Antenatal Diagnosis for Anomalies of the Corpus Callosum

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Objective
To assess the diagnostic accuracy of ultrasound and fetal MRI in the diagnosis of anomalies of the corpus callosum.

Methods
Hospital ultrasound and MRI databases were searched for cases of suspected callosal anomalies between 2003 and 2012. Subsequent ultrasound scans, fetal MRI, postnatal imaging, postmortem investigations and birth records were reviewed. Fetuses with major additional extracranial anomalies, abnormal karyotype and multiple pregnancies were excluded. Callosal anomalies were classified into isolated or complex based on the presence or absence of accompanying intracranial findings.

Results
47 callosal anomalies were diagnosed during the study period. 66% were detected on a second trimester morphology ultrasound, 26% from a later ultrasound, and 9% from MRI performed for the investigation of ventriculomegaly. Of the 43 cases suspected from ultrasound, 77% had a subsequent MRI. In 27% of cases where callosal anomalies were suspected on ultrasound, fetal MRI revealed one or more additional diagnoses. Two thirds of these were anomalies of cortical development. MRI changed the classification to complex anomaly in 21% of cases thought to be isolated from ultrasound. 20% of cases thought to be isolated antenatally (following ultrasound +/- MRI) were diagnosed with additional anomalies after birth.

Conclusions
In cases of callosal anomaly suspected on ultrasound, MRI provides greater certainty and the potential to identify significant additional anomalies. The additional information may alter or clarify prognosis and help parents to better understand the pathology, allowing for informed decisions about the pregnancy to be made. However, despite extensive antenatal investigation, some cases may still be diagnosed with additional anomalies after birth and parents should be aware of such limitations. Availability of local data as compiled in this study will be of value for future parents facing this challenging clinical scenario.
Prenatal diagnosis of sirenomelia by combining new fetal skeletal rendering, three-dimensional helical computer tomography and magnetic resonance imaging

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Objective
To evaluate the value of prenatal diagnosis of skeletal abnormalities in sirenomelia by combining two-dimensional ultrasound, new fetal skeletal rendering, three-dimensional helical computer tomography and magnetic resonance imaging.

Methods Between September 2010 and February 2012, a prospective study was conducted in our hospital. Fetal skeletal rendering, three-dimensional helical computer tomography (3D-HCT) and magnetic resonance imaging (MRI) were performed after two-dimensional ultrasound (2D-US) in seven cases of sirenomelia. Diagnostic skeletal detailed findings with each of the three techniques were compared with postnatal radiological findings and 3D-HCT. All cases performed postnatal autopsy, five cases performed chorionic villus and/or cord blood sampling.

Results
Six cases are singleton and one is conjoined twins. The abnormalities associated with seven sirenomelia cases included different degrees of fusion of the lower extremities, bilateral renal agenesis, absent bladder, absent external genitalia and single umbilical cord. Five cases are associated with Oligohydramnios, five cases with partial absent ribs, seven cases with spine anomalies and five cases with cardiac anomalies. Karyotype and postnatal autopsy show that three cases are male and two are female.

Conclusion
MRI can help to diagnose sirenomelia, it’s less useful to skeletal abnormalities. Although 3D-HCT is a gold standard in diagnosis of skeletal abnormalities, the fetuses can’t be X-rayed, so it is restricted. The new fetal skeletal rendering seem to be useful complementary method to 2D-US, and can quickly provide skeletal imaging just as 3D-HCT, and may improve accuracy of the prenatal diagnosis of skeletal abnormalities in sirenomelia.

[Key words] sirenomelia, two-dimensional ultrasound, fetal skeletal rendering, three-dimensional helical computer tomography, magnetic resonance imaging
**Feasibility of comprehensive hemodynamic assessment in the normal late gestation human fetus by phase contrast MR and T2 mapping**

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**Objective**

Ovine studies have defined oxygen transport in the fetal circulation. We sought to reproduce these findings in the human fetus using a combination of phase contrast (PC) magnetic resonance (MR) with metric optimised gating (MOG) and MR oximetry with T2 mapping.

**Methods**

The major vessels of 15 late gestation normal fetuses (mean GA: 37 weeks SD 1.2 weeks) were studied during late gestation with PC MR with MOG according to our previously published technique\cite{1} and a new T2 mapping algorithm\cite{2}. Vessel T2s were converted to vessel oxygen saturation according to previous work\cite{3}. Using umbilical vein (UV) and descending aorta T2 mapping and UV PC flow, we calculated fetal oxygen delivery (DO2) and consumption (VO2). We investigated the relationship between the distribution of flow in the fetal circulation and vessel T2s, DO2 and VO2 using Pearson’s correlation coefficient.

**Results**

Mean flows and T2s with SDs are shown in Table 1. Fetal DO2 was proportional to UV flow (r = 0.91), while fetal VO2 correlated with UV flow (r = 0.74) and fetal DO2 (r = 0.80). PBF was related to the UV (r = 0.65) and MPA T2 (r = 0.58). We found an inverse relationship between PBF and FO flow (r = -0.75).

| Table 1- Flow, T2 and oxygen saturation in the major fetal vessels |
|---------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| **UV** | **AAO** | **MPA** | **SVC** | **DAO** | **DA** | **PBF** | **FO** |
| Mean Flow (ml/min/kg) | 129±39 | 210±41 | 250±36 | 135±33 | 254±41 | 189±46 | 78±39 | 145±57 |
| Mean Flow (% CVO) | 28±10 | 45±6 | 53±6 | 29±8 | 54±10 | 41±10 | 17±8 | 31±10 |
| Mean T2 (ms) | 199±21 | 127±18 | 107±17 | 91±17 | 108±16 |
| Mean SaO\textsubscript{2} | 0.79±0.06 | 0.60±0.05 | 0.52±0.06 | 0.46±0.07 | 0.53±0.06 |

