MINOR RESEARCH PROJECT

FINAL REPORT

A STUDY ON FUZZY LOGIC AND BI-RADS IN BREAST CANCER

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Submitted To:

Dy. Secretary and the Regional Head

South Western Regional Office

University Grants Commission

Bangalore -560 009.

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DECLARATION

I hereby declare that the project titled "**A study on fuzzy logic and BI-RADS in breast cancer**" is an authentic research work carried out by me during the period 2015-17.
I also certify that the work is done as per the proposal and also by following the guidelines of the University Grants Commission.

Prof. Kochu Thresiamma Joseph
Principal Investigator

DEDICATION

Overwhelmed by the unfeigned memories of my loving daughter and beloved husband, who are no more, suffering the worst clutches of cancer, but have successfully secured their heavenly abode by His benevolence! by the grace of the Most High! with cognizant thanks and praise, the project is dedicated to the interests of those who are victims of cancer.

Contents

CHAPTER I

INTRODUCTION

About one million women are diagnosed with breast cancer every year. Breast cancer makes up one-third of all cancer diagnoses in women. Early diagnosis of breast cancer is crucial and important in reducing mortality rate and improving the patient's quality of life. Current breast imaging diagnosis include: Mammography, Magnetic Resonance Imaging(MRI), Sonograms and Ultrasound images. The mammography is more effective than ultrasound in the early diagnosis of breast cancer calcification and is cheaper than MRI. Mammography offers high-quality images at a low radiation dose, and is currently the only widely accepted imaging method used for breast cancer diagnosis. Hence, Mammography is the major examination of choice since it has been proven capable to detect the disease. However, analyzing a mammogram and concluding in correct diagnosis results is not a trivial medical task. An early diagnosis of this disease has more importance and considerably improves the prognosis and leads to more effective treatment for the patient.

Thus, detecting breast cancer early is difficult but quite important. Both randomized studies and population-based evaluations show that recognizing breast cancer early through mammography significantly increases the survival rate. Mammography can detect the cancer several years before the appearance of physical symptoms; consequently, it is the best screening test at present. However, before more detailed screenings are performed, such as ultrasound imaging or breast biopsy, approximately 5% to 10% of the mammography readings are interpreted as irregular or inconclusive, until final interpretations confirm normal or benign breast tissue. In fact, reports say that malignant pathology is only found in 10% out of 30% of biopsies. The large number of avoidable breast biopsies is a source of serious emotional and physical distress for the patients, in addition to financial costs.

Recently, computer-aided diagnosis (CAD) systems are used that employ lesion descriptions based on BI-RADS. BI-RADS stands for Breast Imaging Reporting and Data System and was established by the American College of Radiology. BI-RADS is meant to transform breast imaging language to a universal one by defining the related descriptive terms, the statistical definitions, and providing recommendations for radiological reports and data archiving system. The latest version covers three imaging modalities, i.e., mammography,

ultrasound and MRI. It cannot replace personal experience, good knowledge of the literature and continuous medical education. Despite its limits, it has proven to be useful tool for communication between physicians of different specialities and researchers. The knowledge of its basic elements is necessary for all physicians who deal with breast diseases and breast cancer screening.

BIRADS is a scheme for putting the findings from mammogram screening (for breast cancer diagnosis) into a small number of well-defined categories. BIRADS is something that mainly benefits the radiologists who report mammogram (and breast MRI and US) findings. It doesn't do anything directly useful for patients or for the doctors who referred a patient for breast imaging.

Mammogram report includes many technical details, which will show BIRADS score. BIRADS is a quality assurance tool originally designed for use with mammography. The system is designed to standardize reporting, and is used by radiologists, medical professionals to communicate a patient's risk of developing breast cancer. This indicates the radiologist's opinion of the absence or presence of breast cancer. "BI-RADS" refers to the mammography assessment categories. These are standardized numerical codes typically assigned by a radiologist after interpreting a mammogram. This allows for concise and unambiguous understanding of patient records. Through a medical audit and outcome monitoring,
BI-RADS provides important peer review and quality assurance data to improve the quality of patient's care.

Fuzzy logic can help reduce the difficulties faced by computational systems to represent and simulate the reasoning and the style adopted by radiologist s in the process of medical image analysis .With the help of fuzzy logic and by a computer based algorithm the classification of BI-RADS score is possible. It gives a more effective and reliable results.

Breast cancer is the cause of the most common cancer death in women. Fuzzy Neural Networks comprises an integration of the merits of neural and fuzzy approaches, enabling one to build more intelligent decision-making systems.

CHAPTER II

BI-RADS MAMMOGRAPHIC ASSESSMENT CATEGORIES

The BI-RADS assessment categories are:

0- incomplete

1-negative

2-benign findings

3-probably benign

4-suspicious abnormality

5-highly suspicious of malignancy

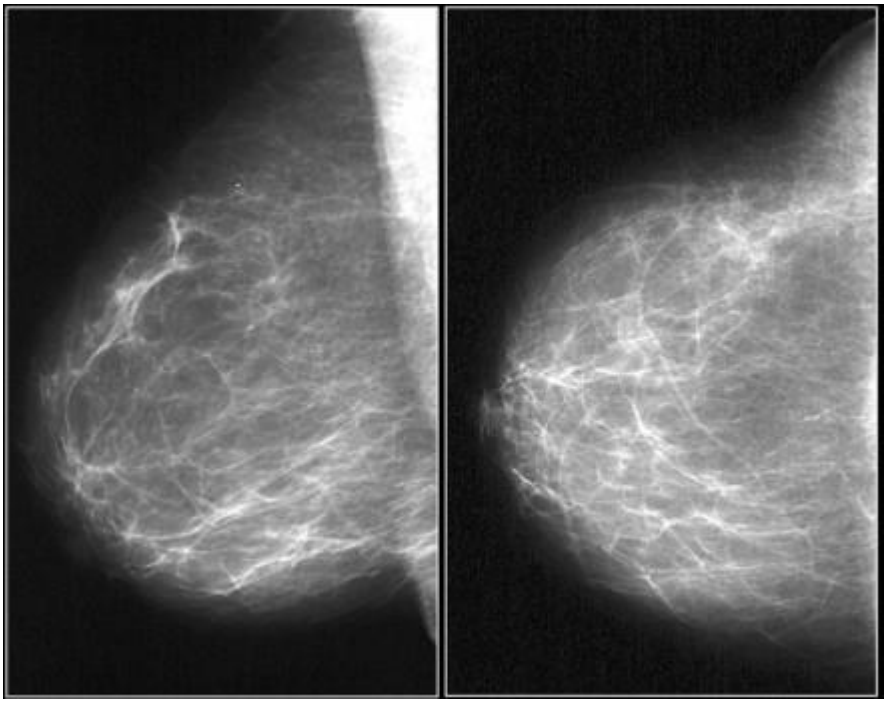
6-known biopsy with proven malignancy

After the initial breast cancer screening, a follow-up or diagnostic mammography is often recommended if the BI-RADS category is 3 or higher. By a huge majority, most breast cancer screening mammograms are classified as either BI-RADS 1 or BI-RADS **2** and those categories are nothing to worry about and require no further treatment. A lot of women over 40 will have BI-RADS categories 1 and 2 following their annual mammogram, they need additional imaging evaluation and/or prior mammograms for comparison: When additional imaging studies are completed, a final assessment is made.

