OP02.09
Measurement of cardiac contractility using fetal isovolumetric contraction time in fetal anemia caused by Rhesus alloimmunization

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Objectives: We examined the influence of fetal anemia seen in Rh alloimmunization on cardiac contractility as measured by the isovolumetric contraction time (ICT). The ICT is the time interval between the onset of the ventricular contraction and cardiac ejection. It is an index of cardiac contractility. This may be measured with a Doppler approach using appropriate frequency digital filters to distinguish the movements of the mitral and aortic valves in the Doppler cardiogram. We have previously reported animal validation and a normal range for human fetuses.
Methods: Our study was carried out in two parts. (A) In six patients undergoing percutaneous umbilical cord blood sampling (PUBS) to assess the level of fetal hemoglobin (fetal Hb) because of Rh alloimmunization, we measured the fetal ICT with the Doppler technique within 24 hours of PUBS. (B) We carried out 2nd daily measurements of the fetal ICT during the 6-week course of antenatal therapy in a patient receiving three fetal intrauterine blood transfusions because of fetal anemia.
Results: (A) In six patients with fetal anemia, there was a significant correlation between the fetal Hb and fetal ICT. The most anemic fetus had the shortest ICT. (B) Serial studies in a patient receiving three intrauterine transfusions demonstrated a shortening of the fetal ICT as the fetus became anemic and after each transfusion, the fetal ICT lengthened back into the 'normal range'.
Conclusions: The ICT measures contractility. The shortened ICT seen in associated with fetal anemia in both our cross-sectional and longitudinal data indicates enhanced cardiac contractility with fetal anemia and we hypothesize that this is a component of the high output state of fetal anemia to maintain oxygen delivery. We did not study any hydropic fetuses but we postulate that a prolonged ICT above our normal range might signal cardiac failure and developing hydrops.

OP02.10
Management of alloimmunized pregnancies and analysis of neonatal outcome

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Objectives: We studied 74 alloimmunized pregnancies referred to our unit between 2001 and 2006, focusing on those managed by fetal blood samples (FBS) and intra-uterine transfusion (IUT) in order to document the indications, complications and outcomes of these procedures.
Methods: Data were collected from ultrasound databases, computerized records and charts. FBS/IUT were determined by the peak velocity in the fetal middle cerebral artery (PSV-MCA), raised antibodies titers, and/or ultrasound signs of fetal anemia.
Results: Among 28 women, 84 FBS (range 1–7/patient) were performed (11 anti-D antibodies, 10 anti-C/D, two anti-c, four anti-Kell, one ABO-B) and 71 (range 0–5/patient) IUTs were carried out. The two main procedure-related complications were fetal bradycardia and needle displacement. There were no cases of fetal intrauterine death. We recorded two cases of delivery related to the procedure, one at 30 weeks with labor onset the day after transfusion, the other due to persistent fetal bradycardia, requiring immediate Cesarean section. PSV-MCA was a good predictor of fetal anemia in 71/84 cases. However, in 3/84 cases PSV-MCA was a false-positive indicator, and in 10/84 cases a false-negative predictor. The median interval between IUTs was 23 days. Median gestational age at delivery was 36 + 2 (range, 30–38) weeks, and only one case delivered before 32 weeks. Median birth weight centile was 42 (range 5–95), with six infants < 10^{th} centile receiving more than 2 IUTs. Phototherapy was needed by 16 infants at birth, nine needed exchange transfusion (ET), and four, top-up transfusions. The median interval from final IUT to delivery was 20 (range, 0–37) days. All the infants survived.
Conclusions: PSV-MCA was a good predictor of alloimmune anemia in 84.5% cases. All cases where PSV-MCA was a false negative or positive had received already 1 or more IUTs. Eight of nine infants who required ET were D-positive; this group had a later diagnosis of anemia, fewer transfusions and a shorter interval to delivery.

OP02.11
Ultrasound investigations of Parvovirus B19 Erythrovirus infected pregnant women in Denmark 1994 to 2006

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Materials and methods: In 1991, before parvovirus B19 diagnostic procedures had been established in Denmark, fetal death due to parvovirus B19 was as high as 15.8% during epidemics, as none of the fetuses was relieved of their hydrops or offered transfusions. Following the establishment of parvovirus B19 analyses with PCR, IgM and IgG antibodies, fetal diagnostics and treatment have been intensified. From 1994, 39 pregnant women diagnosed with parvovirus B19 were transferred from different regions in Denmark. They were monitored to discover signs of hydrops, and from July 2002 measurement of increased peak systolic velocity (PSV) in the fetal middle cerebral artery was included to decide the need for transfusion.
Results: Of the 39 fetuses 16 had severe hydrops, 13 were anemic and 12 received intrauterine transfusions. Fifteen fetuses did not survive, but 24 were healthy liveborns. An accumulation of cases was noted 1994–95, 1997, 2000, 2003 and 2005–06, revealing epidemics approximately every 3 years.
Conclusions: During a 12-year period 39 parvovirus B19 infected pregnant women were examined. Sixteen fetuses had severe hydrops at birth. Fifteen fetuses did not survive despite fetal treatment. Therefore, to improve fetal prognosis, early diagnosis and treatment of fetal disease are required. If parvovirus B19 IgM is present, the mother should be followed by specialists in fetal medicine. When anemia or hydrops is suspected, the pregnant woman should be referred immediately to a regional fetal medicine center able to perform intrauterine transfusion of erythrocytes and thrombocytes.

