นิพนธ์ต้นฉบับ ▪ Original Article

ความแม่นยำของภาพรังสีสนามแม่เหล็กไฟฟ้าในการวินิจฉัยภาวะรกงอกติด

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Accuracy of Magnetic Resonance Imaging in Diagnosis of Morbidly Adherent Placenta.

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หลักการและวัตถุประสงค์: เพื่อประเมินหาค่าความไวและความจำเพาะในการตรวจหาภาวะรกงอกติด โดยภาพรังสีสนามแม่เหล็กไฟฟ้า

วิธีการศึกษา: เป็นการศึกษาย้อนหลังภาพรังสีจากการตรวจสนามแม่เหล็กไฟฟ้าอุ้งเชิงกราน ในผู้ป่วยตั้งครรภ์ระหว่างเดือนมกราคม 2547 ถึงเดือนมิถุนายน 2557 จำนวน 31 การตรวจ โดยรังสีแพทย์ 2 คน ที่ไม่ทราบรายละเอียดใด ๆ ของผู้ป่วยมาก่อน ลักษณะที่ตรวจหาได้แก่ uterine bulging, intraplacental hemorrhage, placenta heterogeneity, intraplacental dark bands และ myometrium plane under placenta

ผลการศึกษา: ค่าความไว ค่าความจำเพาะ ค่าพยากรณ์ผลบวก ค่าพยากรณ์ผลลบ และ ค่าสัมประสิทธิ์แคปปา ของแต่ละลักษณะที่ตรวจพบในภาพรังสีต่อการตรวจหาภาวะรกงอกติด มีรายละเอียดดังนี้ uterine bulging (ร้อยละ 90.9, 75, 66.7, 93.8 และ 0.74 ตามลำดับ) intraplacental hemorrhage (ร้อยละ 81.8, 89.5, 81.8, 89.5 และ 0.78) placental heterogeneity (ร้อยละ 100, 15, 39.3, 100 และ 0.34) intraplacental dark bands (ร้อยละ 100, 55, 55, 100 และ 0.49) partial/absent myometrium plane under placenta accreta (ร้อยละ 100, 80, 73.3, 100 และ 0.83) การตรวจด้วยสนามแม่เหล็กไฟฟ้ามีความแม่นยำในการวินิจฉัยภาวะรกงอกติด ร้อยละ 83.8 (95% CI 66.2-94.5) ร่วมกับค่าสัมประสิทธิ์แคปปา 0.58 แสดงว่าความเห็นของรังสีแพทย์ทั้งสองคนสอดคล้องในระดับปานกลาง

Background and Objective: To determine the sensitivity and specificity of MRI findings for detecting of morbidly adherent placenta.

Methods: A retrospective review of the patients who underwent pelvic MRI during pregnancy between January 2004 and June 2014. Thirty-one image sets that met the following inclusion criteria were enrolled in the study. MR imaging findings included uterine bulging, intraplacental hemorrhage, placenta heterogeneity, intraplacental dark bands, present of myometrium plane were reviewed by two investigators blinded to pregnancy outcome.

Results: In thirty-one image sets of pelvic MRI in the pregnant patients. Sensitivity, specificity, PPV, NPV and kappa value of MRI features had calculated: uterine bulging (90.9%, 75%, 66.7%, 93.8% and 0.74 respectively); intraplacental hemorrhage (81.8%, 89.5%, 81.8%, 89.5% and 0.78); placental heterogeneity (100%, 15%, 39.3%, 100% and 0.34); intraplacental dark bands (100%, 55%, 55%, 100% and 0.49); partial/absent myometrium under placenta (100%, 80%, 73.3%, 100% and 0.83), respectively.Accuracy of MRI to diagnosed morbidly adherent placenta was 83.8% (95% CI 66.2%-94.5%) with moderate interobserver agreement (kappa value 0.58).

