



What are the Double Lines of the Fetal Cavum Septi Pellucidi on Ultrasound?

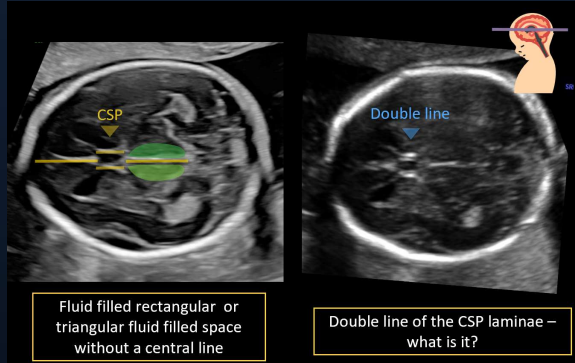
Shannon Green, MD, Dolores H Pretorius, MD, Amanda Crouch, Tracy Anton, BS, RDMS, Marni Jacobs, PhD, MPH, Yoona Ho, MD, Robert Hevner, MD, PhD, Leah Lamale-Smith, MD

UC San Diego Health

Department of Radiology, University of California, San Diego, La Jolla, CA

INTRODUCTION

The cavum septi pellucidi (CSP) is an important landmark in fetal imaging studies. It is defined as the cavity separating the frontal horns of the lateral ventricles and is bounded on all sides: laterally between the septal laminae (SPLs), inferiorly, anteriorly and superiorly by the corpus callosum, and posteriorly by the fornix. The SPLs form the medial walls of the frontal horns of the lateral ventricles.



Non-visualization of the fetal CSP in the second and third trimesters is a well-studied topic and is associated with various types of abnormal central forebrain development, including agenesis of the corpus callosum, septo-optic dysplasia, and holoprosencephaly 1-5. Additionally, as part of the limbic system, the CSP is an important structure in neuropsychiatric development 6. As ultrasound technology advances, the sonographic appearance of the CSP can be further interrogated to identify normal and abnormal qualities and relationships.

METHODS

Retrospective review of images and cine loops

- 522 consecutive uncomplicated singleton pregnancies (15-39 weeks GA)
- Subset of 20 cases
- 10 consecutive cases of double line SCP
- 10 consecutive cases of single line CSP
- 53 fetal patients with normal appearing CSP on fetal US & fetal MRI
- Histology from one neonate with acute hypoxic-ischemic injury

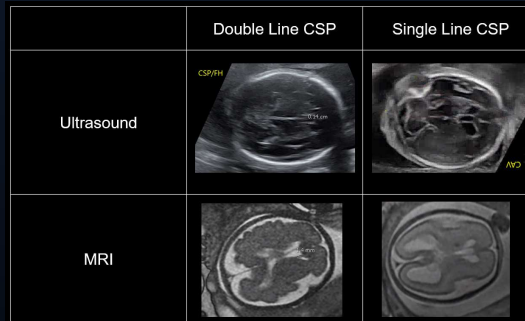
Data recorded

- Single vs. double line
- Maternal BMI and gestational age
- Ultrasound settings
- Thickness (outer edge of outer line to inner edge of inner line) of the septi pellucidi laminae in subset of ultrasound and fetal MR cases
- Histology (1 neonate) reviewed and lamina measured

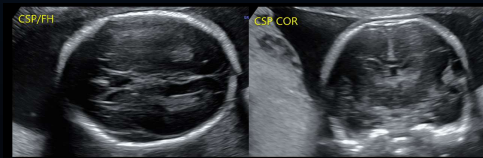
RESULTS

Metric	Double line (n = 188)	Single line (n = 215)	P- value
GA at scan (days) median (IQR)	138 (133, 149)	140 (132, 175)	0.15
Maternal BMI (kg/m ²) median (IQR)	25 (22, 29)	26 (23, 30)	0.62
Maternal BMI category, n (%)			0.57
< 30	124 (75.6)	129 (72.9)	
30+	40 (24.4)	48 (27.1)	
Cavum size (mm) mean (SD)	0.33 (0.09)	0.38 (0.14)	<0.0001

1. Double line seen in ~50% (188/403) of normal fetuses
2. Thickness of lamina (outer to inner line) in 10 cases:
 - Double line cases: 1.4 mm
 - Single line cases: 0.8 mm
3. Double line not seen on fetal MRI (n = 53)
 - 14 Patients had MRI and US within a 4-week period
 - Thickness of lamina on MRI was 1.4 mm (range 1.2-1.7mm) within 0.1 mm of the US measurement

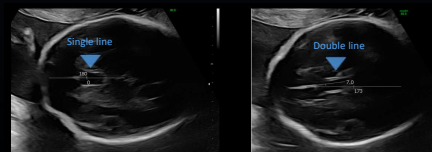


4. Double line not seen on coronal US



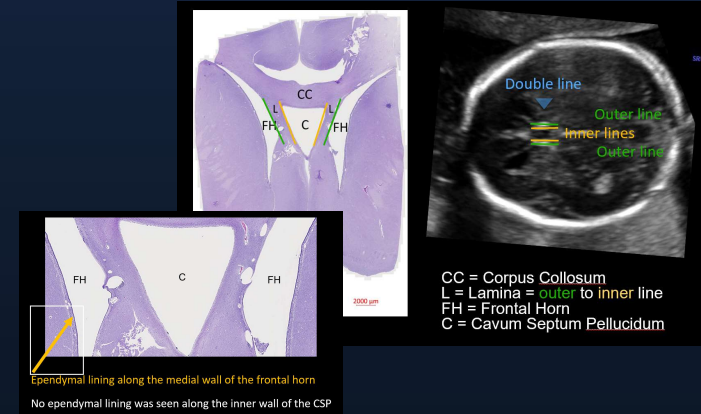
- Double line is not seen on coronal imaging because the angle of the beam is parallel to the lamina layers → No specular reflection at the cell-fluid boundaries

