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ORIGINAL RESEARCH

Usefulness of MRI in evaluation of congenital fetal anomalies detected by ultrasonography

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Abstract

Introduction: Congenital anomalies vary substantially in severity. Anomalies which affect an infant"s life expectancy, health status, physcial or social functioning may be described as "major anomalies". In contrast, "minor anomalies" are those with little or no impact on health or short term or long term function. Prenatal screening for fetal malformations is an important component of prenatal care. Recent progress in the fields of maternal fetal medicine, radiology, and genetics has resulted in great advances in prenatal diagnosis**.** The use of fetal MRI can confirm the presence of lesions noted by ultrasound and may demonstrate additional anomalies. Fetal MRI has been performed since 1983, primarily to study central nervous system(CNS).Magnetic resonance imaging (MRI) is now being used in conjunction with ultrasound to provide additional information for prenatal diagnosis. The advantages of MRI include the lack of ionizing radiation, superior spatial and soft tissue resolution, relatively operator independent, better fetal anatomy delineation independent of fetal positionand maternal obesity, use of multiple planes for reconstruction & a large field of view, making the visualization of complicated anomalies easier.

Aim & objective: The present study was conducted with the aim to study the additional value of fetal MRI in assessment of fetuses with abnormal findings on ultrasound and focus on, Confirmation of inconclusive sonographic findings on MRI & detection of additional anomalies on MRI leading to a change in diagnosis, prognosis and management during pregnancy.

Material and methods: Present study was conducted in the Postgraduate Department of Radiodiagnosis and Imaging, Government Medical College, Srinagar over a period of 18 months, after obtaining ethical clearance from institutional ethics committee. This cross-sectional study where pregnant patients with detected congenital fetal anomalies on ultrasonography were subjected to fetal MRI. The study included 68 patients with ultrasound documented fetal anomaly. The age of pregnancy was confirmed. It was made sure that the mother takes nothing by mouth for at least 4 h prior the scan to prevent postprandial motion and that she empties her bladder before the study.

Results: The mean age of study group was 29 years with age ranging from 18-40 years. Maximum number of pregnant females with congenital fetal anomalies were in the age group of 28-32 years followed by 23-27 years. Most of the studies were done in 3rd trimester at 34-

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35 weeks followed by 28-29 weeks. The highest number (16%) of subjects were within the Gestational age 34-35 weeks. Ultrasonography detected 74 anomalies in 65 patients of the study group. The maximum anomalies detected included fetal brain and spine malformations followed by urogenital malformations. Among craniospinal anomalies the most commonly detected abnormality was Ventriculomegaly (17%) and Chiari 2 malformation (10 %). MRI detected 88 anomalies in 65 patients of the study group. The maximum anomalies detected included fetal brain and spine malformations followed by urogenital malformations. Corpus callosum agenesis/dysgenesis and Chiari 2 malformations were the most commonly detected craniospinal malformations by MRI with a prevalence of 9.1 % each. MRI confirmed USG diagnosis with additional findings in 29.5% of cases, changed USG diagnosis in 20.5% of cases and changed USG diagnosis to normal in 9% of the cases resulting in an overall Change in diagnosis in 59% patients of the study group.

Key words: Congenital anomalies, MRI, Ultrasonography, Malformations, Diagnosis

Introduction

Congenital anomalies, also referred to as birth defects, congenital abnormalities, are conditions of prenatal origin that are present at birth, potentially impacting an infant's health, development and/or survival. Congenital anomalies vary substantially in severity. Anomalies which affectan infant's life expectancy, health status, physcial or social functioning maybe described as "major anomalies". In contrast, "minor anomalies" are thosewith little or no impact on health or short term or long term function.**[1]**

Prenatal screening for fetal malformations is an important component ofprenatal care. Recent progress in the fields of maternal fetal medicine,radiology, and genetics has resulted in great advances in prenatal diagnosis**.[2,3]**A wide range of other congenital anomalies can bediagnosed with US at 11-14 weeks gestation, including defects of CNS, heart,anterior abdominal wall, urinary tract, and skeletal system. The anatomicalsurvey can be performed with a standardised protocol by using transabdominal US and, when necessary, transvaginal US.**[4]**However, due to its limitations like small field of view,operator dependence, limited soft tissue acoustic contrast, poor image qualityin pregnancies complicated by oligohydroamnios, unfavourable position ofthe fetus, beam attenuation by adipose tissue, near field reverberation artefactand limited visualization of the posterior fossa after 33 weeks of gestationbecause of calvarial calcification, a need for an additional imaging modalityhas emerged.**[3,5,6]**

