Sudan University of Science and Technology

College of Graduate Studies

Evaluation of Breast Lesions using MRI

تقييم افات الثدي بواسطة الرنيين المغناطيسي

A Thesis Submitted for Partial Fulfillment of M. Sc. Degree in Medical Physics

By:

Hadba Ibrahim Abdulqadir Makki

Supervisor:

Dr. Hussein Ahmed Hassan

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الآية

قال تعالي :

قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَاۖ إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ

صدق الله العظيم

سورة البقرة الآية (32)

Dedication

Life comes with people who hold you from their volatility.. I was the one who ignited in my heart hope and happiness and inspired me the way..

Family always from pushing me forward.. my mother and my father and sisters ...

To those who occupy my heart daughters.. Dan.. Daleen .. Sama.

Acknowledgments

First of all I would like to thank God who is always appointed.. Dr. Hussein Ahmed Hassan for his guidance and patience.. My sister Dr. Isra Ibrahim to help... and anyone who helped me in the collection and analysis of information.

Abstract

MRI in study and diagnosis of breast masses. This study included 32 female patients who were referred for MRI assessment. The MRI results were correlated with pathological results for all cases. Those 32 patients were classified pathologically into 16 patients with benign breast lesion (50%), 15 patients with malignant lesion (46.9%) and one patient with high risk lesion (3.1%). MRI of the breast had a higher sensitivity for breast cancer detection and more accurate in delineation of the disease extension.

المستخلص

الرنين المغناطيسي في دراسه وتشخيص امراض الثدي الطريقه: شملت هذه الدراسة 32 مريضة تمت إحالتهم لتقييم التصوير بالرنين المغناطيسي. ارتبطت نتائج التصوير بالرنين المغناطيسي مع النتائج المرضية لجميع الحالات، امراض الثدي اصبحت اكثر الامراض شيوعاً بالاخص سرطان السدي للنساء في سن الانجاب،(MRI) تقنية مفيدة للكشف والتشخيص.

النتائج:

تم تصنيف هؤلاء المرضى الـ32 بشكل مرضي في 16 مريضًا لديهم آفة حميدة في الثدي (50٪) ، و 15 مريضًا يعانون من آفة خبيثة (46.9٪) ومريض واحد مصاب بآفة عالية المخاطر (3.1٪).

استنتاج:

كان التصوير بالرنين المغناطيسي للثدي حساسية أعلى للكشف عن سرطان الثدي وأكثر دقة في تحديد امتداد المرض.

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List of Abbreviations

BI-RADs: breast imaging reporting and data system

BRCA breast cancer gene

CAD: computer aided detection

DCE: dynamic contrast enhancement

DCIS: ductal carcinoma in situ

IDC: intra ductal carcinoma

ILC: invasive lobular carcinoma

LCIS: lobular carcinoma in situ

MRI: magnetic resonance image

NPV: negative predictive value

PPV: positive predictive value

T1WI: T 1 weighted image

T2WI: T 2 weighted image

Chapter one

Introduction

1.1. Introduction:

Breast lesions especially breast cancer is a major health problem. Women's awareness of the risks associated with breast cancer has become high and derives from many sources, including health education programs, extensive media coverage and direct knowledge from friends and relatives. Despite this general awareness, the best tool for breast screening is mammography, which has a false negative rate of 10-25%. In addition, mammography has limitations in its ability to accurately determine the extent of the disease in breast cancer for some groups of women undergoing treatment. May reduce the size of lobular cancer up to 25% of cases. For this reason, attention has focused on MRI as an adjunct to mammography. Over the past years, there has been a marked increase in the use of MRI for the breast. Multiple research studies have confirmed improved cancer detection, diagnosis, and evaluation of response to therapy with breast magnetic resonance imaging compared to mammography and ultrasound. With the introduction of this exciting new technique, there is a need to focus work on ideal scanning protocols, appropriate clinical applications, and image interpretation. Both potential benefits and damage should be assessed to guide the optimal use of this imaging technique in selected groups of patients(Frank Netter, 2014).

Magnetic resonance imaging (MRI) has revolutionized many areas of body imaging as a noninvasive non irradiating imaging tool, interest has steadily been developing as to the specific role of MRI in breast imaging, and whether this modality can assist with early detection and hopefully subsequently decrease the mortality of breast cancer (Cornick Beryl,2005)

Mammography has long been used for early detection and screening for breast cancers. With optimal technique and patient conditions, it has a reported sensitivity between 69% and 90 % and specificity between 10% and 40 %. Many factors, including density of breast tissue (i.e., younger patients, implants, and post-surgical state) can affect these values. Ultrasound has

been used as an adjunct to mammography, with particular value in differentiating cystic from solid lesions and in facilitating guided biopsy of suspicious areas. However, ultrasound has limitations, including the possibility of missing micro calcifications [associated with ductal carcinoma in situ (DCIS)] and in ensuring that the entire breast was imaged with the transducer Mammography alone is believed to miss between10% and 30% of all breast cancers. Possible reasons may include density of breast parenchyma, poor technique and positioning, error by the reading radiologist, and slow growing breast cancers. Although certain strategies, such as computer-aided detection (CAD) and/or rereading by another radiologist have been used in some cases, the impact on detection of breast cancer is variable (Cornick Beryl,2005)

1.2. Problem of the study:

Increased incidence of breast lesions, especially breast cancer, has become a frightening and very common complaint for women of all ages, especially during childbearing age. What was detected early and more assured the greater the cure rate.

1.3. Justifications of the study:

MRI is a method of clinical imaging to detect and diagnose breast lesion and to distinguish between benign, malignant and most likely.

The number of unnecessary biopsies recommended can be reduced from traditional operations to detect breast or lesion.

This is a great promise to further improve early and accurate diagnosis of breast cancer.

1.4. Objectives

1.4.1 General Objective

- To Study of Breast Lesions

1.4.2 Specific Objective

- To evaluate sensitivity of MRI in diagnosis of breast lesions.
- To asses different pattern of enhancement of breast lesions.

1.5 Thesis Layout:

- The study contain five chapter, chapter one contain introduction, problem of study, justification of the study, the problem of the study, objectives of the study and thesis layout.

Chapter Two

Literature Review

Chapter Two

Theoretical Background

2.1. Anatomy:

Breast is a double gland located on the front face of the chest, overlies the 2nd to 6th ribs on the anterior chest wall. Different shape and size from one female to another mainly develop in females in adulthood and take the size and shape of the final.

2.1.1 Natural breast structure

The breast consists of two basic types of tissue: glandular tissue and lipid tissue, giving the breast its size and function.

The glandular tissue or milk glands accumulate together in the form of lumps or small nodes called lobules. The lobules join together to give larger structures or clusters of glands called lobes. The breast contains an average of 15-20 lobes.

Between the lobes and lobes, networks of tubes called the ducts of the milk are formed, connect with one another and give larger hollow channels to eventually pour these channels into the nipple (Cornick Beryl ,2005)

The size of the breast means that it is rich in lipid tissue, and this size does not mean that the breast is capable of producing more milk, in other words that the productive glands Milk is responsible for the production of milk, breast size and the abundance of lipid tissue or decreased factors that do not affect the process of milk production in nursing mothers.

Blood supply of the breast is composed of branches of the internal mammary artery (60%), the lateral thoracic branch of the axillary artery (30%), and perforating branches of the anterior intercostal arteries. The venous drainage accompanies the arteries to the axillary and subclavian veins and the azygos system. The majority of the lymph drainage is to axillary chain, with less than 5 % draining to the internal mammary chain (Cornick Beryl,2005).

Finally, the breast takes its shape, which also varies according to each female, through the ligaments that surround it. You attach it to the front chest wall and support it and give it a shape that may be circular, conical or otherwise.

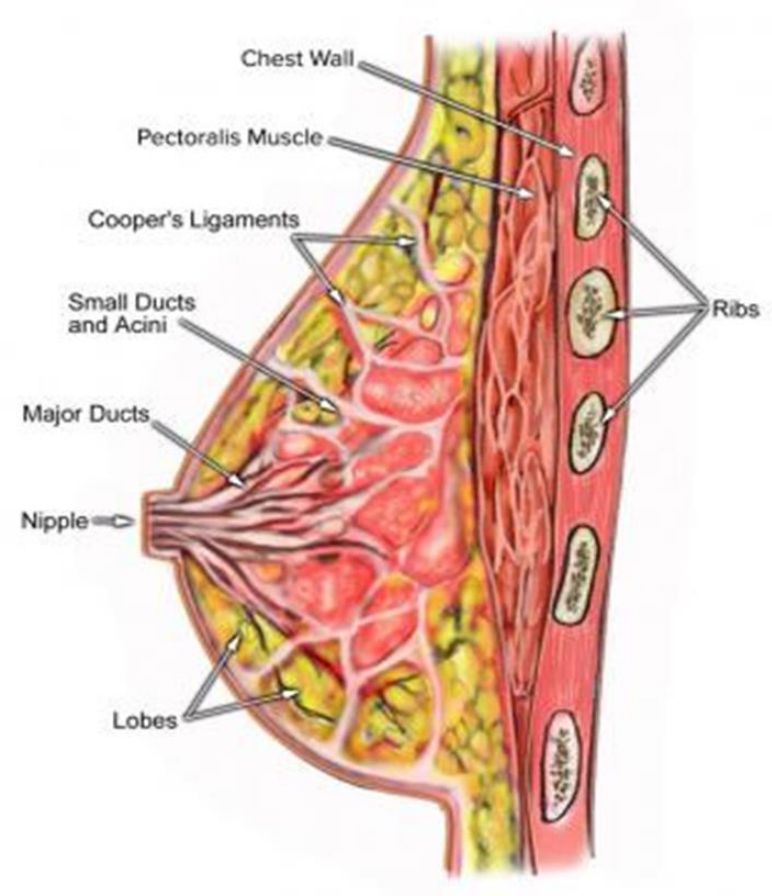

Fig (2. 1) Breast. (Cornick Beryl,2005)

2.2. Pathology:

2.2.1. Benign breast lesions:

This term is often used clinically to imply a specific pathological entity.