BI-RADS 1

Negative:

The breasts are symmetric and no masses, architectural distortion or suspicious calcifications are present.



BI-RADS 1 (normal).

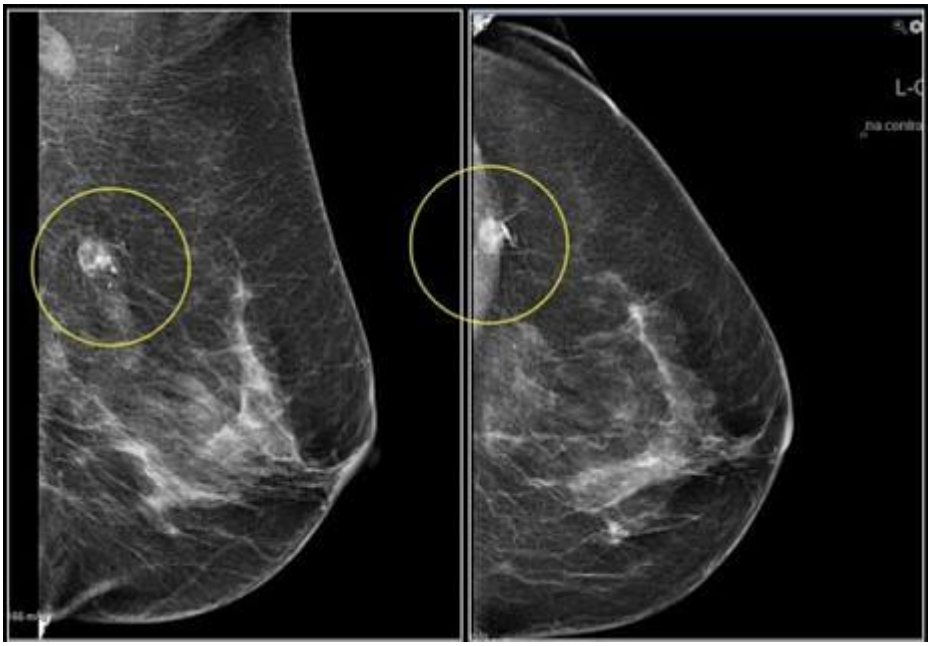
BI-RADS 1

It means that your mammogram is negative(that is, no evident signs of cancer were found) and that you should continue to have routine screenings.

BI-RADS 2

This score means that your mammogram is normal, with no apparent cancer, but that other findings (such as cysts) are described in the report. You'll be instructed to continue your routine screening.

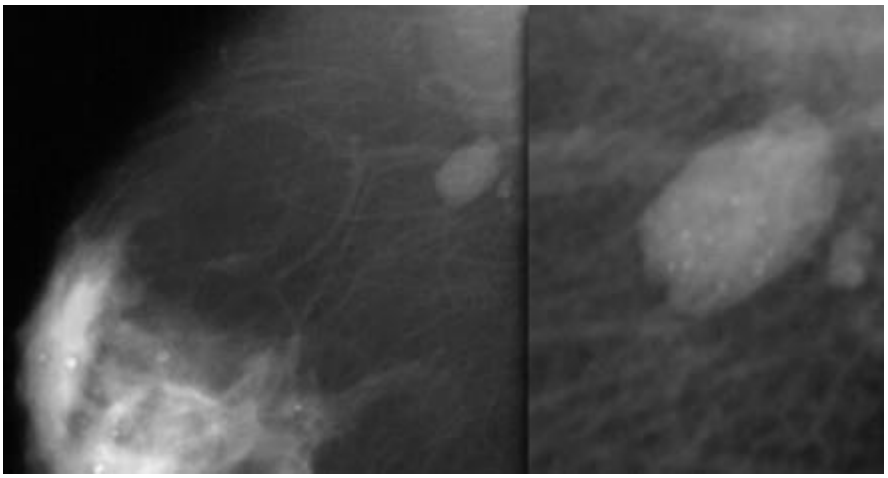
Category		Management	Likelihood of Cancer
2	Benign	Routine Screening	Essentially 0%



BI-RADS 3

Probably Benign Finding Initial Short-Interval Follow-Up Suggested:

A finding placed in this category should have less than a 2% risk of malignancy. You'll be asked to follow-up with a repeat mammogram in six months. And if you have a family or personal history of breast cancer, the radiologist may opt to do more tests now rather than wait.



Here a non-palpable sharply defined mass with a group of punctuate calcifications. The mass was categorized as BI-RADS 3.

Category	Management	Likelihood of Cancer

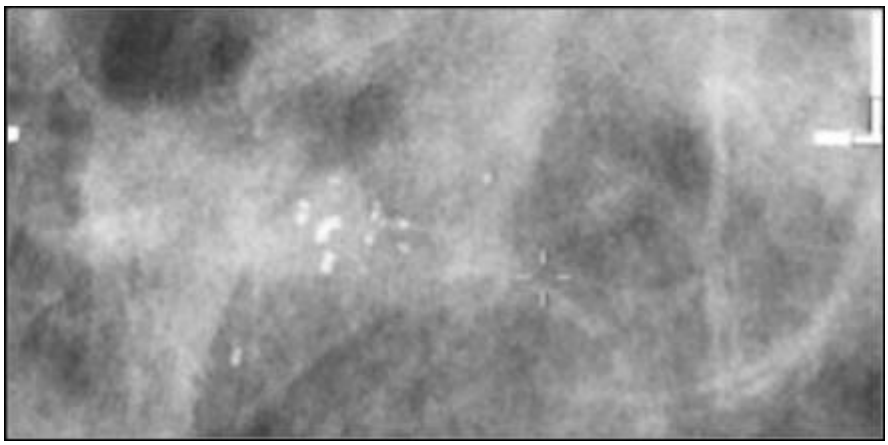
3	Probably Benign	Short interval follow up(6 month) or continued surveillance	0% but <2%

BI-RADS 4

Suspicious Abnormality - Biopsy Should Be Considered:

This category is reserved for findings that do not have the classic appearance of malignancy but are sufficiently suspicious to justify a recommendation for biopsy. BI-RADS 4 has a wide range of probability of malignancy (2% - 95%).

