3D assessment of the umbilical vein deviation angle (UVDA) for the prediction of liver herniation in left congenital diaphragmatic hernia

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Objective
To introduce a new sonographic marker of intrathoracic liver herniation in fetuses with left congenital diaphragmatic hernia (CDH).

Methods
In a consecutive series of fetuses with isolated CDH an ultrasound volume of the fetal abdomen was acquired. On this the offline calculation of the angle formed by the midline of the abdomen (joining the centre of the vertebral body to the abdominal insertion of the umbilical cord) and a second line joining the centre of the vertebral body to the intraabdominal convexity of the umbilical vein was carried out (Umbilical Vein Deviation Angle or UVDA). The UVDA was measured on a group of normal fetuses selected as controls. At follow up the presence of liver herniation was investigated in all cases of CDH. The UVDA values were compared between the CDH group and the controls, and between the CDH liver-up vs liver-down. A receiver-operating characteristics (ROC) curve was built to identify a cut-off value of the UVDA with the highest accuracy in predicting liver herniation in the CDH group.

Results
From 2009 to 2015, 22 cases of left CDH were included in the study group, with 9 cases having liver herniation. 88 fetuses were recruited as controls. The UVDA was significantly higher in the cases vs controls (15.25±7.91° vs 7.68±1.55°, p<0.0001). Moreover the UVDA was significantly increased in CDH fetuses with liver-up vs liver down (21.77±8.79° vs 10.75±1.10°, p<0.0001). At ROC curve the UVDA showed a significant prediction of liver herniation (AUC 0.94 p<0.0001) with the best cut off of 15.2° yielding a sensitivity of 89% and a specificity of 100% (p<0.0001).

Conclusion
In fetuses with CDH the umbilical vein bowing may be quantified measuring the UVDA by 3D ultrasound. This sonographic marker seems an accurate predictor of liver herniation in left CDH.