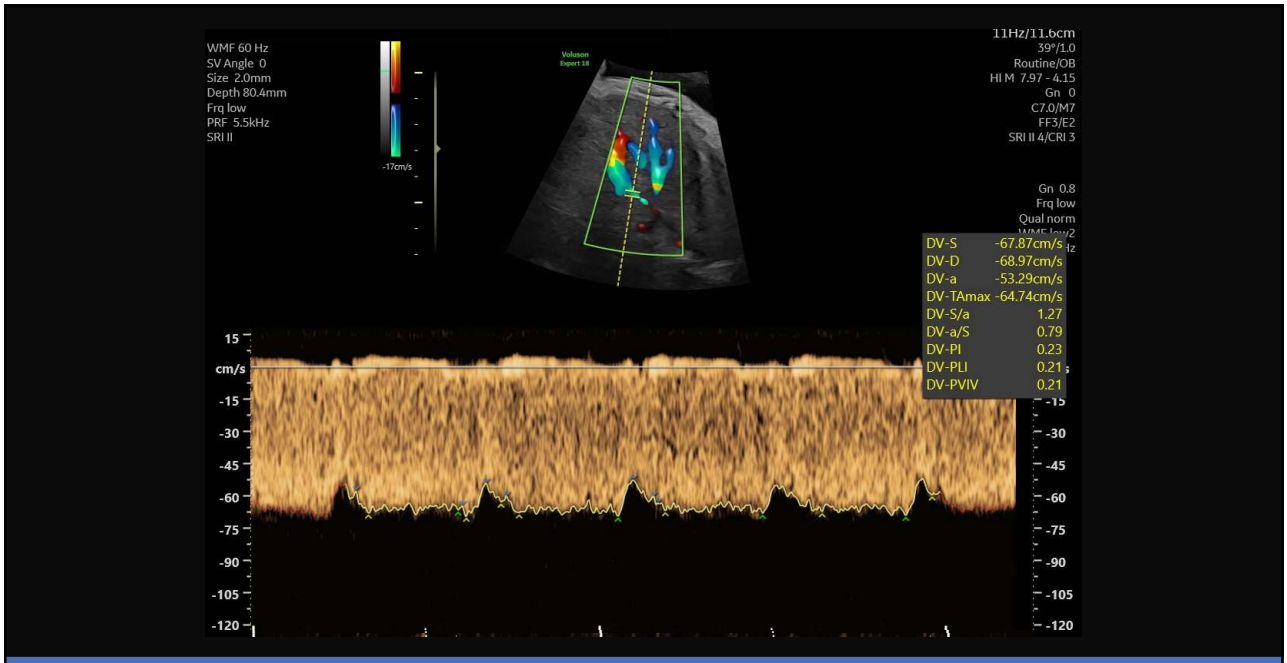

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Abnormal Case Studies

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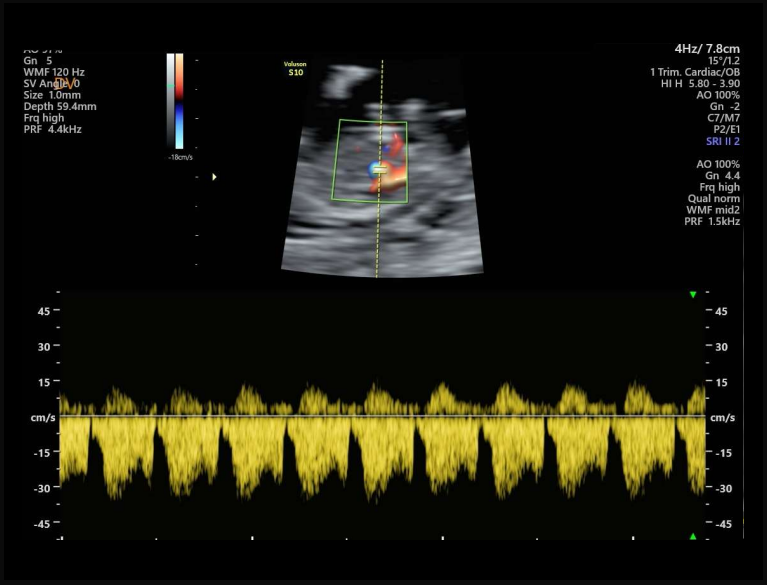
Increased Risk for Aneuploidy



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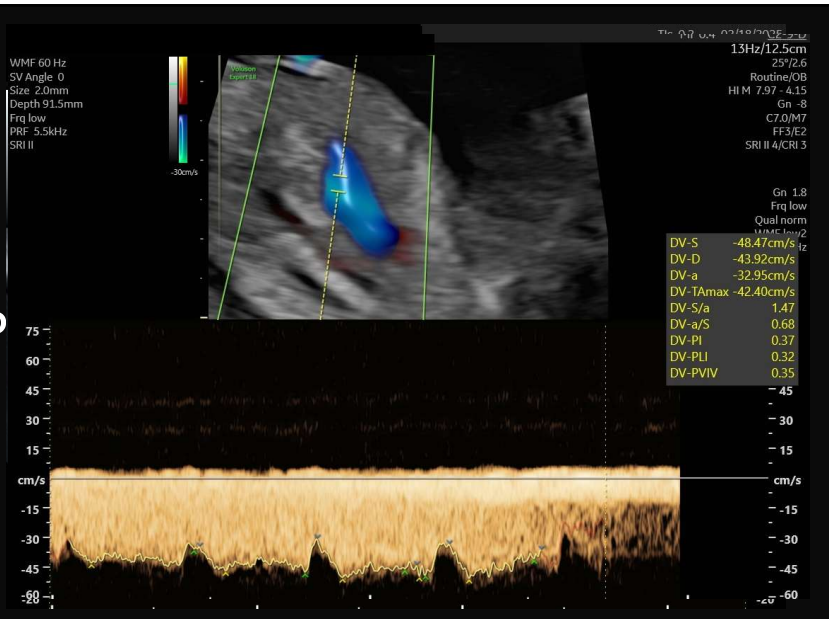
Abnormal NIPT Testing