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สรุป: ลักษณะ uterine bulging, intraplacental hemorrhage และ partial/absent myometrium plane ที่ตรวจพบจากเครื่องตรวจสนามแม่เหล็กไฟฟ้า ช่วยในการวินิจฉัยภาวะรกงอกติด ในกรณีที่พบลักษณะ placental homogeneity และ absent intraplacental dark band ในภาพรังสี T2WI จะสามารถตัดภาวะนี้ออกไปได้

คำสำคัญ: ภาวะรกงอกติด; การตรวจด้วยสนามแม่เหล็กไฟฟ้า อุ้งเชิงกราน

Conclusion: Uterine bulging, intraplacental hemorrhage and partial/absent myometrium plane may be the keys criteria to diagnosis on pelvic MRI. Placental homogeneity and absent intraplacental dark band on T2WI may be exclusive criteria.

Keywords: morbidly adherent placenta; placenta accreta; placenta increta; placenta percreta; pelvic MRI

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Introduction

Abnormal placentation is generally termed of placenta accreta, one of the most serious complications causing massive hemorrhage in peripartum period1. Placenta accreta is a placental implantation disorder with direct invasion of placental villi penetrating the myometrium. It includes placenta accreta, increta and percreta when the placental villi directly onto the myometrium, into the myometrium and beyond uterine serosa, respectively.

The incidence of placenta accreta is markedly increased with the number of previous cesarean sections. In the United States, the incidence of placenta accreta is rising from 1 of 2500 to 1 of 533 deliveries from the period 1980s to 2002 by the increasing rate of cesarean delivery from 4.5% in 1965 to 26.1% in 2002[1,2].

Other risks of placenta accreta include placenta previa, particularly in increasing maternal age and previous uterine surgery.

Prenatal diagnosis of placenta accreta is necessary and can reduce morbidity and mortality[3]. The imaging modality of choice to diagnose placenta accreta is transabdominal or transvaginal ultrasound with color Doppler.When inconclusive diagnosis or posteriorly located placenta or previous myomectomy were presented, a pelvic MRI should be requested for further evaluation[4-6].

Lax A, et al. suggested three features that appear to be useful for diagnosis placental invasion on pelvic MRI: posterior uterine bulging, heterogeneous signal intensity within the placenta and the presence of dark intraplacental bands on T2WI[7].

This study aimed to determine the sensitivity and specificity of MRI features that may predict placental invasion in the diagnosis of morbidly adherent placenta (MAP).

Materials and methods

This retrospective data collection and analytic study had been approved by our institutional review board (IRB) with a waiver of consent. All pregnant patients who underwent pelvic MRI during pregnancy between January 2004 and June 2014 were enrolled in the study. Indications for pelvic MRI included the conditions with or without indication of MAP.

MRI examination was performed by Magnetom 1.5T Aera (Siemens Medical Systems, Erlangen Germany) 24 image sets, 3T MR scanner (Philips Achieva, Philips, Best, the Netherlands) 7 image sets. All image sets composed of routine coronal, sagittal and axial planes of T1 and T2. Contrast-enhanced MRI image was not performed in any patient. The T2 sequences included HASTE and TFE. The T1 sequences included VIBE.

Two radiologists (JS, CA) had reviewed MRI findings of morbidly adherent placenta before starting the study. Thirty-one image sets of 27 patients were independently reviewed by JS and CA who have experienced abdominal imaging for 28 years and 17 years, respectively, with blinded clinical and operative findings. There were 5 patients who underwent MRI twice with the same indication; 2 patients with fetal condition (GA 35/37 weeks and GA 24/34 weeks), 3 patients with suspected PA (GA 32/36 weeks, GA 23/29 weeks and GA 28/35 weeks).

The basic data of demographic data, gravidity, parity, the number of previous Cesarean delivery, type of delivery, estimate blood loss during delivery, hysterectomy, final diagnosis by operative findings and pathological reports were recorded.

MRI findings data included placental location, placenta previa, placenta invasion, intraplacental hemorrhage, grading of placental heterogeneity, intraplacental dark band on T2, placental thickness, and myometrium visualization beneath placenta, loss

of tissue plane between placenta and local structure, and fetal anomaly, respectively[8]. Finally, the investigators gave the conclusion of the placenta as normal, accreta, increta or percreta depending on how deep the placenta attaches into the uterus.

