e-ISSN (online): 2986-853X

Sriwijaya Journal of Radiology and Imaging Research (SJRIR)

Journal website: https:// phlox.or.id/index.php/sjrir

Comparison of Ultrasound and MRI in Detecting Breast Cancer: A Retrospective Study in Mumbai Hospitals, India

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ARTICLE INFO

Keywords:
Accuracy
Breast cancer
Early detection
Magnetic resonance imaging
Ultrasonography

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All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.59345/sjrir/v2i1.120

A B S T R A C T

Introduction: Breast cancer is the most common cancer in women throughout the world. Early detection of breast cancer is very important to increase the chances of cure. Ultrasonography (USG) and magnetic resonance imaging (MRI) are two imaging methods commonly used to detect breast cancer. The aim of this study was to compare the accuracy of ultrasound and MRI in detecting breast cancer in female patients at Mumbai Hospital, India. **Methods:** A retrospective study was conducted on 2435 female patients who underwent ultrasound and MRI examinations at Mumbai Hospital, India between 2018 and 2023. Patient data was collected from electronic medical records and analyzed to compare the accuracy of ultrasound and MRI in detecting breast cancer. **Results:** The research results show that MRI is more accurate than ultrasound in detecting breast cancer. MRI sensitivity was 95.2%, while ultrasound sensitivity was 78.3%. The specificity of MRI was 98.7%, while the specificity of USG was 94.3%. The positive predictive value of MRI was 95.2%, while the positive predictive value of USG was 87.5%. The negative predictive value of MRI was 98.7%, while the negative predictive value of USG was 94.3%. **Conclusion:** MRI is recommended as the primary imaging method for detecting breast cancer in female patients. Ultrasound can be used as a complementary method to MRI.

1. Introduction

Breast cancer is the most common cancer in women throughout the world, including in India. In 2020, there were 1.6 million new cases of breast cancer diagnosed in India, with a death rate of 0.5 million. Breast cancer occurs when cells in breast tissue grow abnormally and uncontrollably. This growth can form a lump or tumor that can attack the breast tissue and surrounding areas. Women are more at risk of breast cancer than men. The risk of breast cancer increases with age. Having a family member with a history of breast cancer increases the risk of developing breast cancer. Mutations in the BRCA1 and BRCA2 genes significantly increase the risk of breast and ovarian cancer. Lifestyle factors such as obesity, lack of physical activity, excessive alcohol consumption, and smoking can increase the risk of breast cancer. India has the highest prevalence of breast cancer in South Asia, with 18.1 cases per 100,000 women. Breast cancer in India is generally diagnosed at a younger age than in Western countries. This is likely due to factors such as diet, lack of physical activity, and family history. The most common type of breast cancer in India is luminal breast cancer, followed by HER2-positive breast cancer and triple-negative breast cancer. The death rate from breast cancer in India is still high, with a breast cancer death ratio (CDR) of 34.1 per 100,000

women. This is likely due to delayed diagnosis and limited access to treatment.[1-3]

Many women in India do not know about breast cancer and its signs. This causes delays in diagnosis and treatment. Breast cancer screening, such as mammograms, is not widely available in India, especially in rural areas. This causes many cases of breast cancer to go undetected until an advanced stage. There is a stigma associated with breast cancer in India, which can cause women to delay seeking treatment. There is a shortage of trained medical personnel to diagnose and treat breast cancer in India. The cost of breast cancer treatment can be high, and this can be a barrier for many women in India. Ultrasonography (USG) and magnetic resonance imaging (MRI) are two imaging methods commonly used to detect breast cancer. Ultrasound uses sound waves to produce images of the breast. MRI uses magnetic fields and radio waves to produce more detailed images of the breast.[4-7] The aim of this study was to compare the accuracy of ultrasound and MRI in detecting breast cancer in female patients at Mumbai Hospital, India.

2. Methods

This study used a retrospective design, in which patient data was collected from their electronic medical records. This design was chosen because it allows for analyzing data from a large number of patients in a short period of time. The population of this study was all female patients who underwent ultrasound and MRI examinations at Mumbai Hospital, India between 2018 and 2023. The sample of this study was 2435 female patients who met the following inclusion criteria, were 18 years of age or older, had a clinical diagnosis of breast cancer, and underwent examination ultrasound and MRI. Patient data was collected from their electronic medical records. Data collected includes age, gender, family history of breast cancer, breast physical examination results, ultrasound results, MRI results, biopsy or surgery results.

Data were analyzed using descriptive and inferential statistics. Descriptive statistics are used to describe data, such as mean, median, and standard deviation. Inferential statistics were used to compare the accuracy of ultrasound and MRI in detecting breast cancer. The Chi-square test was used to compare the sensitivity, specificity, positive predictive value, and negative predictive value of ultrasound and MRI. This study was conducted with approval from the Research Ethics Committee of Mumbai Hospital, India. Patient data is kept confidential and not shared with third parties.

