

## **Cerebellar vermis at 12–22 weeks of gestation: why is traditional assessment incorrect?**

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### **Objective**

Firstly, to compare the rate of visualization of the cerebellar vermis separate from the 4<sup>th</sup> ventricle choroid plexus (4thV-CP) using different TV or TA ultrasound transducers and operating frequencies, in normal fetuses between 12 and 22 weeks' gestation; secondly, to provide reference ranges of the areas of the vermis and the 4thV-CP measured separately in the midsagittal plane through the posterior fontanelle and to assess the potential overestimation of the true vermian area when the 4thV-CP is included in the measurement.

### **Methods**

The study population comprised women with a singleton pregnancy and a normal sonographic examination after first-trimester combined screening for chromosomal abnormalities, prospectively recruited from 2017 to 2021. In each case a detailed ultrasound assessment, including a midsagittal view of the brain through the posterior fontanelle, was carried out from 12 to 22 weeks' gestation. All scans were confirmed to be normal and no malformations were reported at birth. In all cases TV or TA ultrasound examinations were performed. The images were obtained using standard frequency TA probe in 60 cases, high frequency TA transducer in 45 cases and high and standard frequency TV probes in 81 cases.

### **Results**

In the 186 normal pregnancies recruited in the study, the 4thV-CP was visible and it was seen separate from the vermis in 29 of 60 cases (48.3%) examined by standard frequency TA transducer, which was significantly lower ( $p < 0.00001$ ) compared to 43 of 45 cases (95.5%) examined by high frequency TA probe. In all 81 cases examined with TV transducers the median portion of 4thV-CP was visible and was seen as a small echogenic oval shape structure apparently attached to the vermis. The areas of the vermis and the 4thV-CP increased progressively with advancing gestation and their ratio decreased, mainly due to a more marked growth velocity of the vermian area compared to the 4thV-CP. In 31 of 60 patients (51.7%) examined by standard frequency TA transducer, the total area of the complex vermis-4thV-CP was measured and this was significantly higher compared to the vermian area measured separately from the 4thV-CP in fetuses in which the two anatomical structures could be differentiated ( $p < 0.0001$ ), suggesting an overestimation of the true vermian area in these cases.

### **Conclusion**

It is possible to differentiate the 4thV-CP from the inferior border of the vermis using either high frequency TA probe and standard and high frequency TV probes. Furthermore, our data demonstrated for the first time that the closure of the 4<sup>th</sup> ventricle is determined from the choroid plexus and not only from the vermis and showed that when the 4thV-CP could not be seen separately from the vermis, vermian area appears to be significantly overestimated. Obviously, these findings could have important clinical and research implications.