The Influence of MR Imaging on Changes in Patient Counseling in Obstetric Patients with Suspected Fetal Anomalies by Ultrasound

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Objective: *To determine the frequency of additional information provided by magnetic resonance (MR) imaging in supplement to ultrasound (US) in patients with fetal anomaly and to determine the influence of MR imaging findings on patient counseling.*
Material and Method: *MR imaging of fetus was performed in 26 patients who have abnormal ultrasound results. Referring obstetricians were asked about how the additional information provided by MR imaging have effect on their decision marking, patient counseling, and case management.*
Results: *MR imaging in 23 of 26 fetuses was technically successful. MR imaging provided additional information in 14/23 (60.9%) cases. In the other nine (39.1%) cases, MR imaging confirmed US diagnosis but did not give supplementary information. Additional information from MR imaging affected patient counseling in five (21.7%) cases and did not affect patient counseling in the other nine (39.1%) cases. In 14 cases with additional information from MR imaging, there were isolated CNS involvement in five (35.7%) cases, isolated extra-CNS involvement in two (14.3%) cases, multisystem involvement in five (35.7%) cases, and other-category in two (14.3%) case.*
Conclusion: *MR imaging can provide additional information that have influence on patient counseling and patient care, particularly in cases with CNS and multisystem anomaly.*

Keywords: *MRI, Magnetic resonance imaging, Fetus, Fetal, Anomaly, Effect, Influence*

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Ultrasound (US) has been a modality of choice to detect fetal anomaly for a couple of decades. However, in case of complex congenital anomalies, oligohydramnios, large maternal body habitus, or complex anatomical structures, it may be difficult to be accurately assessed by US. It is well known in the literature that magnetic resonance (MR) imaging is a valuable complement to US when additional information is needed to make treatment decision[1-7]. For example, the US evaluation of fetal central nervous system (CNS) is limited by skull and image resolution, subtle parenchymal abnormalities may not be depicted. MR imaging has been proved to be beneficial in fetal CNS because MR imaging can provide an excellent CNS anatomical structure and image in three orthogonal planes. In addition, high density of the skull does not have effect in MR imaging. There are researches in the literature[1,2,4,5], which studied effect and influence of MR imaging on patient's counseling and management. However, no study has ever been performed in Thailand. The purpose of the present study was to compare the diagnostic utility of fetal MR imaging and US, to determine if MR imaging could provide additional information supplement to US and to evaluate the influence of MR imaging on changes in patient counseling.

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Material and Method

Patients

The present study was a multicenter study. Written informed consents were obtained from each patient. From 2004 to 2010, 26 pregnant patients were enrolled in the study. The targeted populations were women in second or third trimester of pregnancy, who have abnormal fetal US results. Of 26 patients, three patients were excluded from the study due to technically unsuccessful in MR imaging. The mean gestational age was 27.6 weeks (range, 18-36 weeks). There was one patient with twin pregnancy in which only one fetus was studied.

Methods

Ultrasound

The fetal US of all patients were performed by obstetricians who have experience in high-risk obstetric US. The mean time period between US and MR examination was 15 days (range, 5-25 days).

MR imaging

MR imaging of all patients were performed by 1.5 Tesla superconducting system (Avanto; Siemens, Erlangen, Germany) and Phillips (Achieva; Phillips Medical Systems, Best, The Netherlands) by using phased array body coil. Patients were scanned in the supine position and feet first to the gantry to minimize claustrophobia. Two patients could not lie in the supine position for a long period of time due to back pain and lay in lateral decubitus position. Scout scans of mother's abdomen were obtained in three planes by using scout spoiled gradient. Subsequently, fetal body images were obtained by using the following technique:

Siemens: True fast imaging with steady-state precession (TrueFISP) (TR/TE (msec), 3.7/1.8; flip angle, 70 degree; matrix 256x192; section thickness 4-5 mm), Half-Fourier acquisition turbo spin echo (HASTE) (Effective TE (msec), 97; refocus flip angle, 147 degree; matrix 256x256; section thickness 4-5 mm), T1W 2D gradient-echo fast low-angle shot (FLASH) (TR/TE (msec), 511/8.8; flip angle, 65 degree; matrix, 256x256; section thickness, 4-5 mm).

