Sudan University of Science and Technology

College of Graduate Studies

Study of female secondary infertility causes using ultrasound

دراسة اسباب العقم الثانوى للنساء باستخدام الموجات فوق الصوتية

A thesis Submitted for Partial fulfillment of the Requirement of M.Sc Degree in Diagnostic Medical Ultrasound

Presented by:

Mazaher Alamin Mahmud

Supervisor:

Dr. Mona Ahmed Mohamed

2015

الآيـــــــــة

قال تعالي:

قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ الْعَلِيمُ)

(الْحَكِيمُ

صدق الله العظيم

سورة

البقرة الآية (32)

Abstract

The main objective of this study to detect causes of female secondary infertility using u/s 60 patients were scanned by u/s, following the international scanning guidance and protocols. Their age ranging from 15-35 years.

this study done in different centers in khartoum state .

The study showed that the causes of female secondary infertility was most common among the age group (30-35), highly economic status (65%) and obesity (35%) is most common risk factors.

The study found that u/s the best efficient method to diagnosis most of causes of female secondary infertility which include PCOD 33%, PID 16%, fibroid 17%, simple cysts 13% ovarian mass 7% and dermoid cysts 1%. In addition to that the study found that there are some cases of secondary infertility were normal finding on ultrasound evaluation . (hormonal disturbance and other an known causes .

خلاصة البحث

هدفت هذه الدراسة لتقيم دور الموجات فوق الصوتية في اكتشاف حالات اسباب العقم ,من خلال هذا البحث تمت دراسة 60 حالة مرضية متتالية من الإناث اللائي تعاني من العقم الثانوي يتراوح اعمارهن بين 15 الى 35 سنة أجريت هذه الدراسة بمراكز مختلفة بولاية الخرطوم بالسودان في الفترة ما بين أغسطس 2013 إلى ديسمبر 2014 .

أخضع جميع المرضى للتشخيص بواسطة الموجات فوق الصوتي وفقاً للبرتوكولات العالمية.

وقد أوضحت هذه الدراسة أن معدل عدم الإنجاب الثانوي اكثر شيوعا عند النساء اللائي أعمارهن بين 30 الى 35 سنة وهذا العمر المتغير بالإضافة إلى الحالة الاقتصادية العالية والسمنة من أكثر الأسباب التي تمثل خطورة على معدل الخصوبة عند النساء.

وقد كان للموجات الدور الفعال في تشخيص الأسباب التي تؤثر في معدل الخصوبة عند النساء والتي تحوي :-

- **المبيض متعدد الأكياس بنسبة 33%.**
- **التهابات الحوض 16%.**
- **الأورام الرحمية 17 %.**
- **الأكياس المبيضة البسيطة 13%.**
- **الأورام المبيضة. 7%.**

بالإضافة لذلك هناك بعض الحالات لم تعلل بواسطة الموجات فوق الصوتية (اختلال الهرمونات وأسباب غير معروفة).

وجد أن تشخيص هذه الأمراض بواسطة الموجات فوق الصوتية ذو فعالية عالية إضافة لكونها الأقل تكلفة والأكثر توفراً لمتناول المرضى. بالإضافة لذلك تلعب الموجات فوق الصوتية الدور الحيوي الفعال لتشخصيها أمراض الخصوبة الثانوية.

Dedication

To:

My family

My Mother

My husband

My collages

Atia ,Sida ,Fdowa,Naheid

&

all my teachers

Acknowledgement

My acknowledgement and great fullness at the beginning and end to Allah.

My special gratitude to my supervisor Dr: Mona Ahmed who do her best helping and guiding me to this thesis. I am very grateful to, all my teachers in all educational levels, especially thanks for my teachers Dr: Ahmed Mustafa.

My great thanks to my collages in ministry hospital and Durar Hatem help and support.

List of Appreviations

Appreviation	Words
BCTs	Benign cystic Teratomas
TLCs	Theca lutein cysts
CAC	Corpus Albicans cysts
FCs	Follicular cysts
HOC	Hemorrhagic ovarian cysts
CLC	Corpus luteum cysts
OHSS	Ovarian hyper stimulation syndrome
SES	Surface Epithial – stromal Tumors
PCOD	Polycystic ovarian disease
PID	Pelvic inflammatory disease
TAS	transabdominal sonography
EVS	endovaginal sonography
TPS	transperineal sonography
TRS	transrectal sonography
ELS	endoluminal
SHS	sonohysterography
SSS	sonosalpingography
U/S	ultra sound

Table of contents

Topics	Page number
Quran	I
Abstract	II
ملخص البحث	III
Dedication	IV
Acknowledgement	V
List of Appreciations	VI
Table of contents	VII
List of figure	XI
List of tables	XII

CHAPTER ONE

Topic	Page No
1.1 Introduction	1
1.2 The problem of the study	2
1.3 Objective	2
1.3.1 General Objective	2
1.3.2 Specific objective	2
1.4 Overview of the study	2

CHAPTER TWO

Topic	Page No
2.1 Introduction	3
2.1.1 prenatal development of reproductive organs	3
2.1.2 Gross Anatomy	4
2.1.3 The Pelvic Muscles	4
2.1.3.1 Piriformis Muscles	4
2.1.3.2 Obturator Inter us Muscle	4
2.1.3.3 Lvator Ani Muscle	5
2.1.3.4 Iliopsoas Muscle	5
2.1.4 Pelvic Organs	5
2.1.4.1 Urinary Bladder	5
2.1.4.2 Colon Pelvic	6
2.1.4.3 The Sigmoid colon	6
2.1.4.4 The small bowel	6
2.1.4.5 Genital organs	6
2.1.4.5.1 Female reproductive system (external)	6
2.1.4.5.2 Female internal reproductive systems	7
2.1.4.5.2.1 The ovaries	7
2.1.4.5.2.2 Fallopian tubs	10
2.1.4.5.2.3 Parts of the uterus	11
2.1.4.5.2.3.1 The fundus	11
2.1.4.5.2.3.2 The body	11
2.1.4.5.2.3.2.3 The cervix	12
2.1.4.5.2.3.2.4 Tissue layers of the uterus	13
2.1.4.5.2.3.2.4.1 Endometrium	13
2.1.4.5.2.3.2.4.2 The myometium	14
2.1.4.5.2.3.2.4.3 The myometrium	15

2.1.4.5.2.3.2.4.4 The uterine cavity 15
2.1.4.5.2.3.2.4.5 Uterine position 16
2.1.4.5.2.3.2.4.6 Uterine measurements 17
2.1.4.5.2.3.2.4.7 Uterine length 17
2.1.4.5.2.3.2.4.8 Endometrial thickness 18
2.1.4.5.2.4 The vagina 19
2.2 Reproductive physiology 20
2.2.1Ovarian cycle 20
2.2.2 Endometrial cycle 22
2.3. Pathology: Causes of Infertility 24
2.3.1 Congenital Anomalies of the Ovary 24
2.3.2 Congenital anomalies of the uterus 24
2.3.2.1 Agenesis /Hypoplasia 24
2.3.2.2 Unicornuate Uterus 25
2.3.2.3 Arcuate Uterus 25
2.3.2.4 Didelphys 25
2.3.2.5 Bicornuate Uterus 25
2.3.2.6 Septate uterus 26
2.3.2.7 Uterus septus 26
2.3.2.8 Uterus Subseptus 26
2.3.2.9 Rudimentary Hor n 26
2.3.3 Congenital Anomalies of The Vagina 27
2.3.3.1 Vaginal agenesis 27
2.3.3.2 Imperforate Hymen 28
2.3.3.3 Vaginal Septum 28
2.3.2 Acquired Disease 28
2.3.2.1 Hemorrhagic Ovarian Cysts 28

2.3.2.2 Normal Cysts 29
2.3.2.3 Pathologic Physiologic Cysts 30
2.3.2.3.1 Follicular Cysts 30
2.3.2.3.2 Corpus Lutwum/ Corpus Alibicans Cysts 31
2.3.2.3.3 Serous Inclusion Cysts 32
2.3.2.3.4 Theca Lutein Cysts 32
2.3.2.4 Benign Cystic Teratomas (BCTs) 33
2.3.2.5 Surface Epithelial (SES) 34
2.3.2.5 Fibromas 36
2.3.2.6 Polycystic Ovarian Disease (PCOD) 36
2.3.2.7 Pelvic Inflammatory Disease 38
2.3.2.8 Endometritis 39
2.3.2.8 Synechiae 40
2.3.2.9 Endometriosis 40
2.3.2.10 Myomas 41
2.3.2.10.1 Interamural Myomas 43
2.3.2.10.2 Subserous or Subserosal Myomas 43
2.3.2.10.3 Submucous or Submucosal Myomas 44
2.3.2.10.4 Intraligmentary Myomas 45
2.3.2.10.5 Cervical Myomas 45
2.4 Scanning Techniques for Obgyn Studies 46
2.4.1 Transabdominal Sonography (TAS) 47
2.4.1.1 Patient preparation 47
2.4.1.2 Patient Position 47
2.4.1.3 Transducer Frequency 47
2.4.1.4 Transdcer Preparation and Care 47
2.4.1.5 Planes of Section 48

2.4.1.6 Transducer Manipulations 48
2.4.2 Endovaginal Sonography (EVS) 48
2.4.2.1 Transducers 48
2.4.2.2 Transducer Preparation and Care 49
2.4.2.3 Patient Preparation 49
2.4.2.4 Patient Position 49
2.4.2.5 Planes of Section 50
2.4.3 Advantages and Disadvantages of Teas and Evs 51
2.5 Previous Studies 51

CHAPTER THREE

Topic Page No
3 .Material and method: 53
3.1 Material 53
3.1 . Study group 53
3.1.2 machine used 53
3.2methods 53
3.2.1 Technique used 53
3.2.2 variables of the Study 54

CHAPTER FOUR

Topic Page No

Result 55

CHAPTER FIVE

Topic Page No

5.1 Discussion 66

5.2 Conclusion 68

5.3 Recommendation 69

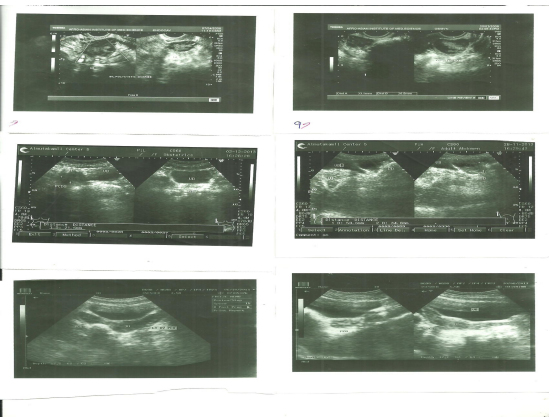
References 70

Appendix -1 71

List of figure

Number	Figure	Page Number
2-1	Anatomy of external reproductive system	7
2-2	Cross section anatomy of the ovary	9
2-3	Description passage of the ovum	11
2-4	Anatomy of the uterus	11
2-5	Blood supply to female reproductive tract	12
2-6	Uterine anomalies	27
2-7	Hemorrhagic cysts	29
2-8	Follicular cysts	31
2-9	Corpus luteum cysts	31
2-10	Theca lutein cysts	33
2-11	Dermoid cysts	34
2-12	Serouscystadenoma	35
2-13	Mucinouscystadenoma	35
2-14	Fibroma	36
2-15	PCOD	37
2-16	Hydrosalpinges	38
2-17	Endometritis	39
2-18	Endometrosis	41
2-19	Different type of uterine fibroid	42
2-20	Intramural fibroid	43
2-21	Subserous fibroid	43
2-22	Pedunculated subserous fibroid	44
2-23	Submucosal fibroid	45
2-24	Cervical fibroid	46

5-1	Bulky uterus	71
5-2	bilateral PCO	71
5-3	bilateral PCO	72
5-4	bilateral PCO	72
5-5	bilateral PCO	73
5-6	PID	73
5-7	bilateral PCO	74
5-8	simple ovarian cyst	74
5-9	bilateral PCO	75
5-10	PCO	75
5-11	simple ovarian cyst	76
5-12	intra mural fibroid	76
5-13	dermoid cyst	77



List of table

Number	Table	Page
4.1	age distribution	55
4.2	last pregnancy distribution	56
4.3	parity distribution	57
4.4	Socioeconomic status distribution	58
4.5	Patient occupation distribution	59
4.6	Symptoms distribution	60
4.7	Symptomatic patients	61
4.8	Risk factor distribution	62
4.9	Risk factor distribution	63
4.10	Ultra sound finding distribution	64
4.11	Abnormal ultra sound finding distribution	65

CHAPTER ONE

1.1Introduction:

Infertility is inability of a couple to obtain clinically recognizable pregnancy after 12 months of unprotected intercourse. Primary infertility those who have never conceived in the past and who have regular unprotected intercourse for 12 months. Secondary infertility is inability to become pregnant ,or to carry a pregnancy to term, following the birth of one or more biological children the birth of the first child does not involve any assisted reproductive technologies or infertility medication . (Jeffrey -2011)

Approximately 10 – 15% of couples are affected by infertility; the single most important factor in determining prognosis is age of the female partner. If the female age is 35 years or above fertility is halved, fertility declines sharply after the age of 37 years. Prevalence of infertility is said to be increasing globally . Specific causes of infertility cases are due to male factor about 40% female factor about 40% and the remaining 20% to a combination of male and female factors. (Najla ,2005 -2006)

Causes of female infertility include ovulatory failure, tubal damage, endometriosis ,abnormal cervical mucus, infection, PID, uterine diseases, polycystic ovarian disease (PCOD), ectopic pregnancy, medication, inflammatory bowel disease, thyroid problem, epilepsy, other miscellaneous causes.(Devin ,etal, 1992)

Ultrasound is an excellent, noninvasive imaging modality, freguently used in diagnosis of infertility, also it play a role in follow up evaluation and management of infertility. Ultrasound is play very importance role in evaluation of uterine disease and it is effective in the diagnosis of it. It is essential to start investigation early after six months after unprotected intercourse. (Devin , etal,1992)

There are others methods for investigation include: Hormone Tests, endometrial biopsy, Tests of tubal patency, Laparoscopic-hydrotubation, Hystrosalpingography, Sonohystrosalpingoraphy: Falloposcopy, Magnetic resonance imagine (MRI), Computerized Tomography (CT), Hysterography and Hysteroscopy (Sandra -1993).

1.2The problem of the study:

A lot of women attended in gynecological departments complaining of infertility. The number increased recently. Inappropriate investigation leading to delay in proper management this study aims to determine the causes of female secondary infertility by ultrasound as a rapidly evolving imaging modality in the diagnosis of infertility.

1.3 Objective:

1.3.1 General objective:- To study causes of female secondary infertility by ultrasound

1.3.2 Specific objective:

To evaluate the ability of ultrasound in the diagnosis of secondary infertility .

To determine the relationship between frequency of incidence and different risk factors.

1.4 Over view of the study:- study cover about six chapters ,chapter one The introduction . chapter two The literature review . chapter three The material and methods. chapter four the results . chapter five discussion, conclusion, recommendation , references and appendix

CHAPTER TWO

2.1Introduction:

the abdominal pelvic cavity is continuous space containing the major organs of the abdomen and pelvis. pelvic cavity is caudal portion of the abdomino- pelvic cavity extending from the iliac crests superiorly to the pelvic diaphragm inferiorly

the organs contained within the female pelvis include the urinary bladder ;genital tract and pelvic colon the ovaries and genital tract comprise the primary reproductive organs of the female ; the ovaries are paired organs; responsible for the production of the female gametes , the human ovum is fertilized within the fallopian tube - the fertilized ovum transported to the uterus through the fallopian tube the uterus provides suitable environment for implantation of fertilized egg

and for fetal development -together the fallopian tube ;uterus and vagina form the continuous muscular channel o f the genital tract (Keithl , 1998)

2.1.1Prenatal development of reproductive organs :

the reproductive organs develop with the urinary system from two urogenital folds in the early embryo. each urogenital fold consists of gonads and mesonephros. differentiation of the gonads into ovaries or testes is dependent on the genetic make-up of the embryo. the gonads are initially located in cephalic position and descend into the true pelvis during fetal development. the mesonephros is precursor of the metanephros, the urogenital sinus , wolffian (mesonephric)ducts and the mullerian (paramesonephric)ducts . the metanephros and the urogenital sinus form the urinary system, the wolffian and mullerian ducts of the female embryo fuse midline to form vagina ,uterus ,and fallopian tubes –the wolffian degenerate in the female embryo ,leaving only remnants along the broad ligaments and vaginal walls . (Devin ,etal,1992)

2.1.2gross anatomy:

the pelvic skeleton consist of the sacrum and coccyx and innominate bones. the sacrum and coccyx constitutes the distal segment of the vertebral spine and form posterior border of the pelvic cavity .the innominate bone encircle most of pelvic cavity , forming it’s lateral and anterior margins , each innominate bones join posteriorly at the sacrum and coccyx and fuse anteriorly at the symphysis bubic . the iliac crest of

the innominate bones defines the most superior aspect of the pelvic cavity , the two iliac crests and symphysis bubic are palpable external landmark which aid in evaluating the pelvic .(Keithl,1998)

2.1.3 The pelvic muscles:

the major skeletal muscles of pelvis include piriformis , obturator ,levator ani ,lliopsoas ,and rectus abdominus

2.1.3.1 Piriformis Muscle

The piriformis muscle is located in the deep pelvis lateral to the sacrum (it originates from the sacrum and inserts into the greater trochanter of the femur posteriorly). The piriformis m. may be seen posterolateral to the body of the uterus (assuming the uterus is in a median location) or posterior to the ovary. (Devin ,etal,1992)

2.1.3.2 Obturator Internus Muscle

The obturator internus (OI) muscle is located along the pelvic (inner) surface of the ilium.