Thirty-six patients with 40 imaging sets were performed pelvic MRI and 9 patients were excluded (7 patients had no delivery data, 1 patient had inadequate imaging data and the last one had a dead fetus in utero with deformed conceptus). Six patients had available pathological specimens which were reviewed by one gynecological pathologist (PK) without clinical data. Although, the pathological diagnosis is the definite diagnosis, most of the subjects' diagnoses were made by operative findings, which is the limitation of this study.

Statistical analysis

All data were analyzed by STATA version 10.1. Demographic data were analyzed using mean, t-test (for normal distribution data), Mann-Whitney U-test (for non-normal distributions data). A p value of less than 0.05 was considered a statistically significant difference. Each MRI findings were analyzed for sensitivity, specificity, PPV, NPV and kappa coefficient. Placental thickness in which numerical data was analyzed by ICC (intraclass correlation coefficient).

Results

From January 2004 to June 2014, 27 pregnant patients with 31 image sets of pelvic MRI were enrolled in the study. Indications for pelvic MRI included the suspected placenta accreta (18 image sets), maternal conditions (3 cases; suspected adrenal mass, adnexal mass evaluation, and evaluation of maternal hydronephrosis) and fetal conditions (10 image sets; Galen's vein malformation, cystic hygroma or lymphangioma at neck and other congenital brain malformation). (Figure 1) Twenty image sets showed the absence of MAP during delivery and11image sets presented with placenta invasion. (Table 1)

The mean age of group without MAP was 28.1 years, the group with MAP was 33.2 years which no significant difference between 2 groups was presented (p = 0.07). Gravidity, parity, gestational age at delivery and estimated blood loss during delivery showed statistical significances (p< 0.05) between 2 groups. (Table 2)

Uterine bulging and intraplacental hemorrhage had a substantial agreement (kappa > 0.7)[9]. (Figure 2) The sensitivity of uterine bulging and intraplacental hemorrhages were 90.9% and 81.8%

