Article published online: 2021-07-30

Magnetic resonance imaging - A troubleshooter in obstetric emergencies: A pictorial review

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Abstract

The application of magnetic resonance imaging (MRI) in pregnancy faced initial skepticism of physicians because of fetal safety concerns. The perceived fetal risk has been found to be unwarranted and of late, the modality has attained acceptability. Its role in diagnosing fetal anomalies is well recognized and following its safety certification in pregnancy, it is finding increasing utilization during pregnancy and puerperium. However, the use of MRI in maternal emergency obstetric conditions is relatively limited as it is still evolving. In early gestation, ectopic implantation is one of the major life-threatening conditions that are frequently encountered. Although ultrasound (USG) is the accepted mainstay modality, the diagnostic predicament persists in many cases. MRI has a role where USG is indeterminate, particularly in the extratubal ectopic pregnancy. Later in gestation, MRI can be a useful adjunct in placental disorders like previa, abruption, and adhesion. It is a good problem-solving tool in adnexal masses such as ovarian torsion and degenerated fibroid, which have a higher incidence during pregnancy. Catastrophic conditions like uterine rupture can also be preoperatively and timely diagnosed. MRI has a definite role to play in postpartum and post-abortion life-threatening conditions, e.g., retained products of conception, and gestational trophoblastic disease, especially when USG is inconclusive or inadequate.

Key words: Emergency; hemorrhage; MRI; placenta; pregnancy

Introduction

USG is the mainstay modality for obstetric imaging. It is safe, accurate, fast, and inexpensive. However, it is operator dependent and limited by factors like bowel gas, small field of view, and obesity. USG suffers limitation in differentiating hemorrhage from other fluids which is important in ectopic pregnancy (EP) and antepartum hemorrhage (APH). Poor acoustic window in advanced pregnancy hampers proper visualization of posterior placenta and adnexal regions, which is important in placenta accreta and adnexal torsion. Small field of view (FOV) makes assessment of congenital uterine anomalies difficult. If USG findings are equivocal, the imaging work-up of a pregnant patient meets a dead end. Therefore, the need for a complimentary obstetric imaging modality has long been felt. Computed tomography (CT) does not fill this void because of the risk of radiation-induced teratogenesis.[1,2]

Magnetic resonance imaging (MRI), apart from being non-ionizing, offers other advantages like larger FOV, multi-planar imaging, excellent soft tissue contrast, and

Access this article online	
Quick Response Code:	Website: www.ijri.org
	DOI: 10.4103/0971-3026.178292

Cite this article as: Gupta R, Bajaj SK, Kumar N, Chandra R, Misra RN, Malik A, *et al*. Magnetic resonance imaging - A troubleshooter in obstetric emergencies: A pictorial review. Indian J Radiol Imaging 2016;26:44-51.

ability to differentiate blood from other fluids.[1-3] To date, no adverse effect to the fetus has been documented at the magnetic strengths used in diagnostic imaging and earlier fears concerning teratogenicity of MRI have been allayed. The 1.5 T MRI is safe in 2nd and 3rd trimesters as per the current US Food and Drug Administration (FDA) guidelines. MRI can even be performed in the 1st trimester when used judiciously. Gadolinium (Gd) is known to cross the placenta into the fetal circulation from where it is excreted by the fetal kidneys into the amniotic fluid, swallowed by the fetus, and can remain in this cycle for an indeterminate period. The potential risk is unknown, so routine use of Gd in pregnancy is not recommended as yet.[4,5]

Still, most of the obstetric MRI requests are limited to evaluation of fetal anomalies[3,6] and there is general reluctance in the obstetrician family to use MRI in the emergency situations. This is mainly because of the practical difficulties in conducting emergent MRI study in an unstable gravid patient with acute hemorrhage or pain and obtaining optimal image quality in such conditions.[2,7] Although these factors greatly affected image quality in the past, the current-day scanners have reduced the acquisition time considerably and most of the motion artifacts due fetal movement, maternal peristalsis, and breathing have been overcome.[1,6] Diagnostic quality images can now be obtained even in challenging situations. This pictorial review highlights the above message.

The role of MRI in obstetric emergencies is discussed herein as it evolves and becomes one of the more important and safe tools in the hands of radiologist, particularly in situations where other modalities are found wanting.

MRI Protocol

A robust MRI protocol is a prerequisite. Informed consent is needed, whether or not Gd is used. No specific patient preparation or premedication is required. In early pregnancy and postpartum cases, the FOV is usually limited to pelvis, so Turbo Spin Echo images can be used [Table 1].[8,9] In the 2nd and 3rd trimesters, abdominopelvic imaging is required. MRI technique should be such as to overcome the limitations caused by fetal motion and maternal breathing [Table 2]. Optimal use of parallel imaging can produce quality images. Specific absorption rate (SAR) is the mass normalized rate at which Radiofrequency energy is coupled to biologic tissue and is dependent on multiple variables in the MRI protocol.[10] MRI protocol should be tailored to minimize the SAR in a pregnant patient.[11]

Table 1: Magnetic resonance imaging protocol for early pregnancy

Parameter	Imaging planes	TR/TE (ms)	Flip angle (°)	FOV (mm)	Matrix	Parallel imaging factor	Slice width/ intersection gap	NSA	Acquisition time (ms)
T1W TSE*	Axial	600/13	90	400-450	256×224	2	5/0	2	1240
	Coronal								
T2W TSE*	Axial	4750/120	90	400-450	256×224	2	5/0	2	1260
	Coronal								
	Sagittal								

