"EFFICACY OF MRI OVER ULTRASOUND IN EVALUATION OF ABNORMAL UTERINE BLEEDING WITH HISTOPATHOLOGICAL CORRELATION"

By

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DISSERTATION SUBMITTED TO SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, KOLAR, KARNATAKA

In partial fulfilment of the requirements for the degree of

DOCTOR OF MEDICINE
IN
RADIODIAGNOSIS

Under the Guidance of

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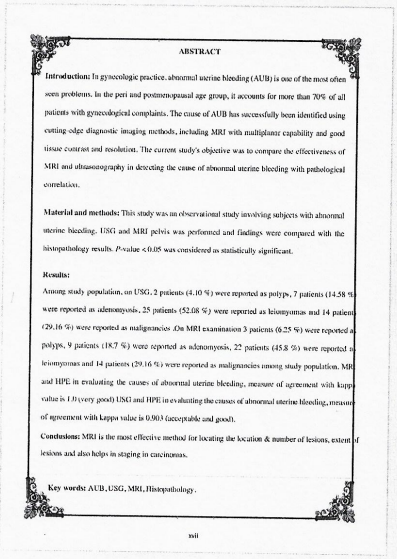

ABSTRACT

Introduction: In gynecologic practice, abnormal uterine bleeding (AUB) is one of the most often seen problems. In the peri and postmenopausal age group, it accounts for more than 70% of all patients with gynecological complaints. The cause of AUB has successfully been identified using cutting edge diagnostic imaging methods, including MRI with multiplanar capability and good tissue contrast and resolution. The current study's objective was to compare the effectiveness of MRI and ultrasonography in detecting the cause of abnormal uterine bleeding with pathological correlation.

Material and methods: This study was an observational study involving subjects with abnormal uterine bleeding. USG and MRI pelvis was performed and findings were compared with the histopathology results. *P*-value <0.05 was considered as statistically significant.

Results:

Among study population, on USG, 2 patients (4.10 %) were reported as polyps, 7 patients (14.58 %) were reported as adenomyosis, 25 patients (52.08 %) were reported as leiomyomas and 14 patients (29.16 %) were reported as malignancies .On MRI examination 3 patients (6.25 %) were reported as polyps, 9 patients (18.7 %) were reported as adenomyosis, 22 patients (45.8 %) were reported as leiomyomas and 14 patients (29.16 %) were reported as malignancies among study population, MRI and HPE in evaluating the causes of abnormal uterine bleeding, measure of agreement with kappa value is 1.0 (very good) USG and HPE in evaluating the causes of abnormal uterine bleeding, measure of agreement with kappa value is 0.903 (acceptable and good).

Conclusion: MRI is the most effective method for locating the location & number of lesions, extent of lesions and also helps in staging in carcinomas.

Key words: AUB, USG, MRI, Histopathology.

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LIST OF ABBREVIATIONS

GLOSSARY	ABBREVIATIONS
AMH	Anti mullerian hormone
AUB	Abnormal uterine bleeding
CI	Confidence interval
CT	Computed tomography
D&C	Dilatation and curettage
DUB	Dysfunctional uterine bleeding
ESS	Endometrial stromal sarcoma
FIGO	Federation Internationale de Gynecolgie et d'Obstetrique
FSE	Fast spin echo
GESI	Gynec endocrine society of India
HPE	Histopathological examination
JZ	Junctional zone
MR	Magnetic resonance
MRI	Magnetic resonance imaging
SD	Standard deviation
TAS	Transabdominal scan
TVS	Transvaginal scan
US	Ultrasound
USG	Ultrasonography

ABSTRACT

Introduction: In gynecologic practice, abnormal uterine bleeding (AUB) is one of the most often seen problems. In the peri and postmenopausal age group, it accounts for more than 70% of all patients with gynecological complaints. The current study's objective was to compare the effectiveness of MRI and ultrasonography in detecting the cause of abnormal uterine bleeding with pathological correlation.

Material and methods: This study was an observational study involving subjects with abnormal uterine bleeding. USG and MRI pelvis was performed and findings were compared with the histopathology results. *P*-value < 0.05 was considered as statistically significant.

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Conclusions: MRI is the most effective method for accurate identification of location & number of lesions, extensions and also helps in staging in carcinomas.

Key words: AUB, USG, MRI, Histopathology.

INTRODUCTION

INTRODUCTION:

At least one-third of women are likely to experience abnormal uterine bleeding (AUB) at a certain time during their lifetime. Uterine bleeding without pregnancy is referred to as AUB and is abnormal in terms of regularity, volume, frequency, or duration.[2] AUB can be classified as structural or nonstructural. Adenomyosis, uterine polyps, leiomyoma, endometrial or myometrial malignancy, and endometrial hyperplasia are structural causes of AUB.

Nonstructural causes are Coagulation disorders, primary endometrial disorders-molecular deficiencies, ovulatory dysfunction, intrauterine devices, iatrogenic etiologies - exogenous gonadal steroids, and other unclassified causes.[1, 2] nonstructural causes will not be further described in this document because they cannot be determined through imaging. On the other hand, imaging can be used to diagnose structural causes. In perimenopausal women, adenomyosis, leiomyoma and endometrial polyps are the most common causes of AUB. [3] Endometrial cancer is the lethal cause in postmenopausal women and need to evaluate AUB caused by structural causes by polyps or endometrial hyperplasia .[3-5] A comprehensive history, physical examination, imaging, and the required laboratory testing of a patient initially with abnormal bleeding. Imaging may also be used to help identify and treat women in reproductive age group and post-menopausal women suffering AUB. [3, 5-7].

MRI (magnetic resonance imaging) has the potential to be a promising and accurate imaging technique when the clinical diagnosis cannot be validated and sonography is misleading even when the patient has normal findings and still exhibits symptoms.[8]

The current investigation will be conducted to assess different structural causes of AUB using USG and MRI. The pathological diagnosis will be correlated with the imaging findings. By determining the root cause of AUB, this study aids in avoiding

needless procedures like hysteroscopy, diagnostic laparoscopy and hysterectomies.

NEED FOR THE STUDY:

In gynecologic practice, abnormal uterine bleeding (AUB) is among the most prevalent health issues. The peri and postmenopausal age group accounts for more than 70% of all patients with gynaecological complaints. [9] Menorrhagia, polymenorrhagia, polymenorrhea, metrorrhagia, and menometrorrhagia are a few of the different appearances that it might have. [10] The International Federation of Gynecology and Obstetrics recognised a revised categorization for the etiology of AUB in the reproductive age group in November 2010. The method built around the acronym was created in response to worries over the planning and interpretation of clinical studies that might be connected to the AUB proble.(endometrial polyps, leiomyoma adenomyosis, hyperplasia, and hyperplasia, coagulation and ovulatory disorders, , iatrogenic, not classified).[11]

AUB can be a symptom of benign or malignant female genital tract diseases, or it might be a manifestation of the hormonal environment. However, structural problems are not always visible, and this is referred to as dysfunctional uterine bleeding (DUB). The most prevalent hyper estrogenic disorders include DUB, uterine fibroid, and adenomyosis, in which the endometrium continues to be in a proliferative phase and may develop into endometrial cancer if left untreated. Therefore, a clinical examination and further research must be conducted in order to identify the etiological aspect of a patient presenting with AUB. For AUB, organic diseases were led out using ultrasonography (USG). It is widely acknowledged that histopathological analysis may accurately identify a variety of disease pathologies (HPE). According to GESI (Gynec endocrine society of India) recommendations, ultrasound examination of the uterus, adnexa, and endometrium are required in AUB.[12]

Over the years, a variety of imaging methods have been used to identify the origin of AUB, including computerized tomography, magnetic resonance imaging, Hysterosonosalphingography, transabdominal ultrasound, and transvaginal ultrasound. Transabdominal ultrasonography is still the preferred screening imaging technique.[12]

To choose a treatment strategy, it is critical to assess the cause of AUB. Myomectomy or hysterectomy, for instance, may be performed in the event of a myoma. Hysterectomy, however, is the preferred method of treatment for Adenomyosis.[13,14] This emphasizes the importance of a certain preoperative diagnosis.

A hysteroscopic excision is an option in situations with fibroid submucosal in location if circumference of uterine surface is > 50% if not laparoscopic resection should be performed [12] Otherwise, a laparoscopic resection should be performed. For extramural fibroids, location and number of lesions can influence whether laparoscopic excision or hysterectomy is recommended. It explains the requirement of precise measurements of the lesion's size and circumference as well as its exact placement.

To some extent, transvaginal ultrasound was utilised to provide answers, but it is dependent on operator, and large lesions can't be seen in field of vision on TVS. Only endometrial lesions can be visualised by Hysterosonosalphingography. CT is mostly used to stage carcinomas and examine uterine lesions. MRI is another diagnostic modality for definitive characterizations of uterine lesions in preoperative evaluation Body surface coils are used in T2 & T1 weighted sequences on MRI, & performed in coronal, sagittal and axial planes.[13]

AIMS & OBJECTIVES

AIM AND OBJECTIVES:

1. To perform USG abdomen and pelvis in patients with AUB.
2. To perform an MRI abdomen and pelvis in patients with AUB.
3. To compare findings on ultrasound with MRI.
4. To correlate USG & MRI findings with histopathological findings.

Research question

Is MRI more efficient than USG in the evaluation of cause of AUB?

REVIEW OF LITERATURE

REVIEW OF LITERATURE:

Anatomy of the uterus:

The Uterus in non-gravid patient is a hollow, muscular, pear-shaped organ which is around 7 - 8 cm in length, 5 cm in width and 2.5 cm in thickness in anteroposterior aspect. Depending on age, parity, and menstrual cycle phase, these measurements vary. The uterine corpus and cervix make up the mature uterus. The Fundus is the area of the uterine corpus that is cephalad to the line that connects the two fallopian tube origins. The fallopian tubes are segmented into four sections and measure about 10 cm in length. The short intramural component is the medial extent. Its myometrium encircles it. The isthmus follows, which is a short, straight section. This is located at the broad ligament's upper margin. The larger ampulla is located beyond this. The infundibulum, an extended open end, is the lateral extent and it is located beyond broad ligament close to the side wall of pelvis. The endometrium lines the uterine cavity. Myometrium, a thick muscle layer, and a serosal coating covers it. Depending on the type and level of ovarian hormonal stimulation, the normal endometrium exhibits a variety of constantly changing normal patterns. Ovarian hormones cause the endometrium to proliferate synchronously, differentiate and ultimately dissolve every month.[14,15]

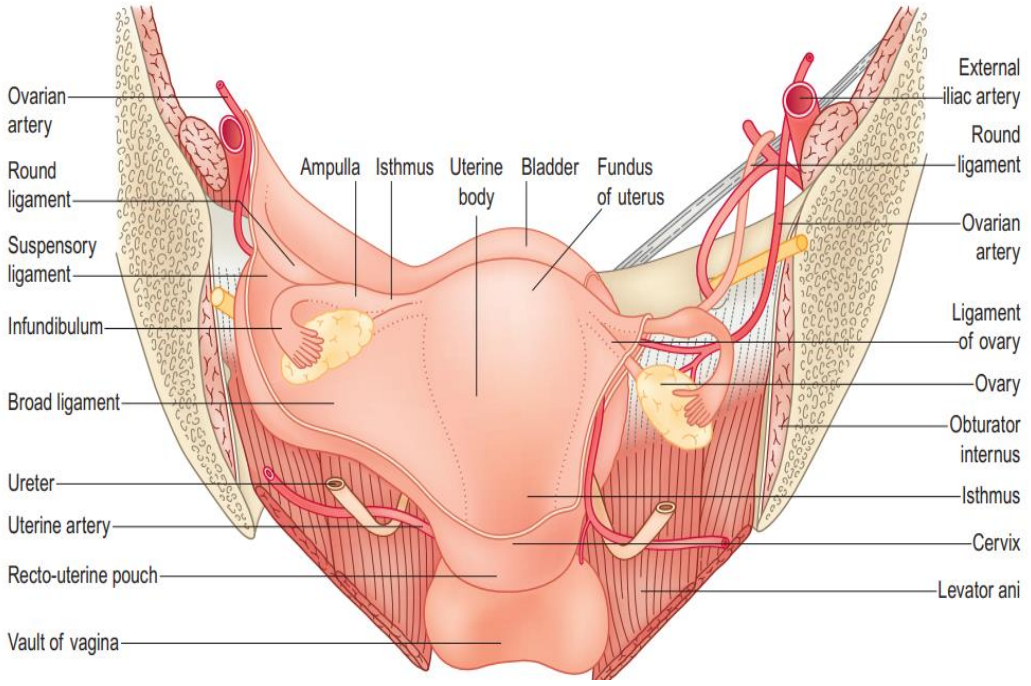

Figure 1: Gross anatomy of the uterus. Coronal view of the female pelvis viewed from behind showing the uterus, tubes, ovaries and related structures. The broad ligament has been removed on the right side

Embryology:

The process of the female reproductive system's development takes a long period. Gonads, reproductive ducts, and external genitalia are the three categories of female genital organs. Mesenchyme, primordial germ cells, mesoderm and coelomic epithelium are the four sources of reproductive system in females. Organogenesis which is Mullerian in origin is where uterus develops, along with cervix, the upper vaginal wall, and both fallopian tubes. [16,17]

The 5th and 6th weeks of the foetus' life are when the genital organs first become active. The mesonephric (Wolffian duct) and paramesonephric pairs of genital ducts (Mullerian duct) are present during this gestation period. Wolff duct regression and

additional Mullerian duct differentiation occur in females without the SRY gene and anti-Mullerian hormone (AMH). The paramesonephric ducts are warehouses of the cervix, uterus, both fallopian tubes and upper third of the vagina.[17]

During 7th week, localised coelomic epithelial invaginations give way to paired paramesonephric ducts on the top pole of each mesonephros. The urogenital ridges are reached by caudal and lateral growth of Mullerian conduits.[18]

Paramesonephric ducts fuse vertically at 8th week and combined cranial end gives rise to the left and right halves and finally forms uterus. Mesoderm present at this tissue develops into myometrium and endometrium. Cranial ends of the Mullerian ducts which are unfused develope in to fimbrial component of the fallopian tubes and fallopian tubes from the tip of Mullerian duct structure, which is funnel-shaped and open. Combined ducts caudal end leads to formation of vagina.[19] These formations have a midline septum, which can persist and cause a septate uterus. The midline septum often reabsorbs fully within the uterine cavity at about 20 weeks.[17]

In the female foetus, the ovarian ligament and round ligament both developed from gubernaculum, which is connected to the ovaries by undifferentiated mesenchymal tissue. [21] By the end of the first trimester, the uterus and further Mullerian duct derived components have reached full development.[18]

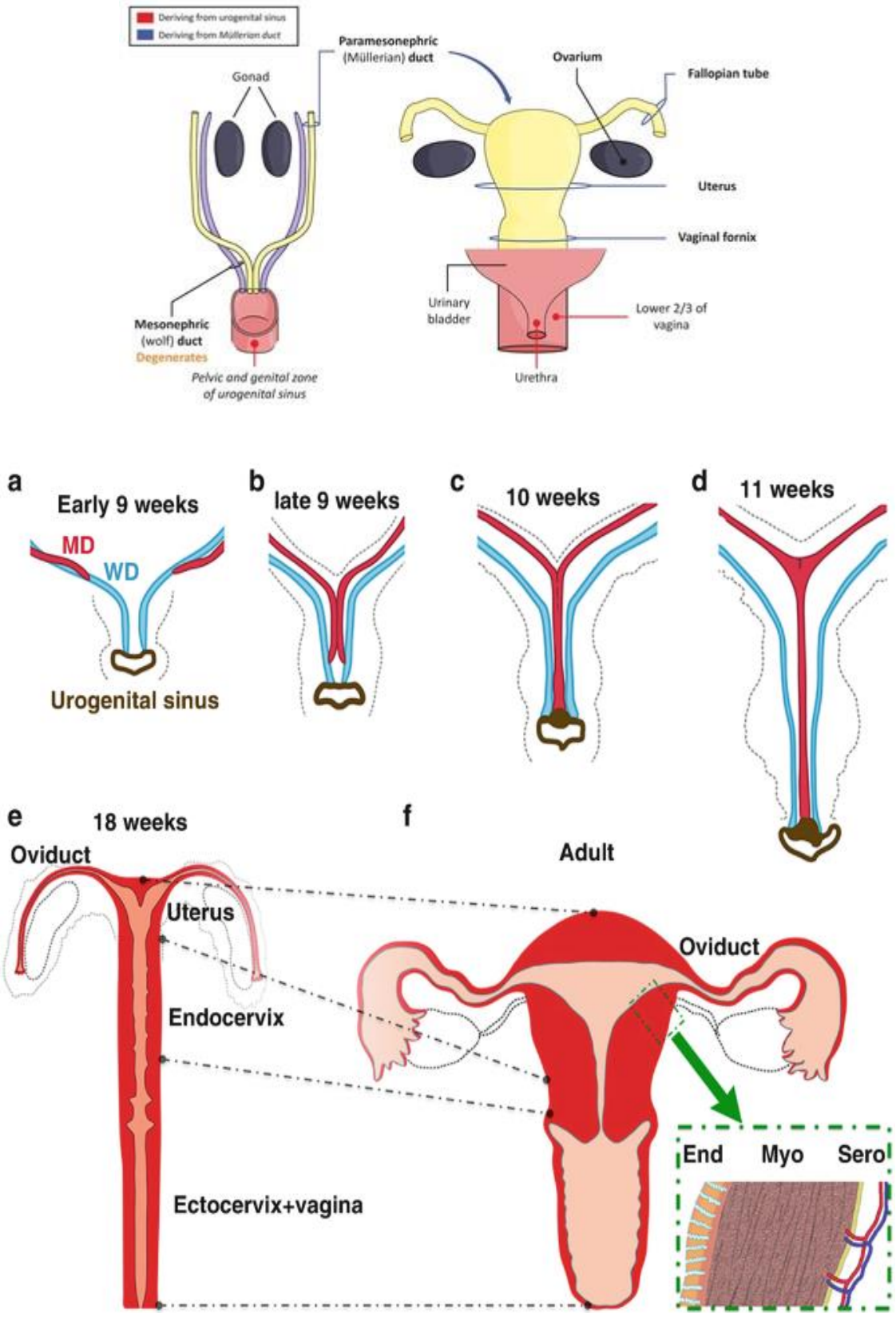

Figure 2: Embryology of the uterus

Blood Supply:

Uterus and fallopian tubes supplied by ovarian and uterine arteries which are the branches of the aorta and internal iliac artery respectively. From base of wide ligament to the cervix, the uterine artery travels medially. It splits off here to reach the cervix and upper vagina. Before turning laterally to reach the cornua, Branches that connect to the myometrium are released as it goes up in broad ligament and it joined to branches of ovarian artery. The uterine vein finally empties into the internal iliac veins after travelling in the same direction as the artery.[22]

THE MENSTRUAL CYCLE

The female reproductive system undergoes regular cyclic changes as a result of the periodic preparations for fertilization and pregnancy. The most obvious characteristic is menstruation, which is a time of irregular vaginal bleeding and endometrial mucosa shedding that occurs between menarche (the beginning of menstruation) and menopause (cessation of menstruation). Between the ages of 10 and 16 is when menarche frequently occurs. Ages 45 to 55 are the usual menopausal transitional years. Although the length of the cycle varies, the average amount of time between the start of one menstrual period and the start of the next is 28 days. The symphonic event of a menstrual cycle is controlled by the hypothalamic-pituitary-ovarian axis' endocrine activity.[23]

OVARIAN CYCLE

There are many primordial follicles that have immature ovum inside them from birth under the ovarian capsule. A few of primordial follicles transform into the antral cavity, which contains the ovum, at the beginning of each cycle and around the 6^{th} day, the

dominant follicle is formed from one of the follicles in each ovary becomes the dominant follicle. The others experience a setback and grow atretic follicles. The ability of the follicles to release circulating estrogens from the granulosa cells of the ovaries and cells of the theca interna of follicles. During ovulation, which usually occurs on 14th day of cycle, the dominant follicle ruptures and the ovum is discharged. The follicle's potential Corpus luteum, which starts luteal phase of menstrual cycle and endures during pregnancy, Corpus hemorrhagicum, a follicle packed with blood, and Corpus Albicans is a result of scar tissue in absence of gestation.[23]

UTERINE CYCLE

Functioning layer sheds when menstruation is finished. The proliferative, preovulatory, or follicular phase of the cycle, which is observed between the fifth and fourteenth days of cycle of menstruation, is characterised by beginning of endometrium's proliferation from the basalis layer under the influence of estrogen from the developing follicle. Under the influence of estrogen and progesterone from the corpus luteum, the endometrium acquires a higher degree of vascularization and moderate edema after ovulation. The glands coil up and release a lot of fluid that is high in glycogen. The Secretary or Luteal phase of the menstrual cycle is indicated by this.[23]

