ORIGINAL RESEARCH PAPER
Volume - 11 | Issue - 04 | April - 2022 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

STUDY OF MRI BREAST WITH SPECIAL REFERENCE TO DIAGNOSTIC ACCURACY AND ASSESSMENT OF MULTIFOCALITY OF CARCINOMA BREAST

Radio-diagnosis

Dr. Jyoti Priyadarshini M.B.B.S, M.D. (Radio-diagnosis), Senior Resident, Department of Radio-diagnosis, Darbhanga Medical College and Hospital, Laheriasarai, Bihar.

Dr. Sanjay Kumar Jha* M.B.B.S, M.D. (Radio-diagnosis), Associate Professor and Head of Department, Department of Radio-diagnosis, Darbhanga Medical College and Hospital, Laheriasarai, Bihar. *Corresponding Author

ABSTRACT

Background: The presence and detection of multifocal and multicentric disease significantly increases the risk of recurrence and changes the best therapeutic approach in patients with breast cancer. Mammography has low sensitivity to detect multiple malignant foci in patients with dense breast parenchyma. We prospectively evaluated Magnetic Resonance Imaging (MRI) as part of preoperative assessment.

Material And Methods: Women with clinical and radiological suspicion of breast cancer and dense breast parenchyma (> 75% dense tissue) were included. All patients underwent mammography, ultrasonogram and MRI prior to surgery. Surgical specimens were used for the detection of multifocal and multicentric disease. Patients who required neoadjuvant chemotherapy or radiotherapy were excluded.

Results: Nineteen patients were evaluated. Histological diagnosis was confirmed in 14 patients, multifocal and multicentric disease was found in five and two patients, respectively. Sensitivity and accuracy to detect multiple malignant foci were 42 and 64%, respectively, for mammography plus ultrasound and 100 and 92% for MRI ($p < 0.05$).

Conclusions: MRI is more sensible and has a better accuracy than mammography plus ultrasound to detect both multicentric and multifocal breast cancer in women with dense breast parenchyma. MRI can improve preoperative assessment of breast cancer in this group of patients.

KEYWORDS

Breast cancer, Dense mammary parenchyma, Magnetic resonance, Mastography, Ultrasonogram, Preoperative stage, Multifocality, Multicentricity.

INTRODUCTION

Breast cancer arises in the lining cells (epithelium) of the ducts (85%) or lobules (15%) in the glandular tissue of the breast. Initially, the cancerous growth is confined to the duct or lobule ("in situ") where it generally causes no symptoms and has minimal potential for spread (metastasis).

Over time, these in situ (stage 0) cancers may progress and invade the surrounding breast tissue (invasive breast cancer) then spread to the nearby lymph nodes (regional metastasis) or to other organs in the body (distant metastasis). If a woman dies from breast cancer, it is because of widespread metastasis.

Breast cancer treatment can be highly effective, especially when the disease is identified early. Treatment of breast cancer often consists of a combination of surgical removal, radiation therapy and medication (hormonal therapy, chemotherapy and/or targeted biological therapy) to treat the microscopic cancer that has spread from the breast tumor through the blood. Such treatment, which can prevent cancer growth and spread, thereby saves lives.

In 2020, there were 2.3 million women diagnosed with breast cancer and 685000 deaths globally. As of the end of 2020, there were 7.8 million women alive who were diagnosed with breast cancer in the past 5 years, making it the world's most prevalent cancer. There are more lost disability-adjusted life years (DALYs) by women to breast cancer globally than any other type of cancer. Breast cancer occurs in every country of the world in women at any age after puberty but with increasing rates in later life.[1]

Breast cancer mortality changed little from the 1930s through to the 1970s. Improvements in survival began in the 1980s in countries with early detection programmes combined with different modes of treatment to eradicate invasive disease.

Surveillance by both mammography and clinical breast examination have resulted in an early diagnosis of breast cancer and an increase in conservative surgical approaches.

Multiple malignant foci in the breast occur with a frequency between 14 and 47%. Excluding the presence of multifocal (one quadrant) or multicentric (two or more quadrants) disease is important to decide the best therapeutic approach. Distance between malignant foci can also be used to define multifocality (< 5 cm) or multicentricity (> 5 cm).[3]

Relapses after conservative surgery are frequent due to undetected malignant foci.[4,5] Moreover, multiple tumors in breast cancer are associated to increased nodal involvement as compared with similar staged unifocal disease. In addition, the sum of the dimensions of multifocal tumors can reclassify these patients as having an advanced stage.[6]

Screening mammography remains as the most important tool to reduce breast cancer mortality. Mammography can often detect clinically occult, early-stage breast cancer that is amenable to successful treatment. However, mammography is not a perfect test and has lower sensitivity in patients with dense breasts.7,8 Additionally, a high percentage of dense tissue is associated with an increased risk of breast cancer and multiple malignant foci.[9]