This lesion is categorized as BI-RADS 4.



Both diagnoses are concordant with the mammographic findings

Category		Management	Likelihood of Cancer
4	Suspicious	Tissue Diagnosis	4a. low suspicion for malignancy(> 2% ≤ 10%) 4b.moderate suspicion for malignancy (> 10% ≤ 50 %) 4c.high suspicion for malignancy (> 50% ≤ 95 %)

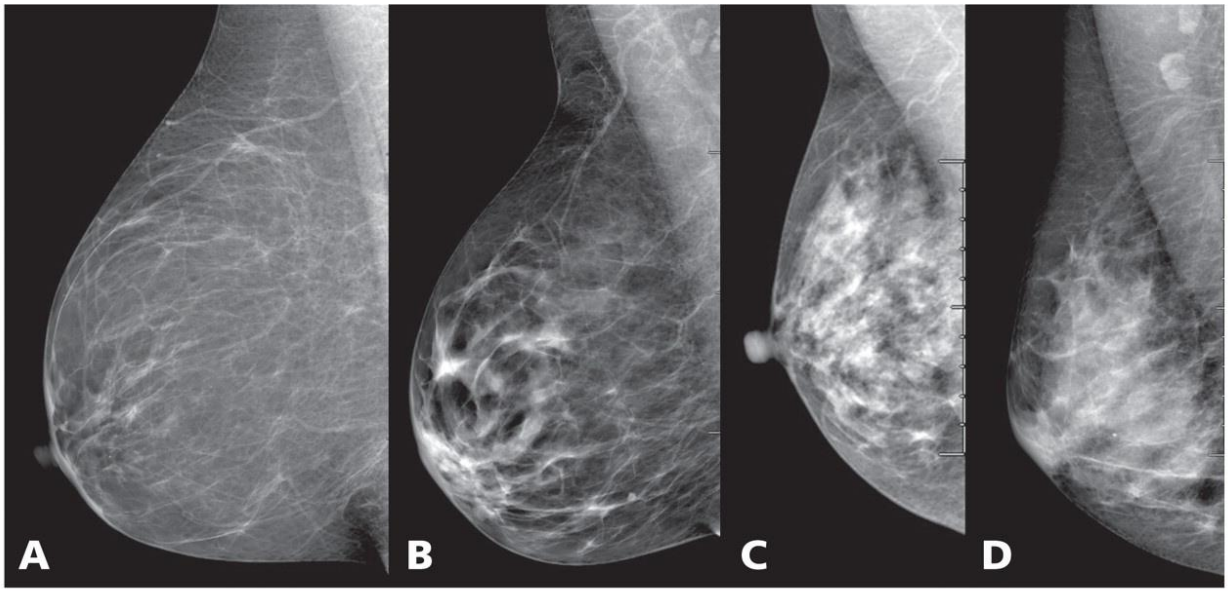


Figure 1 Representations of the 4 Breast Imaging Reporting and Data System (BI-RADS) breast density qualitative and quantitative assessments. A) BI-RADS 1: almost entirely fat; B) BI-RADS 2: scattered fibroglandular densities; C) BI-RADS 3: heterogenously dense; and D) BI-RADS 4: extremely dense.

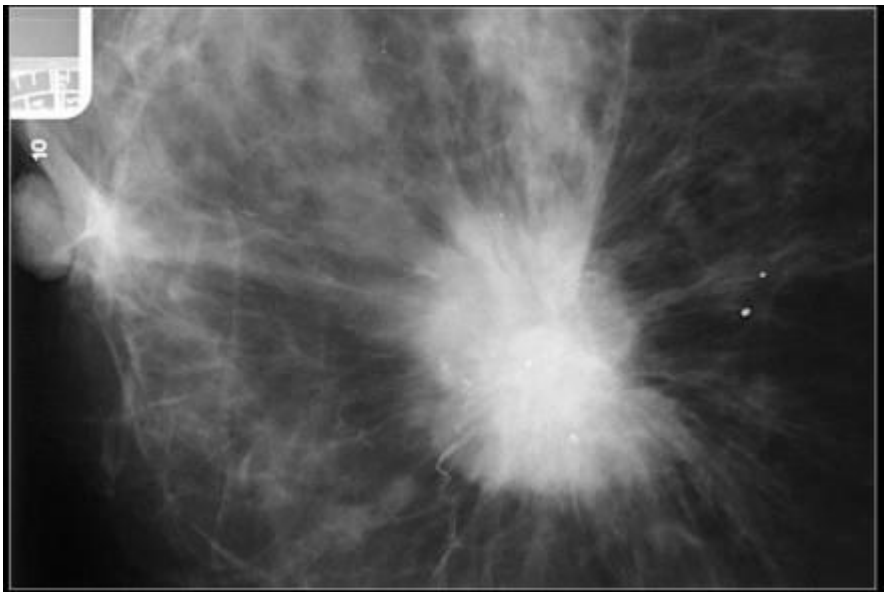
BI-RADS 5

Highly Suggestive of Malignancy.

Appropriate Action Should Be Taken:

BI-RADS 5 must be reserved for findings that are classic breast cancers, with a >95% likelihood of malignancy.

This mass is categorized as BI-RADS 5.



Category		Management	Likelihood of Cancer
5	Highly suggestive of malignancy	Tissue diagnosis	≥95 %

