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Evaluation of Obsteric Abnormalities Using Magnetic Resonance Imaging

Ekta Singh*

[*]Department of Radiology, Sharda School of Allied Health Sciences, Sharda University, India.

Corresponding Email: [*]ekta75287@gmail.com

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Abstract: ***This study is aimed to see different obstetric abnormalities during the pregnancy. In a variety of obstetric emergency situations, MRI plays a great diagnostic role than USG in female abnormalities during serious cases. MRI has a clear role in ectopic pregnancy and uncommon external area is not covered. Ultrasound is for females scan during pregnancy but in these sevier cases also used the magnetic resonance imaging for more effective and high quality images of abnormalities and pathologies. In this project it shows the abnormalities and pathologies of females during the pregnancy, it includes the cases like: placenta accrete, ectopic pregnancy, placenta previa and cyst formation etc. It showing that the Magnetic resonance is more effective in these cases than ultrasound.***

Keywords: ***Magnetic Resonance Imaging, Placenta Abnormalities, Placenta Accreta, Placenta Previa, Uterine Cyst, Hemorrhage.***

1. INTRODUCTION OF MRI

It is a medical imaging which creates precise images of all interior human body structures, including tissues, bones, muscles, ligaments, soft tissues, fluids, etc. Strong magnetic fields, gradient magnetic fields, and radio waves are used in MRI scanners to provide images of the body's organs. Non-ionizing radiations are used instead of x-rays. It is non-ionizing radiations, do not harm the patient body.

The MRI Principle

MRI depend on the principle of nuclear magnetic resonance [NMR]. It is a branch of medicine that studies the behaviour of the nucleus, particularly the proton.
NMR is the foundation of magnetic resonance imaging. When a patient is lying down on the test table, the hydrogen protons in their body align, some parallel and some antiparallel to the external magnetic field of the MRI machine. The excess hydrogen proton is cancelled, creating a net magnetization vector (NMV), which is subsequently switched from longitudinal

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magnetization (LM) to transverse magnetization (TM) by the radiofrequency pulse. Then the radiofrequency pulse [RF] is turned off, the signal is received, and an image appears on the monitor.

Fig-1.0 Magnetic Resonance Imaging tesla Phillips

Components of MRI

Superconducting Magnet

Superconducting magnets are used in superconducting MRI systems. The main benefit is that compared to the other two types (resistive and permanent), a superconducting magnet can generate a magnetic field that is significantly stronger and more stable. A magnetic that functions in a superconducting state is known as a superconducting magnetic. An electrical conductor (wire) known as a superconductor possesses zero resistance to the flow of an electrical current.

Permanent

A permanent magnet that is non-electrical can be used for MRI. The fact that a permanent magnet operates without the need for coolants or electricity is undoubtedly an advantage. However, the range of this kind of magnet is likewise restricted to weak field intensities. Typically, vertical magnetic fields that run between the two magnetic poles are produced by both resistive and permanent magnets.

Gradients

The gradient coil is used to provide magnetic variation in MRI. The main function of this coil is to spatially modulate the main magnetic field with the bore of magnet. The magnetic field is relatively uniform or homogenous over the patient's body when the MRI equipment is at rest

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and not really creating a picture. These gradients must be used to distort the field throughout the imaging process. Simply put, a gradient in the patient's body is a shift in field strength from one spot to another.

Shimming

A homogenous magnet field is one need for excellent imaging. This is a field where the field strength is constant throughout the image region. Shimming is the process of uniformly altering the magnetic field. Materials placed in the magnetic field that are magnetically sensitive frequently cause inhomogeneities. These substances cause inhomogeneities, which are distortions of the magnetic field, to exist. Both the internal and external regions of the field are susceptible to this. There are some inhomogeneities created each time a different patient is positioned in the magnetic field.

Role of MRI in Obsteric

The use of MRI in the treatment of obstetric patients is becoming more prevalent. MRI has been used for the past 30 years and is currently regarded as an established supplementary imaging modality for obstetric care, even if sonography also used for the evolution of pregnant patients. Obstacles to an accurate ultrasound evaluation can include maternal obesity, oligohydramnios, fetal posture, and ossification. The expansive imaging capabilities, and image collection in numerous real orthogonal planes are all benefits of MRI. We can identify soft tissue, fluid, hemorrhage, fat, and meconium using different sequence.