The OI is a flat, thin muscle that can be seen in some patients adjacent to the posterolateral wall of the distended bladder. (Devin ,etal,1992)

2.1.3.3 Levator Ani Muscle

The levator ani and the coccygeus muscles form the floor of the pelvis (referred to as the pelvic diaphragm). The right and left levator ani m. meet in the midline and blend together to form a supporting hammock which

support the pelvic viscera. . The levator ani m. is very thin. . (Devin ,etal,1992)

2.1.3.4 Iliopsoas Muscle

The iliopsoas muscle is a compound muscle formed by the convergence of the psoas major and the iliacus m. The IP m. is located in the lateral aspect of the greater pelvis in a relatively superficial, anterior position The external iliac vessels are located directly anterior to the IP m. On the right side, the cecum and appendix are also located anterior to the IP m. the IP m. and external iliac vessels serve as landmarks for the localization of the appendix. (Devin ,etal,1992)

2.1.4 Pelvic organs:

2.1.4.1 Urinary bladder

The urinary bladder is a muscular organ with a central cavity which collects and store urin, empties via the urethra during micturition or voiding. The bladder is located in the lesser pelvis anterior to the vagina and cervix and caudal to the antiverted uterus and small bowel, the bladder is the most anterior organ in the lesser pelvis; although an expandable organ. It expands cranially pushing pelvic structures cranially and posteriorly including the antiverted uterus, ovaries, and small bowel, The bladder is only covered by peritoneum cranially making it an extraperitoneal structure the superior and inferior vesical arteries , branches of the internal iliac arteries supply the bladder , the vein from vesical venous plexus ,it is drained into the internal iliac vein , the lymph vessels drain into the internal

and external iliac nodes the nerve supply to the bladder is formed the inferiorhypogastric plexuses – the sympathetic postganglionic fibers originate in the first and second lumber ganglia and descend to the bladder via the hypogastric plexuses . (Devin,etal,1992)

2.1.4.2pelviccolon :

The rectum is located in the midline posterior to the uterus and vagina; it is a fixed structure and joins the sigmoid colon at about the third sacral vertebrae, the posterior cul-de-sac lies immediately anterior to the cranial portion of the rectum . (Devin ,etal,1992)

2.1.4.3The Sigmoid Colon

The sigmoid colon joins the rectum at approximately the third sacral vertebrae; it is attached to the posterior pelvis wall by a short mesentery; the sigmoid coursesd anteriorly, cranially, and in a leftward direction into the left flank region to become the descending colon. (Devin ,etal,1992)

2.1.4.4The Small Bowel

The small bowel is located centrally in the mid and lower abdomen cranial to the bladder and anterior to the uterus. (Devin ,etal, 1992)

2.1.4.5 genital organs

the female reproductive organs ,or genitalia ,are divided into external and internal organs.

2.1.4.5.1 female reproductive system (external)

*__Mons pubic__ or”mound of Venus’s is the v-shaped area covered with hair *labia majora are the part around the vagina containing two glands (bartholins) which helps lubrication during intercourse .

*__labia minora__ are the thin hairless ridges at the entrance of the vagina ,which joins behind and in front . in front they split to enclose the clitoris

*__the clitoris__ is small pea-shaped structure (equivalent to penis in males) it plays an important part in sexual excitement in females

*__the urethral orifice__ or external urinary opening is below the clitoris on the upper wall of the vagina and is passage for urine

__*the introitus__ or opening of the vagina is separate from the urinary opening (unlike males) and located below it

__*the hymen__ is athin cresentic fold of tissue which partially covers the opening of the vagina .it proof of virginity as it is broken after the first sexual intercourse. However it is stretchable , and may break due to vigorous, exercises ,cycling ,gymnastic or tampon use. (stevenm -2011)

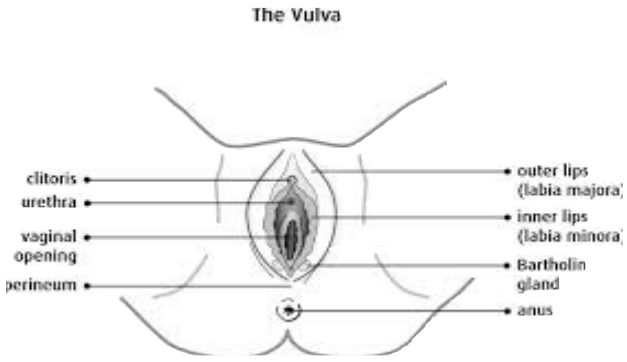


Figure 2-1

Anatomy of external reproductive system

2.1.4.5.2 female internal reproductive system

2.1.4.5.2.1The ovaries :

The ovary is divided into an outer cortex, and a central medulla. The cortex contains ovarian follicles in different stages of development, the corpus luteum, stromal tissue, and remnants of "burnt out" secondary follicles (atretic follicles) and corpus lutea(corpus albicans).

The medulla contains the larger vascular elements (ovarian artery and vein, and lymphatics) and connective tissue.With both TAS and EVS, the ovaries typically appear as distinct adnexal ovoid structure, texture similar to myometrium. In the menstruating adult woman, a normal ovary is seen to contain follicles in different stages of development depending on the phase of the menstrual cycle. The ovaries prior to puberty and in postmenopausal patients are smaller and generally more difficult to visualize because they usually lack any detectable physiologic cystic components. Ovarian follicles vary in size and maturity. Primary (primordial) follicles are small cellular complexes without a fluid-filled antrum . Each ovarian follicle contains an ovum (oocyte, egg or germ cell) surrounded by a few layers of specialized cells (granulosa cells) which secrete estrogen and progesterone. With each menstrual cycle there are numerous primary follicles which are stimulated to develop into secondary follicles. Secondary follicles develop a fluid-filled antrum (cavity) which becomes sonographically detectable as small subcortical cysts when they reach a diameter of 12 mm.Typically secondary

follicles reach a diameter of 10 to 15 mm. There is normally only one secondary follicle which grows to maturity and ovulation.

This secondary follicle is known as the dominant(Graafian) follicle. At or near the time of ovulation, the dominant follicle has an average diameter of about 20 mm (range of 18 to 25 mm). The dominant follicle appears as a spherical, anechoic, thin-walled cyst. The corpus luteum can usually be distinguished from the dominant follicle as it typically appears as a thick-walled, irregular structure containing diffuse, internal low amplitude echoes. At the end of the menstrual cycle. In the absence of pregnancy, the corpus luteum degenerates and involutes into an atretic structure called the corpus albicans which is not sonographically detectable. The position of the ovary is quite variable and dependent on the position and size of the uterus since the ovary is connected to the cornu of the uterus by the ovarian ligament. In the majority of women, the ovaries will be seen in the adnexa posterolateral to the body of the uterus. Ovaries are quite mobile and may be seen anywhere in the pelvis or lower abdomen, especially in multiparous women. When the uterus is displaced to one side, the ipsilateral ovary is generally posterior to the uterus and the contralateral ovary is more anterior; when the uterus is retroverted or retroflexed, both ovaries are typically more cranial and generally difficult to visualize in women with a hysterectomy, the ovaries may be seen in a midline location next to the vaginal cuff.

Ovarian Volume (cc) = L x AP x W x 0.5

length (L), antero-posterior dimension (AP), widthor transverse dimension (W).

When the ovary is in the ovarian fossa, it is closely related to the ureter and iliac vessels; the ureter and internal iliac vessels are located posterior to the ovary, and the external iliac vessels are located anterolateral and somewhat cranial to the ovary. Size and measurement Like the uterus, the size of the normal ovary is most dependent on the age group of the patient (the ovary exhibits only minor changes in volume with the menstrual cycle). The ovary gradually increases in size during infancy and attains its largest volume during the reproductive years; after menopause, the ovary gradually atrophies.. The normal ovary may not be visualized for a variety of reasons but the most common reason is an ovary which lies beyond the range of the transducer's display or interference by gas containing bowel between the transducer and the ovary . Other factors include previous oophorectomy (history is important!), or an ovary which is relatively small and difficult to visualize (before puberty and after menopause) . (Devin ,etal, 1992)

Figure 2-2: Cross section anatomy of the ovary –

(www.diagnosticimaging.com)

2.1.4.5.2.2fallopian tubes

1cm long, and lies within the myometrium. It is continuous laterally with the isthmus, which is 1 to 5mm wide and 3cm long, and is rounded, muscular and firm. Its lumen is narrow and exhibits three to five longitudinal major folds with a variable degree of relatively simple secondary folding. The isthmus is continuous laterally with the ampulla, the widest portion of the tube with a maximum luminal diameter of 0.1cm. The ampulla is .5cm long and has a thin wall and a tortuously folded luminal surface marked by 4 to 5 major longitudinal ridges on which lie secondary folds, creating an extensive, labyrinthine surface area Typically, fertilization takes place in its lumen. The ampulla opens into the funnel-shaped infundibulum at the abdominal os. Numerous mucosal finger-like folds, c.1mm wide, the fimbriae, are attached to the ends of the infundibulu). They extend from its inner circumference beyond the muscular wall of the tube. One of these, the ovarian fimbria, is longer and more deeply grooved than the others, and is typically applied to the tubal pole of the ovary. At the time of ovulation the fimbriae swell and extend as a result of engorgement of the vessels in the lamina propria, which aids capture of the released oocyte. All fimbriae are covered, like the mucosal lining throughout the tube, by a ciliated epithelium whose cilia beat towards the

ampulla. (susan,1998)

The two uterine (Fallopian) tubes lie on each side of the uterus in the upper

margin of the broad ligament (mesosalpinx) . They are10cm long and are pinkish red . The medial opening of the tube (the uterine os) is located at the superior angle of the uterus. The tube passes laterally and superiorly and consists of four main parts intramural isthmus ampulla and fimbria. (susan-1998)

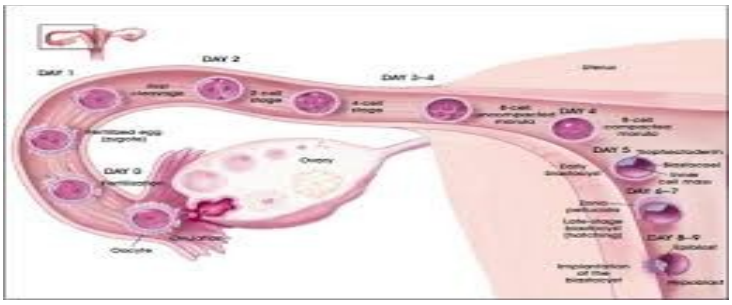


Figure 2-3 Description of passage of ovum

2.1.4.5.2.3 Parts of the Uterus

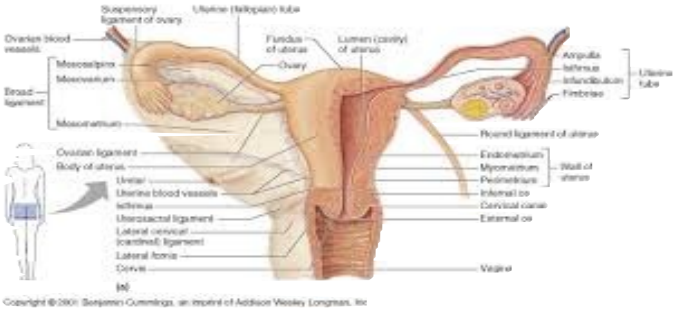
The uterus is anatomically divided into three parts - fundus, body**,** and cervix.

2.1.4.5.2.3.1 The Fundus

is the roof of the uterus. It is the part of the body which extends above the insertion of the fallopian tubes in the uterine wall. The cornu of the fundus is the lateral part which contains the interstitial portion of the fallopian tube. The fundus is the widest and thickest part of the uterus. . (Devin ,etal, 1992)

2.1.4.5.2.3 .2The Body : The body is the uterus above the cervix. The body consists of the bulk of the uterus. In an adult uterus the body is wider and longer than the cervix. About two third of uterine fundal to cervical length is

attributable to the body . (Devin ,etal, 1992) .



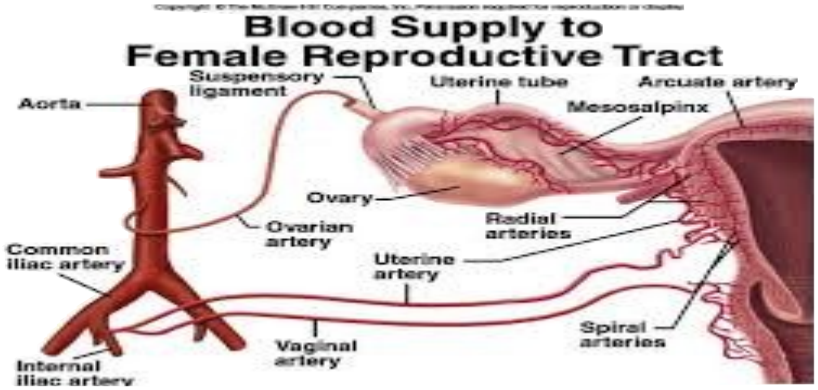
www.diagnosticimaging.com)

figure 2-4 anatomy of the uterus

2.1.4.5.2.3 .2.3The Cervix

The cervix is the lower one-third of the uterus. It is composed mainly of fibroelastic tissues rather than smooth muscle. The transition point between the corpus and cervix is known as the **internal os** and the other end of the cervix is known as the **external os**. **isthmus** is the upper few millimeters of the cervix below the internal os, an area to which the specific function of developing into the"lower segment" of the gravid uterus has been discribed. The opening in the cervix is known as the **endocervical canal.** It is contiguous with and freely communicates with the uterine cavity at one end, and the vaginal cavity at the other. When the bladder distends and drapes the uterus, the cervix is identified on transabdominal scans by its location immediately behind the posterior angle of the bladder. On transabdominal

scans, the external os is roughly located at the level of the superior border of the symphysis pubis. (Devin , etal 1992)



(www.diagnosticimaging.com)

2.1.4.5.2.3 .2.4 Tissue layers of the Uterus:

2.1.4.5.2.3 .2.4.1 Endometrium : The endometrium (mucosa) is the inner most layer of the uterus which lines the uterine cavity. The endometrium is a mucous membrane which serves as the normal implantation zone for the human blastocyst. The endometrium lines the body of the uterus, including the funds however it does not line the cervix. The endometrium consists of two layers, namely the functional layer and the basal layer. The functional layer or stratum functionalis consists of endothelium, glands and stroma. This is the superficial layer of the endometrium (adjacent to the uterine cavity) and is further divided into compact and spongy zones. The functional layer of endometrium is supplied

and drained by the spiral coiled arterioles and veins. Most of the changes in the thickness of the endometrium during the menstrual cycle is attributable to an increase in the deeper, spongy layer.The basal layer is very thin and contains the closed or blind ends of the glands. This basal layer is supplied and drained by the basal arterioles.