Phillips: Balanced fast field echo (bFFE) (TR/TE (msec), 4.5/2.2; flip angle 90 degree, matrix 136x80; section thickness 4 mm), T1W fast field echo (FFE) (TR/TE (msec), 80-100/4.6; flip angle 90 degree; matrix 280x90; section thickness 4-5 mm).

The field of view was tried to use as small as possible for visualization of fetal anatomy without wrap around artifact of the maternal anatomy. Average total examination time for each study was approximately 30 minutes. MR images were reviewed at the time of acquisition by a radiologist (principle investigator) for scan plane, technique quality, and adequacy of the information.

Radiologist (VV) reviewed MR images at the time of acquisition with clinical information and US results to ensure that the MR images were of diagnostic quality and focus in area of interest. The official MR imaging results were given to referring obstetricians in three to five days.

Assessment of influence on counseling

Patient's information, US and MR imaging findings were discussed together with referring obstetrician and radiologist. The obstetricians were asked about how the additional information provided by MR imaging have influence on their decision in terms of alter patient counseling, management plan, mode of delivery, preparation of health care team, and facility at delivery. Because decision making on counseling and management plan in patients with high risk pregnancy depended on many factors, such as gestational age, chromosomal result and maternal status, that may not depend only on US and MR imaging findings, the influence on patient counseling was used as an outcome, unless a clear change in case management occurred.

All pregnant women were followed for outcome of pregnancy. Postnatal information (chromosomal results and physical examination), autopsy results, and postnatal imaging (if available) were collected and recorded. If there was anomaly, which was found in the postnatal period but was not diagnosed in the prenatal imaging, US and MR imaging were reviewed and analyzed for false negative imaging findings.

The present study was approved by institutional ethic committee.

Results

The US, MR imaging findings and outcome are shown in Table 1. Twelve patents did not have postnatal findings due to loss of follow-up or referral to another hospital. Postnatal gross examination or postnatal imaging was available in 11 cases.

Twenty-three fetuses were enrolled in data analysis. Fetal anomalies involved isolated CNS involvement (n = 10), isolated extra-CNS involvement (n = 5), multisystem involvement (n = 5), and

Table 1. US, MR imaging findings and outcome in cases of fetal anomaly

	System	US findings	MR findings	Change counseling	Outcome
Isolated CNS	CNS (n = 10)	Ventriculomegaly (n = 4)	Ventriculomegaly with hemimegalencephaly and polymicrogyria (n = 1); Dandy-Walker complex, absent of corpus callosum, colpocephaly and heterotopias (n = 1); Dandy-Walker variant (n = 1); isolated ventriculomegaly (n = 1)	Yes (n = 1) No (n = 3)	Continue pregnancy (n = 3), terminate pregnancy (n = 1)
		Supratentorial cyst (n = 2)	Cyst at interpeduncular and prepontine cistern (n = 1); anterior midline interhemispheric cyst (n = 1)	Yes (n = 1) No (n = 1)	Continue pregnancy with special perinatal care for respiratory distress and seizure (n = 1), continue pregnancy (n = 1)
		Bilateral schizencephaly and bilateral ventriculomegaly (n = 1)	Same	No	Continue pregnancy
		Holoprosencephaly, cleft lip and cleft palate (n = 1)	Holoprosencephaly	No	Terminate pregnancy
		Arnold-Chiari malformation and open spina bifida at lumbosacral region (n = 1)	Arnold-Chiari malformation and lumbar myelocele	No	Continue pregnancy and cesarean section at term
		Colpocephaly, agenesis of corpus callosum and ventriculomegaly (n = 1)	Same	No	Continue pregnancy
Isolated extra-CNS	KUB (n = 3)	Anhydramnios with suspected renal hypoplasia (n = 2)	Confirm renal hypoplasia with pulmonary hypoplasia (n = 2)	Yes (n = 2)	Continue pregnancy with special perinatal care for respiratory distress
		Large cystic mass in abdomen with dilation of bilateral renal pelvis, ambiguous genitalia (n = 1)	Large urinary bladder with moderate bilateral hydronephrosis and ambiguous genitalia	No	Terminate pregnancy
	Chest (n = 1)	Left diaphragmatic hernia	Same	No	Continue pregnancy
	GI (n = 1)	Omphalocele	Omphalocele with herniation of liver, spleen and small bowel in the sac	No	Continue pregnancy
Multisystem	CNS, KUB (n = 1)	Arnold-Chiari malformation, open spina bifida at lumbosacral region and absent of right kidney	Arnold-Chiari malformation, myelocele at lumbosacral region and cross fused ectopia of right kidney	Yes	Continue pregnancy and special perinatal care for myelocele
	CNS, GI (n = 1)	Spina bifida with myelocele (uncertain about myelomeningocele), omphalocele, club foot and absent of urinary bladder	Myelomeningocele with tetered cord, omphalocele with herniation of liver and small bowel loop in the sac, maldevelopment of external genitalia and cloacal exstrophy	No	Terminate pregnancy
	CNS, KUB, GI (n = 1)	Meckel-Gruber syndrome (Dandy-Walker malformation, occipital encephalocele, pericardial effusion, pulmonary hypoplasia, autosomal recessive polycystic kidney disease and anhydramnios)	Meckel-Gruber syndrome (same findings as US with additional biliary tract dilatation)	No	Terminate pregnancy