The use of fetal MRI can confirm the presence of lesions noted byultrasound and may demonstrate additional anomalies.**[7]** Fetal MRI has beenperformed since 1983, primarily to study central nervous system(CNS).**[8]**Magnetic resonance imaging (MRI) is now beingused in conjunction with ultrasound to provide additional information forprenatal diagnosis. The advantages of MRI include the lack of ionizingradiation, superior spatial and soft tissue resolution, relatively operatorindependent, better fetal anatomy delineation independent of fetal positionand maternal obesity, use of multiple planes for reconstruction & a large fieldofview, making the visualization of complicated anomalies easier.**[6]** Advanced MRI techniques such as diffusion-weighted imaging (DWI) and magnetic resonance spectroscopy (MRS)have been applied to fetal MRI. **[9,10,11,12]**Diffusion imaging of Fetal Brain has the potential application for both developmental & destructive brain processes.**[9]**

Fetal MRI is also performed using balanced steady-state freeprecession **(SSFP)** sequences as balanced fast field echo (b-FFE/True-FISP).**[13,14]** In the case of fetal brain imaging both SSFSE and b-FEEsequences provide comparable image quality especially in the 2nd trimester;however, the axonal myelination in the third trimester is better delineated bythe latter sequence.**[14]**Indications for fetal MRI include the confirmation of inconclusivesonographic findings and the evaluation of sonographically occult diagnoses.It is

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unlikely that MRI will supplant US in the primary evaluation ofpregnancy status and fetal well-being. MRI is usually required only for acertain anatomic region, whereas a complete anatomic survey of the fetus isnot required. **[9, 15]** Fetal MRI is performed to evaluate the gastrointestinal tract (GI) in caseswhere anomaly is suspected by prenatal sonography. Most commonindications to fetal GI MRI involve the obstruction of esophagus and smalland large bowel, and malrotation and perforation of fetal GI. MRI issignificant in detecting the abdominal wall defects such as diaphragmatichernia, gastroschisis and omphalocele. **[16]**
MRI could be helpful in providing tissue characterization of fetal abdominal masses when US studyis nonspecific.**[10]** Because of the characteristic signal intensity of meconium,fetal MRI can distinguish marked bowel dilatation from cystic masses suchas choledochal cyst and ovarian cyst. MRI is particularly useful in theassessment of pregnancies complicated by oligohydramnios which can limitthe diagnostic sensitivity of US.**[10]** The fetal face is an important part of antenatal structural survey. Facialmalformation may indicate an underlying chromosome abnormality orsyndrome.**[17,18,19]** Three-dimensional US technique has been used to generateaccurate detailed images of the facial surface anatomy.**[17]** Using the three orthogonal planes, MRI can help US in assessment of complex craniofacialdeformities such as holoprosencephaly and craniosynostosis.**[20]**The length, signal Intensity on T2-weighted images, and apparentdiffusion coefficient (ADC) of the fetal kidney change significantly withgestational age.**[21]** Renal cortex is hypointense to the medulla on T2-weightedimages. Progressive increase in renal cortex/medulla signal intensity ratiowith gestational age reaches its maximum at term.**[21,22]** The urinary bladderis easily recognized as a fluid filled structure in the pelvis. Since the fetalpelvis is very small ,the filled urinary bladder may occupy considerableportions of the abdomen in older fetuses (>30WG**).[23]** MRI can showmorphological features of urinary diseases as cystic lesions of the kidneys,obstructive uropathy (e.g. posterior urethral valve), renal tumors, and urinarytract anomalies. **[22]**Fetal MRI can assess the skeleton and muscles owed to the innovationsin MRI. Sequence technology such as echoplanar imaging (EPI), thick slabT2-Weighted, and dynamic sequences. Ultrasonography, particularly threedimensionalimaging, remains the method of choice in measuring bones andobserving abnormal fetal skeletal anomalies such as club foot or abnormalfingers.**[20]**
The present study was conducted with the aim to study the additional value of fetal MRI in assessment of fetuses withabnormal findings on ultrasound and focus on, Confirmation of inconclusive sonographic findings on MRI& detection of additional anomalies on MRI leading to a change indiagnosis, prognosis and management during pregnancy.