UV- umbilical vein, AAO- ascending aorta, MPA- main pulmonary artery, SVC- superior vena cava, DAO- descending aorta, DA- ductus arteriosus, PBF- pulmonary blood flow, FO- foramen ovale, CVO- combined ventricular output, SaO\textsubscript{2}- oxygen saturation.
Conclusion

This approach represents the first attempt to non-invasively characterize oxygen delivery and consumption in the human fetal circulation, made possible by combining MR oximetry and PC MRI. The results are in keeping with previous invasive measurements in human fetuses[4] and animal experiments[5] showing that fetal DO2 is matched by VO2, with both related to placental blood flow. Our demonstration of streaming of oxygenated blood across the FO and the relationship between PBF and MPA and UV T2 are is in keeping with the known hypoxic pulmonary vasoconstriction mechanism operating in the human fetal lung.

References

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In utero brain growth of foetuses with congenital heart disease: Case control study using 3D SSFP
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Introduction
Ultrasound and MRI studies have indicated there is an association between congenital heart disease (CHD) and abnormal brain development in utero [1,2,3]. We used a three dimensional steady state free precession (3D SSFP) sequence [4] to assess brain growth during late gestation in fetuses with complex CHD compared with normals.

Methods
45 fetuses with CHD and 25 normal fetuses were studied with MRI on a 1.5T system (Siemens Avanto) at mean gestational age of 36 weeks. 3D SSFP data were acquired during a maternal breath hold and segmented to yield fetal and brain volumetry which was converted to estimated fetal and brain weights (EFW and EBW) based on published formulas [5,6]. EBW for normal and CHD fetuses were compared with gestational age adjusted autopsy data [7] and a Z-score calculated for each brain (Z=1 SD) (ref 7). EBWs were also indexed to fetal weight and a student t-test used to compare the CHD and normal groups.

Results
We found no significant difference between mean EBW Z-score (-0.35, SD 0.93) or EBW/EFW in CHD fetuses (10.5, 1.1) compared with EBW Z-score; (-0.07, 0.92) and EBW/ EFW (10.6, 1.3) in normal fetuses (p = 0.23 and 0.71 respectively). Three fetuses with CHD had EBW Z-score >2SDs below the mean, while all of the normal fetuses were within 2 SDs of the mean.

Conclusions
Contrary to one similarly sized previous study [2] we found no significant difference between EBW or EBW/EFW in fetuses with CHD compared with controls. The reason for this is not entirely clear but may be in part due to the difference in technique. In keeping with previous studies, we did find examples of fetuses with EBWs below the 5th centile [2,8].

Figure. Estimated fetal brain weight (EBW) Z-scores in the congenital heart disease (CHD) group vs. controls.
References
Fetal "Black Bone" MRI, a new sequence in the fetal MRI imaging armamentarium

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Objectives
Recent advances in the adult musculoskeletal literature have led to the development of the “black bone” MRI sequence. This sequence was developed in response to growing concerns regarding the harmful effects of radiation.

Fetal CT is now being increasingly used for assessment of fetal skeletal abnormalities. However there is also concern regarding harmful effects particularly as the fetus is considered to be more radiosensitive due to rapid growth, cell division and organogenesis.

Although the poor detail of bone on MRI has been a significant limitation of MRI in assessment of bony structures, Echo-Planar Imaging has recently been used to assess human long bone development. Fetal MRI therefore has the potential to reduce or avoid radiation exposure from fetal CT.

Methods
Susceptibility Weighted Imaging is a technique developed by Siemens. The technique gives high contrast between bone and soft tissues, but low contrast between different soft tissues, thus the low signal bone is easily distinguished from the surrounding soft tissues. Thus the SWI sequence can be used for “black bone” imaging in the fetus.

Results
We have used the SWI sequence to assess the skeleton, in particular the skull and axial skeleton, particularly in the assessment of spinal abnormalities, most commonly in myelomeningocele.

Conclusion
Fetal “black bone” MRI is a new technique for evaluation of the fetus, particularly in cases of spinal pathology, and also demonstrates potential use in the evaluation of craniofacial pathologies related to fetal syndromes, for evaluation of fetal skeletal dysplasias, and for fetal MR necropsy.
Managing fetuses at high risk of retinoblastoma: lesion detection on screening MRI

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Objective
To describe the positive magnetic resonance imaging (MRI) findings in a 35 week old fetus with familial retinoblastoma (RB) and report the use of antenatal ultrasound and MRI screening in the management of fetuses at high risk of RB.

Methods
A retrospective review of the antenatal course and immediate post natal findings in all children considered at high risk of RB who had antenatal imaging with both ultrasound (US) and MRI at our institution over a 5 year period.

Results
Five patients met the inclusion criteria. No lesions were identified on US in any patients. Fetal MRI identified bilateral posterior pole lesions in one patient at 35 weeks gestation. Of the 4 remaining patients, 3 developed lesions by 5 weeks of age. Only 1 fetus was delivered early following detection of RB.