US = Ultrasound; MR = magnetic resonance; CNS = central nervous system; KUB = kidneys, ureter, and bladder; GI = Gastrointestinal

Table 1. (cont.)

	System	US findings	MR findings	Change counseling	Outcome
Multisystem	CNS, KUB, face (n = 1)	Twin pregnancy; 1 fetus with spina bifida, mild ventriculomegaly and left paramedian cleft lip	Same findings as US with additional moderate left hydronephrosis	No	Continue pregnancy
	CNS, Chest (n = 1)	Left diaphragmatic hernia and polyhydramnois	Same findings are US with additional Dandy-Walker complex and agenesis of corpus callosum	No	Terminate pregnancy
Other	Other (n = 3)	Sacrococcygeal teratoma (n = 1)	sacrococcygeal teratoma with most of the tumor extent was external to fetal body, single umbilical artery	No	Continue pregnancy with cesarean section
		Intraabdominal pregnancy (n = 1)	Intraabdominal pregnancy, severe left hydronephrosis and severe left hydroureter	No	Continue pregnancy and cesarean section
		Hydrop fetalis (bilateral pleural effusion, ascites and polyhydramnios) (n = 1)	Same	No	Pleural tapping before delivery by cesarean section

US = Ultrasound; MR = magnetic resonance; CNS = central nervous system; KUB = kidneys, ureter, and bladder; GI = Gastrointestinal

other-category (n = 3) (Table 2). MR imaging demonstrated additional more information than did US in 14/23 (60.9%) cases. Additional information from MR imaging had effect on patient counseling in 5/23 (21.7%) cases and did not have effect on patient counseling in other 9/23 (39.1%) cases. In the other 9/23 (39.1%) cases, MR imaging confirmed diagnosis but did not have supplementary information.

In 14 cases with additional information from MR imaging, there were isolated CNS involvement in 5/14 (35.7%) cases, isolated extra-CNS involvement in 2/14 (14.3%) cases, multisystem involvement in 5/14 (35.7%) cases, and other-category in 2/14 (14.3%) cases. In five cases, which MR imaging had effect on patient counseling, there were isolated CNS involvement in two cases, isolated extra-CNS involvement in two cases and multisystem involvement in one case. These cases were described as follows.

The first case, US found severe ventriculomegaly with absent of cerebellar vermis. MR imaging demonstrated additional hemimegalencephaly and polymicrogyria. Cerebellar vermis was present. Patient counseling was changed from continue pregnancy to terminate pregnancy. The fetus died at birth.

The second case, US found a 4.4x3.7 cm cystic lesion at occipital area just above thalamus and cerebellum, close to skull base and pituitary gland. US diagnosis was porencephaly. MR imaging demonstrated cystic lesion at interpeduncular and prepontine cistern. This cyst extended to suprasellar region. MR imaging diagnosis was arachnoid cyst (Fig. 1). The patient was counseled appropriately and was planned to undergo vaginal delivery with special attention on perinatal and postnatal care. The patients decided to deliver her child in another hospital.

