ROLE OF ULTRASONOGRAPHY AND MRI IN OVARIAN MASS LESIONS: A PROSPECTIVE STUDY IN A HOSPITAL IN RURAL SOUTH INDIA

By

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Under the guidance of

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LIST OF ABBREVIATIONS

FOV	→	Field of View
GRE	→	Gradient sequence
MRI	→	Magnetic Resonance Imaging
CT	→	Computed Tomography
STIR	→	Short Tau Inversion Recovery sequence
T1WI	→	T1 weighted image
T2WI	→	T2 weighted image
TA	→	Time of acquisition
TE	→	Time to echo
TR	→	Time to repetition
USG	→	Ultrasonography
TAS	→	Transabdominal sonography
TVS	→	Transvaginal sonography

ABSTRACT

Background

Patients presenting with ovarian lesions are common in daily practice. It is third most common cause of cancer death in women in India. The incidence of ovarian tumors amongst gynecologic admissions varies from 1-3%. 75% of these are benign, 20% of ovarian lesions are malignant. The imaging modalities are used to identify and characterize ovarian lesions.

When a neoplasm is suspected, the main task is to differentiate benign from borderline and malignant ovarian lesions. Preoperative classification of an ovarian mass as benign or malignant is imperative for appropriate patient triage, referral, and management. Patients suspected of having ovarian lesions frequently undergo extensive testing to confirm malignancy and determine metastasis if any.

There is a need to analyze the pattern of ovarian tumors in rural South India along with imaging findings.

Objectives

- To evaluate the ovarian lesions with imaging findings [Ultrasonography, MRI and CT if required].
- To determine the accuracy of imaging findings compared with that of histopathological findings of the ovarian lesions.

Methods

1) All patients suspected to have ovarian mass lesions are included in this study. The consent of the patients will be taken prior to the investigation.

2) The cases for this study were collected from R.L. Jalappa Hospital and Research Center which is attached to Sri Devaraj Urs Medical College, Kolar which include evaluation of cases over a period of two years i.e. from December 2010 to December 2012 (30 cases).

3) The investigation will be performed with

- Transabdominal scan- SIEMENS SONOLINE G50, C5-2mhz
- Transvaginal scan- SIEMENS SONOLINE G50, EC9-4mhz
- MRI- SIEMENS 0.35 tesla MAGNETOM CI by taking plain and post contrast thin contiguous sections of pelvis in the axial, coronal and sagital planes.

4) Imaging findings will be correlated with postsurgical histopathological findings.

Statistical analysis was done using Microsoft Excel software.

Results

In 30 patients, 36 ovarian masses were found. Out of which 25[69%] are benign and 11 [31%] are malignant.

In our study, the youngest patient was 18 yrs old and the eldest patient was 66 yrs old.

In determining the origin of 36 masses sonography had poor agreement with the final diagnosis whereas MRI had excellent agreement.

Sonography could detect the origin of mass accurately in 29 (80.5%) masses.

MRI could detect the origin accurately in 34 (94.4%) masses.

In determining the tissue content of 36 masses sonography characterized 33/36 (91.6%) masses correctly. MRI correctly characterized 34/36 (94.5%) cases and tissue content was identified correctly.

The ovarian masses were diagnosed based on various ultrasound and MRI imaging characteristics. The various ovarian lesions diagnosed are simple cyst, serous cystadenomas, serous cystadenocarcinoma, mucinous cystadenoma, mucinous cystadenocarcinoma, endometrioma, cystic teratoma / teratoma, fibroma, dysgerminoma, malignant germ cell tumor.

Conclusion

The clinical and radiologic diagnosis of the specific nature of an ovarian mass can be difficult. This is due in part to the large number of pathologic conditions that can affect the ovary but is also related to the similar clinical presentations and radiologic appearances of the various ovarian masses. The study has show that ultrasound, which currently is the initial imaging modality in the investigation of pelvic pathology, is inaccurate in characterizing few ovarian lesions and can confidently identify the tissue of origin of the lesion in only 80.5% of cases. MRI is significantly superior to US in all

respects due to the excellent soft tissue contrast and organ-specific information generated in the pelvis. The tissue contrast provided by MRI in the pelvis results specific technique-based advantages. Hence, we suggest that all patients with a pelvic abnormality identified on US or in whom there is a strong clinical suspicion of disease should undergo MR pelvic imaging because of its better soft tissue resolution and multi-planar capability resulting in higher accuracy rates.

Keywords

Ultrasonography, MRI Pelvis, Benign and Malignant ovarian lesions

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INTRODUCTION

The Ovary is unique in the range and variety of tumors that arise from it and in the number of malignant tumors from the primary site that metastasize to it. As it is a deep-seated organ, pathology of the ovary is the most difficult gynaecologic disease to evaluate clinically.

Ovarian tumors are common forms of neoplasia in women. Ovarian tumors account for about 30% of female genital cancers.[1] Asian countries have rate of 2-6 new cases per 1,00,000 women per year.[2] Ovarian carcinoma is the fourth most common female cancer and the fourth leading cause of death among cancer deaths in female.[3-5]

It accounts for 25% of all gynaecologic malignancies and cause 47% of all deaths due to gynaecologic cancer. Because there are a few clinical symptoms, 60-70% of patients have distant metastasis at the time of diagnosis. Mattingly sums up the problem nicely: "Of all gynaecologic disease, tumours of the adnexa pose the most difficult of all diagnostic problem and offer the best reward for the greatest therapeutic effort. Strongly, the ovarian tumours, which appear most frequently are usually physiologic in organ, produce acute symptoms, and receive the most radical of all surgical treatments. In contrast, malignant tumours of the ovary are the most lethal of all gynaecologic tumours and usually remain silent until unbeatable". Diagnosis of ovarian tumours at the earliest is highly desirable.

These tumors behave in diverse way and generally escape the detection until they attain a larger size. Diagnosis of various patterns of ovarian tumors is very important in the treatment and prognosis.

Ultrasonography is extensively used by radiologists and sonologists to detect or assess gynaecologic disease. It provides an important tool in diagnosing different types of ovarian tumours and detection of early ovarian cancer. Recent improvements including gray scale imaging technology, real time imaging, high frequency focused transducer and low level echo enhancement now permit improved resolution and detailed tissue characterization.[6] Transabdominal sonography (TAS) can confirm the presence of the pelvic masses and help to document the origin of the mass and determine whether it is uterine, adnexal or gut related. The ultrasound examination also provides information about the size of the mass and its consistency: cystic, solid or mixed; unilocular or multilocular which can help to determine its management. Detection of early ovarian cancer has been encouraging but specifically has been limited.

Development of transvaginal sonography (TVS) since the mid- 1980's has added another level of sophistication to this evaluation by better characterizing the mass, thus improving diagnostic specificity or at least narrowing the differential diagnosis considerably. Transvaginal sonography has the advantage of additional information about the internal architecture or anatomy of the mass. The advantages of this approach are two-fold: Firstly, the ultrasound transducer is closer to the object of interest and not separated from them by layers of fat and muscle. The pelvic organ can therefore, be

studied with higher ultrasound frequencies, producing images of greater resolution and enhanced qualities secondly the need for a full bladder is obviated.[6]

On the other hand, there are some disadvantages to TVS. It is invasive and postmenopausal vaginal atrophy may limit access to patient acceptability. The high ultrasound frequencies provide improved resolution, but decreased penetration over 10 centimeters. Thus, ovaries situated high or lateral in the pelvis, may not be seen on transvaginal scan. Co-incident abdominal palpation or bimanual pelvic examination or transabdominal scan should ensure that such ovaries are detected.

One of the most common indications of transvaginal sonography is to characterize an adnexal mass better, suspected on transabdominal ultrasound.[7] TVS might also be performed when a mass is suspected on bimanual examination or when the ovaries are not visualized on transabdominal ultrasound. Studies are currently been undertaken to evaluate TVS as a means of screening for ovarian cancers.[8] Such studies will need to assess whether the increased resolution leads to reliable identification of post menopausal ovaries and changes associated with every ovarian cancer.[9] Recent studies have shown a very high sensitivity (>95%) in detecting early stage ovarian cancer of TVS.

Transabdominal ultrasound is usually performed before TVS in most cases, although in some it may be used as a replacement for transabdominal ultrasound. The transabdominal approach provides a global overview of the pelvis in a rapid manner, thus focusing the endovaginal study to particular areas of interest and decreasing the time of examination. Large masses and some normal ovaries are also better visualized with

transabdominal ultrasound than with transvaginal ultrasound. Most women prefer the opportunity to empty their urinary bladder before the endovaginal examination.

More recently, colour and pulsed Doppler sonography have been advocated for distinguishing benign from malignant ovarian masses. Support is based on the premise that malignant masses, because of internal neovascularization, will have high diastolic flow that can be detected on spectral Doppler wave forms. However, numerous subsequent articles have been unable to reproduce such high sensitivity and specificity and have shown considerable overlap between benign and malignant lesions. Some reports have compared the morphologic features on sonography with the Doppler findings and found the Doppler did not add any more diagnostic information than did morphologic assessment alone. Others have found that Doppler, when added to sonographic morphologic assessment, improves specificity and positive predictive value. Doppler is probably not needed if the mass has a characteristic benign morphology, as sonography is highly accurate in this group of lesions. Doppler may be of value in assessing the mass that is morphologically indeterminate or suggestive of malignancy.

Advances in imaging technology have provided computed tomography (CT) and magnetic resonance imaging (MRI) as newer non-invasive methods for imaging. CT may prove valuable in the primary diagnosis of pelvic tumours where obesity, previous surgery or an unstable bladder precludes satisfactory ultrasound imaging. It is also valuable in the staging of malignant ovarian tumours. Contrast enhancement may help differentiate the primary tumours from the uterus and assist in evaluating local invasion. CT is more accurate in demonstrating peritoneal seedling especially in the presence of

ascites. However, ultrasound is the primary imaging investigation of choice in most cases since it is both accurate and much cheaper than CT. CT utilizes X-ray radiation in imaging which limits its use in pregnancy and young patients.[10]

MRI is an important technique in evaluation of pelvic pathology due to its ability to obtain images with a high soft tissue contrast resolution and discrimination in multiple planes and it is now the primary technique of choice in staging of pelvic malignancy. It is very much expensive and is not widely available. A meta-analysis evaluating the incremental value for an indeterminate adnexal mass detected on gray-scale ultrasound determined that MRI with IV contrast administration provided the highest posttest probability of ovarian cancer when compared with CT, Doppler ultrasound, or MRI without contrast administration. MRI is useful for definitively diagnosing many common benign adnexal lesions.

MRI is useful for definitively diagnosing many common benign adnexal lesions. MRI better characterizes indeterminate adnexal lesions seen on ultrasound and CT, especially if an extraovarian cystic lesion is suspected but a normal ipsilateral ovary is not seen and if a predominantly solid lesion requires more tissue- specific characterization for diagnosis. Cystic extraovarian lesions include peritoneal inclusion cysts, paratubal cysts, and hydrosalpinx.

Solid-appearing adnexal lesions include dermoids, exophytic uterine and broad ligament fibroids, and ovarian fibrothecomas. MRI is well known to provide accurate information about hemorrhage, fat, and collagen. It is able to identify different types of

tissue contained in pelvic masses, distinguishing benign from malignant ovarian tumors, with an overall accuracy of 88% to 93%.

Finally, MRI is a valuable tool in characterizing a complex cystic ovarian mass as an endometrioma and may detect signs of relatively rare malignant degeneration within it.[11]

The goal of imaging in ovarian cancer detection is to expeditiously distinguish benign adnexal lesions from those requiring further pathologic evaluation for malignancy. Ultrasonography is considered to be the best, simple, rapid, widely available and inexpensive modality of choice for imaging of ovarian tumours. It has proved itself to be highly efficient in reducing unnecessary operation and also in the detection and screening of early ovarian cancers. For lesions indeterminate on ultrasound, MRI increases the specificity of imaging evaluation, thus decreasing benign resections.

AIMS AND OBJECTIVES

1. To evaluate the ovarian lesions with imaging findings [Ultrasonography, MRI and CT if required].

2. To determine the accuracy of imaging findings compared with that of histopathological findings of the ovarian lesions.

DEVELOPMENT OF THE OVARY

The ovary is developed on either side from the genital (or) gonadal ridge. This ridge is formed in a four week embryo between the dorsal mesentry and the mesonephros by the multiplication of the coelomic epithelium along with condensation of the underlying mesenchyma.[12]

The cortex and the covering epithelium are developed from the coelomic epithelium and the medulla from the mesenchyma. The germ cells are of endodermal origin. They migrate from the yolk sac to the genital ridge along the dorsal mesentry by amoeboid movement between 20 and 30 days. The germ cells undergo a number of rapid mitotic division and differentiates into oogomia. The number of oogonia reaches its maximum at 20^{th} week numbering about seven million. The mitotic division gradually ceases and majority enter into the prophase of first mitotic division and are called primary oocytes. These are surrounded by flat cells (granulosa cells) and are called primodial follicles. At birth, there is no more mitotic division and all oogonia are replaced by primary oocytes. The estimated number at birth is about two million.[13]

This drops to few hundred at puberty. This process of degeneration continues throughout child bearing period with the result that no ovum can be detected in the ovaries of a woman who was attained menopause.[12]

THE ANATOMY OF THE OVARY [Fig 1 & 2]

The ovaries are situated one on each side of the uterus close to the lateral pelvic wall, they are attached to the posterior-superior aspect of the broad uterine ligament, postero-inferior to the uterine tube.

The ovaries are grayish pink and smooth before the ovulation begins but thereafter are distorted by degeneration of successive corpora lutea.

The ovaries are almond shaped about 3 cm long, 1.5 cm wide and 1 cm thick. It has lateral and medial surfaces, tubal and uterine extremities and meso-ovarian and free borders. It occupies the ovarian fossa, on the lateral pelvic wall bounded anteriorly by obliterated umbilical artery and posteriorly by ureter and internal iliac artery. To the tubal (superior) extremity, near the external iliac vein, are attached the ovarian fimbria of the uterine tube and a peritoneal ovarian suspensory ligament which contains the ovarian vessels and nerves and passes over the external iliac vessels.

The uterine extremity faces downwards towards the pelvic floor.

The lateral surface is in contact with the parietal peritoneum in the ovarian fossa and the uterine tube largely covers the medial surface.

The meso-ovarian border is straight and facing the obliterated umbilical artery. The convex free border faces the ureter.[14]

Blood supply and lymphatic drainage

The ovarian artery, a branch of abdominal aorta runs along the anterior border of the ovary and finally.[14]

THE HISTOLOGY OF OVARY

The surface of the ovary is covered, in young females by a layer of cuboidal cells which flattens in later life. This is the germinal epithelium.