Conclusion
We present the first reported case of RB detected in a high risk fetus on screening MRI at 35 weeks gestation. Protocols for screening this population using both imaging modalities are suggested. The benefit of improved visual outcomes is to be balanced with potential morbidity from early delivery.
The diagnostic value of antenatal Magnetic Resonance imaging in cases suspected to have Placental Adhesive Disorders (PAD).

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Objectives
To evaluate the impact of antenatal diagnosis of PADs on pregnancy outcome, assess modalities used for diagnosis and the value of the individual MRI criteria.

Methods
Retrospective analysis of patient data in period between February 2010-2013 has. 43 cases recruited and 2 excluded because of unknown outcome leaving 41 for statistical analysis.

Results
7/41 cases had PAD and only one case missed in antenatal diagnosis. Risk factors analysis showed that Odds ratio of H/O caesarean section (P=0.59), placenta praevia (P=0.72), is high though not statistically significant for invasion. Blood loss was significantly higher in invaded compared to non-invaded cases (p<0.001). Women with an invasive placenta had significantly more blood transfused (p<0.001). Median days in hospital was significantly longer in invaded group compared to that of non invaded (p<0.001). MRI was better than ultrasound having both higher sensitivity (86% vs 43%) and specificity (81% vs 79%). The most useful sign was heterogeneity being both highly sensitive (86%) and specific (91%) for placenta invasion. Median blood loss was higher in women with multiple bands (3000 l) compared to those with single bands (600 l).

Conclusion
Antenatal diagnosis although aided in surgery planning, favourable pregnancy outcome has not been achieved yet. MRI proved to have better diagnostic sensitivity than that of US and it was successful in defining depth of invasion in the majority of cases indicating its importance in recruitment of the specific expertise required. Multiple dark bands seem to be a useful predictor of blood loss in PAD.
Use of ultrasonography and magnetic resonance imaging in the diagnosis of placenta membranacea

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Objective
To analyze the contribution of ultrasonography and magnetic resonance imaging in the evaluation of placenta membranacea.

Methods
This was a prospective study involving 2 fetuses suspected of having placenta membranacea on ultrasound examination. MRI was used to analyze the location of the placenta, and to distinguish the normal placenta and placenta membranacea in a twin pregnancy. All the results were compared with pathology results.

Results
A 25-year-old woman and a 24-year-old woman were referred to our unit for abnormal placenta, at 24 weeks and 3 days and 25 weeks and 5 days, respectively. The latter was a twin pregnancy. No obvious abnormality were detected in all the fetuses, however, placenta abnormalities were detected in the first fetus and one of the latter fetuses. Displayed by ultrasonography, the abnormal placenta nearly occupied the whole uterine cavity, and showed diffuse low-level internal echoes inside the placenta. Displayed by MRI, the abnormal placentas showed hyperintense T2-weighted signal and flowing void effect consistent with vascular branches. In the first case, a few normal placenta were seen. In the latter case, normal placenta were not seen in the fetus with placenta membranacea. Postpartum histologic examination revealed chorionic villi directly attached to the fetal membranes in these two cases, consistent with the diagnosis of placenta membranacea.

Conclusion
Ultrasonography could be used to display the 2D image and color Doppler image of the placenta membranacea in real time, and the hemodynamics change are very important in the prognosis analysis. MRI are good complementary tool to ultrasonography for identifying the outline of placenta, especially the spatial relationship between normal placenta and placenta membranacea in twin pregnancy.
MRI of the Fetal Cerebellum and Posterior Fossa - Spectrum of Abnormalities
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Objective
Ultrasound is the imaging modality of choice for screening the pregnant patient and performing a structural survey. However, fetal MRI has greatly improved analysis and diagnosis of fetal cerebral and cerebellar anatomy and pathology. The spectrum of cerebellar abnormalities will be reviewed.

Methods
Review of fetal MRI database was performed, cases involving cerebellar pathology were identified. In all cases, multiplanar MRI was performed on a 1.5 Tesla system. Single shot fast spin echo T2, gradient echo, T1, and diffusion weighted sequences were obtained.

Results
Cerebellar abnormalities can be divided into disorders of development, presenting with either a large posterior fossa, or with a normal or small posterior fossa, and destructive disorders. Disorders presenting with a large posterior fossa include the Dandy-Walker malformation, mega cistern magna, posterior fossa arachnoid cyst, and Blake’s pouch cyst. Disorders presenting with a normal or small posterior fossa include the Dandy-Walker variant, cerebellar hypoplasia/agenesis, and rhombencephalosynapsis. Destructive disorders include cerebellar hemorrhage and infarct.

Conclusion
A detailed ultrasound examination of the fetus will detect abnormalities involving the posterior fossa and cerebellum. Precise evaluation and delineation of cerebellar abnormalities can be accomplished with the additional use of MRI. By providing a more accurate determination of pathology, MRI can facilitate genetic counseling to patients with fetuses with abnormal appearing posterior fossa/cerebellum on ultrasound.
Objective
Ultrasound is the imaging modality of choice for screening the pregnant patient and performing a structural survey. However, MRI has been utilized as a complementary tool in the imaging workup for over 20 years. The indication to perform an MRI is determined by a detailed ultrasound examination.

Methods
Multiplanar MRI was performed on a 1.5 Tesla system. Single shot fast spin echo T2, gradient echo, T1, and diffusion weighted sequences were obtained. The results of antenatal ultrasound and in utero magnetic resonance were compared.