The sonographic appearance of the normal endometrium varies with the phase of the menstrual cycle and is strongly dependent on the effects of estrogen and progesterone. The two parameters that can be seen to vary significantly are thickness and the appearance of the functional layer, the basal layer is relatively constant in thickness and texture throughout the cycle. The endometrium appears thinnest during the menstrual and early proliferative phases; there is gradual thickening during the proliferative and early secretory phases, with maximum thickness achieved around the mid secretory phase. During the menstrual and early proliferative phases, the normal endometrium appears moderately echogenic and there is no distinction between layers. During the late proliferative and early secretory phases (periovulatory period), the endometrium has a multilayered appearance largely due to the new growth of the functional layer. The basal layer appears uniformly echogenic and the functional layer appears to have a two tiered echo appearance, with the Zone next to the basal layer appearing uniformly hypoechoic and the zone closest to the uterine cavity appearing uniformly echogenic. The multilayered echo appearance of the endometrium is a distinct feature of the periovulatory period (mid cycle).

During the mid and late secretory phases, the endometrium appears uniformly echogenic as the hypoechoic region of the functional layer increases in echogenicity and blends in with the basal layer and the more superficial zone of the functional layer. (Devin ,etal 1992)

2.1.4.5.2.3 .2.4.2 The Myometrium

The myometrium is the middle and thickest tissue layer of the uterus. It is made up of smooth muscle arranged in three zones to optimize uterine contractility during labour and delivery.

The three zones are referred to as inner, middle, and outer. The inner or internal zone of myometrium consists largely of longitudinal and circular fibres. The outer or external zone consists mainly of longitudinal fibres that pass over the fundus and converge at the cornua.

The middle or intermediate zone is the thickest, consisting of two principal groups of symmetric smooth muscle, each arising in each uterine cornu. The two systems interdigitate in the mid sagittal plane of the uterus.In general, the myometrium appears as a tissue with a uniform echo texture consisting of low to moderate echo amplitude. Myometrial inhomogeneity is a sign of abnormal tissue and may be associated with several diseases. The inner zone of myometrium is usually sonographically distinct from the middle and outer zones. The inner zone of myometrium generally appearsas a 1-2 mm hypoechoic band referred to as the subendometrial or myometrial halo. (Devin ,etal 1992)

2.1.4.5.2.3 .2.4.3 The Perimetrium

The peritoneum is the outer tissue layer covering the body of the uterus. This layer is a thin serous lining which represents the visceral layer of the peritoneum. The perimetrium is continuous with the broad ligament which stretches laterally on both sides towards the pelvic side walls. The perimetrium only covers the vesicular (bladder) surface of the uterus up to about the level of the internal os, however it reflects over the entire rectal surface of the uterus including the cervix. The perimetrial surfaces of the uterus should appear smooth. Irregularity of the perimetrium is an abnormal finding and associated with several uterine diseases). (Devin ,etal,1992)

2.1.4.5.2.3 .2.4.4 The Uterine Cavity

The endometrium lines the central cavity of the uterus known as the uterine or endometrial cavity. The normal uterine cavity is usually empty and appears on TAS and EVS as a central echoes. This stripe should always be seen when the uterus is empty however it may be difficult

To visualize for technical reasons. The empty uterine cavity is a specular reflector which means display of the echo is very dependent on the angle of incidence. If the sound beam is perpendicular to the normal cavity, a bright echo should be displayed. Conversely, a weak echo or no echo will be seen depending on the degree of oblique incidence. It is usually very difficult with

TAS to see the uterine cavity stripe when the uterus is retroverted since the angle of incidence is usually too oblique; converse, the cavity stripe of a retroverted uterus is usually easy to visualize with EVS because perpendicular incidence is easier to achieve. (Devin ,etal,1992)

2.1.4.5.2.3 .2.4.5 Uterine Position

Several ligaments support and maintain the uterus in a midline position The broad ligament is a double fold of peritoneum attaching the uterus to the right and Left pelvic side walls (the broad ligament is a direct peritoneum attaching the uterus to the right and left pelvic side walls (the broad ligament is a direct extension of the anterior and posterior peritoneal surfaces of the uterus (perimetram) .Uterine blood vessels, the ureters, and nerves pass between the Tow leaves of the broad ligament . The uterine tubes course in the cranial "free" margins of the broad ligaments ,The round ligament (of the uterus) arises from the anterior cornual region of the uterus and courses forward and downward to pass in the inguinal canal and insert in the labia major; it is the key ligament maintaining the normal uterus in an anteverted position .The uterosacral ligament courses from the posterior surface of the cervix to the front of the sacrum. The transverse cervical or Cardinal ligament courses laterally from the uterus and vagina to a wide insertion in the lateral pelvic wall .The ovarian ligament attaches the ovary to the cornual region of the uterus; consequently changes in uterine position and size have a direct affect on the position of the ovary . The normal, non-gravid uterus is located in the midline posterior to the urinary bladder and

small bowel, and anterior to the rectum. In the majority of women, the fundus is directed anteriorly and the cervix posteriorly with a slight bend between the axis of then body and cervix (i.e. anteverted and slightly anteflexed). When describing uterine position, version and flexion are used. Anteversion describes a uterus with the fundus directed anteriorly towards the anterior abdominal wall. Retroversion describes a uterus with the fundus directed posteriorly towards the rectum and sacrum. Anteflexion describes a folded uterus with the fundus directed caudally and the body lying anterior to the cervix . Retroflexion describes a folded uterus with the fundus directed caudally and the body lying posterior to the cervix The body of the uterus may also be tilted to the right or left of midline. (Devin ,etal,1992)

2.1.4.5.2.3 .2.4.6 Uterine Measurements

Potential uterine measurements include uterine and cervical length, anteroposterior (AP) and transverse diameters of the body and cervix, AP and transverse diameters of the cervix, endometrial thickness, and uterine volume. Most practitioners routinely measure only uterine length. Endometrial thickness should be measured. it is usually measured in postmenopausal women and infertility patients. (Devin ,etal,1992)

2.1.4.5.2.3 .2.4.6 Uterine length

should be measured from the external os to the serosal surface of the fundus in an appropriate image through the centre of the uterus. This

measurement is more difficult to perform with EVS since the image display area is smaller than accorded with TAS transducers. The mean length of the normal, non gravid, nulliparous uterus in a patient of reproductive age is about 7.5 cm. Parity status has the greatest effect on the size of the non gravid, non diseased uterus, e.g. woman who has given birth to four children (multiparous will have a uterus which is significantly larger than a nulliparous uterus). The postpartum uterus takes approximately four to six weeks to return to a pregravid size after parturition (delivery). The AP diameter of the uterus may be measured on an appropriate sagittal or transverse TAS image and on an appropriate sagittal or coronal EVS image of the body near the fundus. Calipers are placed on the near and far side perimetrial surfaces of the uterus for the AP measurement and on the right and left uterine surfaces for the transverse measurement. . (Devin ,etal,1992)

2.1.4.5.2.3 .2.4.7 Endometrial Thickness

Endometrial thickness should be measured on a sagittal (long axis) TAS or EVS image of the uterus. the standard endometrium thickness measurement is the widest anteroposterior diameter of the double thickness of endometrium (near the fundus). The measurement cursors should be positioned at the myometrium-endometrium boundary perpendicular to the axis of the uterine cavity. Pitfall :The inner myometrium (hypoechoic myometrial halo) should not be included in the endometrial measurement.

Normal postpubertal endometrial thickness is very dependent on the phase of the menstrual cycle. During the proliferative phase, the normal endometrium typically measures 2-8 mm. During the secretory phase, the endometrium gradually thickens and measures 8-14 mm. In postmenopausal women, the normal, unstimulated endometrium should be thin and typically measures less than 5 mm. Endometrial Volume as previously indicated, 3D ultrasound imaging is more accurate than conventional 2D planar imaging for volume assessment however clinical results to date indicate endometrial volume measurement is of limited value in the diagnosis of endometrial abnormalities (2D section thickness measurements provide adequate information). Uterine Size and Body-to-Cervix Proportions uterine size and shape vary with the age, parity, and the patient's endocrinologic status. Neonatal Uterus - The uterus may appear relatively large in a neonate due to the influence of maternal and placental estrogen on the fetus. At birth, the uterus begins to gradually atrophy to an infantile size. Infantile Uterus - The mean length of the infantile uterus is about 3 cm. The cervix to body ratio is approximately two to one (2/3 of the uterine length consists of cervix). At about 7 years of age, the uterus begins to gradually increase in size and attains adult proportions at puberty. The endometrium is thin throughout infancy. Postpubertal Uterus - at puberty, with the full production of estrogen, the uterus grows and attains adult size and body-to-cervix proportions. The body gains the most bulk and is longer and wider than the cervix. The cervix-to-body ratio is approximately one-to-two (1/3 of the uterine length consists

of the cervix; these proportions are inverse of the infantile uterus. The endometrium undergoes cyclic thinning and thickening during the menstrual cycle. Postmenopausal Uterus - Menopause typically occurs at the beginning of the fifth decade of life although it may occasionally occur before this or be delayed. At menopause, the uterus begins to atrophy gradually due hypoestrogenism. Most of the`seventh and eighth decade, the cervix typically appears larger than the body. (Devin Dean ,etal,1992) Effects of Parity - Normal uterine size in the reproductive years is significantly affected by parity. In general, the greater the parity, the larger the size of the normal, non gravid uterus . (Devin ,etal,1992)

2.1.4.5.2.4 The vagina:

The vagina is a tubular structure lined with a mucous membrane. The opening of the vagina is called the **introitus**. The vagina extends from the introitus to the cervix, the canal of the vagina is normally collapsed. It is situated between the urinary bladder and the rectum. It is directed superiorly and posteriorly, where it attaches to the cervix ,the vagina surrounds approximately the outer two thirds of the cervix ,the vaginal canal between the cervix and the vaginal wall is known as a **fornix** , including anterior, posterior, right and left lateral components. The posterior fornix extends more cranially (deeper) than the anterior and two lateral fornices. The posterior fornix is intimately related to the posterior cul-de-sac which extends behind it. The anterior cul-desac is smaller than its posterior counterpart and does not as closely related to the anterior fornix.. The

vagina is anchored in the midline between the lower aspect of the urinary bladder anteriorly and rectum posteriorly. Although the position of the vagina is unaffected by bladder distention, it may be elongated by a filled bladder. The long axis of the vagina is approximately perpendicular to the long axis of the anteverted uterus when the bladder is empty. (Devin ,etal,1992)

2.2 Reproductive physiology:

In the normal female between the age of 9 and 16, cyclic changes occur in the ovaries and the uterus in response to endocrinologic activities. These cyclic changes are known as the menstrual cycle and represent the reproductive phase of a female's life cycle. The changes associated with the ovary are known as the **ovarian cycle** whereas those associated with the endometrium are known as the **endometrial cycle**. The purpose of the ovarian cycle is to provide a suitable ovum for fertilization, whereas that of the endometrial cycle is to provide a suitable site in which the blastocyst can implant and develop properly. Since the endometrial changes are regulated by the ovarian hormones, the two cycles are intimately related. The typical menstrual cycle is 28 days however variations are very common and normal. For the purpose of description, the 28 day "idealized" cycle is used. The cycle is divided into four or five phases. It is customary to assign the first day of menstruation as the first day of the cycle. (Devin ,etal,1992)

2.2.1 Ovarian Cycle:

Throughout the reproductive years, at the onset of each menstrual cycle, a number of small, immature follicles known as **primary** or **primordial follicles**, undergo growth and development. The hormonal stimulus that activates the follicular process is mediated by follicle-stimulating hormone or FSH which is secreted by the anterior pituitary gland. With each menstrual cycle, there is usually only one mature follicle, known as the **dominant** or **Graafian follicle**, which makes its way to the surface of the ovary where it appears as a transparent cyst. The mature preovulatory follicle contains the ovum at one end and a cystic cavity or antrum at the other. There are several layers of specialized cells known as **theca** and **granulosa cells** which secrete estrogen,progesterone and luteinizing substances. The ovum is released from the mature follicle during ovulation. Ovulation normally occurs on day 14 which is the mid-point of the idealized cycle. Following ovulation, the ruptured dominant follicle becomes the corpus hemorrhagicum which is then followed by the **corpus luteum**. The corpus luteum (CL) secretes progesterone (as well as estrogen) which is absolutely necessary to maintain the endometrium for successful implantation. If fertilization does not occur, the CL undergoes regressive changes, progesterone output is diminished, and by the end of the cycle complete regression occurs. The failing CL triggers endometrial sloughing, and menstrual bleeding ensues. The end point of the regressing CL is the **corpus albicans**, which is a small fibrous area in the cortex of the ovary. the theca interna cells of multiple secondary follicles full fill an endocrine function as they differentiate into

estrogen. secreting cells the hormone estrogen promotes proliferation of the endometrium while many follieles develop in the ovaries in response to follicle stamulating hormone (FSH), only one follicle matures completely to be released at avulation. Most of the follicles undergo follicular atresia beyond the stage of secondary follicle .one secondary follicle continues to mature to become agraafian follicle prior to ovulation. The ovum continues to mature through meiotic divition, forming the secondary oocyte . Now the oocyte floats freely with in the enlarged follicular antrum of the graafian follicle . The follicular cells of the cumulus oophorus now completely surround the zona pellucida and the secondary oocyte, and are called the corona radiate. The theca interna cells of graafian follicle continue to produce estrogen. The graafian follicle migrates to the surface of the ovary,while the remaining secondary follicle undergo atresia. At approximately day 14 of the ovarian cycle ,the mature ovum is expelled into the peritoneal cavity. The fimbria of the ovi duct draws the released egg into the infundibulum. At ovulation ,5 to 10 ml of follicular fluid is released into the peritoneal cavity ,settling into the posterior cul de sac. the rupture graafian follicle collapse ,fills with blood, and is transformed into a temporary endocrine gland. This begins the luteal phase of the ovarian cycle (day 15 to 28). The remaining follicular structre is now called corpus luteum and contains a central blood clot surrounded granulosa luteal cells ,theca luteal cells ,and the theca externa . The granulosa luteal cells enlarge and secreate progesterone which promotes glandular secretion of the endometrium. The

theca luteals continue the estrogen secretion of their precursor (theca interna), maintaining the proliferated endometrial lining of the uterus .the outer theca externa cells support the rich vascular network characteristic of an endocrine gland. Luteinizing hormone (LH) is produce by the anterior pituitary gland throughout the ovarian cycle. This hormone promotes secretion of estrogen and progesterone by the ovary. Both estrogen and LH peak immediately prior to evulation, while the corpus luteum is dependent on LH ,progesterone negatively inhabits the production of LH stimulation, and only afibrous tissue mass , called the corpus albicans, remains in the ovary. When the levels of the estrogen and progesterone diminish, the thickened endometrial lining of the uterus is shed through menstruation of the fertilized ovum human chrionic gonadotropine (HCG) is secreted by the developing placenta. This hormone has an analogous function to LH, maintaining the corpus luteum. Thus, during pregnancy, the corpus luteum continues to secrete estrogen and progestore throughout the first trimester. The placenta ultimately lakes over this endocrine function and the corpus luteum regresses, forming the corpus albicans. (Sukkar- , 2006)

2.2.2Endometrial Cycle

With each menstrual cycle, and in step with ovarian activity, the functional layer of the endometrium undergoes changes characterized by regeneration, proliferation, secretory activity, necrosis, and sloughing. During menstruation, the functional layer of the endometrium is sloughed off and along with blood, passes into the vagina. Following menstruation, new

functional layer begins to form from the basal layer. Primed by estrogen secreted by the ovary, the endometrium progressively thickens throughout the proliferative and secretory phases.