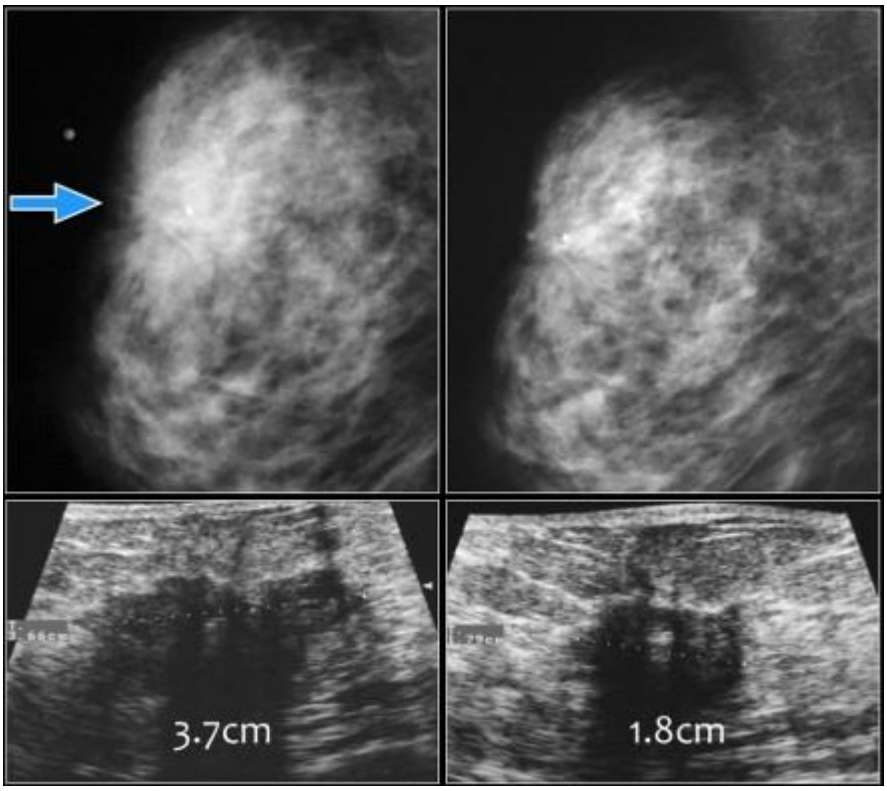
BI- RADS 6

Category		Management	Likelihood of Cancer
6	Known biopsy proven malignancy	Surgical excision when clinical appropriate	n/a

The tumor is not visible on the mammogram. Ultrasound showed shrinkage. Here images of a biopsy proved malignancy. On the initial mammogram a marker is placed in the palpable tumor.

Due to the dense fibro glandular tissue the tumor is not well seen. Ultrasound demonstrated a 37mm mass with indistinct and angular margins and shadowing.

The Mass is categorized as BI-RADS 6



On the left BI-RADS 5 lesion. On the right after neo-adjuvant chemotherapy BI-RADS 6. After chemotherapy of the tumour to an 18 mm mass, this was categorized as BI-RADS 6.

CHAPTER III

FUZZY APPLICATION

Experience shows that the fuzzy-genetic tool is a promising approach in the investigation and diagnosis of cancer. Fuzzy system appeals linguistic rules instead of learning examples as previous knowledge, the input and output variables have to be narrated linguistically. If the knowledge is incomplete, wrong or contradictory, then the fuzzy system must be better functioned. The tuning of Fuzzy system is discharged in a heuristic way. This is time consuming task.

Neuro-fuzzy system is an acquiring machine that finds the factors of a fuzzy system (i.e., fuzzy sets, fuzzy rules) by employing approximation techniques from neural networks.

Table 1: Comparison of neural control and fuzzy control

Neural Networks	**Fuzzy Systems**
no mathematical model necessary	no mathematical model necessary
learning from scratch	apriority knowledge essential
several learning algorithms	not capable to learn
black-box behaviour	simple interpretation

The neuro-fuzzy system has a 3 layered feed forward architecture. The units network use t-norms or t-conorms as activation function. The hidden layer represents fuzzy rules. Fuzzy sets are encoded as (fuzzy) connection weights.

A neuro-fuzzy system is represented as special three-layer feed forward neural network.

The first layer corresponds to the input variables.

The second layer symbolizes the fuzzy rules.

The third layer represents the output variables.

The fuzzy sets are changed into (fuzzy) connection weights.

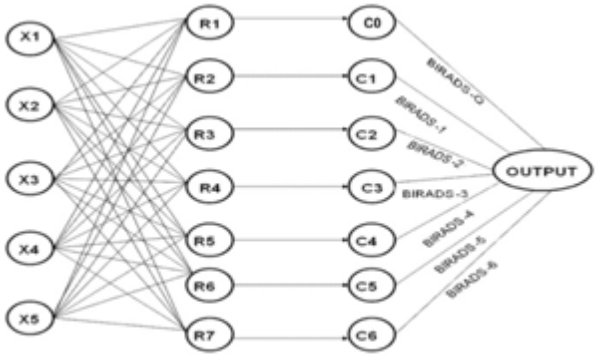
The first layer contains five input units (x1..X5) representing the pattern features. The hidden layer holds rule units, (R1-R7) representing the fuzzy rules and the third layer consists of six output units. There are 7 fuzzy rules using BI-RADS (1-6) and five inputs Mass shape, Mass Margins, Mass density, Calcification and Calcification Distribution. Neuro fuzzy model is created for interactive expert systems to diagnose Breast Cancer Inference engine.

X1: Mass Shape X2: Mass margin

X3: Mass Density X4: Calcification

X5: Calcification Distribution

Fig: 1 The Neuro Fuzzy model created for interactive neurofuzzy expert system



The input Mass Shape contains five categories Round, Oval, Lobular and irregular, uncertain. Oval and round masses are usually benign. The data set is converted in to digital data coded in binary form. Round-0000, Oval-0001, Lobular-0010, irregular-0011 and uncertain -0100. The Margins of the Masses are the most important indicators of likelihood of malignancy. The margins can be described as circumscribed -0000, obscured -0001, micro lobular -0010, Indistinct -0011 and speculated -0100.

The mass density contains fat density -0000, Low density -0001, Isodense-0010, High density – 0011 and Has Central Lucency-0100

The Calcification distribution can be categorized in five groups

1. Diffused and scattered 0000 (Not Suspicious)
2. Regional 0001 (low Suspicious)
3. Segmental 0010 (High Suspicious)
4. Linear branching 0011 (Very high Suspicious)
5. Grouped/clustered 0100 (Suspicious Malignancy)

Mass

A 'Mass' is a space occupying 3D lesion seen in two different projections. If a potential mass is seen in only a single projection it should be called an 'asymmetry' until its three-dimensionality is confirmed.

Shape: oval (may include 2 or 3 lobulations), round or irregular

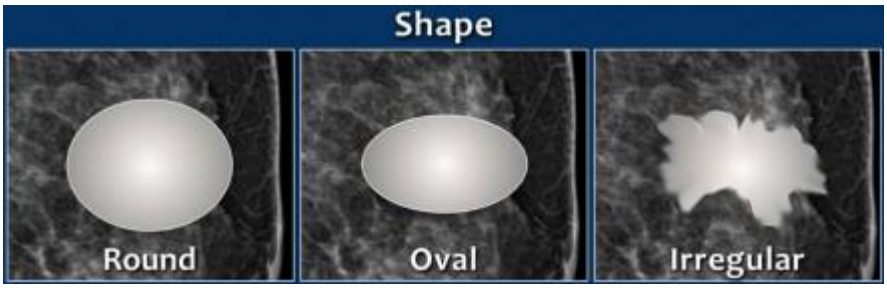
Margins: circumscribed, obscured, microlobulated, indistinct, speculated

Density: high, equal, low or fat-containing.