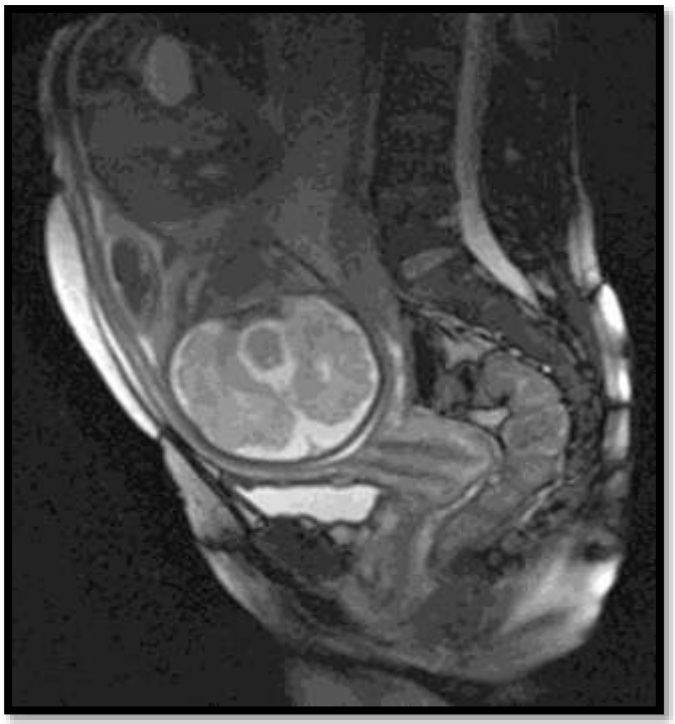

Fig-1.1 Role of MRI in obstetric.

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Introduction to Female Reproductive Organs

The organs of the female reproductive system produce and nourish the female sex cells, also called ova or egg cells. They also transfer the cells to a site where sperm can fertilize them, provide an environment that is conducive to the growth of the fetus, move the developing fetus to the outside once it has finished developing, and produce female sex hormones. The female reproductive system consists of the ovaries, Fallopian tubes, uterus, vagina, accessory glands, and external genital organs. The system is made up of tissues and organs found both inside and outside the body. Among the internal organs are:

Uterus
Two ovaries
Two fallopian tubes
Cervix
Vagina

Ovaries

There are two ovaries in the reproductive system of females. About 700,000 immature eggs, or oocytes, are present in each of the two ovaries at birth (Trusted Source). After a person reaches puberty, these eggs begin to develop inside the ovary follicles. Approximately once per month, the ovaries release an egg that is fully developed. Ovulation, a process that occurs during the menstrual cycle, is what produces eggs. It also makes pregnancy possible.

Fallopian Tube

The fallopian tubes are used to carry eggs to the uterus. They are composed of the following structures: the fimbriae, which are projections that resemble fingers surrounding the aperture; the cilia, which are hair-like structures inside the fallopian tubes; and the infundibulum, which is a funnel-shaped hole near the ovaries. and fimbriae propel an egg out of an ovary and toward the fallopian tube entrance. Once inside, the cilia direct the egg toward the uterus.

Uterus

The uterus is an organ with a shape and size similar to a pear. Another name for it is the womb. Its walls are skeletal, and the size of the endometrial lining varies with each menstrual cycle. After ovulation, the endometrium thickens to make room for a fertilized egg. In approximately two weeks, if the egg is not fertilized, the lining of the womb sheds. As the lining breaks down, blood is produced and leaves the body through the vagina. Menstruation, or periods, are what are happening right now.

Vagina and Cervix

The cervix is a small structure located at the base of the uterus. It fulfills several functions: Whether a woman is pregnant or not, the cervix secretes cervical mucus, which keeps sperm from entering the uterus. Protecting against the spread of infection: Because it keeps bacteria out of the uterus, mucus also maintains the health of the vagina. The base of the cervix has a small opening that allows fluids, including menstrual blood, to pass through. Beneath the cervix is the vagina, a flexible, tubular tube that joins the external and internal reproductive organs. It is situated behind the bladder and in front of the digestive system.