Results
Common indications for fetal CNS MRI include but are not limited to ventriculomegaly, agenesis of the corpus callosum, Dandy-Walker malformation, arachnoid cyst, holoprosencephaly, neural tube defect, and possible intracranial mass or abnormal fluid collection. MRI has been useful for evaluating isolated sonographic findings, normal variants, well defined sonographic cerebral lesions, cerebral lesions in fetuses at high risk for intracranial pathology, and complex fetal anomalies with multiple findings. Additionally, it has facilitated determining prognosis of well defined pathology, assisted in the decision to continue or terminate pregnancy, and has aided in genetic counseling for future pregnancies.

Conclusion
Many studies have shown that MRI is beneficial in the evaluation of fetuses with CNS anomalies. Diagnosis is often changed, occasionally from a poor prognosis to a more favorable one, when a normal variant is diagnosed. Timing/mode of delivery is adjusted based on MRI findings. MRI is an integral component in evaluation of CNS anomalies, aiding and often altering antenatal management.
Fetal MRI of Chest Masses

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Objective
Fetal chest anomalies have a broad differential diagnosis. Some can be difficult to discern on ultrasound. MRI provides excellent depiction, allowing for a more accurate diagnosis.

Methods
Multiplanar MRI was performed on a 1.5 Tesla system. Single shot fast spin echo T2, gradient echo, T1, and diffusion weighted sequences were obtained. The results of antenatal ultrasound and in utero magnetic resonance were compared.

Results
Review of fetal MRI database was performed. A multitude of chest anomalies were identified. These included congenital diaphragmatic hernia (right, left, and bilateral), congenital pulmonary airway malformation, bronchopulmonary sequestration, diaphragmatic eventration, lung agenesis, congenital lobar emphysema, and hybrid lesions with components of both congenital pulmonary airway malformation and sequestration.

Conclusion
MRI is complementary to ultrasound in discerning various anomalies and can be problem solving. The ability to differentiate between mass (cystic or solid), hyperinflated lung, and bowel enhances diagnostic accuracy. The differentiation between lesions is important for patient management and directing appropriate prenatal counseling and postnatal treatment planning.
43459
Placental Pathology: Spectrum of MRI Findings

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Objective
Obstetric hemorrhage is one of the leading causes of maternal morbidity and mortality, with placental abnormalities as one of the leading causes. There is increasing use of MRI for evaluation of possible placental pathology. Knowledge of placental pathology and its appearance on both ultrasound and MRI is crucial in managing the high risk obstetric patient.

Methods
Multiplanar MRI was performed on a 1.5 Tesla system. Single shot fast spin echo T2, gradient echo, T1, and diffusion weighted sequences were obtained.

Results
Retrospective review of fetal MRI database was performed. Indications for referral for MRI evaluation included prior history of cesarean section, history of bleeding during pregnancy, and abnormal appearance of the placenta on ultrasound. Common placental abnormalities identified included placental abruption, placenta previa, abnormal placentation (placenta accreta, increta, percreta), and retained placenta.

Conclusion
MRI is complementary to ultrasound in discerning placental pathology and can be problem solving. MRI should be performed when ultrasound is non-diagnostic, when visualization of a normal placenta is difficult in the obese patient, in high risk patients who present with bleeding, even without definite signs of accrete on ultrasound, and when there is suspicion of placental pathology with a posteriorly located placenta. MRI can guide the clinicians as to conservative or expectant management versus surgical management and can impact the need for multidisciplinary involvement in suspected emergent, high risk cases.
43463
The role of Fetal MRI in difficult cases
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Fetal MRI has gradually established itself as a useful adjuvant imaging modality in cases where the Ultrasound is inconclusive. This means that the more complicated cases are referred for fetal MRI and may not be resolved with the additional imaging modality. The role here is to add information for the management of the pregnancy and the safe delivery of the fetus rather than provide a definitive diagnosis.

Poor images of the spine on the 20-week ultrasound and again at 24 weeks. Bony spur seen in the thoracic spine at 24 weeks plus, cervical spine still unclear and no clear view of the spinal cord.

Fetal MRI demonstrated a thoracic diastomatomyelia and wide spinal canal throughout. In addition the foramen magnum was very wide and the cervical spine was not clearly seen. The neck appeared to be absent with elevation of the shoulders and absent muscles on both the axial and sagittal views and a mass of soft tissue anteriorly under the chin. The diagnosis was still uncertain but the main concern was method of delivery and protection of the neck to avoid damage to the spinal cord and brain stem.

A further MRI showed some cervical vertebra but no additional details.

The baby was delivered by caesarean section and the neck stabilised. Post natal MRI was identical to the antenatal imaging. X-rays confirmed absent posterior aspect of the cervical spine.

Fetal MRI may not provide the diagnosis but aids management and delivery.
Objectives
Fetal corpus callosum (CC) is a sensitive indicator for brain development and maturation. It provides inter-hemispheric-communication of sensory, motor and higher-order information. We compared the growth of CC in appropriate-for-gestational-age (AGA) and growth-restricted-fetuses (GRFs) using two-dimensional-neuroimaging.

Methods
42 pregnant women in their third-trimester (25-37 weeks) were enrolled from October-December 2013. They had singleton fetuses without structural or chromosomal abnormalities or medical complications. CC length was measured across outer-outer and inner-inner diameters along with its area in mid-sagittal plane using trans-abdominal approach. Mean of three measurements recorded in millimetres was included in the analysis.

