Sudan University of Science and Technology

College of Graduate Studies

Characterization of Female Pelvic Tumors using Magnetic Resonance Imaging

توصيف اورام الحوض النسائية باستخدام التصوير بالرنين المغناطيسي

A thesis Submitted for Partial Fulfillments for the Requirements of M.Sc. Degree in Diagnostic Radiological Technology

BY

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الآيــة

قال تعالى:

(إِنّ الّذِينَ آمَنُوا وَالّذِينَ هَادُوا وَالنّصَارَى وَالصّابِئِينَ مَنْ آمَنَ بِاللّه وَالْيَوْمِ الْآخِرِ وَعَمِلَ صَالِحًا فَلَهُمْ أَجْرُهُمْ عِندَ رَبّهِمْ وَلَا خَوْفٌ عَلَيْهِمْ وَلَا هُمْ يحزنون)

سورة البقرة (62)

Dedication

To my soft **Mother** the greatest person I have ever seen in my life

To my great **Father**

To my Sisters and **Brothers**

To all my **Friends**

To all **People** close my heart

Acknowledgement

My acknowledgements and gratefulness firstly to my god ,who gave us the gift of the mind and blessed and guided me to a accomplish this thesis.

My gratitude is extended to my supervisor **DR. Asma Ibrahim Ahmed ALamin** for his support and his good guidance and help through this thesis.

My gratitude is also extended to **Sara Bazaraa Hassan** who helped me in this research and this research could never been without him.

Finally I would like to thank ever body who helped me in preparing and finishing this study.

Abstract

This descriptive study done on 50 women with abnormal pelvic disease based on U/S

with age from18-80years .the objectives of the study was

To characterize pelvic tumor, to determine commonest pelvic tumor and

to determine most age affected with tumor

The study conclude that Magnetic resonance imaging is a sensitive and specific for detection of pelvic tumors and the uterine fibroid is the most pelvic tumors in premenopausal and postmenopausal women but in some cases MRI does not give final diagnosis so biopsy is recommended -The study recommend that to do further studies with full patient history because data about parity are not taken in this study.

-Any ovarian cyst appears on sonography with a typical sonographic features must be imaged with MRI

MRI machine must be available at hospitals and diagnostic center and

Imaging with MRI must be not cost effective.

الخلاصة

أجريت هذه الدراسة الوصفية على 50 امرأة مصابة بمرض الحوض غير الطبيعي بناءً علي الموجات فوق الصوتية من سن 18-81سنة. كانت أهداف الدراسة لتمييز ورم الحوض، لتحديد ورم الحوض الأكثر شيوعا لتحديد معظم السن تتأثر بالورم.

أظهرت النتائج أن تواتر المجموعة العمرية لجميع المرضى كانوا من المرضى الذين تتراوح أعمارهم بين 41-50 سنة وكان أكثر من 13 مريضا

تبين أن التاريخ السريري لمعظم المشاركين (40٪) كان ألمًا في الحوض ، حيث كان (16٪) منهم عبارة عن نزيف دموي (النزيف الرحمي) ، وكان (12٪) منهم مصابًا بنزيف ما بعد انقطاع الطمث أو بدون أعراض ، بينما كان (8٪) كان منهم ألم في الحوض الأيمن أو ألم في الحوض الأيسر ، في حين أن (2٪) منهم فقط كانوا يعانون من عدم انتظام الدورة.

عرض معظم المشاركين من تشخيص كيس المبيض الأيمن وكيس المبيض الأيسر لديهم تاريخ سريري لألم الحوض الأيسر ، اليسار ألم الحوض أو عدم وجود أعراض ، لأن معظمهم الذين شخصوا مع التهاب الحوض ، تضخم الرحم , بطانة الرحم الكثيفة ، ورم المبيض ، وسرطان عنق الرحم لديهم تاريخ سريري لألم في الحوض ، في حين أن معظمهم الذين تم تشخيصهم بالورم الليفي الرحمي وسرطان بطانة الرحم لديهم تاريخ سريري من النزيف الرحمي ونزيف ما بعد انقطاع الطمث

وخلصت الدراسة إلى أن التصوير بالرنين المغنطيسي حساس ومحدّد للكشف عن أورام الحوض وأن الورم الليفي الرحمي هو أكثر أورام الحوض لدى النساء قبل انقطاع الطمث وبعد انقطاع الطمث ولكن في بعض الحالات لا يعطي التصوير بالرنين المغناطيسي التشخيص النهائي لذا يُوصى بإخذ عينة للقيام بمزيد من الدراسات مع تاريخ المريض الكامل لأن البيانات لم تؤخذ في كامله هذه الدراسة.

يظهر أي كيس مبيض في التصوير فوق الصوتي مع ميزات غير نموذجية للذلك يجب تصويرها ايضا ر بالرنين المغنطيسي.

يجب أن تكون آلة التصوير بالرنين المغناطيسي متاحة في المستشفيات ومركز التشخيص ويجب أن لا يكون التصوير باستخدام التصوير بالرنين المغنطيسي ذو تكلفه عاليه.

Table of Contents

Topics	Page No.
الاية	I
Dedication	II
Acknowledgement	III
Abstract (English)	IV
Abstract(Arabic)	V
List contents	VI
List of tables	VIII
List of figures	IX
Abbreviations	X
Chapter one Introduction	
1.1 Introduction	1
1.2 Problem of study	2
1.3 Objective of study	2
1.4 Overview of the study	3
Chapter two Theoretical Background and Previous Studies	
2.1 Female reproductive anatomy	4
2.2Physiology of female reproductive	10
2.3 pathology of female reproductive	19
2.4Previous studies	38
Chapter three Material and Methods	
3.1 Material	40
3.2 Methods	41
Chapter Four Results	
4. Results	44

Chapter five **Discussion, conclusion and recommendations**	
5.1 Discussion	53
5.2 Conclusion	55
5.3 Recommendations	56
References	57
Appendices	

List of Tables

Table	Page No
(2.1) Summary of the location and description and function of the female reproductive system	18
(4.1) show age group frequency for all patients	44
(4.2) show frequency distribution of clinical history for all patients	45
(4.3) show contrast frequency for all patients	46
(4.4) shows a frequency distribution of diagnose finding for all patients	47
(4.5) show cross tabulation between age group and clinical history	47
(4.6) show cross tabulation between age group and diagnose finding	49
(4.7) show cross tabulation between age group and contrast	50
(4.8)show cross tabulation between Diagnose finding and contrast	51
(4.9)show cross tabulation between diagnose finding and clinical history	52

List of Figures

Figure Title	Page No.
(2.1) shows female reproductive system.	4
(2.2) shows internal structure of the uterus.	5
(2.3) show of the ovary.	7
(2.4) show of the ovaries ligament.	8
(2.5) show of the fallopian tube.	8
(2.6) sagittal cut show female breast and mammary gland.	16
(4.1) show age group frequency for all patients	44
(4.2) show frequency distribution of clinical history for all patients	45
(4.3) show contrast frequency for all patients	46
(4.4) shows a frequency distribution of diagnose finding for all patients	47
(4.5)show cross tabulation between age group and clinical history	47
(4.6) show cross tabulation between age group and diagnose finding	49
(4.7) show cross tabulation between age group and contrast	50
(4.8) show cross tabulation between Diagnose finding and contrast	51
(4.9) show cross tabulation between diagnose finding and clinical history	52

List of Abbreviations

CT	Computed Tomography
IUCD	Intrauterine Contraceptive Devices
MRI	Magnetic Resonance Imaging
NMR	Nuclear Magnetic Resonance
PCO	Polycystic Ovarian
PID	Pelvic Inflammatory Diseases
RF	Radiofrequency
U/S	Ultrasound

Chapter one

1.1 Introduction

Magnetic resonance imaging (MRI) scan of the pelvis is noninvasive method to create detailed images of the area between the hip bones. This part of the body called the pelvic area; the pelvic area contains the reproductive organs. In women, it includes the womb (uterus), cervix, ovaries, vagina and fallopian tubes. In men it includes the prostate gland, vase deference, seminal vassals and ejaculatory ducts. (Wilkinson et al, 2008).

Magnetic resonance imaging (MRI) is an imaging modality that has been developed and used since the mid-1970s. MRI has several advantages over computed tomography (CT) and ultrasonography, one important feature its noninvasiveness; the imaging components include a large static magnetic field and an electromagnetic field produced by radio frequency (RF) waves. Although once termed nuclear magnetic resonance imaging, MRI uses no ionizing radiation; the nucleus being studied in this form of imaging is naturally occurring hydrogen nucleus, proton, which is ubiquitous in the body by virtue of its presence in water. (Helen H. Kay.2008).

A second feature that makes MRI particularly attractive is its capability for multiplanar imaging, without repositioning the patient, transverse, sagittal, coronal, and nonorthogonal views may be obtained in short time. Such capabilities allow excellent study of normal and abnormal anatomy. Compared with MRI, ultrasonography examination allows more tissue planes to be observed in real time. However, the window of view is actually relatively small, and a simultaneous display of large portion of the body is not possible. (Helen H. Kay. 2008).

A third advantage of MRI is its excellent tissue differentiating capabilities, made possible because the biochemical characteristics of the nuclei within their microscopic environments alter the information (called signals) received during an MRI acquisition. MRI acquisitions may further alter and differ contrast. These signals are not influenced by the amount of bladder filling, the size of patient, or the mount of gas in the surrounding bowel, but these factors have an important role in the quality of an ultrasonography image. With MRI, excellent tissue differentiation is possible without the use of contrast agent. However, newly developed contrast agent may further augment tissue contrast and are much safer than iodinated equivalents used in CT. (Helen H. Kay. 2008).

1.2 problem of study

In some pelvic tumors especially ovarian tumors the u/s not give final diagnosis and give many differential diagnosis for masses which have atypical sonographic appearances.

1.3 objectives

1.3.1 General objective of the study

To characterization the female pelvic tumors using magnetic resonance imaging (MRI).

1.3.2 Specific objective of the study

-To characterize pelvic tumor.

-To determine commonest pelvic tumor.

-To determine most age affected with tumor.

1-4 over view of the study

This study consisted of five chapter with chapter one is an introduction, which include problem of the study, objective and significance of the study, while chapter two it literature review which include a brief theoretical background and previous study.

Chapter three includes material used to collect the data and the method followed to collect the data and hence.

Chapter four presented the results in table and figures and finally chapter five gives interpretation of the results, which discussed in regards to previous study as well as conclusion and recommendations.

CHAPTER TWO

Theoretical Background and Previous Studies

2.1 Reproductive female anatomy:

The female reproductive organ includes the uterus, fallopian tubes and the ovaries. Their position, size and anatomic relation vary considerably with age and the physiologic changes of menstruation pregnancy and menopause. The function of the female reproductive system Formation of the ova, reception of spermatozoa, Provision of suitable environment for fertilization and fetal development, parturition (childbirth) and Lactation, the production of the breast milk, which provides complete nourishment for the baby in its early. (Ross and Wlsion2006).