*Imaging planes were taken as anatomical planes. Oblique planes along the uterus were used in case of any ambiguity in anatomical plane images. Frequency-selective fat saturation was used with T1W images for detection of blood versus fat and with T2W images to better define edema and fluid collections. Gadolinium can also be used for difficult cases of ectopic pregnancy where noncontrast images are inconclusive. FOV: Field of view, NSA: Number of signal average, TR: Repetition time, TE: Echo time, T1W: T1-weighted, T2W: T2-weighted, TSE: Turbo spine echo

Table 2: Magnetic resonance imaging protocol in second and third trimesters*

Parameter	SSFP#		SSh T2W#,**			T1GRE#,**		
	Coronal	Axial	Coronal	Axial	Sagittal	Coronal	Axial	Sagittal
TR/TE (ms)	4/2	4/2	3500/80	3500/80	3500/80	170/5	170/5	170/5
Flip angle (°)	60	60	90	90	90	80	80	80
FOV (mm)	350-400	350-400	350-400	350-400	350-400	350-400	350-400	350-400
Matrix	256×224	256×224	256×224	256×224	256×224	256×224	256×224	256×224
Slice width/intersection gap (mm)	5/0-1	6/0-1	5/0-1	6/0-1	5/0-1	5/0-1	6/0-1	5/0-1
NSA	2	2	2	2	2	3	3	3
Parallel imaging factor	2	2	2	2	2	2	2	2
Acquisition time (s)	17-20	19-20	8-10	12-15	8-10	10	12	10
Merits	High SNR, fast, less sensitive to flow artifacts, low SAR		Minimizes motion artifacts			Low SAR, allows breathhold imaging		
Demerits	Sensitive to magnetic susceptibility artifacts		High SAR			Sensitive to magnetic susceptibility artifacts		

*DWI has been reported to have a role in antepartum hemorrhage, but was not used in the cases illustrated in this review, #Imaging was done using respiratory triggering if the patient could not do breathold, **Fat saturation was done with frequency selection wherever necessary as per the clinical question. SSFP: Steady state free precession, SSh T2W: Single shot T2-weighted, T1GRE: T1 gradient echo, FOV: Field of view, NSA: Number of signal averages, TR: Repetition time, TE: Echo time, SAR: Specific absorption rate, SNR: Signal-to-noise ratio, DWIs: Diffusion-weighted images

Gd is best avoided during pregnancy, but is safe when used selectively for postpartum indications.[11,12] Available data suggests that the percentage of Gd excreted in breast milk is too small to cause any adverse effect in the infant, so, it is safe to continue breast feeding, although ultimately the informed decision may be left to the mother to discontinue breast feeding for 12–24 h after Gd injection.[4]

MRI in Early Pregnancy

Ectopic pregnancy

EP is the most common life-threatening emergency in early gestation, presenting usually around 6 weeks gestation. Incidence is rising due to infertility treatments and tubal surgeries.[8,13]

The most definite diagnostic finding of EP on transvaginal sonography (TVS) is the presence of an extrauterine gestational sac (GS) with yolk sac and embryo within. The diagnosis is, however, difficult in the presence of hematoma and hematosalpinx, or in cases of extratubal implantation, where findings may mimic other adnexal masses because of inability of USG to identify the blood products [Figure 1].[13] MRI can serve as a troubleshooting modality in such cases. On MRI, GS is seen as a cystic structure with thick T2-hyperintense wall. Hallmark of GS is presence of fresh blood within the wall, seen as distinct low signal intensity areas on T2-weighted images [Figure 2]. GS mimickers like corpus luteal cyst, on the other hand, rarely contain acute hematoma. In the presence of hemoperitoneum, GS may not be clearly discernible within the heterogeneous pelvic mass. Contrast-enhanced MRI is then useful to identify GS as a discrete structure with thick, brightly enhanced wall and papillary solid placental tissues. Therefore, when TVS is inconclusive, MRI helps to diagnose EP by detection of fresh blood and is highly specific in rare extratubal types of EP [Figure 3].[8,14,15] As per the literature, if both direct and indirect signs are included, the overall sensitivity and specificity of USG and MRI in EP are 63% and 69%, and 91% and 100%, respectively.[16,17]

MRI in 2nd and 3rd Trimester

Antepartum hemorrhage

APH is one of the major conditions where accurate diagnosis and timely intervention can be life saving. TVS has a high accuracy for diagnosis of placenta previa, but does not always rule out or allow confident diagnosis of placental abruption.