Infections: Breast infections are rare, and mainly occur in association with breast feeding, unless effectively treated staphylococcal mastitis may cause a lobulated breast abscess.

Duct ectasia: It is a progressive dilatation of large or intermediate ducts with surrounding chronic inflammatory changes; it is usually present with nipple

discharge. Less commonly, contraction of periodical fibrous tissue may cause nipple retraction and raise the suspicion of carcinoma.

Traumatic fat necrosis:

It is caused by injury to fatty breast parenchyma, and often present as a hard ill-defined mass.

Galacto cele: This is a cystic swelling of a lactiferous duct which develops during lactation, apparently due to obstruction of the duct.

Fibro adenoma: It is one of the commonest breast lesions, due to localized hyperplasia rather than development of a true neoplasm, it present as a well-defined mass, often in young women.

Phyllodestumour: (giant fibroadenoma or cystosarcomaphyllodes)

Usually present in middle aged or elderly women as a well-defined mass, it is usually benign although rarer borderline and malignant forms may occur.

Hamartoma: It is relatively uncommon, may occur at any age from a disordered collection of lobules, stroma and fat.

Fibrocystic changes: It is the commonest breast lesion, due to changes in hormone level/sensitivity, present clinically as ill-defined thickening or lumpiness in the breast during the reproductive decades.

Papilloma: It is present with nipple discharge and less commonly lump in middle aged women Duct papillomas can be separated into two main groups, central and peripheral. Central papillomas are usually single and occur in the main nipple duct and carry no risk of subsequent carcinoma, unlike peripheral papillomas which are more usually multiple and appear to be has an increased risk of subsequent carcinoma (Morris EA,2001).

2.2.2. Malignant breast lesions:

Carcinoma: Breast cancer is the commonest female cancer, it may occur at any age but rare before 25 years. In screening programme the lesions are detected as micro calcifications, masses, distortions of breast parenchyma

and are often impalpable. Histological types of invasive breast carcinoma are:

- Ductal carcinoma (50%).
- Invasive lobular carcinoma (15%).
- Tubular carcinoma.
- Medullary, mucinous and invasive cribriform carcinoma.
- Metaplastic carcinoma.

The routes of spread are via lymphatic system to axillary lymph nodes, hematogenous, particularly to the lung, bone and liver and direct infiltration of skin, muscle and chest wall (Ryan S et al, 2011), (Reid R. et al,2008).

Sarcomas: Most type of connective tissue tumor has been described in the breast, but all are very rare.

Lymphoma: The breast is an unusual primary site of lymphomas but involvement of the breast in disseminated lymphomas is the commonest.

2.3. MR principle:-

Magnetic resonance imaging (MRI) makes use of the magnetic properties of certain atomic nuclei. An example is the hydrogen nucleus (a single proton) present in water molecules, and therefore in all body tissues. The hydrogen nuclei behave like compass needles that are partially aligned by a strong magnetic field in the scanner. The nuclei can be rotated using radio waves, and they subsequently oscillate in the magnetic field while returning to equilibrium. Simultaneously they emit a radio signal. This is detected using antennas (coils) and can be used for making detailed images of body tissues. Unlike some other medical imaging techniques, MRI does not involve radioactivity or ionizing radiation. The frequencies used (typically 40-130 MHz) are in the normal radiofrequency range, and there are no adverse health effects. Very detailed images can be made of soft tissues such as muscle and brain. The MR signal is sensitive to a broad range of influences,

such as nuclear mobility, molecular structure, flow and diffusion. MRI is consequently a very flexible technique that provides measures of both structure and function.

Rule 1:

MRI requires (strong magnetic field) and 2(radio frequency radio waves) .

Rule 2:

The magnetic resonance signal is taken from the protons present in the hydrogen. Note that the hydrogen atom consists of only one proton.

There are two properties possessed by the proton make it act like a magnet:

The proton has a positive charge. The proton moves a spindle called a spin

We know that when there is a moving charge (electricity is an example) a magnetic field is generated. This is what happens to the positive proton when it moves spherically. It is a magnetic field, also called a magnetic moment. Thus, the proton is like a magnet with poles north and south. (https://www.7aleeb.com)

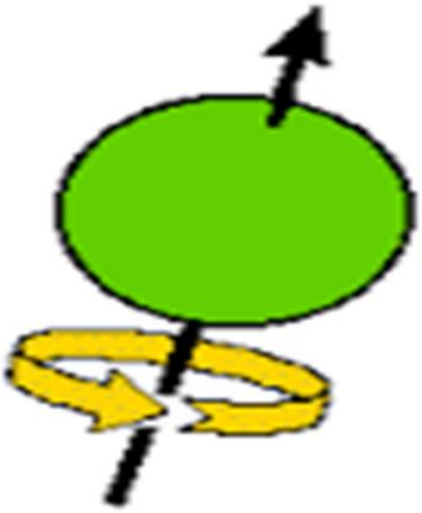

Fig (2. 2) positively charged proton orbits itself (https://www.7aleeb.com)

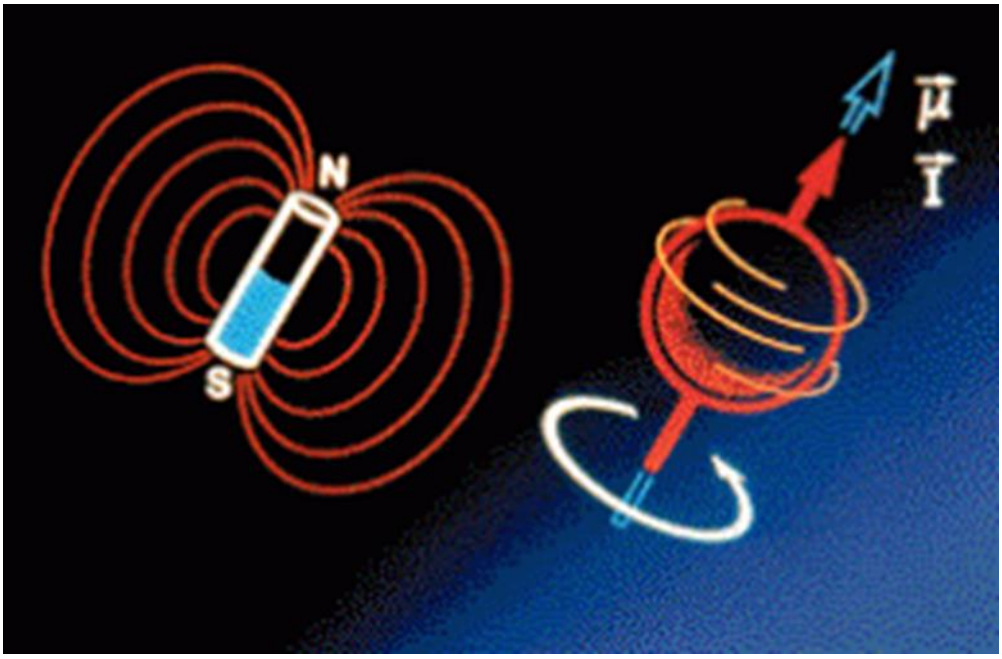

Fig (2. 3) Spin movement (https://www.7aleeb.com)

Rule 3:

Electricity and magnets are two sides of a single coin according to the laws of Electromagnetism. The current can create a magnetic field. Conversely, a variable magnetic field can create an electrical current in a physical phenomenon called electro-magnetic induction.

Rule 4:

The spindle motion makes the proton like a magnet with two poles, one north and the other south, in addition to a magnetic field.

The magnetic field of the proton is limited and very small. This does not make human magnets even though there is a magnetic phenomenon. But the human body contains many protons of hydrogen, especially since the human body is 70% water! However, it has little effect, because it is scattered in the human body and eliminates one another. We can describe this in a scientific way by saying that the total magnetic momentum of the protons is zero. net magnetic moment = zero. (https://www.usd114.org)

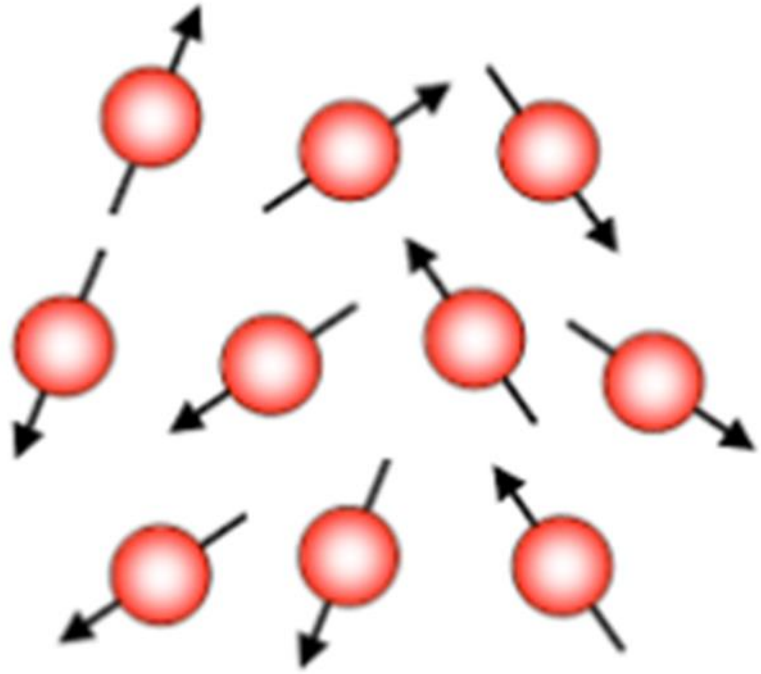

Fig (2. 4) Spindle movement in all directions (https://www.usd114.org)

Rule 5:

Although there is a magnetic field of protons inside the human body, the total of its magnetic value is zero. Because it is the direction of their magnetic fields are scattered and cancel the effect of each other

Outer magnetic field B0 (to benefit from protons)

Protons in the human body are magnets but have no overall effect and we cannot take any indication of them. When placed inside an external magnetic field we call it B0

Two things happen mainly:

Protons will unify the directions of their magnetic fields either with the direction or opposite of the magnetic field. The magnetic field of the proton moves a circular motion called precession. (https://www.usd114.org)