Factors associated with an increased percentage of density (which represents the amount of breast parenchyma in mammography) are nuliparity in both premenopausal and postmenopausal women, late age at first pregnancy, younger age, low body mass index and the use of hormone replacement therapy.[10]

Magnetic resonance imaging (MRI) has been shown to depict breast cancers that are occult to other forms of detection, including mammography.[11]

Because of its ability to image dense breasts, MRI has a high potential for screening high-risk cases such as BRCA-positive patients.[10-12] Added to standard imaging methods in cases of highly suspicious findings, breast MRI has shown to result in a change of treatment in many cases due to the assessment of further lesions in the contralateral breast or the assessment of multicentricity and multifocality.[11-13]

In a diagnostic setting, MRI is virtually uninfluenced by breast density, but the specificity is variable and it can be associated with false-positive findings that require unnecessary biopsies and follow-up examinations that are extensive and costly.[14] We conducted a prospective study to evaluate the utility of MRI for the detection of multifocal or multicentric disease in women with extremely dense breast parenchyma with clinical and radiological suspicion of cancer.

MATERIAL AND METHODS

This a prospective study was conducted at Department of Radio-diagnosis, Darbhanga Medical College and Hospital, Laheriasarai, Bihar from October 2021 March 2022, of patients with percutaneously proven unilateral breast cancer and dense breast parenchyma to evaluate multifocal and multicentric disease by magnetic resonance imaging.

All patients met the following criteria: tumor evidence by physical

examination, mammography and/or ultrasonogram suggestive of cancer; mammography with extremely dense breast parenchyma according to the American College of Radiology Breast Imaging Reporting and Data System (BIRADS) 4 (>75% of dense tissue);15 being considered for surgical treatment, and having a breast MRI before undergoing tru-cut percutaneous biopsy performed by the same doctor, with subsequent pathologic follow-ups available. Both USG and MRI were performed by the same team of radiologists (S.O.M, Y.V.N and T.F.C.). A total of 19 patients were studied. Five patients were excluded due to lack of malignancy in the surgical specimen or candidacy to neoadyuvant chemotherapy due to evidence of locally advanced disease (tumors > 5 cm, lymph node involvement by physical examination, skin infiltration and inflammatory tumors, as well as candidates to surgery who needed neoadyuvant chemotherapy to reduce the size of the tumor).

Statistical Analysis

For descriptive purposes, continuous variables were summarized as arithmetic means, medians and standard deviations (error) and categorical variables as proportions with 95% confidence intervals.

Sensitivity, specificity, positive and negative predictive values, as well as accuracy and 95% confidence intervals for the detection of multifocality or multicentricity by mammogram/ultrasound and MRI was determined by the Epidat 3.0 software.

Comparisons between clinical and radiological variables with the presence of multifocality or multicentricity in the histopathological report were performed using Fisher's exact test. Statistical significance was determined as $p < 0.05$ with a two tailored test. SPSS software package version 10 (SPSS Inc., Chicago, IL) was employed to analyze the data.

RESULTS

A total of 19 patients with clinical suspicion of breast cancer were initially included in our study.

Five patients were excluded due to absence of malignancy (BIRADS 2 by MRI) or the requirement of neoadjuvant chemo or radiotherapy. Clinical and pathological characteristics are shown in table 1. Median age was 48 ± 2.9 years. Only 29% (4/14) of patients were in premenopausal state and 50% (7/14) of the patients had a positive family history of breast cancer. Median major diameters of clinically and pathologically evaluated tumors were of 2.2 and 2.5 cm, respectively. Pre-surgical evaluation showed that 28.6% of patients were in stage I, 64.4% stage II and 7.1% stage III. Multifocal disease was observed in 50%. Conservative surgery was performed in 57.1% (8/14) and radical mastectomy in 42.9% (6/14). No statistically significant differences between the clinicopathological characteristics and the presence of unifocal and multifocal/ multicentric tumors were found.

Table 1 : Clinical And Pathological Characteristics Of The Patients

Characteristics	Values	Number
Age, year (Median±SD)	48(±2.9)	14
Family history (%)	50%	7/14
Menopause (%)	71%	10/14
Site :		
UEQ	50%	7/14
UIQ	35%	5/14
IEQ	14.3%	2/14
IIQ	0	
Range (Median±SD)	2.2(±0.2)	4/14
Positive ganglia	21.4%	3/14
Stage :		
I	28.6%	4/14
II	64.3%	9/14
III	7.1%	1/14
Treatment :		
Mastectomy	42.9%	6/14
Quadrantectomy	57.1%	8/14
Range of Pathology	2.5(±0.23)	14
Histologic Type :		
Ductal	85.7%	12/14
Lobular	14.3%	2/14
Tumor grade :		
I	21.4%	3/14
II	35.7%	5/14
III	42.9%	6/14
Estrogen receptor :		
Negative	50%	7/14
Positive	50%	7/14
Progesterone receptor :		
Negative	50%	7/14
Positive	50%	7/14
Multifocality	37.5%	5/14
Multicentricity	14.3%	2/14

UEQ: Upper External Quadrant. UIQ: Upper Internal Quadrant. IEQ: Inferior External Quadrant. IIQ: Inferior Internal Quadrant. SD: Standard Deviation.