Results
There were 31 AGA fetuses and 11 GRFs based on their estimated-fetal-weight. Mid-sagittal view was successfully obtained in all except for 4 AGA fetuses (90%). Mean maternal age, mean gestational age (GA) and mean CC area did not differ between the groups (p-value > 0.05). Mean outer-outer and inner-inner diameters of CC were significantly lower for GRFs [37.12 (S.D. = 4.6) and 31.27 (S.D. = 4)] compared to AGA fetuses [41.2 (S.D. = 3.4) and 35.8 (S.D. = 2.4)] (p-values: 0.006 and 0.001), respectively. However, both the diameters showed a positive correlation with GA in AGA and GRFs.

Conclusions
GRFs show a diminished growth of CC suggesting possible fetal brain remodelling as an adaptation to compromised intra-uterine environment. Further studies with larger sample size and with inclusion of additional neural-biomarkers are needed to validate our findings and to evaluate the effect of reduced fetal CC growth on cognitive and motor development during early childhood.
Thirteen-Year Review of the Prenatal Diagnosis of Congenital Cystic Adenomatoid Malformations at a Single Institution

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Objective
Congenital cystic adenomatoid malformations (CCAM) are hamartomatous lung lesions often detected on second trimester ultrasound. They frequently regress in size after 30 weeks gestation and fetal hydrops is a poor prognostic indicator. Over the past 15 years fetal MRI has been increasingly used for diagnosis. This study aimed to audit prenatal surveillance of CCAM and evaluate the use of fetal MRI.

Method
A retrospective review was performed of cases with a prenatal diagnosis of fetal CCAM since 2001 at a major perinatal referral centre in Queensland.

Results
57 cases with suspected CCAM were managed at this institution from 2001-2013. The average gestation at referral was 22 weeks. 44% of lesions were classified as microcystic, 23% macrocystic, 14% mixed, 1% uniform and 18% were not classified. The average gestation at peak size was 27.3 weeks. Mediastinal shift occurred in 54% and polyhydramnios in 10%. Sonographic regression was observed in 67% of cases (occurred after 31 weeks in only 3 cases). Hydrops occurred in 5 cases of which 2 pregnancies were terminated, 2 survived to delivery at 34 and 39 weeks and 1 suffered intra-uterine fetal death at 30 weeks. MRI was performed for 40 cases with presumed CCAM confirmed in 39. The average number of examinations (USS or MRI) was 5.8 per pregnancy. Median gestation at delivery was 39 weeks.

Discussion
This study contributes to the literature regarding the natural disease progression of prenatal CCAM and optimization of surveillance. MRI is useful in diagnosis and informing patient counseling.
Placental T2* in normal pregnancy and in two cases of Fetal Growth restriction.

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Objective
To investigate placental T2* in uncomplicated pregnancy and in two cases of fetal growth restriction (FGR) due to placental insufficiency.

Methods
T2* was estimated in 24 uncomplicated pregnancies between gestational week 24 and 40 and in two extreme cases of FGR. In FGR cases ultrasound Doppler examination demonstrated redistribution of fetal blood flow indicating light fetal hypoxia (case 1, gestational week 30+3) and severe hypoxia and acidosis (case 2, gestational week 24+5). T2* measurements were performed using a gradient recalled echo sequence with multiple readouts at 16 different echo times. T2* value was calculated using a non-linear fitting algorithm. The linear correlation between T2* measurements and gestational age was estimated by Pearson's correlation coefficient.

Results (figure 1)
In normal pregnancies the mean T2* was 81.3±28.1 ms and a negative linear correlation between T2* and gestational age was found (R² =0.68, p<0.001) with a decline of 4.8 ms per week. In the FGR cases T2* was 29.6 ms and 27.0 ms respectively.

Conclusion
In normal pregnancies T2* decreases with gestational age. This finding reflects a combination of: (1) A morphological maturation of the developing placenta as previously demonstrated by placental T2 measurements; and (2) A decrease in placental oxygenation as pregnancy advances, which is a result of an increasing metabolic demand of the fetoplacental unit. In the FGR cases the T2* was reduced suggesting abnormal placental morphology and reduced placental oxygenation. Placental T2* measurement has the potential to become a non-invasive test of placental morphology and oxygenation in FGR pregnancy.

Figure 1: Placental T2*: Blue dots: normal pregnancies, green dot: case 1, red dot: case 2.
Placental BOLD MRI: Oxygen test in two cases of Fetal growth restriction.

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Objective
Fetal growth restriction (FGR) due to placental insufficiency is associated with an increased risk of fetal morbidity and mortality, and fetal prognosis is closely related to placental function. In two cases of FGR placental function was estimated by placental BOLD (Blood Oxygen Level Dependent) MRI during oxygen test, as the hyperoxic increase in placental BOLD signal reflects the placental oxygen transport. Fetal wellbeing was estimated by ultrasound Doppler flow examination: Case 1: Moderate hypoxia. Case 2: severe hypoxia and acidosis. Fetal characteristics and outcome are presented in Table 1.

Method
Dynamic T2* weighted placental BOLD MRI was performed during maternal hyperoxia, and the hyperoxic increase in placental BOLD signal was estimated. Scan protocol: TE=50, TR=8000, Flip: 90°. The two cases were compared to eight normal controls.

Results
In the BOLD image the placentas of the FGR cases appeared darker than normal (Figure 1). The oxygen test: Case 1 demonstrated a strong placental BOLD response above normal and Case 2 demonstrated no increase in placental BOLD signal, Figure 2.
Conclusion

Placental BOLD MRI demonstrated a clear visual difference between the normal and the FGR placenta, as the latter appeared darker in the BOLD image. Furthermore, the oxygen test was different in the two FGR cases. The placental non-response of Case 2 indicates a very poor placental oxygen transport, which explains the adverse neonatal outcome in this case. Placental BOLD MRI has the potential to become a non-invasive test of placental function, and thereby a predictor of fetal outcome in cases of FGR.