When fertilization is unsuccessful, the corpus luteum regresses and the hormones that support the endometrium are withheld. During the menstrual phase, which also signals the start of a new cycle, the endometrium is shed. Astonishingly consistently, the secretory period lasts 14 days. The length of the menstrual cycle varies according to changes in the proliferative phase's duration.[23]

ANOVULATORY CYCLES

During anovulatory cycles, which take place when there is no ovulation because there is no corpus luteum, the progesterone effect on the endometrium is removed. Unopposed estrogen causes proliferative endometrium to continue expand until it is thick enough to breakdown and slough. Premenopausal women frequently experience these cycles in the first 12 to 18 months after menarche, and teenagers also experience them at this time.[23, 24]

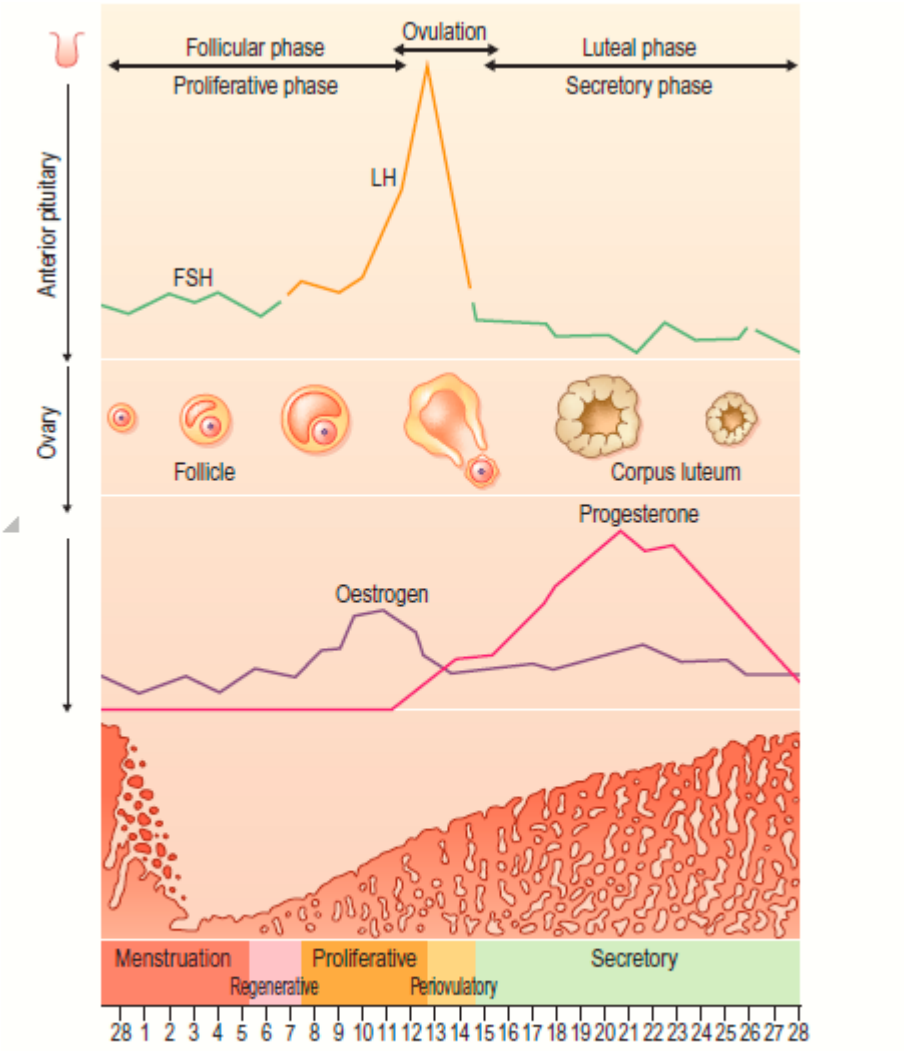

Figure 3: The physiology of the female menstrual cycle.[25]

Techniques and Anatomy of the Ultrasonography:

TAS:

Urinary bladder serves as acoustic window during transabdominal scanning and by inferior angling of transducer, vagina can be visualized as straight, central structure in longitudinal or sagittal plane. While the walls are hypoechoic and a hyperechoic midline stripe is produced by the apposed anterior and posterior walls. The vagina in transverse plane is seen as a flattened rectangle with a midline hyperechoic band. In order to accommodate the cervix, it is observed that the upper vagina enlarges. The uterus is visualized as a larger portion with reduced caudal angulation.[24]

The hypoechoic myometrium is seen around endometrium which is hyperechoic lining uterine cavity in longitudinal plane.

In the non-gravid uterus, echogenic line runs between apposed posterior and anterior endometrial surfaces. When transducer is rotated to 90 degrees, the uterus appears oval shape. When the endometrium reaches the cornua, it turns cephalad in the direction of the fundus and uterus' serosa should be smooth surface.[24]

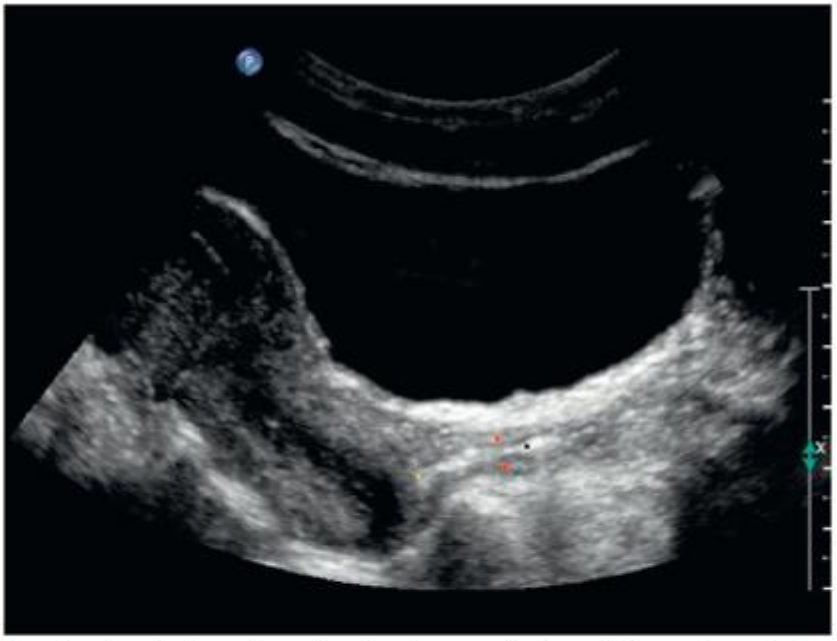

Figure 4: TA scan longitudinal plane showing the hyperechoic midline echo of the apposed anterior and posterior vaginal walls (black dot). Note the hypoechoic vaginal walls (red dots). The upper vagina expands to accommodate the cervix (yellow dot).[26]

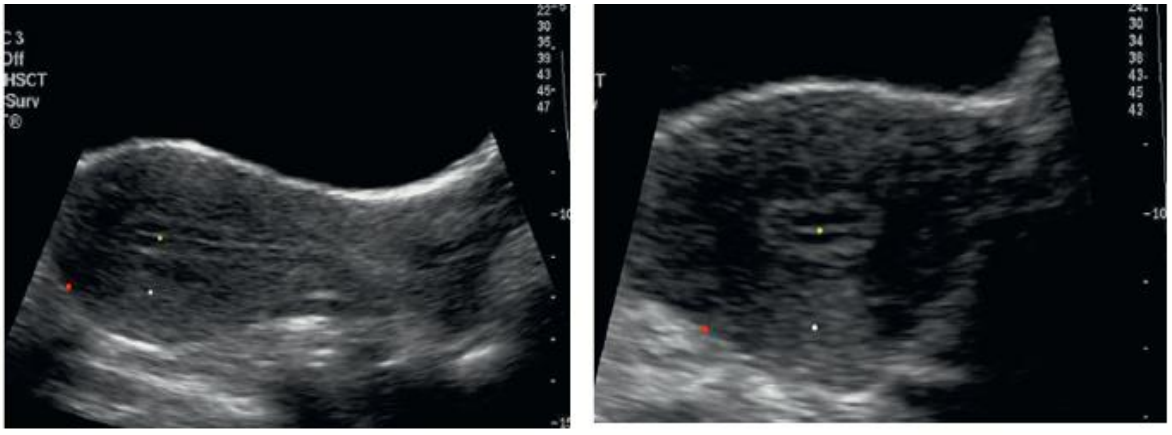

Figure 5: TA scan (A) longitudinal/sagittal and (B) transverse images of the uterus. The serosal surface is smooth (red dot). The myometrium is homogeneous and hypoechoic relative to the endometrium (white dot). The midline stripe is hyperechoic (yellow dot). [26]

Transvaginal scanning:

Transvaginal scanning is a skill that takes time to perfect. Before scanning a patient, a spotless probe cover with coupling gel must be placed over the transducer and applied over the probe cover's tip's outside surface. The woman's posture must be maintained with adequate pressure by the operator probe handle. There are several ways to accomplish this. An effective manoeuvre is to ask the patient to supinely lie over examining bed with her bottom at the foot of the sofa and her head in the centre. A chair is placed at the end of the bed that faces the floor and allows her feet to rest on the chair, the woman flexes her knees.[25]

When the tip of the transducer probe detects resistance in the posterior fornix after being carefully introduced into the vagina. The probe handle frequently has to be lowered toward the floor when there is an Anteverted uterus present in order for the ultrasonic beam to travel through the entire organ. The handle might need to be elevated if the uterus is retroverted. The transducer should move slowly and with modest movements to allow systematic interrogation of the region of interest without moving the uterus out of the range of vision.[25]

For those with radiology training, the picture is often seen with the scan sector's peak at the top of the screen. In the sagittal plane, the fundus on the monitor's left side is anteversion and on the right is retroversion.

An uninterrupted echogenic midline stripe characterizes the ideal sagittal midline picture, albeit this is not always possible. Endometrial thickness is calculated using this midline picture and the two endometrial layers are really measured from the anterior to the posterior interface. In pre-and postmenopausal women, a small amount of fluid in the uterine cavity is normal and this might occur during menstruation and around ovulation in premenopausal women. If the fluid is present, it shouldn’t be measured

with endometrial thickness. The endometrial layers are individually counted summed up. The echogenic midline stripe in the endometrium may indicate disease in the uterine cavity if it cannot be distinguished or if it is broken. A polypoid fibroid or an endometrial polyp may be a part of this disease.[25]

The whole uterus is evaluated from side to side in the sagittal plane and a transverse picture of the uterus is visualized by rotating the transducer to 90 degrees where the leading edge is towards the operator's side.

When the uterus is Anteverted, it is necessary to progressively raise the probe handle from position of a relative depression in order to pan across the organ from the fundus to the cervix. Retroversion is the exact reverse.

In the transverse plane from the serosa to endometrial contact, the myometrium can be assessed in its entirety. It is also possible to visualize the endometrium's expansion to the cornua. As the cornua is a hysteroscopy blindspot, considerable vigilance is suggested in this situation.[25]

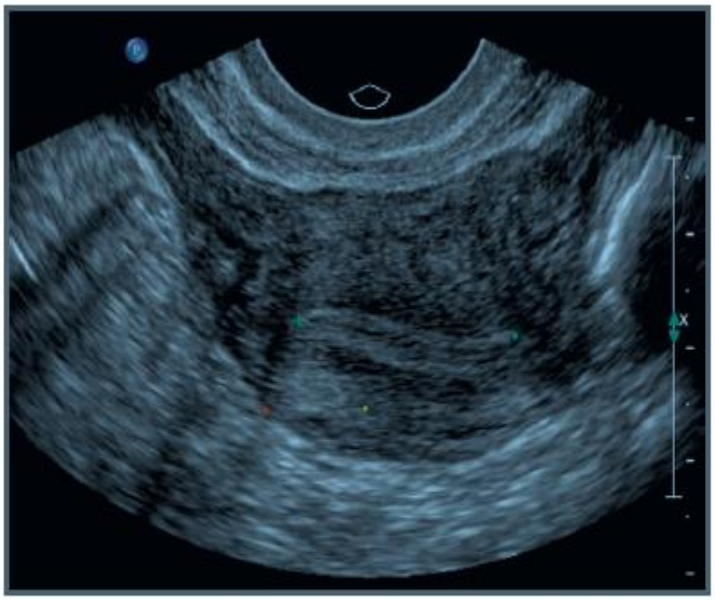

Figure 6: TV scan transverse image of the uterus showing a smooth serosal surface (red dot), homogeneous myometrium (yellow dot) and the endometrium elongating out towards the cornua (green dots). [26]

Ultrasound anatomy:

The uterus' serosal surface is sticky and the Homogeneous intermediate-level echoes are produced by the myometrium. The arcuate branches of the uterine circulation are reflected in the veins and enter into the outer myometrium. [27] The inner layer of the myometrium is echo-free which is sub endometrial halo because It is made up of tightly packed muscle cells with heightened vascularity. The junctional sub-endometrial myometrium on MRI is related to the inner layer of the myometrium, which enhances sperm transport and protects the endometrium during menstruation. [28,29]

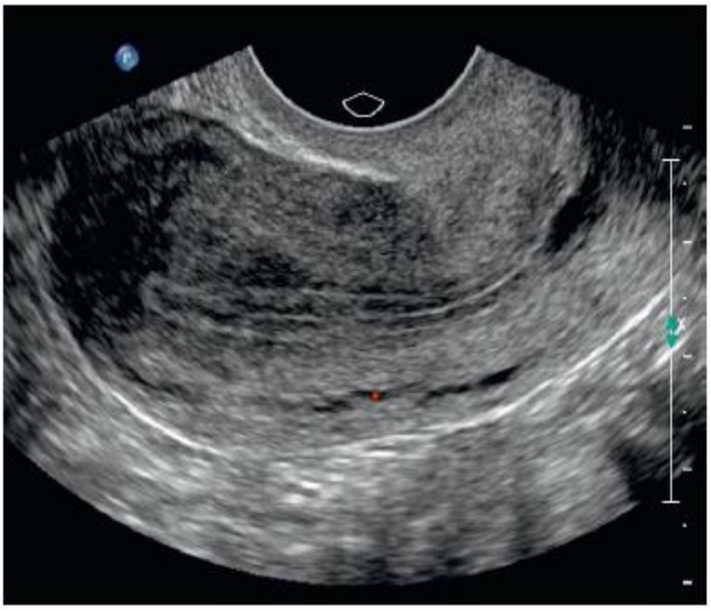

Figure 7: Uterus. TV scan sagittal image showing linear anechoic structures (red dot) in the periphery of the posterior myometrium. These represent the arcuate branches of the uterine circulation. [26]

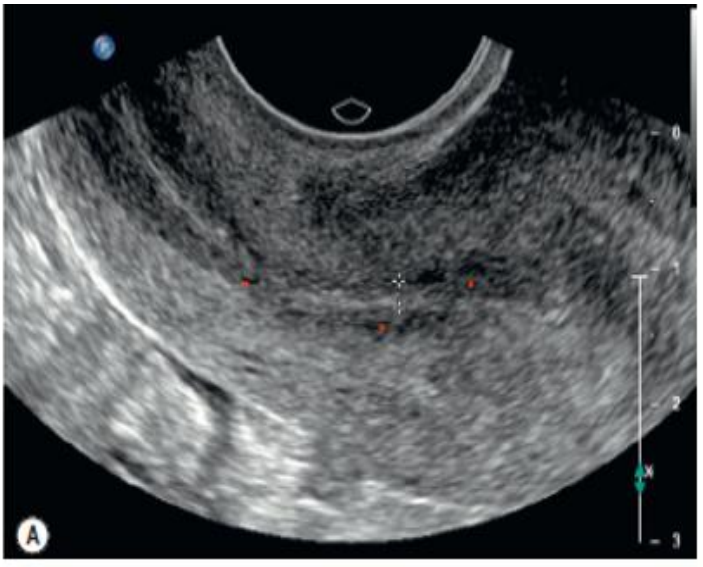

Figure 8: TV scan sagittal plane. Retroverted uterus with a hypoechoic subendometrial halo (red dots) representing the inner myometrium. The callipers are measuring the endometrial thickness.[26]

The endometrium and the underlying myometrium should make a smooth, definite touch. It should be consistently echogenic throughout.

The endometrium is isoechoic or slightly hyperechoic to the outside myometrium during the early proliferative phase of the reproductive cycle. The endometrium begins to take on a layered structure as this period goes on. When viewed from anterior to posterior, the anterior endometrium has an outer hyperechoic basal layer close to the inner myometrium, which is hypoechoic and can be distinguished from its counterpart in the posterior endometrium by the midline echo that denotes the apposed anterior and posterior surfaces which is denoted by the triple line sign.[29] The bilayer can range in thickness from 8 to 12 mm. Eventually, the secretory phase progresses, the layers disappear. In contrast to the external myometrium, which is edematous and has larger endometrial glands produced on by an accumulation of mucus and glycogen, the endometrium develops constantly hyperechoic and can reach a maximum thickness of up to 16 mm.[12,29]

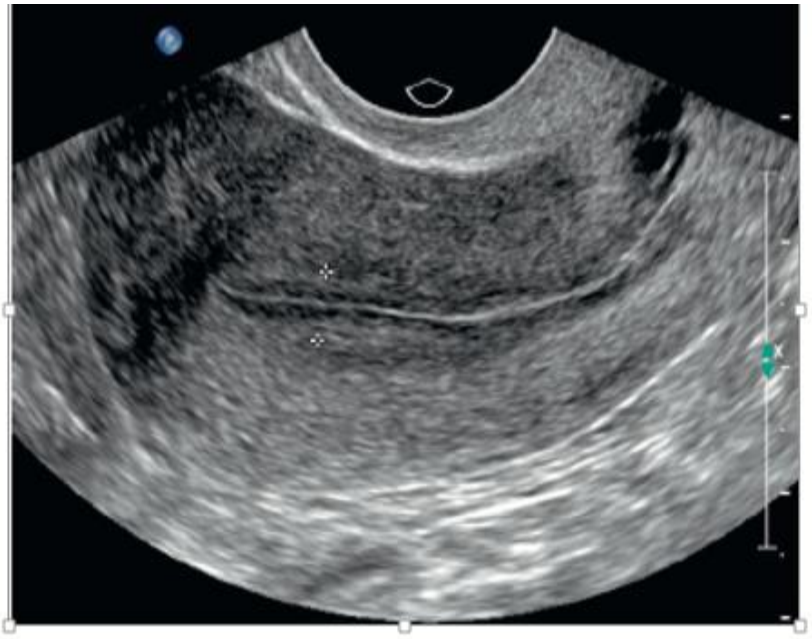

Figure 9: TV scan sagittal image of an anteverted uterus. The endometrium exhibits the multilayered appearance of a proliferative phase endometrium. There is an outer, basal hyperechoic layer (red dots) and an inner hypoechoic functional layer (yellow dots). The midline stripe is hyperechoic. This is the triple line sign. [26]

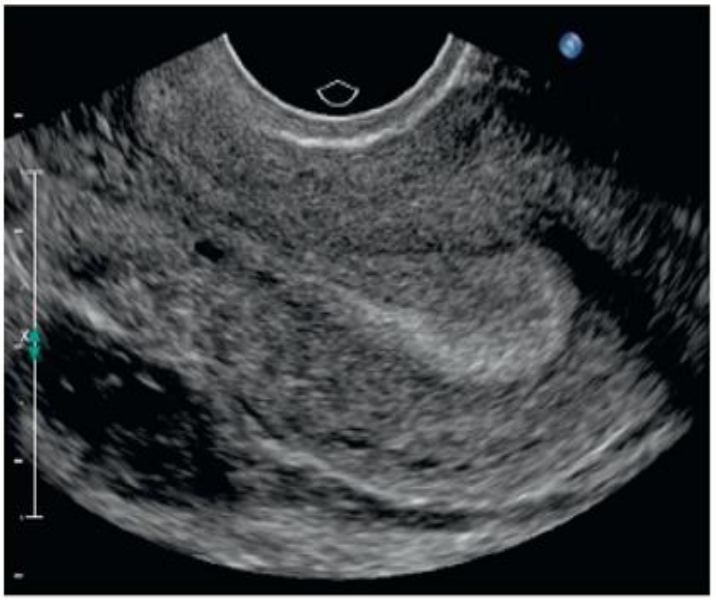

Figure 10: TV scan midline sagittal image of an anteverted uterus. The endometrium is secretory and is uniformly hyperechoic. [26]

Although the proliferative phase is ideal for endometrial investigation for endometrial diseases, TVS can be performed at any time throughout the menstrual cycle. During menstruation, the endometrium expands from 1 to 4 mm, thins, and becomes asymmetrical. There might be fluid inside the uterine cavity.