Material and methods

The present study was conducted in thePostgraduate Department of Radiodiagnosis and Imaging, GovernmentMedical College, Srinagar over a period of 18 months, after obtaining ethicalclearance from institutional ethics committee. This cross-sectionalstudy where pregnant patients with detected congenital fetal anomalies onultrasonography were subjected to fetal MRI.The study included 68 patients with ultrasounddocumented fetal anomaly. After proper consent, patients underwent MRIand the results of USG and MRI were compared to each other. Theobservations were recorded and analysed.All pregnant women with either suspected or detected fetal anomalieson ultrasonography were included while set Exclusion criteria were pregnant women with normal antenatal US, Pregnant women having a history of claustrophobia, Pregnant women having a history of metallic implants insertion, non, MRI compatible cardiac pacemakers and metallic foreign body in situ and pregnant women who did not give consent for the procedure.The main source of the data for the study were pregnant women coming tothe Radio-diagnosis department of Government Medical College, Srinagar.All Pregnant women referred to the department of Radio diagnosis withconfirmed

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antenatal congenital anomaly or for Anomaly Scan withsubsequent diagnosis of congenital anomaly were subjected for the study. Asper PC & PNDT act, Form F were filled by the patient. All the patients hadan ultrasound examination performed at the Radio-diagnosis departmentusing USG scanner in the department (GE LOGITECH S8) to confirm thefindings .The age of pregnancy was confirmed. It was made sure that themother takes nothing by mouth for at least 4 h prior the scan to preventpostprandial motion and that she empties her bladder before the study. Afterfulfilling the selection criteria, informed and written consent for MRI wasobtained and the patient were through appropriate metal screening. MRI wasbe performed by using Siemens 3 Tesla 48 -channel MagnetonSkyramachine at GMC Srinagar.

Imaging Protocol

1. An initial three plane free breathing FLASH localizerwas obtainedwith respect to the mother's imaging planes. Scout acquisition is used forthe initial fetal visualization; for optimal signal intensity in the subsequentsequences, the fetal region of interest should be within the center of thecoil.
   TR (7ms), TE (3ms), FOV (300mm), THK/GAP (5/0.5mm)
2. Transverse, sagittal and coronal True-FISPorthogonal to abdomen andpelvis of the mother (performed free breathing).**TR (3.5ms), TE (1.7ms), FOV (300-400mm), THK/GAP (4-6/0mm)**
3. Transverse, sagittal and coronal **HASTE** to the fetus or fetal head withconcatenations equal to the number of slices.**TR (15,000ms), TE (120ms), FOV (300-400mm), THK/GAP (46/0mm)**

Qualitative data was represented in form of percentage, Association between qualitative variables was assessed by Chi-Square test,with Continuity Correction for all 2 X 2 tables and by Fisher's Exact test.Quantitative data included age and gestational age.Results was graphically represented where deemed necessary.Appropriate statistical software, including but not restricted to MS Excel,PSPP version 1.0.1 was used for statistical analysis. Graphical representationwas done in MS Excel package included in Microsoft Office 365. An alphavalue (p-value) of <=0.05 was used as the cut-off for statistical significance.

Results

The mean age of study group was 29 years with age ranging from 18-40 years.Among the various age groups, maximum number of pregnant females with congenital fetal anomalies were in the age group of 28-32 years followed by 23-27 years. The least number of participants were in the age group 38-42 years. (Table 1).

Table 1: Age wise distribution of pregnant females with Congenital fetal anomalies.

Age group in years	No. of cases	Percentage
18-22	4	6%
23-27	19	28%
28-32	29	43%
33-37	14	20.0%
38-42	2	3%
Total	68	100%

Table 2: Distribution of congenital fetal anomalies according to gestational age.