The third case was a fetus with anhydramios. US showed small in size of urinary bladder and cannot identify both kidneys. MR imaging demonstrated bilateral renal hypoplasia and severe pulmonary hypoplasia. The obstetrician had more confidence to counsel the patient to terminate pregnancy. However, because patient presented at the third trimester, termination of pregnancy was not an appropriate choice. The patient was counseled to continue pregnancy and prepared special postnatal care for pulmonary hypoplasia and renal failure. The patient had normal labor at term. Gross physical examination found additional polydactyly, situs inversus, dextrocardia, severe AV canal defect, and pulmonary artery stenosis. These gross findings were missed by

Table 2. Influence of MR imaging on changes in patient counseling

System	No. of case	No additional information from MRI	Additional information from MRI	Additional information from MRI/affect on counseling	Additional information from MRI/no affect counseling
Isolated CNS	10	5	5	2	3
Isolated extra-CNS	5	3	2	2	-
Multisystem	5	-	5	1	4
Other	3	1	2	-	2
	23	9 (39.1%)	14 (60.9%)	5 (21.7%)	9 (39.1%)

both US and MR imaging, probably due to anhydramnios.

The forth case was a fetus with oligohydramios. US showed hydrop fetalis with mark cardiomegaly, pericardial effusion, and bilateral pleural effusion. Urinary bladder was small in size and both kidneys were not identified. MR imaging confirmed that there was bilateral renal hypoplasia. The obstetrician had more confidence to counsel the patient and termination of pregnancy was considered. The patient has loss follow-up.

The fifth case, US found Chiari's malformation and ventriculomegaly with suspected neural tube defect at lumbar region. Right kidney was not identified. MR imaging demonstrated Chiari's malformation, ventriculomegaly, meningocele at lumbar region, and crossed-fused renal ectopia to the left side (Fig. 2). After meningocele at lumbar region

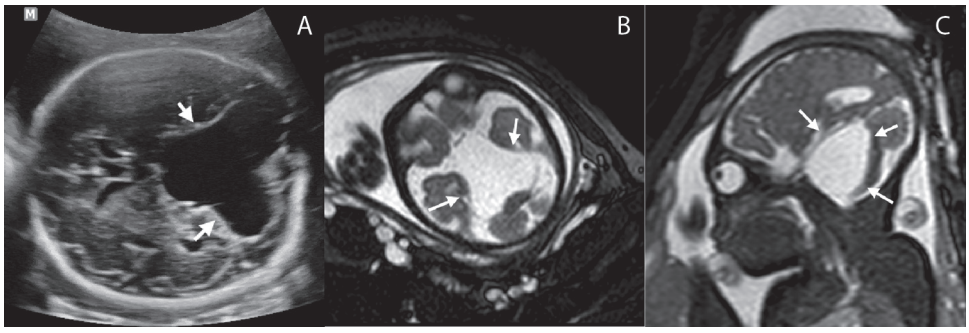

Fig. 1 Arachoid cyst in 29 weeks gestational age. (A) Brain US shows thin wall cystic lesion just above thalamus and cerebellum (arrow). (B, C) Axial and sagittal GRE T2 images show large thin wall cystic lesion at interpendicular and prepontine cistern, compatible with arachnoid cyst (arrow).