USG features of placental hemorrhage are known since decades, but there has been no significant improvement in the sensitivity for detecting placental hematoma despite technological advances in USG over the years.[11]

Acute and subacute hematoma may be isoechoic and appears only as a thickened placenta [Figure 4A]. Blood generally passes through the os and USG fails to detect the thin sleeve

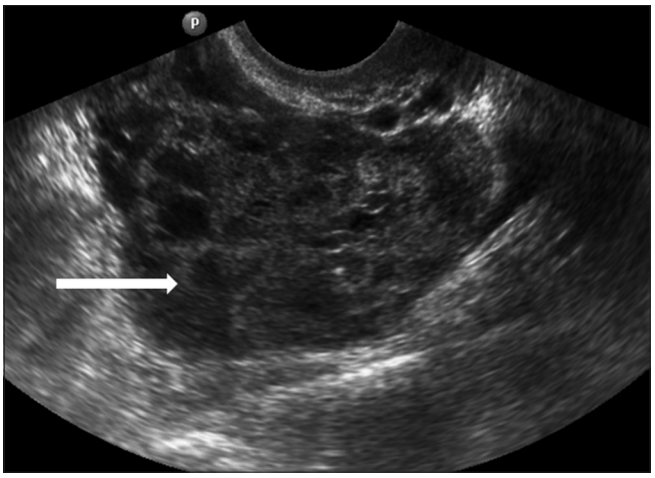

Figure 1: TVS image of a patient with intermittent vaginal spotting for 1½ months with mild RIF pain. Urine pregnancy test was negative and uterine cavity showed no sac. A heterogeneous right adnexal mass was seen. Ovary was not seen separately. The image is nonspecific for any tubo-ovarian mass. Laparoscopy revealed a right tubal EP with hematosalpinx (RIF, Right iliac fossa)

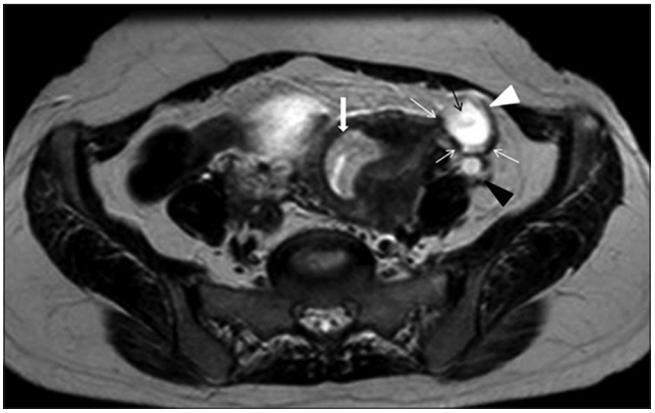

Figure 2: Axial T2W TSE image in a 22-year-old patient with ectopic pregnancy. Uterine cavity (solid white arrow) is empty. A cystic structure is seen in the adjoining left adnexa (white arrowhead). Its wall is hyperintense with distinct low signal foci of acute hemorrhage (small white arrows) within. A yolk sac is also faintly visualized (small black arrow) suggesting the cyst to be a tubal GS. The left ovary (black arrowhead) is seen posteriorly

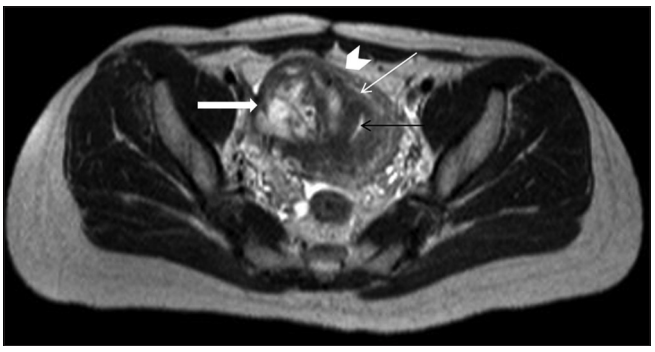

Figure 3: Axial SSh T2W image in a 25-year-old patient with suspected EP. Ectopic GS (solid white arrow) is seen at the right uterine cornua. Claw of myometrium (chevron) draping around the sac and presence of junctional zone (small white arrow) between GS and endometrial cavity (small black arrow) suggest interstitial rather than angular ectopic pregnancy

of hemorrhage left behind. This can be picked up on MRI due to its ability to detect blood products [Figure 4B].[18] The reported sensitivity and specificity of USG and MRI in diagnosis of APH are 53–82% and 71–85%, and 100% and 100%, respectively.[11,19] T1 gradient echo and diffusion weighted imaging are reportedly most accurate, but SSh T2W and SSFP sequences are also very efficacious. MRI can also accurately localize the hemorrhage as marginal subchorionic or retroplacental [Figure 5].[11,18] This affects the management because retroplacental hematoma has much higher risk of fetal demise.[18] The signal intensity based age estimation criteria of intracranial hematoma have been extrapolated to intrauterine hematoma by some authors and have been found to be helpful, as patients with hyperacute and acute hematoma rapidly worsened clinically. Hyperaute blood appears iso- to hypointense on T1-weighted, hyperintense on T2-weighted, and hyper- to hypointense on diffusion-weighted images. The presence of active bleeding is an indicator of instable abruption and, hence, such information is invaluable.[19]

Morbidly adherent placenta

The incidence of morbidly adherent placenta (MAP) has increased from 1 in 7000 in 70s to 1 in 533 live births now due to increasing number of cesarean sections combined with increasing maternal age and repeated cesarean sections. Failure to diagnose the condition prenatally can result in catastrophic intrapartum or postpartum hemorrhage and various surgical complications.

In case of suspicious MAP, imaging should be performed at 32 weeks gestation to confirm the diagnosis and allow time to plan 3rd trimester management and surgical intervention.