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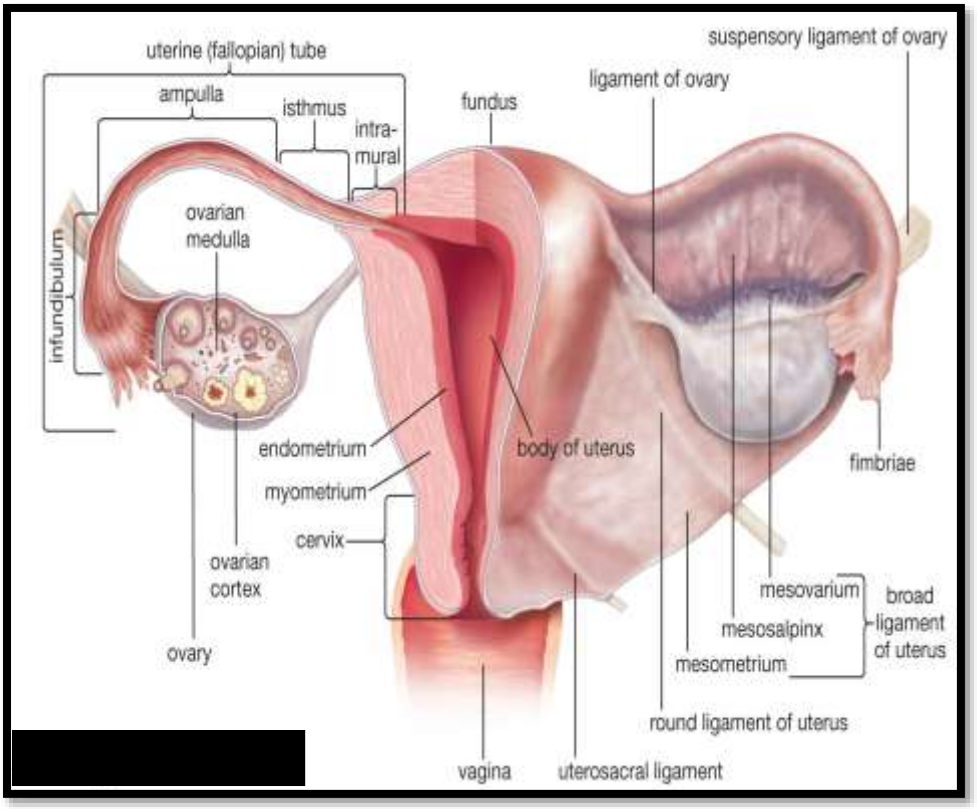

Fig-1.2 Parts of female reproductive system

Anatomy of Female Womb

An organ located in the pelvis or lower abdomen is the uterus. It is a component of the reproductive system in women. It is a baby's growth area. It's referred to as the womb at times. The uterus is shaped like a hollow pear. It is about the size of a fist. Your lower belly, or pelvis. The uterus and fallopian tubes are connected. The eggs are more easily passed on from the ovaries to the uterus thanks to these tubes. The name "cervix" refers to the opening that joins the vagina and the lowest part of the uterus. The upper, wider part of the uterus is called the corpus or fundus. The uterus is divided into four main regions: The body of the uterus, or the majority of it, starts below the fallopian tubes and lower part is vagina.

Layers

Entometrium: The lining within is called the endometrium. During the menstrual cycle, it is lost.

Myometrium: This is the middle, thickest layer of muscle in the corpus or fundus. It grows throughout the pregnancy to make room for the developing baby. During labor, it contracts to push the baby out.

Exometrium or Serosa: outermost layer is this one. The uterus is protected and is given easy access to slide and move as needed within the pelvis thanks to this structure.

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Placenta

During pregnancy, the placenta serves as a temporary organ to join to uterus to growing child. Soon after fertilization, the placenta begins to grow and adheres to the uterine wall. The umbilicus is attached to baby and mother during pregnancy as it is the main part during whole pregnancy. It function as your baby's life support system when they are within the uterus. When egg is fertilized within the femals body the placenta starts to develop. The majority of the blood arteries of the placenta are housed inside of "villi" formations.

Anatomy of Placenta

In the uterus, the placenta can develop anywhere. Everywhere the fertilized egg implants into the uterine wall, it develops. The placenta can be found in a few different places:
Posterior placenta: The placenta develops on the uterine back wall.
The placenta develops on the uterine wall that is closest to the abdomen, known as the anterior placenta.
Fundamental placenta: This organ develops at the upper part of your uterus.
Lateral placenta: The placenta develops on either the left or right uterine wall.

Size

The placenta measures 10 inches in length and 1 inch in thickness in the middle. By the time the child is born, it is about 16 ounces (1 pound) in weight.
The side that is linked to the uterus and the sidee that is closest to your child are the two sides of the placenta. The side facing your baby is gray, whereas the sidee linked to females uterine walls has rich reddish blue tint.

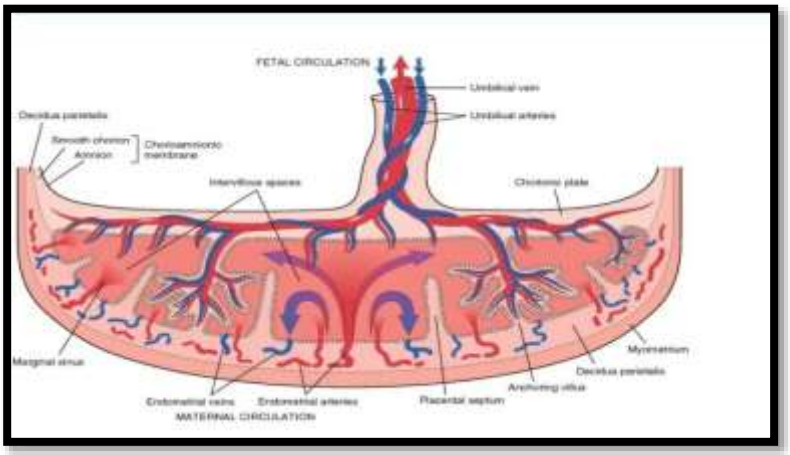

Fig 1.3 Anatomy

Placenta Functions

1. Supplies nutrients and oxygen to the infant.
2. Eliminates carbon dioxide and hazardous waste from the infant.
3. Generates hormones that support the baby's growth.
4. Immunity is transferred from mother to child.
5. It shields the infant**.**

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Abnormalities Found During Pregnancy

Placental Abnormalities

The placenta allows for metabolic exchange between the mother and the fetus by adhering to the uterine wall. There are maternal and embryonic components to the placenta. The outermost embryonic membrane gives rise to the embryonic portion.