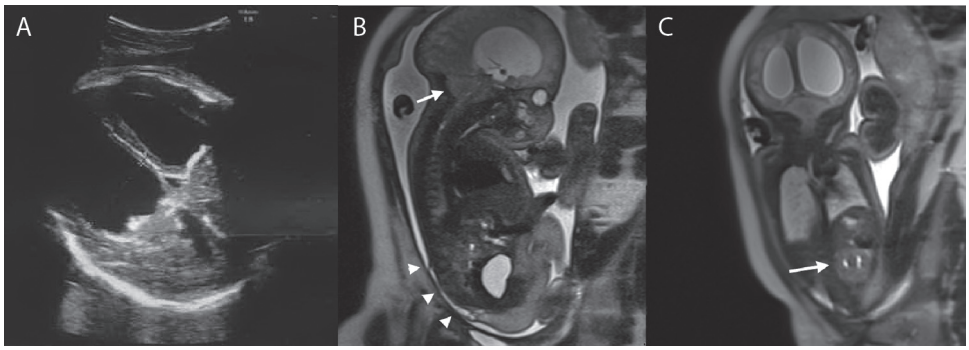

Fig. 2 Chiari's malformation with severe ventriculomegaly and cross-fused renal ectopia in 33 weeks gestational age. (A) Brain US shows severe ventriculomegaly and small in size of posterior fossa. Right kidney is not seen. (B) Sagittal GRE T2 image shows small in size of posterior fossa with low lying of cerebellar tonsil and severe hydrocephalus, consistent with Chiari's malformation (arrow). There is spinal dysraphism with spina bifida at lumbosacral spine (arrow head). (C) Coronal GRET2 image shows additional cross-fused renal ectopia to the left side (arrow).

was confirmed, a neurosurgeon was consulted for appropriate postnatal care. Patient preferred to deliver her child in another hospital.

Those nine cases, which had additional information from MR imaging but did not affect patient counseling or management, were isolated CNS involvement in three cases, multisystem involvement in four cases, and in other-category in two cases. None of these cases was in isolated extra-CNS involvement category. These cases were described as follows.

In isolated CNS involvement category, there was a case with lateral and third ventriculomegaly at US, MR imaging demonstrated Dandy-Walker complex, absent corpus callosum, heterotopia, and colpocephaly. In case with lateral ventriculomegaly with bilateral brain cleft and questionable absent of corpus callosum at US, MR imaging confirmed that there were present corpus callosum, bilateral open lip schizencephaly, and ventriculomegaly. In case with bilateral ventriculomegaly, dilate third and fourth ventricle seen at US, MR imaging found Dandy-Walker variant with hydrocephalus.

In multisystem involvement category, there was a case with neural tube defect, anterior abdominal wall defect, and unilateral clubfoot. US result was questionable about neural content in the neuronal sac and herniated intraabdominal organ outside the body. MR imaging clearly demonstrated myelomeningocele and tethered cord. MR imaging also showed omphalocle with herniation of liver and small bowel loop. There was anterior abdominal wall defect with suspected cloacal exstrophy and maldevelopment of external genitalia. However, unilateral clubfoot cannot be detected by MR imaging. In a case with polyhydramnios and left diaphragmatic hernia detected by US, MR imaging demonstrated additional Dandy-Walker complex and agenesis of corpus callosum. In this case, the patient was counseled to terminate pregnancy according to US results. In the case with twin pregnancy, US in one of the fetuses found neural tube defect, mild ventriculomegaly, and left paramedian cleft lip. MR imaging demonstrated ventriculomegaly, spina bifida, cleft lip, and moderate left hydronephrosis. Postnatal gross examination found skin-covering spina bifida, syndactyly, anostril, and mild skull deformity. Syndactyly, anostril, and mild skull deformity were not identified in both US and MR imaging. In case of Meckel-Gruber syndrome (Dandy-Walker complex, occipital encephalocele, hemimegalencephaly, autosomal recessive polycystic kidney, and dilatation of biliary tract), MR imaging found additional biliary tract dilatation and suspected of choledochol cyst.

In others-category, there was a patient with intra-abdominal pregnancy. The US did not detect any fetal anomaly. MR imaging results were severe left hydronephrosis and left hydroureter. Fetus was delivered safely by cesarean section. Postnatal gross and imaging studies found VECTERL syndrome (congenital scoliosis from hemivertebra at T10 and L3 level, imperforated anus and severe left hydronephrosis from ureterovesicle obstruction). In the case with sacrococcygeal teratoma, MR imaging clearly demonstrated extent of tumor outside fetal body.

In 9/23 (39.1%) cases, MR imaging confirmed US findings but did not add more information or affect counseling. Of these nine cases, there were isolated CNS involvement in five cases, isolated extra-CNS involvement in three cases and other-category in one case. None of these cases was in multisystem involvement category. The cases in isolated CNS involvement category included holoprosencephaly; Arhold-Chairi malformation with neural tube defect at lumbar region; colpocephaly with moderate lateral ventriculomegaly and agenesis of corpus callosum; ventriculomegaly from aqueductal stenosis; anterior midline interhemispheric cyst. The cases in extra-CNS involvement category included left diaphragmatic hernia, omphalocele, ambiguous genitalia with vaginal atresia, and hemocolpos. The cases in others-category included hydrop fetalis with polyhydramnios.