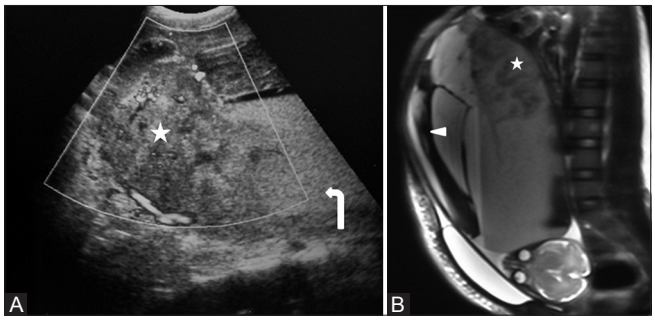

Figure 4 (A and B): Patient with 31 weeks of gestation presenting with acute abdominal pain, tense uterus, and increased fundal height. (A) USG with color Doppler shows a thickened placenta. The fundal component (star) is heterogeneous and vascular, while the caudal component (bent arrow) is homogenously echogenic and shows no flow on color Doppler. Only conclusion drawn from USG is placentomegaly, while the clinical question remains unanswered. (B) Sagittal SSh T2W image shows a huge placenta nearly filling the uterine cavity anteroposterioly. Placental parenchyma (star) is seen at the fundal aspect. A large intraplacental blood-fluid level is seen. Signal intensity of hemorrhage indicates that the darkest appearing chronic bleed (arrowhead) lies just beneath the chorionic plate. A large subchorionic hematoma could be diagnosed on MRI. Conservative management and elective cesarean section at 32 weeks led to delivery of live fetus and a 4 kg placenta with massive subchorionic thrombohematoma

The most predictive sonographic sign is presence of placental lacunae which show turbulent flow. A gray-scale ultrasound evaluation along with Doppler enhances the accuracy of detecting adherent placentae, although these are by no means very sensitive, particularly when the placenta is posterior.[20,21] The sensitivity, specificity, and positive predictive value of USG including 3D and Doppler have been reported as 97%, 92%, and 77%, respectively.[22] The use of MRI as an adjunct modality in troublesome cases increases the detection of true positive cases.

The indications for MRI evaluation include inconclusive or questionable USG findings, inadequate visualization due to posterior placenta, low-lying placenta with other risk factors, and anterior placenta with poor visualization of cesarean scar region or with focal loss of retroplacental myometrial zone.[22]

The cogent role of MRI in placenta accreta is well established in literature. Abnormal features include placental heterogeneity, dark intraplacental bands on T2-weighted images due to fibrin deposition, disorganized intraplacental vascularity with hypertrophied vessels, loss of retroplacental T2 dark zone, focal uteroplacental defect, uterine bulge, and direct invasion of adjacent structures. Of these, intraplacental bands and flow voids are very important for diagnosing placenta accreta [Figure 6A and B].[20] The pitfall is that thin bands and some flow voids can be seen in normal near-term placentae and in placental insufficiency. Keeping the criteria of band thickness >1 cm and deep location of flow voids >6 mm in diameter increases the specificity. Preserved retroplacental clear zone in on USG in doubtful areas on MRI can reduce the rate of false-positive diagnosis. Color Doppler and MRI are, hence, complementary in diagnosis of MAP.[20,22-24]

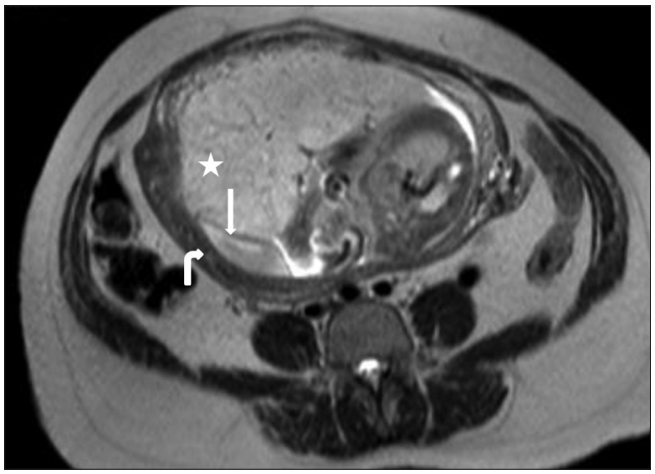

Figure 5: Patient with 26 weeks of gestation presented with APH and abdominal pain. USG revealed central placenta previa, but did not explain the abdominal pain. Axial SSh T2W MRI image shows small collection (straight white arrow) dissecting between the myometrium (bent arrow) and the placenta (star). Hypointense dependent layering is seen within the collection suggestive of placental abruption and marginal subchorionic hematoma

Uterine rupture

Uterine rupture in pregnancy is defined as a full-thickness disruption of the uterine wall that also involves the overlying visceral peritoneum. Diagnosis is often made intraoperatively.

In addition to superior depiction of hemoperitoneum, the excellent soft tissue resolution of MRI permits visualization of the actual uterine disruption, allowing a preoperative diagnosis [Figures 7, 8A and B].[25,26] However, as this condition can be catastrophic, only those patients who are hemodynamically stable should be taken up for MRI.