Figure 1

Legend: (A) Case1: Gest. week 30+3. (B) Case2: Gestational week 24+5. (C) Control: Gestational week 24+5. Arrow marks the placenta.

Figure 2

The hyperoxic placental BOLD response in a group of normal controls (n=8) mean ±SD (Blue), case1 (Green), and case2 (Red).
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>case 1</th>
<th>case 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational week</td>
<td>30+3</td>
<td>24+5</td>
</tr>
<tr>
<td>Estimated fetal weight (UL)</td>
<td>956 g (-43%)</td>
<td>361 (-51%)</td>
</tr>
<tr>
<td>Fetal karyotype (amniocentesis)</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>Fetal malformation (ultrasound)</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Biophysical profile</td>
<td>Normal</td>
<td>Abnormal (Oligohydramnious)</td>
</tr>
<tr>
<td>Cerebro placental ratio</td>
<td>0.89</td>
<td>0.40</td>
</tr>
<tr>
<td>Ductus venosus flow</td>
<td>Normal</td>
<td>Abnormal (Pulsatibility Index:1.63)</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td>Acute caesarian section in gestational week 31 because of non-reassuring fetal heart rate pattern. The neonate had an uneventful admission to neonatal care unit and development is normal at one year.</td>
<td>Still birth in gestational week 26. Because of the small size of the fetus acute delivery on fetal indication was never an option in this case</td>
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Imaging review of fetal neck masses on ultrasound and MRI with a suggested algorithm to aid differential diagnosis

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When antenatal ultrasound detects an abnormality in the fetal neck, magnetic resonance imaging (MRI) is often utilised to confirm the findings and evaluate it further. MRI not only has a role in aiding differential diagnosis, but with its excellent tissue plane differentiation capabilities, helps to illustrate structures involved. This illustration of different tissue planes, means that MRI also has a role in establishing airway patency, alongside ultrasound colour/power Doppler which can demonstrate nasopharyngeal flow. Where airway compromise is confirmed an ex utero intrapartum treatment (EXIT) procedure can be performed, where the fetus is partially delivered and the airway secured prior to umbilical cord clamping.

Neck masses are broadly categorised into anterior and posterior. Posterior neck masses rarely affect the airway but do have other clinical and prognostic implications for the fetus. The anterior neck masses need to be differentiated as not only can they compromise the airway, but can also have major clinical implications for the fetus. This imaging review presents images of the different types of neck masses on ultrasound and MRI, and a suggested algorithm to aid their differential diagnosis.
Fetal Ventriculomegaly diagnosed at the 18 week ultrasound anomaly scan. Management?

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Objective
Optimal tertiary hospital management!? 

Methods
Presentation of 6 cases of CNS ventriculomegaly. 5 within the last calendar year where a multidisciplinary fetal neurologic team approach was added to the usual investigation of CNS anomalies. Multidisciplinary team included fetal medicine specialists, radiologists – fetal MRI, clinical geneticists, neonatologists, paediatric “neurology request”. Investigations included tertiary unit neurosonography in all cases; fetal brain MRI, post-mortem and genetic array.

Results
Investigations which contributed to the diagnoses: fetal neurosonography in all cases ; - MRI in 3* cases; postmortem(PM)-3 cases*;(* 1 case both fetal MRI and PM);. Genetic deletion 1 case.

Diagnoses
3 cases kinked brainstem;2 cases Lissencephaly :-Type II & cobblestone; 1 case progressive unilateral V/megaly MRI at 30 weeks prognostic range of interpretation variable; 1 case 8MB genetic deletion (array).

Outcome
5 terminations of pregnancies and 1 live birth.

Conclusions
Advances in paediatric & fetal neuro-imaging,-genetics, -pathology expertese in relatively few centres throughout the world has raised the standard of prenatal diagnosis significantly. This is associated with significant management challenges for tertiary Fetal Medicine Units & associated disciplines. These include making a timely diagnosis, providing objective prognosis & managing patient FEAR and the consequences thereof. The management, diagnoses & outcomes of the cases presented highlight the challenges facing a single tertiary centre.
Choroidal fissure cysts in the fetus: imaging findings and outcomes
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Objectives
Choroidal fissure cysts (CFC), usually considered an incidental finding on brain imaging, are infrequently reported in the antenatal literature. We illustrate the spectrum of appearances on fetal MRI and correlate with clinical outcome.

Methods
Our fetal MRI database was interrogated to identify all cases of antenatally detected CFC at our institution. The antenatal and postnatal imaging and the clinical records of each case was reviewed to determine clinical outcome.

Results
Six patients with CFC were diagnosed on fetal MRI following detection of an intracranial cyst on routine antenatal ultrasound. Gestational age at time of MRI ranged from 24-34 weeks. Cyst size ranged from 20 mm to 62 mm in maximal dimension. Associated findings included temporal lobe atrophy, hippocampal compression, callosal dysgenesis and ventriculomegaly. Five cases resulted in live births; with a range of clinical outcomes from no neurological sequelae, to seizures, to hydrocephalus with recurrent surgical intervention and related complications. In the sixth case the parents opted for termination of pregnancy due to progressive antenatal expansion of the cyst and associated anomalies including expansion of the hemicranium and callosal dysgenesis.