After puberty the ovary has a thick cortex containing ovarian follicles and corpora lutea surrounding a vascular medulla except at the hilum. The dense cortical stroma contains woven reticular fibres and many fusiform cells resembling non-striated myocytes. Medullary stroma consists of looser connective tissue with many elastin fibres, non striated myocytes and numerous blood vessels, particularly veins. Beneath the germinal epithelium, the cortical connective tissue condenses into a delicate tunica albuginea increasing in density with age.[15]

During the child bearing period the cortex contains ovarian follicles, corpora lutea and atretic follicles.[15]

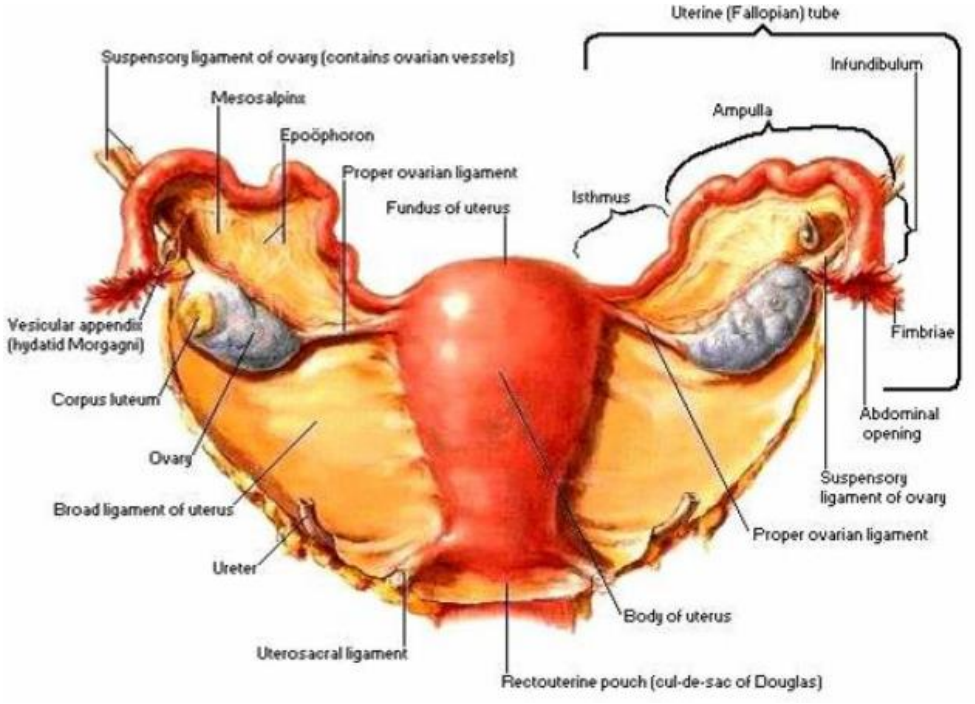


Fig. 1: Diagrammatic representation of uterus and adnexa: Posterior view

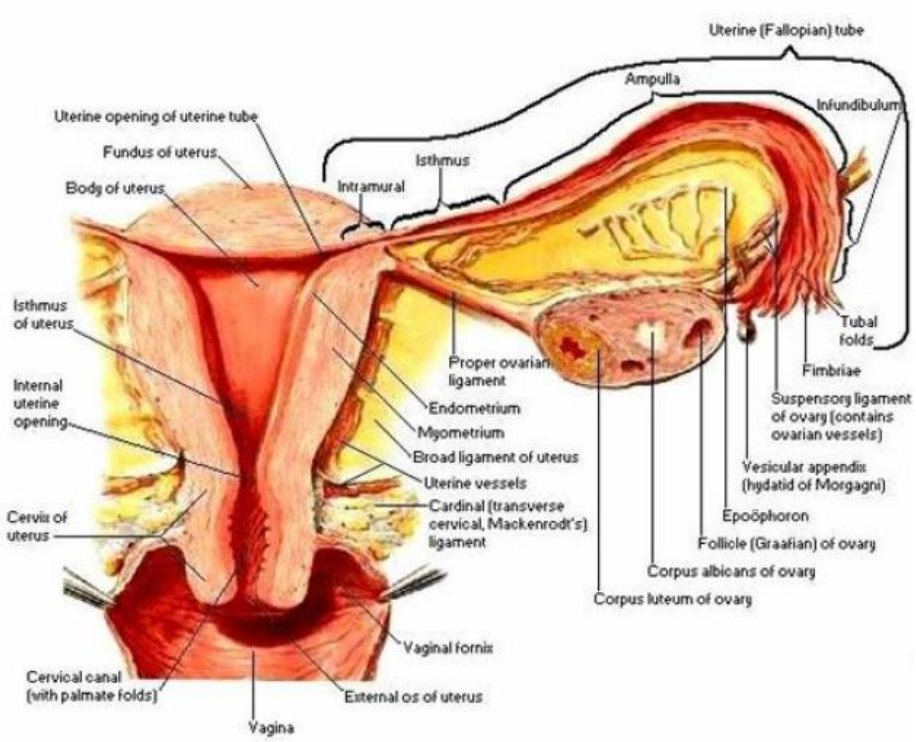


Fig. 2: Diagrammatic representation of uterus and adnexa: Frontal view

IMAGING

USG

The ovaries [**Fig. 3**] can usually be identified in the adnexal areas and in the adults it is possible to see upto five or six small transsonic follicles within the low level echoes of the stroma.

However, if the ovaries lie in the pouch of Douglas it may not be possible to identify them. It is normal to see a small amount of fluid in the pouch of Douglas towards the end of the menstrual cycle.

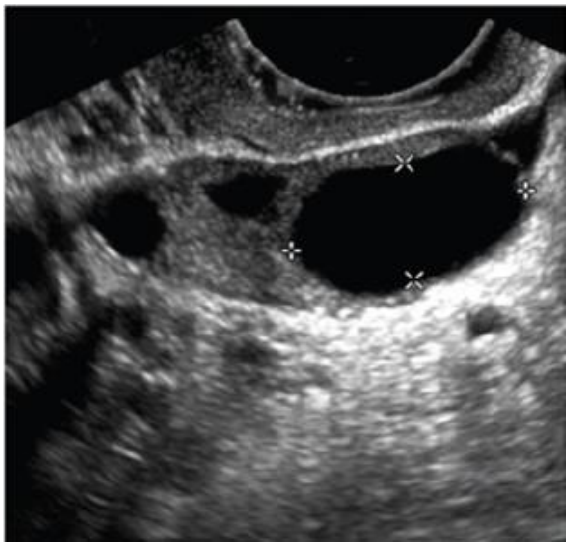


Fig 3: USG image showing normal ovary with few follicles

CT

It is not usually possible to recognize the ovaries unless they are enlarged or contain cysts.

MRI

Normal ovaries can be identified in up to 85% of women of reproductive age. They are low to medium signal on T_1weighted images and higher signal on T_2-weighted images, where a low signal intensity rim occasionally surrounds them. Follicles stand out as hyper intense foci. The broad ligament is often identified as a low signal intensity band running laterally, while the round ligament runs anterolaterally to the inguinal canal.

HISTORICAL PERSPECTIVE

ULTRASOUND

Probably the first successful application of ultrasound to medical diagnoses was reported by the Austrian physician, Karl Dussik, and his physicist brother, Frederick. During 1947-1948, the Dussiks introduced hyperphonography that produced what they believed were ventriculograms, or echo pictures of the ventricles of the brain.

However, four years later (1952), Guttner in Germany showed that this technique actually did not image the ventricles at all but was merely showing variations in attenuation caused by the overlying skull.

In the United States, George Ludwig (1949) experimented with the detection of gall stones and foreign bodies embedded in tissues. He investigated fundamental problems in the physical interaction of ultrasound waves and tissues with the intent of determining their characteristic acoustic properties.

At the University of Minnesota, an Englishman, John J Wild attempted to use ultrasound to measure the thickness of the intestinal wall. He showed that different echo patterns would be obtained from each of the different layers of the intestinal specimen. Of greater importance was the discovery that echoes from tumour invaded tissue was distinguishable from those produced by normal tissue.

In collaboration with engineer, John M. Reid, Wild developed a two dimensional B- mode scanning system. For breast scanning, Wild introduced the first hand held "contact" scanner. Sonic contact was achieved by the use of an aqueous jelly, in contrast to the immersion bath or enclosed water tanks employed by other pioneers of contact scanning. Wild also developed both rigid and flexible probes for transrectal and transvaginal scanning.

In Colorado, Douglas Howry began investigating the idea that ultrasound beams directed into the body would be reflected from tissue interfaces. Scans were made with the transducer immersed in water, which permitted transmission of the sound waves to the object being examined. Howry and Co-workers completed in 1962, the construction of a compound contact scanner. The transducer, mounted within the scanning head was capable of continuous contact with the patient's body surface and could pivot at any point within the cross-sectional plane of the scan.

Using different approaches, the Howry-Holmes and Wild-Reid groups provided invaluable contribution to the development of diagnostic ultrasound.

CT SCAN

Computed Tomography was first introduced in 1972 by Godfrey Hounsfield for which he received a Nobel Prize.

The principle of CT evolved from the work of an Austrian Mathematician, Radon, who demonstrated in 1917 that the image of a three-dimensional object could be reconstructed from an infinite number of two-dimensional projections of the object.

In Hounsfield's initial experiments using a gamma-ray source, it took 9 days to acquire the data and 2.5 hours to reconstruct the image on a large main frame computer. Replacing the gamma ray source with an X-ray tube reduced the scanning time to 9 hours. With this apparatus, Hounsfield was able to differentiate between gray and white matter.

The first clinical prototype EMI head scanner was installed in early 1972 at Atkinson Morley's Hospital, London and an improved version was soon introduced. The acquisition of data took 4.5 minutes. Another 1.5 minutes were required to reconstruct images. The EMI scanner was designed for brain scanning and its applications were limited to the head.

In the United States, a dentist named Ledley became intrigued with the possibility of applying the technique to other regions of the body. He parlayed this interest into funding for construction of the first whole-body scanner. The first clinical unit was named the ACTA Scanner and installed at the University of Minnesota in 1973. However, anatomical motion remained a significant problem in the application of the scanner to regions other than the head and extremities.

Since the development of first generation CT scanners, the major technical advances have been designed to dramatically increase the speed of scanning and image reconstruction.

The fastest second generation CT units could achieve a scanning time of 18 second per slice. The image quality was substantially improved over the mark first generation scanner. However, the second generation units had definite speed limitations resulting from the inertia of the heavy X-ray tube and gantry, as well as the use of the complicated translate-rotate motion.

To increase speed, third and fourth generation systems were developed. The major difference between the third and fourth generation rotational scanners is the motion of the detectors. In the third generation system, the X-ray tube and detector array are mounted opposite one another and pivot around the patient. In fourth generation systems, the detector array is stationary and only the X-ray tube rotates through a circle. Both third and fourth generation scanners can obtain individual slices in 2 to 4 seconds.

A variation of the fourth generation design is the "ultrafast" CT scanners. Designed by Douglas Boyd and collaborators at Imatron for the purpose of imaging of the heart this unit has no moving parts and can acquire and image in as little as 17 msec, virtually free of motion artifacts.

MRI

Magnetic resonance imaging (MRI) was introduced into clinical medicine in 1981, and in short time since then it has assumed a role of unparallel importance in diagnostic imaging. Over the past 15 years, MRI has emerged from the research laboratory to take its place as a premier imaging modality.

Magnetic resonance is a phenomenon involving magnetic fields and radio frequency (RF) electromagnetic waves. It was discovered in 1946 independently by Bloch and co-workers at Stanford and by Purcell at Harvard.

In 1971, Raymond Damadian reported on the capability of NMR spectroscopy to differentiate between healthy and cancerous tissues. In 1973, Paul Lauterber developed and produced the first MRI image using thin-walled capillary tubes of water and deuterium. In 1976, Damadian and his colleagues produced the first MRI image of a live animal. The following year the first human image, depicting a crude representation of the thorax at the T8 level, was published by Damadian and his coworkers.

Moore and Hinshaw produced the first recognizable images of the human brain. MRI can produce images with excellent contrast between soft tissues and a high spatial resolution in every direction. MRI has been a useful tool for analytical chemistry and biochemistry, thanks to the discovery of chemical shift. Similar to other imaging modalities, MRI uses electromagnetic radiation to probe inside the human body. MRI can produce images with excellent contrast between soft tissues and a high spatial resolution in every direction.

MR examinations of the pelvis for ovarian pathology are usually using the body coil. The standard imaging protocol comprises T1 weighted spin echo sequences, T2 weighted fast spin echo sequences, fat saturation, gradient and post-contrast T1 weighted spin echo sequences. Gadolinium-DTPA is the contrast administered intravenously.

REVIEW OF LITERATURE

Ovarian tumours are extremely complicated and at times difficult to classify.

Sushruta has also mentioned these tumours in his book "Susruta Ayurveda".[16] In 1898, Pfannensteil for the first time gave a standard classification of ovarian tumours.[16] Spencer and Reel prepared a classification with a modification of Schiller's classification.[16] Novak in 1958 divided ovarian tumours into solid and cystic. Major classifications were given by Fox (1970), Langley (1973) and Scully.[17]

Mary Crofton[18] says that benign diseases should be investigated initially by ultrasound and then MRI rather than CT which is used to solve specific problems. Staging of malignant disease requires CT or MRI, depending on the site of primary tumour.

Whitehouse GH and Wright CH[19] are of the opinion that ultrasound of the female pelvic is routinely used to depict the normal pelvic and demonstrate both pathological and physiological changes in the structure. The ready availability of high resolution real-time scanners provides initial means of confirming and localizing a clinically suspected pelvic mass and, frequently a definite diagnosis.

Marcus J. Dill - Macky and Mostafa Atri[20] says that transvaginal sonography has revolutionized the ultrasonic pelvic examination and should now be considered a routine complimentary approach to any pelvic ultrasound referral. Transabdominal sonography

provides an overview of the pelvic contents and at times may demonstrate relevant structure that would be otherwise beyond the view of transvaginal probe.

Shia Salem[21] is of the view that sonography is commonly used to evaluate a pelvic mass. Occasionally it may be impossible to determine the exact origin of the mass by sonography and MRI may be helpful.

Kevin M. Sittig et al[22] are of the opinion that USG is useful in patients with acute abdominal pain because, it provides rapid, safe, low cost evaluation of abdominal and pelvic organs.

Dennis A. Sarti[23] is of the opinion that large pelvic masses can be difficult to separate on ultrasound. Various masses in the pelvic may have confusing appearances on ultrasound.

Satoskar P and Deshpande A[24] are of the view that ultrasonography is valuable in diagnosing functional and benign ovarian neoplasm and confirming diagnosis of ectopic pregnancy, if correlated with clinical findings.

Jeremy P. R. Jenkins[25] is of the view that MRI is well suited to the evaluation of the pelvis, providing high soft-tissue contrast resolution and clear anatomical depiction of the pelvic organ. MRI had become invaluable in the evaluation of malignant disease within the pelvis.

Valentin L[26] says that ultrasound is the first-line imaging method for discrimination between viable intrauterine pregnancy, miscarriage and tubal pregnancy in women with bleeding and/or pain in early pregnancy, for discrimination between benign and malignant adnexal masses and for making a specific diagnosis in adnexal tumors (e.g. dermoid cyst, endometrioma, hemorrhagic corpus luteum, etc.), for diagnosing intracavitary uterine pathology in women with bleeding problems, and for confirming or refuting pelvic pathology in women with pelvic pain. Magnetic resonance imaging can have a role as a secondary test in the diagnosis of adenomyosis, 'deep endometriosis' (e.g. endometriosis in the rectovaginal septum or in the uterosacral ligaments), and in the diagnosis of extremely rare types of ectopic pregnancy (e.g. in the spleen, liver or retroperitoneum).

Antonio Carlos A. Westphalen, Aliya Qayyum[27] are of the opinion that Ultrasound is the primary modality for the evaluation of an adnexal mass, and MRI is often used to further characterize indeterminate lesions, since it provides information about soft tissue masses.

Catherine Devine, Janio Szklaruk, Eric P. Tamm[28] are of the view that The evaluation of a pelvic mass often begins with the physical exam and proceeds to ultrasound, computed tomography, or magnetic resonance imaging. Each of these modalities has a role in the work-up of pelvic masses and each modality has inherent advantages and disadvantages.

Margaret H. Pui, Qiu Yan Wang, Bin Xu, Guo Ping Fan[29] are of the view that MRI is multiplanar, has large field of view, superior contrast resolution and no known adverse effect on the reproductive potential of ovaries. It is useful for characterizing solid, cystic or necrotic tissue, blood and fat. Contrast-enhanced MRI is also a comprehensive examination of the entire pelvis including lymph nodes, peritoneum, pelvic sidewalls, bone and muscles. It provides information about areas difficult to assess surgically, can refine staging classification, assists in planning surgery or radiotherapy and may be more cost-effective by limiting use of surgery.

Olson MC, Posniak HV, Tempany CM and Dudiak CM[30] are of the opinion that MR imaging may be more useful than clinical evaluation or other imaging modalities in diagnosing or staging developmental anomalies, leiomyomas, adenomyosis, endometrial or cervical carcinoma, vaginal neoplasms, ovarian cysts, endometriosis, teratomas, polycystic ovaries, or other ovarian masses. It could potentially replace laparoscopy as a more useful tool in the diagnosis of uterine anomalies. MR imaging is generally capable of helping determine whether a pelvic mass is uterine or adnexal in origin and may be used to characterize some adnexal masses.