Adnexal masses

Both ovarian torsion and leiomyoma degeneration have a higher incidence during pregnancy and can present with acute abdominal pain. By virtue of its multiplanar capability, MRI can be a problem-solving tool as it can determine uterine versus adnexal nature of masses. Leiomyoma has a claw-shaped interface with the uterus and degenerated leiomyoma may show classic diffuse or peripheral high signal intensity on T1-weighted images, while its USG features are nonspecific [Figure 9A-C].[27]

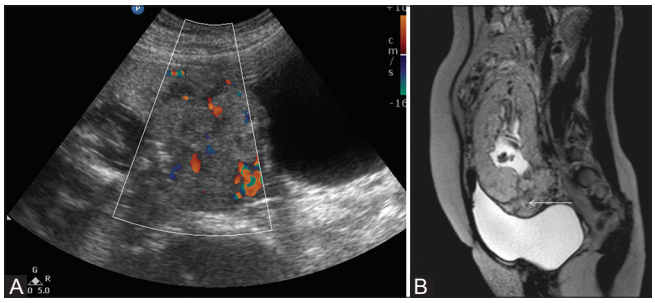

Figure 6 (A and B): Multigravida with previous cesarean section at 28 weeks gestation. (A) Ultrasound reveals low lying placenta with heterogeneity and lacunae showing turbulent flow on Color Doppler. The placenta shows increased vascularity with turbulent flow. (B) Sagittal SSh T2W image shows many thick dark bands (arrow) in the lower part of placenta, which are a specific feature of placental adhesive disorder.

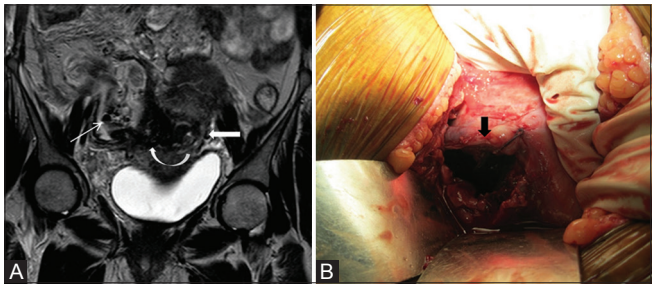

Figure 8 (A and B): Patient with intrauterine demise at 19 weeks gestation and undergoing induction of labor. USG (not shown) revealed a macerated fetus lying outside the uterine cavity. (A) Coronal SSh T2W image shows a wide defect (solid straight arrow) in the lower uterine segment causing expulsion of the sac (curved arrow) and all its contents. The amniotic sac containing the fetus lies in the region of right broad ligament. There are foci of susceptibility artifacts (small white arrow) due to air within the macerated fetus. (B) The large uterine rent (black arrow) as seen on the intraoperative image

USG features of torsion ovary include unilateral enlarged ovary, uniform peripheral cystic structures, a co-existent ovarian mass, pelvic free fluid, lack of arterial or venous flow, and a twisted vascular pedicle. There are several mimics

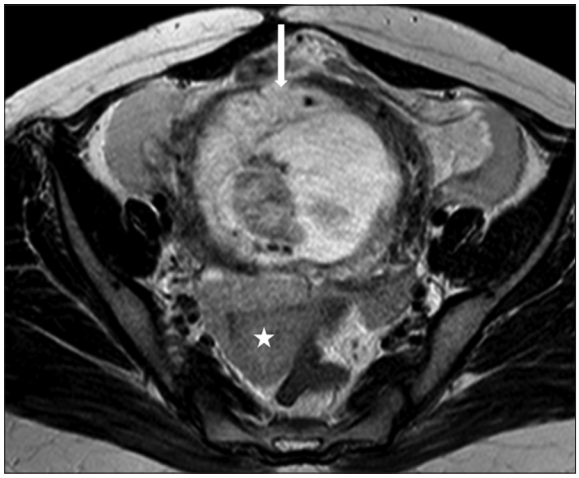

Figure 7: Patient with acute abdominal pain at 16 weeks gestation. USG (not shown) revealed ascites and a live intrauterine fetus. T2W axial MR image shows the ascitic fluid (star) as hypointense to urine suggestive of hemoperitoneum. A full-thickness small midline defect is seen in the anterior myometrium (arrow). Patient had undergone a prior hysterotomy. Findings suggested uterine scar rupture. Laparotomy was done with delivery of dead fetus and primary repair of uterus