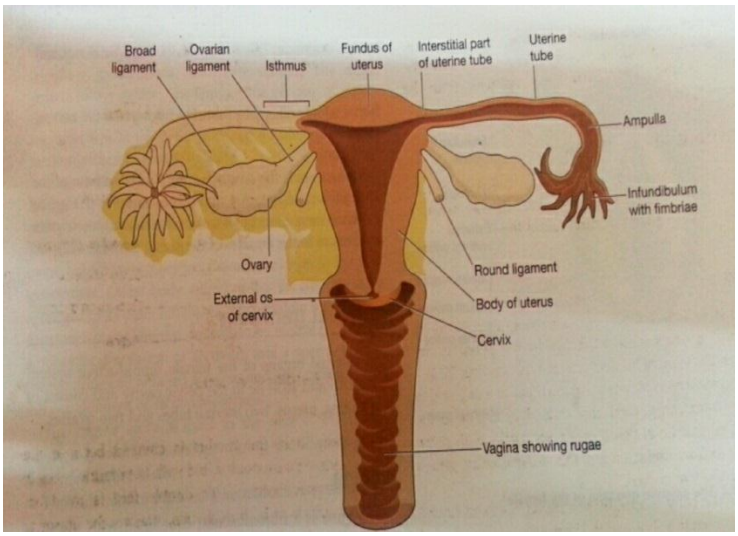

Fig (2.1) show female reproductive organ in the pelvis (Ross and Wlsion2006)

2.1.1 The uterus

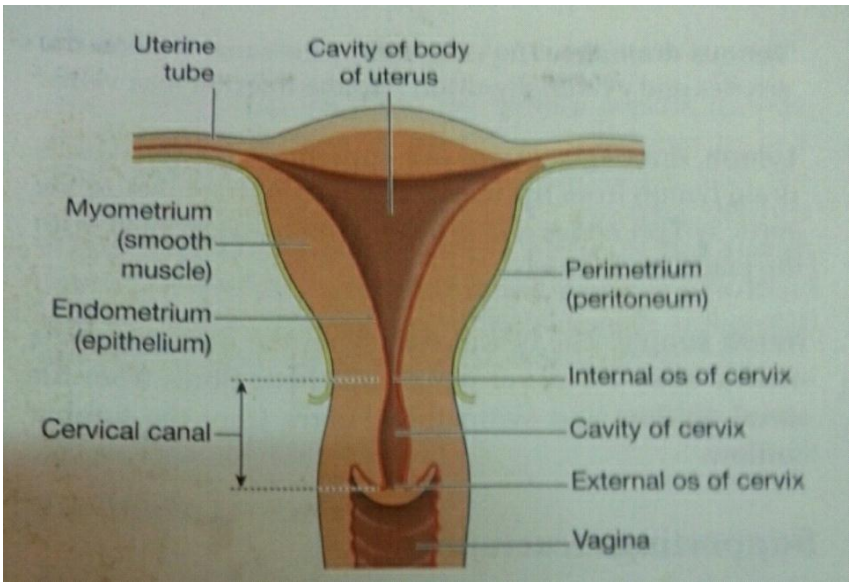

Fig (2.2) show internal structure of the uterus (Ross and Wilson2006)

The uterus is a hollow muscular pear shaped organ, flattened anterior posteriorly. It lies in the pelvic cavity between the urinary bladder and the rectum. It is about 7.5cm long, 5cm wide and its wall about are 2.5cm thick. It weighs from 30to 40 grams. The part of the uterus is the fundus, body and cervix. The fundus is dome-shaped of the uterus above the openings of the uterine tubes. The body is the main part. It is narrowest inferiorly at the internal os where it is continuous with the cervix. The cervix (neck of the uterus). This protrudes through the anterior wall of vagina, opening into it at the external os. The wall of the uterus is composed of the three layers of tissue: perimetrium, myometrium and endometrium**.** This is peritoneum, which distributed differently on various surface surfaces of the uterus. Anteriorly it extends over the fundus and the body where it is folded on to the upper surface of the urinary bladder. This fold of peritoneum forms the vesicouterin pouch. Posteriorly the peritoneum extends over the fundus, the body and the cervix, and then it continues on to the rectum to from the recto uterine

pouch (of Douglas). Laterally, only the fundus is covered because the peritoneum forms a double fold with the uterine tubes in the upper free border. This double fold is the broad ligament, which at the lateral ends attaches the uterus to the sides of the pelvis. Myometrium this is the thickest layer of tissue in the uterine wall. It is a mass of smooth muscle fibers interlaced with areolar tissue, blood vessels and nerves. Endometrium this consists of columnar epithelium containing a large number of mucus-secreting tubular gland. It is divided functionally into two layers. The functional layer is the upper and it thickness and becomes rich in blood vessels in the first half of the menstrual cycle. If the ovum is not fertilized and dose not implant, this layer is shed during menstruation. The basal layer lies next to the myometrium, and is not lost during menstruation. It is the layer from which the fresh functional layer is regenerated during each cycle. The uterus is supported in the pelvic cavity by surrounding organ, muscles of the pelvic floor and ligaments that suspend it from the wall of the pelvis. Broad ligament are formed by double fold of peritoneum, one on each side of the uterus. They hang down from the uterine tubes as though draped over them and their lateral ends they are attached to the sides of pelvis. Round ligament are bands of fibrous tissue between the two layers of broad ligament, one on each side of the uterus. They pass to the sides of the pelvis then through the inguinal canal to end by fusing with the labia majora. Uterosacral ligament these originate from the posterior walls of the cervix and vagina and extend backwards, one on each of the rectum to the sacrum. Transvers cervical ligament these extend one from each side of the cervix and vagina to the side walls of the pelvis. Pubocervical fascia this extends forward from the transvers cervical ligament on each side of the bladder and is attached to the posterior surface of the pubic bones. (Ross and Wilson2006).

2.1.2 The ovaries:

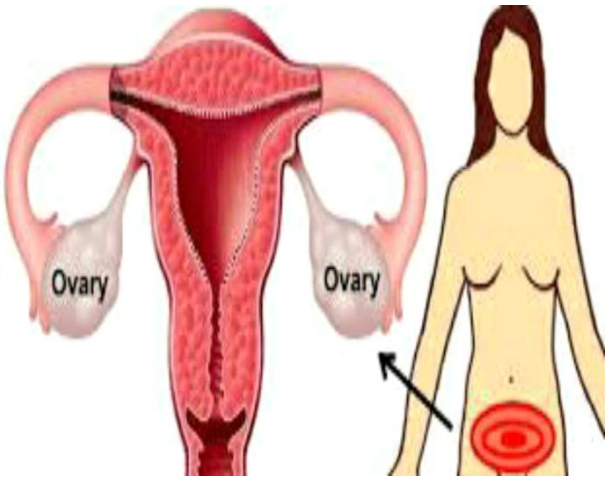

Fig (2.3) show of the ovary (www.wikipedici.com)

The ovaries are avoiding almond shaped Structure that varies considerably in size depending on age, hormonal status and stage of the menstrual cycle. The ovaries are the female gonads (glands producing sex hormones and the ova), and they lie in a shallow fossa on lateral walls of the pelvis. They are 2.5to 3.5cm long, 2cm wide and 1cm thick. Each is attached to the upper part of the uterus by the ovarian ligament and to the back of the broad ligament by broad band of tissue. Blood vessels and nerves pass to the ovary through the mesovarium. The ovaries have two layers of tissue. The medulla lies in the center and consists of fibrous tissue, blood vessels and nerves. The cortex surrounds the medulla, it has framework of connective tissue, or stromal, covered by germinal epithelium Relationship of the ovaries, medially by the fallopian tube, laterally by the lateral pelvic wall, superiorly and anteriorly it is surrounded by the small intestine, inferiorly by the ovarian fossa where the ureter and the internal iliac vessels pass. (Ross and Wilson).

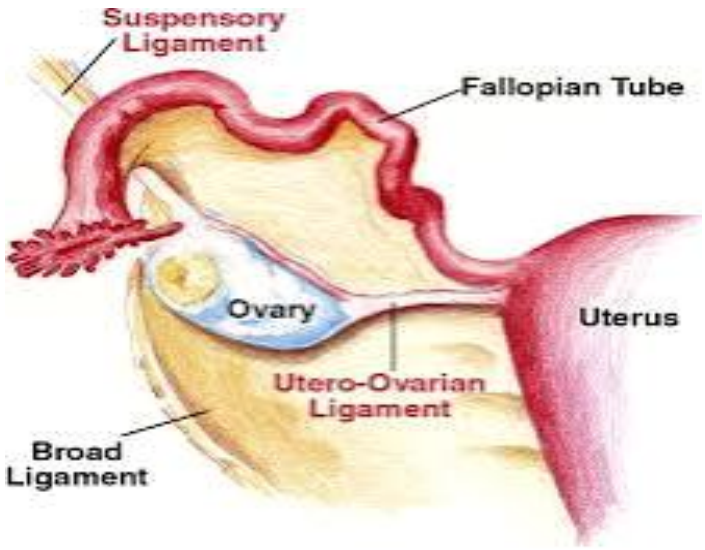

Fig (2.4) show of the ovaries ligament (www.wikipedici.com)

The ovarian ligament (also called the utero-ovarian ligament or proper ovarian ligament) is fibrous ligament that connects the ovary to the lateral surface of the uterus. This ligament should not be confused with the suspensory ligament of the ovary, which extends from the ovary in the other direction.

2.1.3 The fallopian tubes:

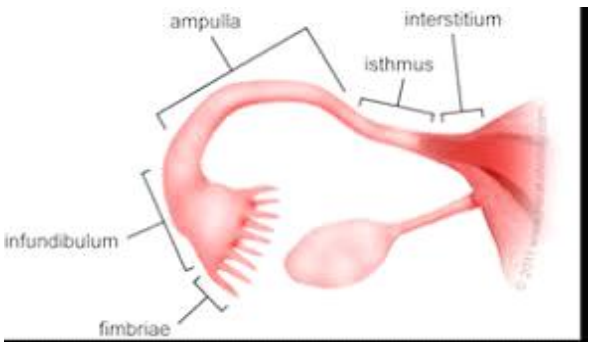

Fig (2.5) show of fallopian tube (www.wikipedici.com)

The uterine (fallopian) tubes are about 10cm long and extend from the sides of the uterus between the body and the fundus. They lie in the upper free border of the border of the broad ligament and their trumpet –shaped lateral ends penetrate the posterior wall, opening into the peritoneal

cavity close to the ovaries. The end of each tube has fingerlike projection called fimbriae. The longest of these is the ovarian fimbria, which is close association with the ovary. The uterine tube have an outer covering of peritoneum, a middle layer of smooth muscle and are lined which ciliated epithelium (Ross and Wilson 2006).

Infundibulum it is the funnel shaped lateral end of the fallopian tube that project beyond the broad ligament and overlies the ovary. The free edge of the infundibulum has several like processes know as fimbriae. Ampulla it is the widest part of the tube, which represent most of the lateral half. Isthmus it is the narrowest part of the tube and lies just lateral to the uterus. Intramural part it is the segment that pierces the uterine wall. (Ross and Wilson2006).

2.1.4 Reproductive female blood supply

2.1.4.1 Uterus

Arterial supply. This is by the uterine arteries branches of the internal iliac arteries. They pass up to lateral aspect of the uterus between the two layers of broad ligament. They supply the uterus and uterine tubes and join with the ovarian arteries to supply the ovaries. (Ross and Wilson 2006).

Venous drainage: Then veins follow the same route as the arteries and eventually drain into the internal iliac veins. (Ross and Wilson2006)

Lymph drainage: Deep and superficial lymph vessels drain lymph from the uterus and the uterine tubes to the aortic lymph nodes and groups nodes associated with the iliac blood supply. (Ross and Wilson2006).

Nerve supply: The nerve supplying the uterus and the uterine tubes consist of parasympathetic fibers from the sacral outflow and sympathetic fibers from the lumbar outflow. (Ross and Wilson 2006).

2.1.4.2 The ovaries

Arterial supply: This is by ovarian arteries, which branch from abdominal aorta just below the renal arteries. (Ross and Wilson 2006).

Venous drainage: This is into a plexus of veins behind the uterus from which the ovarian vein arise. The right ovarian vein opens into inferior vena cava and the left into the left renal vein. (Ross and Wilson2006).

Lymph drainage: This is to lateral aortic and preaortic lymph nodes. The lymph vessels follow the route as arteries. (Ross and Wilson 2006).

Nerve supply: The ovaries are supplied by parasympathetic nerves from the sacral outflow and sympathetic nerves from the lumbar outflow.(Ross and Wilson 2006).

2. .2 Reproductive female physiology

The menstrual cycle, ovulation and pregnancy, the female's role in genetic division, birth control, sexually transmitted diseases and other disease and disorders. (Ahmad.H, etl2007).

2.2.1 Reproduction

Reproduction can be defined as the process by which an organism continues its species. In the human reproductive process, two kinds of sex cells (gametes) are involved: the male gamete (sperm), and the female gamete (egg or ovum). These to gametes meet within the female's uterine tubes located one on each side of the upper pelvic cavity, and begin to create a new individual .the female needs a male to fertilize her egg; she

then carries off spring through pregnancy and childbirth. Female reproductive system: produces eggs (ova), secretes sex hormones, receives the male spermatozoa during sexual intercourse, protects and nourishes the fertilized egg until it is fully developed, delivers fetus through birth canal, provide nourishment to the baby through milk secreted by mammary glands in the breast.(Ahmad.H,etl2007).

2.2.2 The female genital organs is Divided to Tow Main Part

External genital organs, internal genital organs (Ahmad.H, etl2007).

2.2.2.1External Genitals

During sexual excitement, the clitoris erects and extends, the hood retracts, and making the clitoral gland more accessible, the size of clitoral variable between women. On some, the clitoral gland is very small; on others, it is large and the hood dose not completely covers it (Ahmad. H, etl2007).

The opening to the urethra is just below the clitoris. Although it is not related to sex or reproduction, it is included in the vulva; the urethra is actually used for the passage of urine. The urethra is connected to the bladder, in female the urethra is 1.5 inches long, compared to males whose urethra is 8 inches long. Because the urethra is so close to the anus, women should always with wipe themselves from front to back to avoid infecting the vagina and urethra with bacteria. This location issue is reason for bladder infections being more common among females. (Ahmad.H, etl2007).