Acceptable Placenta

A condition known as placenta accreta occurs when the placenta, which gives oxygen and nutrition to the developing fetus, grows too deeply into the uterine wall. In a normal pregnancy, the placenta just separates when you have placenta accreta, the placentaaa has grownnn intoo the uterinee walls and is difficult to remove after birth. It may cause life-threatening vaginal hemorrhage in extreme circumstances. A transfusion of blood and hysterectomy (the removal of uterus from female's body) may be necessary. During pregnancy or delivery, healthcare professionals for expectant mothers detect placenta accreta.

Placenta Accreta Come in Three Different:

Placenta Accreta: The placenta clings strongly to the uterine wall. It doesn't affect the uterus's muscles or pass through the uterus's wall. The most typical kind is this.

Embryonic Increta: placenta is more tightly ensconced in the uterine walls. It is securely connected to the uterus' muscle but still does not pass through the uterine wall. 15% of cases involve placenta increta.

Placenta Percreta: This condition, which is the most serious of the three, occurs when the placenta ruptures the uterine wall. The placenta may develop during pregnancy.

1. Injury to the organs surrounding uterus.
2. Infertility following a hysterectomy.
3. Severe bleeding necessitating transfusions of blood.

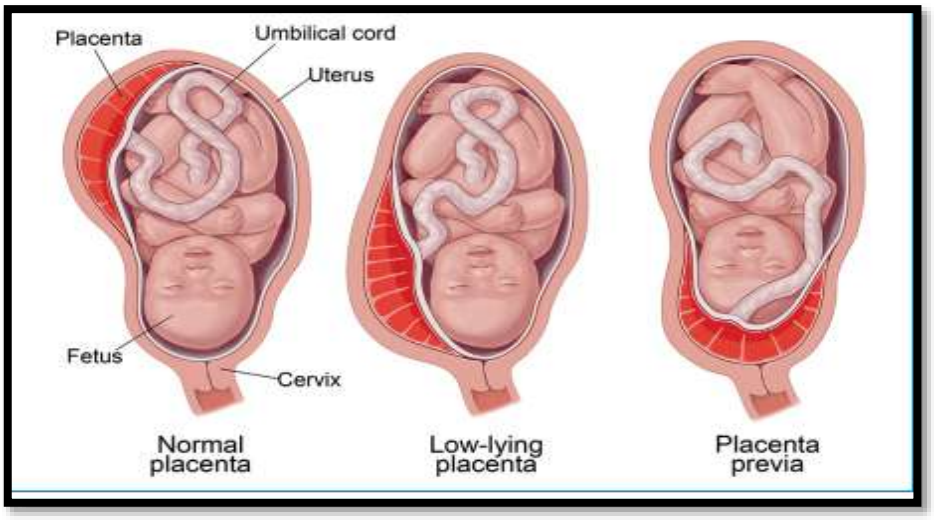

Fig -1.4 Abnormalities Found During Pregnancy

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Placenta Previa
The term "placenta previa" describes a placenta that is excessively low lying and covers the internal cervical or lies close to it. An antepartum hemorrhage [APH] frequently results from it. Both the mother and the child could end up losing their lives as a result of placenta previa. To properly prepare for childbirth, prenatal diagnosis is therefore crucial.

Causes of Previa
Previous cesarean section
Increased maternal age
Increased parity
Large placentas

Vasa Previa
Vasa previa is a rare pregnancy problem that, if not treated carefully, can cause substantial blood loss for your fetus. Unprotected blood arteries from the umbilical cord cross your cervix [or cervical] opening when you have vasa previa. The exposed blood vessels that can burst when your water breaks during birth can result in significant blood loss for your fetus or even death. These risks can be avoided by receiving an early diagnosis of vasa previa and having your baby delivered by c-section.

Ectopic Pregnancy
The most common site of an ectopic pregnancy is the fallopian tube, which carries eggs from the ovaries to the uterus. This type of ectopic pregnancy is called a tubal pregnancy. An ectopic pregnancy can also sometimes develop in the ovary, the abdominal cavity, or the lower part of the uterus (the cervix), which is connected to the vagina.
The development of ectopic pregnancies is abnormal. If the situation is not handled, the fertilized egg will not survive, and the developing tissue may bleed to death.