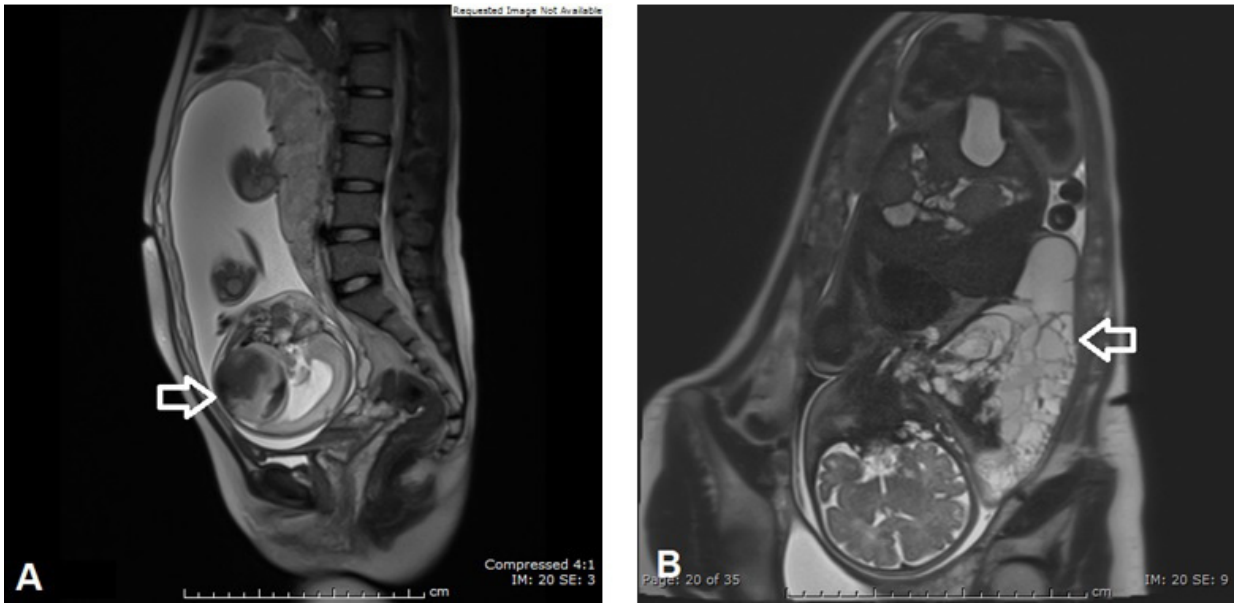

Figure 1 Pelvic MRI for fetal conditions:
(A) A 22-year-old woman, GA 26 weeks T2-HASTE sagittal image shows placenta located at middle and posteriorly. A moderately heterogeneity placenta is found. A large well-defined, round shape lesion is found at the posterior intracranial fossa of the fetus (arrow) which exhibits mixed heterogeneous signal intensity on T1 and T2 weighted images. The normal placenta was demonstrated under Intra-operative findings with a Vein of Galen aneurysmal malformation of the fetus. Another 23-year-old woman, GA 39 weeks (B) T2-HASTE coronal image shows a multi-loculated cystic-liked mass lesion occupying in the neck and upper chest of the fetus (arrow). The final diagnosis is cystic hygroma

Table 1 Demographic data of 31 image sets of pelvic MRI

Code No.	Maternal age (years)	Gravidity	Parity	No. of previous C/S	Indication for MRI	GA at MRI (weeks)	GA at delivery (weeks)	Type of delivery	Estimated blood loss (ml)	Diagnosis	Diagnosis by	Hysterectomy	Maternal complication
01	22	1	0	0	Fetal condition	24	38	C/S	250	No PA	Intra op	No	No
02	37	2	1	1	Suspected PA	33	34	C/S	No data	Increta	Patho	Yes	PPH
03	34	3	1	1	Suspected PA	31	34	C/S	1,200	No PA	Patho	yes	PPH
04	32	2	1	1	Fetal condition	35	38	C/S	700	No PA	Patho	No	No
05	33	3	0	0	Suspected PA	34	36	C/S	300	No PA	Intra op	No	No
06	25	2	1	0	Fetal condition	37	37	C/S	500	No PA	Intra op	No	No
07	40	5	2	1	Suspected PA	32	33	C/S	2,500	Increta	Patho	yes	PPH, tear bladder
08	38	2	0	0	Maternal condition	24	37	F/E	300	No PA	Intra op	No	No
09	34	1	0	0	Suspected PA	36	37	C/S	500	No PA	Intra op	No	No
10	36	4	2	0	Suspected PA	37	37	C/S	500	No PA	Intra op	No	No
11	29	2	1	1	Suspected PA	20	22	C/S	800	Increta	Patho	Yes	No
12	22	1	0	0	Fetal condition	26	34	C/S	300	No PA	Patho	No	No
13	42	4	2	3	Suspected PA	32	36	C/S	1,500	Increta	Intra op	Yes	PPH
14	26	2	1	1	Suspected PA	23	31	C/S	15,000	Percreta	Patho	Yes	PPH, Dead
15	32	4	1	1	Suspected PA	37	37	C/S	1,700	increta	Patho	Yes	PPH
Code No.	Maternal age (years)	Gravidity	Parity	No. of previous C/S	Indication for MRI	GA at MRI (weeks)	GA at delivery (weeks)	Type of delivery	Estimated blood loss (ml)	Diagnosis	Diagnosis by	Hysterectomy	Maternal complication
16	28	2	1	1	Suspected PA	37	38	C/S	500	No PA	Intra op	No	No
17	27	3	1	1	Suspected PA	32	34	C/S	10,000	Accreta	Intra op	Yes	PPH, tear bladder
18	34	1	0	0	Suspected PA	32	37	C/S	400	No PA	Intra op	No	No
19	16	1	0	0	Fetal condition	27	27	NL	100	No PA	Intra op	No	No
20	23	2	1	0	Fetal condition	39	40	C/S	300	No PA	Intra op	No	No
21	34	2	1	1	Suspected PA	28	36	C/S	700	Increta	Intra op	Yes	No
22	47	1	0	0	Suspected PA	31	35	C/S	1,200	No PA	Intra op	No	PPH
23	29	1	0	0	Maternal condition	23	38	C/S	200	No PA	Intra op	No	No
24	15	1	0	0	Fetal condition	25	26	NL	100	No PA	Intra op	No	No
25	39	2	1	1	Suspected PA	36	36	C/S	200	Increta	Intra op	No	No
26	21	1	0	0	Maternal condition	27	37	C/S	500	No PA	Intra op	No	No
27	19	1	0	0	Fetal condition	36	39	C/S	600	No PA	Intra op	No	No
28	34	2	1	1	Suspected PA	35	36	C/S	700	Increta	Intra op	No	No
29	26	2	1	1	Suspected PA	29	31	C/S	15,000	Percreta	Intra op	yes	PPH, Dead
30	22	1	0	0	Fetal condition	34	38	C/S	250	No PA	Intra op	No	No
31	32	2	1	1	Fetal condition	37	38	C/S	700	No PA	Patho	No	No