The vagina is muscular, hollow tube that extends from the vaginal opening to the cervix of the uterus. It is situated between the urinary bladder and the rectum. It is about three to five inches long in grown

women. The muscular wall allows the vagina to expand and contract. The muscular walls are lined with mucous membranes, which keep it protected and moist. A thin sheet of tissue with one or more holes in it, called the hymen, partially covers the opening of the vagina. The vagina receives sperm during sexual intercourse from the penis. The sperm that survive the acidic condition of the vagina continue on through to the fallopian tubes where fertilization may occur. The vagina is made up of three layers, an inner mucosal layer. A middle muscular layer and an outer fibrous layer. The inner layer is made of vaginal rugae that stretch and allow penetration to occur. These also help with stimulation of the penis. The middle layers has gland that secrete acidic mucus (pH of around 4.0.) that keeps bacterial growth down. The outer muscular layer especially important with delivery of fetus and placenta, the purposes, vagina is to receives a male erect penis and semen during sexual intercourse, pathway through women's body for the baby to take during childbirth, provides the route for menstrual blood (menses) from the uterus to leave the body, may hold forms of birth control, such as a diaphragm, female condom (Fem Cap, Nuva Ring)..(Ahmad.H, etl 2007).

The cervix (from Latin "neck") is the lower, narrow portion of the uterus where it joins with the top end of the vagina, where they join together forms an almost 90 degree curve; it is cylindrical or conical in shape and protrudes through the upper vaginal wall approximately half its length is visible with appropriate medical equipment; the remainder lies above the vagina beyond view, it is occasionally called "cervix uteri", or neck "of the uterus". During menstruation, the cervix stretches open slightly to allow the endometrium to be shed this stretching is believed to be part of cramping pain that many women experience, evidence for this is given by fact that some women's cramps subside or disappear after their first

vaginal birth because the cervical opening has widened, the portion projection into the vagina is referred to as the portio vaginalis or ectocervix on average, the ectocervix is three cm long and two and a half cm wide, it has convex elliptical surface and divided into anterior and posterior lips, the ectocervix opening s called the external os, the size and shape of the external os and the ectocervix varies widely with age, hormonal state, and whether the women has had a vaginal birth. In women who have not had a vaginal birth the external os appears as small, circular opening (Ahmad.H,etl 2007).

In women who have had a vaginal birth, the ectocervix appears bulkier and the external os appears wider, more slit-like and gaping, the endocervical canal, its varies widely in length and width, along with the cervix overall. Flattened anterior to posterior, the endocervical canal measures seven to eight mm at its widest in reproductive-aged women. The endocervical canal terminates at the internal os which the opening of the cervix inside the uterine cavity. During childbirth, contraction of the uterus will dilate the cervix up to 10cm in diameter to allow the child to pass through. During orgasm, the cervix convulses and the external os dilates. (Ahmad.H,etl 2007) .

The uterus is shaped like an upside-down pear, with a thick lining and muscular wall. Located near the floor of the pelvic cavity, it is hollow to allow a blastocyst, or fertilized egg, to implant and grow it also allows for the inner lining of the uterus to build up until a fertilized egg is implanted, or it is sloughed off during menses. The uterus contains some of the strongest muscles in the female body. These muscles are able expand and contract to accommodate a growing fetus and then help push

the baby out during labor. These muscles also contract rhythmically during an organ in wave like action. It is thought that this is to help push or guide the sperm up the uterus to fallopian tubes where fertilization may be possible, rapidly and dramatically, the top rim of the uterus is called the fundus is land mark for many doctors to track the progress of a pregnancy; the uterine cavity refers to fundus of the uterus and the body of the uterus, relping support the uterus are ligaments that attach from the body of the uterus to the pelvic wall and abdominal wall, during pregnancy the ligament prolapsed due to the growing uterus, but retract after childbirth in some cases after menopause , they may lose elasticity and uterine prolapsed may occur and this can be fixed with surgery, some problems of the uterus include uterine fibroids , pelvic pain pelvic relaxation (prolapse), heavy or abnormal menstrual bleeding, and cancer it is only after all alternative option have been considered that surgery is recommended in these cases, this surgery is called hysterectomy it's the removal of the uterus, and may include the removal of one or both of the ovaries once performed it is irreversible after hysterectomy, many women begin a form of alternate hormone therapy due to the lack of ovaries and hormone production,(Ahmad.H,elt2007).

At the upper corners of the uterus are the fallopian tubes. There are two fallopian tubes or the oviducts. Each fallopian tube attaches to a side of the uterus and connects to an ovary; they are positioned between the ligaments that support the uterus, the fallopian tubes are about four inches long and about as wide as a piece of spaghetti within each tube is a tiny passageway no wider than a sewing needle, at the other end of the fallopian tube is a is a fringed area that looks like a funnel, this fringed area called the in fundibulum, lies close to the ovary, but is not attached.

The ovaries alternately release an egg, when an Ovary dose ovulate or release an egg, it is swept into the lumen of the fallopian tube by the fimbriae, once the egg is in the fallopian tube, tiny hairs in the tube's lining help push it down the narrow passageway toward the uterus, the oocyte or developing egg cell, takes four to five days to travel down the length of the fallopian tube. If enough sperm are ejaculated during sexual intercourse and there is an oocyte in the fallopian tube, fertilization will occur after fertilization occurs, the zygote, or fertilized egg, will continue down to the uterus and implant itself in the uterine wall where it will grow and develop. If zygote doesn't move down to the uterus and implants itself in the fallopian tube, it is called an ectopic or tubal pregnancy. If this occurs, the pregnancy will need to be terminated to prevent damage to the fallopian tube, possible hemorrhage and possible death of the mother. (Ahmad.H, elt2007).

Mammary glands are the organs the produce milk for sustenance of a baby. These exocrine glands are enlarged and modified sweat glands the basic components of the mammary gland are the alveoli (hollow cavities, a few millimeters large)lined with milk –secreting epithelial cell and surrounded by my epithelial cell, these alveoli join up to from groups known as lobules, and each lobule has a lactiferous duct that drains into openings in the nipple the my epithelial cell can contract, similar muscles cell, and thereby push the milk from the alveoli through the lactiferous ducts towards the nipple, where it collects in widening (sinuses) of the ducts a suckling baby essentially squeezes the milk out of these sinuses.

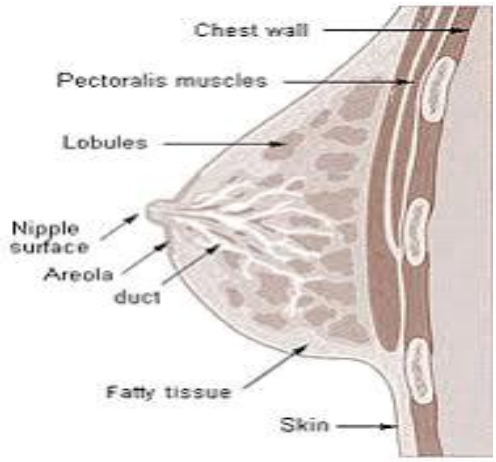

Fig (2.6) sagittal cut shows female breast and mammary gland (www.wikipedici.com)

The development of mammary gland is controlled by hormones the mammary glands exist in both sexes, they are rudimentary until puberty when in response to ovarian hormones they begin to develop in the female estrogen promotes formation, while testosterone inhibits it. At the birth, the baby has lactiferous ducts but no alveoli, little branching occurs before puberty when ovarian estrogens stimulate branching differentiation of the ducts into spherical masses of cells that will become alveoli, true secretory alveoli only develop in pregnancy, where rising level of estrogen and progesterone cause further branching and differentiation of the duct cells, together with an increase in adipose tissue and a richer blood flow. Colostrum is secreted in late pregnancy and for the first few days after giving birth true milk secretion (lactation) begins a few days later due to reduction in circulating progesterone and presence of the hormone prolactin the sucking of the baby causes the

release of the hormone oxytocin which stimulates contraction of the my epithelial cells the cells of mammary glands can easily be induced to grow and multiply by hormones, if this growth runs out of control, cancer result almost all instances of breast cancer originate in the lobules or ducts of the mammary glands.(Ahmad.H,etl20).

Table 2.1 Summary of the location and description and function of the female reproductive system (Ahmad.H, etl2007)

structure	Location &Description
Breasts	Upper chest one on each side containing alveolar cells (milk production), my oepithelial cells (contract to expel milk),and duct walls(help with extraction of milk).
Female gonads))	Uterus.
Uterus	Center of pelvic cavity.
Cervix	The lower narrower portion of the uterus.
Vagina	Canal about 10-8 cm long going from the cervix to the outside of the body.
Hymen	Thin membrance that partially covers the vagina in youbg female .
Clitoris	Small erectile organ directly in front of the Vestibule.
Labia majora	Outer skin folds that surround the entrance to the vagina.
Labia minora	Inner skin fold that surround the entrance to vagina.
Fallopian tubes	Extending upper part of the uterus on either side.
Ovaries	Pelvic region on either side of .
Vulva	Surround entrance to the reproductive tract.(encompasses all external genitalia)
Endometrium	The innermost layer of uterine wall .
Myometrium	Smooth muscle in uterine wall.

2.3 Reproductive female pathology

Women are commonly dealing with many different diseases and disorders that pertain to reproductive system. Here are some of the most common:

2.3.1 Uterine fibroid

There are very common, often multiple, benign tumors of myometrium. They are firm masses of smooth muscle encapsulated in compressed muscle fibers and they vary greatly in size. Large tumors may undergo degenerative changes if they outgrow their blood supply, leading to necrosis, fibrosis and calcification. They develop during the reproductive period and may be hormone dependent; enlarging during pregnancy and when oral contraceptives tumors may cause pelvic discomfort, frequency of micturition, menorrhagia, irregular bleeding, and dysmenorrhea and reduced fertility. Malignant change is rare. (Ross and Wilson2006).

2.3.2 Endometritis

This is usually caused by non –specific infection, following childbirth or miscarriage, especially if fragments of membranes or placenta have been retained in the uterus. It may also be caused by an intrauterine contraceptive device (IUCD). The inflammation may subside after removal of retained products or the ICUD. The infection may spread to surrounding pelvic structures e.g. uterine tubes, or deeper layers of the uterus. (Ross and Wlsion2006).

2.3.3 Endometrial carcinoma

This occurs mainly in nulliparous women between 50and60 years of age. The incidence is increased when an estrogen secreting tumor is present and in women who are obese, hypertensive or diabetic, because they tend to have a high level of blood estrogen. The tumor may develop as a diffuse mass, a localized plaque or polyp and there is often ulceration and bleeding. Endometrium has no lymphatic, so lymph spared is delayed until there is extensive local spread that involves other pelvic structures. Distant metastases, spread in blood or lymph develop later, most commonly in the liver, lungs and bones. Invasion of the uterus leads to hydronephrosis and uraemia, commonly the cause of death (Ross and Wlsion2006)

2.3.4 Cervical carcinoma

Dysplastic changes, referred to as cervical intraepithelial neoplastic (CIN) begin in deepest layer of cervical epithelium, usually at the junction of the stratified squamous epithelium of lower third of the cervical canal with secretory epithelium of the upper two-third. Dysplasia may progress to involve the full thickness of epithelium. Not all possible into malignant disease, but it is not possible to predict how far development will go, and whether it will remain static or regress. (Ross and Wlsion2006).

2.3.5 Ovarian cysts

An ovarian cyst is a sac that forms on the surface of a woman's ovary during ovulation. It holds a maturing egg. Usually the sac goes away after the egg is released. If an egg is not released, or if the sac closes up after the egg is released, the sac can swell up with fluid (Ahmad.H.etl2007).

2.3.6 Ovarian syndromes

Also known by other names affects women and is a complex of symptoms that are not necessarily all present in all case. Some, but not all, affected women have multiple cysts no the ovaries. Other characteristics include the absence menstruation or irregular menstruation, failure of the ovary to release eggs, elevated level of the male hormones known as an androgen, excessive amounts of body hair, a high rate of miscarriage, and infertility. There criteria often used for a diagnosis are menstrual irregularity, hyperandrogenism, and exclusion of other disease. There is some evidence that it is an inherited condition (Ahmad.H, etl2007).

2.3.7 Ovarian cancer

Happens when cells that are not normal grow in one or both of your ovaries. This cancer is often cured when it is caught early. But most of the time, the cancer has already spread by the time it is found. Ovarian cancer dose not usually cause symptoms at first. But most common symptoms are gas and pain or swelling in the belly. Other these symptoms are diarrhea or constipation, or an upset stomach. But these symptoms are general that they are more likely to be blamed on number of other causes. Most the time, the cancer has already spread by the time it is found (Ahmad.H, etl2007).