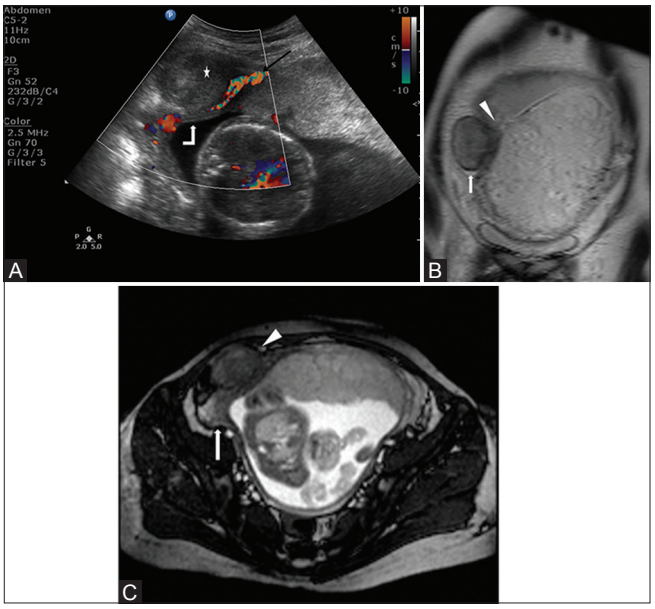

Figure 9 (A-C): Patient with right iliac fossa pain at 20 weeks gestation. (A) USG shows an ovoid heterogeneous mass (star) very close to the right anterior wall of uterus (bent arrow). On color Doppler imaging, bridging vessel sign (black arrow) was present, while no intralesional vessels could be seen. Right ovary was not seen. USG findings were nonspecific for degenerated leiomyoma or adnexal mass. (B) SSh T2W coronal image shows the lesion (straight arrow) as mildly hypointense to myometrium with a beak-like interface (arrowhead) with uterine wall. (C) Axial SSFP image shows the normal right ovary (arrow) posterior to the mass (arrowhead). Multiplanar images revealed the uterine origin of mass. A diagnosis of degenerated subserosal leiomyoma was made and patient improved on conservative management

of these findings, including hemorrhagic cyst, polycystic ovary syndrome (PCOS), and ovarian hyperstimulation syndrome. Also, a co-existent mass may confound the diagnosis. Color Doppler may be normal due to dual arterial supply of ovary.[27,28] MRI features of ovarian torsion initially are ovarian enlargement with diffuse stromal edema seen as hyperintensity on T2-weighted images. Later, the ovary undergoes hemorrhagic infarction; hemorrhage within pedicle, ovary, or peritoneum is noted as dark signal on T2-weighted images and bright signal on fat-saturated T1-weighted images. Tubal thickening >10 mm (mass/target or beak like) may be present [Figure 10A-C]. Lack of post Gd enhancement in the non-viable ovary is best appreciated on subtraction images.[29,30]

Uterine anomalies like bicornuate uterus or rudimentary horn seen during pregnancy can also appear like adnexal masses on USG. Large FOV and tissue signal characterization of MRI help in making proper diagnosis [Figure 11A and B].

MRI in Postpartum/Post-abortion Period

Retained products of conception (RPOCs) appear on MRI as intracavitary uterine soft tissue mass with variable T1- and T2-weighted signal intensity, variable contrast enhancement, variable degree of myometrial thinning, and loss of junctional zone [Figure 12A and B]. MRI can also show associated uterine anomalies, recognition of which can be of profound assistance in surgical planning.

MRI findings of gestational trophoblastic disease (GTD) overlap with RPOCs. Myometrial thinning, loss of junctional zone, and post Gd enhancement are not reliable signs for differentiation. However, presence of abnormal uterine vasculature and theca lutein cysts favor GTD [Figure 13]. MRI is also beneficial in disease staging by showing the uterine invasion and extrauterine disease in GTD.[31]

Conclusion

To summarize, MRI has an excellent troubleshooting role in various obstetric emergency situations. If TVS findings are inconclusive for ectopic gestation or when rare extratubal sites are suspected, MRI has a definite role. It has an edge over USG in APH by detection of small hematomas and active bleeding and should be done when USG is negative or inconclusive. The indications of MRI as an adjunct modality in MAP are now well defined. MRI can avert potential catastrophic event in uterine rupture by showing actual uterine defect as a cause for hemoperitoneum and should be done in hemodynamically stable patients. Multiplanar imaging and large FOV help solve many mysteries of torsed adnexae, uterine masses, and uterine anomalies complicated during gestation. In postpartum patients, RPOCs and GTN have many overlapping findings. Still, MRI can help in diagnosing gestational trophoblastic neoplasia with confidence by showing flow voids within the uterine mass in association with theca lutein cysts.

In conclusion, MRI is a safe imaging modality in pregnancy and fast enough to be done in emergency situations. The authors'

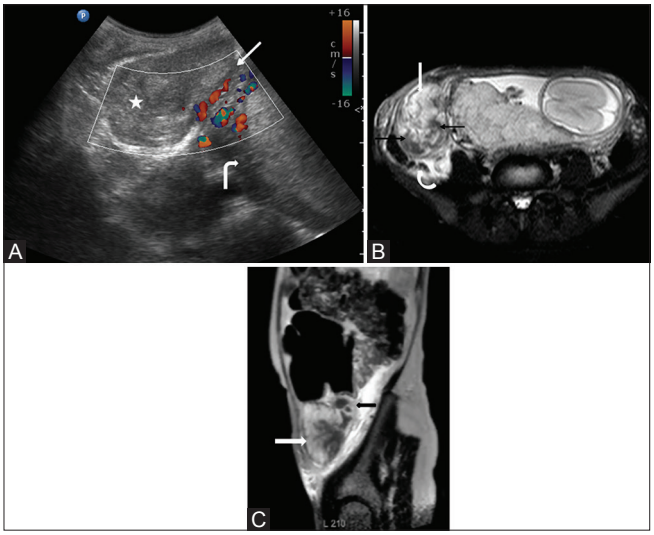

Figure 10 (A-C): A 25-year-old female with 23 weeks of gestation presented with acute RIF pain and tenderness. (A) USG shows a heterogeneous echogenic mass (star) anterior to the right side of the uterus (bent arrow). CDI shows presence of bridging vessel sign (straight arrow). Right ovary was not visualized separate from the mass. USG differential diagnosis was adnexal mass or leiomyoma. (B) Fat-saturated T2W axial image shows an ovoid mass (straight white arrow) in the RIF. Mass is heterogeneous with ill-defined dark areas (black arrows) within and surrounding edema. The normal appendix (curved arrow) is seen posteriorly. (C) Sagittal T2W image shows a thickened heterogeneous pedicle (black arrow) with dark areas of hemorrhage. It forms a beaked protrusion on the superior aspect of mass (white arrow). MRI findings suggested right ovarian torsion with hemorrhagic infarction. A gangrenous ovary was removed laparoscopically (RIF, Right iliac fossa)