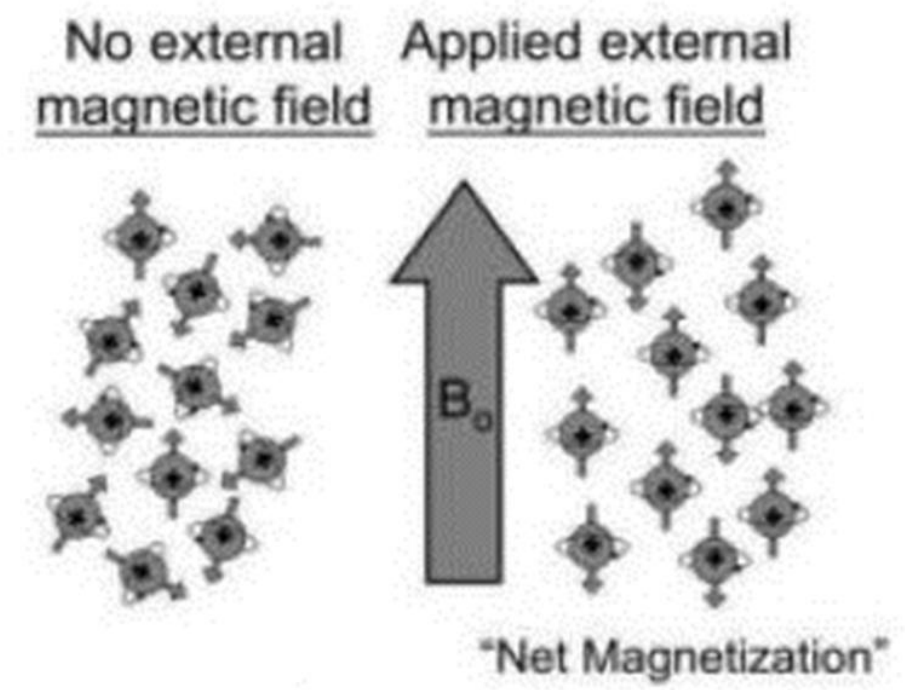

Fig (2. 5) Two things happen mainly (https://www.usd114.org)

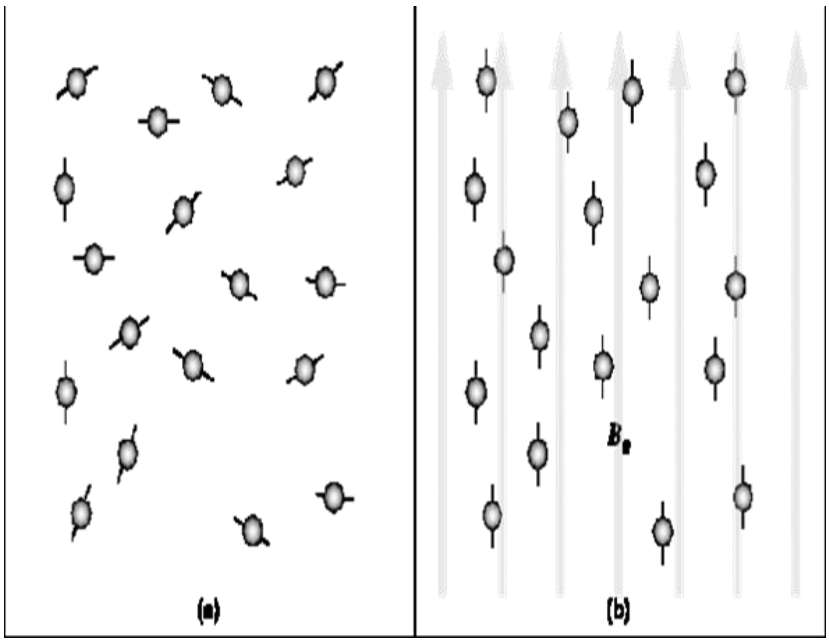

Fig (2. 6) Protons placed in an external magnetic field.

(https://www.usd114.org)

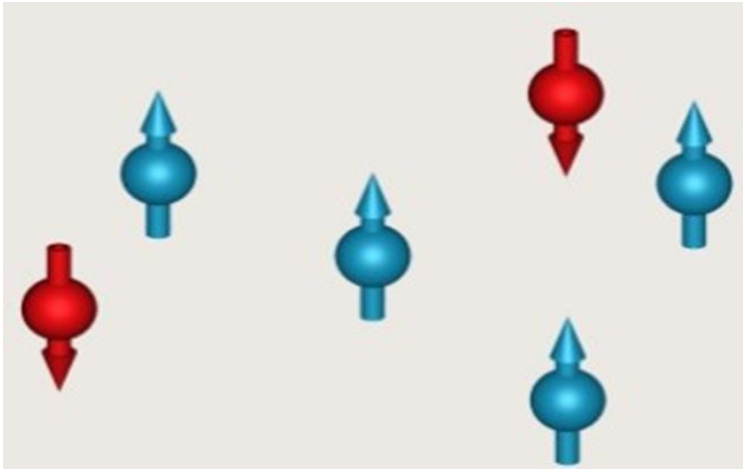

Fig (2. 7) Protons in the direction of the magnetic field larger(https://www.usd114.org)

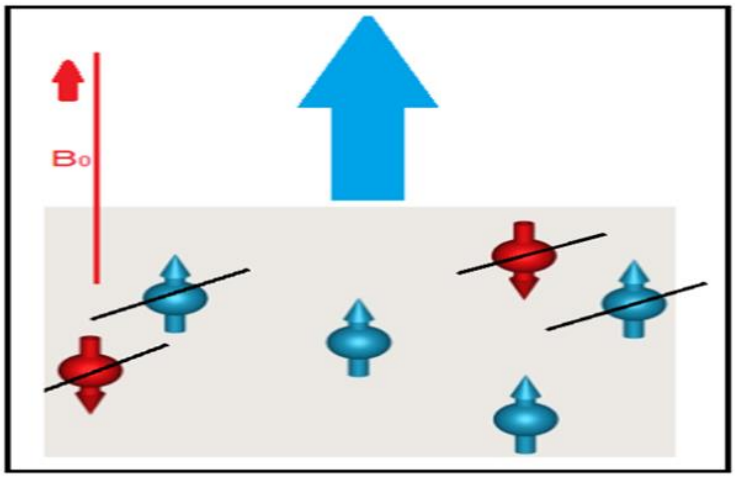

Fig (2. 8) The final actress in the direction of the outer magnetic(https://www.usd114.org)

The opposite magnetic fields cancel some of them and therefore we will ignore them altogether. There is a small amount of protons whose magnetic fields are in the direction of the outer magnetic field and thus we have a net magnetic magnet that can be used to take the magnetic resonance signal. Now only the hydrogen protons in the human body have turned into magnetic force when they were placed inside the outer magnetic field. In magnetic resonance imaging we always visualize the effect of protons as a package rather than as an individual. The proton does not give a signal of

value because its magnetic field is limited and small. So in magnetic resonance we only deal with the magnetic sum which is the sum of the force of all the magnetic fields of the protons.

Outer magnetic field = the main magnetic field = the resonance magnet

The external magnetic field B0 is the same field of magnet found inside the MRI device and is also called the main magnetic field. The magnetic fields in the human body are scattered but when placed inside the MRI, their directions change so that they have a magnetic result in the direction of the external magnetic field. The outer magnetic field B0 is in the direction of Z.

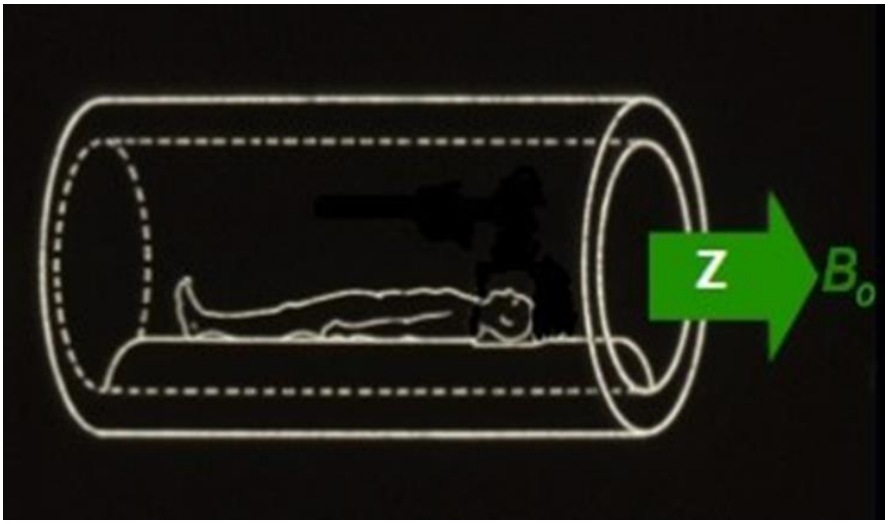

Fig (2. 9) Direction of the outer magnetic field Z

https://www.healthcare.siemens.com.