7, 23

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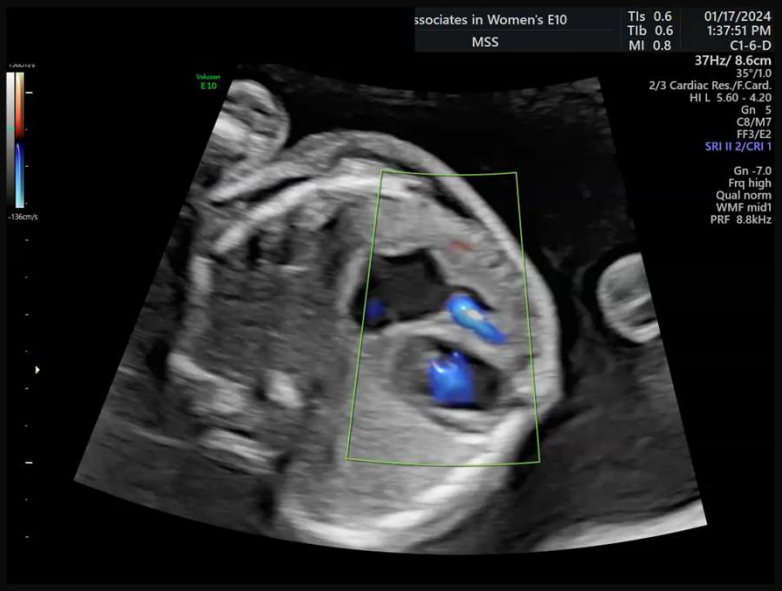
Congenital Heart Defect



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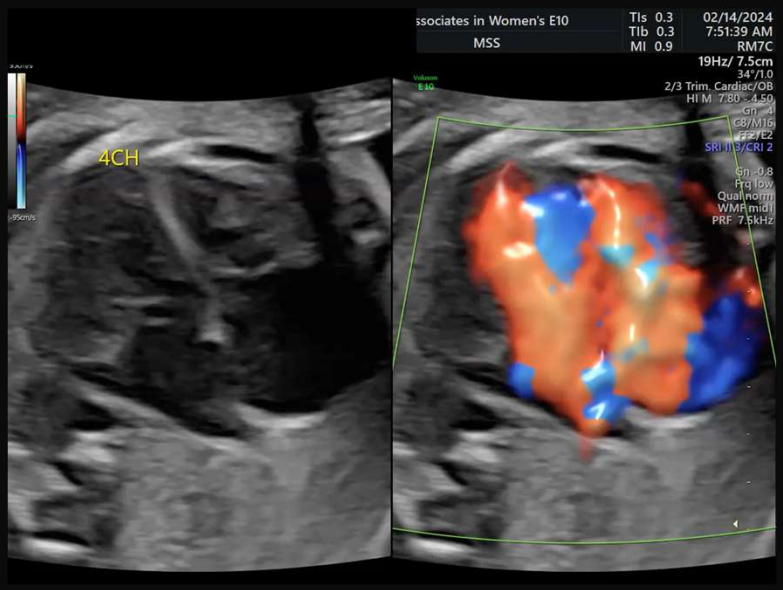
Congenital Heart Defect



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Congenital Heart Defect

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Cardiac Arrhythmias

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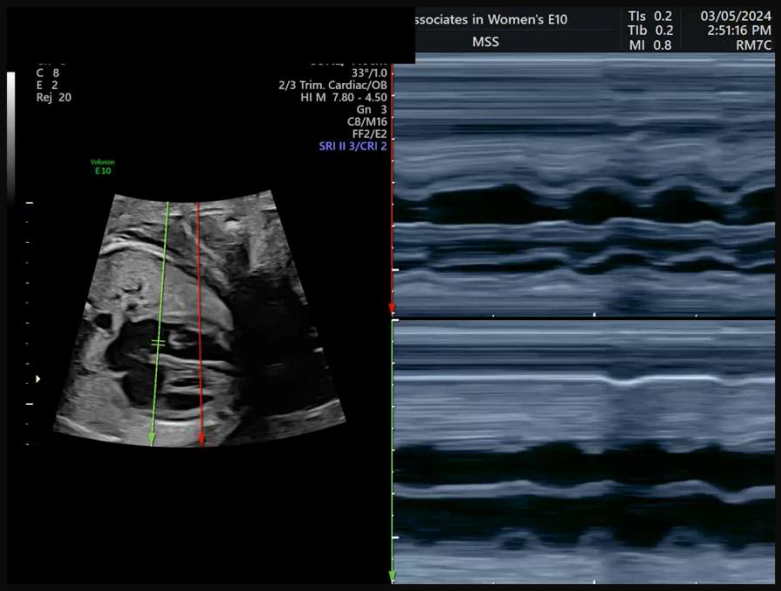
Cardiac Arrhythmias



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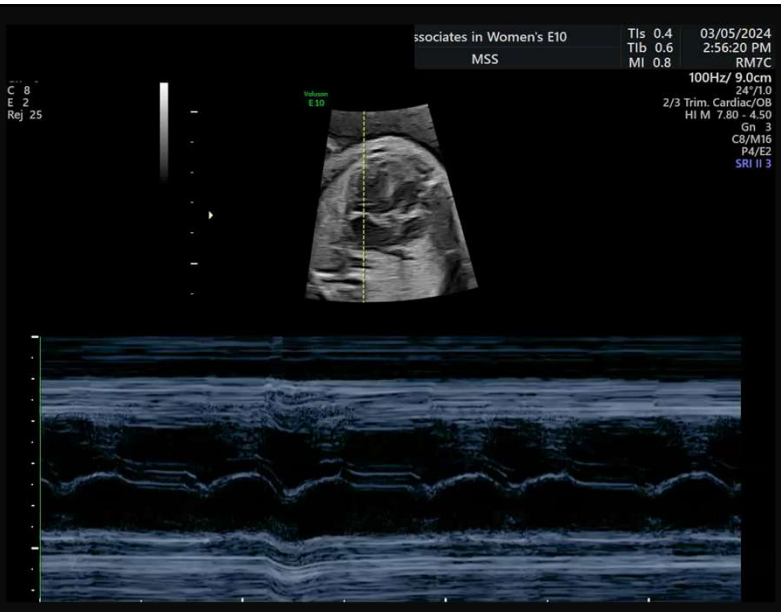
Cardiac Arrhythmias