Surratt JT and Siegel MJ[31] concluded from their study that among the various sonographic patterns observed, those of cystic ovarian masses and complex masses with mural nodules were the most specific, representing simple cysts and benign teratomas, respectively. Sonographic features of the remaining conditions were often similar, and diagnosis required correlation with clinical data and computed tomographic or magnetic resonance imaging findings.

Hedwig Hricak, Min Chen, Fergus V. Coakley, Karen Kinkel, Kyle K. Yu, Gregory Sica, Peter Bacchetti, and C. Bethan Powell[32] are of the view that Gadolinium-enhanced MR imaging depicted 176 (94%) of 187 adnexal masses, with an overall accuracy for the diagnosis of malignancy of 93%. The MR imaging findings that were most predictive of malignancy were necrosis in a solid lesion (odds ratio, 107) and vegetations in a cystic lesion (odds ratio, 40). Use of gadolinium-based contrast material contributed significantly to lesion characterization.

Komatsu T, Konishi I, Mandai M, Togashi K, Kawakami S, Konishi J, Mori T. (1996)[33] concluded from their study that both transvaginal US and gadolinium-enhanced MR imaging were highly sensitive in identification of solid components within an adnexal mass. Gadolinium-enhanced MR imaging was specific, whereas transvaginal US was non-specific for adnexal lesions.

Scoutt LM, McCarthy SM, Lange R, Bourque A, Schwartz PE in 1994 determined the sensitivity, specificity, predictive value, and accuracy of pelvic MRI in the prospective evaluation of women with a clinically suspected pelvic mass. Magnetic resonance was 100% sensitive and 99% specific in prospectively diagnosing dermoids, 96% sensitive and 100% specific in diagnosing subserosal leiomyomas, and 92% sensitive and 91% specific in diagnosing endometriomas. When physical examination or ultrasound examination is inconclusive, pelvic MRI can aid in the evaluation of women with a suspected pelvic mass.

Troiano RN, McCarthy S[34] have studied that MRI has become an important tool in the evaluation of the adnexal mass because of its multiplanar capability and undersurpassed soft tissue contrast. It is particularly effective in defining the origin of a pelvic mass. The recent development of fast spin-echo sequences along with new phased array coils have enabled higher resolution imaging in shortened imaging times. The result is improved characterization of adnexal masses, which often leads to specific diagnoses.

Seung Eun Jung, Jae Mun Lee, Sung Eun Rha, Jae Young Byun, Jung IM Jung and Seong Tai Hahn[35] concluded that certain radiologic findings predominate for each type of tumor. Epithelial tumors are primarily cystic and, when malignant, are associated with varying proportions of a solid component. Papillary projections are a distinctive feature of epithelial tumors. Profuse papillary projections are highly suggestive of borderline (low-malignant-potential) or malignant tumor. Ovarian teratomas demonstrate lipid material at computed tomography and magnetic resonance (MR) imaging. Malignant germ cell tumors manifest as a large, complex abdominal mass that contains both solid and cystic components. Tumor markers are helpful in diagnosis. The radiologic appearance of sex cord-stromal tumors varies from small solid masses to large multicystic masses. Granulosa cell tumors are usually large multicystic masses with solid components. Fibrothecoma, sclerosing stromal tumor, and Sertoli-Leydig cell tumors are usually solid masses. Fibromas have very low signal intensity on T2-weighted MR images.

OVARIAN NEOPLASMS

Classification of most common Primary Ovarian neoplasms[36]

1. Surface Epithelial-Stromal Tumors

    - Serous cystadenoma / carcinoma
    - Mucinous cystadenoma / carcinoma
    - Endometrioid
    - Clear cell
    - Transitional

2. Germ Cell tumors

    - Teratoma- Mature/ Immature / Monodermal / Mixed
    - Dysgerminoma
    - Yolk Sac tumor
    - Embryonal Carcinoma
    - Choriocarcinoma

3. Sex Cord-Stromal Tumors

    - Granulosa cell tumor
    - Thecoma-Fibroma group
    - Sertoli-Stromal Cell tumor

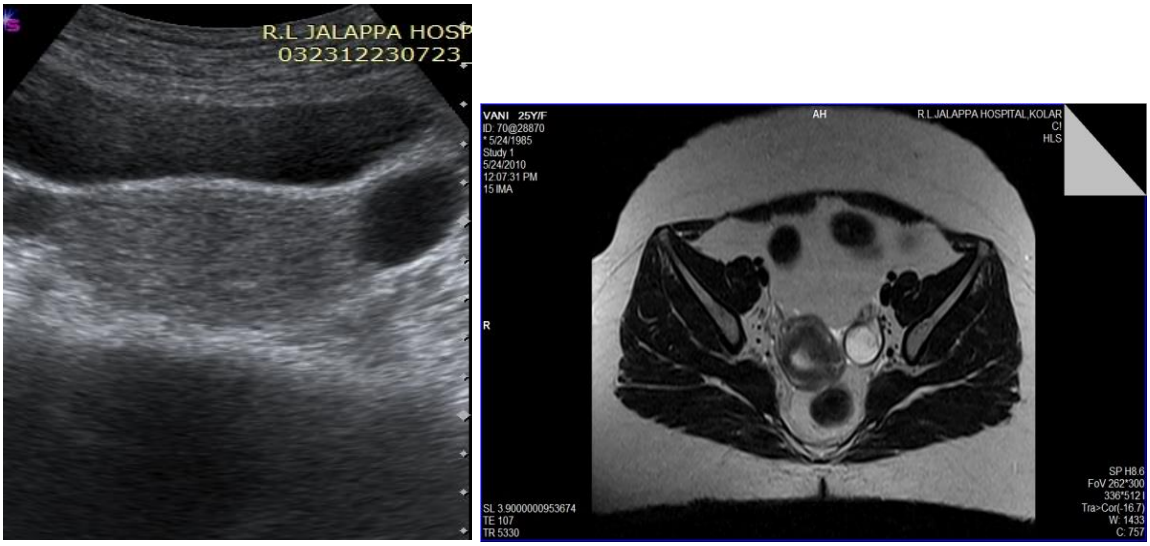
4. Metastatic tumors

    - Genital primary- uterus
    - Extragenital primary- stomach, colon, breast, lymphomas.

Functional Cysts

The management of adnexal masses in women of reproductive age remains a common clinical gynecologic problem. Most ovarian cysts are functional cysts (i.e., follicular cysts that result from a failure of the follicle to rupture or regress or corpus luteum cysts that derive from hemorrhage in a corpus luteum).[37,38] Simple cysts are generally thin-walled (<3 mm), unilocular cysts less than 3 cm in diameter. Corpus luteum cysts may enlarge secondary to internal hemorrhage and cystic transformation. Cysts larger than about 1 cm often represent corpus luteum cysts.[37, 39] Small simple cysts are common in postmenopausal patients.[40] A simple unilocular cyst **[Fig 4 A&B]** without solid components is highly unlikely to be malignant.[40, 41] At US, a functional ovarian cyst is typically anechoic with thin, smooth walls and posterior acoustic enhancement. Similar US characteristics may be seen in benign ovarian neoplasms such as serous cystadenomas. More complex appearances can be produced by hemorrhage in a corpus luteum cyst. Hemorrhagic cysts **[Fig 5 & Fig 6]** have a variety of appearances depending on the stage of evolution of the clot, but lacelike reticular echoes or an intracystic solid clot are most typical.[42,43] Complex cysts with such appearances should lead to follow-up US or further assessment with MR imaging. The most helpful feature in distinguishing functional cysts from ovarian neoplasms is the presence of papillary projections and nodular septa in the latter. [44,45,46,47] The reported blood flow detection rate in functional cysts has ranged from 19% to 61%; however, blood flow assessment at initial Doppler US is not useful in distinguishing functional ovarian cysts from ovarian neoplasms.[48,49,50,51]

Therefore, follow-up US remains the best approach for identifying functional cysts. Follow-up US to assess for cyst resolution is a useful initial study in cysts that are suspicious for hemorrhage and is appropriate in both premenopausal and postmenopausal women.[40,41,42,52] Most ovarian cysts have intermediate to low signal intensity on T1-weighted MR images and very high signal intensity on T2-weighted images owing to the presence of simple fluid. Cyst walls are thin and featureless on T1-weighted images, are usually clearly depicted on T2-weighted images, and enhance with the administration of gadolinium-enhanced contrast agent. Hemorrhagic corpus luteum cysts have relatively high signal intensity on T1-weighted images and intermediate to high signal intensity on T2-weighted images.[39, 53, 54] Corpus luteum cysts do not demonstrate the profound T2 shortening that is seen with many endometriomas.[39, 55]



A. **B.**

Fig. 4: Simple cyst: A-USG image showing simple cyst in left ovary. B- Axial MRI image showing a well defined round cystic lesion in left ovary

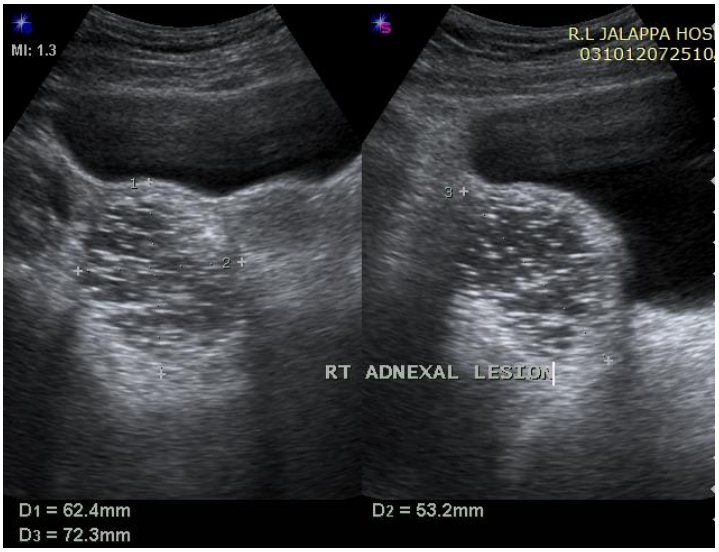
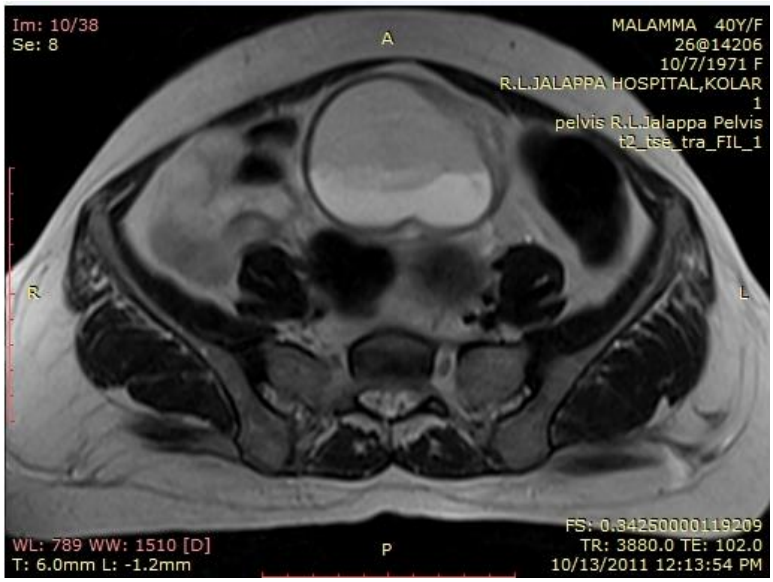


Fig 5: Hemorrhagic cyst: USG image of a 25year old woman was investigated abdominal pain which revealed a well defined hyperechoic lesion in the right adnexa

A



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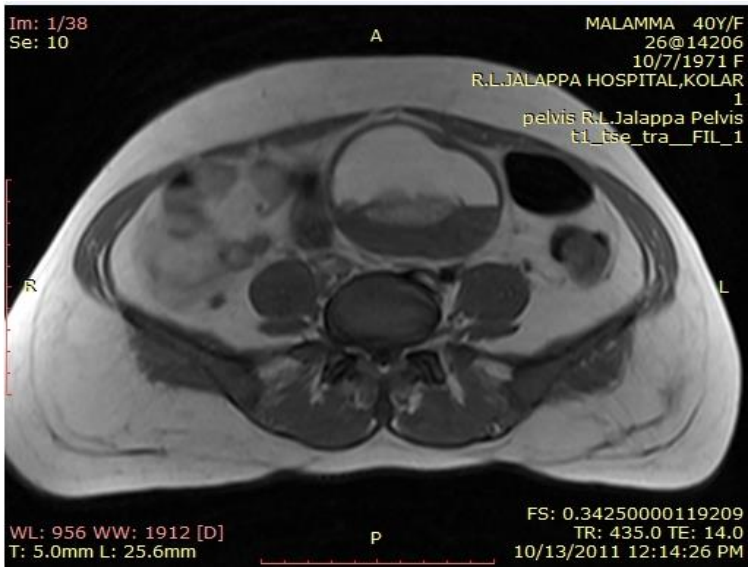


Fig. 6: Hemorrhagic cyst: A & B: MRI of the same patient showing a hyperintense lesion on T1WI and T2WI with fluid-fluid level. Patient was followed up for two months. The lesion completely resolved after 3 months.

Endometriomas [Fig 7 A&B]

Endometriosis is the presence of endometrial glands and stroma outside the uterus and is a common disease in women of childbearing age. Eighty percent of all pelvic endometriosis is found in the ovary.[56,57] Endometrioid cysts, or endometriomas, are usually small but can reach 15–20 cm in diameter. Endometriomas contain an obliterated, mostly endometrial gland lining.[56, 57] The walls of endometriomas are initially thin, but later they become fibrotic and thickened and may have an irregular external border.[58] At US, endometriomas appear as a cystic mass with diffuse, low-level echoes. They have a wide range of manifestations, from cystic to complex, and may have a solid appearance. Endometriomas may have thick internal septa; however, this finding is not common. Fluid-fluid or debris-fluid levels can be seen.[56,57,58]

Patel et al[43] found that cysts with diffuse, low-level internal echoes were highly likely to represent endometriomas if multilocularity or hyperechoic wall foci were present and features such as solid components were absent. Hyperechoic foci result from cholesterol clefts in the wall. CT is not generally useful for evaluating patients with endometriosis. Because of the infiltrative fibrotic wall, endometriomas and implants may mimic malignant disease.

One finding that may be helpful in a minority of cases is a hyperattenuating clot floating dependently within the cyst cavity. The most specific MR imaging findings in endometriomas are multiple cystic masses with high signal intensity on T1-weighted images and low signal intensity on T2-weighted images. On the basis of these criteria, the sensitivity and specificity of MR imaging in the diagnosis of endometrioma vary from

90% to 92% and from 91% to 98%, respectively.[55, 54,59,60,61] Low signal intensity on T2-weighted images is occasionally seen in functional ovarian cysts or adnexal masses other than endometriomas. Endometriomas acquire an iron concentration in their cyst contents many times higher than even that of whole blood.[62,63,64] This property gives them their characteristic appearance of very high signal intensity on T1-weighted images (similar to fat) and low signal intensity on T2-weighted images, a combination of findings not seen in pelvic hematomas at any stage of evolution.[65] Other possible MR imaging findings in endometriomas include high signal intensity on both T1- and T2-weighted images, adhesion to the surrounding organs, and a thickened, low-signal- intensity wall. However, these are nonspecific findings: The first finding may occur with hemorrhagic functional cysts as well as malignant ovarian lesions, whereas the second and third findings frequently also occur in women with pelvic inflammatory disease or a history of pelvic surgery.[54,66] Non-cystic endometrial implants may be especially difficult to define at MR imaging due to their small size, potential obscuration by artifact from bowel peristalsis, and occasional lack of differentiation from adjacent fat on contrast-enhanced images. Small hemorrhagic endometrial implants become more obvious on fat-saturated T1-weighted MR images.[66,59,67,68,69] Implants commonly manifest as solid masses with low signal intensity on T2-weighted images due to fibrosis surrounding the glandular islands.[66,67]

Epithelial Neoplasms

Epithelial ovarian neoplasms represent 60% of all ovarian neoplasms and 85% of malignant ovarian neoplasms. The two most common types of epithelial neoplasms are serous and mucinous tumors, although clear cell, endometrioid, Brenner, and undifferentiated tumors also fit into this category. All epithelial ovarian neoplasms can be classified as benign, borderline (i.e., having a low potential for malignancy), or malignant (carcinomas) on the basis of their histologic characteristics and clinical behavior.[70,71]
Benign forms of serous and mucinous tumor are common, but benign forms of endometrioid and clear carcinoma are rare. Features that are more suggestive of benign cystic neoplasm include unilocularity of cysts, thin walls, minimal septations, and absence of papillary projections.

