

skills acquisition is a poor predictor of skills transfer, which must be considered the primary outcome of interest for ultrasound training.

OP29.09

Development of an obstetrics ultrasound Doppler simulator

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Objectives: Doppler is a fundamental tool in the study of normal and pathological pregnancy. The scan is done, in the vast majority of cases, by medical personnel who do not understand the physics of sound nor the use of the different options available to optimise images to reach appropriated conclusions. Our goal was to develop an Obstetrics Ultrasound Doppler Simulator to practice different approaches to the fetal and maternal vessels on a normal and pathological conditions.

Methods: Using Unity (a game engine by Unity Technologies SF), and a Fourier transform, we developed an user interface, which mimic a B-Mode and a colour Doppler signal, in which a Doppler cursor is place in order to generate an spectral pulse wave Doppler signals. A series of commands are displayed to control gain, power, pulse repetition frequency, zero line, speed, up/down, etc.

Results: We achieved an Obstetrics Doppler Simulator used on laptops and mobile devices. When students go through the user interface, different vessel may be studied (Umbilical artery, medial cerebral artery, ductus venosus and uterine artery). The Doppler cursor may be place in different positions of the vessel in order to get a spectral Doppler signals. Using command the spectral Doppler signal may be changed. Furthermore a pathological condition may be achieve in order to get signals for each of the studied vessels. Simulated signals were analysed by specialists and evaluated in terms of signal realism and dynamics of the normal and pathological changes.

Conclusions: This Obstetrics Ultrasound Doppler Simulator fulfils the realism as a comprehensive anatomical, physiological and pathophysiological model of an ultrasound Doppler generator of the fetal and maternal circulation to practice different approaches on a normal and pathological conditions. Furthermore this simulator provide a risk free and controllable environment for training and the next step will be to integrate this model as a learning object on teaching scenarios.

OP29.10

Simulation in amniocentesis using a training model in a Latin American setting

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Objectives: Amniocentesis is the most frequent invasive procedure in prenatal diagnosis. Other ultrasound-guided invasive procedures, such as chorionic villus sampling and cordocentesis, are based on the same technical principles.

The aim of our study was to compare the learning curves of residents and specialists in Obstetrics and Gynecology (OBGYN) for amniocentesis on a training model in four different Latin American cities.

Methods: We conducted an observational study in 103 physicians (40 residents and 63 specialists in OBGYN) in four Latin American cities: Lima, Peru; Quito and Guayaquil, Ecuador; and Santiago, Dominican Republic, from October 2016 until March 2017.

The participants were evaluated before and after practical and theoretical training. The gravid uterus model we used was the Amnio/Cordocentesis model from Limbs & Things Limited, Bristol, UK).

This model can be explored by ultrasound and any ultrasound-guided procedure can be performed repeatedly.

Confidence gain was assessed subjectively using post-tests questionnaires; and technical quality improvement by how to hold the probe and the needle, how to identify the target, how to keep the entire length of the needle visualised on the screen and how to optimise the ultrasound settings.

Results: Residents and specialists from all the four cities improved their scores in the practice of a correct amniocentesis.

Specialists who already performed amniocentesis had a lower improvement than novice participants during the practice, but the confidence gained was higher showed by the post-test questionnaire.

We assumed that the quality of the procedure increased with the time spent visualising the entire length of the needle on the screen.

In fact, the most difficult skill to improve was related to advancing the needle under full vision towards the target.

Conclusions: Our study concludes that is feasible to implement a training program in ultrasound-guided procedures in fetal medicine in Latin America.

A training model improves the ability and confidence of physicians to perform invasive procedures when initial experience is low.

OP30: FETAL BRAIN NOVEL APPLICATIONS OF ULTRASOUND AND MRI

OP30.01

Photoacoustics as a new imaging technique for *in utero* assessment of fetal cerebellar tissue oxygenation

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Objectives: To assess the feasibility of evaluating the fetal cerebellar oxygenation in pregnant rats by Photoacoustics (PA) imaging on day 20 of pregnancy (E20).

PA imaging is a real-time, non-invasive imaging method, combining laser pulse tissue excitation and ultrasonic detection of the tissue response.

Methods: We conducted an experimental pilot study in four rat fetuses, from two different pregnant rats that were scanned transabdominally on E20 with a PA imaging system coupled to high-resolution ultrasound imaging.

The Vevo 2100 and Vevo LAZR were used to first identify the fetal cerebellum and then assess its oxygen saturation. PA images were acquired with a 15 MHz probe connected to the Vevo LAZR PA imaging system (Fujifilm Visualsonics Inc, Toronto, Canada).

Results: The sO₂ Av represents the average blood oxygen saturation, which is the sum of all oxygenated pixels in the region of interest, divided by the oxygenated and deoxygenated pixels.

The sO₂ Av in the cerebellum of the first two fetuses was 82.44% and 79.76%; and the sO₂ Av 3D was 81.1% and 79.2%; and in the other two fetuses the sO₂ Av was 78.59% and 74.72%; and the sO₂ Av 3D was 80.89% and 78.82%.

The observed range was 74.72% to 82.44% and the median was 79.48% with a SD of 2.31.