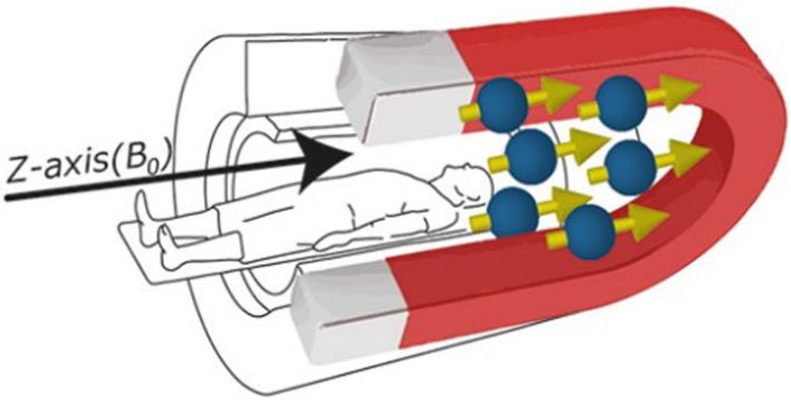

Fig (2. 10) Magnetic proton in the direction Z

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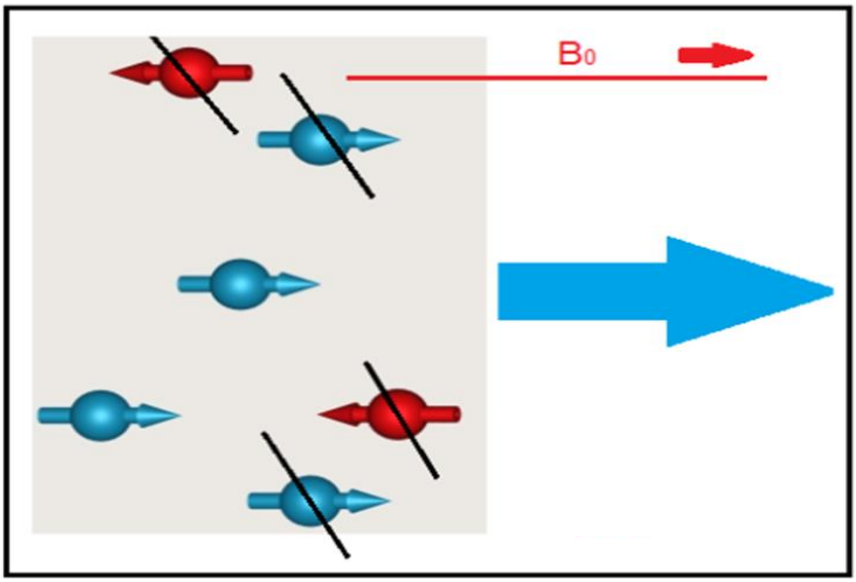


Fig (2. 11) The final result in the direction of the outer magnetic field https://www.healthcare.siemens.com.

Rule 6:

When the protons are placed inside a strong magnetic field called the external or main magnetic field B0 (magnetic resonance imaging device), most of which are organized in the same direction as the magnetic field. The remainder is organized opposite the direction of the magnetic field. The protons that reverse the magnetic field cancel out an equal number of protons in the direction of the magnetic field. Since the latter number is more, the end result is that the sum of the direction of the total magnetic fields of protons is with the direction of the main magnetic field.

Rule 7:

When protons are placed in an external magnetic field, we have a vector that represents the magnetic sum of all the protons that are with the direction of the outer magnetic field. This vector is called Longitudinal Magnetization

Larmor Precession:

In addition to the spinning motion around the spinning axis, the protons move when placed in a magnetic field with a circular motion around the magnetic field, called the larmor precessional movement.

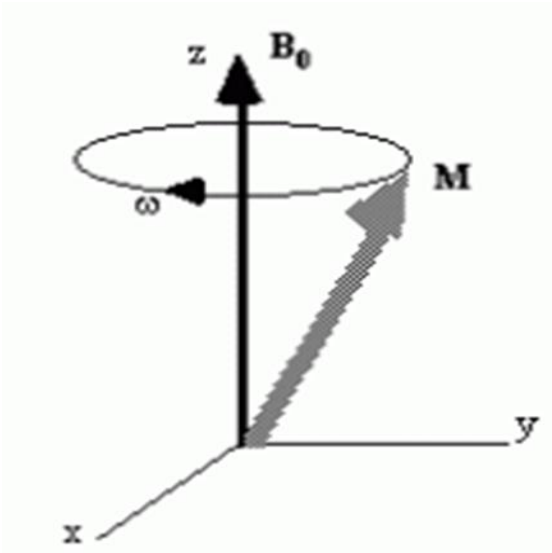


Fig (2. 12) Lamor's movement in coordinate system **(**https://www.healthcare.siemens.com).

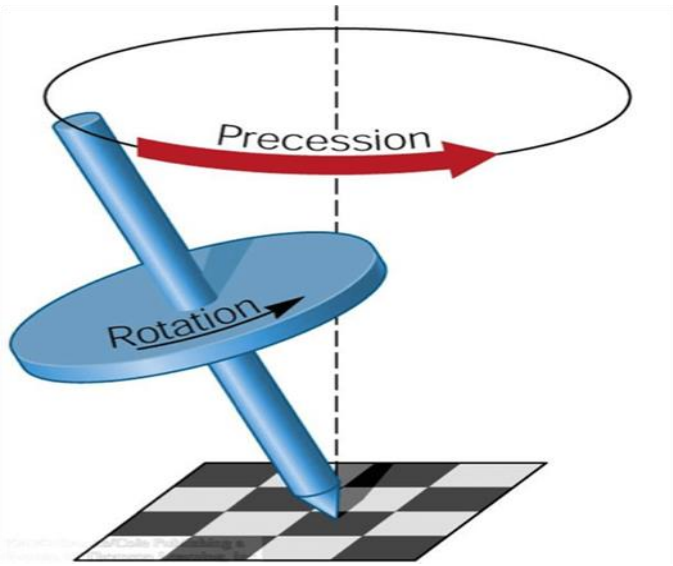


Fig (2. 13) Precession https://www.healthcare.siemens.com.

The velocity of the rotor larmor's motion to the proton varies with the force of the magnetic field. We measure the strength of the magnetic field in the Tesla unit. The frequency of its frequency is Hertz or MHz MHz. Rotational motion increases its frequency by increasing the strength of the magnetic field (positive relationship). This frequency is called the Larmor frequency. The frequency of this movement can be calculated at a specific magnetic field by Larmor's Equation:

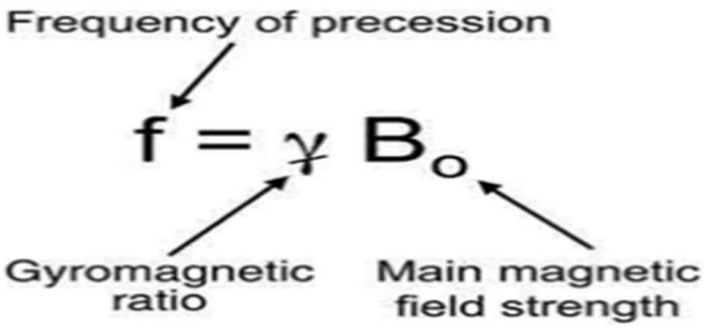


Fig (2. 14) Lamor's equation

Rule 8:

The protons when placed in the main magnetic field acquire a spin motion called precession around the magnetic field lines. This movement has a specific frequency that varies with the force of the magnetic field. The relationship with the magnetic field increased.

The MRI signal is taken from:

1_ Equilibrium State:-

When protons are placed in a main magnetic field (external) their total magnetic output will be parallel to the main field and marked with longitudinal magnetism. Also revolves around the lines of its magnetic field at a certain frequency depends on the strength of the external magnetic field. This is the state of balance.

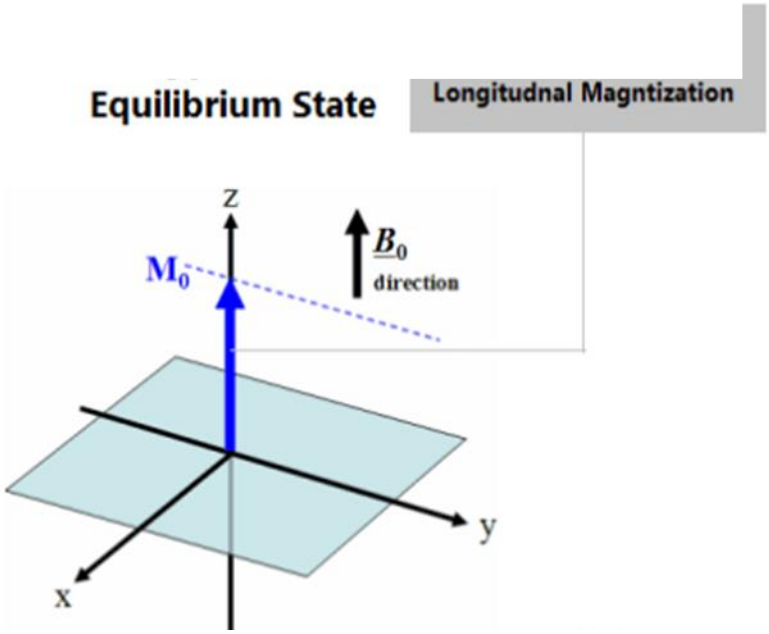


Fig (2. 15) Equilibrium state (https://www.hazemsakeek.net).

The state of equilibrium cannot be taken any signal because the magnetic signal we want to be immersed in the direction of the main field. In order to register, the signal must be raised so that it avoids the direction of the main field.

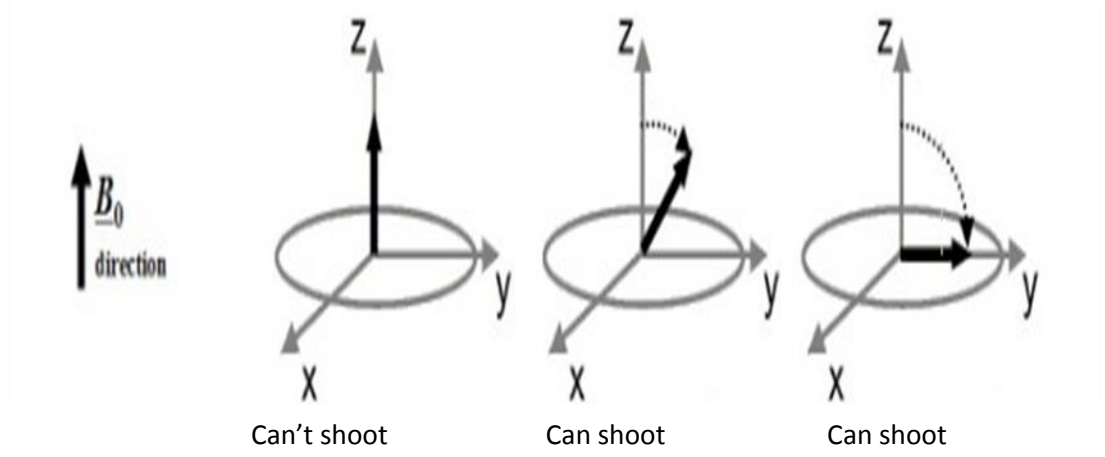


Fig (2. 16) Capture the resulting magnetic protons when they move from the magnetic field (https://www.hazemsakeek.net).