Note: PA = placenta accreta, PPH = postpartum hemorrhage, C/S = Cesarean section, NL = normal labor, F/E = forceps extraction.

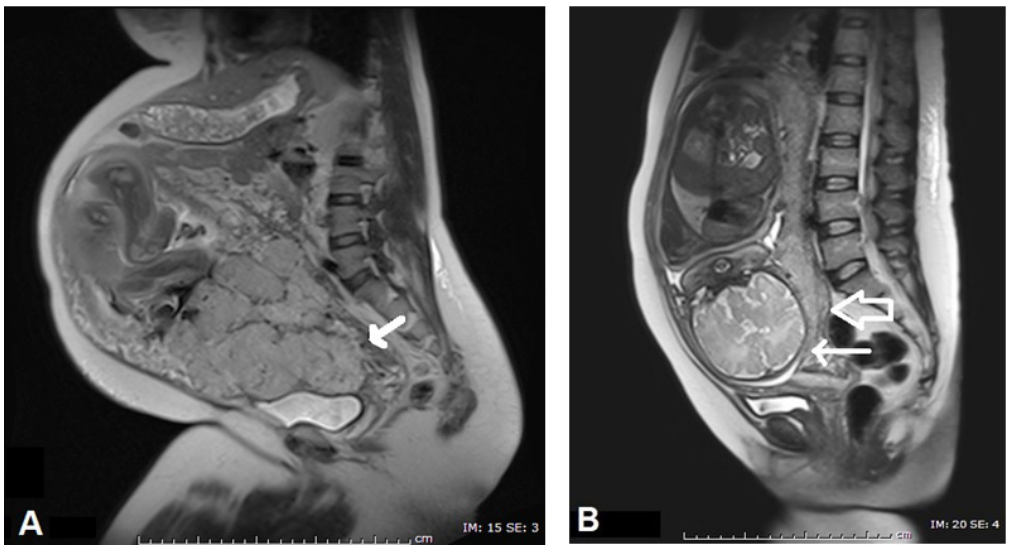

Figure 2 Placenta location of the 2 patients:
(A) A T2-HASTE sagittal view image of a 42-year-old woman with GA 32 weeks, shows placenta previa totallis. Marked placental thickening is also found, measured about 10.4 cm. in a true cross-sectional cut in the sagittal plane. Uterine bulging at the lower uttering segment is noted with the moderately heterogeneous placenta. Partially seen myometrium under placenta is seen (arrow). Placenta increta was diagnosed under intra-operative findings.
(B) A T2-HASTE sagittal view image of a 36-year-old woman, GA 37 weeks shows extending of the placenta into the lower uterine segment and its edge lies 1 cm close to internal os, called low lying placenta (thin arrow). Mild placental heterogeneous signal intensity is noted. Uterine bulging and intraplacental dark bands are absent. Myometrium under placenta is seen entirely (thick arrow). No MAP was detected under intra-operative findings.