5. Double line may "appear" as the angle of ultrasound probe changes



Probe perpendicular to CSP – unable to differentiate the inner and outer walls due to spatial resolution limitations

Probe 7 degrees off axis results in greater distance between the inner and outer walls



CONCLUSION

"Double Line CSP" is seen if:

1. Axial/transverse ultrasound image
2. Thickness of the lamina (from outer to inner line)* is greater than the minimal spatial resolution (~1 mm)
3. Cells lining the cavum and the frontal horns are compact enough to create a specular reflection

* This can be altered by the angle of insonation

REFERENCES

1. Winter TC, Kennedy AM, Byrne J, Woodward PJ. The cavum septi pellucidi: why is it important? J Ultrasound Med Mar 2010;29(3):427-44. <https://doi.org/10.7863/jum.2010.29.3.427>.
2. Jarvis D, Griffiths PD. Normal appearances and dimensions of the foetal cavum septi pellucidi and vergae on in utero MR imaging. Neuroradiology May 2020;62(5):617-627. <https://doi.org/10.1007/s00234-020-02364-5>.
3. Saba L, Anzidei M, Raz E, et al. MR and CT of brain's cava. J Neuroimaging Jul 2013;23(3):326-35. <https://doi.org/10.1111/jon.12004>.
4. Griffiths PD, Batty R, Reeves MJ, Connolly DJ. Imaging the corpus callosum, septum pellucidum and fornix in children: normal anatomy and variations of normality. Neuroradiology May 2009;51(5):337-45. <https://doi.org/10.1007/s00234-009-0506-y>.
5. Maduram A, Farid N, Rakow-Penner R, et al. Fetal Ultrasound and Magnetic Resonance Imaging Findings in Suspected Septo-Optic Dysplasia: A Diagnostic Dilemma. J Ultrasound Med Aug 2020;39(8):1601-1614. <https://doi.org/10.1002/jum.15252>.
6. Flashman LA, Roth RM, Pixley HS, et al. Cavum septum pellucidum in schizophrenia: clinical and neuropsychological correlates. Psychiatry Res Feb 28 2007;154(2):147-55. <https://doi.org/10.1021/psyc.2006.09.001>.
7. Callen PW, Callen AL, Glenn OA, Toi A. Columns of the fornix, not to be mistaken for the cavum septi pellucidi on prenatal sonography. J Ultrasound Med Jan 2008;27(1):25-31. <https://doi.org/10.7863/jum.2008.27.1.25>.
8. Tao G, Lu G, Zhan X, et al. Sonographic appearance of the cavum septum pellucidum et vergae in normal fetuses in the second and third trimesters of pregnancy. J Clin Ultrasound Nov-Dec 2013;41(9):525-31. <https://doi.org/10.1002/jcu.22094>.
9. Ho Y, Herrero T, Aguinaldo J, et al. Ultrasound Measurements of Frontal Horns and the Cavum Septi Pellucidi in Healthy Fetuses in the Second and Third Trimesters of Pregnancy. J Ultrasound Med Jan 2020;39(1):127-137. <https://doi.org/10.1002/jum.15086>.
10. International Society of Ultrasound in O, Gynecology Education C. Sonographic examination of the fetal central nervous system: guidelines for performing the basic examination and the fetal neurosonogram. Ultrasound Obstet Gynecol Jan 2007;29(1):109-16. <https://doi.org/10.1002/uog.3809>.
11. Malling G, Paladini D, Haratz KK, Monteagudo A, Piliu GL, Timor-Tritsch IE. ISUOG Practice Guidelines (updated): sonographic examination of the fetal central nervous system. Part 1: performance of screening examination and indications for targeted neurosonography. Ultrasound Obstet Gynecol Sep 2020;56(3):476-484. <https://doi.org/10.1002/uog.22145>.
12. Larroche JC, Baudey J. [Cavum septi lucidi, cavum Vergae, cavum veli interpositi, cavities of the median line. Anatomical and pneumoencephalographic study in the neonatal period]. Biol Neonat Sep 1981;3:193-236.
13. Tubbs RS, Krishnamurthy S, Verma K, et al. Cavum velum interpositum, cavum septum pellucidum, and cavum vergae: a review. Childs Nerv Syst Nov 2011;27(11):1927-30. <https://doi.org/10.1007/s00381-011-1457-2>.
14. Ng A, Swanevelde J. Resolution in ultrasound imaging. Continuing Education in Anaesthesia Critical Care & Pain 2011;10(01):2011:11(5):186-192. <https://doi.org/10.1093/bjaceaccp/mkr030>.