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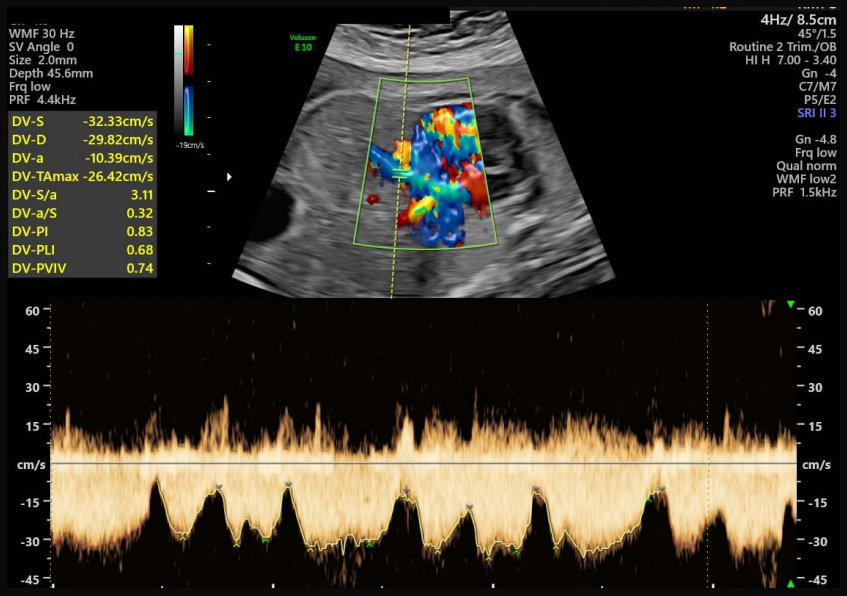
Cardiac Arrhythmias



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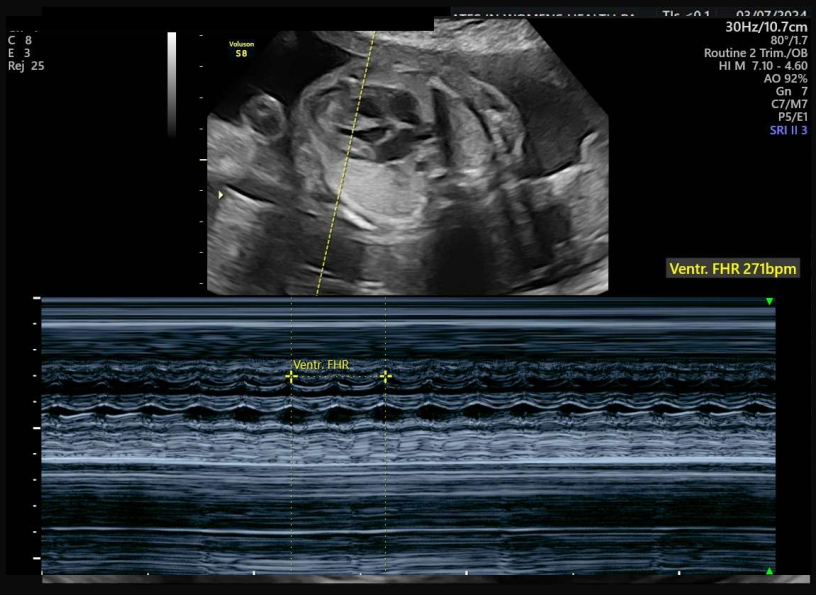
Cardiac Arrhythmias



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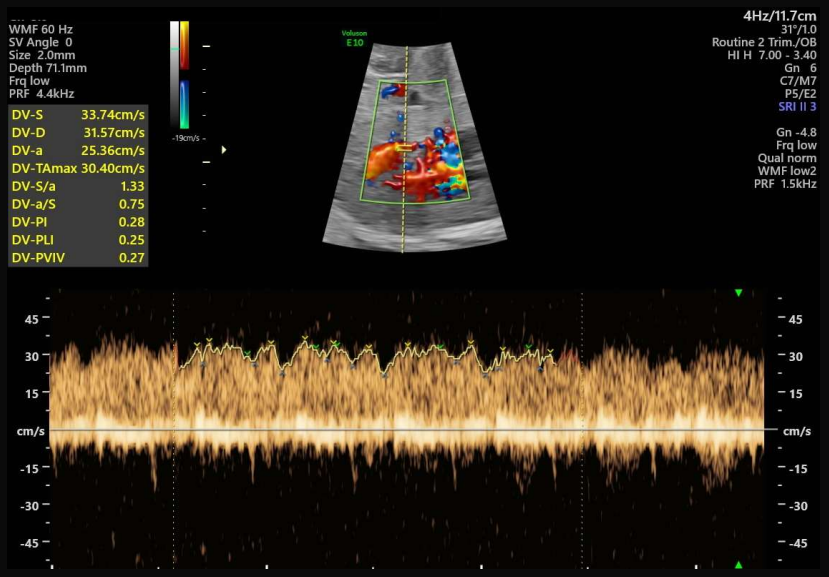
Cardiac Arrhythmias