There were three cases that anomalies were detected in postnatal gross findings but were not diagnosed at prenatal US and MR imaging. The consensus of obstetrician and radiologist was used and determined that the disparity in these three cases represented prenatal false-negative imaging findings (both US and MR imaging).

The first case was fetus with bilateral renal hypoplasia and anhydramnios. Both US and MR imaging cannot demonstrate polydactyly, situs inversus, and dextrocardia.

The second case was fetus with neural tube defect, mid ventriculomegaly and left paramedian cleft lip detected by US. MR imaging found additional moderate left hydronephrosis. However, both US and MR imaging could not demonstrate syndactyly, a nostril, and mild skull deformity.

The third case was a patient with large cystic mass in abdomen with echogenic content and ambiguous genitalia seen at US. Provisional diagnosis by US included distended urinary bladder

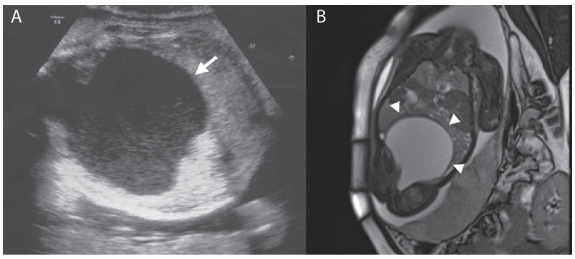

Fig. 3 Ambiguous genitalis, vaginal atresia and hydrocolpos in 33 weeks gestational age (false negative imaging both US and MRI). (A) Abdominal US shows large cystic lesion with internal echogenic content in pelvic cavity (arrow). (B) Coronal GRE T2 image shows large thin wall cystic lesion in pelvic cavity with extension into mid abdomen (arrow head).

(megacystic microcolon disease) and ovarian cyst. MR imaging found large urinary bladder with bilateral hydronephrosis (Fig. 3). MR finding was suspected of urachal cyst. However, postnatal diagnosis was ambiguous genitalia with vaginal atresia and hydrocolpos.

There were two cases with misdiagnosis on the basis of MR imaging study (false negative MR study). In the fetus with cloacal exstrophy, MR imaging cannot demonstrate clubfoot that was found by US. In another fetus with holoprosencephaly, MR imaging cannot demonstrate cleft lip. False negative MR study in both cases was due to patient position during MR examination.

Discussion

Recently, fetal MR imaging has evolved considerably due to faster MR acquisition sequence[1-4]. The benefit of fetal MR imaging for detection of CNS anomaly is accepted[5-7]. Evaluation of fetal CNS by US is limited by 1) technical factors, which difficult to evaluate the brain near the transducer and obscuration by skull at posterior fossa and 2) nonspecific appearance of some anomalies. Given to the benefit of multiplanar views of MR imaging which provide detail information of internal structure, MR imaging is better for evaluation in patients with oligohydramnios, difficult fetal position and in advanced gestational age[8-12]. Because MR imaging is an expensive study and not widely available, most of the indications for the study are limited only in patients with complex fetal anomaly, which has indeterminate or equivocal results by US, or in patients with high risk for fetal anomalies such as fetal anomaly or has chromosomal abnormality in prior pregnancy.

The results of the present study are similar to the previous study by other researchers (Table 3). Coakley et al[13] demonstrated that MR imaging provided additional findings in 12/24 (50%) cases. MR imaging directly influenced fetal care in 4/24 (16.7%) cases. MR imaging provided supplementary findings but did not affect fetal care in other 8/24 (33.3%) cases. The study by Frates et al[14] compared US and MR imaging in diagnosis of fetal anomalies in 28 cases by using postnatal evaluation with imaging, surgery or autopsy as reference standard. The authors showed that MR imaging provided valuable information in 10/28 (36%) cases. However, effect of MR imaging on patient care was not evaluated. The percentage of cases with additional information from MR imaging was slightly less than in our study may be due to difference in study population.