Following ovulation and the formation of the CL, the endometrial glands exhibit secretory activity. If fertilization does not occur, the corpus luteum undergoes regressive changes, and the endometrium, supported by the hormonal output of the ovary, begins to "shrink". The shrinking is due to the loss of tissue fluids and secretions which occurs secondary to the drop in estrogen. Estrogen has a "water-retaining" effect on tissues whereas progesterone is a factor in the secretory activity of the gland. As the endometrium shrinks, the spiral arteries kink resulting in vascular stasis followed by ischemia, necrosis, sloughing and bleeding. The menstrual cycle is a continuous ongoing cycle but for descriptive purposes it is divided into specific phases based on hormonal levels, and events occurring in the ovary and endometrium. The hormonal relationships and the effects of these hormones on the receptor tissues and organs are considered with these phases in mind. The "ideal" 28 day cycle will be considered although in reality the length of the normal menstrual cycle may vary . (Devin ,1992)

2.3 Pathology: Causes of Infertility

2.3.1Congenital Anomalies of the ovary

All forms of congenital development of the ovaries are rare. Bilateral ovarian dysgenesis or aplasia is primarily associated with Turner's syndrome (45,XO). In an adult, Turner's syndrome is characterized by short stature, absence of secondary sexual characteristics and infantile genitalia. All forms of developmental anomalies of the ovary are rare. They include unilateral or bilateral agenesis or dysgenesis, ectopic ovary, third ovary, and false or accessory ovaries. If one ovary or both ovaries are not seen with ultrasound (in the absence of oophorectomy), the most likely explanation is non-visualization for technical reasons, i.e. interference from bowel gas or ovary located beyond field-of-view . (Devin ,etal,1992)

2.3.2 Congenital Anomalies of the uterus

The diagnosis of congenital anomalies of the uterus and vagina is important in the treatment of patients with infertility and recurrent pregnancy loss, and in the management of symptoms that arise from an obstructed or deformed reproductive tract. The use of ultrasound imaging to detect uterine anomalies has increased with the advent of better technologies, especially

endovaginal probes and three-dimensional (3D) displays. Classification**:** there are many different types of uterine anomalies and several classification systems.**v**Our focus will be on the most common anomalies identified with ultrasound evaluation and their sonographic appearance. (Devin,etal,1992)

2.3.2.1Agenesis / Hypoplasia

Agenesis indicates a structure fails to develop and is absent at birth . hypoplasia indicates a structure that is congenitally small or underdeveloped but otherwise usually normal in structure and function. (Devin ,etal,1992)

2.3.2.2Unicornuate Uteru

results in absence of both fallopian tubes and the uterus; agenesis of the cranial end of one Mullerian duct results in absence of a fallopian tube and results in a unicornuate uterus; absence of development of the caudal end of both Mullerian ducts results in agenesis of the cervix and incomplete development results in congenital cervical stenosis; hypoplasia can result in underdevelopment of the uterine tubes or any part of the uterus and the cranial part of the vagina .(Devin ,etal,1992)

2.3.2.2Unicornuate Uterus

Unicornuate uterus describes a uterus with only one fallopian tube and an asymmetric, smaller-thannormal fundus. Synonym - uterus unicornisna . (Devin Dean ,etal,1992)

2.3.2.3Arcuate Uterus

Arucate uterus describes a uterus with a minor saddle-like defect" of the fundus (too small to be classified as a septum). Synonym - uterus arcuatus."

(Devin ,etal,1992)

2.3.2.4 Didelphys

Uterus didelphys describes complete duplication of the uterus including the cervix; frequently associated(75%) with a longitudinal septum of the vagina .

(Devin ,etal,1992)

2.3.2.5 Bicornuate Uterus

Bicornuate uterus describes a uterus with symmetric division of the fundus (bifid or forked fundus), with or without duplication of the cervical canal. A *bicornis bicollis* uterus describes a bicornuate uterus with two cervical canals (medial wall is common). A *bicornis unicollis* uterus describes a bicornuate uterus with a normal cervix. (Devin ,etal,1992)

2.3.2.6 Septate Uterus

A septate uterus is an anomalous uterus with partial or complete division of the uterine cavity by a muscular septum without any serosal indentation of the fundus. Septate uteri are three times more common than bicornuate uterus . (Devin ,etal,1992)

2.3.2.7 Uterus Septus

Uterus septus is the least common form of septated uterus; a muscular septum divides the uterine cavity up to the internal os; the serosal surface of the fundus, the cervix and vagina are all normal**.** (Devin,etal,1992)

2.3.2.8 Uterus Subseptus

Uterus subseptus is a uterus with only partial separation of the uterine cavity by a partitioning

septum; the cranial portion of the uterine cavity is separated by a muscular septum; the serosal

surface of the fundus is normal; the lower portion of the body of the uterus, cervix and vagina are all normal. (Devin ,etal 1992)

2.3.2.9 Rudimentary Horn

One mullerian duct develops normally and forms a uterus with a normal body and cervix and the second mullerian duct only develops partially resulting in a smaller dysfunctional body on the other side. The rudimentary horn may lack a uterine cavity or may have a uterine cavity which may or may not communicate with the main uterine cavity and cervix. At puberty, a rudimentary horn with a non communicating uterine cavity (obstructed horn) results in hematometra (blood in an obstructed uterus) as menstrual flow is unable to reach the

cervix; this is associated with cyclic pain that lasts for several days. Pregnancy can occur in a rudimentary horn, a rare but potentially lethal condition associated with mid trimester uterine rupture and massive abdominal hemorrhaging (Devin,etal 1992).

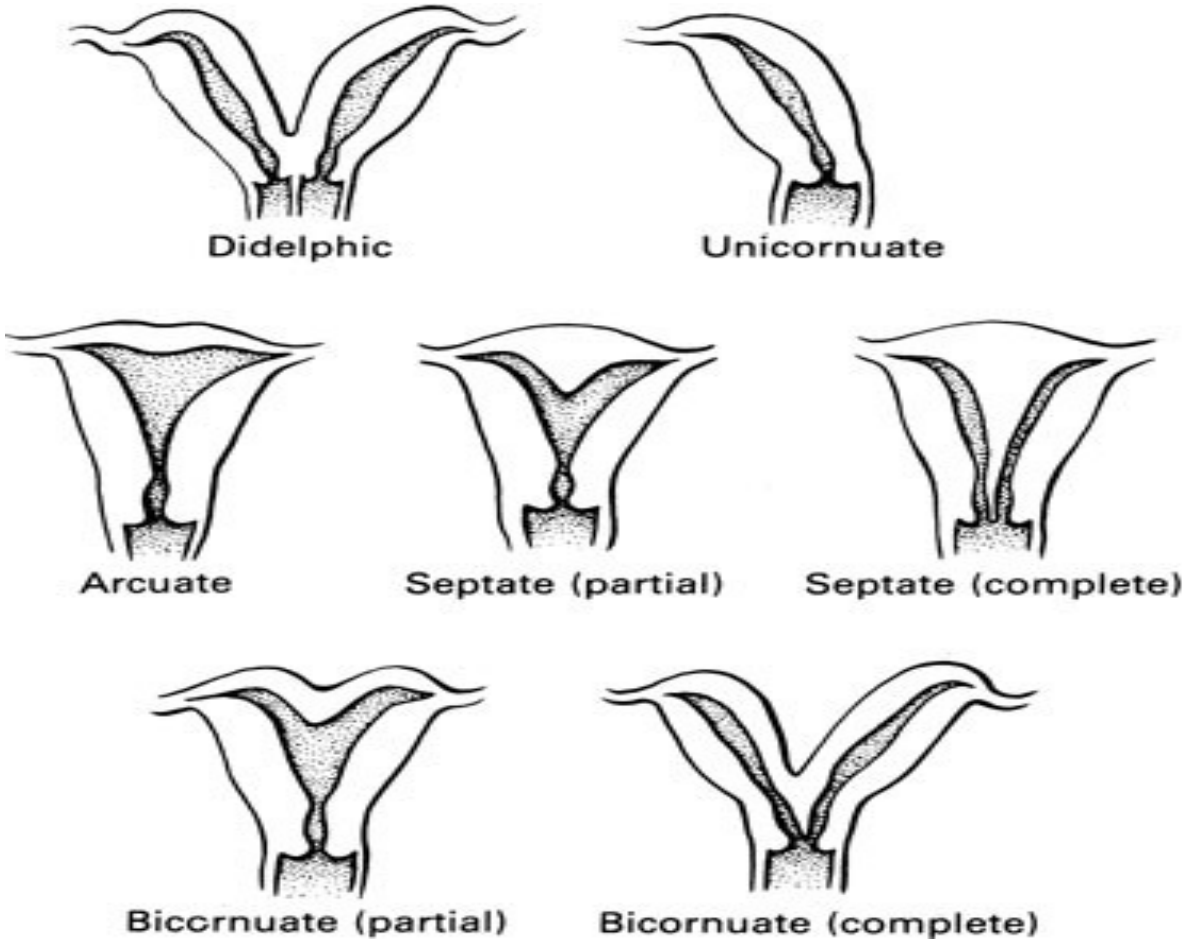


Figure 2-6 Uterine Anomalies – (www.imagingconsult.com)

2.3.3 Congenital Anomalies of the vagina

2.3.3 .1Vaginal Agenesis

The external genitalia are normal, and the fallopian tubes are usually normal. the cervix may be absent (cervical agenesis) or small (cervical hypoplasia). The uterus may be normal or have any variety of mullerian malformation. The majority of cases of vaginal agenesis are associated with uterine agenesis. Mayer-Rokitansky-Küster-Hauser (MKRK) syndrome describes an

individual with a 46,XX karyotype who has normal ovaries and fallopian tubes associated with agenesis of the vagina and different degrees of uterine aplasia. The external genitalia are normal except for the vagina, which is a shallow, undeveloped pouch. The usual clinical presentation is of menarchal delay (primary amenorrhea). Patients with a functional endometrium will also present

with postpubertal cyclic pelvic pain. Ultrasound findings depend on the extent of vaginal agenesis .(Devin ,etal,1992)

2.3.3 .2 Imperforate Hymen

The normal vaginal orifice or introitus is partially covered by a thin fold of tissue known as the hymen. At puberty, menstrual blood is able to pass externally via small perforations in the hymen. An imperforate hymen is an abnormal fibroelastic membrane which completely covers and obstructs the introitus. An imperforate hymen occurs when a lumen fails to develop at the origin of the embryonic vagina in the urogenital sinus. Imperforate hymen is asymptomatic until puberty when the adolescent typically complaints of cyclic, lower abdominal pain and presents with primary amenorrhea. Menstrual flow is obstructed by the imperforate hymen and collects the vagina (**hematocolpos**), if the diagnosis is delayed, menstrual blood may also collect in the uterus (**hematometra**) and in the tubes (**hematosalpinx**)**.** (Devin ,etal,1992)

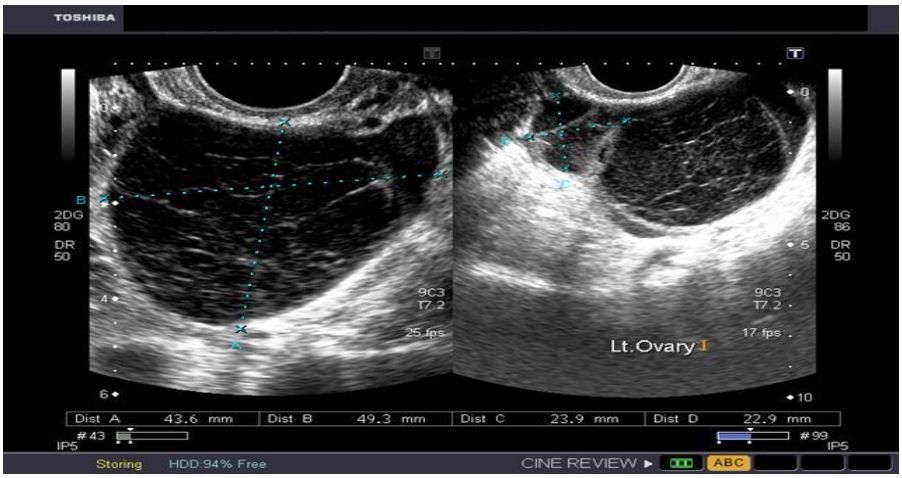
2.3.3 .3 Vaginal Septum

Vaginal septum is a rare abnormality. A vertical or sagittal septum of mullerian origin may divide the cranial portion of the vagina. This type of septum results in a so called “double vagina” and is most commonly associated with uterus didelphys. (Devin etal;1992)

2.3.2 Acquired disease:

2.3.2 .1 Hemorrhagic Ovarian Cysts

Hemorrhagic ovarian cysts (HOC) usually represents acute bleeding in the corpus luteum during the early luteal phase of the menstrual cycle (day 15-21). The majority of patients with HOCs are premenopausal and present with sudden onset of pelvic or lower abdominal pain, an adnexal mass The evolution of fresh blood, fibrin, and clot in HOCs produce changing sonographic appearances that can be appreciated on serial examination. Classically, fresh blood is relatively echo free. In sub acute stages when the clot forms, it becomes echogenic. the echogenicity of the HOC diminishes with time as the red cells undergo hemolysis. In the initial 24 hours the blood is echogenic but after this time its echogenicity decreases so that by 96 hours it may be entirely echofree. The sonographic appearance of HOC is multi-faceted and depends on the timing of the ultrasound study in respect of the hemorrhagic process as well as technical considerations especially transducer frequency . The average diameter of HOCs is 3.0 to 3.5 cm (range, 2.5-8.5 cm) The cyst wall is usually thin, well defined, and smooth. The cyst exhibits posterioracoustic enhancement . (Devin ,etal,1992)



www.ultrasound – images gallery.com

Figure 2-7 . TV scan shows huge complicated Ovarian Cysts consistent with (HOC)

2.3.2 .2Normal Physiologic Cysts

Developing follicles, the dominant follicle and the corpus luteum are all normal, Non- pathologic, physiologic or functional cysts which may be routinely seen with ultrasonography of the ovaries. These physiologic cysts are unilocular, measure less than 3 cm in diameter , and their presence and sonographic characteristics correlate with the phase of the patient's menstrual cycle. Normal physiologic cysts appear and disappear spontaneously during the course of a normal menstrual cycle. Normal, developing follicles are anechoic, thin-walled simple cysts and measure 5 to 15 mm in diameter. The dominant preovulatory follicle is also a simple cyst which measures about 20 mm prior to ovulation. The corpus luteum typically appears as an irregular 20-30 mm cyst with internal echoes secondary to hemorrhage and other cellular debris. . (Devin ,etal,1992)

2.3.2 .3Pathologic Physiologic Cysts

There is variability in the classification and description of pathologic, physiologic, non-neoplastic cysts of the ovary. Not all physiologic cysts of the ovary are hormonally active . These cysts normally regress spontaneously after 1 to 3 months however they may have to be surgically removed if complications arise (hemorrhage, infection, torsion) or if the clinical picture is confusing. (Devin ,etal,1992)

2.3.2 .3.1 Follicular Cysts :

Follicular cysts (FCs) are presumed to occur when a dominant follicle fails to ovulate. FCs may be asymptomatic and incidentally detected on routine pelvic examination. Sonographic appearance of FCs most commonly appear as unilateral simple cysts measuring 3-5 cm in diameter. With hemorrhaging, FCs would be indistinguishable from hemorrhagic ovarian cysts (corpus luteum cysts). FCs typically regress spontaneously within three months. (Devin ,etal,1992)

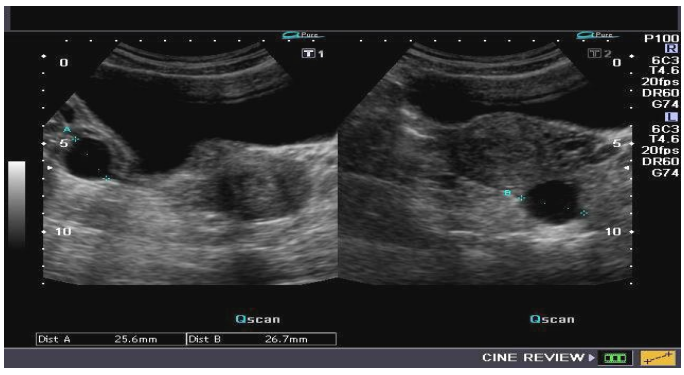


Figure 2-8 TA scan of the female pelvic ultra sound shows **Follicular Cysts**

www.ultrasound – images gallery.com

2.3.2 .3.2 Corpus Luteum/Corpus Albicans Cysts

Excessive bleeding into a corpus luteum or failure of normal organization, absorption, or atresia results in a corpus luteum (CLC) or hemorrhagic ovarian cyst which was previously described. Because the normal function of the corpus luteum is to produce progesterone, CLCs are usually

hormonally active and may cause menstrual disturbances (typically amenorrhea or delayed menstruation). If a CLC persists without hormonal activity (luteal cells stop working), it is referred to as a corpus albicans cyst (CAC). Sonographic appearance: Appear as unilateral cyst with thick irregular wall contain internal echoes . (Devin ,etal,1992)