Borderline tumors show more proliferation (papillary projections) than cystadenomas and may metastasize throughout the peritoneum but are not true malignancies. They are often seen in younger patients. The most important histologic feature that helps differentiate borderline tumors from carcinomas is the absence of stromal invasion.[70,72] Although borderline tumors have been reported in all the epithelial ovarian tumor subtypes, most are serous or mucinous type tumors.[70] Borderline tumors have better prognoses than higher-grade malignancies. The reported 5-year survival rate for women with borderline malignancies varies from 94% to slightly less than 90%.[73]
Epithelial neoplasms are typically primarily cystic, may be either unilocular or multilocular, and in malignant varieties are associated with varying proportions of a solid component.[74,75,76] In general, the cell type (e.g., serous, mucinous) cannot be determined on the basis of appearance at MR imaging, CT, or US. Profuse papillary projections,

which are often more clearly seen after contrast material enhancement, are highly suggestive of borderline or malignant tumors.[77,78,47,74,79]

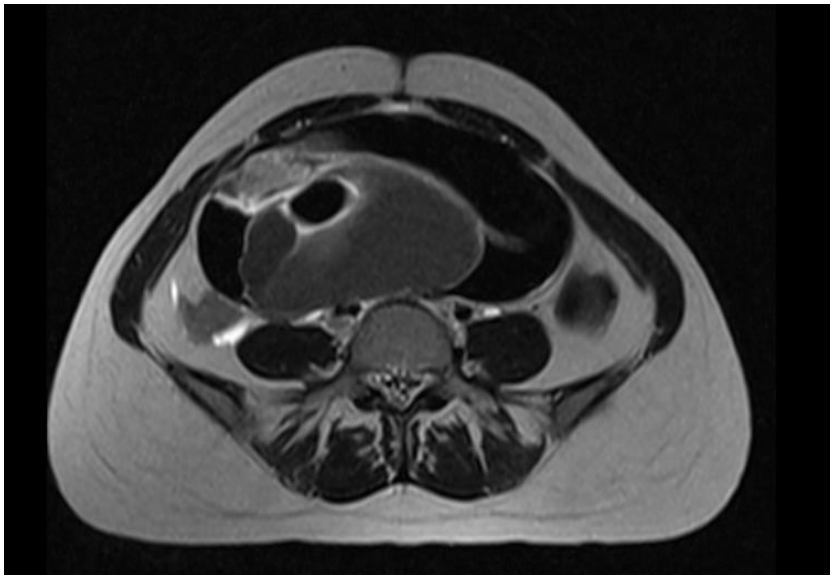
Pathologic and MR imaging studies have suggested that large papillary projections with no solid component indicate a borderline or malignant tumor.[47,71,80] Granberg et al[80,81] found papillary projections in 20%, 62%, and 92% of benign, borderline, and malignant cystic masses, respectively at pathologic examination. In one CT and MR imaging study, papillary projections were found in 9% of benign neoplasms, 67% of borderline neoplasms, and 38% of malignant neoplasms.[75]

Benign epithelial tumors demonstrate smaller, less numerous papillary projections than borderline or malignant masses.[71] Thick walls (>3mm) and septations (>3mm) are less reliable signs of malignancy because they are frequently seen in endometriomas, abscess complexes, peritoneal cysts, and benign neoplasms such as cystadenofibromas and mucinous cystadenomas.[45,66]

Solid, non-fatty, non-fibrous tissue is the most powerful predictor of malignancy. Ancillary findings of pelvic organ invasion, implants (peritoneal, omental, mesenteric), ascitis, and adenopathy are signs that increase diagnostic confidence for malignancy. Serous tumors are the most common neoplasms in both the benign and malignant category. Because these masses are primarily cystic, the terms serous cystadenoma **[Fig 8- A, B & C]** and serous cystadenocarcinoma **[Fig 9- A & B]** are used to describe them. Cystadenomas are usually unilocular, whereas malignancies demonstrate solid components and multilocularity.[71, 74,82] The signal intensity of the cyst contents of these

tumors is variable but is usually low to intermediate on T1-weighted MR images and high on T2WI. At CT, diffuse psammomatous calcifications may cause these tumors or their implants to have very high attenuation.[83]

Mucinous ovarian tumors are less common than serous neoplasms. They represent 20% of all ovarian tumors and approximately 10% of all malignant ovarian tumors.[74] Mucinous ovarian tumors are generally cystic but unlike serous tumors may be very large and tend to be multiloculated.[82] They often have variable signal intensity in the loculi owing to proteinaceous or mucinous contents and hemorrhage.



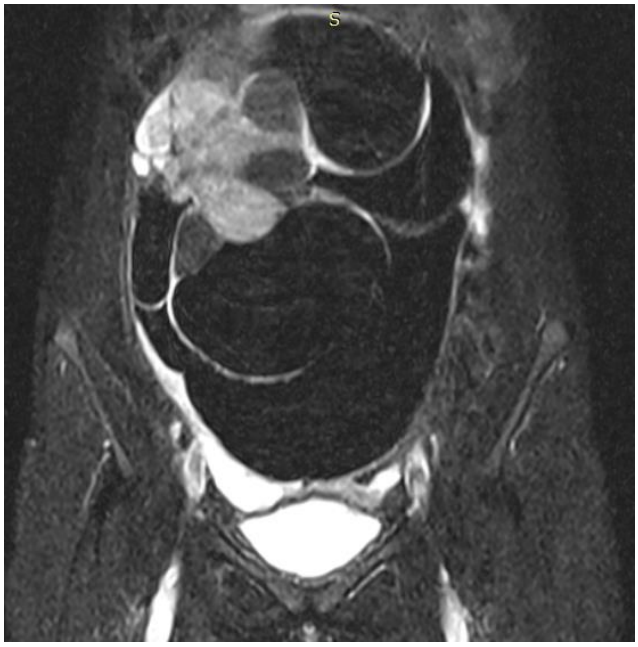
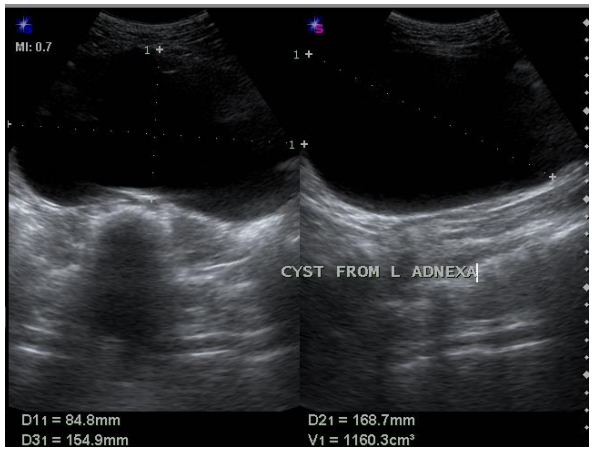
B. 

Fig. 7: Endometrioma: A &B: Axial and coronal MRI image showing a heterogeneous mass lesion but predominantly hypointense on T2WI and Fat sat images. The lesion was also hypointense on T1WI [not shown above].



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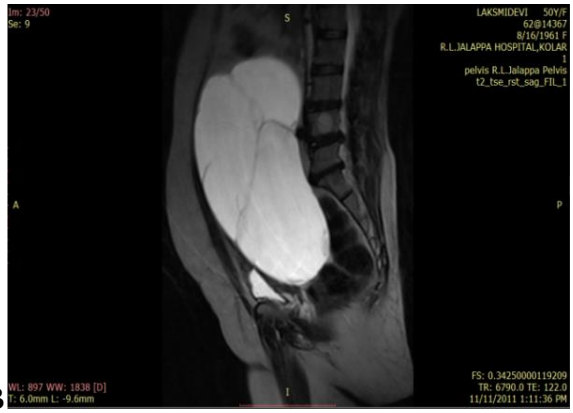

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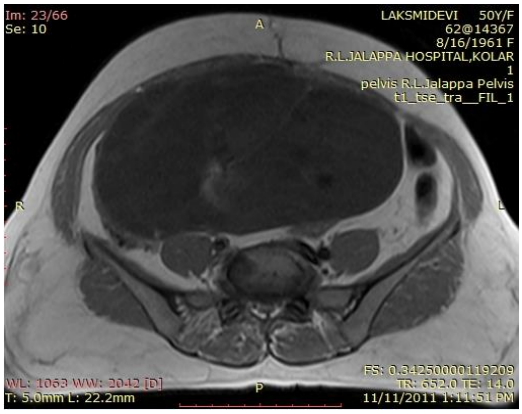

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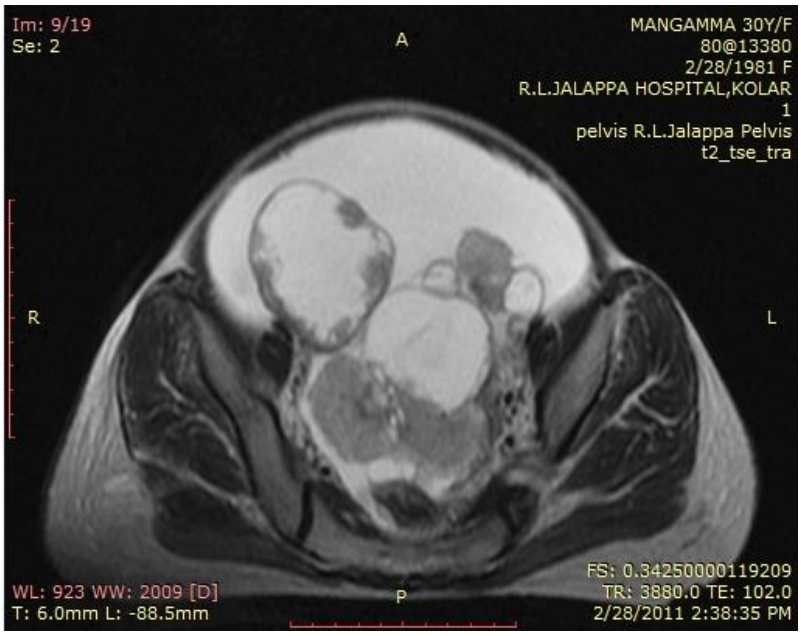
Fig 8: Serous cystadenoma: A- USG image showing a large cystic lesion with few thin septae in lower abdomen and pelvis. B- Sagital T2WI MRI showing a large hyperintense lesion with few thin septae. C- Axial T1WI MRI showing a large hypointense lesion. No suspicious components were noted in USG and MRI.



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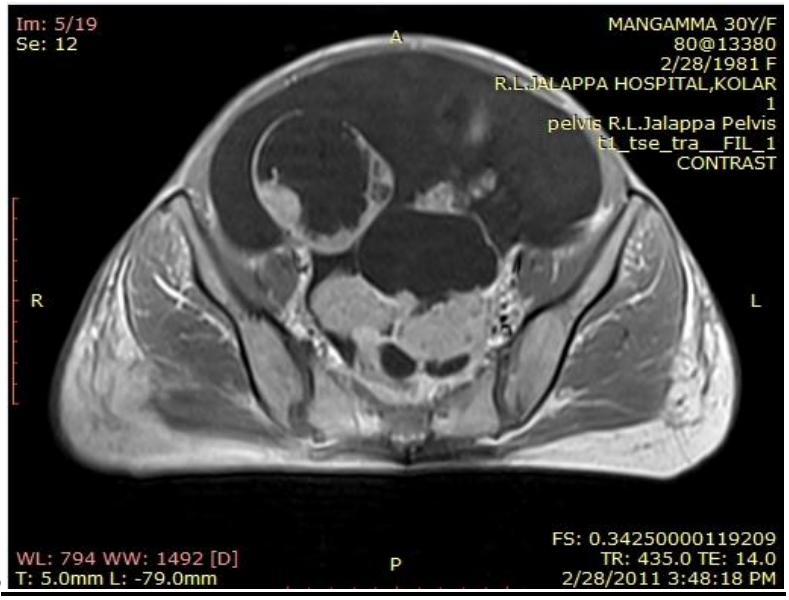

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Fig 9: Serous Cystadenocarcinoma-: A- Axial T2WI MRI showing a multilocular large hyperintense lesion with multiple thick septae and solid component. B- Axial T1WI Post contrast MRI showing that the solid component and thick septae are enhancing

Mature Cystic Teratomas

Mature cystic teratomas **[Fig 10 A, B &C]** are the most common ovarian neoplasm in some series[84] and derive from ovarian germ cells. Although all three germ cell layers are present, ectodermal components predominate, so that these lesions are often referred to as dermoid cysts. Because they are usually asymptomatic, mature cystic teratomas are often discovered incidentally at routine pelvic examination.[85] US features ascribed to mature cystic teratomas include the presence of a shadowing echogenicity, regional or diffuse high echogenicity, hyperechoic lines and dots, and a fat-fluid level. Some of these US features overlap with the US features of other ovarian neoplasms such as endometriomas or ovarian carcinomas.[84,86,87] Mature cystic teratomas are readily recognized at CT by the presence of fat and dense calcifications.

The diagnosis of mature cystic teratoma is straightforward at both CT and MR imaging.

Adipose tissue within the Rokitansky nodule as well as the sebum-rich fluid in the cyst cavity demonstrate fat attenuation at CT.[88,89,90] Calcifications may or may not be present in the wall. A floating mass with hair or a fat-fluid interface can sometimes be identified. Pitfalls in the diagnosis of dermoid cyst at CT include fat blending in with surrounding retroperitoneal fat, occasional dermoid cysts without a fatty component, and lipoleiomyoma of the uterus, an unusual variant of myoma.[91] MR imaging features reflect the composition of the tumors. The lipid-laden cyst fluid demonstrates high signal intensity on T1-weighted images and intermediate signal intensity on T2- weighted images. Fat demonstrates high signal intensity on T1- and T2-weighted fast spinecho

images. Internal patterns of mature cystic teratomas such as palm tree–like protrusions or dermoid nipples are typical findings.[55,86,92]

Both endometriomas and mature cystic teratomas demonstrate high signal intensity on T1- weighted images and therefore must be distinguished from one other.[55,93] The fat in mature cystic teratomas results in chemical shift artifact at the fat-fluid interface. This artifact manifests as bright or dark bands along the frequency- encoding gradient. Use of frequency-selective fat saturation allows differentiation of hemorrhagic lesions from lipid-containing lesions such as endometriomas.[93,94,95]

Besides mature cystic teratoma, the only ovarian mass to demonstrate fat is immature teratoma. This malignant mass is typically large at presentation and has prominent solid components containing small foci of fat and coarse calcifications.