2.3.8 Pelvic inflammatory disease

Is an infection of woman's reproductive organ, this occurs when women fail to contribute in the normal conception process, and also becomes incapable of carrying a pregnancy to full term. Pelvic inflammatory disease can cause scar tissue in the pelvic organs and lead to infertility.

There are different infertility; complete infertility, subfertility, primary infertility, and secondary infertility (Ahmad.H, etl 2007).

2.3.9 Menopause

Is the point in woman's life when she has not had a menstrual period for 1 year menopause the marks the end of childbearing years? It is sometimes called "the change of life" for most women; menopause happens around age 50, but every woman's body has its own timeline. Some women stop having periods in their mid -40s. Other continues well into their 50s. (Ahmad, H, etl2007).

2.3.10 Perimenopause

The process of change that leads up to menopause. It can start as early as your late 30s or as late as your early 50s. How long perimenopause lasts varies, but it usually lasts from 2to 8 years. You may have irregular periods or other symptoms during this time.(Ahmad,H,etl2007).

2.3.11 Menstrual

Periods also may be very irregular at the other end of the menstural years. Many women realize that they are approaching perimenopause and when their otherwise regular periods become irregular. Menopause occurs when it has been 12 months sinceyou have had a menstrual period. (Ahmad, H, etl2007).

2.3.12 Abnormal menstrual

Periods most women have begin the first few years after menstruation starts. It may take several years for the hormones that control menstruation to reach a balance. (Ahmad, H, etl2007).

2.1.4 MRI basic principle and instrumentation

2.1.4.1 Basic Principle of MRI

Magnetic resonance imaging (MRI) is founded on the principle of nuclear magnetic resonance (NMR). The principles of nuclear magnetic resonance are based on the fact that the nuclei of certain elements have a magnetic moment. This means that if a sample of atoms of one of these elements were placed in a magnetic field, its nuclei would tend to line up with the field.

The nuclei don't actually line up exactly in the direction of the magnetic field, however. The laws of quantum mechanics dictate that they align at an angle to the direction of the field.

Each type of nucleus has a quality know as angular momentum associated with it. The idea of an intrinsic angular momentum of the nucleus is fundamental to magnetic resonance imaging. It can be likened to the example of a spining top. When a top is spun at an angle to the vertical, it will process about the vertical axis. That is, the top will rotate about its own axis, and the axis of the top's rotation will revolve about the vertical axis.

This precession is due to the angular momentum of the top, which is in turn due to the spinning of the top, in the same way; a nucleus that is aligned at an angle to the direction of the magnetic field will process about the axis of the field.

The analogy is so exact that the nuclei are commonly referral to as spins that are manipulated to generate images.

In quantum mechanics a number called the spin of the nucleus represents the angular momentum. Depending on the value of the spin number of a particular, there will be several different orientations in which the nuclei may line up in a magnetic field. Each orientation is representing by a

different angle from the direction of the magnetic field about which the nucleus will process.

MRI takes advantage of the fact that the nucleus of a hydrogen atom (a single proton) has a magnetic moment. The spin of the proton is such that the proton has exactly two possible ways to line up with the applied magnetic field. Because of its abundance in the body, hydrogen is a wonderful candidate for use in magnetic resonance imaging.

The frequency at which the nucleus processes is a function of both the strength of the magnetic field and the particular nucleus this frequency, called the larmor frequency, and is equal to the product of the strength of the magnetic field and a constant called the gyro-magnetic ratio. The gyro-magnetic ratio is unique for each nucleus that has a magnetic moment.

The larmor frequency is important, because it's the frequency at which the nucleus will absorb energy that will cause it to change its alignment. In proton imaging this energy is in the radio frequency (RF) range, meaning that the frequency typically varies from(1 to 100)MHz. if an RF pulse at the larmor frequency Bo applied to a proton, the proton will change its alignment so that rather than being aligned with the main magnetic field, it will be aligned opposite the field. Over a period of time the proton will flip back to align with the field. In doing so, it will emit energy whose frequency is also exactly the larmor frequency. It is this emission of energy that made NMR such a useful means to locate on image protons.

The term resonance refers to that property of the procession nucleus in which it absorbs energy only at the larmor frequency. If the frequency is off even by a small amount, the nucleus will not absorb any energy, nor will it change state. (Catherine Westbrook, 2008)

2.1.4.4 MRI Instrumentation:

The MRI system consists of, the magnet, the gradient coils, the radiofrequency subsystem and the computer.

2.1.4.5 The Magnet:

The heart of all MR system is the magnet. There are three types of the magnets in common use for MRI; all have in common that they can generate large uniform magnetic fields. They differ in the cost to produce the magnet, the strength that can be produced, energy requirement to support the magnet, and the direction of the main magnetic fields.

Super Conducting Magnets: By far the most commonly used magnet is the superconducting magnet. This type of magnet is notable in that the magnetic field can be maintained for a very long period of time without requiring a constant source of energy. This allows the use of this type of magnet in systems that require extremely strong magnetic field (above 0.5 T).

A superconducting magnet consists of many winding of wire that carries on electric current. The magnet field generates by this cylinder of wires runs in the direction along the long axis of the cylinder. When used to produces MR. Images the superconducting magnet produces relatively high magnetic field strength with low power requirement.

Resistive Magnets: Resistive magnets are similar to superconducting magnets, in that they are typically coils of wire through which a magnetic field is induced. However, the wires aren't cooled to a superconductive state. Therefore, the wires are resistive, and if a current were applied and the power supply disconnected the current would eventually die out.

The major difference, therefore, is one of tradeoffs in operating cost. A resistive magnet doesn't require liquefied gases (cryogens), but it does require a power supply to keep the magnet at a stable field. As a result of

the increase is cost, these magnets aren't seen in commercial system at field strength over 0.4 T.

Permanent Magnets: The permanent magnet is gaining in popularity for systems that operate at magnetic fields up to about 0.4T. a large part of this popularity is due to the fact that a permanent magnet has few requirement to maintain it. While a superconducting magnet requires cryogens, and a resistive magnet requires a power supply to maintain its current a permanent magnet requires neither.

The disadvantages of using a permanent magnet are its weight and the cost of the magnet and supporting structure. In addition, permanent magnets are susceptible to hysteresis (a time varying change in the field). They are commonly used now for low cost system; the cost (and weight) of the magnets has precluded their use at higher field strengths. (Catherine Westbrook, 2008)

2.1.4.6 Types of Coils according to the usage:

2.1.4.6.1 Shim Coils:

Due to design limitation it's almost impossible to create an electromagnet, which produces a perfectly homogeneous magnetic field. To correct for these inhomogeneities, other loop of current carrying wire are placed around the bore. This process is called shimming and the extra loop of wire is called a shim coil. Shim coils produce magnetic field evenness or homogeneity. For imaging purposes, homogeneity of the order of 10 ppm is required. Spectroscopic procedures require a more homogeneous environment of I ppm.

The shim system requires a power supply which is separate from the other power supplies within the system. This is important because a fault in the shim power supply compromises image quality. (Catherine West brook, 2008)

2.1.4.6.2 Gradient Coils:

The magnetic field strength is proportional to the amount of current passed through the loop of wire, the number of loops in the wire, the size of the loops, and how closely the loops are spaced. If the loops are spaced closely at one end of the solenoid and gradually become farther apart at the other end, the resultant magnetic field becomes stronger at one end than the other. This is called a magnetic field gradient. Gradient coils provide a linear gradation or slope of the magnet field strength from one end of the solenoid to the other. The gradient is applied by passing current through the gradient coils in a certain direction. The amplitude of the gradient slope is determined by the magnitude of the current passing through the coil. (Catherine Westbrook, 2008)

By varying the magnetic field strength, gradient provide position dependent variation of signal frequency and are therefore used for slice selection, frequency encoding, phase encoding, rewinding and spoiling. Gradient coils are powered by gradient amplifiers. Faults in the gradient cods or gradient amplifiers can result in geometric distortion in the MR image. (Catherine Westbrook, 2008)

2.1.4.6.3 Radio Frequency Coils:

The energy required to produce resonance of nuclear spins is expressed as a frequency and can be calculated by the larmor equation. At field strengths used in MRI, energy within the radio frequency (RF) band of the electromagnetic spectrum is necessary to perturb or excite the spins. As shown by the larmor equation, the magnetic field strength is proportional to the RF, the energy of which is significantly lower than that of X-rays. In order to produce an image, RF must first be transmitted at the resonant frequency of hydrogen so that resonance can occur. The

transverse component of magnetization created by resonance must be detected by a receiver coil. (Catherine Westbrook, 2008)

The configuration of the RF transmitter and receiver probes or coil directly affects the quality of the MR signal. There are several types of coils currently used in MR imaging. These are:

Volume Coils: A volume coil both transmit RF and receives the MR signal and is often called a transceiver. It encompasses the entire anatomy and can be used for either head or total body imaging. Because of their large size they generally produce images with lower SNR than other types of coils.

Surface Coils: Coils of this type are used to improve the SNR when imaging structures near the surface of the patient (Such as lumbar spine). As the SNR is enhanced when using local coils (surface coils) greater spatial resolution of small structures can often be achieved when using local coils, the body coil is used to transmit RF and the local coil is used to receive the MR signal.

Phase Array Coils: Phased array coils are now widely used. These consist of multiple coils and receivers whose individual signals are combined to create one image with improved SNR and increased coverage. Therefore the advantages of small surface coil (increased SNR and resolution); can be combined with a large FOV for increased anatomy coverage. Usually up to four coils and receiver are grouped together to increase either longitudinal coverage (for spin imaging), or to improve uniformity a cross a whole volume (pelvic imaging).

Circumferential Coils: At the point where depth equals radius of the structure being imaged, the coil may be placed around the object in a circumferential fashion to form a solenoid. Circumferential coils provide good signal responses across the image because all points are within one radius from the edge of the coil. Two general configurations are possible

with circumferential coils: solenoidal and saddle. It can be used to image the neck, knee, ankle and pediatric. (Catherine Westbrook, 2008)

2.1.4.6.4 The computer system

MRI computer systems vary with manufacture. Most however consist of:

Aminic computer with expansion capabilities, An array processor for Fourier transformation

An image processor that takes data from the array processor to form an image

Hard disc drives for storage of raw data and pulse sequence parameters.

A power distribution mechanism to distribute and filter the alternating current. (Catherine Westbrook, 2008)

2.1.4.7 Spin Echo Pulse Sequences:

2.1.4.7.1 Conventional spin echo:

The spin echo sequence is utilizes a 900 excitation pulse to flip the net magnetization vector (NMV) into the Transverse plane. The NMV precesses in the transverse plane, inducing a voltage in the receiver coil. The precession paths of the magnetic moment of the nuclei within the NMV are translated into the transverse plane. When the 90° RF pulse is remove a free induction decay signal (FID) is produced. T2 dephasing occurs immediately and the signal decays. A 180° RF pulse is then used to compensate for this dephasing.

Spin echo pulse sequences are the gold standard for most imaging. They may be used for almost every examination. Ti weighted images are useful for demonstrating anatomy because they have a high signal to noise ratio (SNR). In conjunction with contrast enhancement however, they can show pathology. T2 weighted also demonstrate pathology. Tissues that

are diseased are generally more edematous and/or vascular. They have increased water content and consequently, have high on T2 weighted image and can therefore be easily identified. The conventional spin echo has the advantages of good image quality, very versatile and true T2 weighted sensitive to pathology. They have the disadvantages of requiring longer scan time. (Catherine Westbrook, 2008)

2.1.4.7.2 Fast Spin Echo (Turbo Spin Echo):

As the name suggests, fast spin echo (FSE) is a spin echo pulse sequence, but with scan times that are drastically shorter than conventional spin echo.

As the scan time is a function of the TR, NEX and number of phase encoding, in order to reduce the scan time, one or more of these factors should be reduced. Decreasing the TR and the NEX affects image weighting and SNR which is undesirable. Reducing the number of phase encodings reduces the spatial resolution, which is also a disadvantage. In fast spin echo, performing more than one phase encoding step and subsequently filling more than one line of K space per IR reduce the scan time. This is achieved by using an echo train that consists of several 180°-rephrasing pulses, at each rephrasing an echo is produced and a different phase encoding step is performed.

In conventional spin echo, raw image from each echo stored in K space, and the numbers of 180° rephrasing pulses applied corresponds to the number of echoes produced per TR. Each echo is used to produce a separate image. In fast spin echo, data from each echo is placed into one image. The number of 180° rephrasing pulses performed per TR corresponds to the number is called the turbo factor or the echo train length. As the turbo factor increase, the scan time decrease, as more phases encoding steps are performed per TR. (Catherine Westbrook, 2008)

The advantages of the fast spin echo is that, the scan times greatly reduced, high-resolution matrices and multiple NEX can be used, and image quality improved, and increased T2 information.