Causes
Inflammation and scarring of the fallopian tubes from a previous medical condition, infection, or surgery.
Hormonal factor.
Genetic abnormalities.
Birth defects.

2. REVIEW OF LITERATURE

Brunelli R, Casciani E, Polettini E, Bertini L, Masselli G
Doctors originally advised against using magnetic resonance imaging (MRI) during pregnancy out of concern for the fetus's safety. The claimed fetal risk has been proven to be unfounded by recent studies, and the procedure is now considered acceptable. Because of its safety certification for use in pregnant women, its application in the diagnosis of fetal anomalies is expanding during pregnancy and puberty. However, MRI is still in its early stages of development and is therefore rarely utilized in emergency obstetric situations involving

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mothers. One of the most dangerous and potentially fatal conditions that commonly arises in the early stages of pregnancy is ectopic implantation. Even with ultrasound (USG) being the generally accepted standard modality, there is often still a diagnostic.

Byun JY, Choi BG, Rha SE, Kim H, Lee JM, Jung SE, and Kim H
Ectopic conception
Around six weeks of gestation is when EP, the most common life-threatening emergency in the early stages of pregnancy, usually appears. Because of infertility treatments and tubal ligations, the prevalence is rising.
The most definitive diagnostic marker of EP is the presence of an extrauterine gestational sac (GS) with an embryo and yolk sac on transvaginal sonography (TVS).

Riteau A, Tassin M, Chambon G
Antepartum hemorrage in mri 2nd and 3rd trimester.
Isoechoic acute and subacute hematomas can only be seen as a thicker placenta. Normal blood flow via the prevents USG from detecting the thin sleeve of hemorrhage left behind. Due to MRI's capacity to identify blood components, this can be found there. According to reports, USG and MRI have sensitivity and specificity of 53-82%, 71-85%, and 100% and 100% for the diagnosis of APH, respectively. The most accurate imaging techniques are apparently the gradient echo and diffusion weighted imaging.

Brunelli R, Parasassi T, Perrone G, Gualdi G, Masselli G.
Rupture of the womb
A full-thickness uterine wall disruption that also affects the visceral peritoneum on top is known as pregnancy-related uterine rupture. Often, the diagnosis is made in the operating room. In addition to offering a superior representation of the hemoperitoneum, which facilitates preoperative diagnosis, MRI's great soft tissue resolution allows imaging of the actual uterine disturbance. But because this illness can be diagnosed, only those who are hemodynamically stable should have an MRI.

Shah RR, Corteville JE, and Baughman WC. Placenta Accreta
The accreta placenta (PA)
The placenta accreta, a defect in the decidua basalis, allows chorionic villi to enter the myometrium. Common causes include placenta previa, any previous uterine surgery, and a previous cesarean section. MRI may be useful in determining the extent of the invasion when US results are not entirely clear. MRI findings include focal areas of myometrial thinning or interruptions, nodular or linear low-signal intensity on T2 WI (intra-placental bands), and a bulging myometrium with loss of the normal pear-shaped shape of the gravid uterus. The placenta's internal hemorrhage or lacunae cause heterogeneous signal intensity. There is disagreement regarding contrast-enhanced MRI in placenta accreta. At the moment, some people who decide to have an abortion or an emergency cesarean.

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Rl, Channdrasekharan A, Joseeph S, Venkata Sai P, Devu B, Reddy Sk Bhardwaj Placenta abruptio (AP)
Although USG is the main method for detecting abruption placentas, MRI provides a greater resolution and diagnosis in circumstances where USG is negative. Hematoma development, which might be retroplacental, subchorionic, or pre-placental, is one of the imaging findings. Additional classifications include hyperacute, acute, subacute, and chronic [10]. It can be challenging to diagnose an acute hemorrhage with solely USG because of its anechoic character. It can be made using an MRI. When the patient is stabilized, an MRI is advised.

Woodfield cherry CA, Lazarus E, Chenjacob KC, Mayo-Smith
Uterine diseases
Uterine rupture, which involves a thickness tear of the uteruss and involves the peritoneum, is a potentially fatal disorder. Hemoperitoneum can be found with USg. However, USG may have trouble identifying the precise interruption site. The precise location of uterine disturbance can be found via MRI due to its improved image. It is only advised, though, if the patient is good. By using MRI, all of these disorders might be accurately detected. The presence of hemorrhagic products in the fibroid was a helpful characteristic to diagnose the degeneration

Jaffe TA, Miller CM, Merkle EM.
Choriocarcinoma, hydropic degeneration, and molar pregnancy are a few other disorders. There are two types of molar pregnancies: partial and full. Although ultrasound is the preferred pregnancy, invasive moles show uterine wall invasion more clearly on MRI than on USG. Gadolinium injection after contrast therapy will reveal the lesion has been much enhanced. When identifying extrauterine extensions, MRI is more accurate than USG. Only patients and those with co-existing other illnesses like leiomyoma are eligible for MRI during molar pregnancy. When a pregnancy is failing due to hydropic degeneration, the placenta enlarges and there are many cystic areas visible on ultrasound.