Fibrotic Tumors

Fibromas account for approximately 4% of all ovarian neoplasms. Women with these tumors are generally asymptomatic, and masses are typically detected in middle-aged women at palpation during routine gynecologic examination. Ovarian fibromas are important from an imaging standpoint because they appear as solid masses, thereby mimicking malignant neoplasms. They are associated with ascites in 40% of cases, particularly in larger lesions, and with pleural effusions (Meig syndrome) in a small percentage of cases.[96,97] Fibromas, thecomas, fibrosed thecomas, and fibrothecomas are ovarian tumors of gonadal stromal origin and may be variants of a single entity. They are composed of fibrous tissue and theca cells with abundant lipid in the cytoplasm. These

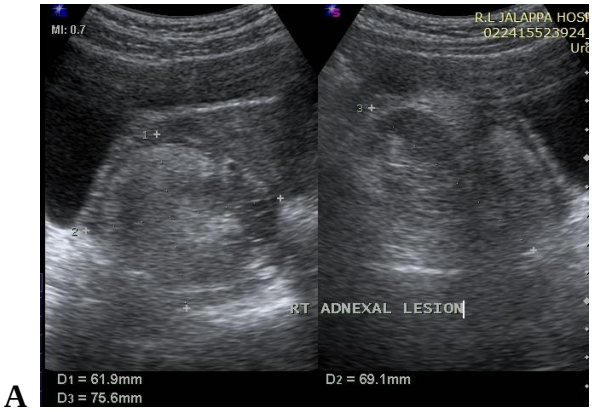
theca cells are responsible for the estrogenic effects of these tumors. Pure fibromas consist of intersecting bundles of spindle cells without theca cells or estrogenic effect.[97,98] Fibromas and cystadenofibromas are not related. Fibromas are of stromal derivation and have no epithelial component. In contrast, in cystadenofibromas, the fibrous component is part of the neoplasm, which is believed to be of epithelial and stromal origin similar to cystadenomas and cystadenocarcinomas.[74,97] At US, fibromas most commonly manifest as solid, hypoechoic masses with sound attenuation, which at times may be striking. However, the US appearance is variable, and hyperechoic masses with increased through-transmission may be seen.[99,100] At CT, fibromas manifest as diffuse, slightly hypoattenuating masses. Unlike most other solid masses, fibromas show poor, very slow enhancement with administration of contrast material.[101]

Fibromas demonstrate homogeneous, relatively low signal intensity on T1-weighted MR images. On T2-weighted images, fibromas appear as well-circumscribed masses with low signal intensity containing scattered high-signal-intensity areas representing edema or cystic degeneration.[104,105] This low signal intensity results from the abundant collagen content of these tumors and is relatively diagnostic for fibromas.[104,105] The fibrotic component of fibrothecoma, cystadenofibroma, and leiomyoma appears as an area of low signal intensity on T2-weighted images, a finding that is similar to that seen in fibromas.[102-105] The imaging appearance of thecomas without prominent fibrosis is similar to that of malignant tumors.[104,106,107] The prominent lipid component of thecomas could theoretically be depicted at chemical-shift MR imaging, which similarly helps detect lipid in adrenal adenomas and clear cell carcinomas of the kidney. Cystadenofibromas usually appear as multilocular cystic masses with a solid fibrotic

component.[105] These tumors are less likely to be borderline or malignant compared with other serous or mucinous tumors. Pedunculated uterine leiomyomas and broad ligament leiomyomas frequently appear as adnexal or ovarian masses at US. These tumors typically demonstrate very low signal intensity on T2- weighted MR images.[102,103] Absence of a normal ipsilateral ovary helps distinguish fibromas from pedunculated leiomyomas. The presence of small follicles surrounding the mass helps identify the ovarian origin of fibromas.[45,108]

Granulosa cell tumors

Granulosa cell tumors **[Fig 11- A &B]** are categorized as sex cord–stromal tumors. Ninety percent of granulose cell tumors are stage I tumors; however, they have malignant potential and can extend beyond the ovary.[109] There are two subtypes: adult and juvenile granulosa cell tumors. The adult type accounts for 95% of cases and often occurs in postmenopausal women. Granulosa cell tumors show a variable spectrum of multilocular cystic or solid and cystic appearances at both gross and imaging examinations[110,111] and may be diagnosed by using the criteria in the "Cystic Masses" or "Cystic and Solid Masses" section. Some of these tumors have a predominantly solid appearance and can be diagnosed by following the indicators in this section. Extensive intratumoral hemorrhage is often identified with MR imaging. In addition, granulosa cell tumors are the most common estrogenic ovarian tumors, and associated uterine enlargement with endometrial hyperplasia may be demonstrated on T2-weighted images.[110,111]



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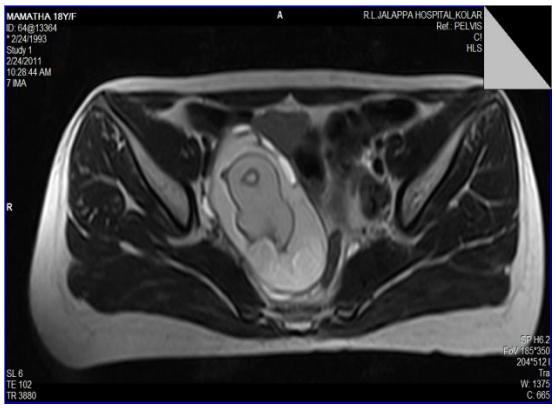

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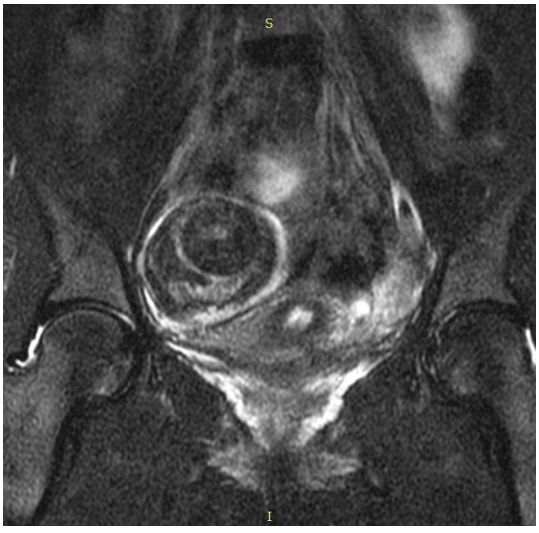

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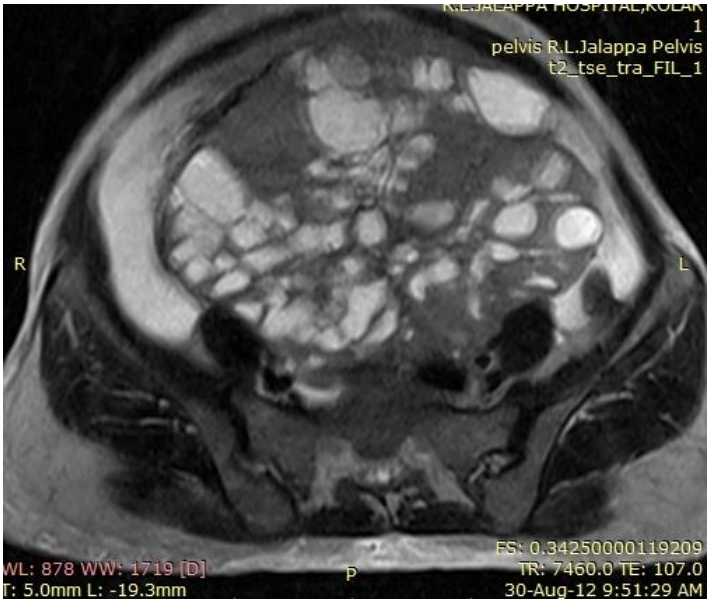
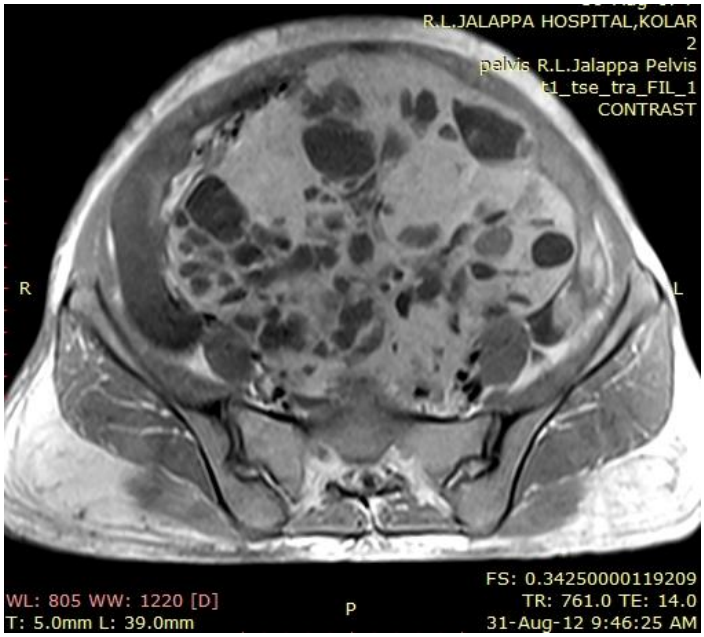
Fig. 10: Teratoma: A- USG image showing a large heterogeneous lesion in right adnexa with hyperechoic component and small foci of calcification within. B- Axial T2WI MRI showing a hyperintense lesion with signal intensity similar to fat. C- Coronal STIR image showing the suppression of fat content within the lesion



A.



B.

Fig. 11: Granular cell tumor- A- Axial T2WI MRI showing a large well defined lesion with both solid and cystic component. B- Axial T1WI Post contrast MRI showing a large lesion with enhancing solid component

METHODOLOGY

Source of data

All patients presenting with ovarian pathology and suspected by ultrasonogram in R. L. Jalappa Hospital and Research Center, Tamaka, Kolar.

Method of collecting data

1) All patients presenting with ovarian pathology in R.L. Jalappa Hospital and Research Center are included in this study. The consent of the patients will be taken prior to the investigation.

2) This prospective study included evaluation of cases over a period of two years i.e. from December 2010 to December 2012 (30cases). The investigation was performed with

- Transabdominal scan- SIEMENS SONOLINE G50, C5-2mhz
- Transvaginal scan- SIEMENS SONOLINE G50, EC9-4mhz
- MRI- SIEMENS 0.35 tesla MAGNETOM CI
- SIEMENS Esprit single slice Spiral CT unit by taking post contrast thin contiguous sections of pelvis and ovarian in the axial plane in supine position.

3) Imaging findings was correlated with post surgical and histopathological findings as and when required.

Inclusion criteria

Ovarian pathology suspected clinically and confirmed on ultrasound.

Exclusion criteria

- Past history of contrast allergic reactions.
- Patients suffering with renal failure.
- Pregnant women.

The data collected from these patients will be analyzed using descriptive statistic tools like proportions.

IMAGING AND TECHNIQUE

Ultrasonogram

Transabdominal and transvaginal sonography where necessary was performed.

Patients were scanned with a full bladder using a transabdominal curvilinear probe- SIEMENS SONOLINE G50, C5-2mhz. Transvaginal scan was done with a high frequency endovaginal probe- SIEMENS SONOLINE G50, EC9-4mhz after emptying the urinary bladder.

The following features of a mass were noted:

- Origin
- Unilocular/Multilocular,
- Anechoic/ Hyperechoic/ Heterogenous,
- Thin wall/ Thick wall,
- Thin septae/ Thick septae,
- Solid component,
- Mural nodule,
- Calcifications,
- Debris,
- Fluid- fluid level,
- Vascularity,
- Ascites.

MRI

MR imaging of pelvis was done for patients using a MRI- SIEMENS 0.35 tesla MAGNETOM CI machine.

Patient's position was kept supine with head first, phased array body coil was fixed to gluteal region to study the pelvis.

The following images were obtained:

1. Localizer intermediate three planes obtained.

2. Sagittal, transverse and coronal T2-weighted fast-spin-echo images from the symphysis pubis to the aortic bifurcation.

3. Transverse T1-weighted spin echo images from the symphysis pubis to the aortic bifurcation.

4. Optional transverse T1 weighted spin echo images through any lesion with high T1 signal intensity by using the same parameters as those described above but with the addition of frequency selective fat suppression. This sequence was performed when a lesion with high T1 signal intensity was noted. Signal loss in the high signal intensity area of the lesion was considered to be diagnostic of fat as in a cystic teratoma.

5. Post contrast transverse T1-weighted spin-echo images from the symphysis pubis to the aortic bifurcation after intravenous injection of 0.1 mmol / kg gadolinium by using the same parameters as those used for pre contrast T1 weighted imaging.

MRI was evaluated for the following:

- Origin of the lesion.
- Unilocular/Multilocular
- T1 Hypo/ Hyper
- T2 Hypo/Hyper
- GRADIANT IMAGES
- STIR IMAGES
- Thin wall/ Thick wall
- Thin septae / Thick septae
- A solid mass or large solid component
- Mural nodule
- Calcifications
- Contrast enhancement
- Ascites

OBSERVATIONS AND RESULTS

This study was done for a period of two years from December 2010 to May 2012.

A total of 30 patients who were clinically suspected to have ovarian pathology were referred to us for ultrasonography.

In 30 patients, who were referred for sonography a total of 36 ovarian masses were found.

Each patient was examined by Transabdominal sonography / Transvaginal sonography, MRI [Pre and Post contrast] and CT when required.

Out of the 30 patients, 24 patients had unilateral ovarian mass while 6 had bilateral ovarian masses. **[Chart 1]**

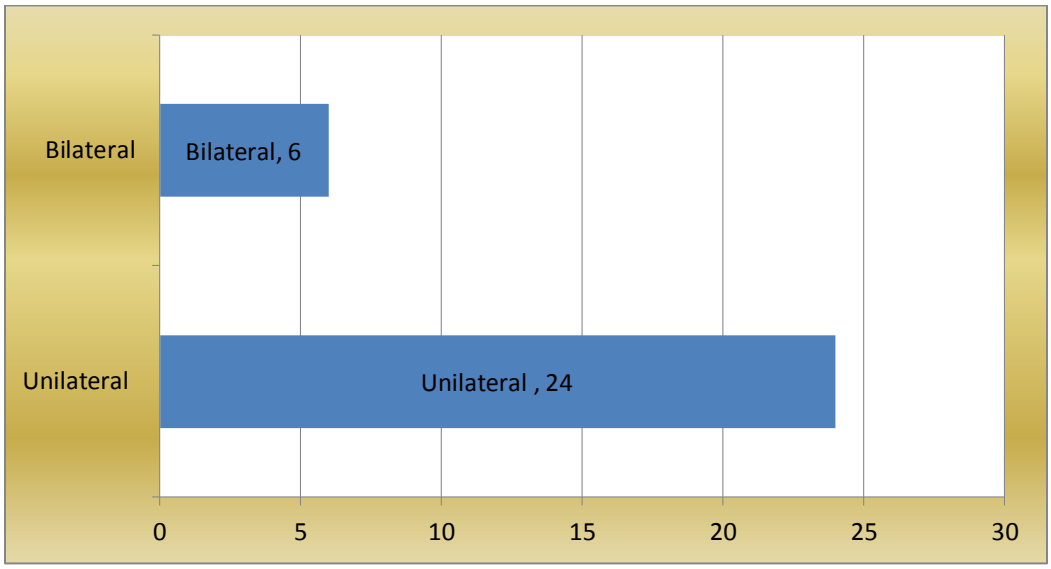
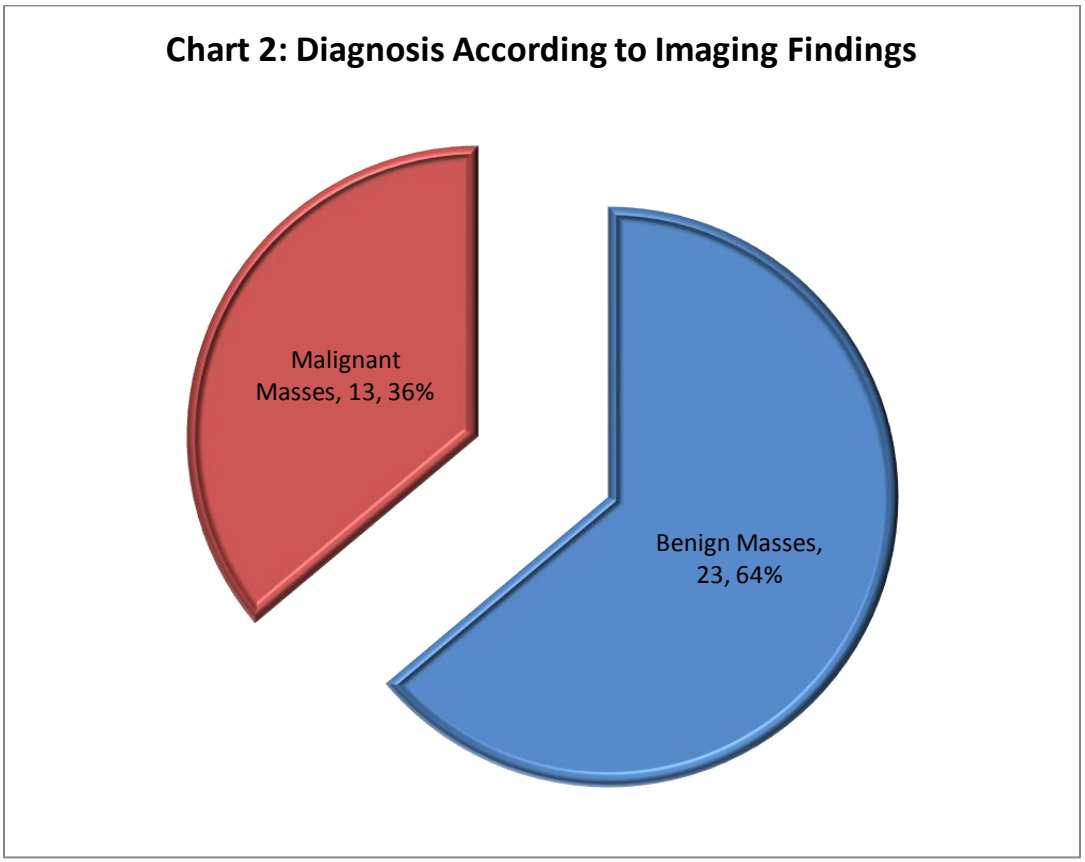