The images show a fat-containing lesion with a popcorn-like calcification.

All fat-containing lesions are typically benign.

These image-findings are diagnostic for a hamartoma - also known as fibroadenolipoma.



The shape of a mass is either round, oval or irregular.

MEDICAL RULES AND PROPOSED DIGITAL LOGIC RULES

In this proposed expert system we convert the medical rules into Digitized Logical rules which are implemented with the following set of Rules. This Conversion procedure helps in generating an accurate advanced and faster tool for diagnosis of Breast cancer.

R1: Rule l

If Mass shape = round and Mass margin = Circumscribed and Mass density = Fat density and Calcification: lucent centered and Calcification distribution diffused and scattered then BIRADS –0 (Re-imaging)

If Mass shape=0000 and Mass Margin=0000 and Mass Density=0000 and Calcification=0000 and Calcification distribution=0000 then BIRADS-0(Re-imaging)

R2: Rule 2

If Mass shape = round and Mass margin= Circumscribed and Mass density = Fat Density and Calcification = Lucent Centered Calcification distribution = diffused and scattered then BIRADS-1(Normal)

If Mass shape =0000 and Mass Margin=0000 and Mass density = 0000 and Calcification = 0000 Calcification distribution =0000 then BIRADS-1(Normal)

R3: Rule 3

If Mass shape = round or oval and Mass margin is circumscribed or obscured, density and Calcification = Lucent cantered or parallel tracks / linear lobular or Coarse / popcorn or large rod like or recent or egg shell rim or milk of calcium and Calcification distribution = diffused and scattered then BIRADS – 2 (Benign)

If Mass shape =0000 or 0001 and Mass Margin =0000 or 0001 Mass density =0000or 0001 and Calcification = 0000/0001/0010/0011/0100/0101/0110 and Calcification distribution = 0000 then BIRADS – 2(Benign)

R4: Rule 4

If Mass shape = Lobular and Mass margin = Micro lobular. Mass density = Isodense and Calcification = Suture calcification or Dystrophic or Punctuate or Amorphous / indistinct Calcification distribution = diffused and scattered or regional or segmental or linear branching then BIRADS -3(Probably Benign)

If Mass shape = 0010 and Mass margin = 0010 Mass density = 0010 and Calcification = 0111or1000 or 1001or 1010 Calcification distribution =0000 or 0001 or 0010 or 0011 then BIRADS -3(Probably Benign)

R5: Rule 5

If Mass shape = irregular and Mass margin= speculated and Mass density = Has central lucency and Calcification= pleomorphic / Heterogeneous Granular Calcification Distribution=

Segmental (very suspicious) or Linear branching (high suspicious. then BIRADS – 4.(Suspicious abnormality)

If Mass shape = 0011 and Mass margin= 0100 and Mass density = 0100 and Calcification= 0010 or 0011 Calcification Distribution= 0010 or 0011 (high suspicious). then BIRADS – 4. . (Suspicious abnormality)

R6: Rule 6

If Mass shape = irregular and Mass margin= speculated and Mass density =Has central lucency and Calcification = pleomorphic / Heterogeneous granular and Calcification distribution = clustered them BIRADS -5(Highly Suggestive Malignancy)

If Mass shape = 0011 and Mass margin =0100 and Mass density=0100 and Calcification =1100 and Calcification distribution= 0100 then BIRADS -5

(Highly Suggestive Malignancy)

R7: Rule 7

If Mass shape = irregular and Mass margin= speculated Mass density= Has central lucency and Calcification = fine linear branching and Calcification distribution = Clustered then BIRADS – 6 (Malignant).

If Mass Shape =0011 and Mass Margin=0100 and Mass density=0100 Calcification =1101 and Calcification distribution =0100 then BIRADS-6(Malignant)

CHAPTER IV

RECOMMENDATIONS

Breast imagers and technology developers should work in collaboration with health care providers and payers to improve the overall quality of mammographic interpretation developing technologies, such as CAD (Computer Aided Detection), that have the potential to improve quality, and expanding their use once they have been validated.

To expand the capacity of breast screening programs, mammography facilities should enlist specially trained non-physician personnel to pre-screen mammograms for abnormalities or double-read mammograms to expand the capacity of breast imaging specialists and treatment can be done by understanding BI-RADS Score. Because understanding the implications of risk plays an important role in breast cancer, so we give considerable attention to the problems involved with risk communication.

Better tools are needed for communicating risk to help health care providers—the physicians, nurses, and counsellors who work directly with patients—communicate more effectively with patients. Conversely, better tools are needed for patients and the public, specifically including the media, so they will have greater understanding of the material. Many physicians do not communicate risk effectively and far too often patients either fail to recognize or are reluctant to admit their confusion.

The National Institutes of Health, Agency for Healthcare Research and Quality (AHRQ), and Centers for Medicaid and Medicare Services (CMS) should collaborate to establish programs and centers (which may be virtual) that bring together expertise and funding to enable a more comprehensive approach to technology assessment and adoption. These efforts should involve collaboration with technology developers, not-for-profit organizations (including professional societies), advocacy groups, private health care payers, and provider organizations.

Experimentation with innovative organizational structures for the centers should be encouraged. Clinical studies are expensive, typically costing millions of dollars in addition to

the time and effort of participating patients, physicians, and nurses, but such studies are essential to the successful evaluation and adoption of new treatments and technologies. Too many clinical studies fail to provide useful data or to answer the basic question of whether a new technology improves health outcomes. That reflects an underlying problem.

Summary of Recommendations

Health care providers and payers should consider adopting elements of successful breast cancer screening programs from other countries. Such programs involve centralized expert interpretation in regionalized programs, outcome analysis, and benchmarking. Breast imagers and technology developers should work in collaboration with health care providers and payers to improve the overall quality of mammographic interpretation by:

- Developing technologies, such as computer aided detection (applying fuzzy logic) that have the potential to improve quality.
- Researchers and technology developers should focus their efforts on developing tools to identify those women who would benefit most from breast cancer screening. Such tools should be based on individually tailored risk prediction techniques that integrate biologic and other risk factors.
- Technology innovators, including basic scientists, should work with clinicians, health systems experts, and epidemiologists from the earliest stages of development in order to increase the likelihood of creating clinically useful tools for the early detection of breast cancer.
- Research funders, including the NCI and private foundations, should develop tools that facilitate communication regarding breast cancer risk to the public and to health care providers.