After menopause, the endometrium becomes atrophied and a thickness of more than 4mm is referred to as abnormal .[13–15]

Cervix:

The cervix can be seen by moving the transducer a few centimeters [(1,2).] In contrast to the uterine body, the ectocervix is immediately visible during an internal gynecological exam, and it may be seen even more carefully during colposcopy. Therefore, gynecologists shouldn't just depend on ultrasonography to assess the cervix. The cervical stroma and serosal surface and muscular layers that surround the endocervical

canal are all features that may be examined. Ultrasonography can be used to assess pathology that may not be visible clinically, such as cervical fibroid. The endocervical canal, which features a central echogenic stripe, serves as a representation of the cervical mucosa. The echogenicity of the cervical stroma and muscular layer is comparable to that of the outer myometrium[9,] and the surface of the serosa is smooth.[14]

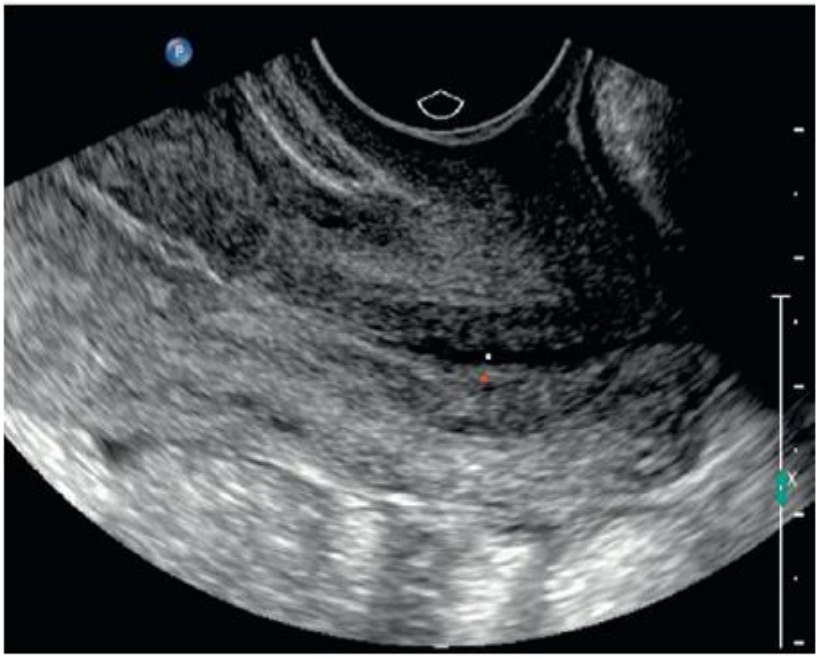

Figure 11: Uterus. TV scan sagittal image showing linear anechoic structures (red dot) in the periphery of the posterior myometrium. These represent the arcuate branches of the uterine circulation. [26]

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MRI -- Normal anatomy of the uterus

On T2-weighted images taken during the reproductive stage, the uterus has three different zonal layers in the uterine corpus and the cervix. These comprise the junctional zone (JZ) in the inner myometrium, the endometrium, which exhibits high signal intensity, and the outer myometrium, which exhibits moderately high signal intensity. [36]

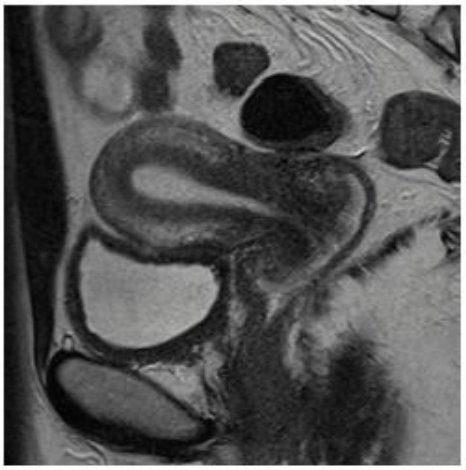


Figure 12: Representative case of a 34-year-old woman with a normal uterus. On T2-weighted images, the uterus shows three distinct layers: a high signal endometrium, a low signal junctional zone, and an intermediate-signal outer myometrium. [45]

On T2WI, the cervix may be divided into three separate layers: the cervical stroma, which contains fibrous connective tissue, has a low signal intensity, the cervical mucosa, which has a high signal intensity, and the outer layer, which has a medium to high signal intensity. [34] premenarchal girls and postmenopausal women often lack zonal segmentation of the corpus. Based on age and menstrual cycle stages, each zone's thickness or signal intensity exhibits cyclical fluctuations.[35-37]

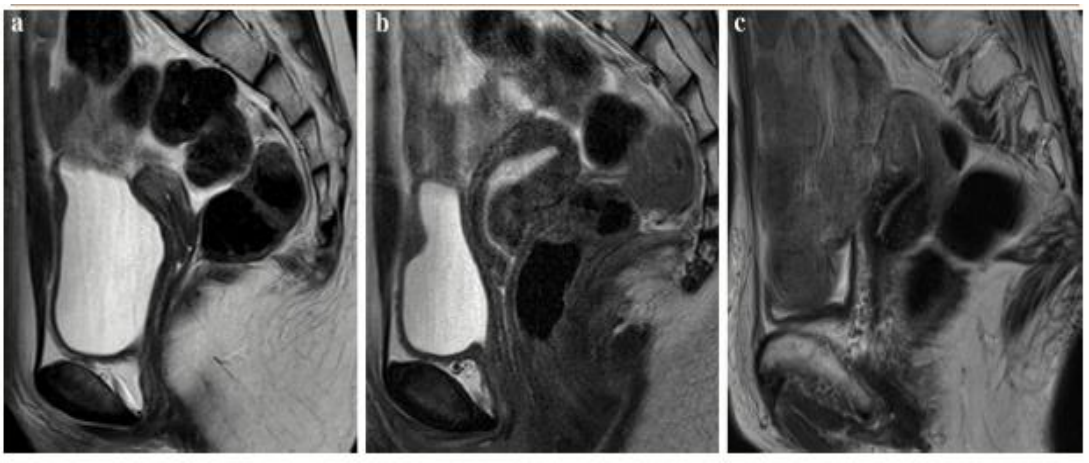


Figure 13: Changes in uterine MR appearance in function of age. (A) Uterus of a 9-year-old girl at premenarcheal state showing a small uterine body, which has almost the same length as that of the uterine cervix. The endometrium is difficult to recognize. (B) Uterus of a 12-year-old girl, as menstruation starts, the uterine body

becomes bigger and the zonal anatomy is clearly recognized with a thickened endometrium.
(C) Representative images of a normal uterus in a 73-year-old woman. The uterine volume shrinks down and returns to its indistinct zonal appearance.[45]

The sub-endometrial halo or subendometrial hypoechoic layer of the myometrium appears differently on endovaginal ultrasound (US) than it does on conventional ultrasound (US).[37]

Stratum Basale is the junctional zone of the endometrium, and Hricak et al stated that it is a physiochemical or vascular phenomenon. [33] Junctional Zone has a morphological variations like larger water content, nuclear area, and vascular density compared to outer myometrium. [39,40,41] Based on MR imaging of the uterus ex vivo, Lee et al. speculated that the Junctional Zone has a physiological phenomenon as opposed to a morphologic zone. [41] The ability to observe changes in Junctional zone thickness in a healthy uterus was made feasible by recent improvements in MR acquisition speed. [42,

Abnormal uterine bleeding (AUB):

"Abnormal uterine bleeding defined as irregularities in the menstrual cycle involving regularity, frequency duration, and volume of flow. Most of the women around 1/3rd has AUB symptoms in their lifetime during menarche and peri-menopause. A normal menstrual cycle occurs every 24 - 38 days and lasts 5 -7 days, with blood loss ranging from 5 -80 millilitres".[44] Abnormal uterine bleeding has four characteristics. Bleeding may deviate from regular menstrual cycles in the following ways:

1. Polymennorrhea- Occur more frequently (less than 21 days apart).
2. Metrorrhagia- Occur frequently and irregularly between periods.
3. Menorrhagia-. More blood loss is involved (loss of more than 80 mL of blood

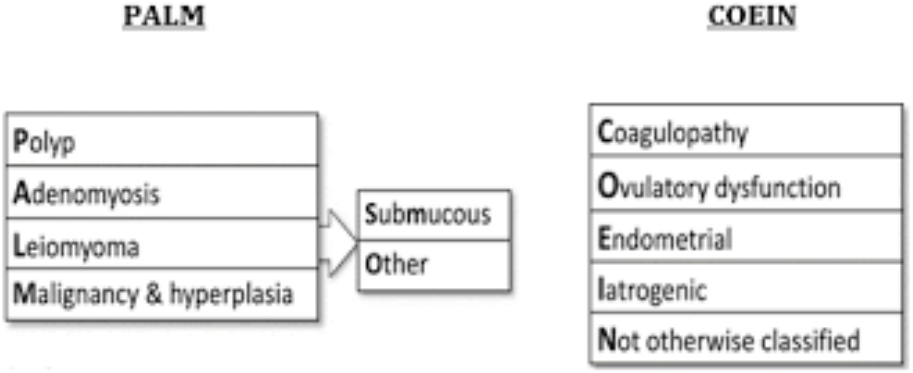
or periods lasting more than 7 days), although it occurs at regular intervals.

4. Menometrorrhagia - More blood loss occurs frequently and irregularly between menstruations.

Uterine bleeding may be Acute or chronic. Acute AUB defined as symptomatic bleeding which requires treatment immediately to prevent further complications and acquire hemostasis. Acute AUB occurs with superadded with Chronic AUB whereas chronic AUB defined as irregular menstrual hemorrhage in last 6 months [44,45].

Etiology:

The International Federation of Obstetrics and Gynecology (FIGO) uses the nomenclature PALM-COEIN to identify the causes of AUB. PALM - the first box denotes the structural causes of AUB and COEIN- the second box denotes the non-structural causes of AUB. The N denotes "not otherwise classified."[2]



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Patients on anticoagulant medications presented with abnormal uterine bleeding categorized to Iatrogenic from coagulopathy in 2018 FIGO classification. Chronic liver diseases, pelvic inflammatory diseases, cervical infections are categorized to ‘not else classified’ conditions which contains the uncommon causes such as arterio-venous malformations (AVMs), Myometrial hyperplasia, and endometrial infections.[1]

Epidemiology:

A higher incidence occurs during menarche and perimenopause, with the prevalence of AUBs estimated to range from 3% --- 30% globally. Many studies concluded that Heavy menstrual bleeding ranges to 35 % or more when the patients has irregular menstrual bleeding.[1] Most of the patients are not visited to healthcare centers despite of prevalence and the diagnosis is challenging because symptoms be either subjective or objective. [46]

Pathophysiology:

The inner layers of the endometrium -- functionalism and basalis layers are supplied with blood by the uterine and ovarian arteries, which grow into arcuate arteries and then into radial branches, respectively. Progesterone levels drop during the end of the menstrual cycle, which causes the endometrium's functional layer to be enzyme, resulting in blood loss and sloughing that is controlled by functional platelets, thrombin and constriction of the arteries supplying the endometrium. "Structural causes PALM – Polyps, adenomyosis, leiomyoma, malignancy, or hyperplasia and Nonstructural causes COEIN- coagulopathy, ovulatory ,endocrine , endometrial and iatrogenic can effect menstrual cycle and results in AUBs".[47]

LEIOMYOMA:

Leiomyoma is a common uterine tumour which is asymptomatic mostly and consists of primarily smooth muscle with various fibrous connective tissues.[48, 49] The patient presented with complaints of abdominal discomfort, infertility, or AUBs and abdominal mass along with the pressure symptoms on subsequent tissues.

Submucosal leiomyomas that protrude into the uterine cavity are classified as intramural leiomyomas, which are restricted to the myometrium. Subserosal leiomyomas are rare, occur around 8% in the cervix and originate from the peritoneal surface of the uterus and causes the most severe symptoms.[49] Leiomyomas can range in size and number and initially, it is benign but transforms into malignant ones where Oestrogen and progesterone are crucial in the development of leiomyomas either from single or multiple myometrial cells Leiomyomas has various morphological variations and appears differently on sonograms – larger in size due to increase blood supply, cystic, hyaline, myxoid, calcific and red degeneration. [49] They are as follows:

1. Globular uterine hypertrophy with varied echotexture brought on by little scattered leiomyomas.
2. Localized leiomyomas show an uneven echotexture and a hypoechoic or heterogeneous echotexture.
3. Due to extensive fibrosis within the tumour, there may be some acoustic attenuation or shadowing in certain locations.
4. Calcification shows as curved echogenic rims in the periphery or as focal regions of enhanced echogenicity with shadowing.
5. Necrosis and cystic degeneration occur centrally, resulting in areas of diminished echogenicity.

Transvaginal ultrasonography is used to emphasise the uterine origin of pedunculated fibroids, better delineate submucosal fibroids, and identify small fibroids.

Transvaginal sonography is significantly more effective in identifying leiomyomas in the retroverted uterus' fundus.

According to research by **Schwartz et al.** [50] on the differentiation of uterine leiomyoma histologic subtypes using pelvic MRI, the uncomplicated subtype has 95% sensitivity

and 72% specificity, the cellular subtype has 10% sensitivity and 100% specificity, the cystic subtype has 80% sensitivity and 98% specificity, and the haemorrhagic subtype has 100% sensitivity and 86% specificity.

Weinreb et al [51] studied that leiomyomas are differentiating from other solid pelvic masses by using MRI values when sonography diagnosing indeterminate masses and concluded that MRI has a distinctive appearance of leiomyomas compared to other pelvic masses.

Togashik, Ozasa etal.[52] concluded that MR imaging is extremely accurate after studying 93 individuals with enlarged uteruses and using MR imaging to distinguish between adenomyosis and leiomyoma.

Murase et al [13] and colleagues found that MRI T2-weighted pictures showed that Non degenerated leiomyomas is well-defined margins with low signal intensity and cellular leiomyomas have high signal intensity with augmentation and contrast images show degenerated leiomyomas in a different ways . . Diagnoses for leiomyoma include uterine leiomyosarcoma, adenomyosis, solid adnexal mass, localised myometrial contraction, and others.

Kim and Park et al.[79] concluded that exophytic uterine leiomyoma diagnosed and distinguished from other adnexal masses using the bridging vascular sign on an MRI. The presence of curving, twisted signal void vascular structures across the uterus and pelvic mass is known as the bridging vascular sign and it is pathognomic of exophytic uterine leiomyomas.

Kawakami S, Togashi K Et al. [55] conducted a retrospective study on the MRI characteristics helpful in uterine leiomyoma red degeneration diagnosis.T1W showed as hyperintense rim and T2W showed as hypointense rim and the rim has signal properties with presence of numerous dilated blood vessels around the lesion's periphery that are filled with red blood cells and a lot of intracellular methaemoglobin.

Whenever leiomyomas are present with T2W images can show a ring of high signal intensity that resembles a pseudo capsule of enlarging lymphatic arteries, veins, or edema. Histologic evidence also supported the peritumoural rim enhancement shown in contrast-enhanced imaging.

Burn et al.[56] assessed the MRI appearances of uterine fibro-leiomyoma before and after uterine artery embolization. Study results showed the volume was reduced by 43% after two months and 59% after six months. Before embolization, the poor response was predicted by high Signal intensity on T1W images. A good reaction was predicted by a high signal intensity on T2W images. The reduction in fibro-leiomyoma volume was not linked with the gadolinium enhancement level. Finally concluded that the MRI features of fibro-leiomyomas before embolization can aid in predicting the treatment's future effectiveness.

Oguchi et al.[57] investigated the relationship between T2 traits and the effects of Gonadotropin-Releasing Hormone (GnRH) analogue medicine, they found that the signal intensity rises when the leiomyoma has higher cellularity and proliferative activity and that it shrinks when treated with GnRH.

ADENOMYOSIS

Adenomyosis is defined by reactive hypertrophy of the surrounding myometrial smooth muscles by the presence of ectopic endometrial glands and stroma inside the myometrium.[50, 51] The direct invasion of the myometrium by basal endometrium is the most likely cause of adenomyosis and resistance to hormonal stimulation. The glands in endometriosis and the normal endometrium have similar changes. Adenomyosis most commonly manifests as a diffuse anomaly called adenomyoma. Dysmenorrhea and menorrhagia, a clinical presentation resembling uterine leiomyoma, may be present. Women over 30 who are multiparous and premenopausal are affected. [48, 49]

The transabdominal sonographic diagnosis has been regarded as challenging. [49]

TVS has more accurate than TAS in diagnosing adenomyosis. The parameters are. [49]

1. Myometrium's inhomogeneous hypoechoic regions with hazy borders
2. In ectopic endometrial tissue, a small myometrial cyst represents dilated glands.
3. Localized adenomyoma appears in the myometrium as irregularly shaped patches with hazy boundaries

In diffuse uterine adenomyosis, **Reinhold C, et al**.[58] investigated the morphologic criteria and diagnostic efficacy of endovaginal sonography. The criteria include ill-defined areas of aberrant echotexture (echogenicity changes, heterogeneous echotexture, and myometrial cysts). Results reveal an 86% sensitivity and 86% specificity. They concluded that endovaginal ultrasonography when used in conjunction with precise sonographic criteria, could reliably identify uterine adenomyosis.

In 45 patients, **Byun, Ki et al**.[59] assessed the MRI imaging findings in diffuse and localised adenomyosis

And concluded that MRI helps in the difference between adenomyosis and uterine myoma and in formulating a proper treatment plan. Compared to unenhanced or contrast-enhanced T1weighted pictures, lesion detection is substantially more accurate using T2-weighted imaging. While diffuse adenomyosis maintains its same thickness throughout the menstrual cycle, the typical junctional zone fluctuates in thickness.

High signal intensity foci in the low signal intensity lesion on T2W images occur in endometrial cyst or tissue and high signal intensities on T1W & T2W images occur in endometrial islands with haemorrhage.

The diagnosis of adenomyosis gains specificity with the detection of punctate high signal intensity foci with 40% of diffuse adenomyosis patients and 100% of localised adenomyosis cases. [58,59]

Ascher, et al.[60] studied that MRI is significantly superior to transvaginal ultrasound in identifying adenomyosis.

In their examination of pelvic endometriosis detection and identification using chemical shift with a clinical diagnosis of endometriosis, **Sugi mura et al.**[80] showed that fat-saturated T1W imaging in conjunction with a traditional technique clearly described the lesions.

The differentiation between Leiomyoma and adenomyosis is necessary because leiomyoma is treated with Myomectomy and adenomyosis is treated with hysterectomy.

Many papers have emphasised the necessity of appropriately diagnosing adenomyosis before surgery. [59,60]

ENDOMETRIAL POLYPS

Endometrial polyps area the unharmed nodular appendages of the endometrium made up of irregularly distributed endometrial glands and stroma. They typically have three components

1. Endometrial glands

2. Focal or diffuse stroma with dense fibrous or smooth muscle tissue

3. Thick-walled vessels

The most frequent type of cystic gland hyperplasia can be found within the polyp.

In their research**, Ralf P. etal.**[22] found that endometrial polyps were more likely than carcinomas to exhibit intratumoral cysts and a central fibrous core which are low signal intensity on T2W images. A significant association existed between myometrial invasion and necrosis and carcinomas. Accuracy alone will not prevent biopsy, in part due to the common coexistence of polyps and malignancy. On ultrasound, a polyp shows as a localised thickening of the endometrium, and on Hysterosonosalphingography, it appears as a homogenous echogenic lesion with a small base of attachment. Due to the fluid surrounding it in the endometrial cavity, it can be seen more clearly. With the colour Doppler, a clearly defined vascular pedicle may be detected. Histologically dilated glands are represented by cystic regions within the polyp.[49]

ENDOMETRIAL CARCINOMA

In western countries, endometrial carcinoma is the most prevalent gynaecological mal ignancy and accounts for 75 – 80 % of postmenopausal women. Most of them appear with spots around 80% are detected in the initial stages. [49]

According to research by **Lee EJ et al**.[53], T2W imaging was more accurate in premenopausal women whereas gadolinium-enhanced T1W was more accurate in postmenopausal patients when it came to staging early endometrial cancer.

MRI coupled with contrast-enhanced dynamic imaging was studied by **Manfredi, et al.** [61] Research on 37 individuals with endometrial cancer shows that MRI is extremely accurate for the regional staging of cancer and is more challenging to evaluate the lymph nodes in the pelvis and lumbar aorta.

Utsunomiya, et al.[62] concluded that the dynamic contrast of T1W improves the staging accuracy by differentiating between the superficial and deep myometrial invasion of endometrial cancer.