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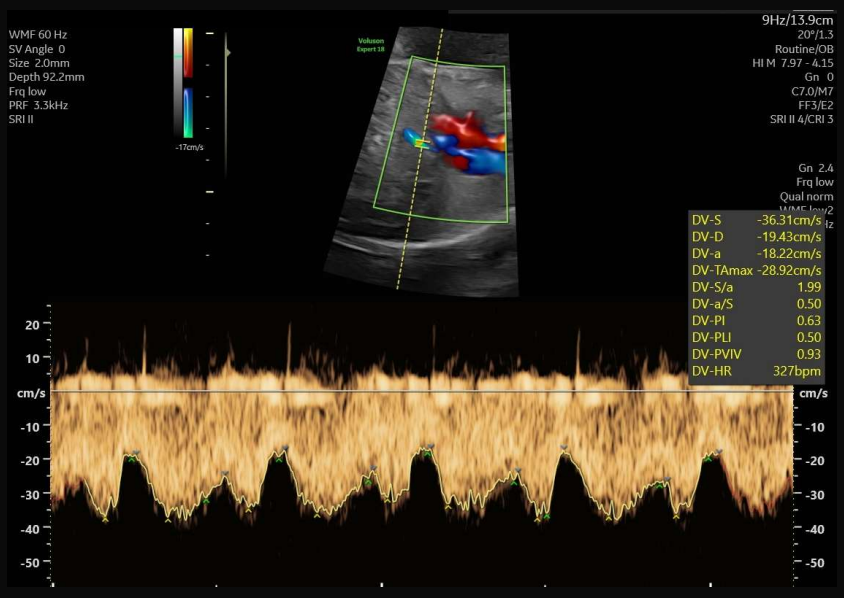
Growth Restriction



13, 15, 20, 21

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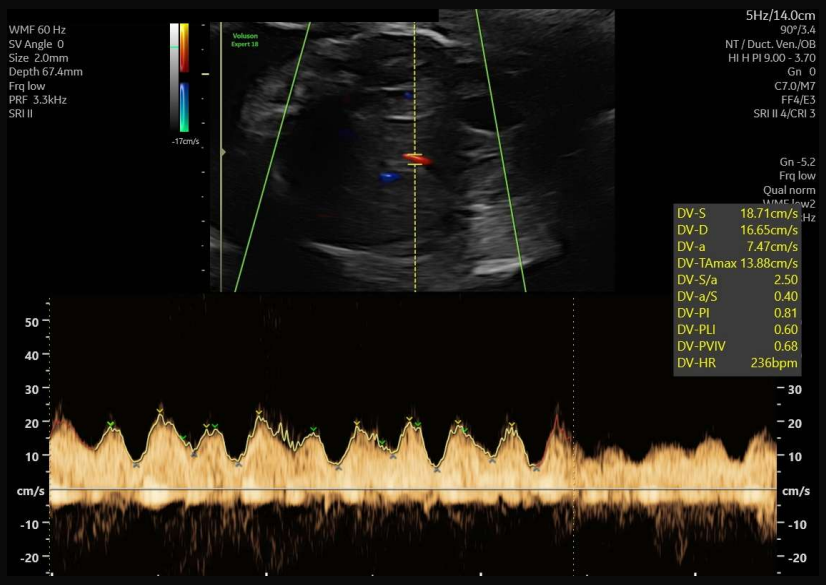
Growth Restriction



13, 15, 20, 21

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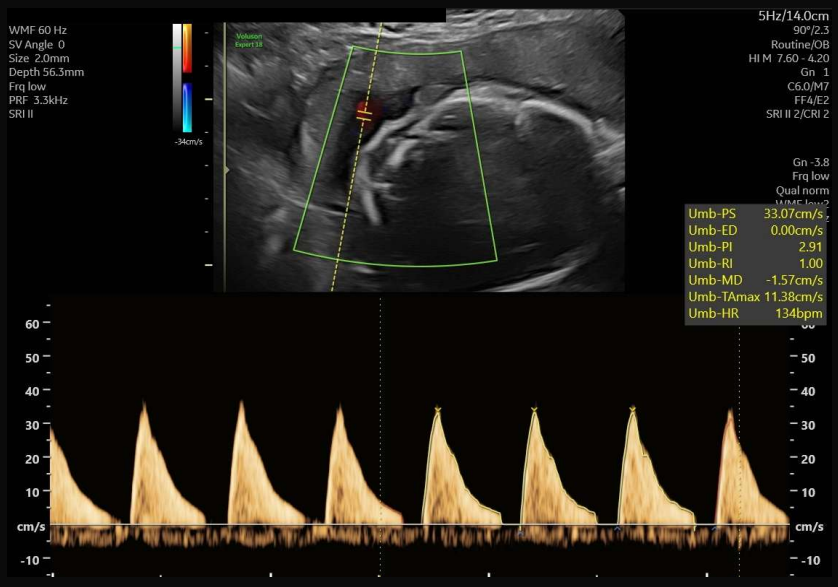
Growth Restriction



13, 15, 20, 21

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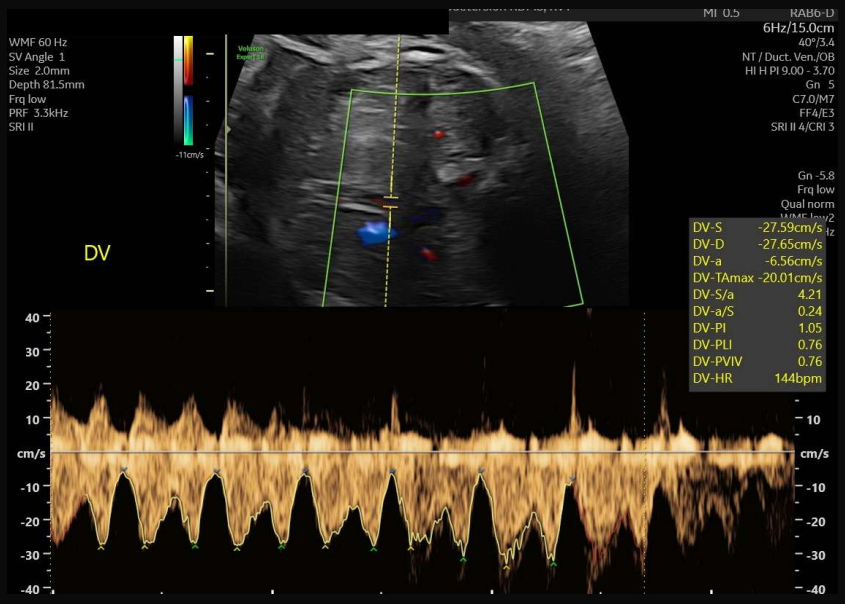
Growth Restriction