Oto A, Ernst RD, Shah R, Koroglu M, Chaljub G, Gei AF
FIBROIDS
Fibroids are a typical obstetric MRI finding. During pregnancy, fibroids frequently grow rapidly, which can cause necrosis and discomfort. The majority of the time, fibroid degeneration symptoms go away within a few days, but inflammation may cause labour to start. By demonstrating point tenderness when scanning over the fibroid, sonography can be used to diagnose pregnant patients with abdominopelvic pain brought on by fibroid degeneration. MR can be useful in making the diagnosis in complex cases.

Born C, Wirth S, Stäbler A, Reiser M.
Deep Venous
One in 2000 pregnanciess are compliicated by deep venous thrombossis. In order to check for clots in the lower extremities, ultrasound is used. MR venography can be done if a pelvic clot is a concern. On SSFSE sequences, clot results in local vein distention with heterogeneous material. It is preferable to use unenhanced MR techniques during pregnancy because

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gadolinium is typically avoided during this time. Bright-signal intensity within the blood vessels can be seen in time-of-flight images that were acquired perpendicular to the vein of interest.

3. METHODOLOGY

Patient Prepration

Firstly, patient's previous history is taken and a written consent form must be taken from patient.

Ask pt to remove all metallic things and change all clothes and wear hospital gown. Most important thing is to take the patient's consent form, allergy history, patient signature and name before the examination.

In case of contrast the KFT report must be normal and ask LMP in case of contrast media.

Provide comfort and extra foam pads for patients comfortness.

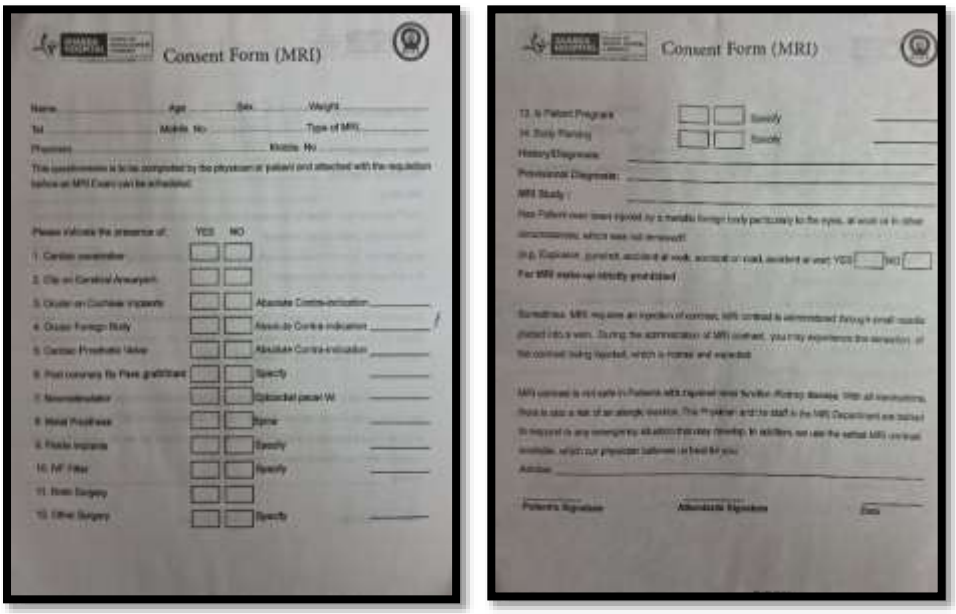

Fig.1.7During procedure consent form in MRI

MRI Sequences for Obstetric

MRI Pelvis

Survey
T2w TSE Cor COR
T2w SPAIR Cor COR
T1 TFE IP COR
T2w TSE SAG
T2w SPAIR SAG
T1 TFE IP SAG
T2w TSE TRA

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T2w SPAIR TRA
For Contrast Media
T1 w TSE+ CM COR
T1W TSE + CM TRA
Case Study on Abnormalities in Obsteric
Case 01z
Name: Karishma
Age: 31yr /female
Investigation: MRI PELVIS
History: Patient with previous history of caesarean section now presented with abdomen pain

Sequences Involved:

- T1weighted- axial and coronal
- T2weighted- coronal and axial
- SPAIR - sag and coronal
- Fat suppression T2w

Findings:
Uterus is graved, Lower uterine cavity is covering the internal os suggestive of IV placenta previa.
Both ovaries are normal and bladder is well distended.