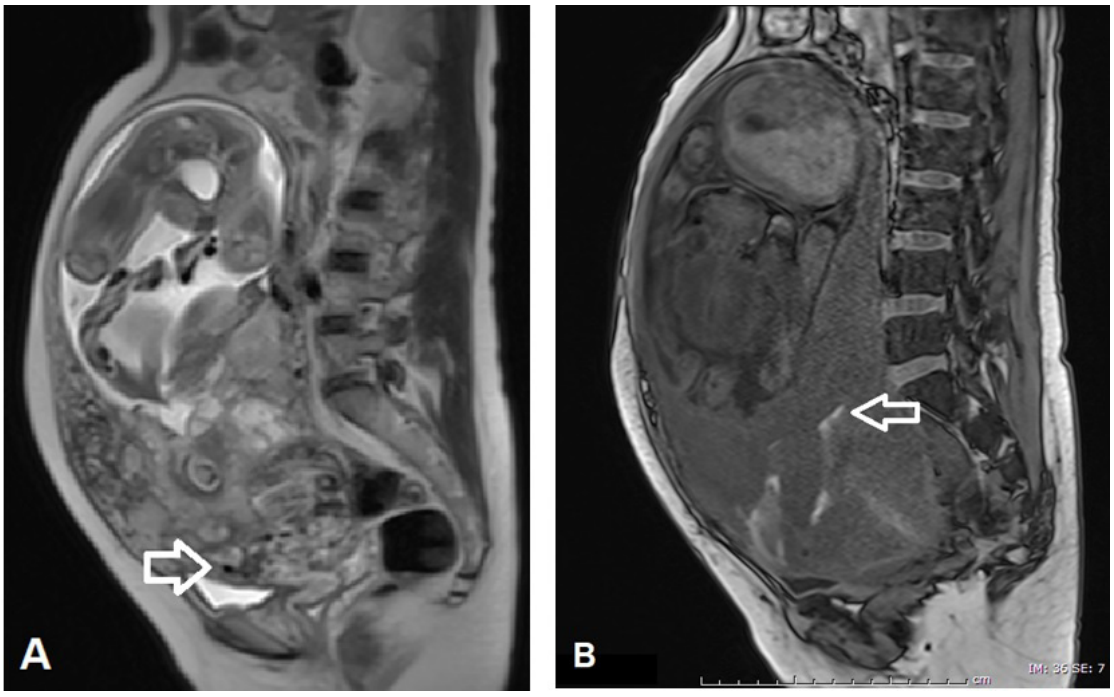

Figure 3 A 26-year-old woman, performed in 2 times of MRI:
(A) At GA 23 weeks, T2-HASTE sagittal view image shows placenta previa totalis, uterine bulging, marked placental heterogeneity, intraplacental dark bands, and loss of tissue plane between placenta and urinary bladder (arrow) which all findings are consistent with placenta percreta.
(B) A second MRI at GA 29 weeks, a T1-Vibe sagittal view image shows the heterogeneous signal intensity of placenta with band-liked hypersignal intensity (arrow) which is representing intraplacental hemorrhage. Placenta percreta was diagnosed under intra-operative findings and pathological proven. This patient was performed cesarean section at GA 31 weeks. The estimated blood loss is about 15,000 ml. with tear urinary bladder and maternal death. Final diagnosis placenta percreta by intra-operative findings.

Table 2 Comparison demographic data of two groups of the patients who underwent MRI (31 patients)

	No morbidly adherent placenta	Morbidly adherent placenta	p value
Cases	20	11	
Mean age	28.1 years (15-47 years)	33.2 years (26-42 years)	0.07
Gravidity	1.65 (1-4)	2.72 (2-5)	0.004*
Parity	0.4 (0-2)	1.1 (1-2)	0.001*
GA at imaging	31.65 weeks (23-39 weeks)	30.63 weeks (20-37 weeks)	0.6
GA at delivery	36.05 weeks (26-40 weeks)	33.27 weeks (22-37 weeks)	0.005*
Estimate blood loss	470 ml. (100-1200 ml.)	4810 ml. (200-15000 ml.)	0.001*