Rule 9:

When the longitudinal magnetism is in the direction of the external magnetic field, we call this state of equilibrium. No signal can be taken from this condition and the protons must be stimulated to be in a different direction than the main magnetic field to obtain a signal.

2_ Excitation State:-

The proton excitation can be stimulated by RF radio waves. Radio waves are energy that is given to these protons so that they can change the direction of their magnetic output from longitudinal magnetization to transverse magnetization.

Radio waves are sent at a specific frequency so that protons that have the same frequency are stimulated only in a phenomenon called resonance. Protons that do not have the same radio frequency do not have any excitation. Thus we can stimulate the desired protons by knowing their frequency.

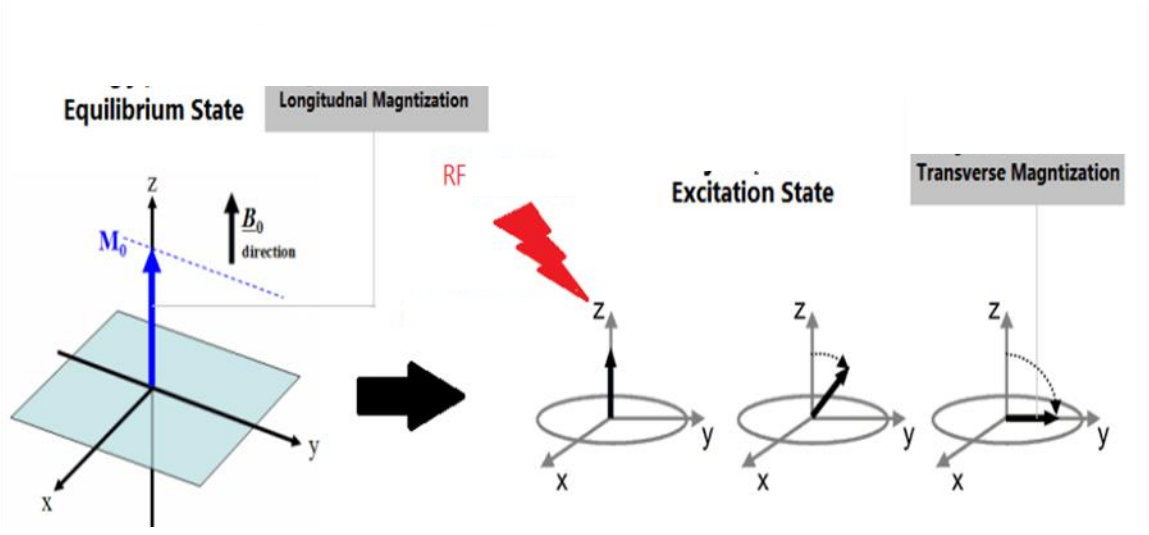


Fig (2. 17) the excitation of protons with radio waves has the same frequency (https://www.hazemsakeek.net).

Rule 10:

The desired protons are stimulated by sending RF frequency equal to the frequency of the processional frequency. The protons acquire energy and are able to change the direction of their magnetic fields away from the main magnetic field. In the case of agitation, longitudinal magnetism disappears and magnifies the occasional magnetism.

The frequency of the protons can be calculated by the law of Larmor and then radio waves equal to this frequency will be emitted.

The frequency of the protons can be calculated by the law of Larmor and then radio waves equal to this frequency will be emitted.

Relaxation:

At this point we get the magnetic resonance signal. After the radio waves are stopped, the protons return to equilibrium. Here is the loss of the occasional magnetism and the height of the longitudinal magnetism. Accidental magnetization is lost due to the loss of protons of the energy acquired by radio waves due to their natural state. This energy loss is the magnetic resonance signal called Free Induction Decay.

In Transverse Magnetization, the signal is at its highest and ends completely when the protons return to the full state of longitudinal magnetization.

Rule Eleven: After RF radio stops, protons lose the energy they gain from these waves and return to their normal state of equilibrium. The magnetic resonance signal is such a loss of energy.

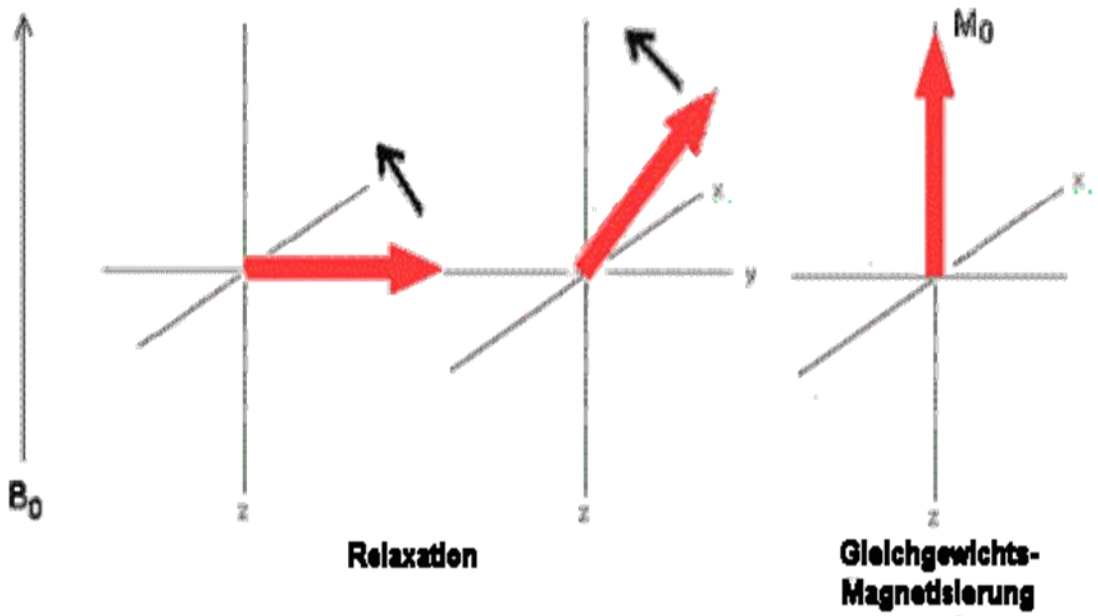


Fig (2. 18) Relaxation (Reid R. et al, 2008)

Chapter Three

Material and Method

Chapter three

Material and Method

3.1. Materials:-

3.1.1. Study group:-

Simple random Sample consists of 36 women with breast lesion aged between 18 to 50 all of underwent MR of Breast, they did not undergo chemotherapy or surgical treatment.

3.1.2 MRI breast coil :

The Variable Coil Geometry design allows each imaging element to be independently positioned and configured for each patient. Patient can then be positioned quickly and effectively as the imaging elements can be positioned as close to the breast as possible optimizing the signal-to-noise ratio for each individual patient. The positioning of the element also assists in immobilizing the breast tissue helping reduce motion artifacts.

3.2 Methods

3.5. MRI protocol:-

The standard breast MRI protocol includes T2 sequences (anatomy and signal analysis), T1 gradient-echo sequences which can detect markers placed after biopsy, and injected dynamic 3D sequences for performing volume and multiplanar reconstructions, which are particularly useful for locating lesions well. Good patient positioning is essential and is obtained by using foam wedges for small breasts, ensuring there are no folds, and the correct position of the nipples. These aspects limit movement artefacts which alter subtraction sequences, so that it must always be possible for reading these sequences to be assisted by comparing them with the native sequences. New functional imagingsequences are now appearing in an attempt to increase the specificity of MRI, which is one of its main limitations. Of these, magnetic resonance spectroscopy appears to be the most promising, highlighting an abnormal choline peak in malignant lesions. This molecular signature provides early information (24 hours after beginning neoadjuvant treatment) on the chemosensitivity of a breast tumour.

T1- and T2-weighted MRI images alone are not useful for the screening or diagnosis of breast cancer.Although breast lesions would be able to be visualized on MRI, the differences in T1 and T2 with regard to benign and malignant changes is not significant, and therefore, one would get many false positives.However, contrast-enhanced MRI has been shown to assist with the differentiation of benign and malignant lesions because of tumormediated angiogenesis .The contrast agents used are gadolinium chelates.[As opposed to the contrast agents used in computerized axial tomography scanning, these agents are not iodine based.Some believe that there may be decreased nephrotoxicity with these agents, although there

havebeen reportsof such side effects.As such, renal failure is a relative contraindication, as well as pregnancy and breastfeeding

Generally, for tumors to grow more than 2 to 3 mm in size, they have to secrete proangiogenic factors. Higher grade tumors are usually associated with increased vascularity. Most breast cancers will show increased enhancement (70% or greater increase in signal intensity) within 5 minutes of administration of intravenous gadolinium. The degree of enhancement is thought to be proportional to the vascularity and hence the suspected grade of the tumor.

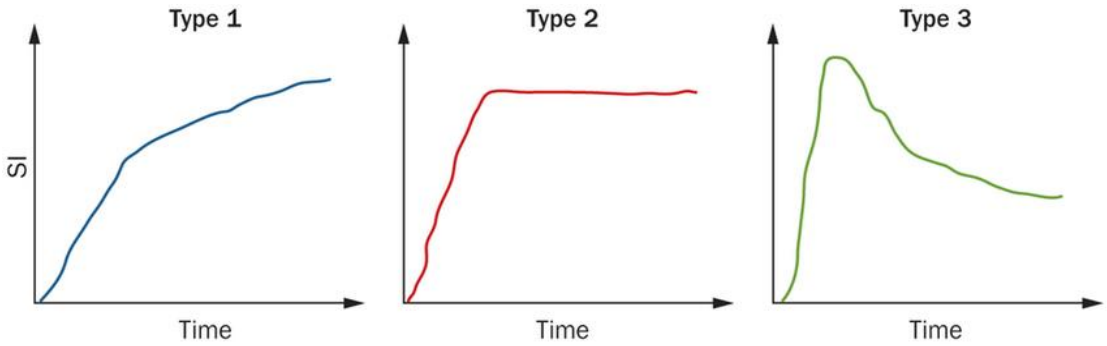
Benign tumors, however, may also enhance. By taking note of the enhancement as a function of time, one can distinguish, in many cases, between benign and malignant lesions. The microvasculature of malignant lesions tends to be more haphazard, with increased capillary permeability and connections between the arteriolar and venous systems, bypassing the capillaries.