Chart 1: No. of lesions unilateral and bilateral

On imaging findings 23masses were determined as benign and 13masses were determined as malignant. **[Table 1 & Chart 2]**

Table 1: Diagnosis According to Imaging Findings

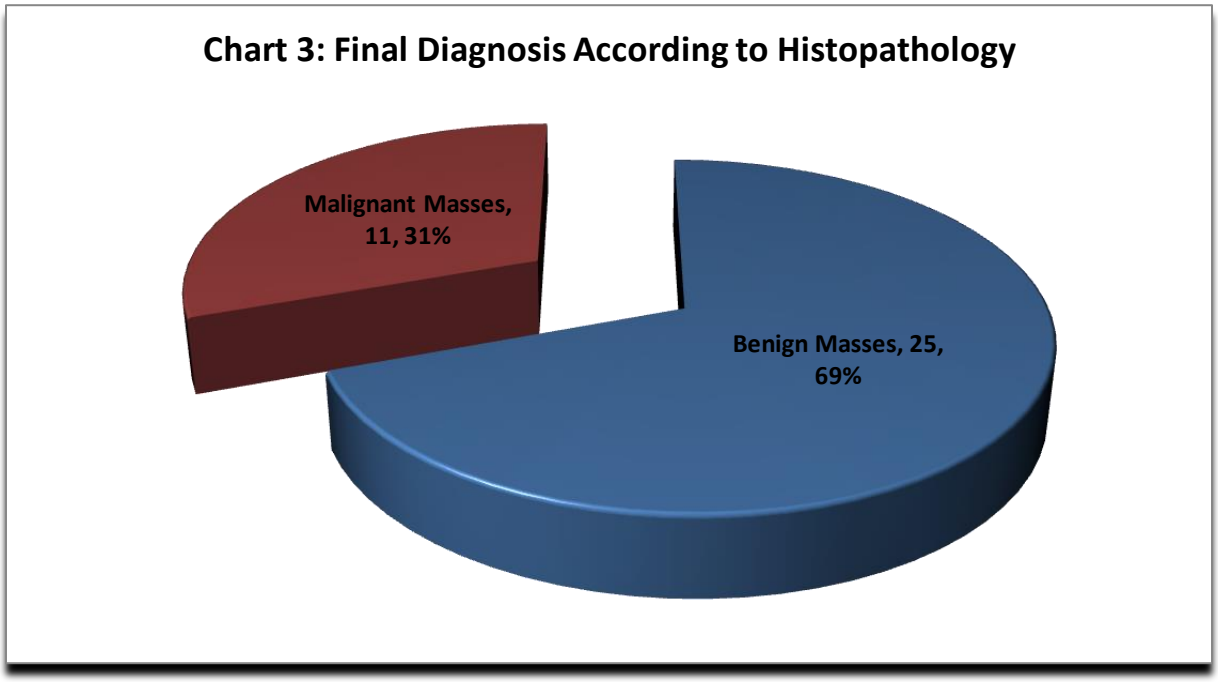
Benign masses	23
Malignant	13



The final diagnosis for all of the 36 masses was established by the postsurgical histopathology findings. Out of which 25[69%] are benign and 11 [31%] are malignant according to histopathological findings. **[Table 2 & Chart 3]**

Table 2: Final Diagnosis According to Histopathology

Benign masses	25
Malignant	11



In our study, the youngest patient was 18 yrs old and the eldest patient was 66 yrs old. The maximum number of patients was found in the range of 41-60 yrs, accounting for 14 patients, followed by 12 patients in 21-40years. **[Table 3 & Chart 4]**

Table 3: Showing age wise incidence

Age Group	No. of patients
0-20	3
21-40	12
41-60	14
61-80	1
81-100	0

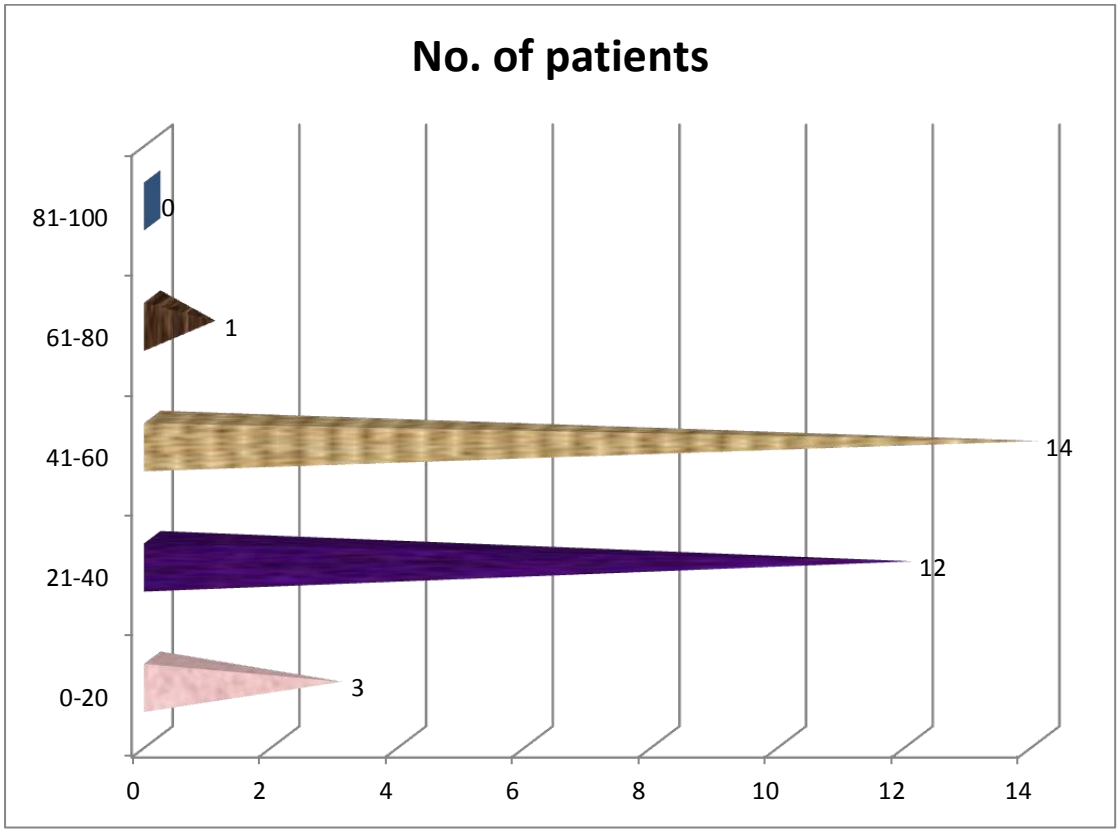


Chart 4: Showing age wise incidence

Determining the origin of the lesion

In determining the origin of 36 masses sonography had poor agreement with the final diagnosis whereas MRI had excellent agreement.

Sonography could detect the origin of mass accurately in 29 (80.5 %) masses due to the large size of few lesions and gross ascitis. 2 lesions were completely missed on ultrasound were as they were picked up on MRI.

MRI could detect the origin accurately in 34 (94.4 %) masses. The origin of 2 masses were not accurately detected on MRI due to non-detection of the normal ovary bilaterally and separate from the large lesion. **[Table 4 & Chart 5].**

TABLE 4: Showing % of origin of lesion accurately detected

Investigation	Total no. of lesions	Origin of lesion accurately detected	% Origin of lesion accurately detected
Sonography	36	29	80.5%
MRI	36	34	94.4%

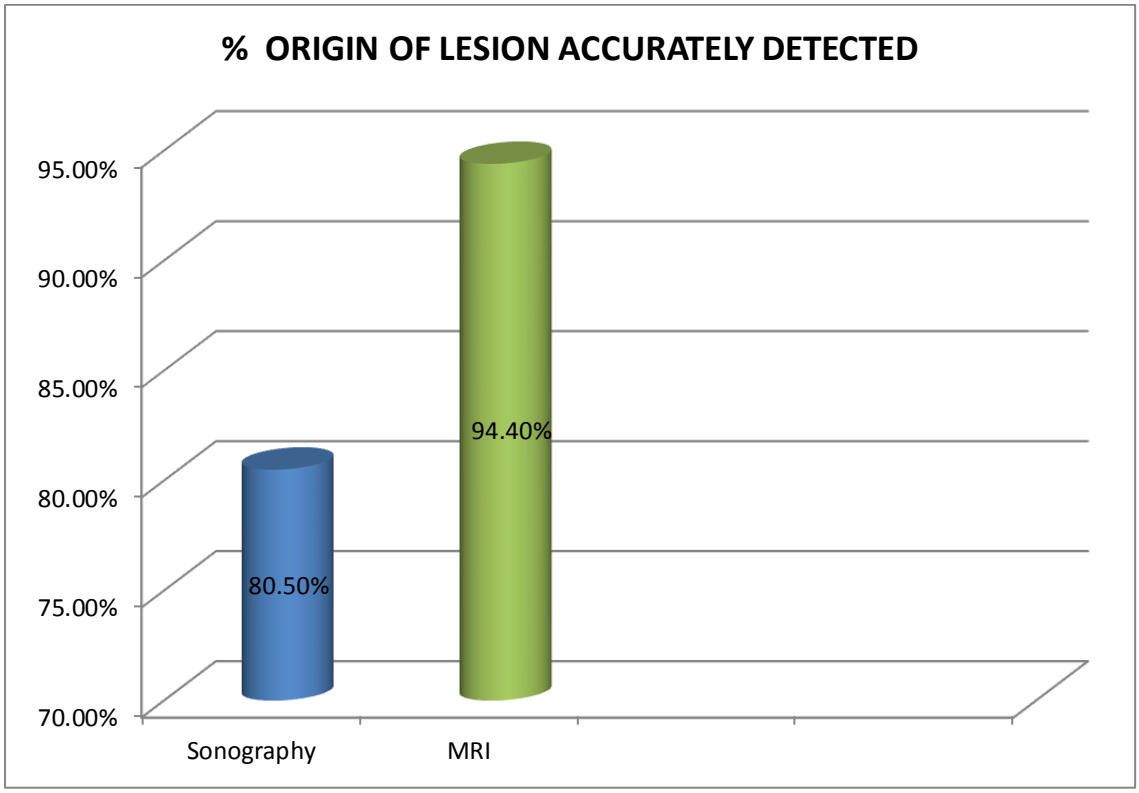


Chart 5: Showing % of Origin of lesion accurately detected

CHARACTERIZATION OF THE LESIONS

In determining the tissue content of 36 masses sonography had comparatively poor agreement with the final diagnosis compared with MRI.

Sonography characterized 33/36 (91.6%) masses correctly. MRI correctly characterized 34/36 (94.5%) cases and tissue content was identified correctly.

Sonography could not characterize a case of endometriotic cyst and 2 cases of cystadenofibroma, whereas the endometriotic cyst was correctly diagnosed on MRI but the 2 masses of cystadenofibroma was diagnosed as serous cystadenocarcinoma due to the presence of solid mass and thick septae within the lesion **[Table 5 & Chart 6].**

Table 5: Showing % Characterization of Lesion

Investigation	Total no. of lesions	Lesions accurately characterized	% of lesions
Sonography	36	33	91.6%
MRI	36	34	94.5%

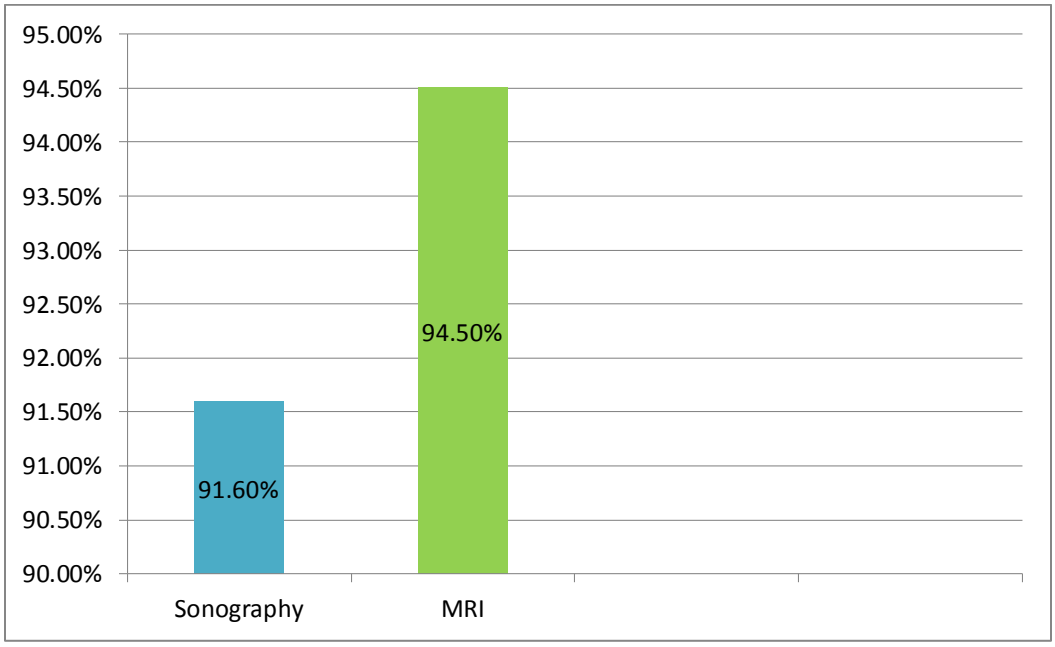


Chart 6: Showing % Characterization of Lesion

TOTAL NUMBER OF EACH LESION DETECTED IN OUR STUDY

The ovarian masses were diagnosed based on various ultrasound and MRI imaging characteristics. The various ovarian lesions diagnosed are simple cyst, serous cystadenomas, serous cystadenocarcinoma, cystadenofibroma, mucinous cystadenoma, mucinous cystadenocarcinoma, endometrioma, cystic teratoma, fibroma, dysgerminoma, malignant germ cell tumor. The total number of each lesion detected in our study is shown in **[Table 6 & Chart 7].**

Table 6: Total number of each lesion detected in our study

Final Diagnoses	**No. of Lesions**
Simple Cyst	5
Serous Cystadenoma	8
Serous Cystadenocarcinoma	5
Cystadenofibroma	2
Mucinous Cystadenoma	4
Mucinous Cystadenocarcinoma	1
Hemorrhagic Cyst	2
Endometriosis	1
Metastasis	4
Teratoma	3
Malignant Solid tumor	1