*Statistical significant

with a specificity of 75.0% and 89.5%, respectively. The intraplacental dark band had a moderate agreement (kappa = 0.49) with high sensitivity (100%) and fair specificity (55%). Loss of tissue plane between placenta and local structure also had a moderate agreement (kappa = 0.51) with high specificity (95%) and low sensitivity (27.3%). Intraplacental hemorrhage had the highest positive predictive value (PPV 81.8%) followed by the loss of tissue plane between placenta and local structure (PPV 75%). The intraplacental dark band and placental heterogeneous features got 100% of NPV. Other MRI features that had high negative predictive value were uterine bulging and intraplacental hemorrhage (NPV 93.8% and 89.5%, respectively). Placental heterogeneity and degree of heterogeneity had slightly agreement (kappa = 0.34) and fair agreement (kappa = 0.18), respectively. (Figure 3) Interobserver agreement was good in presenting the placental thickness (ICC = 0.82). The more increased placental thickness had greater specificity to diagnose placenta accreta. Partial/absent myometrium under placenta has high sensitivity (100%), high specificity (80%) and high interobserver agreement (kappa = 0.83). (Table 3)

For a given final diagnosis of each image sets, a senior reader (JS) had higher accuracy (83.8%) than another reader (CA) (72%) with the moderate interobserver agreement (kappa = 0.58). (Table 4 and 5)

Discussion

Prenatal diagnosis of MAP can reduce peripartum mortality and morbidity, by determining the best time and procedure of delivery. Multidisciplinary surgical management, neonatal intensive care, uterine arterial embolization and adequate blood transfusion in the operating room can only be achieved effectively through the early detection of abnormal placental implantation[10].

Wu found cesarean rates increasing from 12.5% in 1982 to 23.5 % in 2003 which may contribute significantly to the rising incidence of abnormal placental adherence[2]. Even though recent data from Center for Disease Control and Prevention show slightly declined cesarean section rates from 2009 to 2010, cesarean section rates rose nearly 60% from 1996 to 2009[3]. Other significant risk factors for abnormal placentation included advancing maternal age, 2 or more cesarean deliveries, placenta previa, and history of uterine surgery[2,5].

Lax, et al[7] suggested three features that appear to be useful for diagnosis, i.e. uterine bulging, heterogeneous signal intensity within the placenta and intraplacental dark band in T2WI)[5],. Kim and Narra[6] suggested a focal non-visualization of the inner layer between the placenta and myometrium as the diagnostic findings for placenta accreta. The most sensitive MR criteria for the diagnosis of invasive placentation was abnormal placental vascularity which showed dilated tortuous signal void on T2 HASTE images deep within the placenta and increase signal on true FISP images[5].

Some studies reported sensitivity and specificity of MRI to diagnose placenta accreta were 80-88% and 65-100%, respectively. The diagnostic criteria included focal thinning or absence of myometrium at the placental implantation site, a nodular interface between the placenta and uterus, mass effect of the placenta on uterus causing the outer bulging, heterogeneous signal intensity of placenta, dark intraplacental dark band on T2WI and loss of tissue plane between the placenta and bladder wall[11,12].

Most cases in our study underwent 1.5T MRI as

Table 3 Performance in diagnosis of MRI features in morbidly adherent placenta (MAP)

MRI FINDINGS	No MAP (n =20)	MAP (n =11)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	Kappa
Uterine bulging	5	10	90.9% (58.7-99.8%)	75% (50.9-91.3%)	66.7% (38.4-88.2%)	93.8% (69.8-99.8%)	0.74
Intraplacental hemorrhage	2	9	81.8% (48.2-97.7%)	89.5% (66.9-98.7%)	81.8% (48.2-97.7%)	89.5% (66.9-98.7%)	0.78
Placental heterogeneity	17	11	100% (71.5-100%)	15% (3.2-37.9%)	39.3% (21.5-59.4%)	100% (29.2-100%)	0.34
Degree of heterogeneity							
Mild degree	6	1	100%	0%			0.18
Moderate degree	10	6	90.9%	35.2%			
Marked degree	2	4	36.3%	94.1%			
Intraplacental dark band in T2WI	9	11	100% (71.5-100%)	55% (31.5-76.9%)	55% (31.5-76.9%)	100% (71.5-100%)	0.49
Loss of tissue plane	1	3	27.3% (6.0-61%)	95% (75.1-99.9 %)	75% (19.4-99.4%)	70.4% (49.8-86.2%)	0.51
Partial/not seen myometrium under placenta	4	11	100% (71.5-100%)	80% (62.4-97.5%)	73.3% (50.9-95.7%)	100% (71.5-100%)	0.83
Placental thickness							ICC = 0.82
> 4cm	11	10	90.9%	42.1%			
>5 cm	7	9	81.8%	68.4%			
>6 cm	6	6	54.5%	73.6%			
>7 cm	4	6	54.5%	84.2%			
>8 cm	2	4	36.3%	89.4%			