This leads not only to quicker enhancement but also quicker washout times, i.e., the time it takes for clearance of the contrast material from the lesion. Some have categorized the enhancement intensity versus time curve into three groups. Type I curves are characterized by a gradual increase in enhancement over time. This is supportive of a benign lesion. Type II curves are characterized by a rise in enhancement intensity followed by a plateau and can represent either benign or malignant lesions. Type III curves are the classic washout curves for malignancy; a rapid rise in enhancement followed by a decreased intensity of enhancement, usually indicating malignancy.

It is important to recognize caveats to the enhancement guidelines above. DCIS lesions are more commonly missed on MRI. This is due in part to the fact that DCIS lesions are less dependent on angiogenesis because they can get their nutritional supply via diffusion. Hence, DCIS lesions are less likely to enhance compared with other types of breast cancers. major caveat is that

these are general guidelines—benign lesions may sometimes resemble type III curves, whereas malignant lesions may resemble type I curves.

Overall, 7 BI-RADS categories that range from 0-6 are used to assess MRI findings and have associated recommendations for management, of which the final assessment should based on the most suspicious finding in each breast. It is suggested that every effort should be made not to use category 0 (need for additional imaging), as the MRIexamination would likely be able to provide enough information to decide management, such as whether to biopsy a finding without the need for additional imaging. Category 0 can be used to possibly avert a biopsy in the case of an MRI finding that may manifest as beingnon another imaging modality.



BI-RADS category1 (negative) and category2 (benign) denote an essentially 0% likelihood of cancer and routine breast MRI screening may be recommended if the patient has a cumulative life time risk of developing breast cancer of Z20%. BI-RADS category3 (probablybenign) assessment is more intuitive and can be recommended in the case of a uniquefocal finding for which the likelihood of malignancy is Z0% .This type of finding may be managed with a 6-month follow-up. BI-RADS category4 (suspicious) and category5 (highly suggestive of malignancy) describe MRI findings that are suspicious enough to warrant tissue diagnosis. BI-RADS category6 (knownbiopsy- proven malignancy) describes MRI findings of biopsy-

proven breast cancer for which surgical excision is recommended when clinically appropriate.

3.2.2 image interpretation :

The interpretation of breast MRI has been standardized to some degree by the Lesion Diagnosis Working Group Project. Interpretation of MRI images depends on 2 factors, the morphology and the margins. The lesion may be described as round, oval, lobulated, irregular, or stellate. The margins of the lesion may be described as smooth, scalloped, irregular, or spiculated. Margins that are smooth are associated with a 95% negative predictive value for carcinoma, ie, they are probably benign. Lobulated margins have a 90% negative predictive value for carcinoma. On the other hand, irregular margins are associated with an 81% positive predictive value for malignancy, and speculated margins are associated with a 90% positive predictive value for malignancy.

The second part of the interpretation is the pattern of enhancement. The pattern of enhancement may be described as homogenous, heterogeneous, rim pattern (ie, peripheral enhancement), enhancing internal separations, or nonenhancing internal separations. In addition, one may have foci of enhancement, ie, a small area of enhancement without any mass or space occupying lesion. This may or may not represent an area of malignancy.

Nonenhancing masses as well as masses with nonenhancingseptations can also be present, but these tend to be benign lesions. Analyzing lesions by morphology, margins, and patterns of enhancement is sometimes referred to as morphologic analysis.

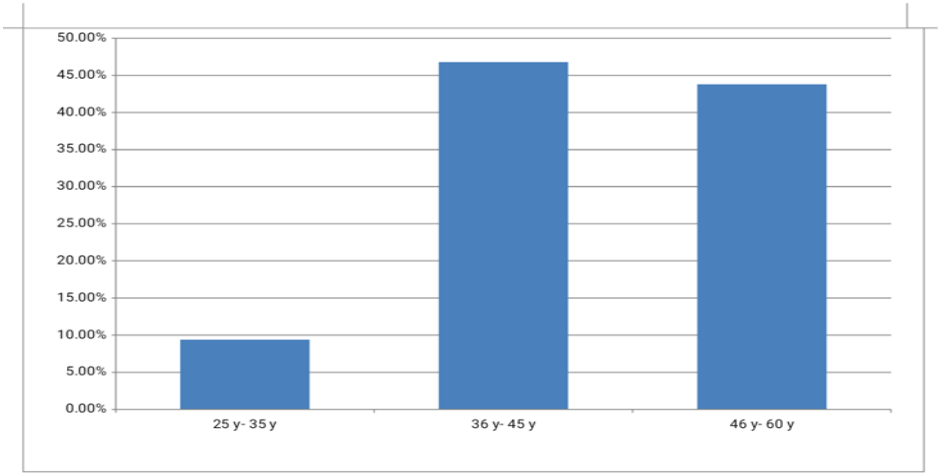
Chapter Four

Results

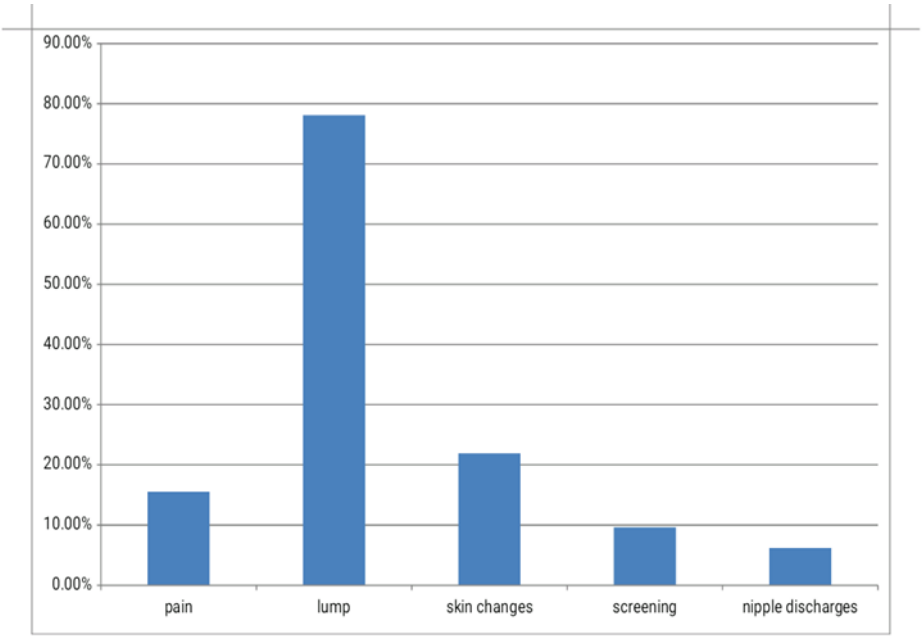
Chapter four

The Results

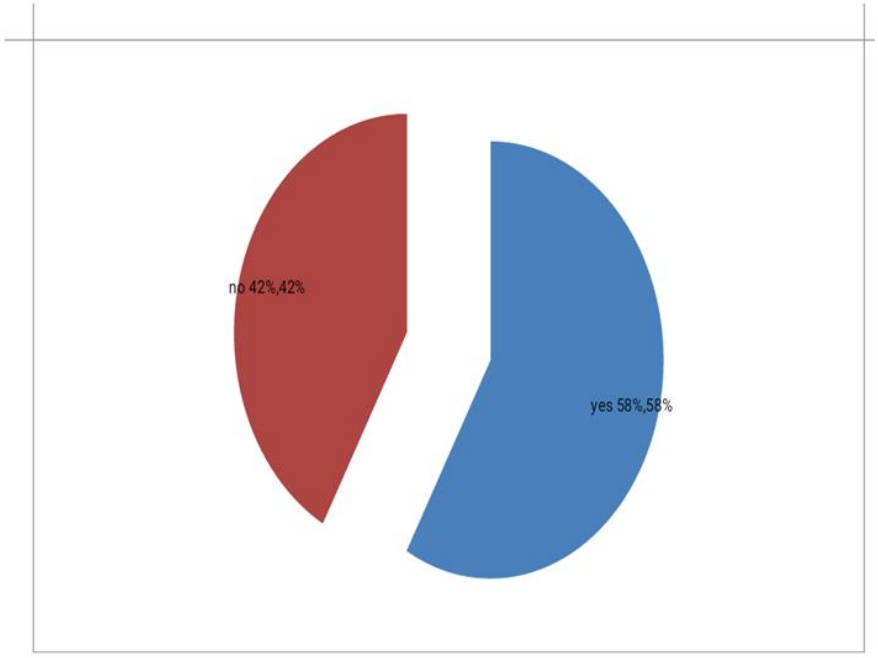
The results of study are presented in the following tables graphs



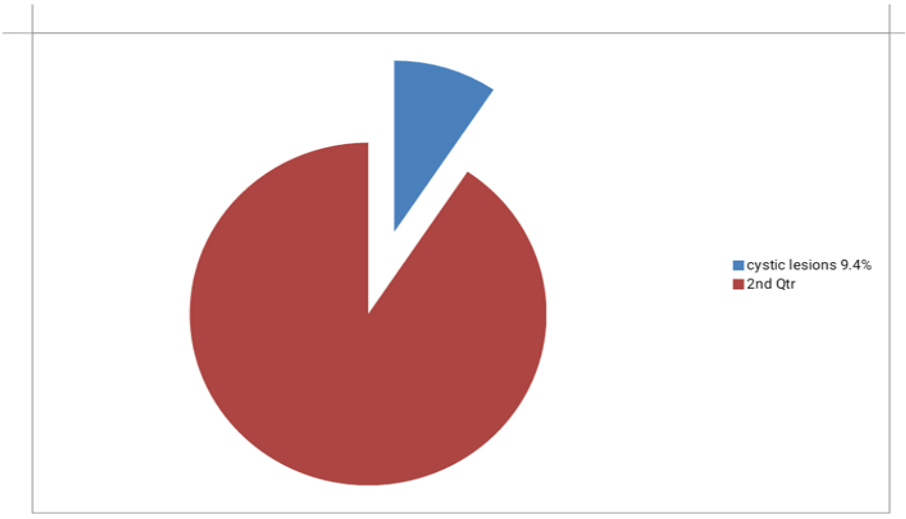
(Figure 1): distribution of the sample according to the age