SUMMARY

The outlook for women with breast cancer has improved significantly since 1989 as the mortality rate has declined steadily, a decline attributed both to earlier detection through wider use of mammography screening and to improved treatments. Yet breast cancer remains a major problem, second only to lung cancer as a leading cause of death from cancer for women. This year over 200,000 new cases will be diagnosed and about 40,000 women—most diagnosed in earlier years—will die from the disease.

As their basic understanding has improved, researchers have discovered that breast cancer is far from simple. The disease has many forms that follow many pathways. Some are swift and lethal while others may never progress. Unfortunately, the tools available today cannot distinguish between the small pre-invasive lesions that will become lethal and those that will not. Consequently, most breast cancers are treated as if they were destined to be lethal and many women undergo difficult treatments, such as mastectomy, radiation, and chemotherapy, that might never have been needed

Current treatments for breast cancer range from the relatively simple, but daunting, procedure known as lumpectomy, which removes cancerous and surrounding breast tissues, to the modified radical mastectomy in which an entire breast and the adjacent lymph nodes are excised. Both may be accompanied by chemotherapy and/or radiation therapy. None of these treatments, however, is guaranteed to save a woman's life, and, because so little is understood about the cellular mechanisms and processes

To date, no way to prevent breast cancer has been discovered and experience has shown that treatments are most effective when a cancer is detected early, while still small and contained and before it has spread to other tissues. Those two facts suggest that, at the present time, improving early detection and diagnosis is the most effective way to continue reducing the toll from breast cancer.

For a variety of reasons, many women do not undergo regular screening. These reasons include limited availability of screening in some areas, inadequate insurance coverage, and misunderstanding of the value of screening. Also, some women are so afraid of breast cancer they choose not to be screened. Others find the procedure painful. The fact that mammography

does not work equally well for all women, especially those with dense breast tissue, is a further complication

In addition, the potential for false-positive and false-negative results remains high. Studies suggest that, due to a lack of sensitivity leading to false-negative findings, mammography screening may miss as many as 1 in 6 tumours. At the other extreme, the risk of a false-positive result is about 1 in 10, meaning that about 1 in 10 suspicious findings on a screening mammogram are false alarms. About three-quarters of suspicious areas biopsied as a result of a mammogram turn out to be benign—though only after a woman has endured the fear that she has breast cancer and borne the costs and discomfort of additional medical process.

A growing shortage of radiologists who specialize in reading mammograms, coupled with an imbalance between the closures and openings of screening facilities, has created unacceptable delays in some parts of the country. At the same time the number of false-positive readings appears to be increasing, possibly due to increasing defensive medicine in reaction to the frequency of malpractice litigation.BI –RADS gives more accurate results and is currently applying by Oncologists

Also, the British National Breast Cancer Screening Program invites every woman for a screening mammogram, which is paid for through the National Health Service—but only at three-year intervals. In the United States, the recommended screening interval is one year, which is likely to detect more cancers, but women do not get screened unless they are referred by health care providers or refer themselves. Many women are never screened because they lack adequate, if any, insurance coverage. That group tends to include underserved women in lower socioeconomic groups in whom breast cancer may not be detected at an early stage when still treatable.

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PRESENTED PAPER

IN THE NATIONAL SEMINAR

FUZZY LOGIC AND DIAGNOSIS OF CANCER

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ABSTRACT

Fuzzy logic plays an important role in the field of medicine and was investigatedin many medical applications. Some of the applications of fuzzy logic in medicine are the diagnosis of breast cancer, lung cancer, colon cancer and prostate cancer. Cancer is a genetic disease, formed as a result of growth and proliferation of cells in an uncontrolled or abnormal manner due to cells exiting from DNA damage, and it is the leading life- threatening forhuman's in today's world.The purpose of this paper is to determine the risks of developing types of cancers in the future for healthy people and to preliminary diagnosis of pilotcancer types. Breast cancer, lung cancer and colon cancer are selected as pilot cancer types. Fuzzy logic gives more accurate results than similar mathematical models. Nowadays, most people who have cancer; get admitted to hospitals at a later stage of disease progression making a good medical intervention and treatment impossible. In this paper some methods such as, FNA method, FK-NN Classifier for diagnosis of cancer especially for breast cancer are explained.

INTRODUCTION

Fuzzy logic aims at modelling ,human thinking and reasoning and applying the model to problems according to needs. It tries to equip computers with the ability to process special data of humans and to work by making use of their experiences and insights. Systems that use fuzzy logic can produce effective results based on indefinite verbal knowledge , like humans. In fuzzy logic , information is verbal phrases, such as 'big' 'small' 'very' or 'few', instead of numeric values.

*Fuzzy logic is conceptually easy to understand and is more intuitive approach. The mathematical concepts behind fuzzy reasoning are very simple.

* Fuzzy logic is flexible.

* Fuzzy logic can model nonlinear functions of arbitrary complexity.

* Fuzzy logic can be built on top of the experience of experts.

After lung cancer, breast cancer is the most frequent type of cancer all over the world. So in this paper, more ideas are given for breast cancer.

BREAST CANCER

Breast cancer is the type that appears firstly in the breast cells. According to the recent researches, occurring one in every eight women will have the breast cancer eventually. Although, males also get caught to breast cancer which are indeed very rare cases. Specifically, women cases are 100 times more than male cases .Since 1970's it has recorded a mass increment in breast cancer cases and modern western life-style is considered as the reason for this increase.

A healthy diet &exercise routine can reduce the chance for breast cancer by nearly 40%.Whendiagnosedearly, breast cancer has a 98% survival rate. Nearly85% of women diagnosed with breast cancer do not have a family history. Over 2Million women in the US those who are following modern life styles have been diagnosed and treated for breast cancer.

Symptoms Of Breast Cancer

Early breast cancer usually doesn't cause symptoms. But as the tumor grows, it can change how the breast looks or feels.

- A lump or thickening in or near the breast or inthe under arm area
- A change in the size or shape of the breast
- Dimpling or puckering in the skin of the breast
- A nipple turned inward into the breast
- Discharge (fluid) from the nipple, especially if it's bloody
- Scaly, red, or swollen skin on the breast or nipple
- The skin may have pitting so that it looks like an orange

These symptoms do not automatically indicate breast cancer. But, if one has any of these conditions, he should tell his health care provider so that the problems can be diagnosed and treated.

For women under 50-years old:

- Employ annual clinical breast examinations and monthly breast self-examinations as a primary early detection protocol.
- Every year, without fail, schedule an appointment with healthcare provider to perform a clinical breast examination
- Every month, without fail, set aside 15 minutes to conduct thorough breast self-examination. It will be better on the first day of menstruation.
- Schedule a mammogram if a lump is suspected .It is better to schedule that within the first 14 days of menstrual cycle.
- In addition, to employ annual thermo graphy screening between the ages of 30 and 50.
- Between the ages of 20 and 30, consider a thermo gram every two years in addition to monthly breast self-examinations.