OP03: MRI

OP03.01
Relationship between lung area at ultrasound and lung volume with magnetic resonance imaging (MRI) in isolated congenital diaphragmatic hernia (CDH)

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Objectives: To prospectively examine the relationship between contralateral lung area by two-dimensional ultrasound and contralateral and total fetal lung volume (FLV) by MRI in the assessment of fetuses with isolated CDH.

Methods: Sixty-six fetuses with isolated CDH were included. Contralateral fetal lung area was measured by 2D ultrasound (longest axis method). Ipsilateral, contralateral and total FLV were measured using multiplanar axial T2-WI MRI. Regression analysis was used to determine the significance of the association between contralateral lung area and total FLV and subsequently the predicted total FLV was calculated using a regression equation. Univariate regression analysis was used to investigate the effect on the proportionate difference between the predicted and the observed total FLV of gestational age (GA), proportionate volume of ipsilateral vs. total FLV, side of CDH, intrathoracic herniation of the liver and intra-tracheal presence of the balloon.
Results: Sixty-six fetuses underwent a total of 191 paired 2D ultrasound and MRI examinations at a median GA of 30 (range, 18–38) weeks. It was possible to visualize and measure the contralateral lung area by 2D ultrasound as well as both the ipsilateral and contralateral lung volumes by MRI in all instances. There was a significant association between contralateral lung area and total FLV ($r = 0.84$; $P < 0.001$). Univariate regression analysis showed that the proportionate difference between the predicted and the observed total FLV was significantly associated with the proportionate volume of ipsilateral vs. total FLV but not with GA, side of CDH, intrathoracic herniation of the liver or intra-tracheal presence of the balloon.
Conclusions: In CDH, contralateral lung area measurement by 2D ultrasound correlates well with total FLV by MRI irrespective of GA, liver herniation or side of herniation. Inconsistencies between both measurements are attributable to the contribution of the ipsilateral lung to the total FLV.

OP03.02
Magnetic resonance imaging of the fetal lung: a pictorial essay

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Objectives: Ultrasound remains the first screening and diagnostic modality in fetal medicine. It is widely available and generally accepted, utilizes a low cost technique and has real time properties. The place of fetal magnetic resonance imaging (MRI) is currently under investigation. Advantages are the absence of known biological risks, the ease of performing fetal MRI examinations, and the superb contrast resolution of MRI. Over the last ten years, technology has advanced dramatically and particularly fast imaging sequences have allowed better visualization of the unborn patient by MRI than ever before. Next to the central nervous system, the fetal lung is the best studied organ.
Methods: We describe how fetal MRI can be used to assess thoracic structural anomalies and lung development as well as maturation.
Results: We will present a pictorial essay of lung development and pathology. We will describe its use in the current fetal therapy program of fetuses with severe lung hypoplasia due to congenital diaphragmatic hernia (CDH).
Conclusions: We aim to introduce obstetricians to the use of MRI to image the lungs of the unborn child, and to point out the strengths and limitations in specific conditions.

OP03.03
The value of ultrasound and MRI in fetal anomalies diagnosis

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Background: From 1998 to 2007 (in two centers) 347 fetal MRI were performed. MRI was performed after preliminary ultrasound had identified or suspected fetal anomalies.
Purpose: To present the value of MRI as an addition to ultrasound in diagnosing fetal anomalies.
Methods: MR imaging was performed using 1.5 T units in 156 cases of CNS defects, 35 cases of spinal malformation, 10 lumbo–sacral tumors, 11 lung malformations, nine diaphragmatic hernias, 20 urinary tract anomalies, 25 anterior abdominal wall defects, three cases of twins that were not finally separated, 26 fetal tumors (three in the ovary, one adrenal tumor, seven head and neck, four in heart), 10 cases of genetic syndromes (Crouson Syndrome, Edward's Syndrome, Down Syndrome, DiGeorge Syndrome), 17 acranias and seven limb body wall complex.
Results: MRI is very useful in diagnosing many fetal structures.
Conclusions: MRI allows for better visualization of some structural anomalies as compared to ultrasound. In diagnostic problems with pathologic masses of the fetus, MR imaging provides additional information that may be helpful in the differential diagnosis, thus leading to proper management.

OP03.04
Fetal malformations: comparison of MR imaging and ultrasonography for diagnosis

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Objectives: To compare antenatal ultrasonography and magnetic resonance (MR) imaging for the diagnosis of fetal malformations (central nervous system, chest, urogenital tract), in cases of attenuated ultrasound signals (i.e. reduced amniotic fluid and/or maternal extended body mass indices).
Methods: Images of 22 fetuses (between 19 and 36 weeks of gestation) with malformations diagnosed at ultrasound were evaluated; in these fetuses, antenatal MR imaging was performed within 2 days of ultrasound. Antenatal ultrasound and MR imaging findings were compared with postnatal diagnoses. Postnatal evaluation included ultrasound, MR imaging, autopsy, surgery and physical examination.
Results: In 13 diagnostic cases, ultrasound and MR imaging findings were in complete agreement with postnatal diagnoses. MR imaging correctly provided additional information to the ultrasound-determined diagnosis in another five cases and correctly changed the ultrasound diagnosis in three cases. The MR-imaging-determined diagnosis was incorrect and the antenatal ultrasound diagnosis was correct in one case when correlated with the postnatal outcome. MR imaging was most valuable in the assessment of malformations of the central nervous system (CNS).
Conclusions: MR imaging can serve as a second imaging tool and adjunct to ultrasound in the evaluation of fetal malformations, especially in cases of difficult ultrasound conditions and those involving the CNS.