Staging of endometrial carcinoma – FIGO

FIGO stage		Criteria
0		Carcinoma in situ
I		Tumor confined to the corpus
	IA	Tumor limited to the endometrium
	IB	Invasion <50% of myometrium
	IC	Invasion >50% of myometrium
II		Tumor involves the cervix but does not extend beyond the uterus
	IIA	Invasion of endocervix
	IIB	Cervical stromal involvement
III		Tumor extends beyond the uterus but not outsides true pelvis
	IIIA	Invasion of serosa, adnexa, or positive peritoneal cytology
	IIIB	Invasion of vagina
	IIIC	Pelvic or paraaortic lymphadenopathy
IV		Tumor extends outside true pelvis or invades bladder or rectum
	IVA	Invasion of bladder or rectal mucosa
	IVB	Distant metastases (includes abdominal or inguinal lymphadenopathy)

According to **Tsuada H etal**.[63] comparative study of the identification of myometrial infiltration by MRI and intrauterine ultrasonography is 85%.

In their study, **Veda M et al**.[64] found that the MRI features of an uneven margin, a nodular lesion at the margin, an intramyometrial nodular extension, and multiple nodular formations may be used to diagnose and distinguish between endometrial stromal sarcoma and endometrial cancer**.**

According to **Hricak et al**., [54] endometrial cancer the staging was 85% accurate overall using MRI. For the identification of myometrial invasion, MR is more effective. The junctional zone in tact suggests stage 1a. Stage 1b is defined as an irregular junctional zone or involvement of the junctional zone between the endometrium and myometrium. 1c refers to myometrial involvement greater than 50%.

According to **Tang X et al**., [65] A diagnostic parameter of MRI, Endometrium - Myometrium ratio for evaluation of myometrium invasion by endometrial carcinoma. If Endometrium -Myometrium ratio is >1, it denotes the myometrium invasion by endometrial carcinoma.

CARCINOMA CERVIX:

In India, the most prevalent genitalia-related cancer is cervical adenocarcinoma.Cervical intra-epithelial neoplasia is the precursor for cervical malignancy. The squamo-columnar junction is where cancer develops. In young women, the tumour grows largely exophytically and extends inferiorly into the vagina in large amounts. Endocervical canal squamocolumnar junction in elderly women with atrophic cervices. It often penetrates the cervical wall laterally and involves upper vaginal region of the cervix.[47,48] It is possible to distinguish between two main histological kinds.

1. Adenocarcinoma – worst prognosis
2. Squamous cell carcinoma.

FIGO staging of cervical carcinoma[1]

Stage	Description
0	Tumor confined to the surface layer (the cell lining) of the cervix; also called carcinoma in situ
I	Extension deeper into the cervix with no spread beyond (extension to the corpus is disregarded)
IA	Invasive carcinoma; may only be diagnosed at microscopy
IA1	Stromal invasion 3.0 mm deep and extension 7.0 mm
IA2	Stromal invasion >3.0 mm and 5.0 mm with extension ≤7.0 mm
IB	Clinically visible lesions limited to the cervix uteri or preclinical cancers higher than stage IA
IB1	Clinically visible lesion 4.0 cm in greatest dimension
IB2	Clinically visible lesion >4.0 cm in greatest dimension
II	Cervical carcinoma extends beyond the uterus but not to the pelvic wall or the lower one-third of the vagina
IIA	No parametrial invasion
IIA1	Clinically visible lesion 4.0 cm in greatest dimension
IIA2	Clinically visible lesion >4.0 cm in greatest dimension
IIB	With obvious parametrial invasion
III	Extension to the pelvic wall, involvement of lower one-third of the vagina, or hydronephrosis or nonfunctioning kidney
IIIA	Involvement of lower one-third of the vagina with no extension to the pelvic wall
IIIB	Extension to the pelvic wall, hydronephrosis, or nonfunctioning kidney
IV	Extension beyond the true pelvis or involvement of the bladder or rectal mucosa (biopsy proved); bullous edema does not convey stage IV disease
IVA	Spread to adjacent organs
IVB	Spread to distant organs

On ultrasonography, a solid, irregular mass in the cervix is what is identified as a carcinoma cervix. It may be connected to pyometra or haematometra. Because cervical cancer has longer T2 values, on MRI it shows as a high signal intensity lesion compared to cervical stroma.[49]

Adenocarcinoma of the uterine cervix was compared to squamous cell carcinoma using T2 weighted rapid spin echo MRI, and **Chung JJ et al**.[67] concluded that Due to the presence of many cancerous tissue glands with cytoplasmic and intraglandular mucin

and serous fluid, the tumour is an adenocarcinoma when the signal intensity ratio is more than 3. Adenocarcinomas have a higher signal intensity than squamous cell carcinomas. But stratified squamous tumour cells in squamous cell carcinoma were shown to be compactly cellular.

Hricak et al [68] compared the results of invasive cervical cancer surgery with those of MR imaging and concluded that MR imaging had an 81% overall staging accuracy. Because MRI excludes the involvement of the parametriual pelvic lateral wall, bladder, and rectal wall while defining the size and depth of stromal penetration, tumour site, and involvement of the lower uterine region.

The following features were regarded by **Kims H, Han MC, et al**.[69] as "suggestive of bladder invasion in their investigation on the MRI evaluation of bladder invasion by cancer cervix. The presence of masses extending into the bladder lumen, nodules and abnormalities in the bladder wall, aberrant soft tissue strands in the uterovesical space, high signal intensity on the anterior side of the posterior wall of the bladder, and others are all indications of bladder abnormality. For all of the above-mentioned lesions, they use T1W fast spin echo sagittal, T2W fast spin echo in two planes are sagittal, either oblique axial plane or oblique coronal plane. Contrast-enhanced T1W images for staging malignant tumour, chemical shift imaging in haemorrhagic cysts, dermoid ovary, and an optional sequence of Gradient echo sequences and fat-sat T2W in hemomatometrocolpos.

Asher et al. [70] compared the Fast spin echo (FSE) sequence with Breath holding FSE for imaging characteristics like quality, anatomy definition, lesion detection, and free

fluid detection and concluded that all pathology detected with T2 FSE was detected on Breath-holding T2 FSE are intrinsically low spatial resolution."

Thurnher et al. [71] compared "the value of post contrast MR images to that of T2 weighted MR images in the diagnosis and staging of pelvic masses in women and came to the conclusion that the sensitivity of contrast enhanced MR images was 96% and the sensitivity of unenhanced T2 weighted images was 97% in depicting pelvic lesions, which were almost equivalent. The accuracy of T2 images and contrast enhanced imaging was 83% and 80% respectively in identifying parametrial invasion in cervical cancer and overall staging. To evaluate the subserous myoma, contrast administration proved ineffective. He has also stressed the use of post-contrast MR as a complimentary sequence to T2 weighted sequence.

1. To determine whether adnexal tumours are cancerous
2. To staging the endometrial carcinoma.
3. To determine tumour extension in the cancer cervix."

DIFFERENTIAL DIAGNOSIS:

The differential diagnosis for leiomyoma includes uterine lipoleiomyoma, uterine leiomyosarcoma, and uterine tumors of smooth muscle origin with malignant potential which is not known. Diffuse uterine leiomyomatosis, endometrial cancer and endometrial stromal sarcoma (ESS are among the alternative diagnoses for adenomyosis. Differential diagnoses for cervical cancer include cervical polyps, cervical leiomyomas, and primary uterine cancer invasion into the cervix, vaginal cancer, cervical lymphomas, and metastases to the cervix.[47]

TREATMENT / MANAGEMENT:

Surgery is used to remove polyps.

Adenomyosis is treated by a hysterectomy. It is less common to do an adenomyomectomy, especially if the tumour is localised. Treatment of fibroids include medical or surgical management, based on the patient's health conditions, desire to conceive, pressure complaints and distortion of uterine cavity. Hysterectomy, uterine artery embolization, and endometrial ablation are all surgical alternatives. Medical treatments include tranexamic acid mixed with NSAIDs, GnRH agonists, systemic progestins, and an intrauterine device (IUD) that releases levonorgestrel.[49]

Endometrial cancer or increased endometrial thickness treated by adjuvant therapy (based on stage), surgery, high-dose progestins when there is contraindication for surgery, or palliative care (eg: radiation).

Surgery, chemotherapy, and radiation therapy are all possible therapies for cervical cancer.

Chemoradiation is used when radical hysterectomy is advised but the patient is not a good candidate, and the oncologic outcomes are comparable. all-surgical treatment of microinvasive illness. [47,49]

If parametria or beyond have not spread, curative radiation therapy or surgery may be an option.

- Chemoradiation and radiation therapy if the cancer has progressed to the parametria or beyond
- Chemotherapy for metastatic and recurrent cancer

Prognosis:

Depending on the cause. While considering present and future fertility aspirations, as well as other concomitant medical problems that may affect therapy or symptoms, the major objectives of diagnosing and treating chronic AUB are to rule out serious illnesses like cancer and enhance the patient's quality of life. The prognosis varies depending on whether surgical or medicinal treatment is used. It has been demonstrated that non-hormonal therapy with anti-fibrinolytic and non-steroidal anti-inflammatory drugs can cut blood loss during menstruation by up to 50%. Despite the possibility that oral contraceptives are effective, there is a paucity of data from randomised studies. The levonorgestrel-releasing IUD has been shown to be more effective than other medical treatments for women with heavy monthly bleeding as their primary symptom of AUB and enhances the patient's quality of life. Up to 50% and 90% of women, respectively, may experience amenorrhea when taking injectable progestogens and GnRH agonists. However, GnRH agonists are typically only used for a 6-month course due to their adverse effects in establishing a low oestrogen state, and injectable progestogens can result in the side effect of breakthrough bleeding.

Complications:

Consistently irregular uterine bleeding can have negative side effects include infertility, endometrial cancer & anemia. Acute irregular bleeding from uterus could result in anemia, hypotension, shock, and even death when proper supportive care & treatment are not initiated. [47,49]

MATERIAL & METHODS

MATERIALS AND METHODS:

Study site: This study was performed in the Department of Radio-diagnosis at R.L Jalappa Hospital and Research center attached to SDUMC, Kolar.

Study population: All the eligible patients who would have undergone USG & MRI pelvis at the Department of Radio-diagnosis at R.L Jalappa Hospital and Research center were considered as the study population.

Study design: The present study was a hospital-based observational study.

Sample size:

Hricak H et al, had reported that the sensitivity of MRI in diagnosing cause of AUB to be 84-87%. 11

Assuming alpha error = 0.05 (95% Confidence Limit) and absolute precision of 10.

The minimum required sample size was calculated to be 43 subjects with AUB.

The sample size was derived from the following formula:

Sample size (n) = $\frac{Z^2(P*Q)}{d^2}$ where;

Z is the value for Confidence Interval

D is the absolute precision

P is the expected proportion and q=1-p

The sample size was calculated using nMaster software version 2.0.

Sampling method: Until the sample size was met, all eligible subjects were sequentially recruited into the study using easy sampling.

Study duration: The data collection for the study was done for a period of 18 Months.

Inclusion Criteria:

1. All adult women with abnormal uterine bleeding.

Exclusion criteria:

1. Pregnant women
2. Patients less than 18 years of age.
3. Patients who do not undergo histopathological examination.

Ethical considerations: The study was approved by the institutional human ethics committee. Informed written consent was obtained from all the study participants, and only those participants willing to sign the informed consent were included in the study. The risks and benefits involved in the study and the voluntary nature of participation were explained to the participants before obtaining consent. The confidentiality of the study participants was maintained.

Data collection tools: "Patients with AUB who undergo USG and MRI pelvis were included in the study if they fulfil the inclusion/exclusion criteria. Written Informed Consent was taken for their willingness to participate in the study. Baseline data were collected from the patients along with pertinent clinical history and relevant lab investigations".

METHODOLOGY:

USG of pelvis in patients with abnormal uterine bleeding is to be done with the help of Philips ultra sound machine or GE voluson E6 ultrasound machine.

MRI pelvis was performed in those patients who underwent USG scan using a 1.5 T 18 channel MR Scanner (Siemens® Magnetom Avanto®).Axial turbo spin-echo T2-weighted (TR/TE: 2500/75, matrix size of 307 × 384, FOV: 220 mm, and slice thickness = 4 mm with intersection gap = 1 mm), coronal turbo spin- echo T2-weighted (TR/TE: 3000/69, matrix size of 307 × 384, FOV: 240 mm, and slice thickness = 5 mm with intersection gap = 1 mm), and axial T1-weighted (TR/TE: 746/11, matrix size of 307 × 384, FOV: 220 mm, and slice thickness = 4 mm with intersection gap = 1 mm) images were obtained. Diffusion-weighted imaging was obtained in the axial plane by single-shot spin-echo echo-planar imaging at b values of 0, 400 and 800 (TE: 70, TR: 5400, slice thickness: 4 mm with no intersection gap and the number of signal acquisition). Results will be analyzed and correlated with histopathological examination findings obtained from sample of hysterectomized uterus, polypectomy, myomectomy or D&C of endometrium

RESULTS

OBSERVATIONS AND RESULTS

A total of 48 subjects were included in the final analysis.

Table 1: Descriptive analysis of age in study population (N=48)

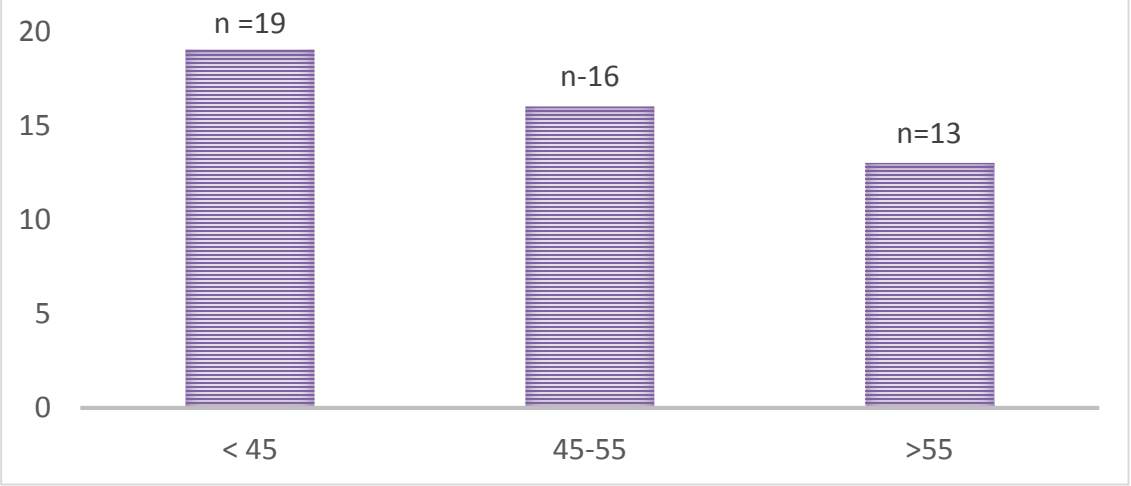
Parameter	Mean ± SD	Median	Minimum	Maximum
Age	46.88± 9.78	45.50	27	67

The mean age was 46.88 ± 9.78 years, ranged between 27 to 67 years in the study population.

Table 2: Age distribution in the study population (N=48)

Age group	Age	Number of patients
premenopausal	<45	19
perimenopausal	45-55	16
postmenopausal	>55	13

Figure 14: Bar chart showing age distribution in the study population (N=48)



Among the study population 19 patients were in premenopausal age group (less than 45 years), 16 patients were in perimenopausal age group (45 to 55 years) and 13 were in postmenopausal age group (more than 55 years).

Table 3: Descriptive analysis of symptoms with which patients presented in the study population (N=48)

symptom	Frequency	Percentages
Menorrhagia	25	52.08 %
Metrorrhagia	11	22.91 %
Polymennorrhea	12	25.00 %
Dysmenorrhea	10	20.83 %

Among the study population, 25 (52.08 %) participants had presented with menorrhagia, 11 (22.9 %) participants had presented with metrorrhagia and 12 (25.00 %) participants had presented with polymennorrhea. Out of all cases 20.83 % had dysmenorrhea as additional symptom especially in case of adenomyosis.

Figure 15: Bar chart showing symptoms with which patients presented in the study population (N=48)

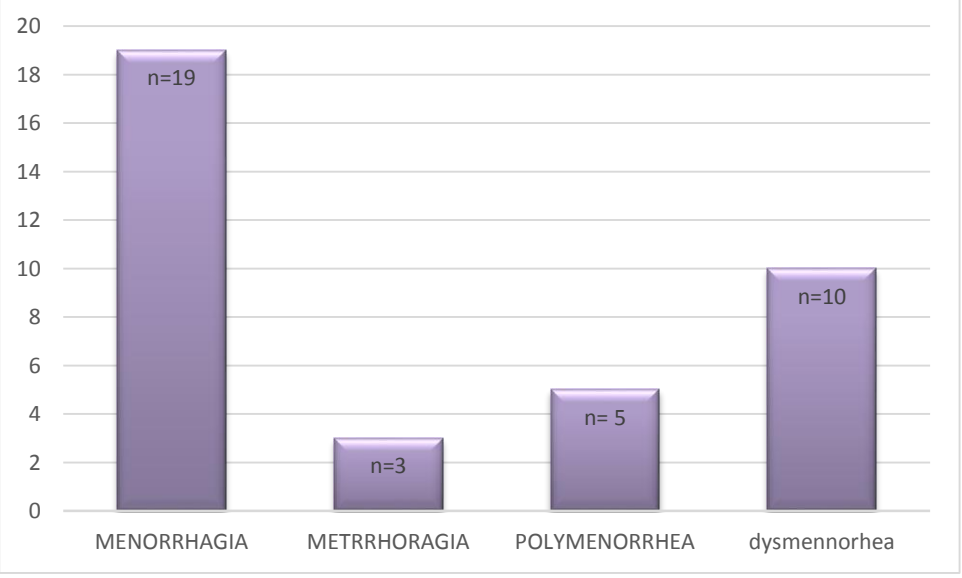


Table 4: Descriptive analysis of causes of AUB on ultrasound (N=48)

Cause	Frequency	Percentages
Polyp	2	4.10 %
Adenomyosis	7	14.58 %
Leiomyoma	25	52.08 %
Malignancy	14	29.16 %

Among the study population, 2 (4.10 %) were reported as polyps, 7 (14.58 %) were reported as adenomyosis, 25 (52.08 %) were reported as leiomyomas and 14 (29.16 %) were reported as malignancies on ultrasound imaging (TAS with or without TVS). (Table 4 and Figure 16)

Figure 16: Pie chart showing causes of AUB on ultrasound in the study population (N=48)

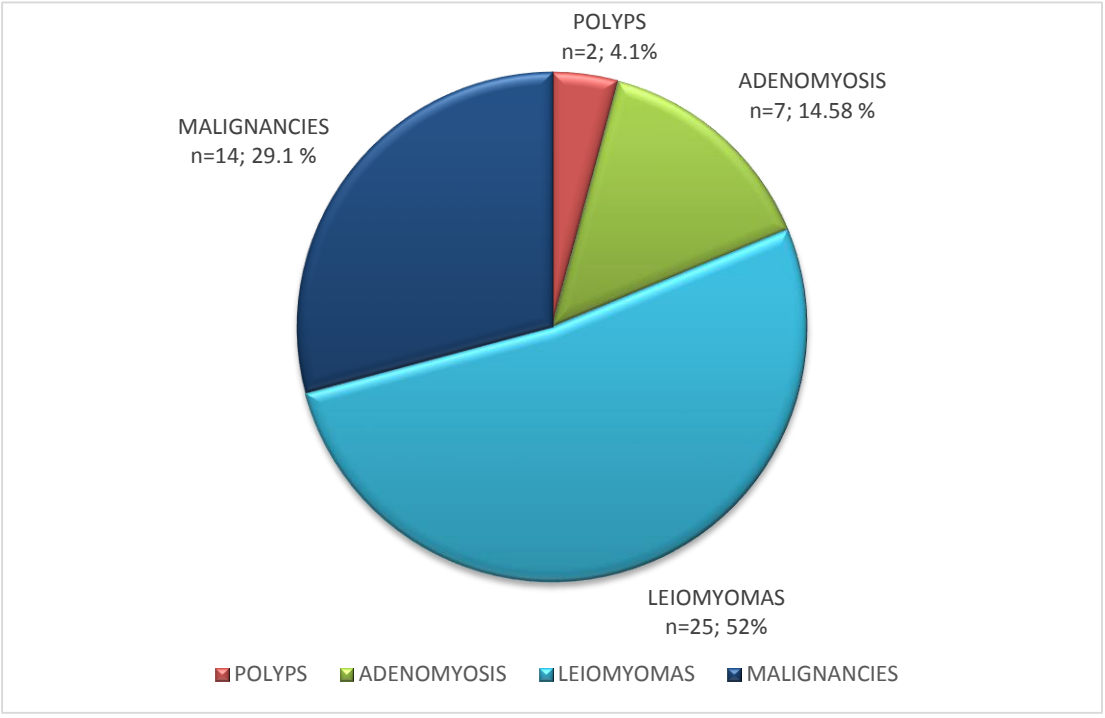


Table 5: Descriptive analysis of causes of AUB on MRI in the study population (N=48)