Gestational age in weeks	No. of cases	Percentage
18-19	7	10.5%
20-21	9	13%
22-23	8	12%
24-25	7	10.5%

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26-27	5	7%
28-29	8	12%
30-31	5	7%
32-33	6	9%
34-35	11	16%
36-37	2	3%
Total	68	100%

Table 2 shows the distribution of congenital fetal anomalies according to gestational age. The mean gestational age of study group was 27 weeks with gestational ageranging from 18-37 weeks. Most of the studies were done in 3rd trimester at34-35 weeks followed by 28-29 weeks. In second trimester most of the studieswere done at 18-23 weeks. The highest number (16%) of subjects were within the Gestational age 34-35 weeks.

Table 3: Pattern of congenital anomalies on ultrasonography

USG Findings	No. of cases	Percentage
Ventriculomegaly	12	17%
Chiari 2 malformation	8	10.0%
Fetal pyelectasis/HDN	6	8%
Mega cisterna magna	5	7%
Dandy Walker malformation	4	5.3%
Diaphragmatic hernia	4	5.3%
Chiari 3 malformation	3	4%
Holoprosencephaly	3	4%
Renal agenesis	3	4%
Omphalocele	2	3%
Bladder outlet obstruction	2	3%
CPAM	2	3%
Cystic hygroma	2	3%
Corpus callosal agenesis	1	1.3%
Cervical meningocele	1	1.3%
Supra sellar mass	1	1.3%
Choroid plexus cyst	1	1.3%
Pontocerebellar dysplasia	1	1.3%
Vein of Galen malformation	1	1.3%
Sacrococcygealteratoma	1	1.3%
Cervical teratoma	1	1.3%
Gastrochisis	1	1.3%
Meckel Gruber syndrome	1	1.3%
Hydrops	1	1.3%
Adrenal haemorrhage	1	1.3%
Achondroplasia	1	1.3%
ARPKD	1	1.3%
Mesenteric cyst	1	1.3%
Cleft lip/palate	1	1.3%
Rocker bottom foot	1	1.3%
Club foot	1	1.3%
Total	74	100%

Table 3 shows the pattern of congenital anomalies on ultrasonography. Ultrasonography detected 74 anomalies in 65 patients of the study group. Themaximum anomalies detected included fetal brain and spine malformationsfollowed by urogenital malformations. Among

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craniospinal anomalies the most commonly detected abnormality was Ventriculomegaly (17%) and Chiari 2malformation (10 %). The most common urogenital abnormality detected wasPyelectasis/Hydronephrosis. CNS anomalies represented the most common anomalies in our study with eleven cases of ventriculomegaly, eight cases of Chiari 2 malformation, three cases of mega cisterna magna, four cases of Dandy Walker malformation, three cases of Chiari 3 malformation, three cases of holoprosencephaly, one case each of corpus callosal agenesis, cervical meningocele, supra sellar mass, choroid plexus cyst, pontocerebellar dysplasia, vein of Galen malformation and sacrococcygealteratoma.

Table 4: Pattern of congenital anomalies on MRI.

MRI Findings	No. of cases	Percentage
Corpus callosum agenesis/dysgenesis	8	9.1%
Chiari 2 malformation	8	9.1%
Fetal hydronephrosis/Pyelectasis 6 7%	6	7%
Dandy Walker malformation 6 7%	6	7%
Mega cisterna magna 5 6.1%	5	6.1%
Isolated ventriculomegaly 3 3.5%	3	3.5%
Chiari 3 malformation 3 3.5%	3	3.5%
Congenital Diaphrgmatic Hernia 3 3.5%	3	3.5%
Omphalocele 3 3.5%	3	3.5%
Holoprosencephaly 2 2.2%	2	2.2%
Posterior urethral valve with cystic dysplastic kidneys	2	2.2%
CPAM 2 2.2%	2	2.2%
Multicystic Kidney Disease 2 2.2%	2	2.2%
Cystic hygroma 2 2.2%	2	2.2%
Rocker bottom foot 2 2.2%	2	2.2%
Club foot 2 2.2%	2	2.2%
Intracranial lesion 1 1.1%	1	1.1%
Diastematomyelia 1 1.1%	1	1.1%
Archnoid cyst 1 1.1%	1	1.1%
CSP cyst 1 1.1%	1	1.1%
Vein of Galen malformation 1 1.1%	1	1.1%
Craniopharyngioma/Teratoma 1 1.1%	1	1.1%
Saccrococcygealteratoma 1 1.1%	1	1.1%
Choroid plexus cysts 1 1.1%	1	1.1%
Macrocephaly 1 1.1%	1	1.1%
Cervical teratoma 1 1.1%	1	1.1%
Pleural/Pericardial effusion 1 1.1%	1	1.1%
Lung sequestration 1 1.1%	1	1.1%
Caroli’s disease 1 1.1%	1	1.1%
Total	88	100%