The disadvantages are some flow and motion affects increased, incompatible with some imaging options, fat bright on T2 weighted images, image blurring can result as data is collected at different TE times, reduce magnetic susceptibility effect as multiple 180° pulses produce excellent rephrasing so it should not be used when hemorrhage is suspected

In recent years, fast spin echo (FSE) sequences have begun to replace conventional spin echo sequences. (Catherine Westbrook, 2008)

2.1.4.7.3 The Gradient Echo Pulse Sequence:

A gradient echo pulse sequences utilizes an RF excitation pulses that is variable, and therefore flips the NMV through any angle (not just 90'). A transverse component of magnetization is created, the magnitude of which is less than in spin echo, where all the longitudinal magnetization is converted to the transverse plane. When a flip angle other than90° is used only part of the longitudinal magnetization is converted to transverse magnetization, which precesses in the transverse plane and induces a signal in the receiver coil.

Gradient echo pulse sequences can be acquired T2*, T1 and proton density weighted, however, there is always some degree of T2* weighted present on any image due to the absence of 180° rephrasing pulse. Gradient echo sequence allow for reduction in the scan time as the TR is greatly reduced. They can be used for signal slice breath-hold acquisition in the abdomen, and for dynamic contrast enhancement. They are very sensitive to flow as gradient rephrasing is not slice selective, so flowing nuclei always give a signal, as long as they have been previously excited.

Because of this, gradient echo sequences may be used to produce angiography, type images.

They provide interesting capabilities in term of contrast and speed. These techniques can be broadly divided into " steady state " sequences, such as gradient recalled steady state (GRASS) and fast imaging with steady state free precession (FISP), and " spoiled " sequences, such as fast low-angle signal-shot (FLASH) and (spoiled GRASS). (Catherine Westbrook, 2008)

2.1.4.7.3 Three-Dimensional Fourier Transform (3DFT):

The great attraction of this technique is that a high resolution volume data set can be processed retrospectively to generate any arbitrarily oriented plane of section. For instance, a radial image can be produced using suitable software. Three-dimensional acquisition is only practical with fast scan sequences.

The advantages of 3DFT imaging are the ability to acquire thin section without gabs and the potential for 3D rendering and reformatting. The disadvantages of 3DFT imaging is that the costs include a significantly lager requirement for resources such as computing power, memory, display, and storage. Other less well-established concerns are that the examinations may take longer to interpret, given that more sections must be viewed, and that there may be a penalty in signal-to-noise and contrast, which accompanies the requirement. (Catherine Westbrook, 2008)

2.1.4.7.4 Inversion Recovery:

Inversion recovery is a pulse sequences that begins with a 180° inverting pulse. This inverts the net magnetization vector (NMV) through I80° into full saturation. When the inverting pulse is removed the NMV begins to relax back to Bo.

A 90° excitation pulse is then applied at a time from the 180° inverting pulse know as time from inversion (I 1). The contrast of the resultant image depends primarily on the length of the TI. If the 90° excitation pulse is applied after the NMV has relax back through the transverse plane the contrast in the image depend on, the amount of longitudinal recovery of each vector (as in spin echo). The resultant image is heavily Ti weighted, as the 180° inverting pulse achieves full saturation and ensure a large contrast difference between fat and water.

If the 90^{o} excitation pulse is not applied until the NMV has reached full recovery, a proton density image result, as both fat and water have full relaxed.

After the 90' excitation pulse, a 180°rephasing pulse is applied at a time TB after excitation pulse. This produces a spin echo. The TR is the time between each 1800 inverting pulse.

Inversion recovery is used to produce heavily Ti weighted images to demonstrate anatomy. The 180° inverting pulse produce a large contrast difference between fat and water because full saturation of the fat and water vectors is achieved at the beginning of each repetition. Inversion recovery pulse sequences therefore produce more heavy T1 weighting than conventional spin echo and should be used when this is required. As the use of contrast primary shortens T1 times of certain tissue, IR pulse sequences increase the signal from structures that have enhanced as a result of a contrast injection.

Inversion recovery has the advantages that it gives very good SNR, as the TR is long and excellent T1 contrast. The disadvantage that is it spends along scan times unless used in conjunction with fast spin echo. (Catherine Westbrook, 2008)

2.1.4.7.5 STIR (short T1 inversion recovery):

Is an inversion recovery pulse sequence that uses a T1 that corresponds to the time it takes fat to recover from full inversion to the transverse plane so that there is no longitudinal magnetization corresponding to fat, When the 90° excitation pulse is applied, the fat vector is flipped through 90° to 180° and into full saturation, so that the signal from fat is nulled. STIR is used to achieve suppression of the fat signal in a T1 weighted image.

One of the advantages of STIR is that it is relatively reliable and system independent. As in spin echo, the contrast mechanism can be fairly easily reproduced from system to system and field strength to field strength, with appropriate correction of timing parameters.

The primary disadvantages lies with scan time. STIR scan time, as for inversion recovery sequences, can be computed as the product {TR x NEXx Matrix}. Since relatively long TR values are generally used, this resultant in scans times comparable to even longer than standard T2 weighted spin echo sequences.

In addition, we must be careful in the use contrast agent in conjunction with STIR sequences. Gadolinium will shorten the T1 relaxation rate for vascularity, its T1 value will not be affected, and however, fatty lesions may experience some T1 shortening and therefore have reduced effectiveness in fat suppression. The combination of STIR with gadolinium enhancement has proven useful in the evaluation of breast lesion where sufficiently suppression of the fat signal combined with enhancement of the lesion has been shown to increase delectability. (Catherine Westbrook, 2008)

2.1.4.7.6 Spectral pre-saturation Inversion Recovery (SPIR):

This method is a combination of the spectral saturation and (STIR) routines it is available on Philips scanners where it is designated Spectral Inversion Recovery (SPIR and GE scanners with the designation Spectral

Inversion at Lipids (SPECIAL). The idea is to apply a spectrally selective pulse to flip fat spins then, after the time interval that lets the Mz of fat reach zero, the excitation pulse is applied and the signal of the water spins give most of the signal.

Time is the major disadvantage of this fat suppression method. The routine is best applied at least once per TR, and for multi-slice sequences once per slice per TR. The best fat suppression is achieved with a 180 degree spectral inversion pulse and a time delay equal that used in normal STIR imaging (approximately 150 msec at 1.5 T) plus the finite time required for the inversion pulse) This is clearly impractical for anything but extremely long TR techniques.

In practice the 'inversion" pulse used ranges between slightly more than 90 degrees but significantly less than 180 degrees the required delay time can be acceptably short. In most scanners using this method the radiographer has control of the inversion flip angle and the system determines the optimum delay time The routine is applied in a "segmented" fashion allowing some small variation in the degree of fat suppression across slices.

SP1R will be as sensitive to local field in homogeneity as spectral saturation routines. It is suitable for use after Gd contrast because only the fat spins are affected by the routine. (Catherine Westbrook, 2008)

2.1.5 Specific female pelvic tumor appearance of pelvic as seen in MRI

2.6.1 Uterus

Normal myometrium in women not on oral contraceptives demonstrates an increase in T1 and T2 relaxation times in the secretory phase of the menstrual cycle. On more T2 weighted images, an increase in signal intensity is evident.

The appearance of myometrium in women on oral contraceptives is one of higher signal intensity on T2weighted images, whereas the endometrial tissue is markedly reduced. (Demas BE1986)

Women taking higher doses of oral contraceptive demonstrate a large degree of myometrial swelling and endometrial atrophy.

It is thought that there is greater water content in the myometrium during the mid-secretory phase and there is an increase in the T1 and T2 relaxation times, resulting in increased signal intensity on T2-weighted images and decreased intensity on T1-weighted images knowing the normal myometrial characteristics of the uterus allows identification of pathological alterations such leiomyoma, a common female pelvic tumors.

Simple myomas tend to be of low signal intensity regardless of pulse sequence used (Hamlin DJ 1985)

They are usually surrounded by a smooth capsule also of low signal intensity.

When compared with ultrasonography or hysterosalpingography, MRI is more accurate in detecting the presence, size, number, and location of leiomyoma's. (Hricak H 1986)

Leiomyoma have various appearances depending on the presence or absence of calcium, hyaline or cystic degeneration, and hemorrhage. (Dudiak CM1988) In the presence of cystic degeneration, the leiomyoma demonstrates increased T1and T2relaxation times, whereas the degenerative area itself has low signal intensity on T-weighted images and high signal intensity on T2-weighted images.

Hemorrhage with in the leiomyoma, however, produces various appearances, depending on the imaging sequence used, can make the diagnosis of leiomyoma more difficult. (Lee JK1985)

2.1.5.1 Endometrium

MRI particularly useful for assessing the endometrium, which can easily be identified and distinguished from the myometrium. Experience to data demonstrates that the endometrial tissue is approximately isointense with myometrium on T1-weighted images but appears higher in signal intensity relative to myometrium on T2-weighted images. The thickness of the endometrium in normal menstruating female varies depending on the phase of the menstrual cycle being thinner in the follicular phase and thicker in the secretory phase. (McCarthy S1986)

MRI is able to define depth of myometrial invasion, tumor sit, and cervical involvement in patient with endometrial cancer. (Powell MC1986)

2.1.5.2 Cervix

A normal cervix has two distinguishable zones on MRI. The stroma is of low signal intensity on T2-weighted images, whereas the endocervical canal is represented by high signal intensity. The multiplanar capabilities of MRI allow excellent visualization of the cervix and the surrounding tissue, which is sometimes difficult on CT or Ultrasonographic examination. (Yamashita Y1993)

2.2 Previous Studies:

Butler H et al 2014 write a research article about Magnetic resonance imaging of the abnormal female pelvis.

And they found that Twenty-three women with 27 instances of pelvic pathology were evaluated by magnetic resonance imaging (MRI). Different pulse sequences were used, which varied the dependence of the images on T1 and T2. Sonography was performed on 22 of the 23 patients. Five patients had CT examinations, including the patient who did not have sonography. MRI was also done in four normal volunteers. The spatial resolution of the MRI scans with short TR and TE intervals approached that of CT. Butler concluded there was overlap of MRI signal characteristics between various pathologic entities and also within the same entity (e.g., cystadenomas and endometriomas).

V. Juhan-Duguet studied the causes of chronic pelvic pain and he found that the Chronic pelvic pain has often multiple causative factors. Careful analysis of clinical history and detailed clinical examination must be carried out to guide further imaging investigations. Endometriosis is a common cause of chronic pelvic pain, although there is no correlation between the severity of lesions and pain intensity. Pelvic ultrasonography should be the first line imaging examination to search for causative conditions that include endometriosis, adenomyosis, pelvic varices and chronic infection. Magnetic resonance imaging (MRI) is useful for making the positive diagnosis and assessing the spread of endometriosis , V.Juhan concluded that the MRI is more accurate than ultrasonography for the diagnosis of tubo-ovarian abscess when an adnexal mass is identified.

Duplex and color Doppler ultrasonography as well as MR angiography are the best imaging technique for the diagnosis of pelvic congestion syndrome. In patients with pudendal neuralgia, cross-sectional imaging help exclude nerve compression

Chapter three

Materials and Method

3.1Materials

This study intended to characterization of female pelvic tumor in Sudanese using MRI.

The data used in this study was collected from hospitals in Khartoum state: Turkish Medical Diagnostic Center.

The data collected from December 2017 to September 2018.

3.1.1 MRI Machine

MRI machines were used to collect data during this study. This machine installed in radiological department.

Hospital	Manufacture	Instillation	Magnet strength
Turkish Medical Diagnostic Center	Siemens	2012	1.5 T

3.1.2 patient data

Target populations of study were 50 Sudanese female the age of patient ranged from 18- 80 years were examined for MRI pelvis.

3.2 Method

3.2.1 Techniques and protocols

3.2.1.1 Patient preparation

The bladder must be full.Explain the procedure to the patient

-Offer the patient ear protector or ear plugs Change the patient clothes to the gown. Ask the patient to remove metal (hearing aids, hair pains, body jewelry).If necessary have intra venous line place.

3.2.1.2 Positioning

Patient should laying supine the feet first but cushion the legs and the arm folded to chest.

3.2.1.3 Coil used

-Body array coil (wraparound) or body coil.
-Or torso speeder 8-chanell. (Siemens coil)

3.2.1.4 Patient positioning and scan planes

After patient enter the MRI room and positioned clearly laying supine on the MRI machine table and after all preparation we get the coil that used for this condition.

And use it and make our center on the patient for the exam that we want to do it and then we return back to the control and entering the data of the patient under exam and begin the investigation.

3.2.1.5 Applied the sequences

- Scout (axis locator).
- Three planes (axial, sagittal, coronal).
- We have to important sequence firstly done before begin the standard protocol.
- Shimming
    - ✓ This sequence used to get measured the different between the water and fat on the patient area under study.
    - ✓ Should measure the entire field under study.