Cause	Frequency	Percentages
Polyp	3	6.25 %
Adenomyosis	9	18.75 %
Leiomyoma	22	45.83 %
Malignancy	14	29.16 %

Among the study population, 3 (6.25 %) were reported as polyps, 7 (18.7 %) were reported as adenomyosis, 22 (45.8 %) were reported as leiomyomas and 14 (29.16 %) were reported as malignancies on MR imaging (Table 5 and Figure 17)

Figure 17: Pie chart showing causes of AUB on MRI in the study population (N=48)

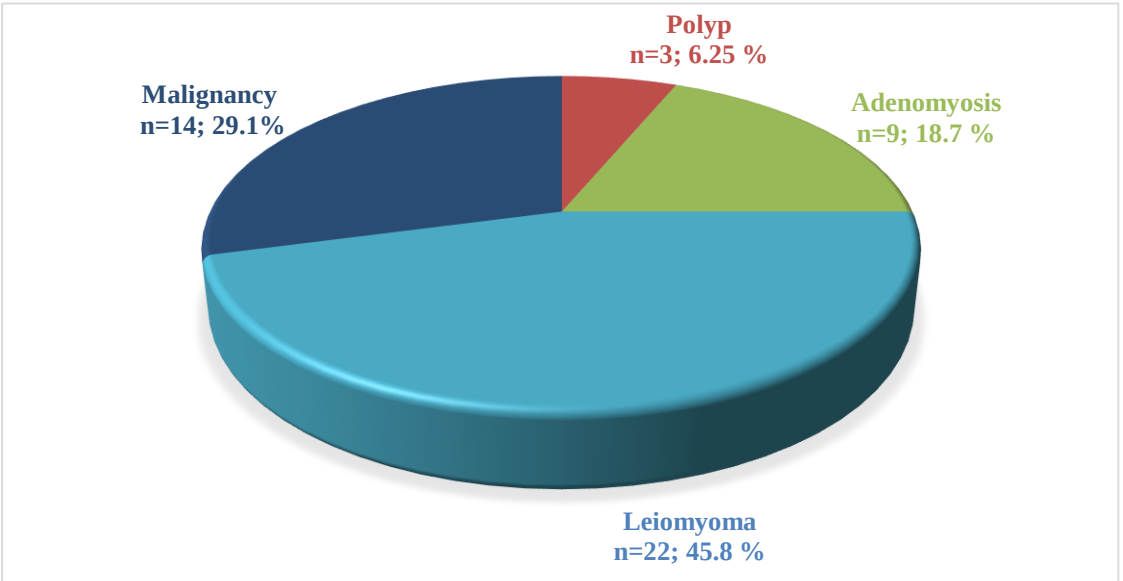


Table 6: Descriptive analysis of causes of AUB ON HPE in the study population (N=48)

Cause	Frequency	Percentages
Polyp	3	6.25 %
Adenomyosis	9	18.75 %
Leiomyoma	22	45.83 %
Malignancy	14	29.16 %

Among the study population, 3 (6.25 %) were reported as polyps, 7 (18.7 %) were reported as adenomyosis, 22 (45.8 %) were reported as leiomyomas and 14 (29.16 %) were reported as malignancies on HPE (Table 6 and Figure 18)

Figure 18: Pie chart showing causes of AUB on HPE in the study population (N=48)

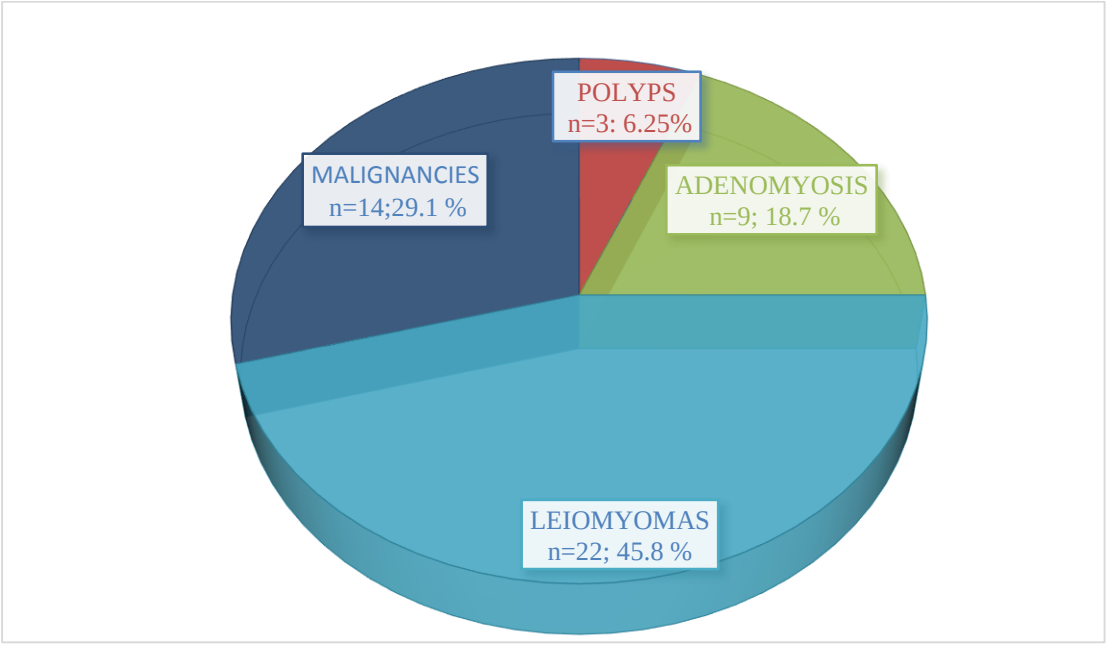


Table 7: Descriptive analysis of types of lesions on HPE in the study population (N=48)

type	Frequency	Percentages
Benign	34	70.83 %
Malignant	14	29. 1 %

Among the study population, 14 (29.1 %) were reported as malignant lesions which includes endometrial carcinomas & cervical carcinomas and 34 (70.83 %) were reported as benign lesions which includes adenomyosis, polyps and leiomyomas.

Figure 19: Doughnut chart showing type of lesions on HPE in the study population (N=48)

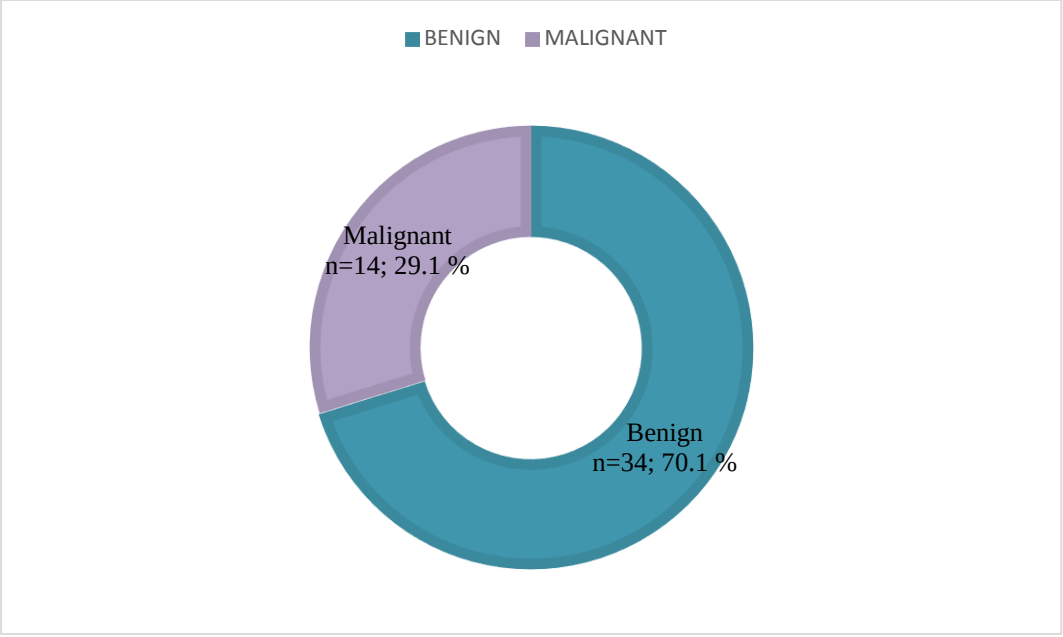


Table 8: Descriptive analysis of types of malignant lesions on HPE in the study population (N=14)

type	Frequency	Percentages
Endometrial carcinoma	3	21.42 %
Cervical carcinoma	11	78.57 %

Out of 14 malignant lesions on HPE, 3 (21.42 %) were endometrial carcinomas and 11 (78.57 %) were cervical carcinomas.

Figure 20: Bar chart showing type of malignant lesions on HPE in the study population (N=48)

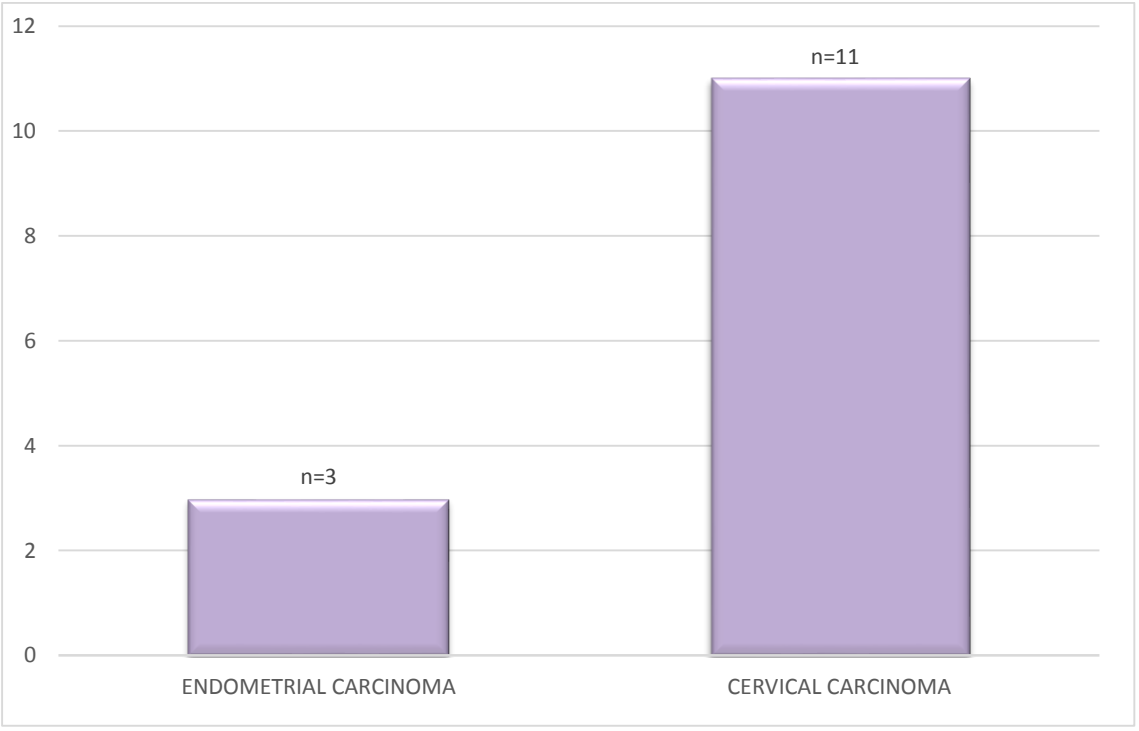


Table 9: Cross table of USG * HPE

Cross table

Count

		HPE				
		Adenomyosis	leiomyoma	malignancy	Polyp	Total
USG	Adenomyosis	7	0	0	0	7
	Leiomyoma	2	22	0	1	25
	Malignancy	0	0	14	0	14
	Polyp	0	0	0	2	2
Total		9	22	14	3	48

Table 10: Measure of agreement (kappa value) of USG * HPE

Symmetric Measures

	Value	Asymptotic Standard Error	Approximate T	P Value
Measure of Agreement Kappa	.903	.054	9.375	.001
N of Valid Cases	48			

When comparing USG and HPE in evaluation of causes of abnormal uterine bleeding, measure of agreement with kappa value is 0.903 (acceptable and good). This difference is because of three lesions which were misdiagnosed USG, which was correctly diagnosed on MRI. Among them one polyp is misdiagnosed as submucosal fibroid and other two are focal adenomyosis which were misdiagnosed as intramural fibroids on USG

Table 11: Cross table of MRI * HPE

Crosstab

Count

		HPE				
		Adenomyosis	LEIOMYOMA	MALIGNANCY	POLYP	Total
MRI	Adenomyosis	9	0	0	0	9
	LEIOMYOMA	0	22	0	0	22
	MALIGNANCY	0	0	14	0	14
	POLYP	0	0	0	3	3
Total		9	22	14	3	48

Table 12: Measure of agreement (kappa value) of MRI * HPE

Symmetric Measures

		Value	Asymptotic Standard Error	Approximate T	P VALUE
Measure of Agreement	Kappa	1.000	.001	10.582	.001
N of Valid Cases		48			

Comparing transabdominal MRI and HPE in evaluation of causes of abnormal uterine bleeding, measure of agreement with kappa value is 1.0 (very good).

Table 13: USG * HPE Cross tabulation for adenomyosis

USG * HPE Cross tabulation

Count

		HPE Adenomyosis	Total
USG	Adenomyosis	7	7
	Leiomyoma	2	2
Total		9	9

Statistic	**Value**	**95% CI**
Sensitivity	77.78%	39.99% to 97.19%
Disease prevalence	100.00%	66.37% to 100.00%
Positive Predictive Value (*)	100.00%	

Table 14: MRI * HPE Cross tabulation for adenomyosis

MRI * HPE Cross tabulation

Count

		HPE Adenomyosis	Total
MRI	Adenomyosis	9	9
Total		9	9

Statistic	**Value**	**95% CI**
Sensitivity	100.00%	66.37% to 100.00%
Disease prevalence	100.00%	66.37% to 100.00%
Positive Predictive Value (*)	100.00%	

In our study population total number of adenomyosis were 9 out of which 7 cases were diffuse adenomyosis and 2 cases were focal adenomyosis which are correctly diagnosed on MRI Two case were misdiagnosed as intramural fibroids on USG. Sensitivity of USG & MRI in detecting adenomyosis were 77.78 % & 100 % respectively

Table 15: USG * HPE Cross tabulation for Polyp

USG * HPE Cross tabulation

Count

		HPE Polyp	Total
USG	Leiomyoma	1	1
	Polyp	2	2
Total		3	3

Statistic	Value	95% CI
Sensitivity	66.66 %	30.9% to 94.57%
Disease prevalence	100.00%	29.24% to 100.00%
Positive Predictive Value (*)	100.00%	

Table 16: MRI * HPE Cross tabulation for Polyp

MRI * HPE Cross tabulation

Count

		HPE Polyp	Total
MRI	Polyp	3	3
Total		3	3

Statistic	Value	95% CI
Sensitivity	100.00%	29.24% to 100.00%
Disease prevalence	100.00%	29.24% to 100.00%
Positive Predictive Value (*)	100.00%	

Out of 48 cases total number of polyps were 3 cases out of which USG was able to diagnose 2 cases with sensitivity of 66.66 % since one case was misdiagnosed as submucosal fibroid. All three cases were diagnosed as polyps on MRI with sensitivity of 100 %.

Table 17: USG * HPE Cross tabulation for Leiomyoma

USG * HPE Cross tabulation

Count

		HPE Leiomyoma	Total
USG	Leiomyoma	22	22
Total		22	22

Statistic	Value	95% CI
Sensitivity	100.00%	84.56% to 100.00%
Disease prevalence	100.00%	84.56% to 100.00%
Positive Predictive Value (*)	100.00%	

Table 18: MRI * HPE Cross tabulation for Leiomyoma

MRI * HPE Cross tabulation

Count

		HPE Leiomyoma	Total
MRI	Leiomyoma	22	22
Total		22	22

Statistic	Value	95% CI
Sensitivity	100.00%	84.56% to 100.00%
Disease prevalence	100.00%	84.56% to 100.00%
Positive Predictive Value (*)	100.00%	

Among total 48 cases, the sensitivity of USG and MRI in detecting fibroids was same that is 100 % but MRI was better in exactly identifying location and number of lesions.

Table 19: USG * HPE Cross tabulation for Malignancy

USG * HPE Cross tabulation

Count

		HPE Malignancy	Total
USG	Malignancy	14	14
Total		14	14

Statistic	Value	95% CI
Sensitivity	100.00%	76.84% to 100.00%
Disease prevalence	100.00%	76.84% to 100.00%
Positive Predictive Value (*)	100.00%	

Table 20: MRI * HPE Cross tabulation for Malignancy

MRI * HPE Cross tabulation

Count

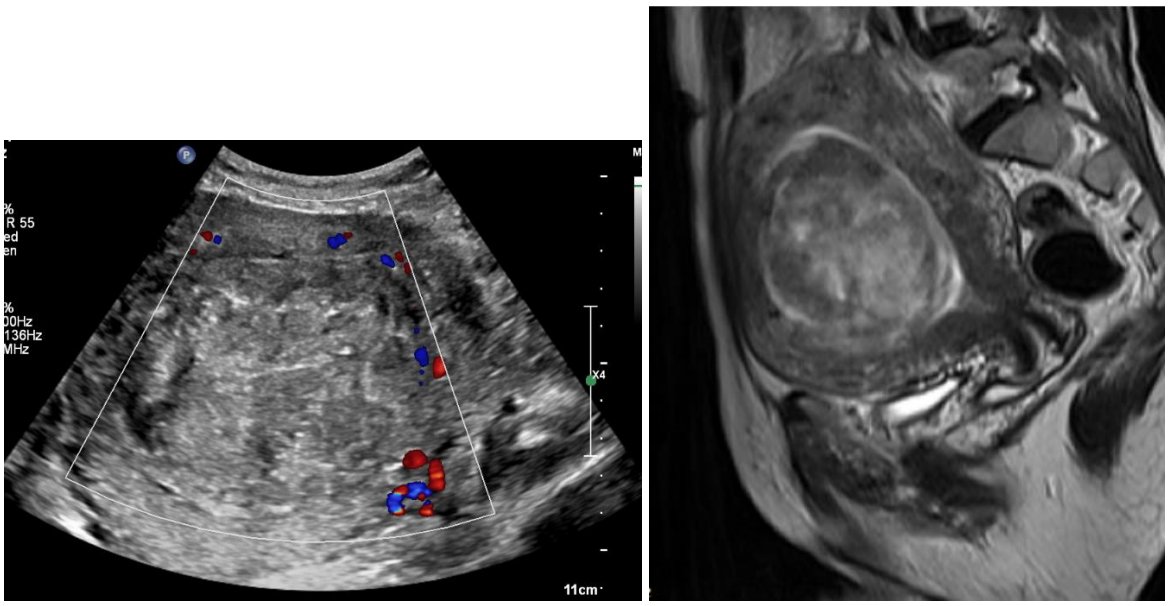
		HPE Malignancy	Total
MRI	MALIGNANCY	14	14
Total		14	14

Statistic	Value	95% CI
Sensitivity	100.00%	76.84% to 100.00%
Disease prevalence	100.00%	76.84% to 100.00%
Positive Predictive Value (*)	100.00%	

There were 14 cases of malignancies out of 48 study population the sensitivity of USG and MRI in detecting malignancies was same that is 100 % but MRI was better in exactly but staging, depth of myometrial / parametrial involvement were assessed on MRI.

USG AND MRI PELVIS IMAGES OF FEW OF MY CASES WITH AUB

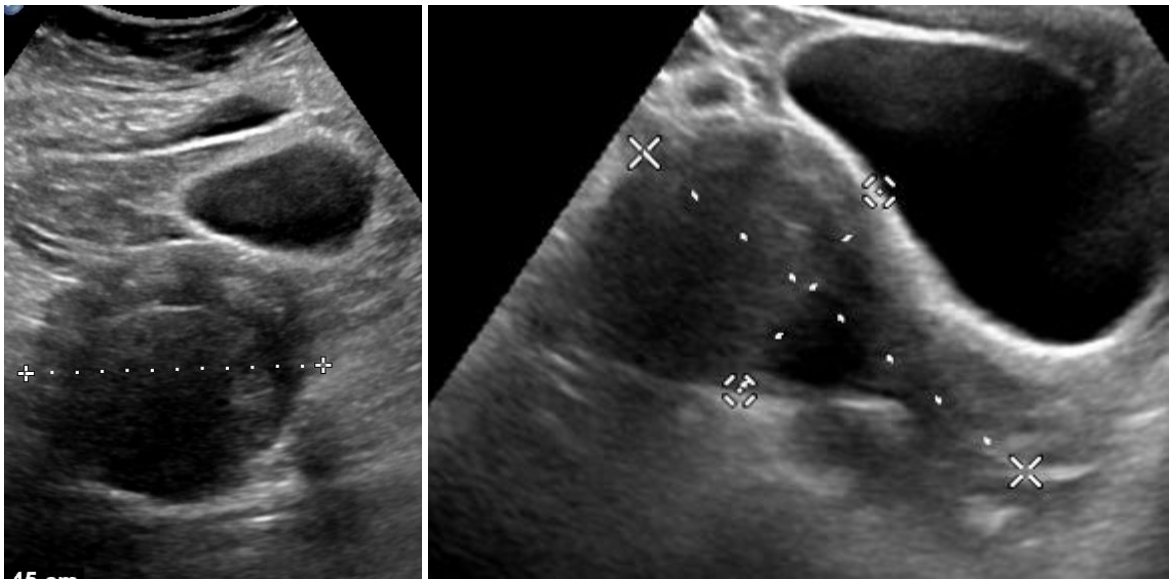
1. CASE OF SUBMUCOSAL FIBROID



A **B**

Figure 21: A:USG pelvis showing a heterogeneously hypoechoic lesion in the submucosal region of uterus occupying the endometrial cavity showing peripheral vascularity on CDI. **B:** MRI pelvis T2 weighted image showing heterogeneously hyperintense lesion filling the endometrial cavity consistent with submucosal leiomyoma.