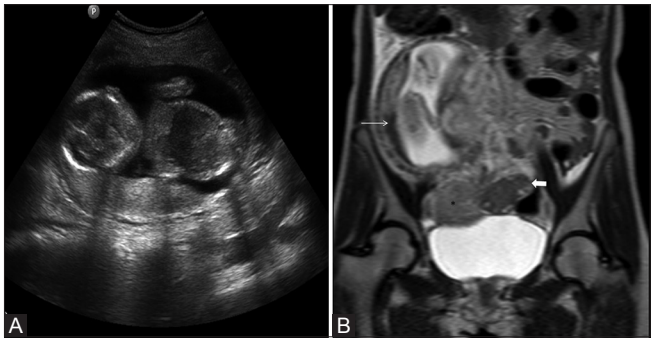

Figure 11 (A and B): Patient presenting at 20 weeks of gestation with sudden abdominal pain. (A) USG image shows a well-defined GS with fetus and placenta, but the uterus (not shown) was empty and location of this ectopic sac was uncertain. (B) Coronal SSh T2-weighted MRI image shows the GS located cranial to the uterus (*). Wall is isointense to myometrium, with T2 dark hemorrhagic areas (thin arrow). It is connected to the ovary by a thick pedicle. The ovary itself is T2 dark and enlarged, suggesting hemorrhagic infarction (thick arrow). Diagnosis of rudimentary horn pregnancy with torsion was made. A rudimentary horn pregnancy with torsion of the gravid horn and ovary was found at surgery

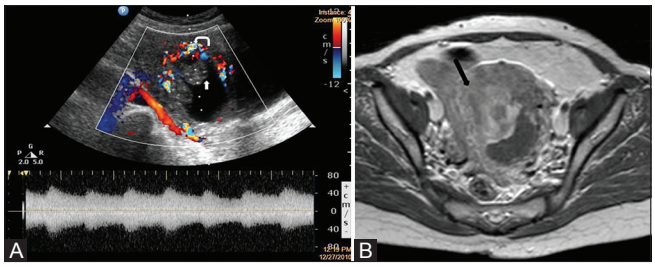

Figure 12 (A and B): Patient presenting 6 weeks after spontaneous abortion with severe vaginal bleeding. (A) USG showed an intracavitary mass (straight arrow) with apparent myometrial invasion (bent arrow) at the fundus. Duplex waveform revealed characteristic low-resistance, high-velocity trophoblastic flow. (B) T1W post Gd image shows bright enhancement in the mass with focal myometrial invasion/thinning at the fundus (black arrow). Probable MRI diagnosis was retained products of conception. S. β-HCG was 240 mIU/ml. D and E was done and histopathology revealed degenerating villi (d and e, Dilation and evacuation; S. β-HCG, serum β-human chorionic gonadotropin)

Figure 13: Patient presenting 6 weeks after spontaneous abortion with severe vaginal bleeding. Coronal fat-saturated post Gd T1W image shows intracavitary mass (straight black arrow) with myometrial invasion and brisk enhancement. There is presence of abnormal clustered flow voids (curved black arrow) within the mass. Bilateral theca lutein cysts (straight white arrows) are also seen. A confident MRI diagnosis of invasive molar pregnancy could be made. Serum β-HCG was >4200 mIU/ml and histopathology confirmed the MRI diagnosis (S. β-HCG, Serum β-human chorionic gonadotropin)