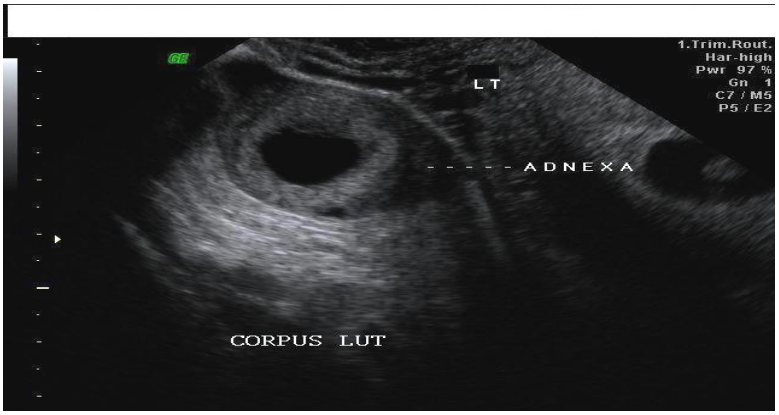


Figure 2-9 TV scan shows Corpus Luteum Cysts (www.ultrasound images gallery.com)

2.3.2 .3.3Serous Inclusion Cysts

These cysts may occur at anytime in life however they are most frequently encountered in postmenopausal women. These cysts are hormonally inactive. These tend to be very small (<1 cm) but occasionally grow to be

several centimeters in diameter. They are typically thin-walled, unilocular, and sonographically simple. Internal echoes may be seen with internal hemorrhage. Since these cysts are functionless, they do not cause menstrual disruption in the menstruating patient or abnormal bleeding in the menopausal patient. Most small, simple cysts seen in postmenopausal ovaries are proven to be serous inclusion cysts. (Devin ,etal,1992)

2.3.2 .3.4 Theca Lutein Cysts :

Theca lutein cysts (TLCs) represent multiple follicular cysts which occur when the ovaries are hyperstimulated or oversensitized to human chorionic gonadotropin (hCG), or less commonly, an infertility drug (e.g. human menopausal gonadotropin or Pergonal) administered in the management of infertility for the purpose of follicular development and ovulation stimulation. TLCs occur most commonly in conditions associated with abnormally high levels of HCG which includes all forms of gestational trophoblastic disease (e.g. hydatidiform mole). Rarely, TLCs may develop with normal multiple pregnancy (twins, triplets, etc...) or even with a normal, singleton pregnancy when the HCG levels are within normal limits for gestational age. When TLCs develop during pregnancy with normal serum levels of HCG, the situation is known as hypereactio luteinalis. TLCs associated with hyperstimulation to an infertility drug (most commonly Pergonal) is known as ovarian hyperstimulation syndrome (OHSS). In more advanced cases of OHSS, patients have ascites and may also have a pleural effusion. Sonographic appearance: TLCs can vary considerably in size (2-10 cm cyst diameter)

depending on the degree of ovarian stimulation. These cysts typically produce a “soap bubble” or “spoke wheel” sonographic pattern. **.** A small area of solid ovarian tissue representing ovarian stroma can usually be seen in the center of the multilocular cystic ovary (the hub of the spoked wheel). TLCs are usually managed conservatively and should regress gradually when the stimulating agent is removed i.e molar pregnancy is evacuated or infertility drug is stoppe . (Devin ,etal,1992)

Figure 2-10 TV scan shows Theca Lutein Cysts

netpub/wwwroot/aaims23/GynAtlas3.htm

2.3.2 .4 Benign Cystic Teratomas(BCTs)

BCTs are ovarian tumors of germ cell origin commonly referred to as **dermoid cysts**. They are the most common benign germ celll tumor and the most common ovarian tumour. BCTs are composed mainly of tissues derived from ectoderm which is the embryonic tissue which gives rise to external tissues such as skin, teeth and hair. BCTs are lined with a skinlike tissue and are typically filled with a sebaceous, greasy or cheesy material land hair. Many BCTs will have a mural nodule (solid component) of variable size known

as a dermoid plug which represents very densely packed hair. It is and common to find teeth in the cyst wall. In the general population, BCTs are the most common ovarian tumors. Approximately 95% of all germ cell tumors are BCTs. Most BCTs are diagnosed between 25 and 50 years of age however 75% of all ovarian tumors that occur before age 20 are BCTs. BCTs are bilateral in 10 to 13 % of cases, and very infrequently multiple BCTs can occur in the same ovary. BCTs typically present as a pelvic mass detected on physical examination or imaging studies in asymptomatic women. Torsion and rupture are uncommon but may lead to the diagnosis. Many BCTs are diagnosed during pregnancy as an incidental finding. Occasionally the diagnosis of BCTs is suspected on an abdominal x-ray when radiopaque densities caused by teeth, bones or areas of calcification are seen. Sonographic appearances BCTs have a wide spectrum of grayscale sonographic appearances including cystic, complex and solid masses. The echogenicity and homogeneity of solid appearing BCTs is variable. (Devin ,etal,1992)

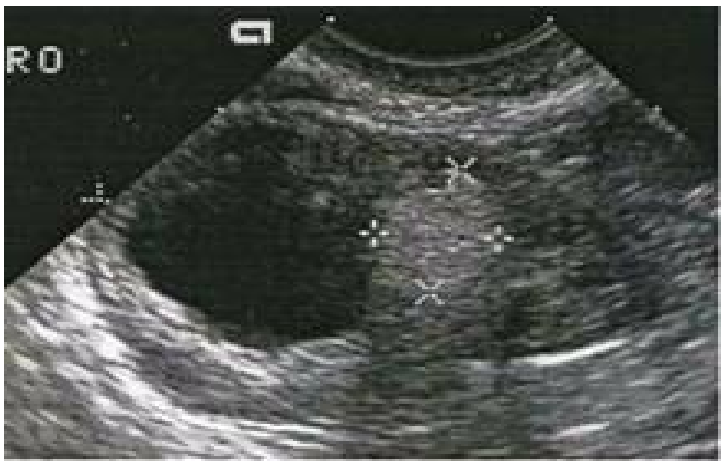


Figure 2-11. TV scan shows cyst contain hyperechoic component has ecoustic shadow consistent with dermoid cysts (netpub/wwwroot/aaims23/GynAtlas3.htm)

2.3.2 .5 Surface Epithelial-Stromal Tumors (SES)

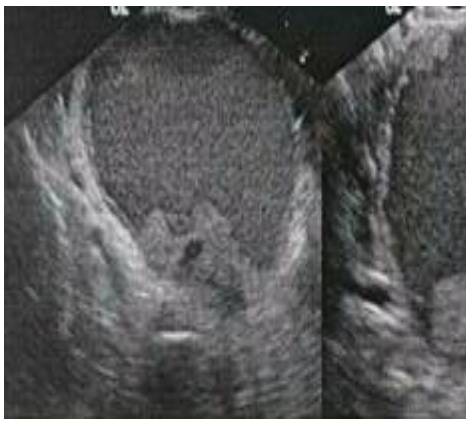
SES tumors of the ovaries account for about 60% of all ovarian tumors and 80% to 90% of primary ovarian malignancies (the majority of ovarian cancers are SES tumors). These tumors

originate from the surface epithelium and adjacent stroma of the ovaries. They rarely occur

before puberty, and in hisage group most are benign, and those that are atypically proliferating are borderline malignant. SES tumors consist of five broad categories of tumors,with the most common type consisting of serous and mucinous cystadenomas and cystadenocarcinomas which I will describe in greater detail. Mucinous types are sometimes referred to as pseudomucinous. Serous and mucinous tumors may be benign or malignant. Cystadenoma refers to the benign type and cystadenocarcinoma refers to the malignant counterpart. The serous type is more common than the mucinous and accounts for the majority of ovarian surface epithelial cystadenocarcinomas. Serous cystadenocarcinomas account for about 40% of malignant ovarian tumors. Grossly, these ovarian tumors are typically cystic masses with numerous internal septations. In addition to septations,

the cysts may also have mural nodules referred to as papillary excrescences. (Devin ,etal,1992)

Figure(2-12)TA U/S showed serouscystadenoma



Figure(2-13) TV U/S showed mucinouscysta

(netpub/wwwroot/aaims23/GynAtlas3.htm)

2.3.2 .5Fibromas are relatively common connective tissue tumors of the Ovary arising from non-functioning ovarian stroma. They are typically solid and bilateral in approximately 10% of cases. They vary in size and may occur at any age but are most common in postmenopausal women. A benign fibroma with concurrent ascites and hydrothorax (pleural effusion) is known as **Meig's syndrome** (less than 5% of patient's with an ovarian fibroma develop this syndrome).

There are no distinguishing sonographic features between ovarian fibromas and other solid ovarian tumors. Typically, ovarian fibromas are myoma-like in

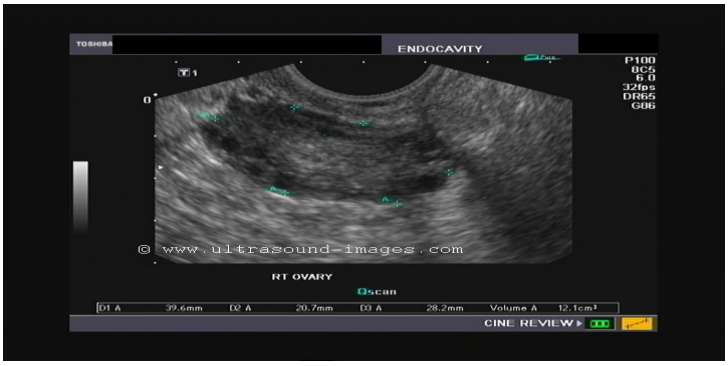
their sonographic appearance (hypoechoic and strongly attenuating). The main differential diagnosis is a pedunculated subserous uterine myoma. (Devin ,etal,1992)

Figure(2-14.) TA ultra sound shows hypo echoic mass consistent with fibroma **(netpub/wwwroot/aaims23/GynAtlas3.htm)**

2.3.2 .6 Polycystic Ovarian Disease (PCOD)

PCOD is a complex endocrine disorder characterized by chronic anovulation associated with elevated serum androgen levels (hyperandrogenemia) and unbalanced elevations of serum LH levels (PCOD is the most common cause of chronic anovulation). The clinical and sonographic manifestations of PCOD are variable depending on the degree of hormonal imbalance. Patients may present with amenorrhea, oligomenorrhea, or other menstrual irregularity; other symptoms include hirsutism, infertility, and obesity. Stein-Leventhal syndrome is the clinical manifestation of PCOD associated with obesity, hirsutism, and amenorrhea. Stein-Leventhal syndrome spans a wide array of clinical manifestations including anovulation and infertility in addition to the classic triad of obesity, hirsutism, and amenorrhea. Women with Stein-Leventhal syndrome represent only a small subset of all women with PCOD

although the names are often used interchangeably. Hormonal findings of PCOD include a generalized increase in serum androgens (androstenedione. testosterone) as well as an elevation of serum LH in the presence of normal to low serum FSH levels, resulting in an increased LH/FSH ratio which in many cases approaches or exceeds 2.5:1. Ultrasound appearances : Patients with PCOD typically have bilateral ovarian enlargement, numerous immature follicles without evidence of dominance (cysts <15 mm), and stromal hypertrophy with increased echogenicity. There are two morphological patterns of polycystic ovaries including peripheral and generalized distribution of cysts. The peripheral pattern is referred to as the “necklace” or “string of pearls” pattern. the endometrium in patients with PCOD thickens even though ovarian production of estrogen is suppressed . The treatment of PCOD depends on the needs of the patient. Infertility secondary to anovulation is usually treated successfully with clomiphene citrate (~80% of women will ovulate in response to clomiphene citrate . (Stevenm – 2011).

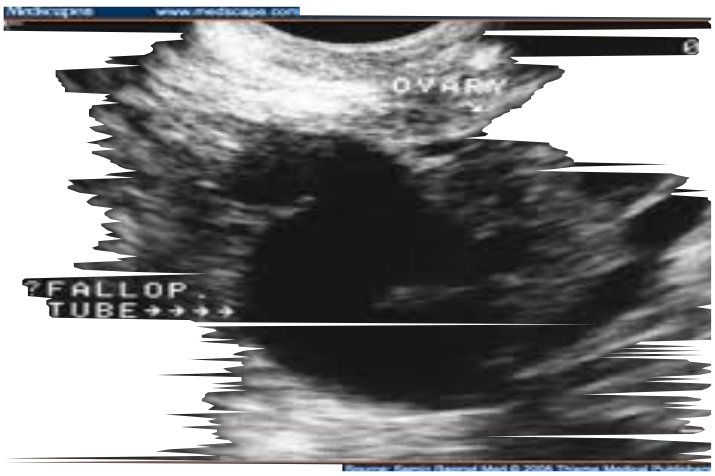


(www.ultrasound images gallery.com)

Figure 2-15 .TV scan shows peripheral multiple follicular cyst consistent with PCOD

2.3.2 .7 Pelvic inflammatory disease

Pelvic inflammatory disease (PID) describes any infectious disease involving the upper genital tract. In the Western world PID is most commonly due to bacterial infections that are sexually transmitted (STDs). The most common STDs reported today are gonorrhea and Chlamydia. Non STD cause of pelvic infection include intrauterine contraceptive devices, postsurgical or postinstrumentation infection, and tuberculosis. The pathway of pelvic infection is variable and includes ascending, direct, and hematogenous modes of disease transmission. STDs generally spread in the genital tract in an ascending fashion (from the external genitalia along the mucosa to the inner structures). Chronic sequelae or complications of PID include tubal dysfunction, adhesions, hydrosalpinx, and peritoneal inclusion cysts. hydrosalpinges is an obstructed, non tender, fluid-distended, fallopian tube most commonly associated with chronic PID. Other causes of hydrosalpinx that have been reported in the absence of a known history of pelvic infection include previous tubal sterilization and hysterectomy . (Devin ,etal,1992)



(www.ultrasound images gallery.com)

Figure(2-16)ultra sound image showed fluid-distended fallopian tube . (hydrosalpinges)

2.3.2 .8 Endometritis

Endometritis is inflammation of the endometrium. Endometritis may occur in the following situations: PID (gonococcal, chlamydial, tuberculous endometritis), following uterine instrumentation or surgery, following delivery (puerperal endometritis), purulent endometritis occurring in pyometra caused by a cervical stricture or following radium insertion, and endometritis that characteristically occurs in the presence of a tailed IUCD. It is most commonly associated with postpartum infection. Patients with endometritis initially present with fever, chills, uterine bleeding, foul lochia, and abdominal and pelvic pain. Infection may progress into myometrium (myometritis), around the uterus (perimetritis), or spread throughout the body, causing septicemia. Potential complications of endometritis include ovarian vein thrombosis. Patients generally respond well to appropriate antibiotic therapy. The sonographic findings of endometritis include non specific endometrial thickening, endometrial fluid, and air. In symptomatic patients, the presence of endometrial fluid with air is strong evidence of infection. . (Devin ,etal,1992)

(www.ultrasound images gallery.com)

Figure(2-17) TV scan shows endometrial fluid this is sign of Endometritis

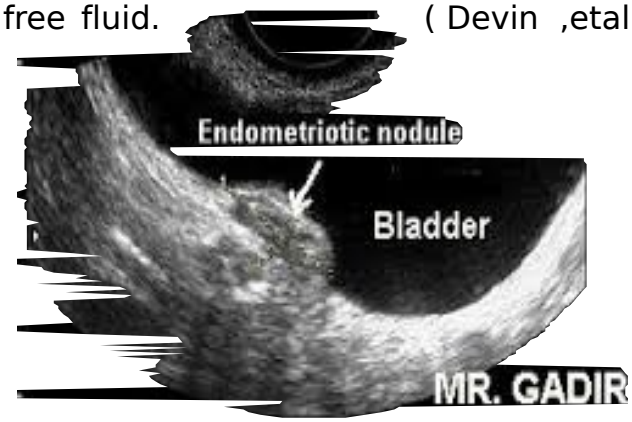
2.3.2 .8 synechiae

is the Intrauterine adhesions . Adhesions form in the uterine cavity secondary to inflammation or infection. Synechiae are most commonly associated with Asherman syndrome or a past history of endometritis Asherman syndrome Is the clinical manifestation of infertility associated with synechiae and a previous history of intrauterine instrumentation, most commonly dilatation and curettage (D&C). Calcification is often associated with synechiae. On conventional 2D EVS synechiae are not visualized directly however they should be suspected if a "break or disruption" of the normal uterine cavity stripe is seen. (Devin ,etal,1992)