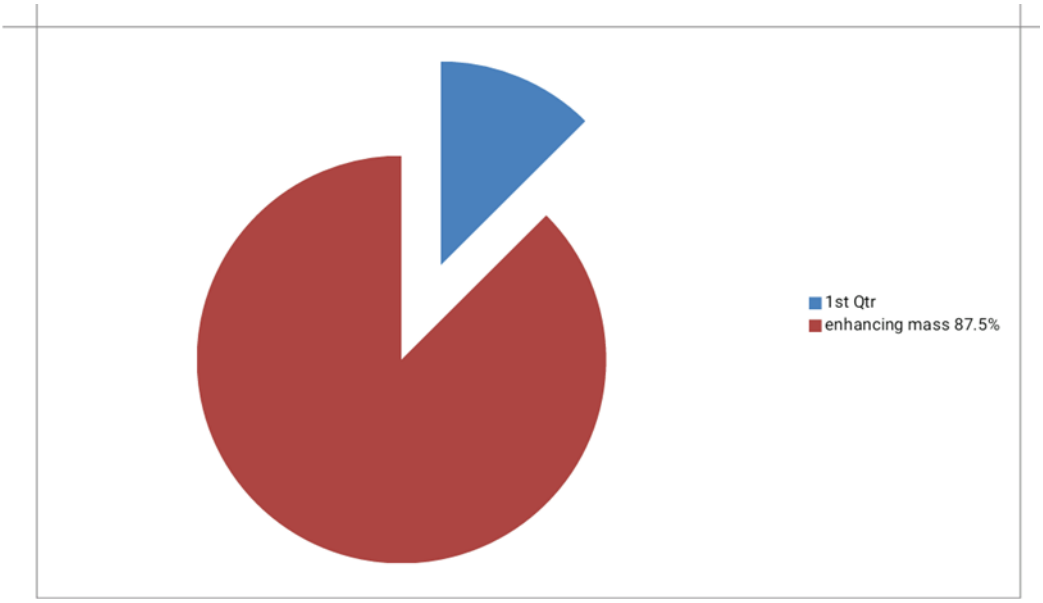
(Figure 2): distribution of sample according to complains



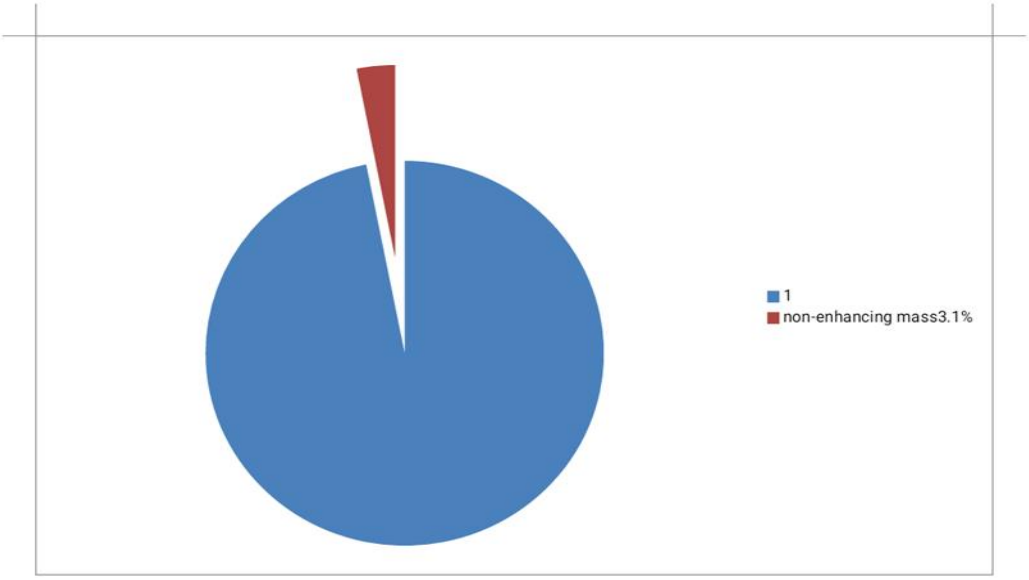
(Figure 3): distribution of the sample according to presence of malignancy risk in malignancy proven patient.



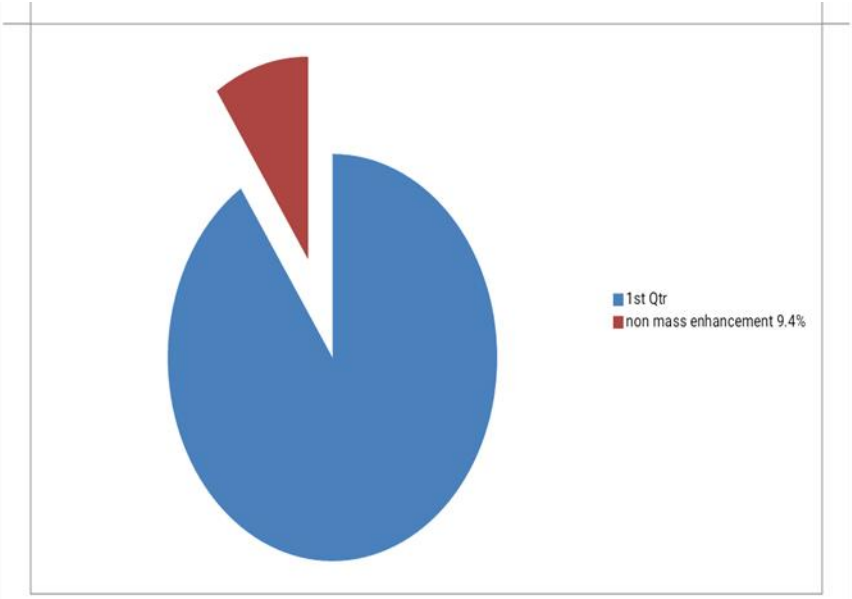
(Figure 4): distribution of breast lesions according to presence of cystic lesions.



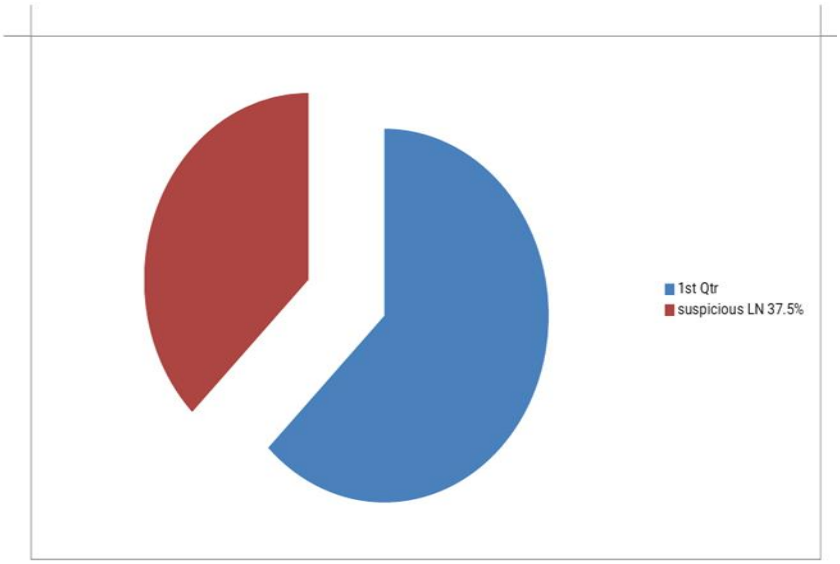
(Figure 5): distribution of breast lesions according to presence of enhancing mass.



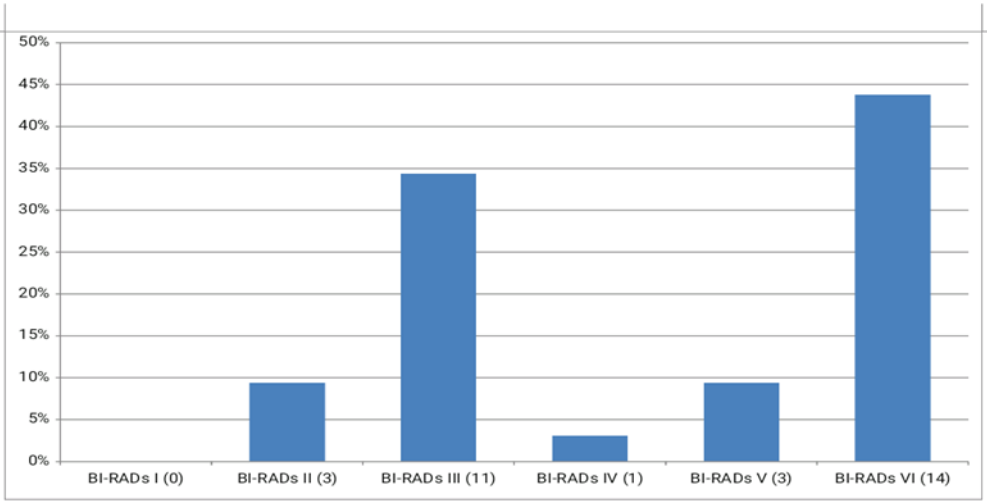
(Figure 6): distribution of breast lesions according to presence of non - enhancing mass.