experience is that it fills the lacuna for a problem-solving tool in potentially catastrophic obstetric conditions where USG is inadequate. Gd should be used judiciously, mainly in EP and postpartum or post-abortion conditions. Close coordination between the obstetric, USG, and MRI departments is crucial for pragmatic use of this much underutilized modality in emergency obstetric conditions.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Nagayama M, Watanabe Y, Okumura A, Amoh Y, Nakashita S, Dodo Y. Fast MR imaging in obstetrics. Radiographics 2002;22:563-80.
2. Masselli G, Brunelli R, Casciani E, Polettini E, Bertini L, Laghi F, *et al.* Acute abdominal and pelvic pain in pregnancy: MR imaging as a valuable adjunct to ultrasound? Abdom Imaging 2011;36:596-603.
3. Jung SE, Byun JY, Lee JM, Rha SE, Kim H, Choi BG, *et al.* MR imaging of maternal diseases in pregnancy. AJR Am J Roentgenol 2001;177:1293-300.
4. ACR Committee on Drugs and Contrast Media. ACR Manual on Contrast Media, 9.0 ed. American College of Radiology; 2013. Available from: http://www.acr.org/qualitysafety/resources/~/media/37D84428BF1D4E1B9A3A2918DA9E27A3.pdf/. [Last accessed on 2015 May 31].
5. Woodfield CA, Lazarus E, Chen KC, Mayo-Smith WW. Abdominal pain in pregnancy: Diagnoses and imaging unique to pregnancy – Review. AJR Am J Roentgenol 2010;194 6 Suppl: WS14-30.
6. Harrison BP, Crystal CS. Imaging modalities in obstetrics and gynecology. Emerg Med Clin North Am 2003;21:711-35.
7. Jaffe TA, Miller CM, Merkle EM. Practice patterns in imaging of the pregnant patient with abdominal pain: A survey of academic centers. AJR Am J Roentgenol 2007;189:1128-34.
8. Tamai K, Koyama T, Togashi K. MR features of ectopic pregnancy. Eur Radiol 2007;17:3236-46.
9. Tanaka YO, Shigemitsu S, Ichikawa Y, Sohda S, Yoshikawa H, Itai Y. Postpartum MR diagnosis of retained placenta accreta. Eur Radiol 2004;14:945-52.
10. Shellock FG, Crues JV. MR procedures: Biologic effects, safety, and patient care. Radiology 2004;232:635-52.
11. Masselli G, Brunelli R, Parasassi T, Perrone G, Gualdi G. Magnetic resonance imaging of clinically stable late pregnancy bleeding: Beyond ultrasound. Eur Radiol 2011;21:1841-9.
12. Baughman WC, Corteville JE, Shah RR. Placenta accreta: Spectrum of US and MR imaging findings. Radiographics 2008;28:1905-16.
13. Lin EP, Bhatt S, Dogra VS. Diagnostic clues to ectopic pregnancy. Radiographics 2008;28:1661-71.
14. Kataoka ML, Togashi K, Kobayashi H, Inoue T, Fujii S, Konishi J. Evaluation of ectopic pregnancy by magnetic resonance imaging. Hum Reprod 1999;14:2644-50.
15. Ha HK, Jung JK, Kang SJ, Koong SE, Kim SJ, Kim JY, *et al.* MR imaging in the diagnosis of rare forms of ectopic pregnancy. AJR Am J Roentgenol 1993;160:1229-32.
16. Takahashi A, Takahama J, Marugami N, Takewa M, Itoh T, Kitano S, *et al.* Ectopic pregnancy: MRI findings and clinical utility. Abdom Imaging 2013;38:844-50.
17. Kao LY, Scheinfeld MH, Chernyak V, Rozenblit AM, Oh S, Dym RJ. Beyond ultrasound: CT and MRI of ectopic pregnancy. AJR Am J Roentgenol 2014;202:904-11.
18. Trop I, Levine D. Hemorrhage during pregnancy: Sonography and MR imaging. AJR Am J Roentgenol 2001;176:607-15.
19. Masselli G, Brunelli R, Di Tola M, Anceschi M, Gualdi G. MR imaging in the evaluation of placental abruption: Correlation with sonographic findings. Radiology 2011;259:222-30.
20. Lim PS, Greenberg M, Edelson MI, Bell KA, Edmonds PR, Mackey AM. Utility of ultrasound and MRI in prenatal diagnosis of placenta accreta: A pilot study. AJR Am J Roentgenol 2011;197:1506-13.

21. Bour L, Placé V, Bendavid S, Fargeaudou Y, Portal JJ, Ricbourg A, *et al.* Suspected invasive placenta: Evaluation with magnetic resonance imaging. Eur Radiol 2014;24:3150-60.
22. Derman AY, Nikac V, Haberman S, Zelenko N, Opsha O, Flyer M. MRI of placenta accreta: A new imaging perspective. AJR Am J Roentgenol 2011;197:1514-21.
23. Dwyer BK, Belogolovkin V, Tran L, Rao A, Carroll I, Barth R, *et al.* Prenatal diagnosis of placenta accreta: Sonography or magnetic resonance imaging? J Ultrasound Med 2008;27:1275-81.
24. Srisajjakul S, Prapaisilp P, Bangchokdee S. MRI of placental adhesive disorder. Br J Radiol 2014;87:20140294.
25. Leyendecker JR, Gorengaut V, Brown JJ. MR imaging of maternal diseases of the abdomen and pelvis during pregnancy and the immediate postpartum period. Radiographics 2004;24:1301-16.
26. Hasbargen U, Summerer-Moustaki M, Hillemanns P, Scheidler J, Kimmig R, Hepp H. Uterine dehiscence in a nullipara, diagnosed by MRI, following use of unipolar electrocautery during laparoscopic myomectomy: Case report. Hum Reprod 2002;17:2180-2.
27. Born C, Wirth S, Stäbler A, Reiser M. Diagnosis of adnexal torsion in the third trimester of pregnancy: A case report. Abdom Imaging 2004;29:123-7.
28. Chang HC, Bhatt S, Dogra VS. Pearls and pitfalls in diagnosis of ovarian torsion. Radiographics 2008;28:1355-68.
29. Pedrosa I, Zeikus EA, Levine D, Rofsky NM. MR imaging of acute right lower quadrant pain in pregnant and nonpregnant patients. Radiographics 2007;27:721-43.
30. Oto A, Ernst RD, Shah R, Koroglu M, Chaljub G, Gei AF, *et al.* Right-lower-quadrant pain and suspected appendicitis in pregnant women: Evaluation with MR imaging – Initial experience. Radiology 2005;234:445-51.
31. Noonan JB, Coakley FV, Qayyum A, Yeh BM, Wu L, Chen LM. MR imaging of retained products of conception. AJR Am J Roentgenol 2003;181:435-9.