Conclusions: This pilot study demonstrates that PA imaging can be a useful tool that enables non-invasive determination of blood oxygen saturation in fetal tissue. This is the first study, to our knowledge, to assess fetal tissue oxygenation using this technology, crucial for future clinical applications.

Supporting information can be found in the online version of this abstract

OP30.02

Ultrasound and MRI abnormalities of fetal cortical plate morphology correlate with development of cerebral malformations

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Objectives: The cortical plate is a transient structure which develops as a result of neuronal precursor migration from the germinal matrix and ganglionic eminence. It gives rise to the future cerebral cortex. The objective of this study is to examine abnormal cortical plate morphology, as a predictor of aberrations of neuronal migration and cerebral cortical development.

Methods: Images of the cortical plate were documented in 30 normal fetuses in the second trimester to establish normative values. Normal imaging findings were compared with 20 cases in which the cortical plate appeared abnormally thick, thin, or irregular in appearance. Images from 8 cases were analysed prospectively and 12 were reviewed retrospectively. Imaging findings were compared with postmortem or postnatal imaging diagnoses.

Results: Normal cortical plate thickness ranged from 1 mm in the early second trimester to 3 mm at the beginning of the third trimester. The surface of the cortical plate and interface with the underlying subplate appeared well-defined and smooth. Among 20 fetuses with suspected brain pathology, an abnormally thick and irregular cortical plate was identified in 6 fetuses, thought to be predictive of polymicrogyria. Subsequent pathological or postnatal imaging examination showed evidence of polymicrogyria or pachygyria in 5/6 cases. There was one false positive diagnosis of polymicrogyria, in a fetus with additional intracranial anomalies. A diffusely thickened, irregular, and poorly defined cortical plate was documented in 4 cases of Type II lissencephaly. Diffuse thinning of the cortical plate was identified in 4 cases of type 1 lissencephaly. Abnormally located focal indentations of the cortical plate predicted abnormal sulcation in 6 cases.

Conclusions: Prenatal ultrasound examination of the cortical plate in the second trimester allows recognition of aberrant migration abnormalities and predicts possible ensuing cerebral malformations.

OP30.03

Segmentation of prenatal cerebellar vermian pathologies in fetal MRI

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Objectives: Predicting postnatal cognitive outcome in fetal hind-brain malformations is generally difficult. An intact cerebellar vermis is considered to be an important marker for a good neurodevelopmental outcome. This fetal MRI study aims to quantitatively assess vermian lobulation in frequent posterior fossa pathologies.

Methods: Cases of Blake's pouch (BP), Megacisterna magna (MM), classical Dandy Walker (DWc, hypoplastic uprotated vermis, elevated torcula) and Dandy Walker "variant" (DWv, hypoplastic uprotated vermis) were retrospectively assessed and compared to brain-healthy fetal controls (HC). The vermian lobules were segmented in a T2 midline sagittal slice. The mean relative areal contribution (MRAC) of each lobule was compared across groups between 18 and 39 gestational weeks (GW).

Results: In HC (78 cases) 7 lobules could be distinguished in all GW, 6 lobules in MM (17 cases) and 5 in BP (13 cases). In DWv (38 cases) significantly more lobules could be differentiated than in DWc (10 cases). Therefore, only DWv subjects with ≥ 5 distinguishable lobules were used for comparison. In all fetuses the number of vermian lobules were brought to a common ground of 5: Lingula+Centralis (LC), Culmen, Declive+Folium+Tuber (DFT), Pyramis and Uvula+Nodulus (UN). In HC, the MRAC of LC and Pyramis reduced with GW, whereas the MRAC of Culmen and DFT increased – UN was stable across all GW. Compared to this allometric growth, the MRAC of all lobules in all pathologies was stable during gestation.

Conclusions: The present study shows that, given optimal image conditions in a T2 mid-sagittal slice, it is possible to differentiate at least 5 vermian lobules in MM, BP and DWv. More interestingly in comparison to HC the assessed pathologies showed a stable MRAC of all lobules.

Supporting information can be found in the online version of this abstract

OP30.04

Fusion imaging (FI) in brain structure measurements on a fetus phantom when combining real-time ultrasound (US) with magnetic resonance imaging (MRI)

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Objectives: The aim was to assess synchronisation of the MRI and US on a fetus phantom by using different numbers of matching landmarks as well as to assess inter-observer difference between fetal head and brain structure measurements.

Methods: FI was performed by combining US and MRI simultaneously. Biometric fetal ultrasound training phantom (CIRS, Virginia, USA) was used. 1.5 Tesla MRI sagittal scans (1 mm slices) on a fetus phantom were acquired and images were uploaded on the US machine (EPIQ 7G, Philips). PercuNav US tracker was fixed to the US probe and thus allowing the system to recognise and display the position and orientation of the transducer. A special fetal phantom tracker was used as a phantom reference. Fusion between real-time US and MRI images was performed and evaluated by using different settings. Real-time US of the phantom head was performed by synchronising US with the uploaded MRI images by using 1, 3, 4 and 5 landmarks. Measurements of fetus phantom head and 5 different brain structures were taken by 3 different observers twice. Differences between measurements on US and MRI images and inter-observers differences were assessed.

Results: Phantom head diameter measurements varied between 5.7 and 7.6mm and size of brain structures measurements varied



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