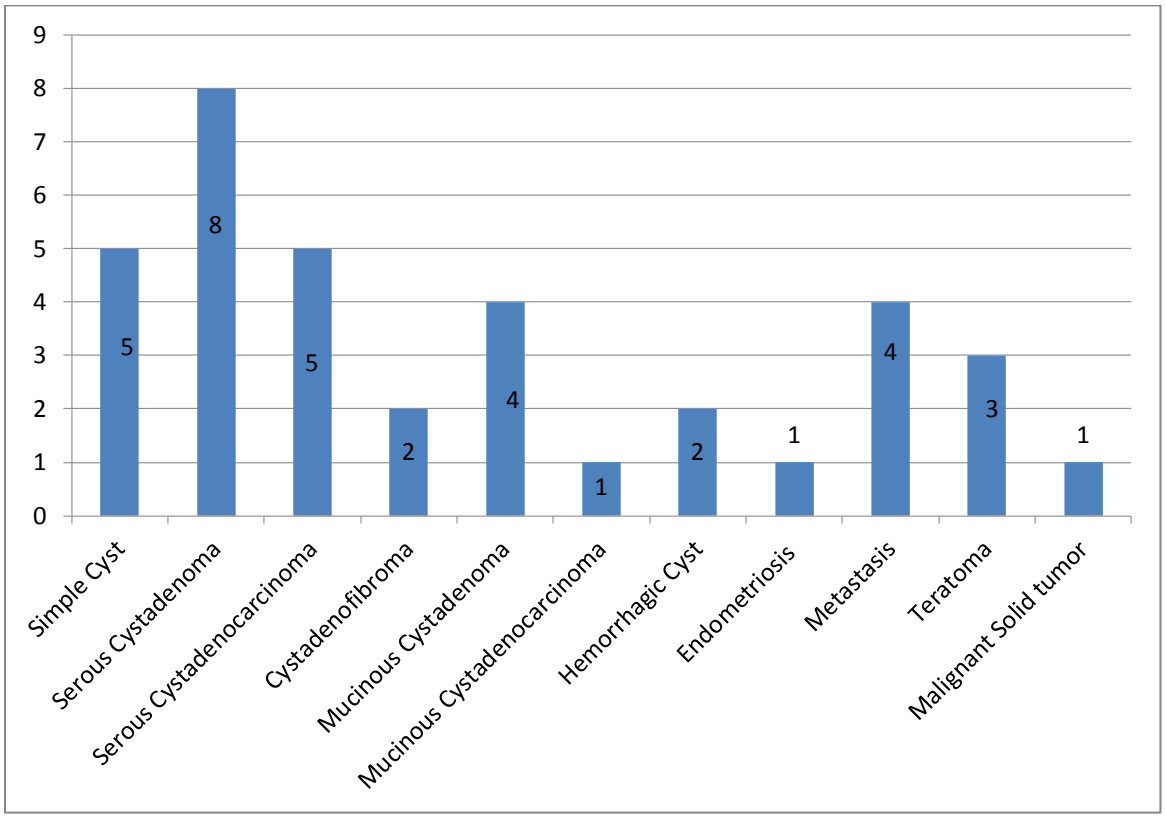


Chart 7: Total number of each lesion detected in our study

In our study, majority of the patients were pre-menopausal accounting for 21 and 9 were postmenopausal [Table 7].

Table 7: Number of pre and postmenopausal patients involved

Pre and Postmenopausal distribution	No. of patients
Pre menopausal	21
Post menopausal	9

Benign lesion group

In the benign group serous cystadenoma included 8, Mucinous cyst adenoma were 4, cystic teratoma were 3, simple cyst were 5, hemorrhagic cyst were 2, endometriosis was 1 and cystadenofibroma were 2 [Table 8 & Chart 8].

Table 8: Showing total number of benign lesions

Benign Masses	No. of Lesions
Simple Cyst	5
Serous Cystadenoma	8
Mucinous Cystadenoma	4
Hemorrhagic Cyst	2
Endometriosis	1
Cystadenofibroma	2
Teratoma	3

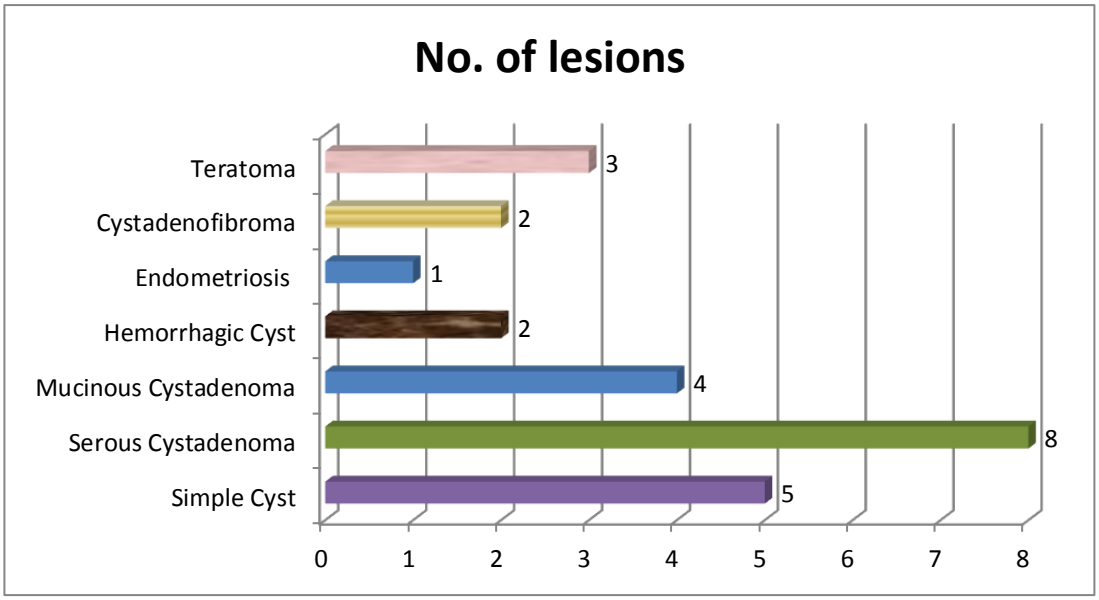


Chart 8: showing total number of benign lesions

In our study, 5 cases were simple cysts. The largest cyst was 6cms in size and the smallest was 3.1cms in size. All the simple cystic lesions were unilocular, anechoic and few contained thin septae.

In the 8 serous cystadenoma all of them were cystic, 3 lesions were unilocular and 5 lesions were multilocular. All 8 of them showed few thin septa measuring less then 3mm in diameter. None of the lesions showed internal echoes and mural nodules.

Among the 4 diagnosed mucinous cyst adenoma all the 4 were cystic with thin septa and internal echoes. All these lesions were hyper intense on T1 and T2.

The 2 diagnosed hemorrhagic cysts were hyperechoic on ultrasonography and hyperintense on T1 and T2 MRI images. Both the lesions were more than 6cms in size.
One lesion was diagnosed as endometriosis using primarily MRI characteristics while on ultrasound the lesion was multilocular, containing multiple cysts with few anechoic and few hyperechoic areas which was inconclusive. On MRI the lesion was hyperintense on T1 and hypointense on T2 weighted images.

None of the above benign tumors showed solid component or free fluid.

Two lesions were diagnosed as malignant lesions on imaging findings due to presence of solid component and thick internal septae as serous cystasenocarcinoma. However, on histopathology these lesions were confirmed as a benign lesions- Cystadenofibroma.

Three lesions were diagnosed as mature benign form of teratoma which appeared as complex cystic mass with solid mural component containing hyperechoic foci and calcifications. CT was done for these cases for confirmation of the calcifications and small foci of fat. On MRI, fat was identified as high signal intensity on T1 and T2 sequences which was seen suppressed on fat saturation sequences.

Malignant lesion group

In the malignant group 5 were serous cystadenocarcinoma, 1 were Mucinous cystadenocarcinoma, 1 was a malignant germ cell tumor [Granulosa cell tumor] and 2 patients had bilateral metastasis i.e. 4 lesions **[Table 9 & Chart 9].**

Table 9: Total number of malignant lesion detected in our study

Final Diagnoses	No. of Lesions
Serous Cystadenocarcinoma	5
Mucinous Cystadenocarcinoma	1
Metastasis	4
Malignant Solid tumor	1

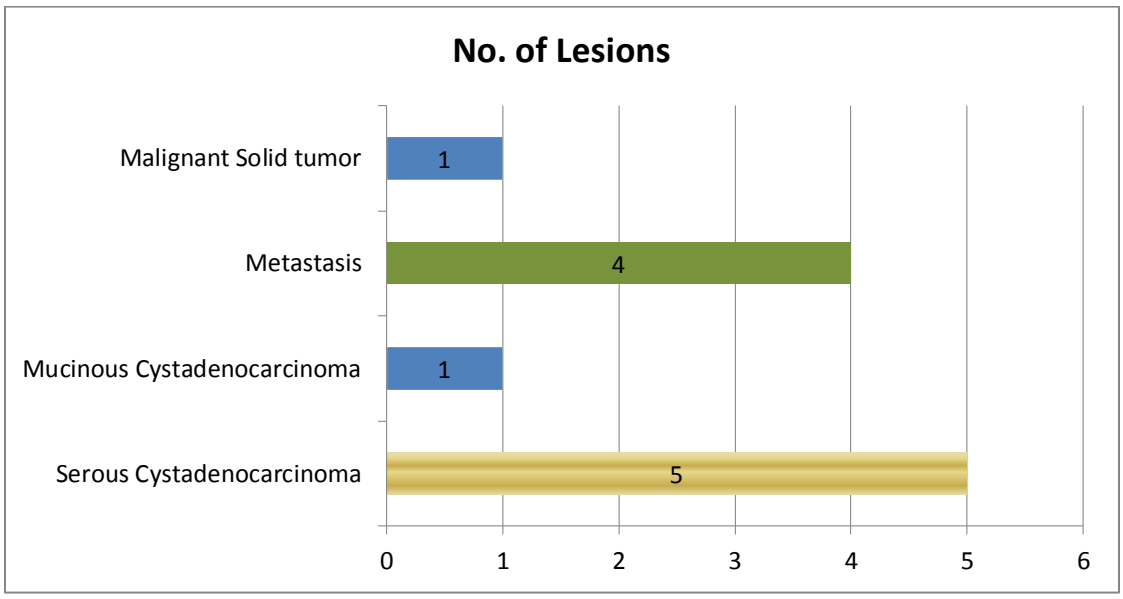


Chart 9: Total number of malignant lesion detected in our study

In the 5 serous cyst adenocarcinoma all appeared cystic and showed solid component. Out of which 4 showed thick septae [measuring more than 3mm], and 3 showed internal echoes while 2 showed free fluid in the pelvis.

One lesion was diagnosed mucinous cyst adenocarcinoma. On USG it appeared cystic and showed mixed echogenicity, solid component, thick septae, internal echoes and free fluid in the pelvis lesion. On MRI the lesion was hyperintense on T1 and T2, and showed solid mass and thick internal septae.

A single case of malignant germ cell tumor [Granulosa cell tumor] was diagnosed which appeared as a heterogeneous mass containing solid and multiple small cystic lesions within. Minimal vascularity was noted within the lesion on USG. On MRI the lesion contained solid component which was isointense with the muscle and the cystic lesions were hypointense on T1 while hyperintense on T2.

Two known cases of carcinoma colon had lesions in bilateral ovaries, which was diagnosed as bilateral metastasis. These patients were operated for the same. On imaging the lesions appeared multilocular, thick septated in bilateral adnexa which was confirmed on histopathology.

IMAGING DETERMINATION OF BENIGNITY AND MALIGNANCY OF A LESION

Out of the 36 masses, sonographically and MRI combinely determined 23 masses as benign and 13masses were determined as malignant.

Sonography could not characterize a case of endometriotic cyst and 2 cases of cystadenofibroma, whereas the endometriotic cyst was correctly diagnosed on MRI but the 2 masses of cystadenofibroma was diagnosed as serous cystadenocarcinoma due to the presence of solid mass and thick septae within the lesion.

Imaging findings [USG & MRI] correctly diagnosed 11 malignant lesions and incorrectly classified 2 benign lesions as malignant. Of the remaining 25 benign diagnoses, imaging findings correctly characterized 23 of the lesions.

The sensitivity of imaging findings for correctly identifying malignant lesions was 100% and sensitivity for correctly making a benign diagnosis was 92.5%.

The specificity of imaging findings for correctly identifying malignant lesion is 92% and specificity for correctly making a benign diagnosis was 84.6% **[Table 10 & Chart 10].**

Table 10: Showing sensitivity and specificity of imaging findings in determining benignity and malignancy

	BENIGNITY (%)	MALIGNANCY (%)
SENSITIVITY	92.5%	100%
SPECIFICITY	84.6%	92%

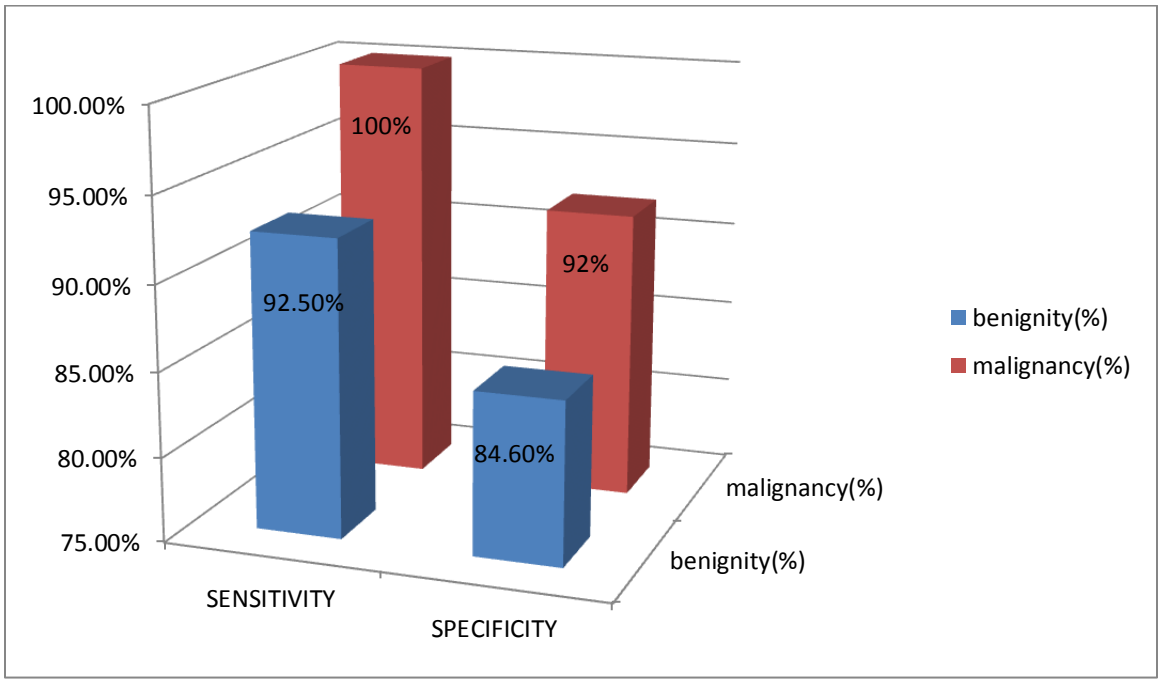


CHART 10: Showing sensitivity and specificity of imaging findings in determining benignity and malignancy

DISCUSSION

Our prospective study confirms previous reports suggesting that imaging investigations [USG & MRI] is helpful in the evaluation of ovarian pathological entities.

Our study revealed 25 final benign diagnoses. The value of reassuring a patient that a sonographically detected mass is not a malignancy but a normal structure cannot be underestimated; patients avoid not only surgery but also unnecessary follow up imaging and anxiety. These issues justify that imaging investigations [USG & MRI] is the appropriate next step after clinical examination.

Our study reveals that sonography performs comparatively poorly than MRI for determining the origin of the mass which is the first essential step in characterizing a pelvic mass. For example, large mass size and non-visualization of the adjacent normal ovary are contributing factor to an indeterminate diagnosis of origin of the lesion with ultrasonography.

Unlike sonography excellent agreement was seen between MRI and the final proven origin of a mass. This stresses the importance of MRI as the best next step in evaluating an ovarian mass before subjecting a patient to surgery that might be unnecessary.

MRI is well suited to the characterization of ovarian masses due to its superiority in tissue differentiation and various sequences which help us in diagnosing various types of lesions. Our study showed that accurate tissue characterization the second essential

component of characterizing an ovarian mass was comparatively poor for sonography than MRI. One lesion was interdeterminate on ultrasonography and was characterized accurately as endometriotic cyst on MRI.