Fig 1.8 Placenta Accreta

Impression: There is marked thinning of the myometrium at the uterine segments with loss of normal retroplacental hypointense zone- likely placenta accreta.

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Grade IV placenta previa.

Case 02

Name: Anu
Age: 29YR/ F
Investigation: MRI PELVIS WITH CONTRAST.
History: patient presented with history of bleeding PV.

Sequences Involved

- T1weighted- axial and coronal
- T2weighted- coronal and axial
- SPAIR - sag and coronal
- Fat suppression T2w

For Contrast

- T1 w TSE+ CM COR
- T1W TSE + CM TRA

Findings: uterus is normal, a well-defined lesion with patchy area of hyperintense T1 signal is seen.

Fig-1.9 Ectopic Pregnancy

Impression: left tubo ovarian mass with ovarian cyst/collection – possibility of concealed ruptured ectopic pregnancy.

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Case 03
NAME- palak
Age- 30yr/F
Investigation- MRI PELVIS WITH CONTRAST
History- patient presented with history of primary amenorrhea.

Sequences Involved
- T1weighted- axial and coronal
- T2weighted- coronal and axial
- Fat suppression T2w

For Contrast
- T1 w TSE+ CM COR
- T1W TSE + CM TRA

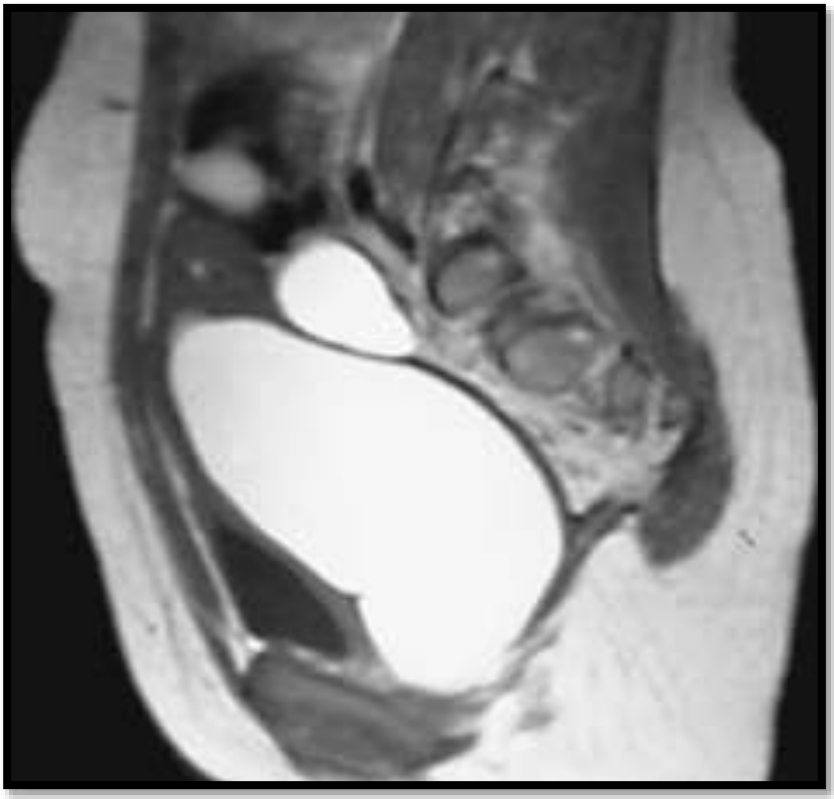

Fig-2.0 Showing Hematocolpos

Impression- Hematocolpos with hematometra and bilateral hematosalpinx**.**
Case 04
NAME- ANJU
Age- 28yr/ F
Investigation – MRI PELVIS

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History- Patient with previous history of caesarean section now presented with abdomen pain and bleeding spoots.
SEQUENCES INVOLVED:

- T1weighted- axial and coronal
- T2weighted- coronal and axial
- SPAIR - sag and coronal
- Fat suppression T2w

Findings- placenta is in abnormal condition and fluid is present in uterine cavity**.**
Uterus is graved, Lower uterine cavity is covering the internal os suggestive of IV placenta previa. Both ovaries are normal and bladder is well distemnded.