13, 15, 20, 21

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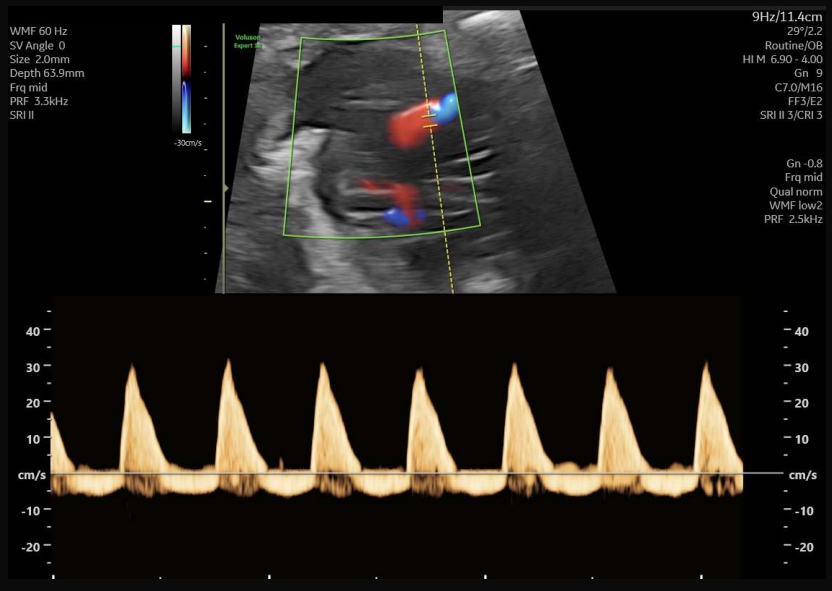
Growth Restriction



13, 15, 20, 21

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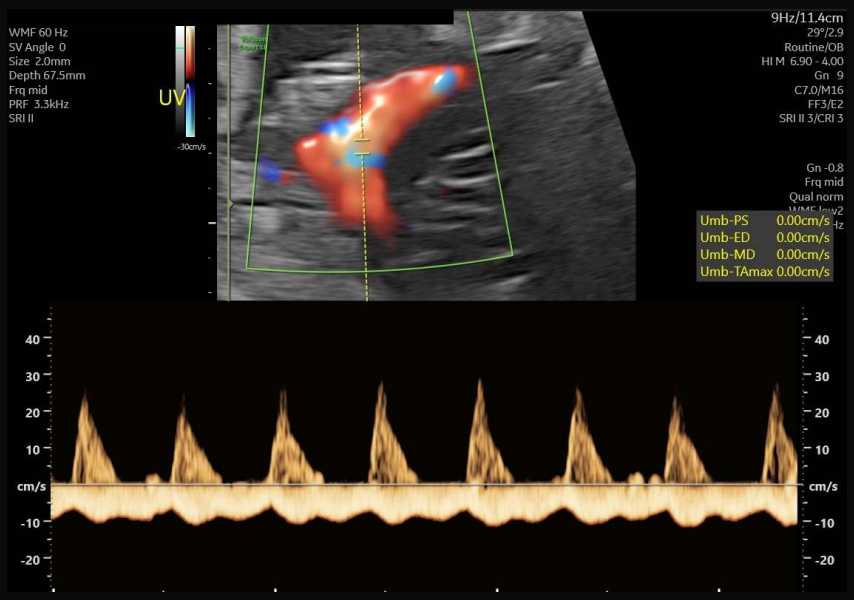
Growth Restriction



13, 15, 20, 21

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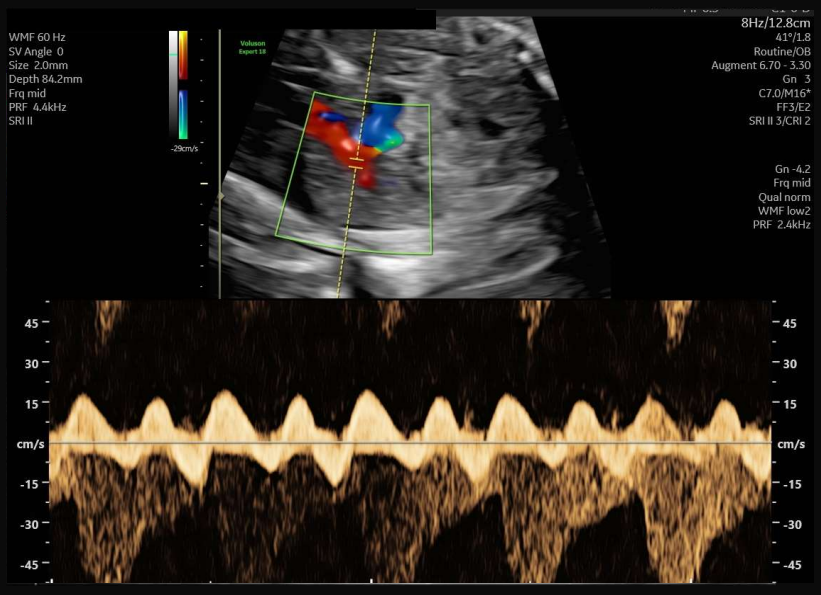
Growth Restriction



13, 15, 20, 21

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DV Doppler Timing with FGR

- At the time of diagnosis (regardless of UA/MCA findings)
- Only when UA is absent/reversed
- Every patient regardless of indication

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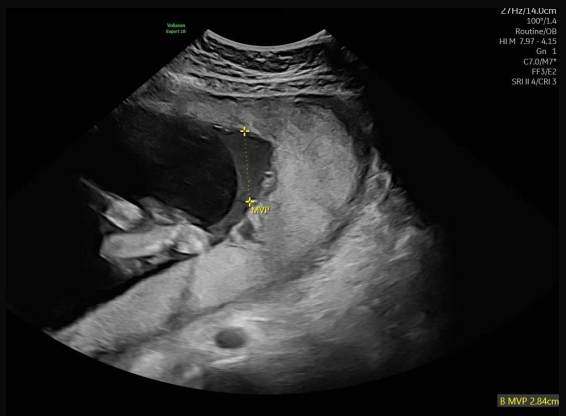
Twin-to-twin Transfusion Syndrome