For cases considered interminate by US, more specific diagnosis by MRI may obviate the need for surgery or otherwise change management by identification of benignity.

The purpose of these examinations is to improve the accuracy of diagnosis of benign masses that are complex on imaging and to permit less invasive management. Unenhanced T1 and T2 weighted imaging is important for accurate tissue characterization. Fat and blood are readily detected on T1-weighted imaging with or without fat suppression. T2 -weighted imaging helps to identify the low signal intensity of fibrous tissue. Gadolinium is usually reserved for improved delineation of mural nodule, thick enhancing septations and wall.

The improved characterization is due to greater conspicuity of the critical imaging findings, including the presence of solid components in a cystic lesion and necrosis in a solid lesion.

On the basis of established practice and a review of literature, it is recommended that Ultrasound remains the primary imaging modality for the evaluation of a clinically suspected ovarian mass. The introduction of high-frequency transvaginal probes has contributed to the development of good quality, high resolution images. TVUS

demonstrates the internal details of masses thereby allowing for a specific diagnosis. When the results of ultrasound evaluation are indeterminate, MR imaging is a cost effective next step.

The principal advantage of MR imaging is its ability to combine some of the best features of both US and CT into one comprehensive examination. Like CT, MR can provide a comprehensive examination of the entire pelvis and can depict abnormalities of lymph nodes, peritoneum, pelvic sidewall, bone, and muscle. MR imaging has the capability to provide direct multiplanar imaging just as US does; however, this capability is more flexible with MR imaging because the planes are not defined by available sonographic windows, as is the case with US. Contrast agents can be used with MR imaging to identify areas of solid tissue, tumor necrosis, and cysts, Most important, soft-tissue contrast is inherently very high with MR imaging, in contrast to both CT and US. Specialized pulse sequences allow the characterization of tissues beyond cystic, solid, or fatty. Finally, MR imaging has no known adverse effects on the fetus, embryo, or reproductive potential of the ovaries. These considerations have encouraged research into the potential of MR imaging of the female pelvis.

Outwater and Dunton revealed that unnecessary surgery was performed in 50-67% of benign cases because of suspicious sonography findings.

The main challenge to the radiologist is to differentiate benign from malignant ovarian masses. Once an ovarian mass is discovered, pathways for diagnosis and planned treatment include clinical follow-up, specific treatment based on the imaging or

biochemical laparoscopy or laparotomy findings. Masses that are large and complex, contain solid components, or are cystic and fail to resolve at serial US examinations timed to the menstrual cycle are considered potentially malignant. For a long time, laparotomy with excision has been recommended for suspicious adnexal masses. Majority of resected adnexal masses are benign. This has prompted consideration of less invasive ways of evaluating these lesions. Less invasive ways of assessing for malignancy include, duplex Doppler US examination, CT, and MR imaging, CA 125 assays and laparoscopy. The purpose of these examinations is to improve the accuracy of diagnosis of benign masses that are complex on imaging and to permit less invasive management.

The pretreatment determinations of the location, size, and likelihood of malignancy of a lesion are becoming increasingly important as treatment options for pelvic masses become more sophisticated and more patient specific. For sonographically indeterminate masses, MRI is useful for additional lesion characterization. Analysis of TI- and T2-weighted signal intensities for benign appearing lesions with the addition of fat saturation for high signal on Tl-weighted sequences may lead to an exact diagnosis or a narrow differential. For cases considered suspicious by US, more specific diagnosis by MRI may obviate the need for surgery or otherwise change management by identification of benign etiology.

CONCLUSION

Thirty patients in the age group of 18 years and above, who were clinically suspected to have ovarian pathology were referred to us for ultrasonography. Out of the 30 patients, 24 patients had unilateral ovarian mass and 6 had bilateral ovarian masses.

- On imaging 23 masses were determined as benign and 13 masses were determined as malignant whereas according to histopathological findings 25 were benign and 11 [31%] were malignant.

- The maximum number of patients was found in the range of 41-60yrs, accounting for 14 patients, followed by 12 patients in 21-40years and only 1 patient was noted in 61-80 years age group.

- Sonography could detect the origin of mass accurately in 29 (80.5 %) masses and MRI could detect the origin accurately in 34 (94.4%) masses.

- Sonography characterized 33/36 (91.6%) masses correctly. MRI correctly characterized 34/36 (94.5%) cases and tissue content was identified correctly.

- In the benign group serous cystadenoma included 8, Mucinous cyst adenoma were 4, cystic teratoma were 3, simple cyst were 5, hemorrhagic cyst were 2, endometriosis was 1 and cystadenofibroma were 2.

- In the malignant group 5 were serous cystadenocarcinoma, 1 were Mucinous cystadenocarcinoma, 1 was a malignant germ cell tumor [Granulosa cell tumor] and 2 patients had bilateral metastasis i.e. 4 lesions.

- The sensitivity of imaging findings for correctly identifying malignant lesions was 100% and sensitivity for correctly making a benign diagnosis was 92.5%.

- The specificity of imaging findings for correctly identifying malignant lesion was 92% and specificity for correctly making a benign diagnosis was 84.6 %.

SUMMARY

- The clinical and radiologic diagnosis of the specific nature of an ovarian mass can be difficult.

- This is due in part to the large number of pathologic conditions that can affect the ovary but is also related to the similar clinical presentations and radiologic appearances of the various ovarian masses.

- The study has showed that ultrasound, which currently is the initial imaging modality in the investigation of pelvic pathology, is inaccurate in characterizing few ovarian lesions and can confidently identify the tissue of origin of the lesion in only 80.5% of cases.

- MRI is significantly superior to US in all respects due to the excellent soft tissue contrast and organ-specific information generated in the pelvis. The tissue contrast provided by MRI in the pelvis results specific technique-based advantages.

- Hence, we suggest that all patients with a pelvic abnormality identified on US or in whom there is a strong clinical suspicion of disease should undergo MR pelvic imaging because of its better soft tissue resolution and multiplanar capability resulting in higher accuracy rates.

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PROFORMA

NAME: HOSPITAL No..:

AGE: IP No./OP No.:-

SEX: DATE:

ADDRESS:

CONTACT No.:

CHIEF COMPLAINT:

BRIEF HISTORY:

PAST HISTORY:

MENSTRUAL HISTORY:

FAMILY HISTORY:

IMAGING FINDINGS:

ULTRASONOGRAPHY:

1. Origin:

2. Unilocular / Multilocular:

3. Anechoic / Hyperechoic / Heterogenous:

4. Thin wall / Thick wall:

5. Thin septae / Thick septae:

6. Solid component:

7. Mural nodule:

8. Calcifications:

9. Debris:

10. Fluid- fluid level:

11. Vascularity:

12. Ascitis:

Magnetic Resonance Imaging

1. Origin of the lesion:

2. Unilocular/Multilocular:

3. T1 Hypo/ Hyper:

4. T2 Hypo/Hyper:

5. Gradient images:

6. Stir images:

7. Thin wall / Thick wall:

8. Thin septae / Thick septae:

9. A solid mass or large solid component:

10. Mural nodule:

11. Calcifications:

12. Contrast enhancement:

13. Ascitis:

MASTER CHART

Sl.No	NAME	AGE	SEX	HOS.No.	ULTRASONOGRAPHY[TAS & TVS]																MAGNETIC RESONANCE IMAGING [MRI]																IMAGING DIAGNOSIS	HISTOLOGICAL TYPE
					ORIGIN	Unilocular	Multilocular	Anechoic	Hyperechoic	Heterogenous	Thin wall	Thick wall	Thin septae	Thick septae	Solid component	Mural nodule	Calcifications	Debris	Fluid- fluid level	Vascularity	Ascites	Origin	Unilocular	Multilocular	T1 Hypo	T1 Hyper	T2 Hypo	T2 Hyper	GRADIANT IMAGES	STIR IMAGES	Thin wall	Thick wall	Thin septae	Thick septae	Large solid component	Mural nodule	Calcifications	Contrast enhancement	Ascites		
1	Muniyamma	30	F	673750	B/L	+	-	+	-	-	+	-	+	-	-	-	-	-	-	-	B/L	+	-	+	-	-	+	-	-	+	-	+	-	-	-	-	-	Bilateral Simple Cyst	Bilateral Follicular Cyst
2	Lakshmidevi	50	F	708748	R	+	-	+	-	-	+	-	+	-	-	-	-	-	-	-	L	+	-	+	-	-	+	-	-	+	-	+	-	-	-	-	-	Serous Cystadenoma	Serous Cystadenoma
3	Munivenkatamma	66	F	670817	R	-	+	+	+	+	-	+	-	+	+	-	+	+	+	+	R	-	+	-	+	+	+	+	+	-	+	-	+	+	-	+	+	-	Teratoma	Benign Cystic teratoma
4	Jayamma	45	F	680079	L	+	-	+	-	-	+	-	+	-	-	-	-	-	-	-	L	+	-	+	-	-	+	-	-	+	-	+	-	-	-	-	-	Benign left ovarian cyst	Simple cyst of left ovary
5	Shahataj begum	52	F	698435	R	-	+	+	-	-	-	+	-	+	+	-	-	-	-	+	+	B/L	-	+	+	-	-	+	-	-	-	+	-	+	+	-	-	+	+	Metastasis	Metastasis from CA Colon
6	Valli	40	F	669823	L	-	+	+	+	+	-	+	-	+	-	-	-	+	-	-	+	L	-	+	-	+	-	+	-	-	-	+	-	+	-	-	-	-	+	Mucinous Cystadenocarcinoma	Mucinous Cystadenocarcinoma
7	Lakshmamma	45	F	664860	R	-	+	+	-	-	-	+	-	+	+	-	-	+	+	+	-	R	-	+	+	+	-	+	-	-	-	+	-	+	+	-	-	+	-	Malignant Solid tumor	Granulosa Cell Tumor
8	Mallakka	35	F	699643	L	+	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	L	+	-	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	Simple Cyst	Follicular cyst
9	Mariyamma	52	F	665985	R	-	+	+	+	+	-	+	-	+	-	+	-	+	+	+	+	R	-	+	+	+	-	+	-	-	-	+	-	+	-	+	-	+	+	Serous Cystadenocarcinoma	Serous Cystadenocarcinoma
10	Dhanalakshmi	30	F	781063	B/L	-	+	-	+	-	-	+	-	+	-	-	-	+	-	+	+	B/L	-	+	+	+	+	+	-	-	-	+	-	+	-	-	-	+	+	B/L Serous cystadenocarcinoma	B/L Borderline serous cystadencarcinoma
11	Venkatamma	50	F	705382	R	+	-	+	-	-	+	-	+	-	-	-	-	-	-	-	-	R	+	-	+	-	-	+	-	-	+	-	+	-	-	-	-	-	-	Serous Cystadenoma	Serous Cystadenoma
12	Puttamma	56	F	771282	R	-	+	+	+	+	-	+	-	+	+	-	-	-	-	+	-	R	-	+	+	+	-	+	-	-	-	+	-	+	+	-	-	+	-	Serous Cystadenoma	Serous cystadenocarcima
13	Shanthamma	42	F	701228	R	-	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-	R	-	+	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	Serous Cystadenoma	Serous Cystadenoma
14	Parvathamma	50	F	719858	B/L	-	+	-	+	-	+	+	-	+	-	-	-	-	-	-	-	B/L	-	+	+	-	-	+	-	-	+	+	-	+	-	-	-	-	-	B/L Serous Cystadenoma	B/L Serous Cystadenoma
15	Nanamma	50	F	764318	R	-	+	-	+	-	-	+	-	+	-	-	-	+	-	-	-	R	-	+	+	-	-	+	-	-	+	-	+	-	-	-	+	-	-	Serous Cystadenocarcinoma	Serous Cystadenocarcinoma

MASTER CHART

Sl.No	NAME	AGE	SEX	HOS.No.	ULTRASONOGRAPHY[TAS & TVS]															MAGNETIC RESONANCE IMAGING [MRI]																IMAGING DIAGNOSIS	HISTOLOGICAL TYPE
					ORIGIN	Unilocular	Multilocular	Anechoic	Hyperechoic	Heterogenous	Thin wall	Thick wall	Thin septae	Thick septae	Solid component	Mural nodule	Calcifications	Debris	Fluid- fluid level	Vascularity	Ascites	Origin	Unilocular	Multilocular	T1 Hypo	T1 Hyper	T2 Hypo	T2 Hyper	GRADIANT IMAGES	STIR IMAGES	Thin wall	Thick wall	Thin septae	Thick septae	Large solid component	Mural nodule	Calcifications	Contrast enhancement	Ascites		
16	Lakshmidevmma	30	F	680075	R	+	-	+	-	-	+	-	-	-	-	-	-	-	-	-	R	+	-	+	-	-	+	-	-	+	-	-	-	-	-	-	-	Simple Cyst	Follicular Cyst
17	Sathya	49	F	598481	L	-	+	+	-	-	-	+	+	-	-	+	-	+	-	-	L	-	+	+	-	-	+	-	-	-	+	+	-	-	+	-	+	-	Serous Cystadenocarcinoma	Serous cystadenoma
18	Mamatha	18	F	656566	R	-	+	-	+	-	+	-	-	-	+	-	+	-	-		-	R	-	-	-	+	+	+	+	+	+	-	-	-	+	-	+	+	-	Teratoma	Cystic teratoma
19	Lakshmidevamma	26	F	665535	L	-	+	-	+	-	+	-	-	+	-	-	-	+	+	-	-	L	-	+	-	+	-	+	+	-	+	-	-	+	-	-	-	-	-	Hemorrhagic Cyst	Chocolate Cyst
20	Shanthamma	42	F	701228	R	-	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-	R	-	+	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	Serous Cystadenoma	Serous Cystadenoma
21	Soundarya	15	F	715558	L	+	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	L	+	-	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	Serous cystadenoma	Serous Cystadenoma
22	Kamakshi	21	F	718414	B/L	-	+	-	+	-	-	+	-	+	-	-	-	+	-	-	-	B/L	-	+	-	+	-	+	-	-	-	+	-	+	-	-	-	+	-	B/L Mucinous Cystadenoma	B/L Mucinous Cystadenoma
23	Muniyamma	60	F	717360	R	+	-	+	-	-	-	+	-	-	-	+	-	-	-	-	-	R	+	-	+	-	-	+	-	-	-	+	-	-	-	+	-	+	-	Serous Cystadenocarcinoma	Borderline Serous Cystadenocarcinoma
24	Parvathamma	50	F	791321	R	-	+	-	+	-	+	-	-	-	-	-	-	+	-	-	-	R	-	+	-	+	-	+	-	-	+	-	-	-	-	-	-	-	-	Mucinous Cystadenoma	Mucinous Cystadenoma
25	Navya	18	F	754243	R	-	+	+	+	+	-	-	-	-	+	-	+	-	-	-	-	R	-	+	+	+	-	+	+	+	-	-	-	-	+	-	+	+	-	Teratoma	Mature Teratoma
26	Sheela	23	F	742659	R	-	+	+	+	+	+	-	+	-	-	-	-	-	-	-	-	R	-	+	+	+	+	+	-	-	+	-	+	-	-	-	-	+	-	Endometriosis	Endometriotic cyst
27	Mamatha	28	F	703248	R	+	-	-	+	-	+	-	-	-	-	-	-	+	+	-	-	R	+	-	-	+	-	+	+	-	+	-	-	-	-	-	-	-	-	Hemorrhagic cyst	Chocolate/ Hemorrhagic cyst
28	Mangamma	30	F	648702	B/L	-	+	+	+	+	-	+	-	+	+	+	-	+	+	+	+	B/L	-	+	+	+	+	+	-	-	-	+	-	+	+	+	-	+	+	Metastasis	Metastasis
29	Munindramma	26	F	702166	L	-	+	+	-	-	-	+	-	+	-	+	-	-	-	-	-	L	-	+	+	-	-	+	-	-	-	+	-	+	-	+	-	-	-	Serous Cystadenocarcinoma	Serous Cystadenocarcinoma
30	Susheelamma	35	F	704131	L	+	-	-	+	-	-	+	+	-	-	-	-	+	-	-	-	L	+	-	-	+	-	+	-	-	-	+	+	-	-	-	-	-	-	Mucinous cystadenoma	Mucinous cystadenoma