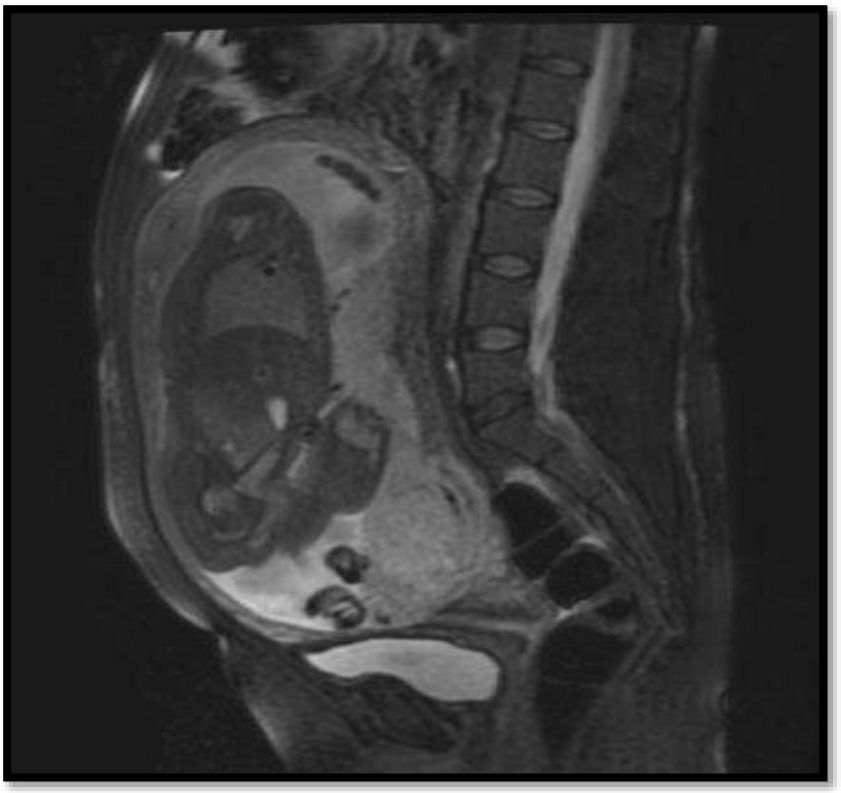

Fig- 2.1 Vasa Previa

Impression: there is marked thinning of the myometrium at the uterine segments with loss of normal retroplacental hypointense zone- likely VASA PREVIA.

Case 05
Name – soni
Age -30yr /F
Investigation – MRI PELVIS WITH CONTRAST.
History – patient presented with abdominal pain since 2 years.

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Sequences Involved

- T1weighted- axial and coronal
- T2weighted- coronal and axial
- SPAIR - sag and coronal
- Fat suppression T2w

For Contrast

- T1 w TSE+ CM COR
- T1W TSE + CM TRA

Fig 2.2 Hemorrhage Cyst

Impression: Bilateral adnexal lesion with necrotic lymph nodes. Left adnexal cystic lesion like hemorrhage cyst.

4. RESULT & DISCUSSION

Magnetic resonance imaging has excellent spatial and contrast resolution, is free of ionizing radiation, and produces non-operator-dependent results, it is a useful tool for evaluating a variety of obstetric and non-obstetric conditions during pregnancy. But using it while pregnant brings up a lot of ethical, legal, and medical questions. Although there haven't been any human studies that show any detrimental effects on the fetus from MRI exposure without contrast

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agent during any trimester of pregnancy, there is a tendency to be more cautious when it comes to using contrast agent during this time, as recommended by international guidelines.

Discussion

The benefits of using MRI as identifying the actual uterine defect as the source of the hemoperitoneum, MRI can prevent a potentially fatal uterine rupture and should be performed on patients who are hemodynamically stable. All are often clarified by multiplanar imaging and large FOV. There are numerous similarities between RPOCs and GTN findings in postpartum patients. An accurate diagnosis of gestational trophoblastic neoplasia can be made with the aid of an MRI, which can demonstrate flow voids within the uterine mass. It also help in finding all the types of abnormalities within the body.

Summary

Magnetic resonance imaging is imaging technique that can be used during pregnancy and is quick enough to be used in an emergency. According to the authors' experience, it fills the gap left by USG as a problem-solving tool in potentially fatal obstetric situations. Gd should only be used sparingly, primarily in conditions related to EP, postpartum, or post-abortion. The obstetric, USG, and MRI departments must work closely together if this underutilised modality is to be used in emergency obstetric situations.

Ionizing radiation is not used in (MRI), and there are no known biologic concerns related to this imaging technique. Maternal problems during pregnancy can be evaluated with MRI, including unusually advanced ectopic pregnancies, suspected appendicitis, pelvic tumors, hepatic and genitourinary disorders, and placenta accreta.

5. CONCLUSION

MRI is a helpful supplement to sonographic diagnosis for suspected central nervous system (CNS) abnormalities in fetuses, especially isolated mild ventriculomegaly. For some prenatal thoracic lesions, MRI may offer extra information. It can also help determine the prognosis of diaphragmatic hernias and offer further details in the case of complex fetal genitourinary disorders. In situations where an ultrasound imaging diagnosis was ambiguous, it has been discovered that MRI is helpful in the detection of aberrant placental implantation. As MRI technology develops, fetal structures can be resolved more clearly. It is expected that this method will be used more frequently to diagnose and assess fetal anomalies during pregnancy.it is very useful technique to find all the types of abnormalities.

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