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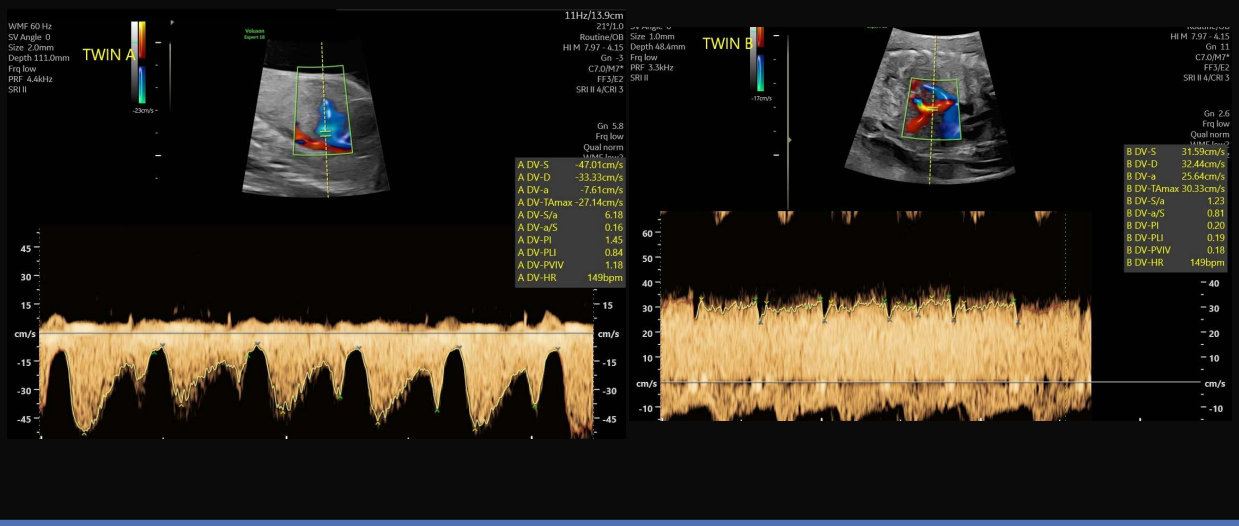
Twin-to-twin Transfusion Syndrome



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Twin-to-twin Transfusion Syndrome

Fetal Doppler (1)

Umbilical Artery: normal. EDF: positive				
PI	1.31		38%	Schaffer
RI	0.71		34%	Schaffer
PS	22.85 cm/s		<1%	Ebbing
ED	6.74 cm/s			
TAmax	12.30 cm/s		<1%	Ebbing
MD	6.50 cm/s			
S / D	3.39		26%	Acharya
HR	149 bpm			
Mid Cerebral Artery: normal. EDF: positive				
PI	1.13			
RI	0.68			
PS	23.24 cm/s		19%	Mari
PS	0.86 MoM			
ED	6.68 cm/s			
CPR PI	0.86		3%	Ebbing
Right Mid Cerebral Artery:				
PI	1.13			
RI	0.68			
PS	23.24 cm/s		19%	Mari
ED	6.68 cm/s			
TAmax	14.16 cm/s		73%	Ebbing
MD	6.62 cm/s			
S / D	3.19			
HR	161 bpm			
Ductus Venosus: abnormal				
S-wave	-47.01 cm/s			
D-wave	-33.33 cm/s			
A-wave	-7.61 cm/s	positive flow		
TAmax	-27.14 cm/s			
PIV	1.45		>99%	Hecher
PVIV	1.18			
PLI	0.84		>99%	Baschat
S/a	6.18			
a/S	0.16		<1%	JSUM
D/a	4.38			
HR	149 bpm			
Umbilical Vein:				
TAmean	9.86 cm/s			

Fetal Doppler (2)

Umbilical Artery: normal. EDF: positive				
PI	1.47		66%	Schaffer
RI	0.78		67%	Schaffer
PS	33.87 cm/s		27%	Ebbing
ED	7.39 cm/s			
TAmax	18.01 cm/s		10%	Ebbing
MD	7.30 cm/s			
S / D	4.58		75%	Acharya
HR	145 bpm			
Mid Cerebral Artery: abnormal. EDF: positive				
PI	1.24			
RI	0.68			
PS	28.53 cm/s		62%	Mari
PS	1.06 MoM			
ED	9.00 cm/s			
CPR PI	0.84		3%	Ebbing
Right Mid Cerebral Artery:				
PI	1.24			
RI	0.68			
PS	28.53 cm/s		62%	Mari
ED	9.00 cm/s			
TAmax	15.71 cm/s		88%	Ebbing
MD	8.90 cm/s			
S / D	3.14			
HR	152 bpm			
Ductus Venosus: normal				
S-wave	31.59 cm/s		<1%	Hecher
D-wave	32.44 cm/s		<1%	Hecher
A-wave	25.64 cm/s	positive flow		
TAmax	30.33 cm/s		<1%	Hecher
PIV	0.20		<1%	Hecher
PVIV	0.18		<1%	Hecher
PLI	0.19		<1%	Baschat
S/a	1.23		3%	Baschat
a/S	0.81		97%	JSUM
D/a	1.27			
HR	149 bpm			
Umbilical Vein: normal				
TAmean	-12.65 cm/s			

18

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Agenesis of the Ductus Venosus

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Agenesis of the Ductus Venosus

- Absence of the Ductus Venosus between the umbilical vein and IVC
- Suspected when course of the umbilical vein is abnormal
- Absence confirmed with color Doppler
- Rare; 0.04 to 0.6% of pregnancies

8, 14, 19

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Agenesis of the Ductus Venosus

- Absence creates need for alternative routes of venous flow
- 2 alternative routes: Intrahepatic and Extrahepatic
- Intrahepatic:
  - More common
  - Umbilical vein connected directly to portal sinus
- Extrahepatic:
  - Less common
  - Umbilical vein connected directly to systemic veins

14, 17, 19

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Agenesis of the Ductus Venosus

- Isolated
- Associated Anomalies:
  - Cardiac:
    - ASD, VSD, DORV, TGA
  - Multisystem:
    - Urogenital, alimentary, skeletal
  - Agenesis of the portal system:
    - Associated with extrahepatic route
    - Cardiomegaly, chromosomal anomalies, genetic disorders
- Limitations
  - Contamination of waveform by the umbilical vein