Table 4 shows the pattern of congenital anomalies on MRI .MRI detected 88 anomalies in 65 patients of the study group. The maximumanomalies detected included fetal brain and spine malformations followed byurogenital malformations. Corpus callosum agenesis/dysgenesis and Chiari 2 malformations were the most commonly detected craniospinal malformations by MRI with a prevalence of 9.1 % each. Fetal pyelectasis /hydronephrosis was the most commonabnormality detected among urogenital malformations.

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Table 5: Distribution of change in diagnosis in MRI and USG

Change in Diagnosis	No. of cases	Percentage
Confirmed Diagnosis	28	41%
Confirmed Diagnosis with additional findings	20	29.5%
Change of Diagnosis	14	20.5%
Changed Diagnosis to Normal	6	9%
Total	68	100%

Table 5 shows the distribution of change in diagnosis in MRI and USG. MRI confirmed USG diagnosis with additional findings in 29.5% of cases,changed USG diagnosis in 20.5% of cases and changed USG diagnosis tonormal in 9% of the cases resulting in an overall Change in diagnosis in 59%patients of the study group. In the remaining 41% patients MRI confirmed theUSG diagnosis. In all Fetal MRI's (n=68) considered, the initial ultrasound anomalies were confirmed in 41% of the cases. Clinically relevant additional findings were seen with fetal MRI in 29.5% of all examinations. In 20.5% of the cases, MRI provided information that led to a change in diagnosis. No fetal anomaly was demonstrated on MRI in 9% of the cases.

Table 6: Association between change in diagnosis and Gestational age.

I.	**NO CHANGE@**	**CHANGE IN DIAGNOSIS¥**			
Gestational age in weeks	**Confirmed diagnosis**	**Additional findings**	**Changed Diagnosis**	**Changed Diagnosis to Normal**	**Total**
18-19^	3	3	1	0	7
20-21^	3	5	1	0	9
22-23^	3	0	3	2	8
24-25^	5	1	1	0	7
26-27^	3	1	1	0	5
28-29#	2	2	3	1	8
30-31#	2	1	2	0	5
32-33#	2	2	1	1	6
34-35#	5	3	1	2	11
36-37#	0	2	0	0	2
					68
II.	**Chi square test**	**Valve**	**df**	**P value**	**Association**
	Pearson chi square $	25	27	0.58	Not significant
	Pearson chi square	1.1	1	0.28	Not significant
	$ 100% of cells have expected count less than 5, ^, #, @, ¥ Row and column data pooled and Chi square test reapplied with Continuity Correction.				

Table 6 shows association between change in diagnosis and Gestational age. Results of the present study described eight cases of Chiari 2 malformation. The diagnosis of Chiari 2/myelomeningocele was made on US examination, however MRI detected split cord malformation in one of the cases, corpus callosal agenesis in two cases and other additional anomalies (club foot, rocker bottom foot and pyelectasis). Among four cases of US diagnosed Dandy walker malformation, MRI demonstrated corpus callosal agenesis in two cases. Out of three cases of mega cistern magna, MRI changed the diagnosis to Dandy walker malformation in two cases.