2. CASE OF INTRAMURAL AND SUBSEROSAL FIBROIDS



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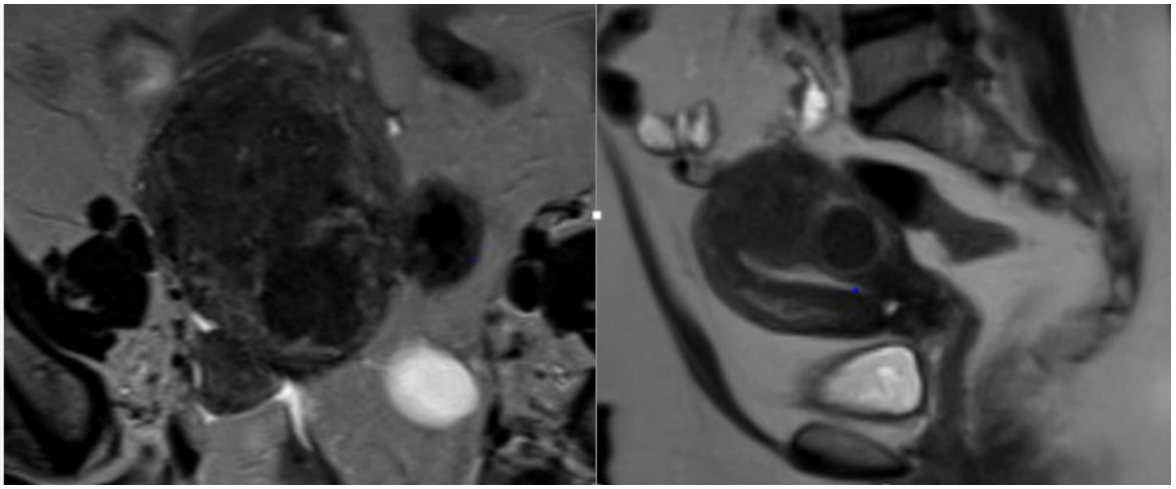
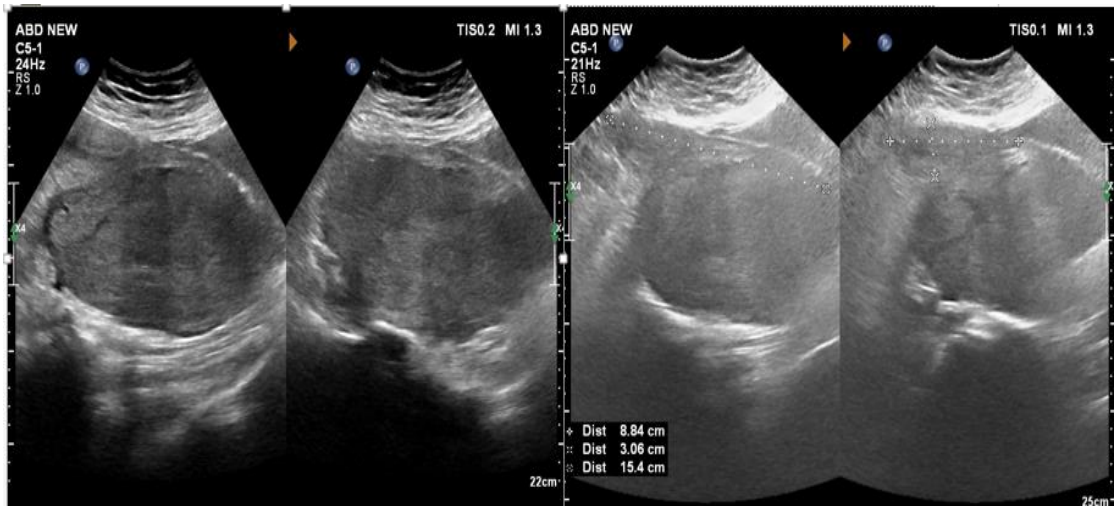


B

Figure 22: A: USG pelvis showing two heterogeneously hypoechoic lesions noted in posterior myometrium. **B:** MRI pelvis T2 weighted axial and sag images showing two iso-hypo intense lesions in posterior wall. There is one more sub serosal fibroid arising from post wall

3. CASE OF LARGE CERVICAL FIBROID



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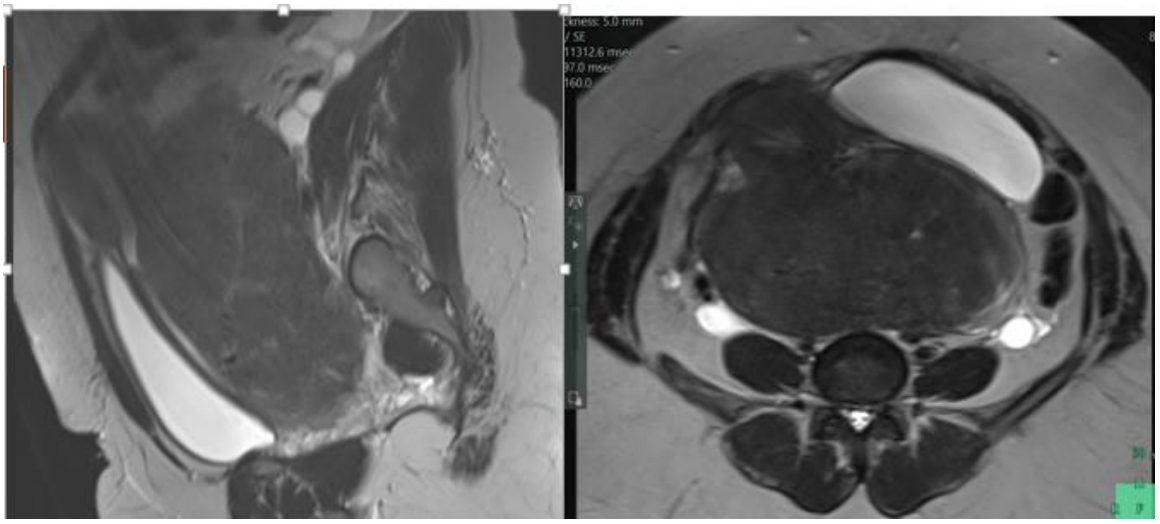
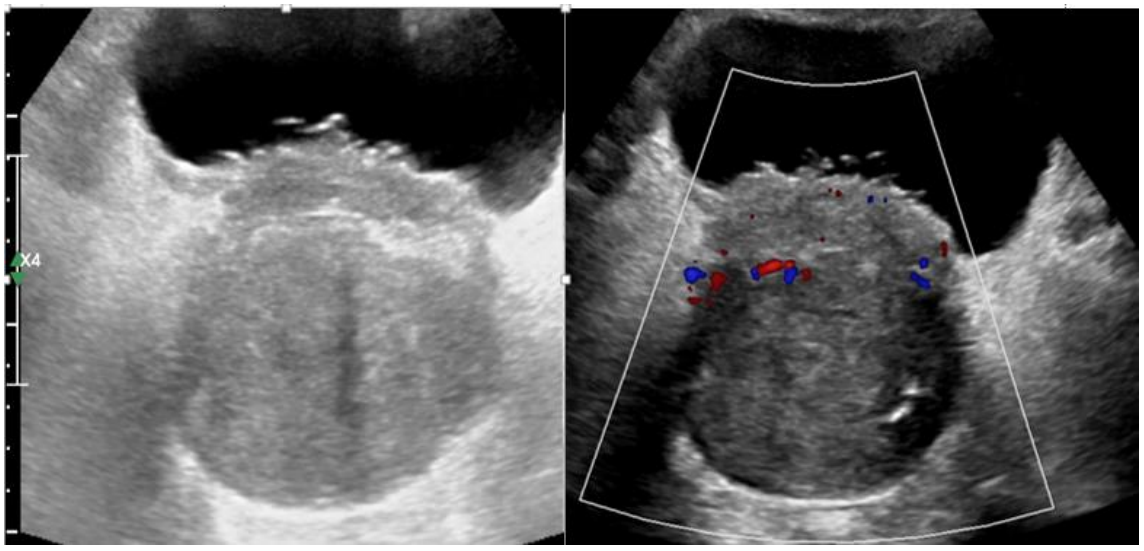


B

Figure 23: A: USG pelvis showing a large heterogeneously iso-hypoechoic lesion in pelvic cavity pushing the uterus anteriorly, cervix not visualized separately. **B:** MRI pelvis T2 weighted sag and axial images showing heterogeneously hypoechoic lesion in pelvis arising from cervix- consistent with cervical fibroid

4. CASE OF CERVICAL CARCINOMA



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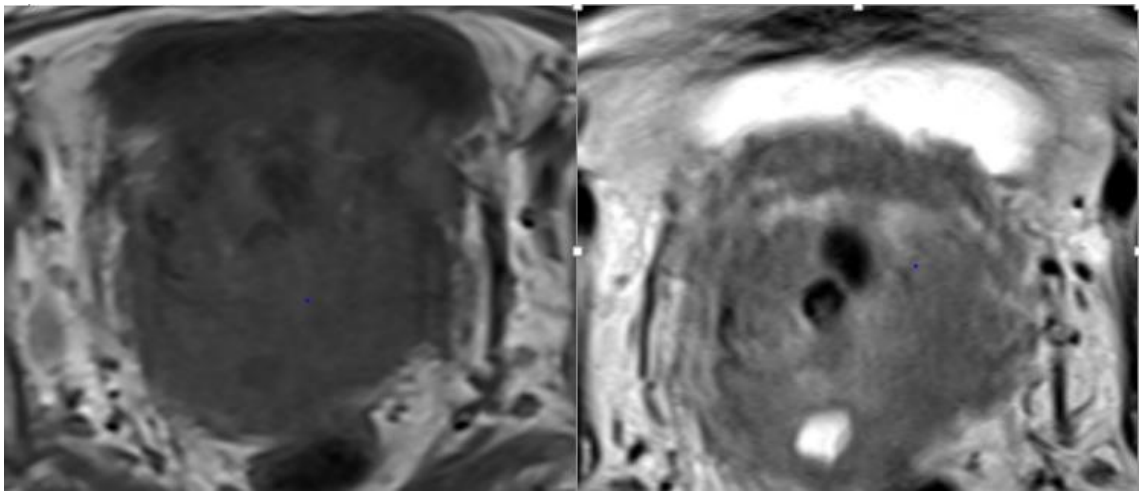

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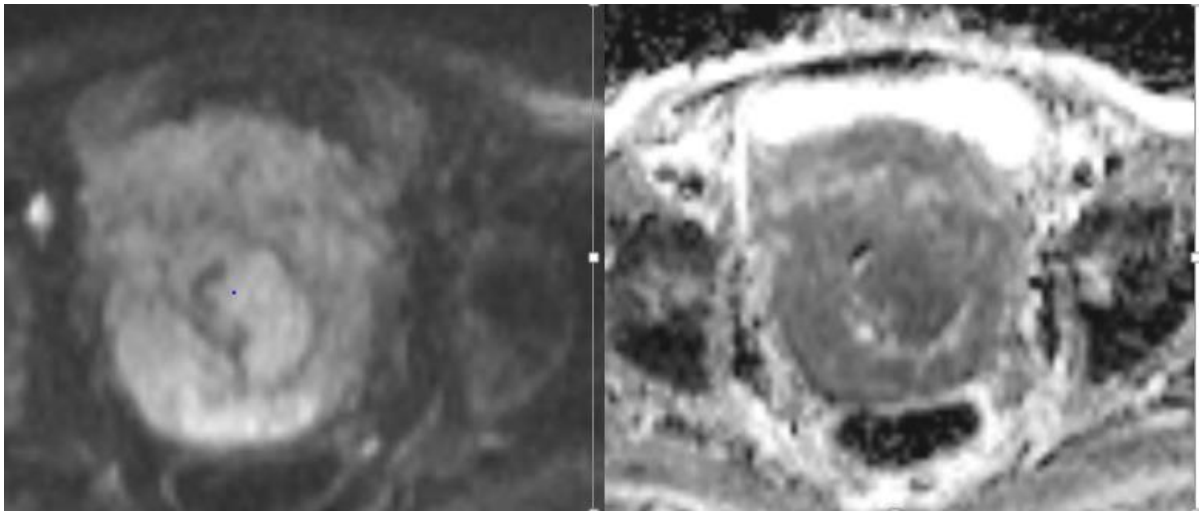


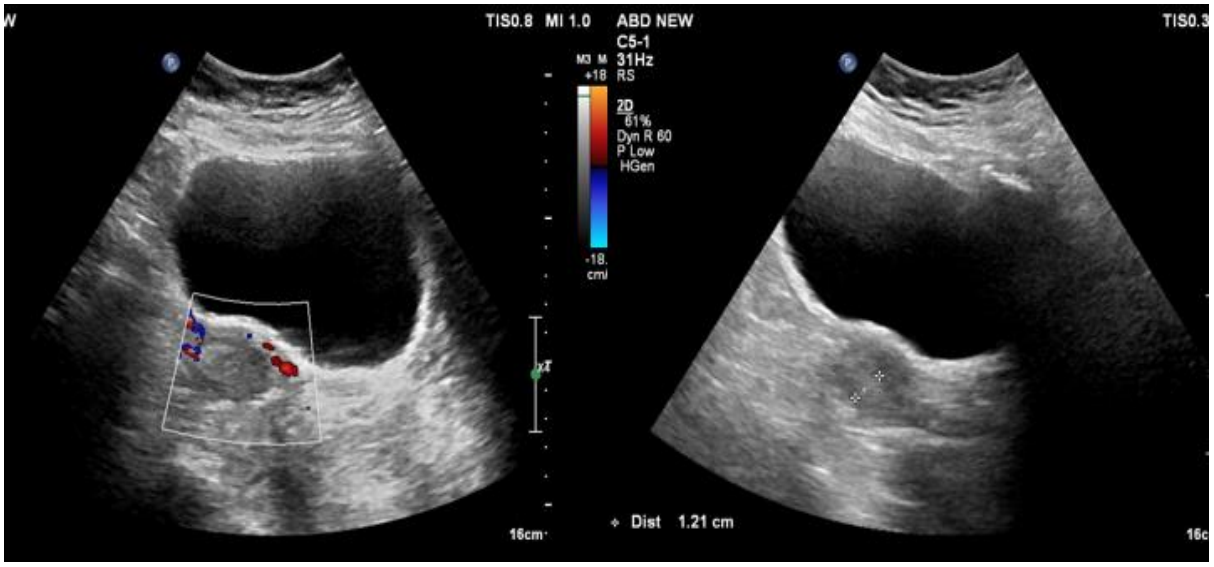
C

Figure 24: A: USG pelvis showing bulky cervix with heterogeneously hypoechoic lesion demonstrating internal vascularity on cdi the lesion is seen infiltrating base of bladder

B: MRI T1 and T2 axial images showing a large fairly defined T1 iso, T2 heterogeneously hyperintense lesion in cervix infiltrating posterior wall of urinary bladder.

C: MRI pelvis axial section DWI and corresponding ADC where the lesion is showing patchy areas of restriction

5. CASE OF ENDOMETRIAL CARCINOMA



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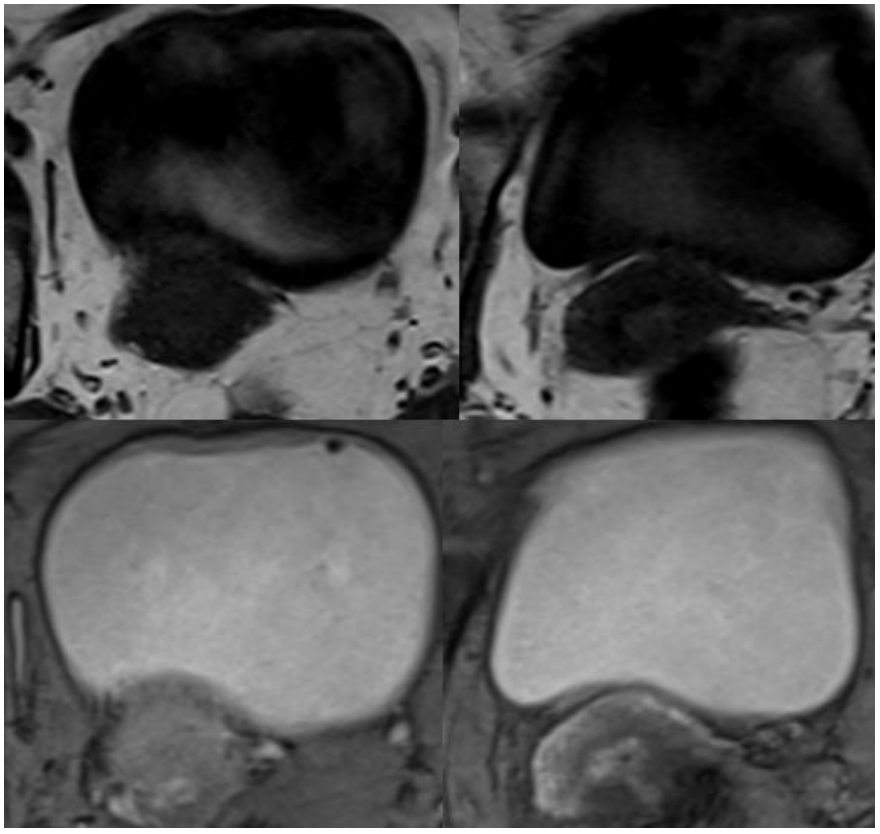

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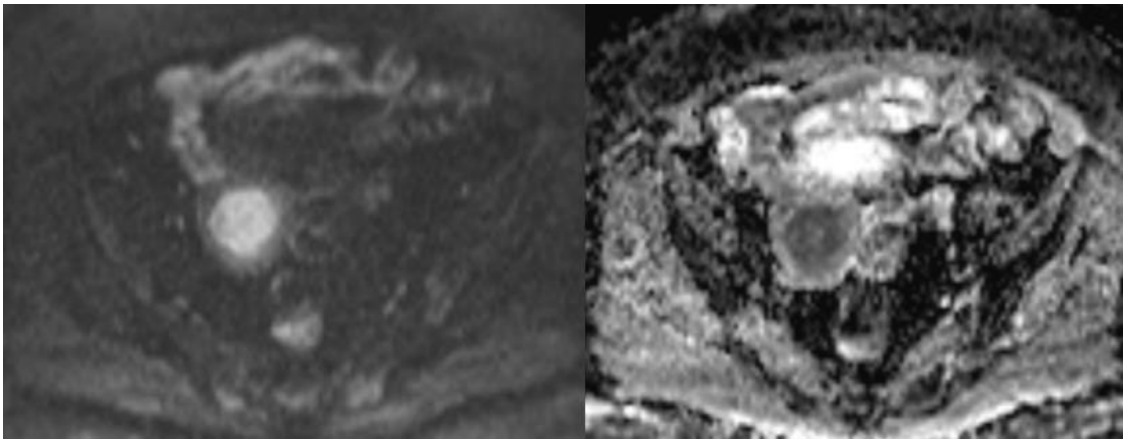
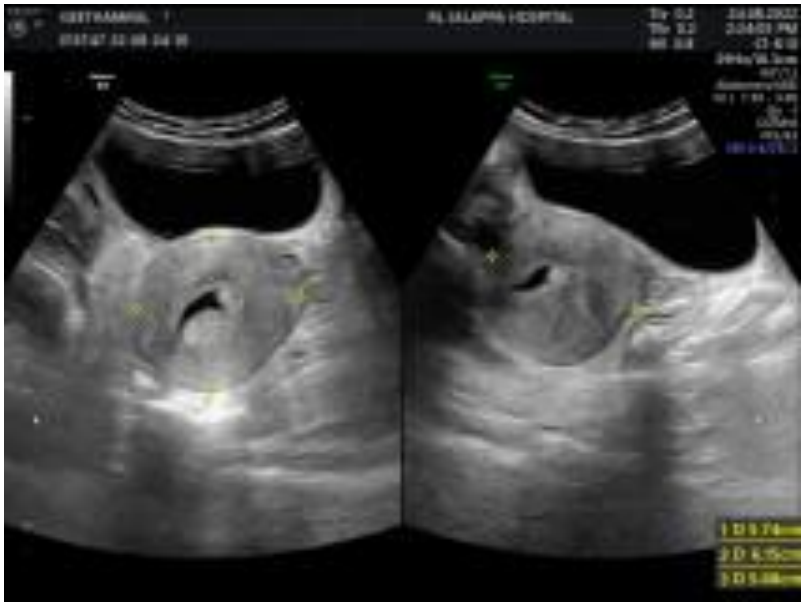


C

Figure 25: A USG pelvis showing thickened and heterogenous endometrium. Uterus appears atrophied.