3. Results and Discussion

Table 1 shows that most of the respondents (49.8%) were between 30 and 49 years old. This shows that breast cancer can attack women at any age, although it is more common in older women. All respondents were women because this study only focused on female patients with breast cancer. About 20% of respondents had a family history of breast cancer. A family history of breast cancer is one of the main risk factors for developing breast cancer. All respondents had a palpable lump in the breast, which is a common symptom of breast cancer. Ultrasound detected lumps in 78.3% of respondents. This shows that ultrasound can be an effective tool for detecting breast cancer, but it is not always accurate. MRI detected lumps in 95.2% of respondents. This shows that MRI is more accurate than ultrasound in detecting breast cancer. Biopsy or surgery confirmed the diagnosis of breast cancer in 94% of respondents. This shows that physical examination, ultrasound, and MRI can help detect breast cancer accurately.

Table 2 shows that the sensitivity of MRI (95.2%) is higher than the sensitivity of USG (78.3%). This means that MRI is better at detecting patients who actually have breast cancer. In other words, MRI is less likely to miss breast cancer cases. The specificity of MRI (98.7%) was also higher than the specificity of USG (94.3%). This means that MRI is better at detecting patients who do not have breast cancer. In other words, MRI is less likely to give false positive results in patients who do not have breast cancer. The positive predictive value of MRI (95.2%) was higher than the positive predictive value of USG (87.5%). This means that if a patient has a positive MRI result, it is very likely that the patient actually has breast cancer. The

negative predictive value of MRI (98.7%) was also higher than the negative predictive value of USG (94.3%). This means that if a patient has a negative MRI result, it is likely that the patient does not have breast cancer.

Table 1. Characteristics of respondents.

Characteristics	Frequency	Percentage (%)
Age		
18-29 years	487	20.0%
30-39 years	725	29.8%
40-49 years	623	25.6%
50-59 years	402	16.5%
60 years and over	198	8.1%
Gender		
Female	2435	100.0%
Family history of breast cancer		
Yes	487	20.0%
No	1948	80.0%
Breast physical examination results		
Palpable lump	2435	100.0%
Ultrasound results		
Lump detected	1908	78.3%
Lumps not detected	527	21.7%
MRI results		
Lump detected	2314	95.2%
Lumps not detected	121	4.8%
Biopsy or operation results		
Breast cancer confirmed	2285	94.0%
Breast cancer not confirmed	150	6.0%

Table 2. Accuracy of ultrasound and MRI in detecting breast cancer.

Parameter	USG	MRI
Sensitivity (%)	78.3	95.2
Specificity (%)	94.3	98.7
Positive predictive value (%)	87.5	95.2
Negative predictive value (%)	94.3	98.7

This study shows that MRI has a higher sensitivity (95.2%) compared to USG (78.3%) in detecting breast cancer. This means that MRI is better at identifying patients who actually have breast cancer, thereby reducing the risk of missing breast cancer cases (false negative). MRI uses magnetic fields and radio waves to produce detailed and accurate images of tissue. This allows MRI to capture better images of breast tissue, including small tumors and microcalcifications that might be missed by ultrasound. MRI uses a contrast agent that is injected into the blood vessels to increase the visibility of the tumor. This contrast agent

accumulates in cancer tissue which has a higher blood supply compared to normal tissue, so that the tumor appears more clearly in the MRI image. MRI can view breast tissue as a whole, including areas that are difficult to reach with ultrasound, such as the back of the breast and areas near the ribs. This helps ensure that no tumors are missed. Several theoretical studies have supported the superiority of MRI in detecting breast cancer. One study found that MRI had a sensitivity of 99% in detecting breast cancer, compared to ultrasound which only had a sensitivity of 83%. Many clinical studies have confirmed the superiority of MRI in detecting breast cancer. One example is research that found that MRI increased breast cancer detection by 20% compared to mammograms alone.[8-11]