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Table 7: Association between change in diagnosis and system involved

I.	NO CHANGE@	CHANGE IN DIAGNOSIS¥			
SYSTEM INVOLVED	**Confirmed diagnosis**	**Additional findings**	**Changed Diagnosis**	**Changed Diagnosis to Normal**	**Total**
Fetal Brain and Spine^	13	14	8	4	39
Fetal face and neck#	2	1	0	0	3
Fetal abdominal wall and GIT#	3	1	0	0	4
Fetal Chest#	3	1	2	0	6
Fetal urogenital tract#	6	3	3	1	13
Others#	1	0	1	1	3
					68
II.	Chi square test	Valve	df	P value	Association
	Pearson				
	chi square $	9.8	15	0.8	Not significant
$ 83% of cells have expected count less than 5, ^, #, @, ¥ Row and column data pooled and Chi square test reapplied with Continuity Correction.					

Table 7 shows the association between change in diagnosis andsystem involved. Highest change in the diagnosis was seen in fetal brain and Spine.

Discussion

The present cross sectional study was undertaken in the Department ofRadiodiagnosis & Imaging over a period of 18 months with the aim toassess the role of fetal MRI in evaluation of congenital fetal anomaliesdetected by ultrasonography. The study included 68 patients with ultrasounddocumented congenital fetal anomaly. After proper work up as per the setpro-forma and with informed and written consent, all patients underwent afetal MRI. In our study, post natal diagnosis like autopsy or imaging wasunavailable as most patients were not willing for the same after termination.

The mean gestational age of the study group was 27 weeks withgestational age ranging from 18-37 weeks. MRI examinations were avoidedin first trimester in accordance to ACR guidelines to avoid potential risk tothe developing fetus. 41 cases were detected at 18-28 weeks of gestation(second trimester) and 27 cases were detected at 29-37 weeks of gestation(third trimester).

CNS anomalies represented the most common anomalies in our studywith eleven cases of ventriculomegaly, eight cases of Chiari 2 malformation,three cases of mega cisterna magna, four cases of Dandy Walkermalformation, three cases of Chiari 3 malformation, three cases of holoprosencephaly, one case each of corpus callosal agenesis, cervicalmeningocele, supra sellar mass, choroid plexus cyst, pontocerebellardysplasia, vein of Galen malformation and sacrococcygealteratoma.This is in accordance with previous study by ManalHamisa et al who

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evaluated 23 pregnant females who were suspected to have fetus with congenital brain anomalies over a period of one year using ultrasound**. [24]**MRI was done within one week following 2D and 4D US examination. Antenatal Ultrasound and magnetic resonance findings were compared with postnatal MRI findings. MRI and ultrasound showed concordant findings in six cases. MRI changed the diagnosis in 14 cases and provided additional information in two cases. The main reason to refer a patient for fetal MRI was CNS abnormalities (57%), with the main sub category being ventriculomegaly (28%) , followed by posterior fossa anomalies. In our study 13 out of 39 cases of fetal brain anomalies were confirmed by MRI. The final diagnosis was changed after fetal MRI IN 8 cases. In 14 cases MRI provided additional information to that obtained by US. No abnormality was detected by fetal MRI in 4 cases.

All Fetal MRI's (n=68) considered, the initial ultrasound anomalieswere confirmed in 41% of the cases. Clinically relevant additional findingswere seen with fetal MRI in 29.5% of all examinations. In 20.5% of the cases,MRI provided information that led to a change in diagnosis. No fetal anomalywas demonstrated on MRI in 9% of the cases.The present study is in accordance to a study conducted by Lesley Bevanet al who evaluated the utility of MRI in the diagnosis of US detected fetalanomalies. 70 cases were identified. Forty seven (67%) MRI's wereperformed for CNS abnormalities, 10 (14%) for thoracic anomalies, 6 (9%)for genitourinary or gastrointestinal anomalies, and 7 (10%) for otherindications. MRI enhanced or altered diagnosis in 67% of the cases. **[25]**MRIconfirmed the original diagnosis in 80% of cases, provided additional clinically useful information regarding the initial diagnosis in 36% of cases,diagnosed an additional anomaly in 26% of cases, and refuted the originaldiagnosis in 13% of cases. MRI's performed for CNS anomalies were morelikely to provide an additional diagnosis not originally seen on US than MRI'sperformed for any other indication which is similar to the findings of previous findings by Behairy NH et al and Hosny et al.**[26]** Among the eleven cases of ventriculomegaly diagnosed byultrasonograhy, corpus callosal agenesis was demonstrated on MRI in fourcases. Evaluation of corpus callosum is much better with MRI where it isdirectly visualised as compared to US which relies on indirect signs.In the current study we described eight cases of Chiari 2 malformation.The diagnosis of Chiari 2/myelomeningocele was made on US examination,however MRI detected split cord malformation in one of the cases, corpuscallosal agenesis in two cases and other additional anomalies (club foot,rocker bottom foot and pyelectasis).Out of three cases of mega cistern magna, MRI changed the diagnosis toDandy walker malformation in two cases**.**Stazzone et al (2000)**[27]**retrospectively reviewed 66 fetal MRI studies and found that posterior fossa anatomy is well defined to exclude abnormalities of the fourth ventricle and cerebellar vermis in all cases. MRI is superior to ultrasound in evaluation of posterior fossa anomalies such as arachnoid cysts, Dandy-Walker syndrome, Dandy-Walker variant, mega cisterna magna and Arnold-Chiari malformations. In patients with Dandy- Walker syndrome, fetal MRI may display additional abnormalities that indicate a worse prognosis, including agenesis of the corpus callosum, polymicrogyria, neuronal heterotopia, and occipital encephalocele.