Levine et al[15,16] evaluated effect of MR imaging in CNS and thoracic anomalies. MR imaging provided additional information in 10/18 (55%) cases with CNS anomaly. Of these 10 cases, MR imaging affected pregnancy care in 7/10 (70%) cases (39% of total). However, in fetus with thoracic anomalies, MR imaging provided additional information in 28/74

Table 3. Influences of MRI on patient counseling, diagnosis and management in the literature

Authors	Total cases	Additional information from MRI	Have affect on counseling or management	
Varavithya et al.	23	14 (60.9%)		5 (21.7%)
Coakley et al.[13]	24	12 (50.0%)		4 (16.7%)
Frates et al.[14]	28	10 (36.0%)		-
Levine et al.[15]	18	10 (55.0%)		7 (39.0%)
Levine et al.[16]	74	28 (38.0%)		6 (8.0%)
Levine et al.[17]	145	-	Counseling	72 (49.6%)
			Diagnosis	46 (31.7%)
			Care	27 (18.6%)

(38%) cases. Of these 28 cases, MR imaging affected pregnancy care in 6/28 cases (8% of total). The results of these two studies showed that MR imaging provided less additional information and has less effect on patient case in thoracic anomaly when compare to CNS anomaly. It may be due to US having less limitation in evaluation of thoracic anomaly compared to CNS anomaly.

MR imaging diagnoses helped a specific discussion of type of anomaly and potential outcome of pregnancy. Results of the present study showed that MR imaging has less effect on patient counseling as compare to a large series of cases performed by Levine et al[17] in 145 fetuses with abnormal CNS findings in US. The authors showed that MR imaging led to a change in maternal counseling in 72/145 (49.6%) cases, a change in diagnosis in 46/145 (31.7%) cases and a change in care in 27/145 (18.6%) cases. The lower number of cases that MR imaging has effect on patient counseling in the present study may be due to different study population and less number of cases. The less number of cases may decrease variation and number of fetal anomalies and lead to underestimate the percentage of benefit of MR imaging on patient counseling.

The present study also showed that MR imaging provided additional information in cases with isolated CNS (5 cases) and multisystem involvement (5 cases) more than in cases with isolated extra-CNS involvement (2 cases) and in others-category (2 cases). However, this does not represent that information by US in most of the fetus with isolated extra-CNS involvement is enough for decision-making. There are few conditions in extra-CNS involvement, which additional information from MR imaging help decision making[18,19]. The study by Hubbard et al[20] showed that MR imaging help demonstrated the location of liver in fetus with diaphragmatic hernia, whereas its location was not demonstrated with US. This information is important if fetal surgery is contemplated. Another research by Victoria T et al[21] studied about the use of MRI to determine prenatal prognosis of the fetus with isolated left congenital diaphragmatic hernia and found that herniated intrathoracic liver and MRI measurement of observed versus expected calculated fetal lung volumes (O/E FLV) were strong indicators of postnatal survival. Since MR imaging provided a large field of view and better tissue differentiation, it is more helpful in fetus with complex multisystem involvement. Supplementary information from MR imaging also facilitates an increase in obstetrician confidence in the diagnosis and counseling as seen in two cases in the present study with renal hypoplasia. US cannot clearly identify kidney with certainty due to severe oligohydramnios.

Although MR imaging provides valuable information of the fetus or helps confirm the diagnosis, replacement of US with MR imaging for screening of fetal anomaly is inappropriate because cost of the MR study is expensive and not widely available. MR imaging should be used as an adjunct to US in the cases in which complex anomalies are suspected or US findings are equivocal. This role is more obvious in cases with CNS and multisystem anomaly. MR imaging can provide information for patient counseling for not only the diagnosis, but also possible prenatal intervention, planned delivery at a hospital, which had fully perinatal and postnatal support.

Three cases were misdiagnosis in both US and MR imaging (false negative by both studies) and two cases were misdiagnosis in MR imaging but anomalies were detected by US (false negative by MR imaging). It represented that even multiplanar abilities of US and MR imaging, few complex fetal anomaly is still difficult to determine the origin and diagnosed prenatally especially in case with severe oligohydramnios. MR imaging also has limitation to demonstrate superficial lesions such as cleft lip, syndactyly and polydactyly. Interpretive expertise is beneficial.