17, 19

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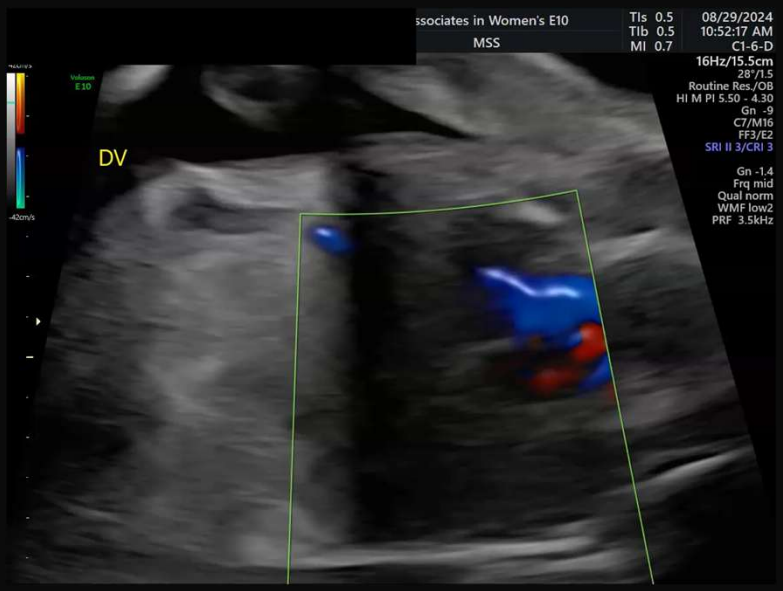
Agenesis of the Ductus Venosus



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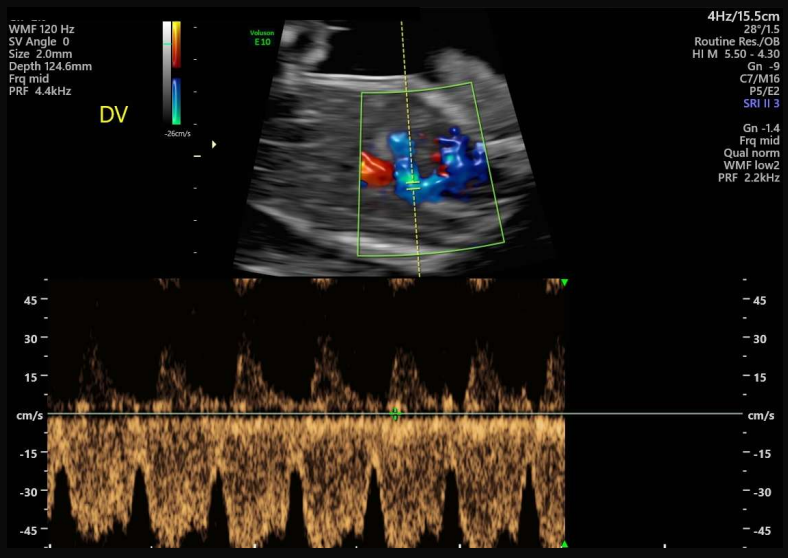
Agenesis of the Ductus Venosus



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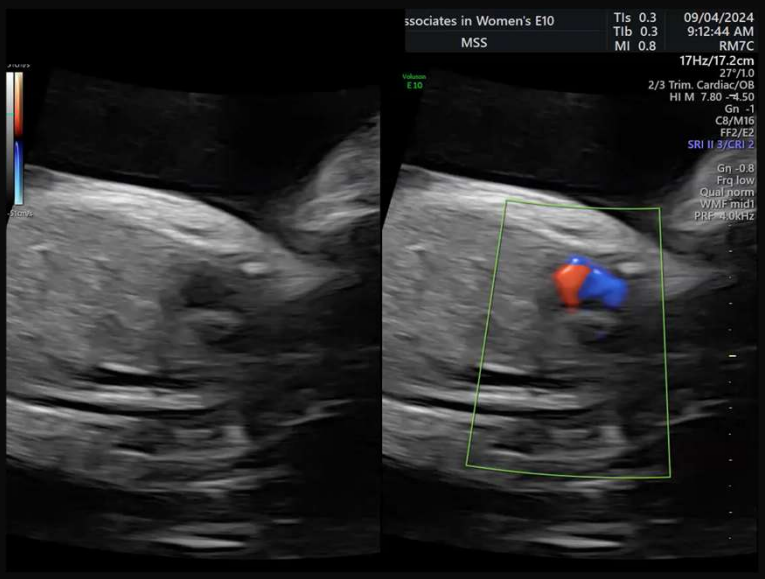
Agenesis of the Ductus Venosus



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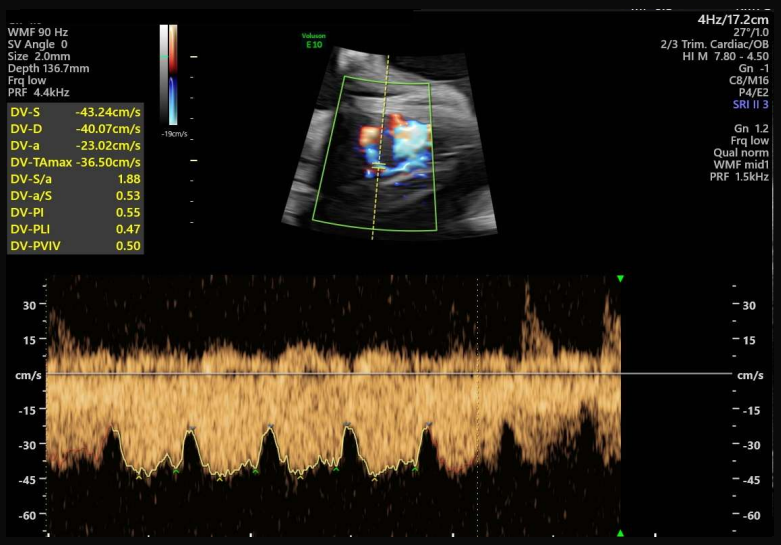
Agenesis of the Ductus Venosus



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In Conclusion

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Thank you!