2.3.2 .9Endometriosis

Endometriosis is a pelvic disease characterized by symptomatic functioning endometrial tissue in the pelvis. Adenomyosis specifically defines functioning endometrial tissue in the myometrium. Although adenomyosis can coexist with endometriosis, it is usually a separate disease and is covered with

acquired uterine disease. The term “external endometriosis” is sometimes used in reference to endometriosis and “internal endometriosis” in reference to adenomyosis Endometriosis is a very common disease. It has been estimated to be present in 10 to 20 percent of premenopausal women and the incidence appears to be rising. Complications associated with pelvic endometriosis include ectopic pregnancy and infertility. In women with chronic pelvic pain and/or infertility, endometriosis has been found in up to 50 percent. With endometriosis, endometrial implants may appear in a variety of sites but they are almost always located in the pelvis below the umbilicus. Common sites in decreasing order of frequency are the ovary, broad ligament, pouch of Douglas, rectovaginal septum, and sigmoid colon Related symptoms depend on the site and extent of disease. Endometrial implants undergo cyclic bleeding during periods, resulting in mild pelvic peritonitis and formation of adhesions. Diffuse disease usually results in a variety of symptoms including premenstrual pain, dysmenorrhea, dyspareunia, and dyschezia. Extensive pelvic adhesions Ultrasound/Doppler Endometrial cysts can exhibit a variety of sonographic patterns however over 90% appear as a thick-walled, unilocular cyst containing homogeneous (uniform), diffuse, low amplitude echoes with a ground-glass likeness. Adhesions may be visualized with EVS in the presence of a significant amount of pelvic free fluid. (Devin ,etal,1992)



Figure(2-18) .TA ultra sound for female suffer from heamatouria each cycle that diagnosed **Endometrosis . (www.ultrasound images gallery.com)**

2.3.2 .10Myomas

Myomas or myomata are benign tumors arising from smooth muscle. A myoma is composed mainly of smooth muscle with varying amounts of fibrous tissue. Myomas may also be referred to as leiomyomas and fibromyomas. **“Fibroid”** is a popular slang referring to a myoma of the uterus (fibroid is the word generally used in the clinical setting by sonographers and gynecologists). Myomas can occur in any structure with smooth muscle including the fallopian tubes, bladder and gastrointestinal tract. The most common location for myomas is the body of the uterus. Myomas are the most common masses of uterine origin and are one of the most frequent abnormalities palpated in the pelvis. The exact incidence of myomatous disease of the uterus is uncertain but it is diagnosed in about 20% to25% of women 35 years of age or older; the incidence is up to seven times higher in black women compared to Caucasians. Evidence strongly suggests that uterine myomas are dependent on estrogen for growth as they

are rarely found before puberty and stop growing and atrophy after menopause (in well documented cases, new myomas rarely appear after menopause). During pregnancy, when blood estrogen levels are sustained and relatively high, there is often rapid growth of myomas. They are frequently diagnosed in conditions of hyperestrogenism including anovulation, endometrial polyps. and endometrial hyperplasia. Myomas respond to GnRH agonists which have an antiestrogenic effect. Estrogen receptors have been shown to be higher in myomas compared to normal myometrium. Although myomas are associated with conditions involving high levels of estrogen. (Devin ,etal,1992)

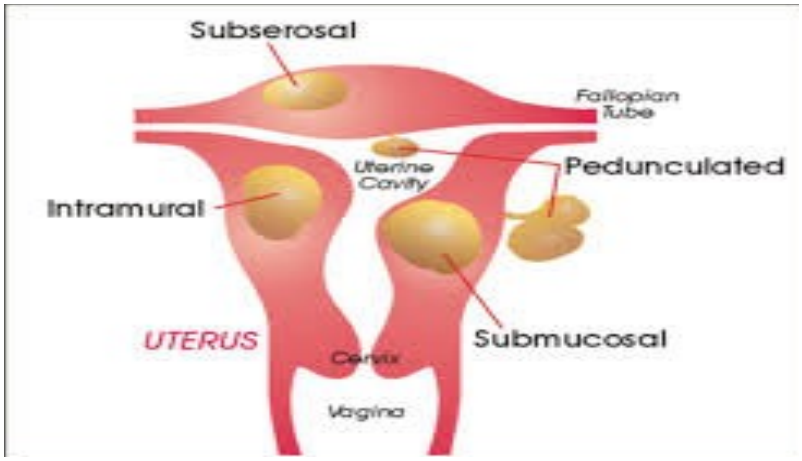


Figure 2-19 . different types of uterine fibroid (www.medcinenet.com)

2.3.2 .10 .1Intramural myomas

Are small and located within the myometrium without distorting the endometrium or serosal surface of the uterus. These small lesions are generally asymptomatic . (Devin ,etal,1992)

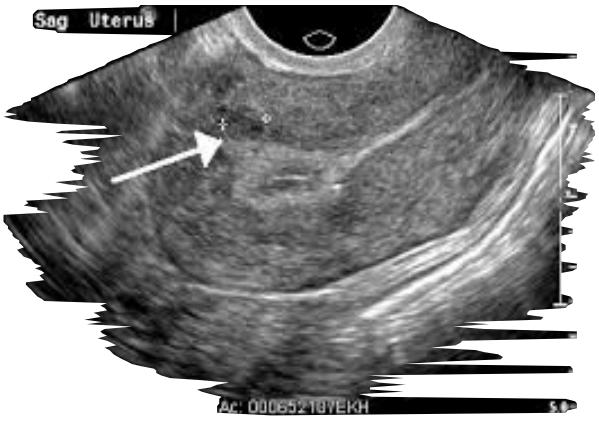


Figure 2-20. small intramural fibroid **(www.ultrasound images gallery.com)**

2.3.2 .10 .2Subserous or **subserosal myomas :**are myomas which grow externally towards the serosal surfaces of the uterus and cause the contour of the uterus to be lumpy or irregular.. (Devin ,etal,1992)

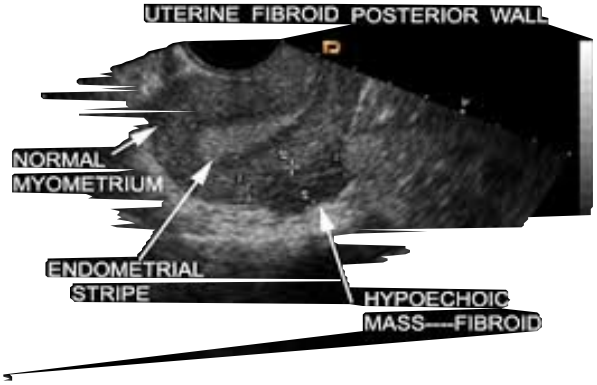


Figure 2-21.TV scan shows posterior subserous fibroid

(www.ultrasound images gallery.com)

Pedunculated, subserous myomas may reach a large size within the peritoneal cavity without producing symptoms. These potentially mobile myomas present as solid abdominal masses that do not appear to be uterine in origin. Rarely, a pedunculated subserous myoma may develop a very long pedicle and be very distant from the uterus i.e. palpated as a mid or upper abdominal mass. adistant pedunculated subserous myoma is known as a **wandering** or **migratory myoma**. Interestingly, a pedunculated subserous myoma may attach to the omentum or mesentery of the small bowel and gain an additional blood supply from these structures; with subsequent degeneration of the pedicle (possibly due to intermittent torsion) the myoma becomes dependent on the auxiliary blood supply. This type of myoma is known as a **parasitic myoma**. (Devin ,etal,1992)

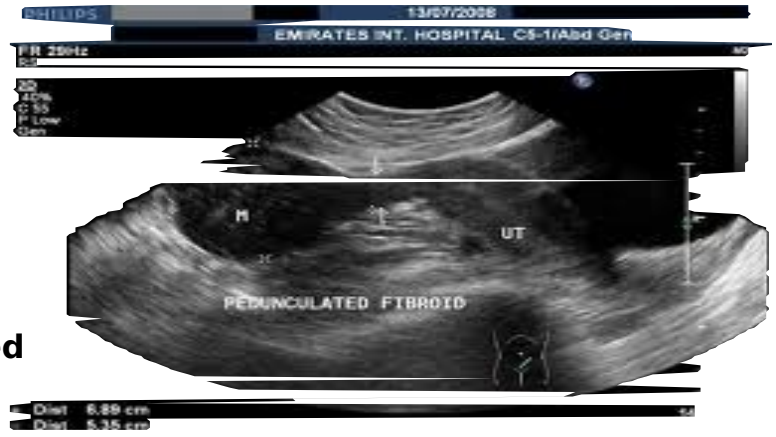


Figure 2-22. pedunculated subserous myoma

(www.ultrasound images gallery.com)

2.3.2 .10 .3 Submucous or **submucosal myomas**

Are myomas which are located immediately beneath the endometrium and distort the uterine cavity. Like subserous myomas, submucous myomas can

also develop a vascular pedicle and grow into the uterine cavity to become Pedunculated, intracavitary myomas a pedunculated, intracavitary myoma may protrude to or through the cervical os. (Devin ,etal,1992)

***Figure(2-23)ultra sound images showed* submucosal myomas (www.ultrasound images gallery.com)**

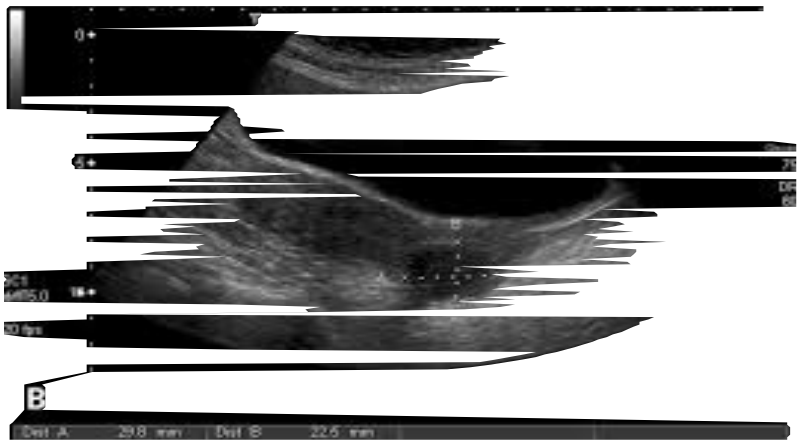
2.3.2 .10 .4 Intraligamentary myomas

describe myomas which grow laterally between the two leaves of the broad ligament. These myomas are relatively fixed in the pelvis, and because of their proximity to the pelvic portion of the ureter are the most likely myomas arising from the body of the uterus to cause ureteralobstruction and hydronephrosis (obstructive uropathy). (Devin ,etal,1992)

2.3.2 .10 .5 Cervical myomas

occur in less than 10% of cases of myomata uteri. Large cervical myomas are of most concern during pregnancy since they may interfere with normal vaginal delivery. Although cervical myomas are uncommon, they are frequently associated with urethral obstruction and hydronephrosis

(obstructive uropathy) since the terminal portion of the ureters course immediately lateral to the cervix. (Sween 1992).



Figure(2-24)ultra sound image showed **Cervical myomas**

(www.ultrasound images gallery.com)

2-4 Scanning techniques for OBGYN studies

There are several scanning techniques for evaluating the female pelvis including:

transabdominal sonography (TAS)

endovaginal sonography (EVS)

transperineal sonography (TPS)

transrectal sonography (TRS)

endoluminal (ELS)

sonohysterography (SHS)

sonosalpingography (SSS)

The two commonly applied techniques are TAS and EVS. **Endocavitary sonography** is a broad term that applies to any method that places the transducer inside a body cavity. SHS and SSS use an ultrasound liquid contrast media to visualize the uterine cavity and lumen of the fallopian tubes respectively. Originally SHS and SSS were performed with TAS however these studies are now done with EVS.). (Devin ,etal,1992)

2.4.1Transabdominal Sonography (TAS)

TAS is performed by placing the transducer in contact with the skin just above the symphysis pubis. TAS is also known as transvesical sonography.

2.4.1.1 Patient Preparation

A reasonably full urinary bladder is essential for TAS when it is used as the primary technique. Patients are instructed to arrive with a full bladder by drinking 20 to 30 ounces of water or other liquids about one hour before the scheduled examination. This is a general guideline and some patients will be overfilled and unable to hold on until the examination starts. A full bladder indicates bladder distention just to the point of mild patient discomfort. On a midline scan, the optimal bladder volume is evident when the bladder has a triangular shape and the fundus of the normal, nongravid anteverted uterus is covered by the bladder. If the roof of the bladder appears rounded and extends significantly beyond the fundus of a normal size uterus, the bladder

is probably too full. The bladder is likely underdistended if the normal uterus is difficult to visualize due to interference from overlying bowel gas. (Devin ,etal,1992)

2.4.1.2 Patient Position

TAS study is generally performed with the patient in a supine or recumbent position.

2.4.1.3 Transducer Frequency

TAS probes are typically available in the 3 MHz to 5 MHz range.

2.4. 1.4Transducer Preparation and Care

There is no special transducer preparation prior to performing TAS scans however it should be clean and electrically safe to operate, e.g. cable should not be frayed. A copious amount of scanning gel is applied to the transducer tip to ensure good transducer skin contact and easy movement of the transducer. Desirable properties of ultrasound gel include water solubility, non staining, hypoallergenicity, and goodnsound conductivity. Gel should be mechanically wiped off the transducer at the end of every study. It is also advisable to clean the transducer with soap and water (cleansing solution in a spray bottle such as Hydrox) or 70% alcohol wipe between patients to reduce the risk of cross-infection from skin flora which has been shown to occur from patient to patient during abdominal ultrasound examination. (Devin ,etal,1992)

2.4.1.5 Planes of Section

TAS scans are obtained in sagittal (longitudinal) and transverse (horizontal) planes. A true sagittal plane of section is an anterior to posterior vertical plane; a midline or midsagittal plane of section is one that cuts the body into equal right and left halves.

A true transverse plane of section is an anterior to posterior horizontal plane of section that is perpendicular to the sagittal plane. In order to optimize the use of the urinary bladder and to demonstrate the best view of structures and pathology, the transducer is usually angled or rotated to obtain oblique sagittal and transverse sections. (Devin ,etal,1992)

2.4.1.6 Transducer Manipulations

The basic TAS transducer manipulations are sliding, rocking, tilting, rotating, and compression

2.4.2 Endovaginal Sonography (EVS)

EVS is also known as transvaginal and vaginal sonography. EVS is performed by inserting a specialized endovaginal transducer in the vagina.

2.4.2 .1Transducers

The success of EVS as a major ultrasound modality is due to the superior resolution provided by higher frequency transducers. Endovaginal probes generally operate at frequencies of 5 to 10 MHz, with an average operating frequency of 7.5 MHz offered by most manufacturers. The minimum transducer frequency required to provide good axial resolution is 5 MHz. The focal zones of endovaginal probes is typically 2 to 12 cm with higher frequencies having shorter focal distances. Vaginal probes vary widely in

their operating design and features; for example, probes may be end-fired or angle-fired, and have a straight or curved handle. The scanning plane of an end-firing probe is parallel to the long axis of probe whereas the scanning plane of angle-firing probes (also known as offset probes) is at an angle to the long axis of the probe. The monitor image presentation is the same for both types of transducers. (Devin ,etal,1992)

2.4.2 .2Transducer Preparation and Care

A small amount of scanning gel is applied to the tip of the transducer. The transducer is covered with a disposable barrier prior to insertion. EVS probe barriers may be specially designed polyethylene covers (prelubricated with scanning gel), latex condoms, or a latex surgical glove. If the barriers used are condoms, these should be nonlubricated and nonmedicated. Users should be aware that condoms have been shown to be less prone to leakage than commercial probe covers, have a six-fold enhanced acceptable quality level when compared to standard examination gloves, and an equal to that of surgical gloves. Users should be aware of latex-sensitivity issues and have nonlatex-containing barriers available . (Devin ,etal,1992)

2.4.2 .3 Patient Preparation

For gynecological EVS evaluations, the patient's bladder should be empty since this allows close proximity of the vaginal transducer to the body of the anteverted uterus. With bladder distention, the anteverted uterus is displaced cranially outside the effective viewing range of the EVS probe.

2.4.2 .4 Patient Position

Ideally, an EVS study is performed with the patient on a gynecological examination table and the patient in a lithotomy position (flat on her back, legs flexed on the thighs, thighs flexed on the abdomen and abducted with stirrups used to support the feet and legs. This setup enables free, unobstructed movement of the probe in both vertical and horizontal directions by the operator. If a regular, flat examination table is used, the patient lies flat on her back with legs bent (approximately shoulder width apart) and feet flat on the table. This setup limits the vertical and horizontal movement of the probe but usually permits complete evaluation of the pelvis.