- Map
  - ✓ It's like the suet that we used to cover the patient should cover the patient should cover all the area under the examination.

3.2.1.6 Protocol used for pelvic investigation (standard protocol)

Ax T2w	TR 5450	TE 94
Ax T1 w	TR 411	TE 13
SG T2	TR 2400	TE 99
CO T2 w	TR 5400	TE 94
CO	TR 6020	TE 97

3.2.2 Ethical Consideration

Approval from university, verbal consent and permission from hospital of the study were taken

Verbal permission was taken from study population.

Data of the study was used for purpose of the research.

3.2.4 Analysis of Data

The data collected from the cases of patient and interred to the Microsoft office excel using frequency table the data c calculated and the result was shown.

Chapter Four

Results

4.1 Results:

Table 4.1 show age group frequency for all patients:

Age Group	Frequency	Percent
18-30	5	10.2
31-40	11	22.4
41-50	13	24.5
51-60	11	22.4
61-70	8	16.3
71-80	2	4.1

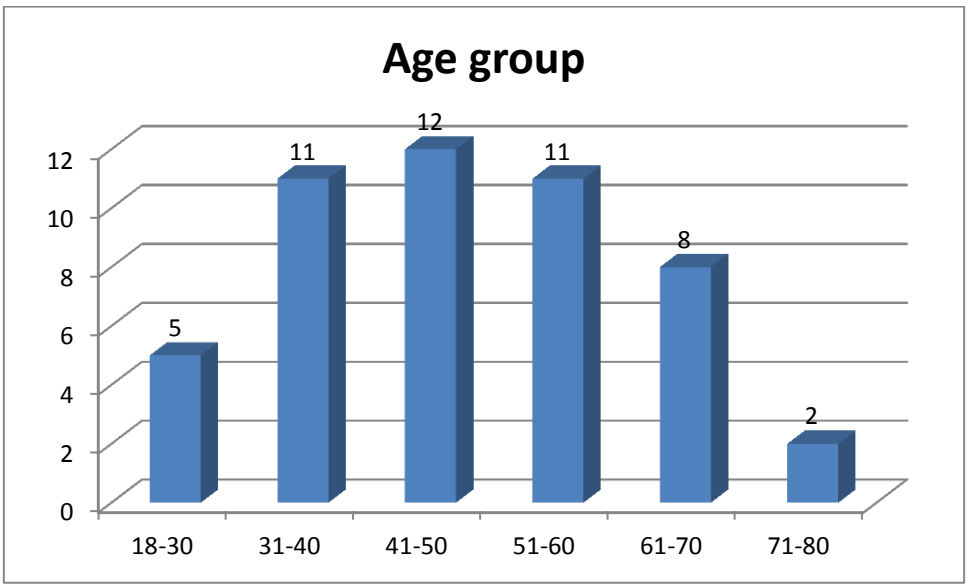

Figure 4.1 show age group frequency for all patients

Table 4.2 show frequency distribution of clinical history for all patients:

Clinical history	Frequency	Percent
Right Pelvic pain	4	0.08
Left Pelvic pain	4	0.08
Pelvic pain	20	0.40
Metrorrhagia	8	0.16
No symptoms	6	0.12
Post-menopausal bleeding	6	0.12
irregular cycle	1	0.02
Hematuria	1	0.02
Total	**50**	**100.0**

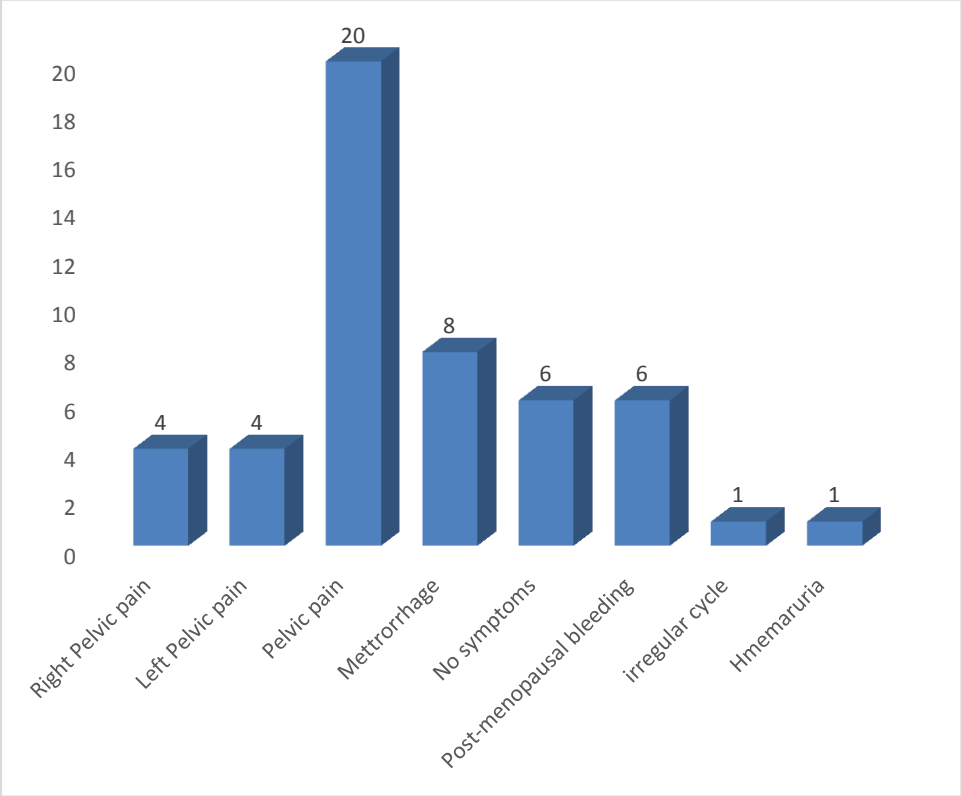

Figure 4.2 show frequency distribution of clinical history for all patients

Table 4.3 show contrast frequency for all patients:

Contrast	Frequency	Percent
Without	27	0.54
with	23	0.46
Total	**50**	**100.0**

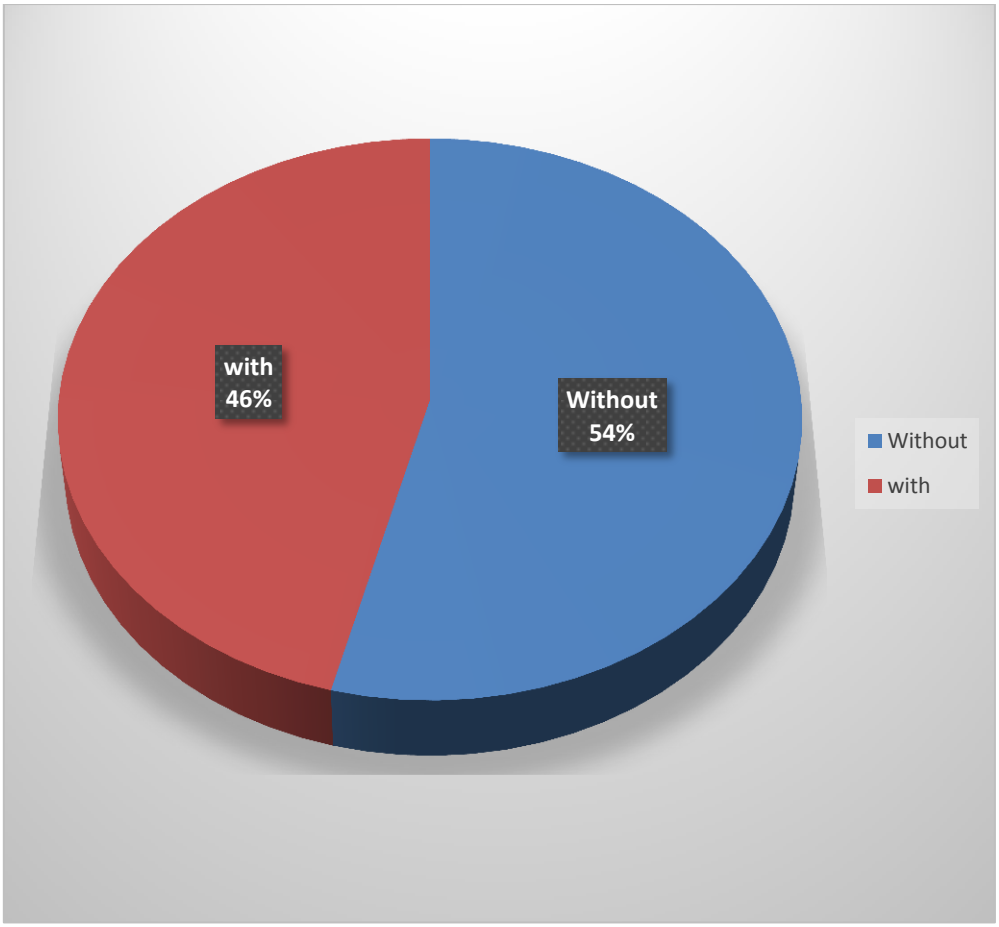

Figure 4.3 show contrast frequency for all patients

Table 4.4 shows a frequency distribution of diagnose finding for all patients:

Diagnose	Frequency	Percent
Right ovarian cyst	8	0.16
Left ovarian cyst	6	0.12
PID	2	0.04
Uterine fibroid	10	0.2
Endometrium carcinoma	6	0.12
PCO	1	0.02
Focal urinary bladder mass	1	0.02
Bulk uterus with thick endometrium	3	0.06
Normal	2	0.04
Ca ovary	7	0.14
Cervical carcinoma	4	0.08
Total	**50**	**100.0**

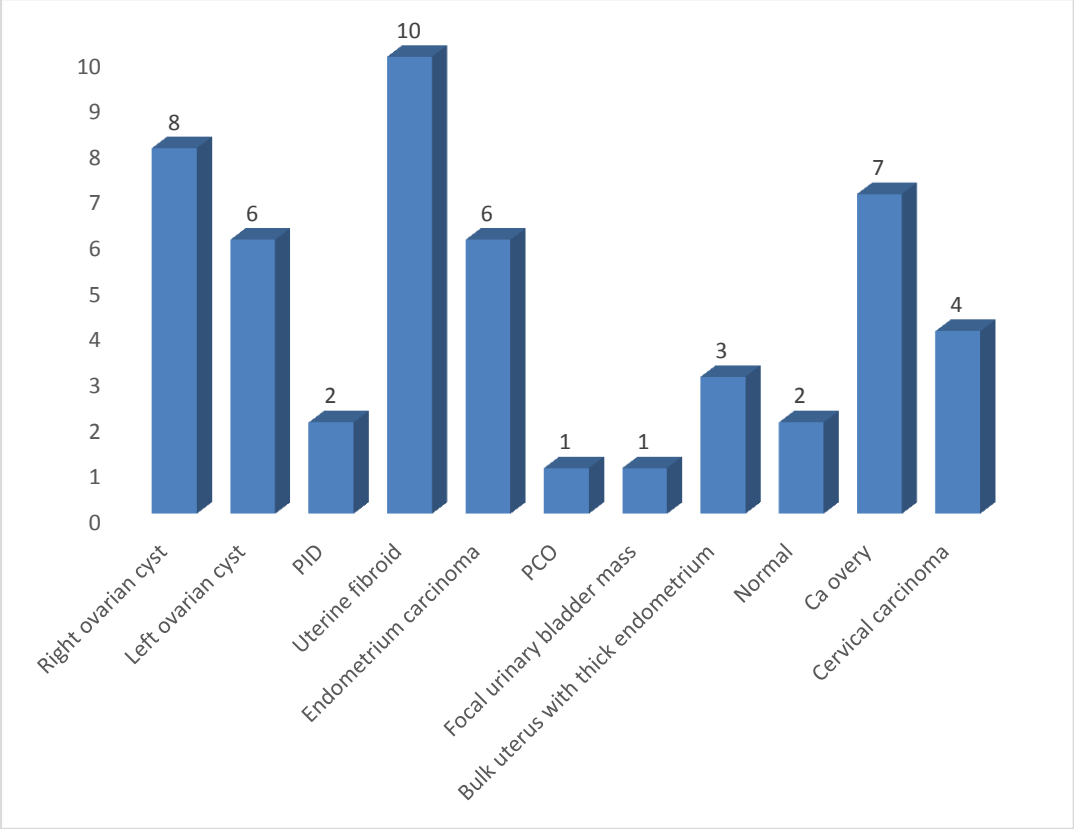

Figure 4.4 shows a frequency distribution of diagnose finding for all patients

Table 4.5 show cross tabulation between age group and clinical history:

	Clinical history								
Age Group	**Right Pelvic pain**	**Left Pelvic pain**	**Pelvic pain**	**Metrorrhagia**	**No symptoms**	**Post-menopausal bleeding**	**irregular cycle**	**Hematuria**	**Total**
18-30	1	1	2	0	2	0	1	0	**7**
	14%	14%	29%	0%	29%	0%	14%	0%	100%
31-40	1	2	2	4	2	0	0	0	**11**
	9%	18%	18%	36%	18%	0%	0%	0%	100%
41-50	1	0	6	2	1	0	0	1	**11**
	9%	0%	55%	18%	9%	0%	0%	9%	100%
51-60	1	0	4	2	1	3	0	0	**11**
	9%	0%	36%	18%	9%	27%	0%	0%	100%
61-70	0	0	5	0	0	3	0	0	**8**
	0%	0%	63%	0%	0%	38%	0%	0%	100%
71-80	0	0	1	0	1	0	0	0	**2**
	0%	0%	50%	0%	50%	0%	0%	0%	100%

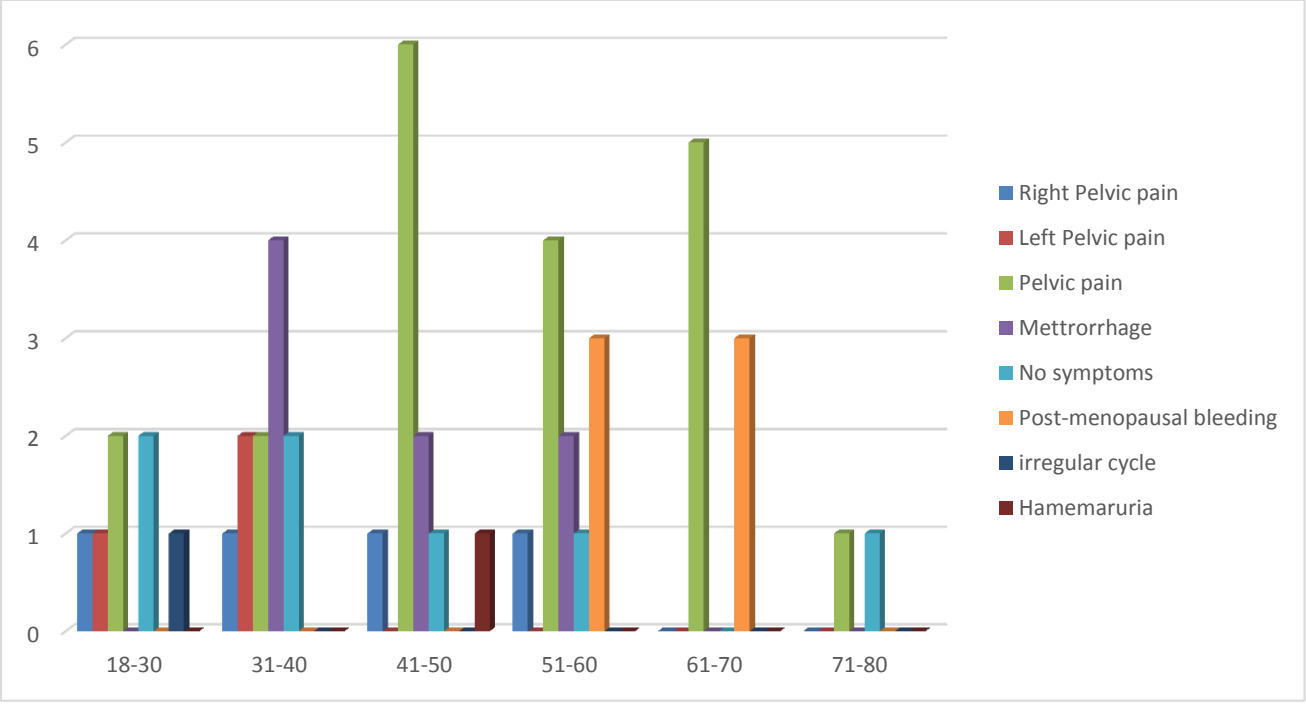

Figure 4.5 show cross tabulation between age group and clinical history

Table 4.6 show cross tabulation between age group and diagnose finding:

	Age Group						
Diagnose	**18-30**	**31-40**	**41-50**	**51-60**	**61-70**	**71-80**	**Total**
Right ovarian cyst	1	2	2	1	1	1	**8**
	13%	25%	25%	13%	13%	13%	100%
Left ovarian cyst	1	1	2	2	0	0	**6**
	17%	17%	33%	33%	0%	0%	100%
PID	2	0	0	0	0	0	**2**
	100%	0%	0%	0%	0%	0%	100%
Uterine fibroid	0	4	4	2	0	0	**10**
	0%	40%	40%	20%	0%	0%	100%
Endometrium carcinoma	0	0	0	3	3	0	**6**
	0%	0%	0%	50%	50%	0%	100%
PCO	1	0	0	0	0	0	**1**
	100%	0%	0%	0%	0%	0%	100%
Focal urinary bladder mass	0%	0	1	0	0	0	**1**
	0%	0%	100%	0%	0%	0%	100%
Bulk uterus with thick endometrium	0	0	0	0	2	1	**3**
	0%	0%	0%	0%	67%	33%	100%
Normal	0	1	1	0	0	0	**2**
	0%	50%	50%	0%	0%	0%	100%
Ca ovary	0	1	2	3	1	0	**7**
	0%	14%	29%	43%	14%	0%	100%
Cervical carcinoma	0	0	2	1	1	0	**4**
	0%	0%	50%	25%	25%	0%	100%

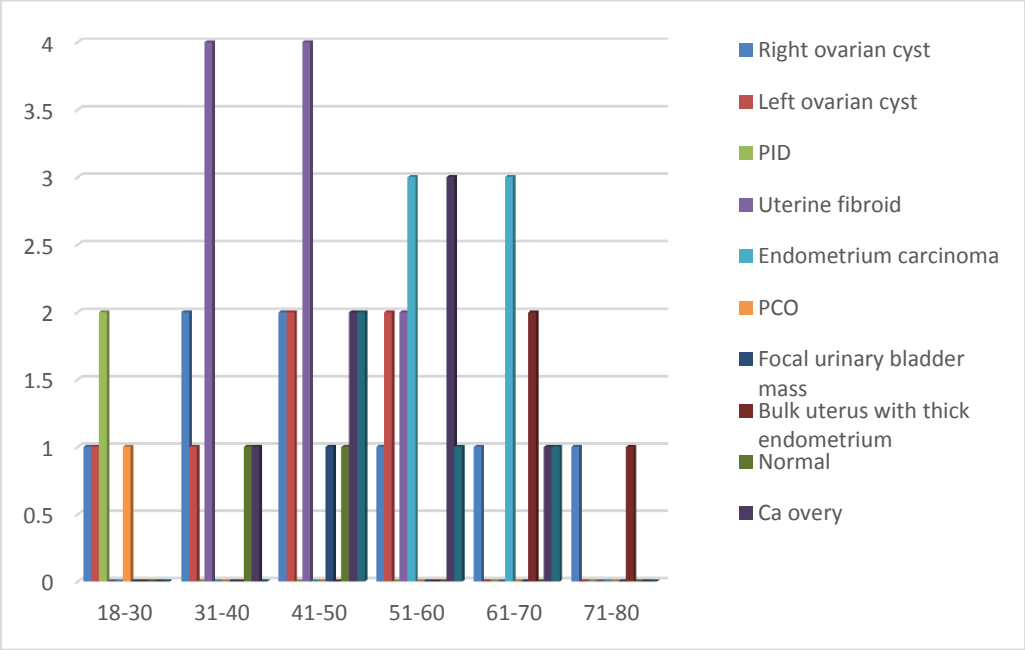

Figure 4.6 show cross tabulation between age group and diagnose finding

Table 4.7 show cross tabulation between age group and contrast:

	Contrast		
Age Group	**Without**	**with**	**Total**
18-30	1	5	**6**
	17%	83%	**100%**
31-40	8	3	**11**
	73%	27%	**100%**
41-50	6	6	**12**
	50%	50%	**100%**
51-60	8	3	**11**
	73%	27%	**100%**
61-70	2	6	**8**
	25%	75%	**100%**
71-80	2	0	**2**
	100%	0%	100%

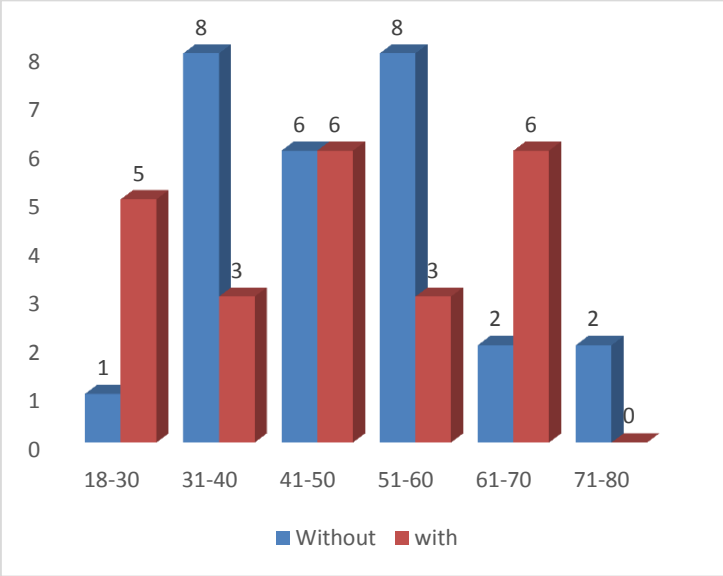

Figure 4.7 show cross tabulation between age group and contrast

Table 4.8 show cross tabulation between Diagnose finding and contrast:

	Contrast		
Diagnose	**Without**	**Without**	**Total**
Right ovarian cyst	4	4	**8**
	50%	50%	100%
Left ovarian cyst	4	2	**6**
	67%	33%	100%
PID	0	2	**2**
	0%	100%	100%
Uterine fibroid	5	5	**10**
	50%	50%	100%
Endometrium carcinoma	5	1	**6**
	83%	17%	100%
PCO	0	1	**1**
	0%	100%	100%
Focal urinary bladder mass	0	1	**1**
	0%	100%	100%
Bulk uterus with thick endometrium	1	2	**3**
	33%	67%	100%
Normal	1	1	**2**
	50%	50%	100%
Ca overy	4	3	**7**
	57%	43%	100%
Cervical carcinoma	3	1	**4**
	75%	25%	100%

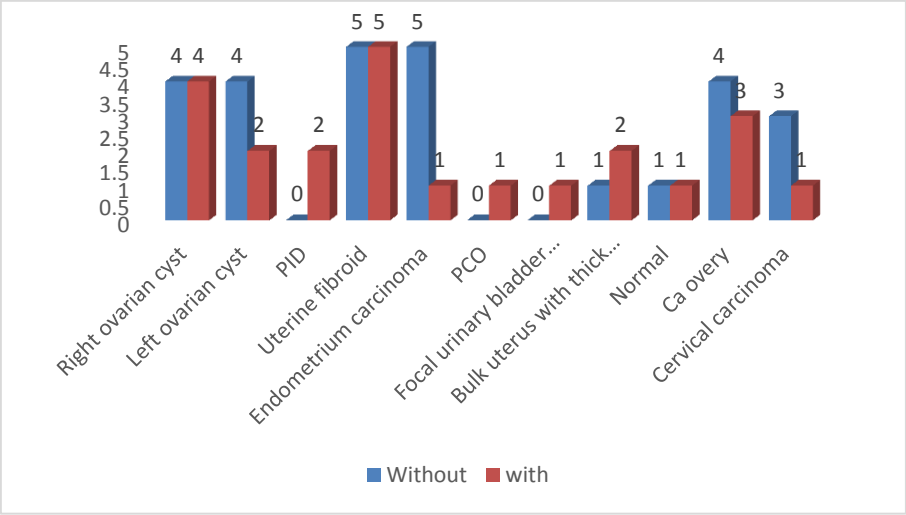

Figure 4.8 show cross tabulation between Diagnose finding and contrast

Table 4.9 show cross tabulation between diagnose finding and clinical history

	Clinical history								
Diagnose	Right Pelvic pain	Left Pelvic pain	Pelvic pain	Metrorrhagia	No symptoms	Post-menopausal bleeding	irregular cycle	hematuria	**Total**
Right ovarian cyst	4	0	0	0	4	0	0	0	**8**
	50%	0%	0%	0%	50%	0%	0%	0%	100%
Left ovarian cyst	0	4	0	0	2	0	0	0	**6**
	0%	67%	0%	0%	33%	0%	0%	0%	100%
PID	0	0	2	0	0	0	0	0	**2**
	0%	0%	100%	0%	0%	0%	0%	0%	100%
Uterine fibroid	0	2	0	8	0	0	0	0	**10**
	0%	20%	0%	80%	0%	0%	0%	0%	100%
Endometrium carcinoma	0	0	2	0	0	6	0	0	**8**
	0%	0%	25%	0%	0%	75%	0%	0%	100%
PCO	0	0	0	0	0	0	1	0	**1**
	0%	0%	0%	0%	0%	0%	100%	0%	100%
Focal urinary bladder mass	0	0	0	0	0	0	0	1	**1**
	0%	0%	0%	0%	0%	0%	0%	100%	100%
Bulk uterus with thick endometrium	0	0	3	0	0	0	0	0	**3**
	0%	0%	100%	0%	0%	0%	0%	0%	100%
Ca overy	0	0	7	0	0	0	0	0	**7**
	0%	0%	100%	0%	0%	0%	0%	0%	100%
Cervical carcinoma	0	0	4	0	0	0	0	0	**4**
	0%	0%	100%	0%	0%	0%	0%	0%	100%