Note: ICC = intraclass correlation coefficient.

Table 4 Accuracy of MRI diagnosis by reader A in morbidly adherent placenta (MAP)

		Diagnosis by operative finding/pathological report				
		No MAP	Accreta	Increta	Percreta	Total
Reader A	No MAP	16	0	0	0	16
	Accreta	1	0	0	0	1
	Increta	2	0	8	0	10
	Percreta	1	1	0	2	4
	Total	20	1	8	2	31

Note: Accuracy 83.8% (95% CI 66.2%-94.5%)

Table 5 Interobserver agreement of diagnosis in morbidly adherent placenta (MAP)

		Reader A				
		No MAP	Accreta	Increta	Percreta	Total
Reader B	No MAP	16	0	1	0	17
	Accreta	0	0	3	1	4
	Increta	0	1	5	1	7
	Percreta	0	0	1	2	3
	Total	16	1	10	4	31

Note: kappa value = 0.58

most studies. In general, 3T MRI has attained interest recently because of its increased signal to noise ratio, faster sequences, and higher spatial resolution, in comparison with 1.5T MRI. The 3T MRI of placenta is acceptable and no proven reproducible harmful effects have been reported so far[13]. However, 3T MRI showed no better benefit than 1.5T MRI in our study. There was a substantial agreement of placental location in both cranio-caudal axis and axial plane. Selection bias from prenatal ultrasonogram and small sample size may result in the perfect agreement of placenta previa, which presented only 2 types (low lying placenta and placenta previa totalis) in this study. From our study, the sensitivity and the specificity of MRI for MAP were 81.8-100% and 55-89.5%, respectively. The uterine bulging, partial/not seen myometrium under placenta and the intraplacental hemorrhage showed high sensitivity (90.9%, 100% and 81.8%, respectively), high specificity (75%, 80% and 89.5%, respectively) and substantial interobserver agreement (kappa = 0.74, 0.83 and 0.78, respectively). These 3 features maybe key diagnostic criteria for MAP. Placental heterogeneity and intraplacental dark band in T2WI are the highest sensitivity (100%, both) and highest NPV (100%, both), but less specificity (15% and 55%, respectively) and fair to moderate interobserver agreement (kappa = 0.34 and 0.49, respectively). Placental homogeneity and absent intraplacental dark band on T2WI may be exclusive criteria.

The most specific MRI features of MAP is a loss of tissue plane between placenta and local structure (95% specificity), but less sensitivity (27.3%) and moderate interobserver agreement (kappa = 0.51). This finding may increase diagnostic confidence.

Placental thickness had a high interobserver agreement (ICC = 0.82). The authors observed the placental thickening greater than 7 cm had 54.5% sensitivity and 84.2% specificity for MAP. The degree of placental heterogeneity has a poor interobserver agreement (kappa = 0.18), which may result from the subjective definition of the degree of placental heterogeneity.

The accuracy of MRI for MAP from our study was 83.8% (95% CI 66.2%-94.5%) with the moderate interobserver agreement (kappa = 0.58).

Although we collected all available image sets within the 10-year duration, very few MAP were identified resulting in limitation of interpretation. The further multicenter study may be required.

Conclusion

Uterine bulging, intraplacental hemorrhage and partial/not seen myometrium under placenta may be key criteria for the diagnosis of MAP. Placental homogeneity and absent intraplacental dark band on T2WI may be exclusive criteria. Loss of tissue plane between placenta and local structure may increase diagnostic confidence.

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