To allow for maximum pooling of small amounts of intraperitoneal free fluid, a minor **reversed Trendelenburg position** is desirable. If tilting of the examination table is not possible, a sponge block or other convenient objects (pillow, rolled sheet) can be placed behind the patient's lower back to tilt the pelvis forward. Tilting the pelvis in this fashion may also be helpful to better visualize the fundus of an anteverted uterus. Elevating the pelvis provides extra space for the transducer handle and makes it easier for transducer tilting in the coronal plane. (Devin ,etal,1992

2.4.2.5 Planes of Section

EVS scans are obtained in sagittal and coronal planes. A true coronal plane of section is a plane of section at right angle to the sagittal plane that divides the body into anterior and posterior portions. As for TAS, in order to optimize visualization of the uterus, ovaries, and other structures, the transducer is

angled and rotated to obtain oblique sections in the sagittal and coronal planes. (Devin ,etal,1992)

2.4.3 Advantages and Disadvantages of TAS and EVS

Several published studies have concluded that EVS is more accurate that TAS for gynecological diagnosis and some authors have indicated that EVS can effectively replace TAS as the initial examination technique. The AIUM practice guideline states that, “all relevant structures should be identified by the abdominal and/or vaginal approach. If an abdominal examination is performed and fails to provide the necessary diagnostic information, a vaginal scan should be done when possible. Similarly, if a vaginal scan is performed and fails to image all areas needed for diagnosis, an abdominal scan should be performed. In some cases, both an abdominal and a vaginal scan may be needed. Many studies have been published comparing TAS and EVS. Some have concluded that EVS can effectively replace TAS as the initial mode of examination however most authors agree that the two modalities are complementary techniques. The choice of technique depends on the indication for the study and the clinical circumstances; in general, neither technique used alone is the absolute ideal. (Devin ,etal,1992)

Advantages and Disadvantages of EVS and TAS:

a. EVS is performed with the patient’s bladder empty. This can save valuable time and is generally more acceptable to the patient than the full bladder experience associated with TAS. Most surveys indicate patients find EVS to be a more comfortable and acceptable technique than TAS.

b. EVS offers improved resolution and tissue characterization attributable to the use of higher frequency transducers. This allows for significantly improved visualization and assessment of early pregnancy (normal and abnormal intrauterine, and ectopic pregnancy), endometrium, ovaries (follicles, corpus luteum), and small vessels.

c. EVS is the method of choice for evaluation of obese women. Obesity does not interfere with EVS since the probe is positioned in the vagina and lies in close.(Devin ,etal 1992)

2.5 Previous studies:-

There are many studies on causes of female secondary infertility around the world.

Cletus found that common causes of female infertility in Benin, Nigeria. (37. % of women were in the 34-39 years age range, 70.0% percent of them were investigated for secondary infertility. Twenty-five (25.0%) percent of women studied had normal , 27.0% had tubal occlusion while Asherman’s syndrome 6 (3%) Uterine Fibroids 24 (11%) (Cletus , 2013)

Najla found that u/s the best efficient method to diagnosis most of causes of female secondary infertility , Najla said most causes of female secondary infertility which include PCO 40%, PID 21%, fibroid 17%, complex cysts 13% endometrioma 0% A sherman's syndrome 0%, Nabothian cysts 0% ovarin mass 6% and dermoid cysts 3%. (Najlar ,2005 -2006) .

Izatulla Found that main known cause of infertility was the anovulation diagnosed in 65.0% (78) of patients. Anovulation was associated with

menstrual cycle disorders, algodysmenorrhoea, dyspareunia,. Tubal blockage was diagnosed in 23.3%, . Nearly half of the infertile women (47.5%) were service holders, 28.4% were industrial workers, and 15.8% were housewives. income and the fear of poverty among women were significantly associated with infertility. Out of a total of 118 infertile women who responded, 59.3% estimated their income as ‘less than needed . 46.2% infertile women responded ‘not bad’(Izatulla ,etal 2009)

Shanthakumari found that Infertile Women Three fourth (80%) were in the age group of 25 to 32 years. (93.3%) were house wife. About half of the (46.7%) women were in 4-6 years of marital duration and slightly more than three forth (78.3%) of women had regular menstrual pattern. most of these abnormal findings were found in those patients with older age between 31 and 45 years and those with long duration of infertility more than 5 years There is strong association between the obesity and secondary infertility . (Shanthakumari , (May-Jun. 2014))

CHAPTER THREE

3 .Material and method:

3.1 Material

3.1 . Study group :

Patients who had referred to the ultrasound department for pelvic investigation. There were 60 patients which referred to Ultrasound department for pelvic scan these patient suffer from secondary infertility ,were selected randomly . Inclusion criteria all patient under 35 years . Exclusion criteria all patient above 35 years and any women take infertility medication in at the first birth

3.1.2 machine used:

1) mindary (SSD-500) with Transabdominal probe 3.5 MHz.

2) Siemens (G -20) with Trans abdominal probe 3.5 MHz’s

3) Fukuda Denshi 4100 with Tran abdominal probe 3.5 MHz’s.

3.2methods

3.2.1 Technique used :

A permission is taken from each patient for research purpose . All patients prepared with full bladder and they were seated supine a generous couple

of gel is applied to the patient for better resolution . Axial , transverse and oblique planes were used to visualize the pelvic organ.

The data of each pt is recorded immediately after finishing the exam. The data was tabulated for analysis and results .

3.2.2 variables of the Study :

patient age.

last pregnancy.

Socioeconomic status.

Parity .

Symptoms.

Risk factor

CHATER FOUR

Table No. (4.1) study group age distribution

Age group	Number of patients	Percentage
15 – 25	6	10%
25 – 30	24	40%
30 – 35	30	50%
Total	60	100 %

Figure (4.1) showing the distribution of patients age

Table No. (4.2) study group last pregnancy distribution

Last pregnancy	Number of patients	Percentage

5-9	42	70%
2-5	18	30%
Total	60	100%

Figure (4.2)) showing the distribution of last pregnancy

Table No. (4.3) study group parity distribution

Parity group	5-9 r of patients	2-5 ercentage
1 – 2	43	71%
3 – 4	17	29%
Total	60	100%

Figure (4.3) showing the patients parity distribution

Table No. (4.4)

study group Socioeconomic status distribution

Socioeconomic status	Number of patient	Percentage
Low	6	10%
Moderate	15	25%
High	39	65%
Total	60	100%

Figure (4.4)) showing the patients socioeconomic status distribution

Table NO.(4.5) study group Occupation distribution

Occupation	Number of patient	Percentage
House wife	45	75%
Employee	3	5%

Worker	12	20%
Total	60	100%

Figure (4.5)) showing patients occupation distribution

Table NO.(4.6) study group symptoms distribution

Symptoms	Number of patient	Percentage
Symptomatic	55	91%
Asymptomatic	5	9%
Total	60	100%

Figure (4.6) showing patients symptoms distribution

Table NO.(4.7)

study group symptoms distribution

Symptoms	Number of patient	Percentage
Irregular cycle	30	50%
Poly menorrhea	10	16%
pelvic pain	8	13%
Palpable mass	7	11%
Total	55	91 %

Figure (4.7) showing symptomatic patients distribution

Table NO.(4.8)

study group risk factor distribution

Risk factor	Number of patient	Percentage
Present	41	68%
No risk factor	19	32%

Total	60	100%

Graph

figure (4.8)showing patient risk factor distribution

Table NO.(4.9)

study group risk factor distribution

Risk factor	Number of patient	Percentage
Obesity	21	35%
Psychological	15	25%
Weight loss	5	8%
Total	41	68%

figure (4.9)showing patient risk factor distribution

Table NO.(4.10)

Table for ultra sound finding:

study group ultra sound finding distribution

ultra sound finding	Number of patient	Percentage
Positive	50	83%
Normal	10	17%

Figure (4.10)showing patients ultra sound finding distribution

Table NO.(4.11)

study group of abnormal ultra sound finding distribution

U\s finding	Number of patient	Percentage
PCO	20	33%
Fibroid	10	17%
PID	8	13%

Ovarian mass	4	7%
ovarian cyst	7	12%
Dermoid cyst	1	1%
Total	50	83%

Figure (4.11) showing patients abnormal ultra sound finding distribution

CHAPTER FIVE

5.1 Discussion :

These study includes 60 cases of infertile women attended to ultrasound department for investigation to determine the causes of secondary infertility.

Regarding the maternal age the study found that there is strong relationship between advanced maternal age and female secondary infertility. The rate of female secondary infertility increased in women above 31 years age table(4.1) agree with Najla 2005

In this study we found that most infertile women status were high (39 patient) which is 65% , moderate socioeconomic status was (15 patient) which is 25% and low socioeconomic status was (6 patient) which is 10% . table (4.4) agree with Najla 2005 ,

In our study most of these abnormal findings were found in those patients with older age between 31 and 35 years and those with long duration of infertility more than 5 years table

(4-2) agree with Shanthakumari, *May-Jun. 2014*

Analysis of association between the causes of female secondary infertility and selected variable that there was no significant association between the parity and selected variables .table (4-3) .

In this study we found that most infertile women were house wife (45 patient)which is 75%, worker (12 patient) which is (20%) and employee (3 patient) which is (5%) table (4. 5) agree with Shanthakumari ,(*May-Jun. 2014) and* Najla, 2005

In this study we found that the most risk factors of secondary infertility was the obesity (21patient) which is (35%), then the psychological condition (15) which is (25%), and other less risk factors affected infertility ,include weight loss, (5) which is (8%). Table(4.9) agree with Najla, 2005-2006

This finding suggests that there is strong relationship between risk of female secondary infertility (obesity) and high socio-economic status .

In our study we found that most clinical investigation are menstrual disorder (30 patients) which was 66%, then poly menorrhea (10 patients) which was 16%,(8 patients) came with pelvic pain which is 13%, the least was the palpable pelvic mass or abdaminopelvic mass (7patient) which was 11% only. Table (4.7) agree with NAJLA 2005

In our study we found that ultra sound finding showed the most causes of the secondary infertility was PCOs (20.patients) which is (33%) the second was Pelvic inflammatory diseases PID(8 patients) which is (13%) . The third was uterine fibroids (10 patients) which is (17%) . Ovarian causes represent Ovarian mass (4 patients) which is 6% , simple cyst (7 patients) which is (12%), desmoids cyst (1 patient) which is (1%), and endometrioma (0%).table (4.11) .not agree with NAJLA agree with clutes, 2012 .

In addition to that the study found that there are some cases of secondary infertility were normal finding on ultrasound evaluation. 10 patient which is 17% ,Table (4.10)

5.2**Conclusion**

A lot of women complaining of secondary infertility. The number increased recently. Inappropriate investigation leading to delay in proper management this study aims to determine the causes of female secondary infertility by ultrasound as a rapidly evolving imaging modality in the diagnosis of infertility.

Ultrasound imaging of female secondary infertility has contributed greatly to the understanding, identification, and diagnosis of numerous conditions.

Trans abdominal, trans-vaginal and Doppler ultrasound are anon invasion specific and sensitive imaging technique that detect some causes of secondary infertility.

Endovaginal ultrasound is often supervisor to trans-abdominal ultrasound in evaluation of female secondary infertility.

The most causes of female secondary infertility are PCOs, PID, and uterine fibroid. High socio-economic status, house wife and obesity were the most common risk factor of female secondary infertility.

5.3 Recommendation :

Ultra sound is an important modality for early detection and diagnosis Causes of secondary infertility .

All mass must be scan by Doppler machine because the color Doppler plays an important role in diagnosis and differentiated benign from malignant masses by measuring the resistive index of the mass.

Endovaginal ultrasound is often supervisor to trans-abdominal ultrasound in evaluation of female secondary infertility.

5.4 References:

Devin Dean, RTR, RDMs, RDcs, gynecology obstetric, Burwin institute of diagnostic medical u/s. , 1992.

Keithl. Moore, Clinically oriented anatomy 4th edition 1998.

M.Y. Sukkar, H.A. El- Munshid, M.S.M Ardawi, Concise Human physiology Second edition 2006.

Najla elser , Role of ultra sound in diagnosis of female infertility 2005-2006

RNM Mac sween and K Whaly, Muri's text book of pathology, thirteenth edition 1992.

Stevenm- penny – Examination review for ultra sound abdomen and obstetric and gynecology , library of congress cataloging – in publication 20

Susan, Gray's Anatomy 39 edition, 1998.

www.dovepress.com 76secondary-infetility-inwomen: radiologic evaluation Juanury2011Authours jeffrey Deeolpin.