There are five limitations in the present study. First, the study population (n = 23) was relatively small. This may overestimate or underestimate the influence of MR imaging in patient counseling. Second, all patients enrolled in the present study had abnormal US findings, which was indicative of a selection bias. However, fetal MR imaging is not intended to be used as a screening method. In real-life situation, only fetuses with inconclusive US findings or who are planned for fetal intervention will be sent for MR study. Third, the radiologist, who performed MR examination, had knowledge of clinical and US results, which may introduce bias in the present study. Fourth, because decision making on counseling and case management in patient with high-risk pregnancy depends on many variables that may not depend only on US and MR imaging findings, the influence on patient counseling was used as an outcome. Fifth, postnatal confirmation of diagnosis was no obtained in all cases by either pathologic conformation or imaging.

In conclusion, the study showed that MR imaging could provide additional information that

have influence on patient counseling and patient care, particularly in cases with CNS and multisystem anomaly. The role of MR imaging are contributive in confirm diagnosis in equivocal US findings, adding supplement information, which may increase confidence to obstetricians for decision making, affect patient counseling, and patient care.

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Potential conflicts of interest

None.

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อิทธิพลของการตรวจคลื่นแม่เหล็กไฟฟ้า (MRI) ของทารกในครรภ์ ต่อการให้คำปรึกษาในมารดาที่สงสัยทารกในครรภ์ผิดปกติจากการตรวจอัลตราซาวด์

วิทย์ วราวิทย์, สิทธิ์ พงษ์กิจการุณ, เกษม เรืองรองมรกต, จิตติมา รุจิเวชพงศธร, อภิชาต จิตต์เจริญ

วัตถุประสงค์: *เพื่อศึกษาความถี่ของทารกในครรภ์ที่ตรวจพบความผิดปกติจากการตรวจ magnetic resonance imaging (MRI) เพิ่มเติมจากการตรวจอัลตราซาวด์ และศึกษาอิทธิพลของผลการตรวจที่ได้รับเพิ่มเติมต่อการให้คำปรึกษาในการตั้งครรภ์และการคลอด*

วัสดุและวิธีการ: *การศึกษาได้ทำการตรวจ MRI ทารกในครรภ์จำนวน 26 ราย ที่มีความผิดปกติจากการตรวจอัลตราซาวด์ สูติแพทย์ผู้ส่งตรวจจะได้รับการถามเกี่ยวกับอิทธิพลของข้อมูลจากการตรวจ MRI ที่ได้เพิ่มเติมต่อการตัดสินใจ การให้คำปรึกษา และการรักษาพยาบาลต่อการตั้งครรภ์ในแต่ละราย*

ผลการศึกษา: *การตรวจ MRI สามารถทำได้สำเร็จในทารกจำนวน 23 ราย ใน 26 ราย MRI สามารถให้ข้อมูลเพิ่มเติมในทารก 14/23 (60.9%) ราย ในทารกที่เหลืออีก 9 (39.1%) ราย MRI สามารถยืนยันการวินิจฉัยที่ได้จากการตรวจอัลตราซาวด์แต่ไม่ให้ข้อมูลเพิ่มเติม ข้อมูลที่ได้เพิ่มเติมจาก MRI มีผลต่อการให้คำปรึกษาในทารก 5 (21.7%) ราย และไม่มีผลต่อการให้คำปรึกษาในทารก 9 (39.1%) ราย ความผิดปกติที่ตรวจพบเพิ่มเติมในทารก 14 ราย สามารถแบ่งได้เป็นความผิดปกติของระบบประสาทส่วนกลางจำนวน 5 (35.7%) ราย ระบบการทำงานส่วนอื่น ๆ ที่ไม่ใช่ระบบประสาทส่วนกลางจำนวน 2 (14.3%) ราย ความผิดปกติหลายระบบจำนวน 5 (35.7%) ราย และระบบอื่น ๆ จำนวน 2 (14.3%) ราย*

สรุป: *การตรวจ MRI สามารถให้ข้อมูลเพิ่มเติมที่มีอิทธิพลต่อการให้คำปรึกษาและการดูแลรักษาผู้ป่วยที่มีความผิดปกติของทารกในครรภ์ โดยเฉพาะอย่างยิ่งในทารกที่มีความผิดปกติของระบบประสาทส่วนกลางและความผิดปกติหลายระบบ*