Conclusions
CFC detected in fetuses are usually larger than those seen incidentally in children and adults, and can be associated with other structural brain anomalies and post natal neurological morbidity. Therefore they cannot be regarded as benign entities. Increasing diagnostic accuracy of antenatal ultrasound and fetal MRI is likely to increase the frequency of detection of CFC. There is currently little published data on clinical outcome and standardised management. Caution is therefore advised in counselling of these patients due to the broad range of possible clinical outcomes.
Klippel Feil syndrome with diastematomyelia and inner ear dysplasia: unexpected diagnosis on fetal MRI

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Objectives
Klippel Feil syndrome (KFS) is characterised clinically by a triad of short neck, low posterior hairline and limited neck movement; and radiologically by a congenital defect in the formation or segmentation of the cervical spine. It is associated with multiple developmental abnormalities, and is almost exclusively a postnatal diagnosis. We present a case of KFS with associated cervical diastematomyelia and inner ear dysplasia demonstrated on fetal MRI, performed for an unrelated indication.

Methods
The fetal MRI and postnatal imaging of a known case of Klippel Feil is reviewed.

Results
Fetal MRI performed at 33 weeks gestation for suspected congenital diaphragmatic hernia showed minor bilateral diaphragmatic eventrations. In addition, the fetal neck was short and extended with a split cervical cord and the inner ears were dysplastic. Postnatally the infant had a webbed neck and hearing deficiency, with complex cervical segmentation fusion anomalies, cervical diastematomyelia and dysplastic inner ear structures on imaging.

Conclusions
KFS is associated with defects in many organ systems including the inner ear and spinal cord. We report an unsuspected case with diagnostic features on fetal MRI. This illustrates that although MRI is often used as a problem solving tool to answer specific clinical questions prompted by abnormal ultrasound findings, careful inspection of the entire study can lead to an unexpected diagnosis.
Objective
To evaluate the value of ultrasonography and magnetic resonance imaging in the diagnosis of fetal small bowel obstruction.

Methods
14 fetus with “double bubble” sign or dilated small bowel were included in this study. MRI was used to analyze the location of the obstruction and the visibility of the colon and rectum. The final diagnosis was based on postnatal or fetal pathological examination.

Results
With ultrasonography, 6 fetus showed classic “double bubble” sign, and the other 8 fetus showed vary degrees of dilated small bowel. 10 of them were associated with polyhydramnions, while 4 of them were associated with normal amniotic fluid volume. With MR, the “double bubble” sign were confirmed in 7 fetus. Besides, MR precisely determined the site of occlusion, such as superior part, descending part, horizontal part or ascending part. The postatretic bowel were also clearly displayed by MR.

Conclusions
MRI are good complementary tools to prenatal ultrasonography for identifying small bowel obstruction. MRI could assess the location of the obstruction and the postatretic bowel.

Key words - Fetus; Duodenal atresia; Jejunal atresia; Ileal atresia; Ultrasonography.
Prenatal ultrasound and MRI findings of temporal and occipital lobe dysplasia in a twin with achondroplasia
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Thanatophoric dysplasia, hypochondroplasia and achondroplasia are all caused by FGFR3 (fibroblast growth factor receptor 3) mutations. Neuropathological findings of temporal lobe dysplasia are found in thanatophoric dysplasia and recently, temporal and occipital lobe abnormalities have been described in brain imaging studies of children with hypochondroplasia. We describe twins discordant for achondroplasia, in one of whom the prenatal diagnosis was based on ultrasound and fetal MRI documentation of temporal and occipital lobe abnormalities characteristic of hypochondroplasia in addition to the finding of short long bones. Despite the intracranial findings suggestive of hypochondroplasia, achondroplasia was confirmed on postnatal clinical and genetic testing. These intracranial abnormalities have not been previously described in a fetus with achondroplasia.
Dysgenesis of corpus callosum in surviving fetus of monochorionic twins with one fetal demise: findings of neurosonography and fetal MRI

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Objective
To demonstrate brain lesions of surviving twins in monochorionic twins with one intrauterine fetal demise with neurosonography and fetal MRI.

Method
A 32-year-old woman, G2P0A1, without past history, was pregnant with monochorionic twins; selective IUGR had been noted since early second trimester. Amniocentesis reported 46,XX. Single intrauterine fetal demise was found at 22+5 weeks of gestation and was transferred to our hospital at 24+5 weeks of gestation.

Result
Transabdominal sonography of the surviving fetus showed dysgenesis of the corpus callosum. Transvaginal neurosonography revealed multiple tiny cysts over cortical area of parietal lobes and paraventricular white matter area, highly suspected clastic lesions resulting from hypoxic-ischemic insult; polymicrogyria was also suspected due to abnormal sulci of cortex. Fetal MRI confirmed multicystic encephalomalacia affecting the cingulate gyri with destruction of the body and splenium of the corpus callosum. The couple decided to terminate the pregnancy after feticide. Autopsy was declined. In our case, prenatal neurosonography is useful for assessment of brain lesions. Fetal MRI confirmed our neurosonographic findings, expect polymicrogyria.

Conclusion
For monochorionic twins, single intrauterine death is associated with high risk of long-term neurological sequelae for the surviving fetus. Both fetal neurosonography and MRI were useful to exclude cerebral lesions in surviving fetus of monochorionic twins with one intrauterine fetal demise. The use of transvaginal sonography gives great information for fetus with vertex presentation. The experiences of sonographist and radiologist are crucial for accurate detection of hypoxic-ischemic brain lesions.
MR Assessment of Blood Flow in the Microvasculature of Placenta using Diffusion Weighted Imaging
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Introduction
The fetal-placental hemodynamics have not been well investigated with MRI, due primarily to motion artifacts. Few studies have shown that placental blood flow could be assessed with diffusion weighting imaging (DWI); however, there is a need for improved acquisition and analysis tools.