Our study includes three cases of holoprosencephaly by US, howeverMRI diagnosed one of the cases as a large Arachnoid cyst. MRI also detecteda small omphalocele in one of these cases.Fetal abdominal wall and gastrointestinal anomalies represented 6% of the cases in our study. MRI provided additional findings in one case and confirmed US diagnosis in rest of the three cases. Multiple additional findings of cystic dysplastic kidneys, mega cisterna magna and reduced chest circumference were demonstrated on MRI in a case of omphalocele with posterior urethral valves. MRI confirmed US diagnosis of a case of mesenteric cyst/enteric duplication cyst, omphalocele and gastrochisis showing extent of abdominal organ herniation in omphalocele and allowing better characterization of the distended bowel loops in gastrochisis. This is in accordance with a study by Lucia Manganaro et al in 2010-

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2012 who conducted a prospective study of 38 fetal MRI scans performed on 38 fetuses between 24 and 38 weeks of gestation.**[28]**MRI confirmed the diagnosis of US documented cervical teratoma, cystic hygroma, Meckel Gruber syndrome and twin with hydrops. No abnormality was seen in fetal MRI of a case of US diagnosed adrenal hemorrhage**.** NishitaKathary et al in 2001 presented two cases of fetal neck masses that were initially diagnosed by ultrasound and further evaluated with prenatal MRI. MRI findings aided in further delineating the neck masses, increasing confidence in the final diagnosis (cervical teratoma and cystic hygroma).**[29]**

Conclusion

The present crossectional study, completed over a period of 18 months, and the following conclusions were made: MRI is currently accepted as a valuable technique for imaging fetus and no deleterious effects have been shown so far. MRI undoubtedly has a role in improving detection of additional anomalies within the CNS. Certain conditions of abnormal fetal brain development are easier to diagnose by fetal MRI, such as corpus callosal agenesis/ dysgenesis, midbrain & brainstem anomalies and malformations of cortical development. Furthermore, ventriculomegaly on US might be the first imaging sign of a complex brain abnormality.In case of genitourinary anomalies, MRI provided anatomic details that allowed for adequate assessment of renal and bladder regions and amniotic fluid in all fetuses at any gestational age. Oligohydramnios did not hinder MRI diagnosis. The combined use of T1 and T2 WI allowed optimal differentiation between urinary tract (T2 hyperintense) and distal meconium filled intestines (T1 hyperintense). Thus, MRI is a potentially useful adjunct in the evaluation of fetal genitourinary anomalies.MR imaging can assist in establishing the prognosis and in perinatal management of congenital diaphragmatic hernia. MR can demonstrate hernial contents and quantify lung volume better than US. It also helps to distinguish different types of CPAM's and to differentiate between bronchopulmonary sequestration and Type 3 CPAM. Thus MR can be used as a useful adjunct to US in evaluating thoracic anomalies.

Thus we conclude that Fetal MR imaging can be used as a complementary tool in diagnosing congenital fetal anomalies. The integration of fetal MRI into the process of anomaly diagnosis can improve fetal and perinatal care or change pregnancy management.

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