

Fetal brain examination: anterior-posterior complexes and landmarks of the proximal hemisphere

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Objective

To assess the feasibility of identifying the structures included in both anterior (AC) and posterior complexes (PC) of the transventricular (TV) plane of the fetal brain as well as a series of anatomic landmarks that could help to demonstrate the integrity of the proximal hemisphere (PH), in a large number of fetuses.

Methods

This was a prospective observational study of healthy women with singleton pregnancies, with no increased risk of fetal CNS anomalies, attending routine ultrasound screening at 20⁺⁰ – 33⁺⁶ weeks' gestation, between March and May 2017. Exclusion criteria were fetuses with chromosomal or structural anomalies, unknown pregnancy outcomes and absence of informed consent. Following a formal onsite training session, four physicians with no expertise in fetal neurosonography and one expert performed transabdominal (TA) ultrasound in Concepción, Chile. A sixth physician located remotely in a tertiary referral centre in Madrid, Spain received a detailed description of the plane views required, along with a set of videoclips of example scans. In order to provide a defined list of structures and landmarks (Table 1), all participants were asked to acquire a 5 second videoclip of the standard TV and transthalamic plane, as well as a magnified videoclip of the AC, PC and PH using a technique previously reported. Blind analysis by a non-expert and two experts in fetal neurosonography was used to assess the structures included in each plane view. For the purposes of analysis, the population of fetuses was separated into three groups: 20-23⁺⁶, 24-27⁺⁶- and 28-33⁺⁶-weeks' gestation. Cerebral structures assessed in each plane transventricular plane. Structures included in the anterior complex are part of this plane. Visualization of the anterior and posterior horn of the lateral ventricle with smooth inner surface and filled with uniformly anechoic fluid. Periventricular zone is smooth and regular in its echogenicity. Choroid plexus fills the ventricular cavity, is closely apposed to both the medial and lateral walls of the ventricle and its glomus is visible. Continuity of the interhemispheric fissure posterior to the cavum septi pellucidi or cavum vergae. Temporal and/or occipital cortical surface visible. Attempt to visualize these structures in the proximal and distal hemisphere. Transthalamic plane: Frontal horns of the lateral ventricles, the cavum septi pellucidi, the thalami and the hippocampal gyri. Anterior complex: Interhemispheric fissure, callosal sulcus, corpus callosum, presence of cavum septi pellucidi and its aspect, aspect of anterior horns of the proximal and distal lateral ventricles, visualization of the proximal and distal germinal matrix area and the proximal and distal periventricular area immediately lateral to anterior horn. Posterior complex: Interhemispheric fissure, callosal sulcus, corpus callosum, parietooccipital fissure, oblique disposition to the midline of the proximal and distal lateral ventricles and/or both proximal and distal choroid plexus of the lateral ventricles. Proximal hemisphere: Visualization of the anterior and posterior horn of the lateral ventricle with smooth inner surface and filled by uniformly anechoic fluid. Periventricular zone is smooth and regular in its echogenicity. Choroid plexus fills the ventricular cavity, is closely apposed to both the medial and lateral walls of the ventricle and its glomus is visible. Atrium visible. The Sylvian fissure is visible and its morphology is compatible with the gestational age and comparable with that of the proximal hemisphere, while the brain surface of the temporal and occipital lobes and the homogeneity of the periventricular white matter are normal.

Results

Of the population studied (n=747), 477 correspond to mid trimester scan (20-23⁺⁶ weeks') and in this group the body mass index (BMI) was significantly different (p<0.001) between the Chilean population (mean 26.3; range, 17.4-52.1 kg/m²) and the population from Madrid, Spain (mean 24.7; range, 16.7-44.1 kg/m²). The detection by the three examiners exceeded 94%, 93% and 96% of the structures defined for the AC, PC and PH respectively, with an agreement of 97%, 94% and 98% when comparing an expert with a non expert examiners. Kappa coefficient was mostly good or very good, and only occasionally moderate. Comparing to the total population, the 20-23⁺⁶ weeks gestation group achieved higher agreement between the two examiners. All the results were statistically significant.

Conclusion

Our results confirm that both complex and real-time access to the proximal hemisphere can be integrated into routine axial examination, in order to improve antenatal detection of cerebral anomalies.