Objective
Measure capillary blood flow in human placenta in vivo using MRI without the use of extrinsic-contrast agents.

Methods
8 pregnant women were imaged on a 1.5 T Siemens scanner using phased array coils. Study had IRB approval; subjects were considered to have normal placentas. Entire placenta was imaged using a respiratory-triggered DW_SS_EPI sequence. Parallel-imaging and navigator respiratory-triggered techniques were used to minimize motion artifacts (imaging time 124 s, 13 b-values).

Analysis
In placenta vascular compartment is large, thus diffusion decay is bi-exponential; a component corresponds to diffusing water, the other to water in the microvasculature. This is the Intravoxel Incoherent Motion (IVIM) model:

\[
S'/S_0 = (1 - f) \exp(-bD) + f \exp(-bD^*)
\]

where parameters are $S$(DW signal), $S_0$(b=0 signal), and blood flow related $D$ and $D^*$(diffusion and pseudo-diffusion) coefficients and $f$-perfusion fraction. ROI-analysis as well as pixel-by-pixel parametric maps were performed.

Results
IVIM parameters were not dependent on gestational age. Whole placenta values were: 
$D=$(1.76±0.215)x10-3mm2/s, $D^*=$(30.30±11.65)x10-3mm2/s, and $f=$(39.46±6.36 %). $D^*$ variation is directly related to the velocity of circulating fetal blood and the length of randomly-oriented capillary segments. Conclusion: Parametric maps were consistent with placental structure and fetal/maternal hemodynamics. Such maps could identify tissue differences and give important insight into placental transport. This technique could become instrumental in the assessment and management of abnormal pregnancies.
Does MRI have an impact on clinical decision making for CNS anomalies initially defined by ultrasound?

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Objectives
In Vietnam, most pregnant women are offered ultrasound scans at 12, 22 and 32 weeks. If an anomaly is diagnosed, then women are referred to Tudu hospital for further assessment or advice about prognosis. We were the first centre in Vietnam that has been able to offer fetal MRI as an additional method of imaging assessment, with a service starting in April 2010. We present data on the impact of this technology on the diagnosis of fetal CNS abnormalities.

Methods
This is a retrospective review of women who had both US and MR imaging of potential CNS anomalies over a three year period (April 2010 - April 2013). 621 pregnant women were imaged for indications including ventriculomegaly (n=273; 43.9%), abnormalities of the posterior fossa (n= 128; 20.6 %), abnormalities of the corpus callosum (n=81; 13.1%) and others (n = 139, 22,4%)

Results
The findings at MRI were the same, showed minor differences / further information or changed in diagnosis and clinical management in 354 (57%), 96 (15.5%) and 171 (27.5%) patients respectively. The original ultrasound diagnosis was most likely correct and complete for fetuses with isolated microcephaly, ventriculomegaly, an arachnoid cyst or mega cisterna magna. The US diagnosis was least likely correct / complete for callosal anomalies, posterior fossa anomalies, liscencephaly or intracranial haemorrhage.

Conclusions
MRI is a valuable tool, improving the diagnosis and management of fetal CNS abnormalities in a significant proportion (43%) of cases. MRI appears to be particularly valuable for accurate diagnosis of abnormalities of the corpus callosum and posterior fossa.
**45791**  
**DCDA Twins with T21 and ovarian metastatic signet ring adenocarcinoma: MRI used in the diagnosis of an unusual cause of preterm labour.**  
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A 33 year old primip with a spontaneous DCDA pregnancy presented at 25+6 weeks gestation with threatened preterm labour, hirsutism, acne and clitoromegaly. Ultrasound revealed IUGR in Twin 1, both twins had hypoplastic nasal bones and increased liquor volume (DVP 7/11cm). Incidentally a maternal large LUQ solid cystic mass with ascites was noted. Amnioreduction of both sacs was performed, karyotype 47XY +21 was found in both twins. MRI examination further defined the ovarian pathology: Left ovary (22 x 13 x 17 cm) solid mass with multiple peripheral cysts, right ovary (7 x 5 x 8 cm) multicystic. Raised tumour markers (βHCG, DHEA-S, Testosterone, SHBG, FAI, αFP and inhibin) were noted. Medical termination of pregnancy was undertaken (with Ethics Approval), followed by ovarian biopsy, debulking/staging laparotomy and endoscopy, confirming the diagnosis of metastatic signet ring adenocarcinoma of likely GI origin. The patient is now nine months post-surgery, having completed eight cycles of FOLFOX chemotherapy (Oxaliplatin with fluorouracil (SFU) and folinic acid).

Up to 2% of pregnancies are complicated by adnexal masses but only approximately 10% of these are malignant. The vast majority of these are primarily ovarian in origin (epithelial or germ cell). As in the non-pregnant population, a small proportion of ovarian malignancies are metastatic, the commonest primary sources are breast and gastric cancers. Interpretation of tumour markers during pregnancy is difficult, as many demonstrate a physiological rise. Metastatic signet-ring cell adenomucinous carcinomas (Krukenberg tumours) are most commonly found in pre-menopausal women, and have been reported in the perinatal period.