B: Large irregular T2 hypointense lesion ~ 28 x 25 x 33 mm with intense restriction on DWI seen with in the endometrial cavity with loss of anterior endo myometrial junction. Cervix shows few nabothian cysts. **C:** This is DWI and corresponding ADC showing thickened ET which id hyper in DWI and showing restricted diffusion on ADC – suggestive endometrial malignancy

6. CASE OF ENDOMETRIAL POLYP



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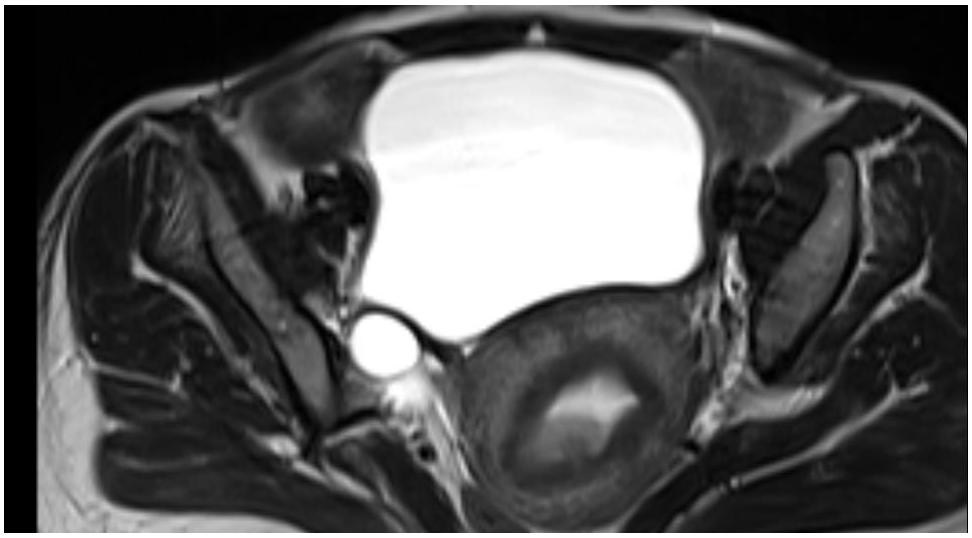
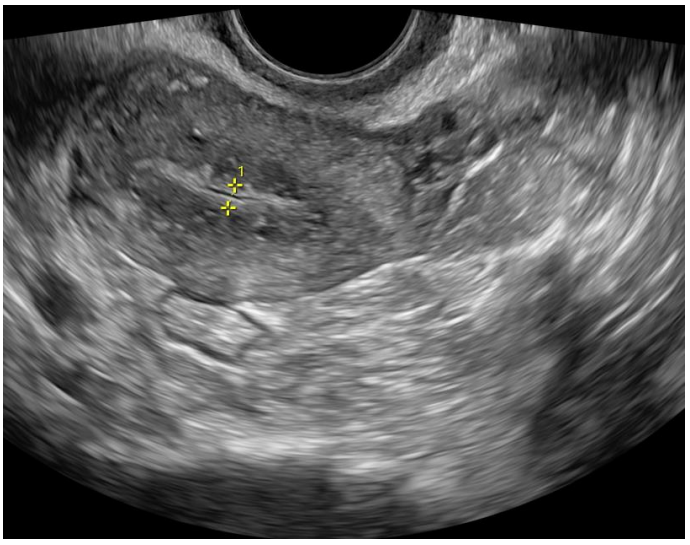


B

Figure 26 A: USG pelvis showing two hyperechoic lesions in the endometrial cavity. **B:** MRI pelvis T2 weighted image showing three iso intense lesions within the endometrial cavity.

7. CASE OF ADENOMYOSIS



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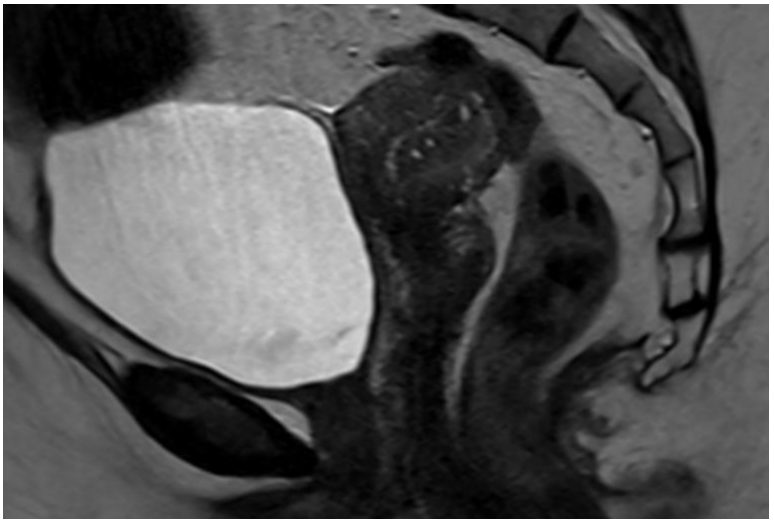

B

Figure 27 A: USG pelvis showing sub-endometrial echogenic linear striations, extending from endometrium and into inner myometrium. Irregular endo-myometrial junction. Few hyperechoic islands noted. **B**: MRI pelvis T2 weighted sagittal image showing widening of junctional zone and few cystic areas in anterior and posterior myometrium.

DISCUSSION

DISCUSSION

48 patients who were referred from the department of Obstetrics and Gynecology for examination of abnormal uterine bleeding underwent transabdominal USG with or without transvaginal USG and MRI. Patients underwent cervical biopsy, endometrial curettage, myomectomy, or hysterectomy. The patients' ages ranged from 27 to 67 years old. The mean age of the patients was 46.88 ± 9.78 years, ranging between 27 to 67 years in the study population. Patients in premenopausal age group (less than 45 years) were 19, in perimenopausal age group (45 to 55 years) were16 and in postmenopausal age group (more than 55 years) were 13. The majority of the patients in our study were premenopausal.

Among study population, 25 (52.08 %) participants had presented with menorrhagia, 11 (22.9 %) participants had presented with metrorrhagia and 12 (25.00 %) participants had presented with polymennorrhea. Out of all cases 20.83 % had dysmenorrhea as additional symptom especially in case of adenomyosis.

The total number of patients was divided into four subcategories based on histopathological diagnosis. Polyp -3 (6.25 %) patients, Adenomyosis –7 (18.7 %) patients; leiomyoma –22 (45.8 %) patients; malignancies –14 (29.16 %) patients.

Among the study population, 2 (4.10 %) were reported as polyps, 7 (14.58 %) were reported as adenomyosis, 25 (52.08 %) were reported as leiomyomas and 14 (29.16 %) were reported as malignancies on ultrasound imaging (TAS with or without TVS).

Among the study population, 3 (6.25 %) were reported as polyps, 7 (18.7 %) were reported as adenomyosis, 22 (45.8 %) were reported as leiomyomas and 14 (29.16 %) were reported as malignancies on MR imaging.

Sensitivity was calculated for each modality in each subgroup and compared.

Comparing transabdominal MRI and HPE in evaluation of causes of abnormal uterine bleeding, measure of agreement with kappa value is 1.0 (very good).

When comparing USG and HPE in evaluation of causes of abnormal uterine bleeding, measure of agreement with kappa value is 0.903 (acceptable and good). This difference is because of three lesions which were misdiagnosed USG, which was correctly diagnosed on MRI.

Among them one polyp is misdiagnosed as submucosal fibroid and other two are focal adenomyosis which were misdiagnosed as intramural fibroids on USG.

MRI is the best tool for determining the location and number of lesions. It provides the surgeon with a visual image. All infertile women undergoing uterine preservation surgery should have an MRI before the procedure.

Among patients with fibroids cystic degeneration were seen in 5 with USG and in 7 on MRI. Patients showing calcifications on USG were 4 and on MRI were 2.

Specificity cannot be calculated in the present study since we don’t have true negative cases as we are not comparing with normal population.

Out of 48 cases total number of polyps were 3 cases out of which USG was able to diagnose 2 cases with sensitivity of 66.66 % since one case was misdiagnosed as

submucosal fibroid. All three cases were diagnosed as polyps on MRI with sensitivity of 100 %.

In population under study, total cases of adenomysis were 9 out of which 7 cases were diffuse adenomyosis and 2 cases were focal adenomyosis which are correctly diagnosed on MRI Two case were misdiagnosed as intramural fibroids on USG. Sensitivity of USG & MRI in detecting adenomyosis were 77.78 % & 100 % respectively.

Among 48 cases, the sensitivity of USG and MRI in detection of fibroids was same that is 100 % but MRI was better in exactly identifying location and number of lesions.

There were 14 cases of malignancies out of 48 study population the sensitivity of USG and MRI in detecting malignancies was same that is 100 % but MRI was better in exactly but staging, depth of myometrial / parametrial involvement were assessed on MRI.

Rahel A. et al in their study concluded that "MRI offers an outstanding and reproducible map of the size, site and distribution of leiomyomas" [47]

Zawin M et al[81] studied high-field MRI and USG in 23 women having leiomyomas. They discovered that while MRI allowed for accurate uterine volume determination in all cases, USG was limited in uteri > 140 cc. The visibility of contour abnormalities in USG was obscured by marked enlargement. In 21 of 23 ultrasound examinations, the endometrial stripe and junctional zone were not clearly visible. The researchers concluded that MRI detects more submucosal (14) lesions than USG in women with leiomyoma. This is consistent with findings in our study, in which the exact origin of one large pelvo-abdominal fibroid was not clearly seen on TAS or TVS but was seen arising from the cervix on MRI.

In eight cases of adenomyosis, dysmenorrhoea was present. One patient was infertile. All of the patients were between the ages of 31 and 39. This is consistent with the findings of **VG Padubidri et al** [14], who found adenomyosis in parous women with age > 40 presenting with menorrhagia and gradually increasing dysmenorrhoea.

Turner DA, et al [71] concluded that if adenomyosis was diagnosed completely based on thickness of junctional zone on images obtained on MRI examination, 5mm must not be considered as upper limit of normal, as it might result in a greater number of false positives. According to standards established in the preceding study, the minimum JZ thickness in our study is 10 mm.

Phillips et al[77] found that transabdominal uterine biopsy or resectoscopic endometrial biopsy confirmed the MRI diagnosis of adenomyosis in all 20 patients. Similarly, our study correctly identified all nine positive MRI cases.

Ascher SM et al[60] conducted a study over 20 pateints on whom MRI, transvaginal ultrasound & HPE were performed. Adenomyosis affected 17 people. In MR, 15/17 cases were diagnosed correctly. Two false negative and one false positive diagnosis were made on MR.

Transvaginal ultrasound correctly diagnosed 9/17 cases. One false positive and eight false negatives were reported, with misinterpretation of adenomyosis as leiomyoma being the most common cause of false negative diagnosis with transvaginal ultrasound.

Similarly, to previous study, two fibroid cases diagnosed by USG turned out to be focal-adenomyosis. Due to misinterpretation of adenomyosis as leiomyoma, only 7 of 9 cases were correctly diagnosed as adenomyosis on USG.

Tamai K et al.[76] investigation on the relationship between MR imaging findings of adenomyosis, characteristics on histopathology, and diagnostic blunders underscore the previously indicated reality.

Leiomyoma, endometrial stromal sarcoma, metastasis, adenomatoid tumour and endometrial cancer are among the diagnostic problems they have mentioned for adenomyosis. concluded that understanding the varied adenomyosis manifestations and potential errors in differential diagnosis aid in determining the best course of treatment.

In research conducted by **Mark AS et al**.[54] on 21 premenopausal patients, they found that 12 had fibroids, 8 of them had adenomyosis and 1 was normal. On MRI, all 8 adenomyosis were identified. MRI properly identified 10/12 fibroids. In two cases, it was challenging to distinguish between an adenomyosis and a fibroid.

In research by **Togashi et al**. [52] among 93 individuals, 71 patients with fibroid, 16 patients with adenomyosis, and 6 patients with both. In our research among 48 cases, 22 cases were diagnosed fibroid, 9 cases were diagnosed adenomyosis, and 1 case was diagnosed with both.

According to the **Byun JY et al**.[59] investigation, diffuse adenomyosis affected 66.7% (30 patients) while focal adenomyoma affected 33.3% (15). JZ is 7–37 mm in diffuse adenomyosis. Only 4 focal adenomyomas showed high T2 signal intensity and 11 of these tumours were visible on both T2 & T1 image sections. Our examination discovered 2 localised cases and 7 widespread cases of adenomyosis. The JZ's range of thicknesses is 10 to 22 mm.

Yamashita Y et al.[78] examined the prospective effects of endometrial cancer invasion on the myometrium. To assess the depth of myometrial invasion in 40 patients, transvaginal sonography and CE-MR imaging were compared. Myometrial invasion depth was then divided into three stages: "Stage E (tumours limited to the endometrium), Stage S (superficial invasion tumours invade up to 50% of the myometrium), and Stage D deep invasion (tumours invade more than 50% of the myometrium). It was found that when comparing the accuracy of TVS, unenhanced T2 weighted (68%) and T1 weighted (85%) imaging, contrast enhanced T1 weighted MR imaging is considerably improved."

False positive in T2 weighted imaging was brought on by leiomyoma, myometrial atrophy, poor contrast between tumour & myometrium and pyometra. Greater capacity to identify between endometrial cavity, residual myometrium, tumour and tumour invaded myometrium was cause of the increased accuracy in contrast-enhanced pictures.

"According to the outcomes of another study on the detection of abnormal uterine cavities, malignancy can be identified when a lesion has invaded the myometrial junctional zone or when its enhancement is less than that of the surrounding myometrium.

Since every patient with cervix cancer arrived at or after stage IIb, every case was accurately identified by every modality. But in this case, staging is the main function of MR, and if vaginal wall or parametrial involvement is found, the staging is upgraded. Because breach in the hypointense line of the outer stroma is better observed in axial images, parametrial invasion is mostly recognised in T2 axial or contrast enhanced T1

weighted axial imaging. Sagittal and coronal images make vaginal and body expansions easier to see."

According to **Shiraiwa M etal**[75], thin slice oblique-axial T2 weighted images had given an excellent cross-section of the cervix, more reliably detect invasion of parametrium than axial images. There was only one iliac node with displaced iliac arteries and thrombosis.

This implies that MRI is the preferred method for staging cervical cancer, preferably with contrast enhancement for a better ability to detect extensions. The surgical management is dramatically changed by the final MRI diagnosis. The MRI provides a more accurate description of all uterine lesions. MRI allows for more accurate site localization and number detection. MRI can reveal precise dimensions, the lesion's diameter, and degenerative changes. MRI imaging provides a more accurate representation of the lesions' extent, which aids in staging the tumour.

CONCLUSION

CONCLUSIONS:

- Study conducted was a hospital based observational study involving 48 patients, mean age of the patients 46.88 ± 9.78 years, ranging between 27 to 67 years

- The majority (39.5 %) of patients in our study were in age group of premenopause.

- Among patients most of them presented with menorrhagia (52.08 %) followed by polymennorrhea (25.0%) and metrorrhagia (22.9 %). Dysmenorrhea (20.83 %) was also present as additional symptom especially in case of adenomyosis.

- According to histopathological Diagnosis, patients were categorised in to 4 sub types; Polyp -3 (6.25 %) patients, Adenomyosis –7 (18.7 %) patients; leiomyoma –22 (45.8 %) patients; malignancies –14 (29.16 %) patients.

- On ultrasound examination (TAS with or without TVS), 2 patients (4.10 %) were reported as polyps, 7 patients (14.58 %) were reported as adenomyosis, 25 patients (52.08 %) were reported as leiomyomas and 14 patients (29.16 %) were reported as malignancies among study population.

- On MRI examination 3 patients (6.25 %) were reported as polyps, 9 patients (18.7 %) were reported as adenomyosis, 22 patients (45.8 %) were reported as leiomyomas and 14 patients (29.16 %) were reported as malignancies among study population.

- MRI and HPE in evaluating the causes of abnormal uterine bleeding, measure of agreement with kappa value is 1.0 (very good)

- USG and HPE in evaluating the causes of abnormal uterine bleeding, measure of agreement with kappa value is 0.903 (acceptable and good).

- MRI is the most effective method for locating the location and number of lesions. The surgeon gets a clear visual from it.

- Sensitivity of USG in diagnosing polyps was 66.66 % since one case was misdiagnosed as submucosal fibroid. Sensitivity of MRI in diagnosing polyps was 100 %

- Sensitivity of USG in diagnosing adenomyosis was 77.78 % and Sensitivity of MRI in diagnosing adenomyosis was 100 %.

- Sensitivity of USG and MRI in detecting fibroids was same that is 100 % but MRI was better in exactly identifying location and number of lesions

- Sensitivity of USG and MRI in detecting malignancies was same that is 100 % but MRI was better in assessing exact staging, depth of myometrial / parametrial involvement.

SUMMARY

SUMMARY:

High spatial resolution MR imaging is useful for characterising, localising, and evaluating the cause of abnormal uterine bleeding & helps in staging of malignant lesions.

Best way to diagnose adenomyosis is with an MRI. Transabdominal USG can be used to screen for myometrial lesions such as fibroid. USG detects calcific degeneration more accurately. Cystic degeneration is more easily identified on USG and MRI. MRI characterises submucosal lesions better than USG. As a screening modality USG is best modality which can be used in the detection of endometrial lesions. For characterisation of lesions T2 & contrast enhanced T1 weighted MRI sequences can be used.

In endometrial carcinomas, an MRI diagnosis does not eliminate the need for an endometrial biopsy. In the case of endometrial carcinoma, MRI detects myometrial invasion and lesion extension better. MRI detects cervical lesions MRI detects the extensions of carcinoma cervix, vaginal extension, invasion of parametrium, haematosalphinx and haematometrocolpos, more efficiently than USG, allowing for more appropriate staging.

As there is different strategy of surgery used for treating fibroid and adenomyosis, usage of MRI should in cases of suspicion between adenomyosis and infertility should be done.

Ultimately, we draw the conclusion that MR imaging is a non-invasive, accurate and well-tolerated technique for identifying the causes of atypical uterine bleeding, with great histological correlation, when compared to USG. Because of this, it is a superb and accurate preoperative imaging modality for identifying, locating, and figuring out how many and how large uterine mass lesions are.

LIMITATIONS & RECOMMENDATIONS:

- Few patients who met the inclusion criteria were willing to undertake an MRI as a diagnostic tool. The primary causes of this were the high cost and the general lack of understanding about how useful MRI is for early detection and diagnosis.
- There are no true negative cases, so calculation of specificity was not possible

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ANNEXURE

PATIENT PROFORMA

"EFFICACY OF MRI OVER ULTRASOUND IN EVALUATION OF ABNORMAL UTERINE BLEEDING WITH HISTOPATHOLOGICAL CORRELATION"

DEMOGRAPHIC DETAILS:

-Name:

-Age:

-UHID:

CLINICAL HISTORY:

USG FINDINGS:

Uterus:

- Number of lesions:
- Location of lesion:
- Size of lesion:
- Vascularity of lesion:

POD:

Endometrial thickness:

Ovaries:

MRI Findings:

Uterus:

- Number of lesions:
- Location of lesion:
- Size of lesion:
- POD:
- Endometrial thickness:

Ovaries:

Other findings:

Characteristics of lesion on MRI:

T1	T2	RESTRICTION

USG diagnosis:

MRI diagnosis:

Histopathological Diagnosis (final diagnosis):

INFORMED CONSENT FORM

STUDY TITLE: **EFFICACY OF MRI OVER ULTRASOUND IN EVALUATION OF ABNORMAL UTERINE BLEEDING WITH HISTOPATHOLOGICAL CORRELATION**

CHIEF RESEARCHER/ PG GUIDE'S NAME: Dr. DEEPTI NAIK

PRINCIPAL INVESTIGATOR: Dr. KALATHURU UHASAI.