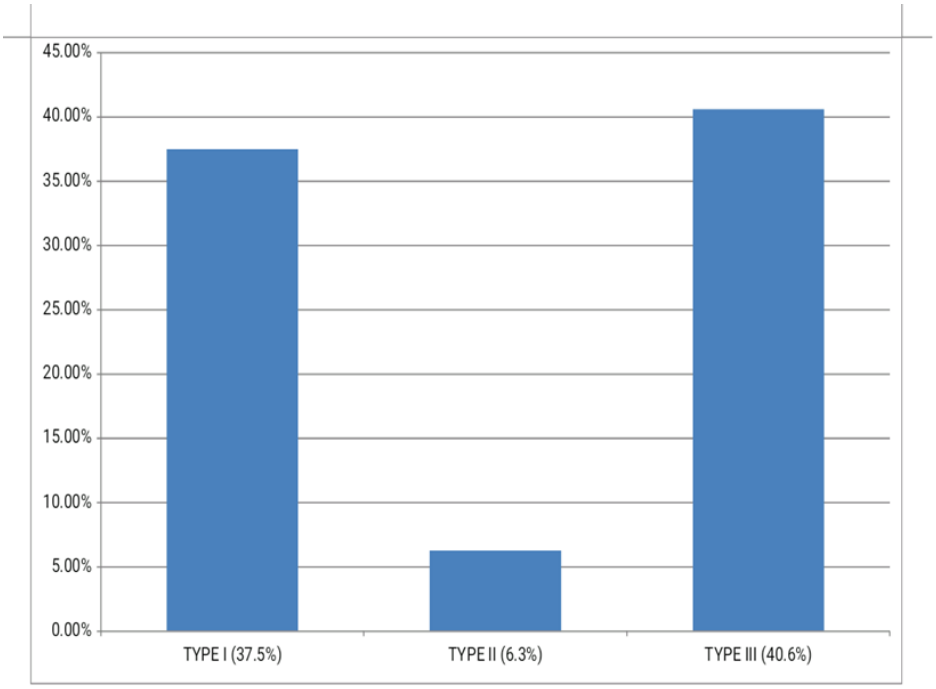
(Figure 7): distribution of breast lesions according to presence of non - mass enhancement.



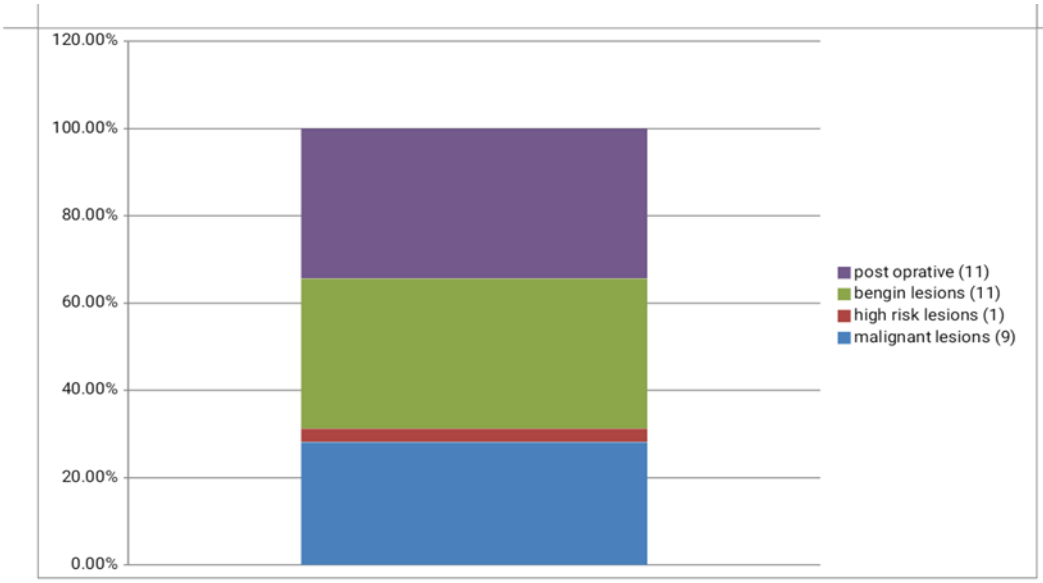
(Figure 8): distribution of breast lesions according to presence suspicious lymphadenopathy.



(Figure 9): distribution of breast lesions according to BI-RADs calcification.



(Figure 10): distribution of breast lesions according to dynamic curve intensity.



(Figure 11): distribution of breast lesions according to histo-pathological findings.

(Table 1): distribution of malignant and high risk lesions according to histo-pathological findings

	No. of pt.	%
Malignancy		
DCIS	3	9.4%
IDC	4	12.5%
ILC	2	6.2%
High risk lesions	No. of pt.	%
Atypical hyperplasia	1	3.1%

(Table 2): distribution of benign lesions according to histo-pathological findings

	No. of pt.	%
Benign		
Fibroadenoma	6	18.8%
Lipoma	1	3.1%
Hamartoma	1	3.1%
Galactocele	1	3.1%
Abscess	2	6.3%

(Table 3): distribution of post operative cases according to histo-pathological findings

	No. of pt.	%
Post operative		
Scar tissue	4	12.4%
Recurrence	7	21.9%

(Table 4): correlation between DEC and histopathological findings

	Bengin	High risk lesions	Malignant
Type I	1173.3%	0 0%	0 0%
Type II	2 13.3%	0 0%	0 0%
Type III	1 6.7%	1 6.7%	16100%

(Table 5): correlation between BI-RADs calcification and histopathological findings

	Bengin	High risk lesions	Malignant
BI-RADs1,2,3	1493.3%	0 0%	0 0%
BI-RADs4,5,6	1 6.7%	1 6.7%	1688.9%

(Table 6): final result of DEC - MR

	MRIDEC curve
T +ve	13
T -ve	18
F +ve	1
F -ve	0
Sensitivity	100%
Specifity	94.7%
Accuracy	96.9%
PPV	92.9%
NPV	100%

(Table 7): correlation between patients complaint and final diagnosis.

	lump	Skin change	pain	Nipple discharge	Total no.
DCIS	3 100%	1 33.3%	-	2 66.7%	3
IDC	4 100%	2 50%	1 25%	1 25%	4
ILC	2 100%	2 100%	1 50%	-	2
Atypical hyperplasia	-	-	1 100%	-	1

Fibroadenoma	6	100%	1	16.7%	4 66.7%		-		6
Lipoma	1	100%	-		1	100%	-		1
Hamartoma	1	100%	-		1	100%	-		1
Galactocele	1	100%	1	100%	1	100%	-		1
Abscess	2	100%	2	100%	2	100%	2	100%	2
Scar tissue	3	75%	4	100%	3	75%	-		4
Recurrence	5	71.4%	7	100%	5 71.4%		-		7

Chapter Five

Discussion, Conclusion and Recommendations

Chapter Five

Discussion, Conclusion and Recommendations

5.1. Discussion:-

All 32 female patients of our study underwent breast MR examination and compared with pathological findings of each one.

The use of MRI for screening high risk patients is now recommended by almost all major medical societies. Breast cancers in the high risk populations generally present at younger age and screening with both mammography and MRI is recommended beginning at age 30 years. Breast MRI is clearly the most sensitive method for breast cancer detection and specificities are comparable if not superior to other breast imaging methods.

The biggest advantage of both MRI methods is the lack of ionizing radiation and non-invasivity. Despite these facts, MRI is still not so frequently used in comparison to mammography and breast ultrasound. Which appear clearly in small data of our study (32 patients), in our study the main complaint was a lump followed by skin changes in post-operative cases.

The Fibro adenoma was the most common benign breast lesion (18.8%) detected in our study.

One lesion is prove to be atypical hyperplasia and showed NMLE with type III enhancing curve.

And recurrence representing 21.9% in our study .

The study showed three cystic lesion which was proven to be 2 abscesses and one galactocele and showed type I enhancing curve.

Our study showed that the enhancing mass was the most common MR finding (87.5%)

In our study type III curve was representing all pathologically proved malignant cases (100%). Also type 1 curve was detected in (73.3%) of benign lesions . malignant and benign lesions exist in the distribution of

curve type, in DEC and it is useful in differentiating malignant lesions from benign ones.

in the study included size, morphology, type (mass, non-mass like enhancement, cystic lesion) and BI-RADS category and were divided into two groups; G.I; included BI-RADS 1, 2, 3 (i.e. MRM non-suspicious lesions) and G.II; Included BI-RADS 4, 5, 6 (i.e. MRM suspicious breast lesion) (93.3%).And (88.8%) of G II were proved to be malignant .

After establishing the existence of a lesion in the breast, it is critical to determine whether this lesion is benign or malignant.

The sensitivity of breast cancer detection by mammography is 69– 90%. Sonographic classification of benign and malignant tumors is of low specificity as well-approximately 30%.The sensitivity reported for diagnosis of breast cancer using MRI is larger than 90%, and using DCE MRI is in the range of 90% to 100%.

The specificity in both methods varies considerably. In our study we found that the sensitivity , specificity and accuracy were found to be (100%) ,(94.7%) and (96.9%) respectively.

5.2. Conclusion:

The utility of MRI in breast imaging has undergone much advancement in the last years. It shows promise in many areas, including staging of breast cancers, determination of tumor size and spread, and may be a valuable screening tool for those patients with a high risk of breast cancer. It may also be of value in those patients whose breasts that are too dense for mammography, as high breast density has been shown to only minimally affect MRI sensitivity. Various studies have demonstrated that although the sensitivity of MRI in detection of breast cancer is high, the specificity of this technique varies. In addition, many studies have demonstrated the highest sensitivity and specificity when using a combination approach, i.e., using X ray mammography, ultrasound, and MRI together when evaluating patients, especially for those who are at high risk for breast cancer. Further studies are needed to elucidate the exact role of MRI in the realm of breast imaging.

- DCE-MRI of the breast had a higher sensitivity for breast cancer detection and more accurate in delineation of the disease extension.

5.3. Recommendations:

- Breast MRI should be clinically accepted and routinely used by the local breast surgeons and oncologists in our region for preoperative breast cancer staging and post-operative follow up regardless of breast density on mammography as it has high sensitivity and specificity comparing to U/S and mammography.
- Development of multidisciplinary team including radiologist for better management.
- Clear statement of the indications for the study.
- Comparison with previous images of different modality should be carried out when even possible to increase sensitivity and specificity.
- Development one language report including morphology, enhancement type and distribution.
- Long term study regarding the high risk patients as it represent small number in our study.
- Future study using of MRS and DWI which carrying promising results with marked increasing in accuracy.
- Improving of archiving system in the diagnostic centre will facilitate the future study.

5.4. Limitation:

- MRI breast is infrequently requested by physicians.
- Most of centers lack proper organization and archiving of patient information.
- Some patient refused to be involved in the study.
- Lack of communic.

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