www. Medicine healthy .com

Appendix. 1

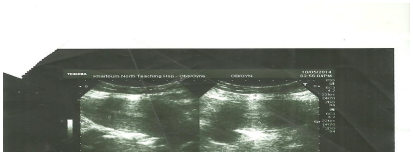


Image (1) 28 Years old (symptomatic) ultra sound showed Bulky uterus

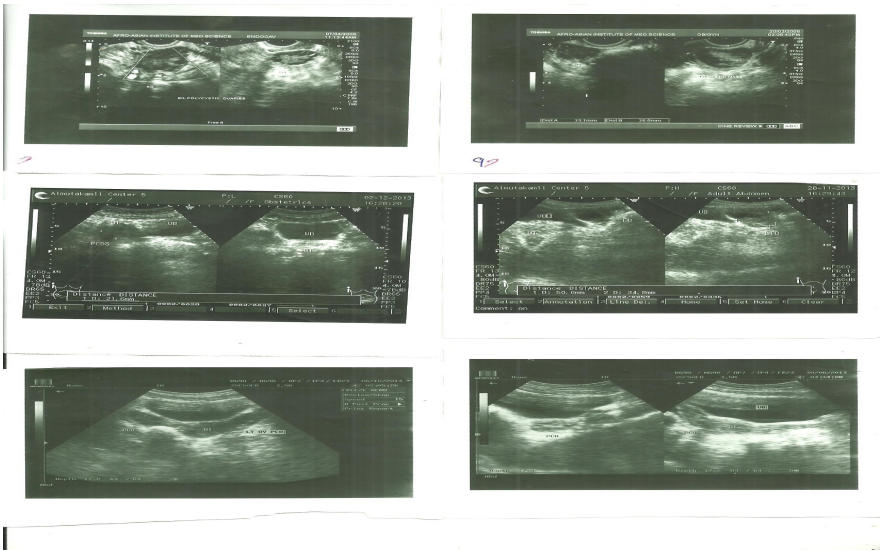


Image (2) 33 Years old (symptomatic) ultra sound showed bilateral PCO

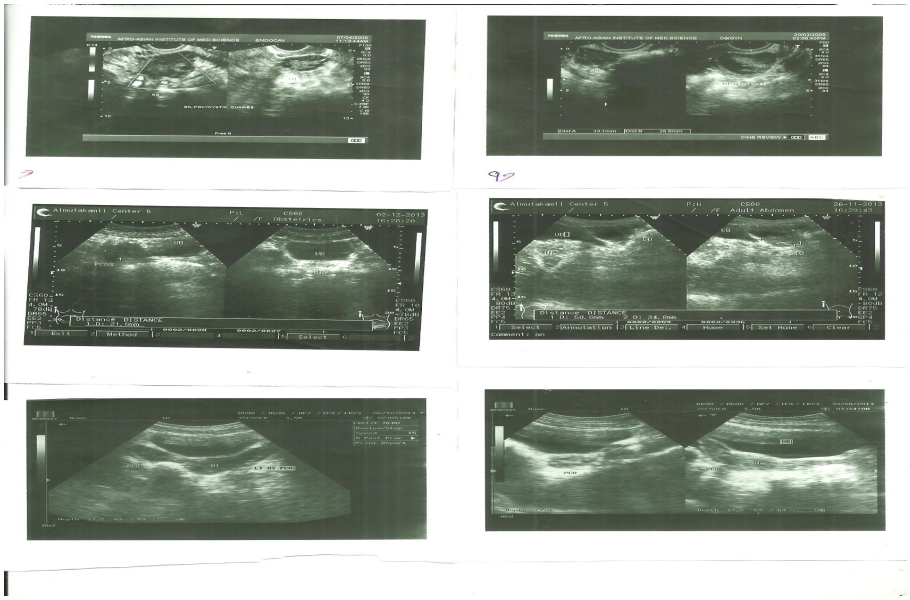


Image (3) 31 Years old (symptomatic) ultra sound showed bilateral PCO

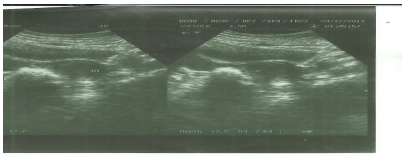


Image (4) 28 Years old (symptomatic) ultra sound showed bilateral PCO

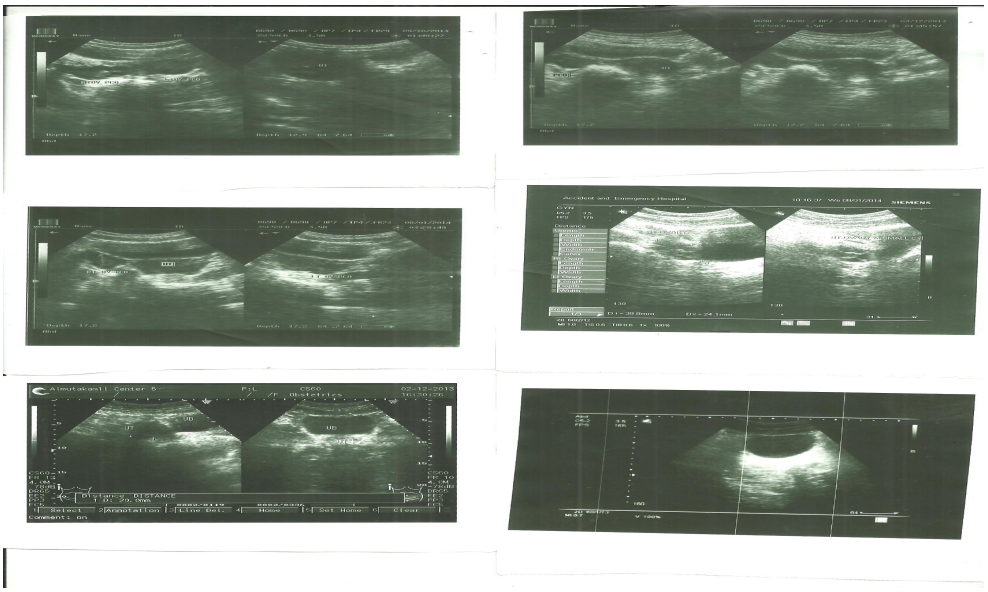


Image (5) 31 Years old (symptomatic) ultra sound showed bilateral PCO

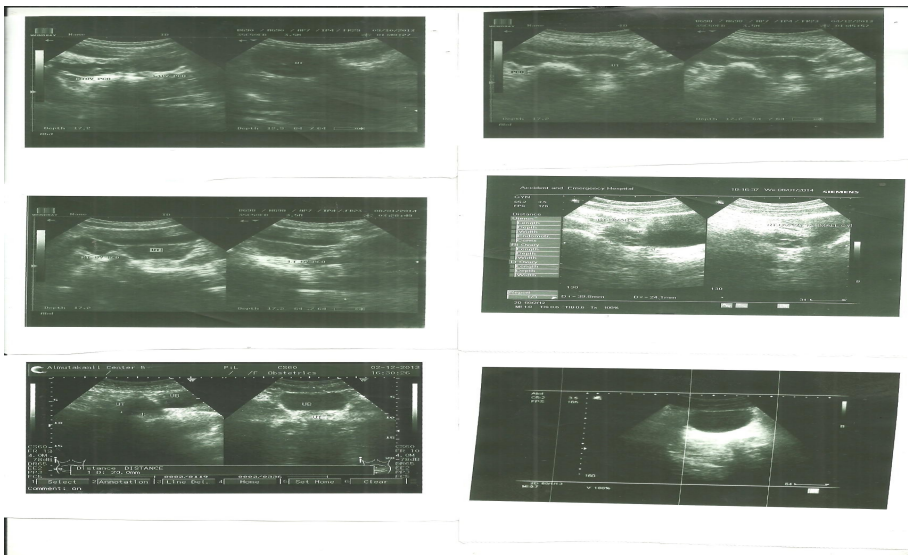


Image (6) 32 Years old (symptomatic) ultra sound showed fluid collection in posterior cul de sac consistent with PID

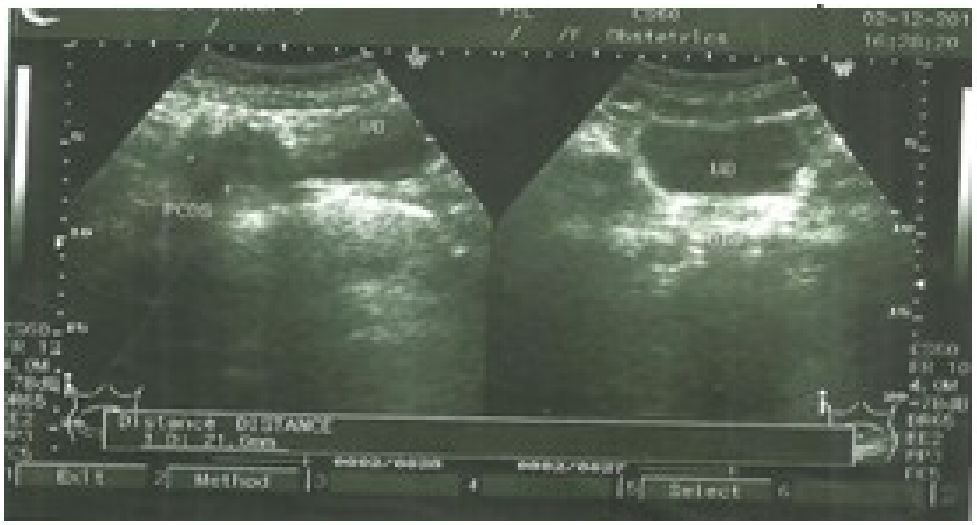


Image (7) 29 Years old (symptomatic) ultra sound showed bilateral PCO

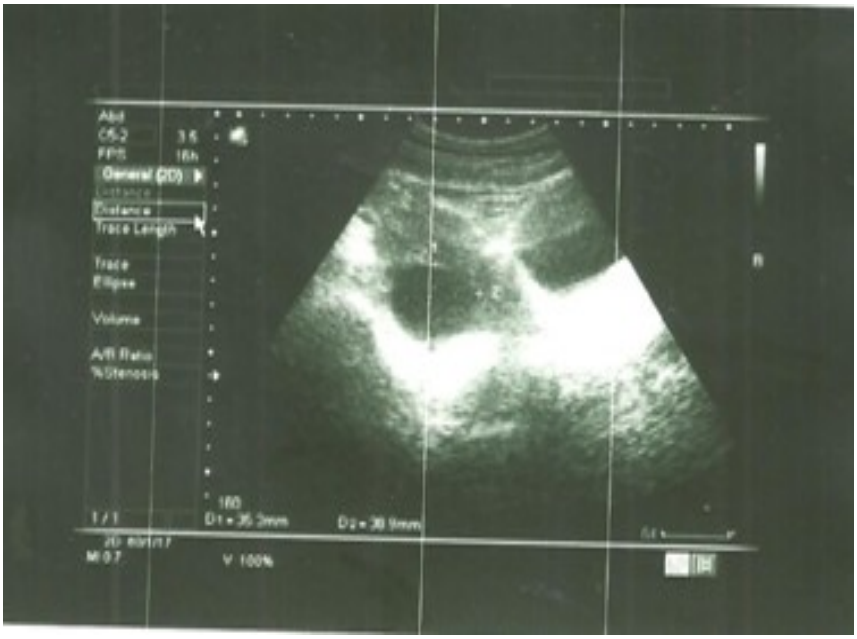


Image (8) 29 Years old - ultra sound showed simple ovarian cyst

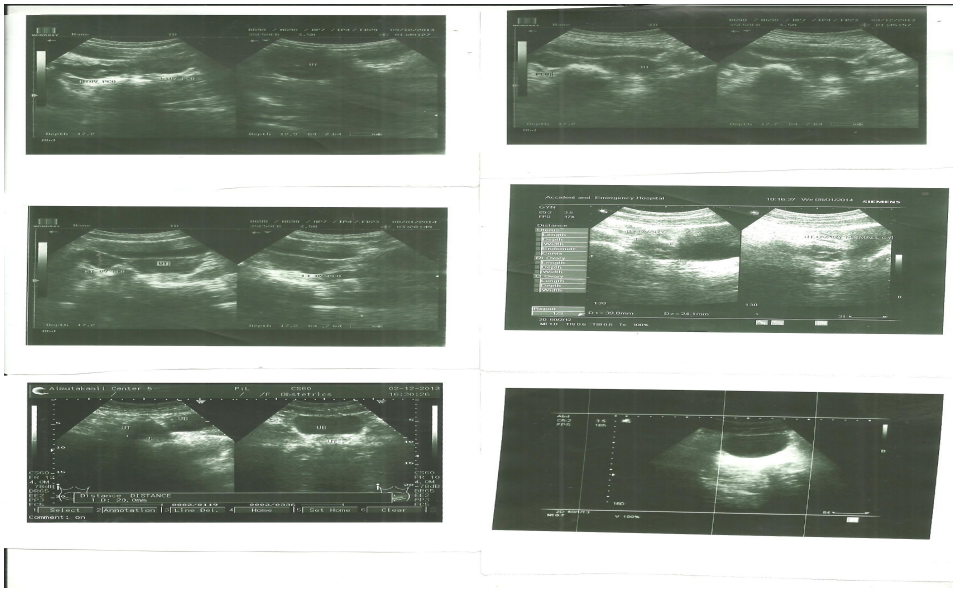


Image (9) 28 Years old (symptomatic) ultra sound showed bilateral PCO

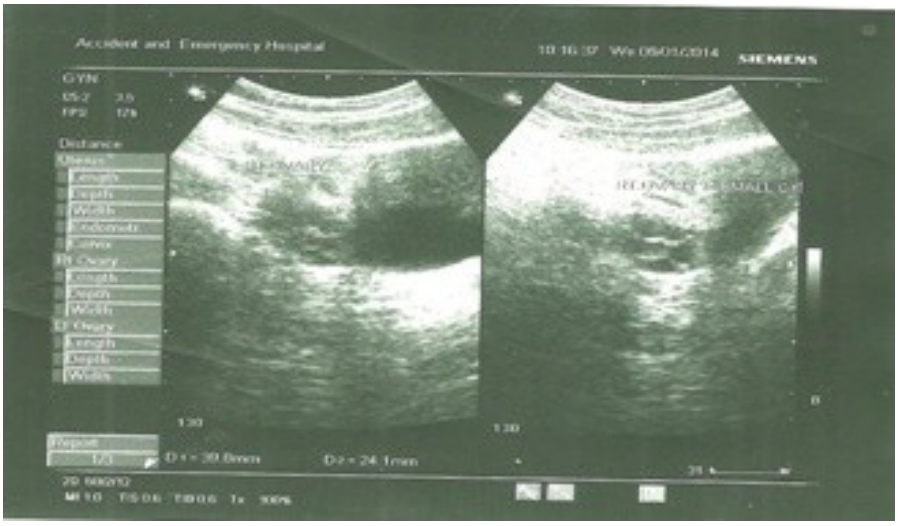


Image (10) 28 Years old (symptomatic) ultra sound showed bilateral PCO

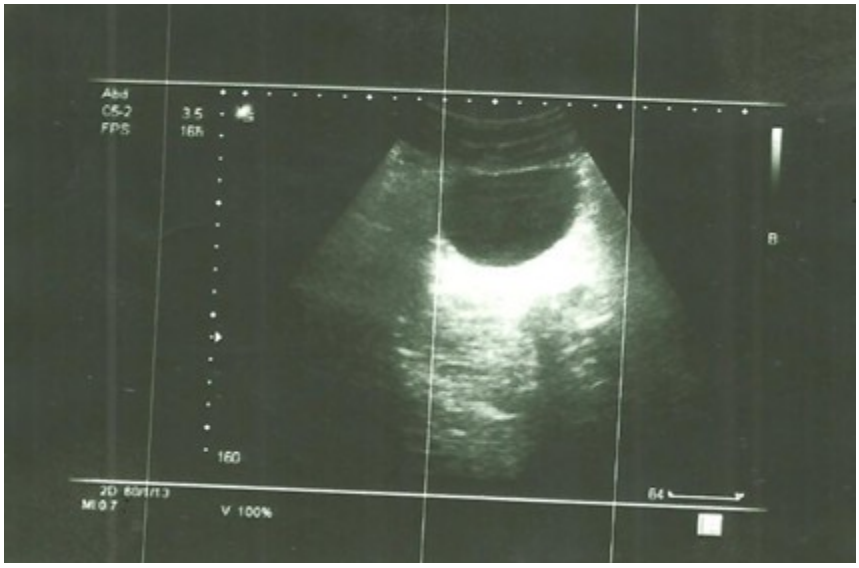


Image (11) 28 Years old - ultra sound showed simple ovarian cyst

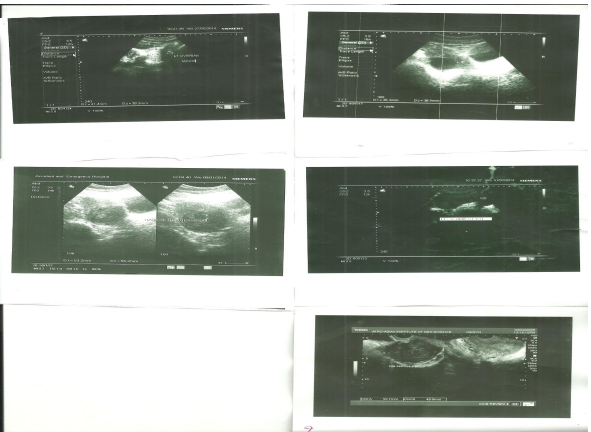


Image (12) 34 Years old - ultra sound showed intra mural fibroid

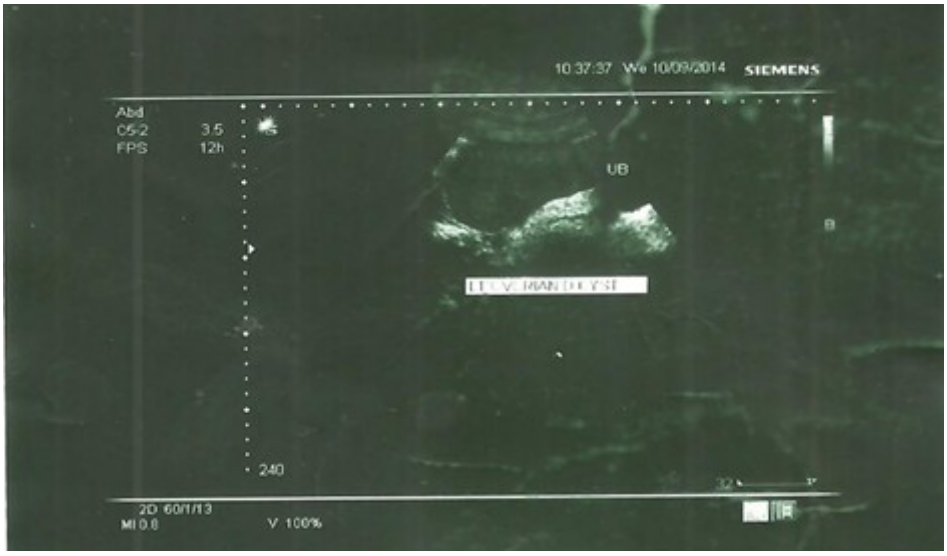


Image (13) 32 Years old - ultra sound showed Lt ovarian mass contain hyper echoic material consistent with dermoid cyst

Appendix. 2

Sudan university

Data collection sheet

Diagnosis of female secondary infertility by using u/s

Date:…… No( )

- Patient data :
- Name:
- Age: 15---20 ( ) 21….30 ( ) 31….35 ( )
- Occupation: employee( ) worker ( ) house wife ( )
- Socioeconomic status: high( ) moderate( ) low ( )
- Reproductive status: parity ( ) last delivery ( )
- Clinical feature: symptomatic ( ) asymptomatic ( )

  In case of symptomatic patient symptoms are

  -Menstrual disorders: yes ( ) No ( )

-pelvic pain: yes ( ) No ( )

-Vaginal bleeding: yes ( ) No ( )

- Presence of risk factor:

  Positive risk factor ( ) No risk factor ( )

  Obesity: yes ( ) No ( )

  Wt loss: yes ( ) No ( )

  Psychological: yes ( ) No( )

- Ultra sound finding:

  positive findings ( ) No finding ( )