For women over 50-years old:

- Employ annual clinical breast examinations and monthly breast self-examinations as a primary early detection protocol.
- Every year, without fail, schedule an appointment with healthcare provider to perform a clinical breast examination.
- Every month, without fail, set aside 15 minutes to conduct a thorough breast self-examination.
- Schedule a mammogram if a lump is suspected
- If a positive result comes back from the thermo gram, employ mammogram at the earliest.

CANCER of the breast is a major health burden worldwide. Despite the billions of dollars spent on breast cancer research, incidence rates have been climbing steadily in industrialized countries since the 1940s . Female breast cancer represents one in ten of all new cancers

diagnosed and almost one in four cancers diagnosed in women worldwide. Every year, more than 1.1 million women are diagnosed with breast cancer and the numbers of women being diagnosed annually worldwide has almost doubled since 1975 . Cancer management using consequent screening programs, which allow early detection and timely, optimal and varied methods of treatment, is a widely used and successful way of attempting to reduce morbidity and mortality . Recently, soft-computing techniques such as Fuzzy logic and Neural Networks techniques have been applied successfully to different applications for decision support systems. These techniques have many features that make them a particularly appealing and promising approach. Accurate and reliable decision making in oncological prognosis can help in the planning of suitable surgery and therapy.

Fuzzy k-nearest neighbor (FK-NN) Classifier

Fuzzy k-nearest neighbor (FK-NN) classifier as a fuzzy logic method that provides a certainty degree for prognostic decision and assessment of the markers, and to compare it with: 1) logistic regression as a statistical method and 2) multilayer feed forward back propagation neural networks an artificial neural-network tool. The two techniques having been widely used for oncological prognosis. In order to achieve this aim, breast and prostate cancer data sets are considered as benchmarks for this analysis. The overall results obtained indicate that the FK-NN-based method yields the highest predictive accuracy, and that it has produced a more reliable prognostic marker model than both the statistical and artificial neural-network-based methods**.**

Fine Needle Aspirate (FNA)

Across the globe, breast cancer is one of the leading causes of death among women and, currently, Fine Needle Aspirate (FNA) with visual interpretation is the easiest and fastest biopsy technique for the diagnosis of this deadly disease. Unfortunately, the ability of this method to diagnose cancer correctly when the disease is present varies greatly, from 65% to 98%. This article introduces a method to assist in the diagnosis and second opinion of breast cancer from the analysis of descriptors extracted from smears of breast mass obtained by FNA, with the use of computational intelligence resources - in this case, fuzzy logic.

For data acquisition of FNA, the Wisconsin Diagnostic Breast Cancer Data (WDBC), from the University of California at Irvine (UCI) Machine Learning Repository, available on the internet through the UCI domain used.

1.1.1.1 PDM-FNA-Fuzzy

Pre-Diagnosis Module FNA-Fuzzy performs the analysis of extracted descriptors of smears from breast mass obtained by FNA, considering the parameters that indicate malignant and benign diagnosis. The fuzzy rules are applied for the analysis.

The PDM-FNA-Fuzzy developed in four steps: 1) Fuzzification Stage; 2) Rules Base; 3) Inference Stage; and 4) Defuzzification Stage. The final validation was held by a pathological specialist.

CONCLUSION

The Fuzzy Method developed provides pre-diagnosis of breast cancer with 98.59% sensitivity (correct pre-diagnosis of malignancies); and 85.43% specificity (correct pre-diagnosis of benign cases). Due to the high sensitivity presented, these results are considered satisfactory, by the opinion of medical specialists by comparison with other studies involving breast cancer diagnosis using FNA. The fuzzy logic provides the quickest solution to the problem and prevents time loss than other methods. As a result of the implementation of fuzzy system has become successful in between the rates of 80 to 85%. Fuzzy logic system which is used in this study, gets more accurate results than similar mathematical models. With this study, it can be made risk analysis for cancer which is threatening the future of humanity. Medical oncologists diagnose breast cancer based on past professional experience and knowledge. Computer-based fuzzy logic techniques are becoming powerful enough to emulate an expert's choice. Without any analysis or expert advice, a person can calculate the risk status of any of the three cancer types conveniently with the help of FK-NN software in any computer.

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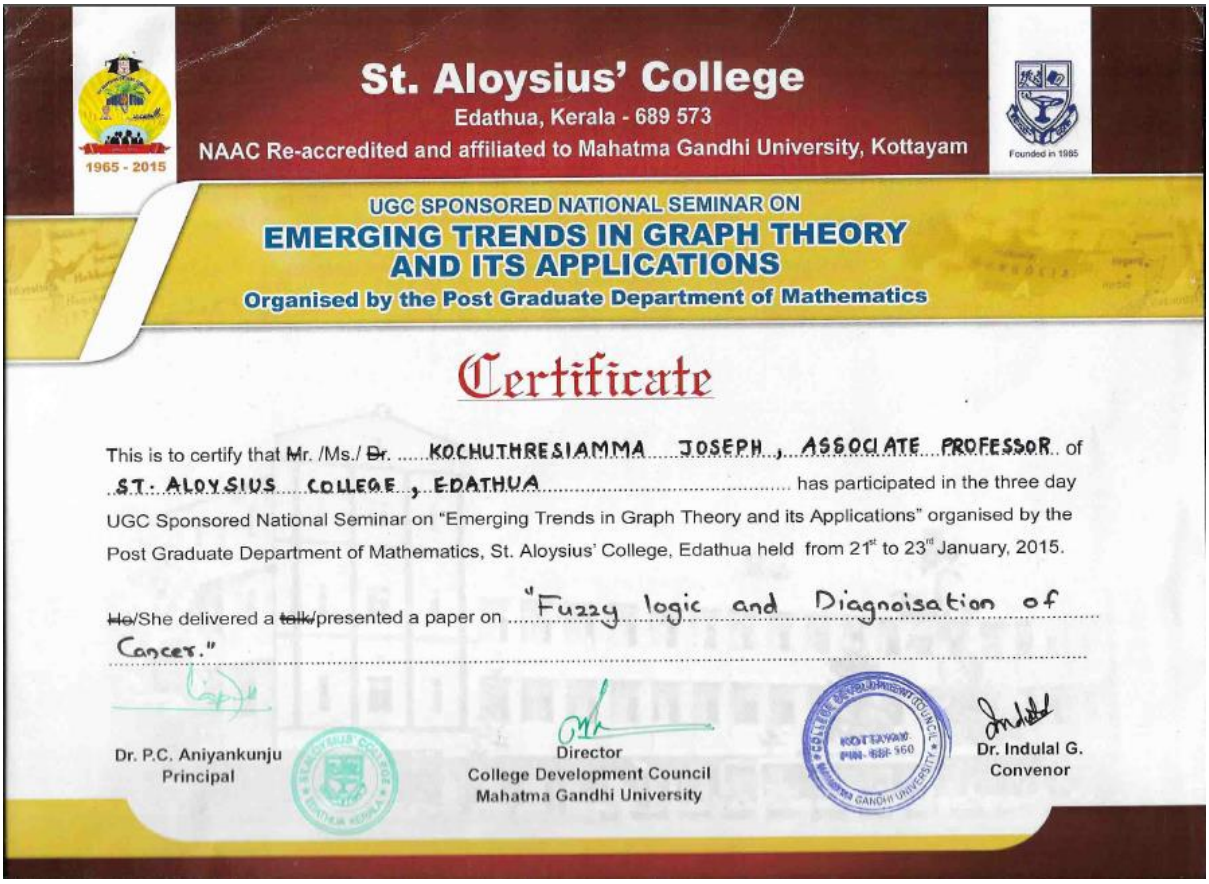