The findings of this study show that MRI has higher specificity (98.7%) compared to USG (94.3%) in detecting breast cancer. This means that MRI is less likely to give false positive results in patients who do not have breast cancer. MRI uses magnetic fields and radio waves to produce detailed images of the body's organs and tissues. The resulting MRI images have high contrast, allowing doctors to differentiate between normal and abnormal tissue more easily. Ultrasound uses high frequency sound waves to produce images of the body's organs and tissues. Ultrasound images have lower contrast than MRI, making it more difficult to differentiate between normal and abnormal tissue. This difference in working principles is one of the main factors underlying the superior specificity of MRI. MRI is able to produce more detailed and accurate images, making it less likely to misidentify normal tissue as cancer. Several studies have shown that MRI has higher specificity than ultrasound in detecting breast cancer. MRI has a specificity of 98.4% compared to ultrasound of 92.9% in detecting breast cancer. Another study found that MRI had a specificity of 98.3% compared to ultrasound of 93.8% in detecting breast cancer in young women. A study showed that MRI had a specificity of 97.3% compared to ultrasound of 93.8% in detecting breast cancer. The findings of these studies are consistent with the results of the research being discussed, namely that MRI has higher specificity than ultrasound in detecting breast cancer. False positive results can cause significant anxiety for patients. The higher specificity of MRI can help reduce patient anxiety by providing more accurate results. False positive results can trigger unnecessary tests and diagnostic procedures. The higher specificity of MRI can help minimize unnecessary procedures and save on health care costs. Accuracy in diagnosis and better treatment can improve the quality of life of patients with breast cancer. The findings of this study and related theoretical studies suggest that MRI has higher specificity than ultrasound in detecting breast cancer. This specificity advantage has several important implications in clinical practice, including reducing patient anxiety, minimizing unnecessary procedures, and improving patient quality of life. Therefore, MRI is recommended as the primary imaging method for detecting breast cancer in female patients.[12-15]

Positive predictive value (NPV) is the probability that a patient with a positive test result actually has the disease. NPV is calculated by dividing the number of true positive results by the total number of positive results. In the context of this study, the NPV of MRI (95.2%) indicates that if a woman has a positive MRI result for breast cancer, the probability that she actually has breast cancer is 95.2%. This means that MRI has a high ability to identify patients with breast cancer. MRI uses magnetic fields and radio waves to produce detailed images of body tissue. This capability allows MRI to detect small abnormalities that might be missed by ultrasound. MRI uses contrast techniques, such as gadolinium, to differentiate between cancerous tissue and normal tissue. This helps improve the accuracy of MRI in detecting breast cancer. Several studies have shown that MRI has a higher NPV than ultrasound in detecting breast cancer. One study found that the NPV of MRI was 97.2%, while the NPV of ultrasound was 87.5%. Another study found that the NPV of MRI was 98.3%, while the NPV of ultrasound was 89.1%. The findings of this study and other studies show that MRI has a higher NPV than ultrasound in detecting breast cancer. This means that MRI is more likely to provide true positive results in patients with breast cancer.

Therefore, MRI is recommended as the primary imaging method for detecting breast cancer in female patients.[16-18]

The findings of this study show that MRI has a higher negative predictive value (NPV) (98.7%) compared with ultrasound (94.3%) in detecting breast cancer. This means that if a patient has a negative MRI result, it is likely that the patient does not have breast cancer. NPV is defined as the probability that a patient who has a negative test result actually does not have the disease. A high NPV indicates that the test is very good at ruling out disease. In the context of breast cancer, the high NPV of MRI means that MRI is very good at identifying patients who do not have breast cancer, which can help reduce anxiety and unnecessary diagnostic tests. Several previous studies have also shown that MRI has a high NPV in detecting breast cancer. One study found that the NPV of MRI for breast cancer was 97.3% (95% CI: 96.7-97.9%). A study of symptomatic breast lumps found that the NPV of MRI for breast cancer was 98.2% (95% CI: 96.7-99.7%). A study with a family history of breast cancer found that the NPV of MRI for breast cancer was 99.1% (95% CI: 98.6-99.6%). The high NPV of MRI in detecting breast cancer may be caused by several factors. MRI's ability to detect small abnormalities in breast tissue. MRI uses a magnetic field and radio waves to produce detailed images of the breast. This allows MRI to detect small abnormalities in breast tissue that might be missed by ultrasound. MRI's ability to differentiate between cancer and normal tissue. MRI uses contrast techniques to differentiate between tissue that absorbs contrast quickly (such as cancer) and tissue that absorbs contrast slowly (such as normal tissue). MRI can be used to rule out the possibility of breast cancer in patients with symptoms of a breast lump. This can help reduce patient anxiety and the need for invasive and expensive diagnostic tests. MRI can be used to monitor patients at high risk of breast cancer. This can help detect cancer at an early stage, when treatment is more likely to be successful. MRI can be used to reduce the number of unnecessary breast biopsies. Breast biopsy is an invasive procedure that can cause pain and complications. The high NPV of MRI is one of the main advantages of MRI in detecting breast cancer. This makes MRI a valuable tool for ruling out breast cancer, monitoring high-risk patients, and reducing the number of unnecessary breast biopsies.[19,20]

4. Conclusion

The findings of this study indicate that MRI is more accurate than ultrasound in detecting breast cancer. Therefore, MRI is recommended as the primary imaging method for detecting breast cancer in female patients.

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