NAME OF THE SUBJECT:

AGE:

a. I have been informed in my own language that this study involves MRI, USG & HPE as part of procedure. I have been explained thoroughly and understand the procedure.

b. I understand that the medical information produced by this study will become part of institutional record and will be kept confidential by the said institute.

c. I understand that my participation is voluntary and may refuse to participate or may withdraw my consent and discontinue participation at any time without prejudice to my present or future care at this institution.

d. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).

e. I confirm that Dr. DEEPTI NAIK / Dr. KALATHURU UHASAI. (chief researcher/ name of PG

guide/name of the principal investigator) has explained to me the purpose of research and the study procedure that I will undergo and the possible risks and discomforts that I may experience, in my own language. I hereby agree to give valid consent to participate as a subject in this research project.

Participant’s signature/thumb impression

Signature of the witness: Date:

1)

2)

I have explained to_____(subject) the purpose of the research, the

possible risk and benefits to the best of my ability.

Chief Researcher/ Guide signature Date:

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION

AND RESEARCH, TAMAKA, KOLAR, KARNATAKA

PATIENT INFORMATION SHEET

Principal Investigator: Dr. KALATHURU UHASAI / Dr. DEEPTI NAIK

I, Dr. KALATHURU UHASAI, post-graduate student in Department of Radio-Diagnosis at Sri Devaraj Urs Medical College, will be conducting a study titled "EFFICACY OF MRI OVER ULTRASOUND IN EVALUATION OF ABNORMAL UTERINE BLEEDING WITH HISTOPATHOLOGICAL CORRELATION" for my dissertation under the guidance of Dr. DEEPTI NAIK, Professor, Department of Radio-Diagnosis. This will facilitate identifying AUB with the help of ultrasound and MRI in treating it. It will also benefit other patients with AUB undergoing medical therapy in the future. You are free to opt-out of the study at any time if you are not satisfied or apprehensive to be a part of the study. Your treatment and care will not be compromised if you refuse to be a part of the study. The study will not add any risk or financial burden to you if you are part of the study

Your identity and clinical details will be confidential. You will not receive any financial benefit for being part of the study. You are free to contact Dr. KALATHURU UHASAI or any other member of the above research team for any doubt or clarification you have.

Name and Signature of the Principal Investigator

Date

MASTER CHART

SL NO	UHID	AGE	SYMPTOMS	UTERUS SIZE		ENDOMETRIUM								
				USG	MRI	THICKNESS in mm		LESION				MRI	COLLECTION	
						USG	MRI	USG				JZ THICKNESS	USG	MRI
								ECHOGENICITY	CDI	INTENSITY	DWI			
1	880611	61	MENO	NORMAL	NORMAL	12	13	HYPERECHOIC	VASCULAR	T1-HYPO, T2-HYPER	RESTRICTION	5	NIL	NIL
2	765432	58	MENO	NORMAL	NORMAL	15	14	HYPERECHOIC	NOT VASCULAR	T1-HYPO, T2-HYPER	RESTRICTION	7	NIL	NIL
3	754321	47	POLY	NORMAL	NORMAL	24	22	HETERO	VASCULAR	T1-HYPO, T2-HYPER	RESTRICTION	6	NIL	NIL
4	889290	35	MENO,DYS	ENLARGED	ENLARGED	8	9	NA	NA	NA	NA	14	NIL	NIL
5	883297	37	MENO	NORMAL	NORMAL	7	6	NA	NA	NA	NA	13	NIL	NIL
6	896632	38	MENO	ENLARGED	ENLARGED	9	11	NA	NA	NA	NA	22	NIL	NIL
7	862952	29	MENO,DYS	ENLARGED	ENLARGED	11	11	NA	NA	NA	NA	19	NIL	NIL
8	896882	34	DYS	ENLARGED	ENLARGED	6	5	NA	NA	NA	NA	14	NIL	NIL
9	931081	35	MENO,DYS	ENLARGED	ENLARGED	8	7	NA	NA	NA	NA	14	NIL	NIL
10	914229	32	MENO,DYS	NORMAL	NORMAL	12	13	NA	NA	NA	NA	9	NIL	NIL
11	904055	34	MENO	ENLARGED	ENLARGED	7	9	NA	NA	NA	NA	13	NIL	NIL
12	789456	42	MENO	NORMAL	NORMAL	6	7	NA	NA	NA	NA	9	NIL	NIL
13	924424	47	MENO	NORMAL	NORMAL	5	4	NA	NA	NA	NA	3	NIL	NIL
14	44578	34	POLY	NORMAL	NORMAL	6	6	NA	NA	NA	NA	5	NIL	NIL
15	46321	54	MENO	NORMAL	NORMAL	4	4	NA	NA	NA	NA	6	NIL	NIL
16	48245	53	METRO	NORMAL	NORMAL	3	4	NA	NA	NA	NA	8	NIL	NIL
17	57501	43	MENO	NORMAL	NORMAL	6	7	NA	NA	NA	NA	9	PRESENT	PRESENT
18	39654	61	MENO	NORMAL	NORMAL	4	5	NA	NA	NA	NA	10	NIL	NIL
19	567804	45	POLY	NORMAL	NORMAL	8	8	NA	NA	NA	NA	7	NIL	NIL
20	66380	67	MENO	NORMAL	NORMAL	4	3	NA	NA	NA	NA	8	NIL	NIL
21	47895	56	MENO	NORMAL	NORMAL	6	5	NA	NA	NA	NA	5	PRESENT	PRESENT
22	56798	55	METRO	NORMAL	NORMAL	8	6	NA	NA	NA	NA	6	NIL	NIL
23	98756	42	MENO	NORMAL	NORMAL	7	4	NA	NA	NA	NA	8	PRESENT	PRESENT
24	137856	62	POLY	NORMAL	NORMAL	6	7	HYPERECHOIC	VASCULAR	HYPO	NA	8	NIL	NIL
25	134257	46	MENO	NORMAL	NORMAL	7	7	NA	NA	HYPO	NA	7	NIL	NIL
26	143256	39	MENO	NORMAL	NORMAL	6	5	HYPERECHOIC	VASCULAR	HYPO	NA	5	NIL	NIL
27	76669	40	MENO	ENLARGED	ENLARGED	NA	4	NA	NA	NA	NA	5	NIL	NIL
28	69463	48	MENO	NORMAL	NORMAL	5	6	NA	NA	NA	NA	6	NIL	NIL
29	931080	27	POLY	NORMAL	NORMAL	NA	2	NA	NA	NA	NA	8	NIL	NIL
30	62010	54	MENO	ENLARGED	ENLARGED	7	6	NA	NA	NA	NA	9	NIL	NIL
31	73988	50	METRO	NORMAL	NORMAL	8	8	NA	NA	NA	NA	10	NIL	NIL
32	80118	38	MENO	ENLARGED	ENLARGED	5	6	NA	NA	NA	NA	7	NIL	NIL
33	921157	46	MENO	NORMAL	NORMAL	NA	NA	NA	NA	NA	NA	8	NIL	NIL
34	23365	57	POLY	NORMAL	NORMAL	4	3	NA	NA	NA	NA	5	NIL	NIL
35	66524	50	MENO	ENLARGED	ENLARGED	4	5	NA	NA	NA	NA	6	NIL	NIL
36	75543	45	MENO	ENLARGED	ENLARGED	NA	2	NA	NA	NA	NA	8	NIL	NIL
37	36751	52	METRO	NORMAL	NORMAL	NA	NA	NA	NA	NA	NA	5	NIL	NIL
38	48069	41	MENO	ENLARGED	ENLARGED	3	3	NA	NA	NA	NA	6	NIL	NIL
39	49707	58	POLY	ENLARGED	ENLARGED	5	4	NA	NA	NA	NA	8	NIL	NIL
40	50485	58	MENO	NORMAL	NORMAL	NA	NA	NA	NA	NA	NA	8	NIL	NIL
41	51047	50	MENO	ENLARGED	ENLARGED	4	5	NA	NA	NA	NA	7	NIL	NIL
42	80031	49	METRO	ENLARGED	ENLARGED	6	6	NA	NA	NA	NA	5	NIL	NIL
43	83879	43	MENO	NORMAL	NORMAL	4	3	NA	NA	NA	NA	5	NIL	NIL
44	83380	45	METRO	NORMAL	NORMAL	4	4	NA	NA	NA	NA	6	NIL	NIL
45	54303	52	MENO	NORMAL	NORMAL	NA	3	NA	NA	NA	NA	5	NIL	NIL
46	86978	41	MENO	ENLARGED	ENLARGED	3	5	NA	NA	NA	NA	6	NIL	NIL
47	55128	58	POLY	ENLARGED	ENLARGED	3	4	NA	NA	NA	NA	8	NIL	NIL
48	52674	58	MENO	ENLARGED	ENLARGED	5	7	NA	NA	NA	NA	5	NIL	NIL

MYOMETRIUM										CERVIX				STAGING IF ANY	USG DIAGNOSIS	MRI DIAGNOSIS	HPE	FINAL DIAGNOSIS	FINAL DIAGNOSIS
USG	MRI	MYOMETRIAL LESION		LOCATION						LESION							METHOD		
		NUMBER		SUBSEROSAL		SUBMUCOSAL		INTRAMURAL		USG		MRI							
		USG	MRI	USG	MRI	USG	MRI	USG	MRI	ECHOGENICITY	CDI	INTENSITY	DWI						
NORMAL	INVASION	0	0	0	0	0	0	0	0	0	NIL	0	0	Ib	ENDOMETRIAL CA	Endometrial CA	D&C	ENDOMETRIAL CA	ENDOMETRIAL CA
NORMAL	NORMAL	0	0	0	0	0	0	0	0	0	NIL	0	0	Ia	ENDOMETRIAL HYPERPLASIA	Endometrial CA	D&C	ENDOMETRIAL CA	ENDOMETRIAL CA
INVASION	INVASION	0	0	0	0	0	0	0	0	3	NIL	T1 HYPO, T2-HYPER	R	2A	ENDOMETRIAL CA	Endometrial CA	D&C	ENDOMETRIAL CA	ENDOMETRIAL CA
HETERO	HETEROGENOUS	0	0	0	0	0	0	0	0	0	NIL	0	0		ADENOMYOSIS	ADENOMYOSIS	HYSTERECTOMY	ADENOMYOSIS	ADENOMYOSIS
NORMAL	HETEROGENOUS	0	0	0	0	0	0	0	0	0	NIL	0	0		NORMAL	ADENOMYOSIS	HYSTERECTOMY	ADENOMYOSIS	ADENOMYOSIS
HETERO	HETEROGENOUS	0	0	0	0	0	0	0	0	0	NIL	0	0		ADENOMYOSIS	ADENOMYOSIS	HYSTERECTOMY	ADENOMYOSIS	ADENOMYOSIS
HETERO	HETEROGENOUS	0	0	0	0	0	0	0	0	0	NIL	0	0		ADENOMYOSIS	ADENOMYOSIS	HYSTERECTOMY	ADENOMYOSIS	ADENOMYOSIS
NORMAL	HETEROGENOUS	0	0	0	0	0	0	0	0	0	NIL	0	0		NORMAL	ADENOMYOSIS	HYSTERECTOMY	ADENOMYOSIS	ADENOMYOSIS
HETERO	HETEROGENOUS	0	0	0	0	0	0	0	0	0	NIL	0	0		ADENOMYOSIS	ADENOMYOSIS	HYSTERECTOMY	ADENOMYOSIS	ADENOMYOSIS
NORMAL	FOCAL HETEROGENOUS	0	0	0	0	1	0	0	0	0	NIL	0	0		1 SUBMUCOSAL	FOCAL Adenomyosis	HYSTERECTOMY	FOCAL ADENOMYOSIS	FOCAL ADENOMYOSIS
HETERO	HETEROGENOUS	0	0	0	0	0	0	0	0	0	NIL	0	0		ADENOMYOSIS	ADENOMYOSIS	HYSTERECTOMY	ADENOMYOSIS	ADENOMYOSIS
NORMAL	HETEROGENOUS	1	0	0	0	1	0	0	0	0	NIL	0	0		1 SUBMUCOSAL	FOCAL ADENOMYOSIS	HYSTERECTOMY	FOCAL ADENOMYOSIS	FOCAL ADENOMYOSIS
NORMAL	NORMAL	0	0	0	0	0	0	0	0	0	VASCULAR	0	0	II A	CA CERVIX	CA CERVIX	D&C	CA CERVIX	CA CERVIX
NORMAL	NORMAL	0	0	0	0	0	0	0	0	0	VASCULAR	0	0	IIB	CA CERVIX	CA CERVIX	D&C	CA CERVIX	CA CERVIX
NORMAL	NORMAL	0	0	0	0	0	0	0	0	0	VASCULAR	0	0	IIIA	CA CERVIX	CA CERVIX	D&C	CA CERVIX	CA CERVIX
NORMAL	NORMAL	0	0	0	0	0	0	0	0	0	VASCULAR	0	0	IIIB	CA CERVIX	CA CERVIX	D&C	CA CERVIX	CA CERVIX
NORMAL	NORMAL	0	0	0	0	0	0	0	0	0	VASCULAR	0	0	IV A	CA CERVIX	CA CERVIX	D&C	CA CERVIX	CA CERVIX
NORMAL	NORMAL	0	0	0	0	0	0	0	0	0	VASCULAR	0	0	IIIC	CA CERVIX	CA CERVIX	D&C	CA CERVIX	CA CERVIX
NORMAL	NORMAL	0	0	0	0	0	0	0	0	0	VASCULAR	0	0	IIIB	CA CERVIX	CA CERVIX	D&C	CA CERVIX	CA CERVIX
NORMAL	NORMAL	0	0	0	0	0	0	0	0	0	VASCULAR	0	0	IIIA	CA CERVIX	CA CERVIX	D&C	CA CERVIX	CA CERVIX
NORMAL	NORMAL	0	0	0	0	0	0	0	0	0	VASCULAR	0	0	IIB	CA CERVIX	CA CERVIX	D&C	CA CERVIX	CA CERVIX
NORMAL	NORMAL	0	0	0	0	0	0	0	0	0	VASCULAR	0	0	IVA	CA CERVIX	CA CERVIX	D&C	CA CERVIX	CA CERVIX
NORMAL	NORMAL	0	0	0	0	0	0	0	0	0	VASCULAR	0	0	IIIB	CA CERVIX	CA CERVIX	D&C	CA CERVIX	CA CERVIX
NORMAL	NORMAL	0	0	0	0	0	0	0	0	0	NIL	0	0		1-POLYP	1-POLYP	POLYPECTOMY SPECIMEN	POLYP	POLYP
NORMAL	NORMAL	0	0	0	0	1	0	0	0	0	NIL	0	0		SUBMUCOSAL FIBROID	1-POLYP	POLYPECTOMY SPECIMEN	POLYP	POLYP
NORMAL	NORMAL	0	0	0	0	0	0	0	0	0	NIL	0	0		2- POLYP	3- POLYP	POLYPECTOMY SPECIMEN	POLYP	POLYP
HETERO	HETEROGENOUS	2	3	0	1	0	0	2	2	0	NIL	0	0		2 INTRAMURAL FIBROIDS	2 INTRAMURAL & 1 SUBSEROSAL	HYSTERECTOMY	2 INTRAMURAL & 1 SUBSEROSAL	2 INTRAMURAL & 1 SUBSEROSAL
HETERO	HETEROGENOUS	5	7	0	0	0	0	5	7	0	NIL	0	0		5 INTRAMURAL	7 INTRAMURAL	HYSTERCTOMY	7 INTRAMURAL	7 INTRAMURAL
HETERO	HETEROGENOUS	2	2	2	2	0	0	0	0	0	NIL	0	0		2 SUB SEROSAL	2 SUBSEROSAL	HYSTERCTOMY	2 SUBSEROSAL	2 SUBSEROSAL
HETERO	HETEROGENOUS	1	1	0	0	0	0	1	1	0	NIL	0	0		1 INTRAMURAL	1 INTRA MURAL	HYSTERCTOMY	1 INTRAMURAL	1 INTRAMURAL
HETERO	HETEROGENOUS	1	1	1	1	0	0	0	0	0	NIL	0	0		1- SUBSEROSAL	1- SUBSEROSAL	HYSTERCTOMY	1- SUBSEROSAL	1- SUBSEROSAL
HETERO	HETEROGENOUS	1	1	0	0	0	0	1	1	0	NIL	0	0		1 INTRAMURAL	1 INTRA MURAL	HYSTERCTOMY	1 INTRAMURAL	1 INTRAMURAL
HETERO	HETEROGENOUS	1	1	0	0	1	1	0	0	0	NIL	0	0		1 SUBMUCOSAL	1 SUBMUCOSAL	HYSTERCTOMY	1 SUBMUCOSAL	1 SUBMUCOSAL
HETERO	HETEROGENOUS	1	1	0	0	1	1	0	0	0	NIL	0	0		1 SUBMUCOSAL	1 SUBMUCOSAL	HYSTERCTOMY	1 SUBMUCOSAL	1 SUBMUCOSAL
HETERO	HETEROGENOUS	2	2	0	0	2	2	0	0	0	NIL	0	0		2 SUBMUCOSAL	2 SUBMUCOSAL	HYSTERCTOMY	2 SUBMUCOSAL	2 SUBMUCOSAL
HETERO	HETEROGENOUS	3	4	1	2	0	0	2	2	0	NIL	0	0		1 SUBSEROSAL, 2 INTRAMURAL	2 SUBSEROSAL, 2 INTRAMURAL	HYSTERCTOMY	2 SUBSEROSAL, 2 INTRAMURAL	2 SUBSEROSAL, 2 INTRAMURAL
HETERO	HETEROGENOUS	1	1	1	1	0	0	0	0	0	NIL	0	0		1- SUBSEROSAL	1- SUBSEROSAL	HYSTERCTOMY	1- SUBSEROSAL	1- SUBSEROSAL
HETERO	HETEROGENOUS	1	1	0	0	1	1	0	0	0	NIL	0	0		1 SUBMUCOSAL	1-SUBMUCOSAL	HYSTERCTOMY	1-SUBMUCOSAL	1-SUBMUCOSAL
HETERO	HETEROGENOUS	2	3	0	0	0	0	2	3	0	NIL	0	0		2 INTRAMURAL	3 INTRAMURAL	HYSTERCTOMY	3 INTRAMURAL	3 INTRAMURAL
HETERO	HETEROGENOUS	2	2	0	0	0	0	2	2	0	NIL	0	0		2 INTRAMURAL	2 INTRAMURAL	HYSTERCTOMY	2 INTRAMURAL	2 INTRAMURAL
HETERO	HETEROGENOUS	3	3	1	0	0	0	2	2	0	NIL	0	0		1 SUBSEROSAL, 2 INTRAMURAL	1 SUBSEROSAL, 2 INTRAMURAL	HYSTERCTOMY	1 SUBSEROSAL, 2 INTRAMURAL	1 SUBSEROSAL, 2 INTRAMURAL
HETERO	HETEROGENOUS	2	2	0	0	0	0	2	2	0	NIL	0	0		2 INTRAMURAL	2 INTRAMURAL	HYSTERCTOMY	2 INTRAMURAL	2 INTRAMURAL
HETERO	HETEROGENOUS	1	1	0	0	1	1	0	0	0	NIL	0	0		1 SUBMUCOSAL	1 SUBMUCOSAL	HYSTERCTOMY	1 SUBMUCOSAL	1 SUBMUCOSAL
HETERO	HETEROGENOUS	2	2	0	0	2	2	0	0	0	NIL	0	0		2 SUBMUCOSAL	2 SUBMUCOSAL	HYSTERCTOMY	2 SUBMUCOSAL	2 SUBMUCOSAL
HETERO	HETEROGENOUS	1	1	0	0	1	1	0	0	0	NIL	0	0		1 SUBMUCOSAL	1 SUBMUCOSAL	HYSTERCTOMY	1 SUBMUCOSAL	1 SUBMUCOSAL
HETERO	HETEROGENOUS	3	3	0	0	0	0	3	3	0	NIL	0	0		3 INTRAMURAL	3 INTRAMURAL	HYSTERCTOMY	3 INTRAMURAL	3 INTRAMURAL
HETERO	HETEROGENOUS	4	5	1	1	1	1	2	3	0	NIL	0	0		1 SUBMUCOSAL 1 SUBSEROSAL & 2 INTRAMURAL	1 SUBMUCOSAL 1 SUBSEROSAL & 3 INTRAMURAL	HYSTERCTOMY	1 SUBMUCOSAL 1 SUBSEROSAL & 3 INTRAMURAL	1 SUBMUCOSAL 1 SUBSEROSAL & 3 INTRAMURAL
HETERO	HETEROGENOUS	2	2	0	0	0	0	2	2	0	NIL	0	0		2 INTRAMURAL	2 INTRAMURAL	HYSTERCTOMY	2 INTRAMURAL	2 INTRAMURAL