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~~He~~/She delivered a ~~talk~~/presented a paper on "Fuzzy logic and Diagnoisation of Cancer."

Dr. P.C. Aniyankunju
Principal

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College Development Council
Mahatma Gandhi University

Dr. Indulal G.
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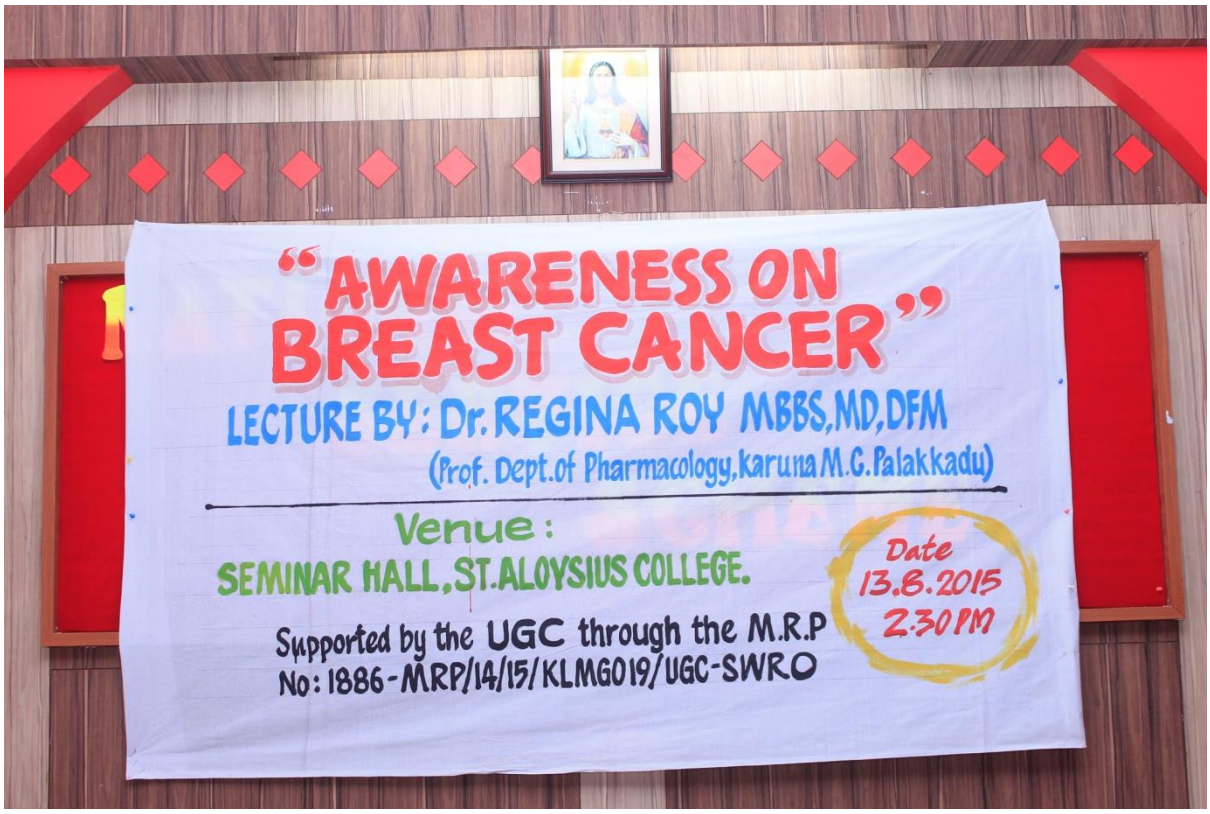

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Fr. Bobby Alex Mannamplackal
Chief Editor, Deepika

Dr. Kurian John Melamparambil
Founder Director, Melam Foundation

Fr. Alex Praikalam CMI
Director, Sargakshetra

We underline the fact that, even today doctors are diagnosing the disease with the help of BI-RADS Score. The following depicts an example of the same.

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Fax: 0091 (0) 484 280 2020

Department Of Pathology

Printed Date:29/05/2018 09:40:26

Surgical Pathology Report

Patient Name: XXXXXXXXX
Date of birth: 16/02/1976
MRD#: 1969255
Sex: Female
Service : Histopath-Breast - Trucut biopsy
Department : Radiology
Ref By : Dr Janaki
Date of sample collection : 23/05/2018
Received on : 24/05/2018
Reported Date : 24/05/2018
Histology Lab No : S18-7324

Clinical Impression :
RB Mass
BIRADS 4 C

Gross Description :
Received in formalin is a specimen labelled as "USG Guided breast biopsy", consists of 5 linear core and smaller fragment longest measuring 1.3x0.1x0.1cm, Smallest measuring 0.6x0.1x0.1cm. Entire specimen submitted in one cassette.

(Dr Hareesh/VS/ba)

Microscopic Description :
USG Guided breast biopsy:- Cores shows an infiltrative neoplasm composed of cells arranged in lobules, trabeculae and in syncitial pattern. The neoplastic cells are polygonal with increased nucleocytoplasmic ratio and pleomorphic nuclei with inconspicous nucleoli, intermixed with dense lymphoplasmacytic infiltrate . 10-12 mitosis noted / 10hpf. No lymphovascular emboli, perineural invasion or ductal carcinoma in situ seen.

Immunohistochemistry Panel-
ER - Negative
PgR - Negative
Her2 - Negative
Ki 67 Index - 90%

Impression :
USG Guided breast biopsy:-
- Invasive ductal carcinoma, NST grade II

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