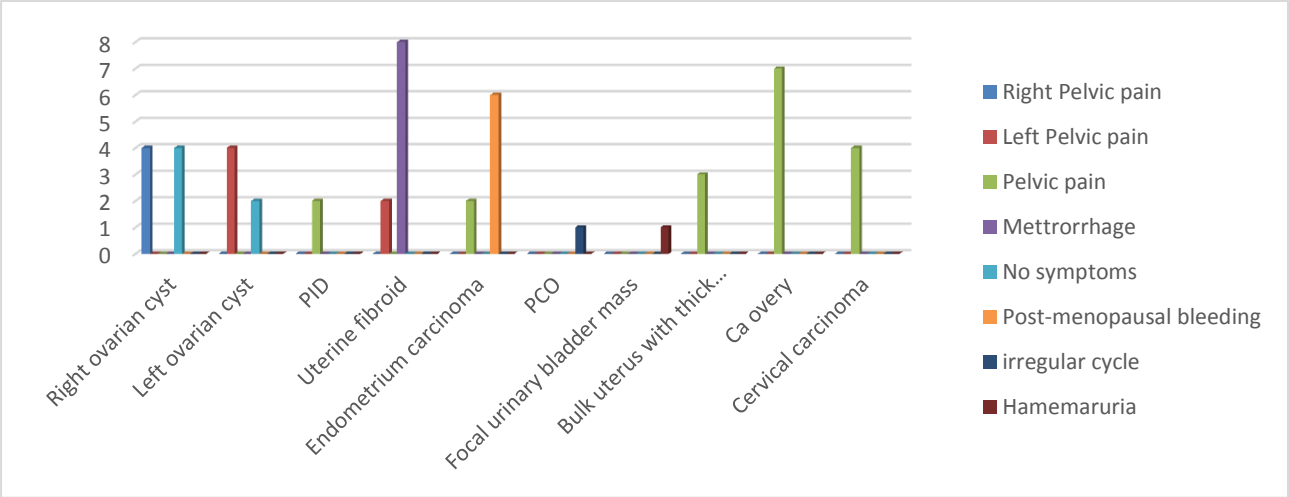

Figure 4.9 show cross tabulation between diagnose finding and clinical history

Chapter Five

Discussion, Conclusion and Recommendations

5.1 Discussion:

Table 4.1 show age group frequency for all patients were the patients from 41-50 years was more frequently with 13 patients then from 31-40 years with 11 patients and the age group from 71-80 years was lower frequently with just two patients as shown in figure 4.1.

Table 4.2 show that the clinical history for most of participants (40%) was pelvic pain, since for (16%) of them was Metrorrhagia, and for (12%) of them was post-menopausal bleeding or no symptoms, while for (8%) of them were right pelvic pain or left pelvic pain, whereas for only (2%) of them were irregular cycle or Hematuria.

Table 4.3 show (54%) of participants without contrast while (46%) with contrast.

Table 4.4 show the most common diagnosis were uterine fibroid (20%), right ovarian cyst (16%), Ca ovary (14%) and left ovarian cyst or endometrium carcinoma (12%), while the less common diagnosis were PID or normal (4%) and PCO or focal urinary bladder mass (2%).

Table 4.5 show the clinical history for most of all age groups were right pelvic pain, left pelvic pain, pelvic pain and no symptoms

Table 4.6 show the diagnosis for most 18-50 years old participants were right ovarian cyst, left ovarian cyst, PID and uterine fibroid, while for most of 51-80 years old participants were uterine fibroid, endometrium carcinoma and bulk uterus with thick endometrium

Table 4.7 show most of participant of 31-40 years and 51-60 years, and all of 71-80 years without contrast, since most of them in 18-30 years and 61-70 years with contrast.

Table 4.8 show most of participant of diagnosed with left ovarian cyst, endometrium carcinoma, Ca ovary or cervical carcinoma without contrast, while most of them who diagnosed with PID, PCO, focal urinary bladder mass, and bulk uterus with thick endometrium with contrast.

Table 4.9 show most of participant of diagnosed with right ovarian cyst and left ovarian cyst have clinical history for right Pelvic pain, left Pelvic pain or no symptoms, since most of them who diagnosed with PID, bulk uterus with thick endometrium, Ca ovary, and cervical carcinoma have clinical history of pelvic pain, while most of them who diagnosed with uterine fibroid and endometrium carcinoma have clinical history of Metrorrhagia and post-menopausal bleeding, respectively, whereas most of participants who diagnosed with PCO and focal urinary bladder mass have clinical history of irregular cycle and Hematuria, respectively.

5.2 Conclusion:

The study concluded that Magnetic resonance imaging was a sensitive and specific for detection of pelvic tumors and the uterine fibroid was the most pelvic tumors in premenopausal and postmenopausal women but in some cases MRI does not give final diagnosis so biopsy is recommended.

5.3 Recommendations:

-The study recommend that to do further studies with full patient history because data about parity are not taken in this study.

-Any ovarian cyst appears on sonography with a typical sonographic features must be imaged with MRI.

-MRI machine must be available at hospitals and diagnostic center.

-Imaging with MRI must be not cost effective.

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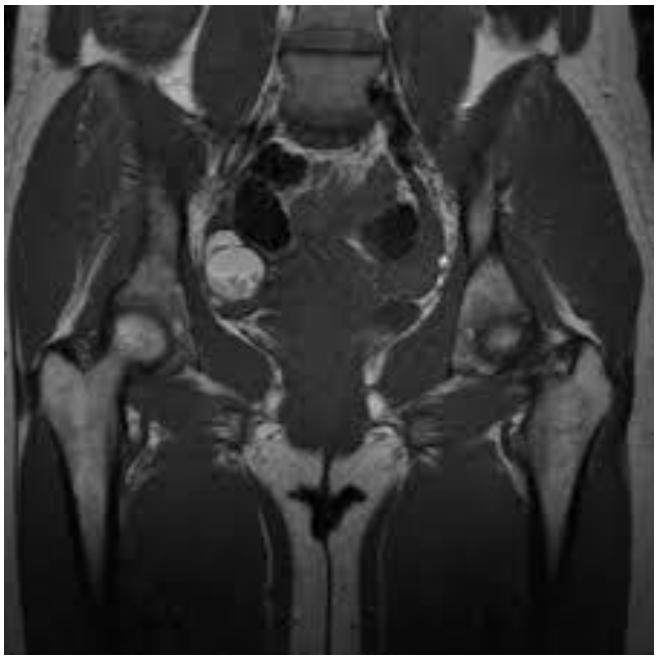
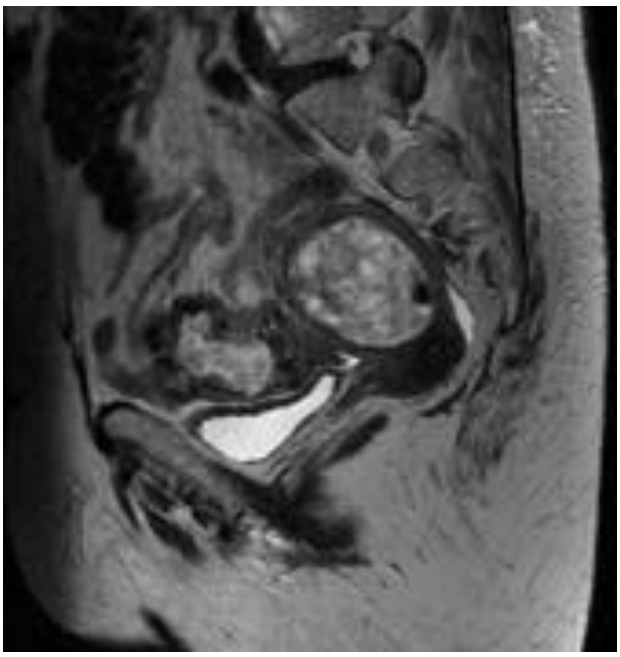
Appendix (A)



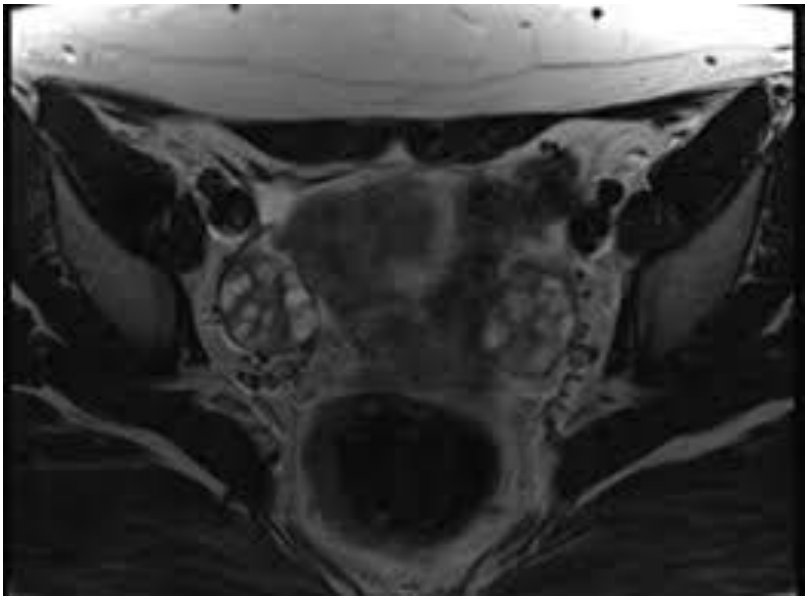
Case No. 1: 32 Yrs female with MRI Images ovarian cyst



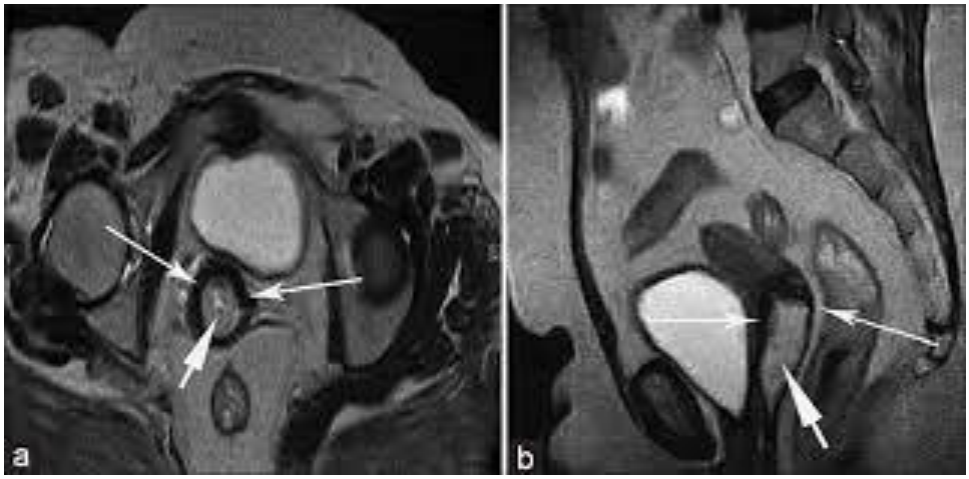
Case No.2: 70 Yrs female with MRI Imaging Endometrium carcinomas

Case No.3:42 Yrs female with MRI Imaging Uterine subserosal fibroid

Case No.4:45 Yrs female with MRI Imaging Ovarian carcinomas



Case No.5:34Yrs female with MRI Imaging PCO



Case No.6:52 Yrs female with MRI Imaging Cervical carcinomas

Appendix (B)

Sudan University of Science and Technology

Faculty of Graduate Studies

Study of Female Pelvic Tumors Using Magnetic Resonance Imaging in Sudan

Data sheet

NO	Gender	Age	Clinical history	Contrast	Diagnosis