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References

1. Abuhamad, A., & Chaoui, R. (2016). Chapter 10 The Venous System. In A. Abuhamad, & R. Chaoui, *A Practical Guide to Fetal Echocardiography* (pp. 134-150). Philadelphia: Wolters Kluwer.

2. Askar, A. A., Elnamory, O. M., Othman, A. M., & Alatar, A. M. (2021). The Doppler velocimetry of ductus venosus in fetuses with cardiac defects during pregnancy. *Tanta Medical Journal*, 247-251.

3. Baran, S., Basar, O., & Yayla, M. (2023). The Predictive Values of Ductus Venosus Pulsatility Index and "A Wave" for Chromosomal Abnormalities. *Journal of Clinical Obstetrics & Gynecology*, 125-132.

4. Bellotti, M., Pennati, G., De Gasperi, C., Bozzo, M., Battaglia, F. C., & Ferrazzi, E. (2004). Simultaneous measurements of umbilical venous, fetal hepatic, and ductus venosus blood flow in growth-restricted human fetuses. *American Journal of Obstetrics and Gynecology*, 1347-1358.

5. Bhide, A., Acharya, G., & Baschat, A. (2021). ISUOG Practice Guideines (updated): use of Doppler velocimetry in obstetrics. *Ultrasound in obstetrics & gynecology: the official journal of the International Journal of Ultrasound in Obstetrics and Gynecology*, 331-339.

6. Braga, M., Moleiro, M. L., & Guedes-Martis, L. (2019). Clinical Significance of Ductus Venosus Waveform as Generated by Pressure-Volume Changes in the Fetal Heart. *Current Cardiology Reviews*, 167-176.

7. Bromley, B. (2025). Sonographic Findings Associated with Fetal Aneuploidy. *UpToDate*.

67

References

8. Contratti, G., Banzi, C., Ghi, T., Perolo, A., Pilu, G., & Visentin, A. (2010). Absence of the ductus venosus: report of 10 new cases and review of the literature. *Ultrasound in Obstetrics and Gynecology*, 605-609.

9. Ilhan, G., Iyibozkur, A., Kalelioglu, H., Ibrahimoglu, L., Zebitay, A., Eken, M., & Karasu, A. (2016). Effects of fetal cardiac anomalies on ductus venosus and aortic isthmus Doppler profiles. *Archives of Gynecology and Obstetrics*, 345-350.

10. Kiserud, T. (1999). Hemodynamics of the ductus venosus. *European Journal of Obstetrics & Gynecology and Reproductive Biology*, 139-147.

11. Kiserud, T., Rasmussen, S., & Skulstad, S. (2000). Blood flow and the degree of shunting through the ductus venosus in human fetus. *American Journal of Obstetrics and Gynecology*, 147-153.

12. Maiz, N., Wright, D., Ferreira, A., Syngelaki, A., & Nicolaides, K. (2012). A mixture model of ductus venosus pulsatility index in screening for aneuploidies at 11-13 weeks' gestation. *Fetal Diagnosis and Therapy*, 221-229.

13. Mari, G. (2025). Fetal growth restriction: Pregnancy management and outcome. *UpToDate*.

68

References

14. Mash, Y., Bardin, R., Gilboa, Y., Geron, Y., Romano, A., Hadar, E., . . . Houri, O. (2024). Agenesis of the Ductus Venosus and its Association with Genetic Abnormalities. *Prenatal Diagnosis*, 1585-1592.

15. Miller, J. (2025). Fetal growth restriction: screening and diagnosis. *UpToDate*.

16. Minnella, G., Crupano, F., Syngelaki, A., Zidere, V., Akolekar, R., & Nicolaides, K. (2020). Diagnosis of major heart defects by routine first-trimester ultrasound examination: association with increased nuchal translucency, tricuspid regurgitation and abnormal flow in ductus venosus. *Ultrasound in Obstetrics and Gynecology*, 637-644.

17. Moradi, B., Hassan Zadeh Tabatabaei, M. S., Naybandi Atashi, S., Shahsavan, K., Kazemi, M. A., Rahmani, M., . . . Davari-Tanha, F. (2024). Ultrasound of Fetal Venous System: Normal Anatomy, Variation and Anomalies; A Review Article. *Journal of Obstetrics, Gynecology and Cancer Research*, 559-612.

18. Papanna, R., & Bergh, E. (2025). Twin-Twin transfusion syndrome: Screening, prevalence, pathophysiology, and diagnosis . *UpToDate*.

19. Rajachander, N., Andrew, C., Shalini, C., & Gopal, S. (2021). Ductus venosus agensis: Ultrasound diagnosis and outcome. *Journal of South Asian Federation of Obstetrics and Gynaecology*, 156-162.

69

References

20. Seckin, K., Karsli, M., Baser, E., Yeral, M., Tasin, C., Ozgu Erdinc, A., & Danisman, N. (2015). Obstetric outcomes in pregnancies with normal nuchal translucency and abnormal ductus venosus Doppler in the first trimester of ultrasonography. *Journal of Obstetrics and Gynaecology*, 440-443.

21. Seravalli, V., Miller, J. L., Block-Abraham, D., & Baschat, A. A. (2016). Ductus Venosus Doppler in the Assessment of Fetal Cardiovascular Health: an Updated Practical Approach. *Acta Obstetricia et Gynecologica Scandinavica*, 635-644.

22. Sidhu, P., & Lui, F. (2023). Embryology, Ductus Venosus. Treasure Island, Florida, United States of America.

23. Timmerman, E., Oude Rengerink, K., Pajkrt, E., Opmeer, B., Van der Post, J., & Bilardo, C. (2010). Ductus venosus pulsatility index measurement reduces the false-positive rate in first-trimester screening. *Ultrasound in obstetrics & gynecology*, 661-667.

24. Wagner, P., Eberle, K., Sonek, J., Berg, C., Gembruch, U., Hoopmann, M., . . . Kagan, K. (2019). First-trimester ductus venosus velocity ratio as a marker of major cardiac defects. *Ultrasound in Obstetrics & Gynecology*, 663-668.

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