Table 2. Detected Foci Of Multifocal And Multicentric Breast Cancer By Mammography/ultrasound And RMI. Pathologic Analysis Of Biopsy Was Used To Confirm Diagnosis.

Multicentric and/or multifocal				
		Present	**Absent**	**Total**
Mamography/ US	Positive	3	1	4
	Negative	4	6	10
	Total	7	7	14
MRI	Positive	7	1	8
	Negative	0	6	6
	Total	7	7	14

Mammography and ultrasound missed a total of 11 malignant foci compared with a total of one malignant foci missed on MRI (Table 2). This foci was a ductal carcinoma for which the mastographic image darkened with the rest of the parenchyma and in the ultrasonographic image it lost its intrinsic vascularity and more than 20% of its margins with the rest of the parenchyma. Median diameters of missed malignant foci were 25 to 50 mm (Table 3), assessed by MRI. No second look ultrasonography was made for any of the lesions.

Table 3 : Mastographic And Ultrasonographic Characteristics

Characteristic	Percentage	N
Mammography		
• Asymmetry	100%	14/14
• Undetermined margins	78.6%	11/14
• Architectural distortion	71.4%	10/14
• Suspicious calcifications	64.3%	9/14
• Thickening of the skin or adjacent tissue	64.3%	9/14
• Range, size of tumor (Median ± SD)	2.3(±0.18)	
• Positive ganglia	64.3%	9/14
Ultrasound		
• Undetermined margins	78.6%	11/14
• Heterogeneous	78.6%	11/14
• Vascularity	78.6%	11/14
• Thickening of the skin or adjacent tissue	71.4%	10/14
• Positive ganglia	64.3%	9/14
• Multicentricity/Multifocality	28.6%	4/14
Mammography/Ultrasound		
• BiRADS	14.3%	2/14
• BiRADS	85.7%	12/14

Contrast-enhanced MRI detected all forms of breast carcinoma consistently. Fat-suppressed three dimensional and enhancement imaging methods demonstrated previously unidentified lesions in women with mammographically dense breasts (Figures 1-3) (Table 4). The sum of diameters of all foci detected by MRI was significantly greater than that of tumors detected by mammography and ultrasound and later measured by MRI (3.5 ± 0.6 vs. 2 ± 0.21, $p < 0.05$). However, no biopsy was taken with the MR image as a guide, and no association was established between the lesions observed by MRI only and their location or histologic type; the characteristics described were merely multifocality and multicentricity (Figure 4).

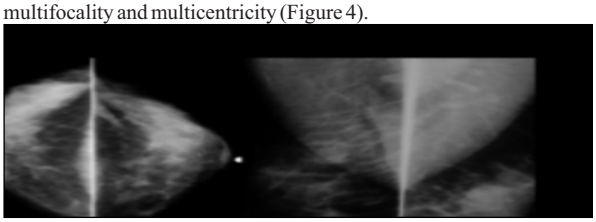

Figure 1. Mammograms Showing A Marked Increase In Density, A Focal Irregular Density On The Right Side.

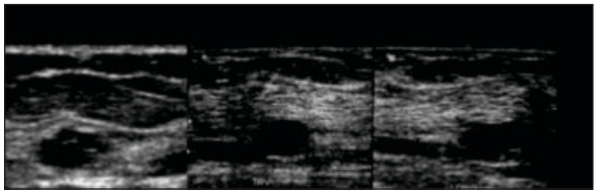

Figure 2. US Image Revealing Corresponding Hypoechoic Solid Masses, In The Upper Quadrant On The Right Breast.

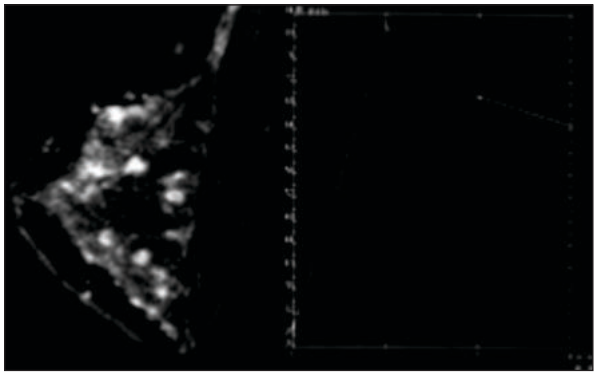

Figure 3. A. Sagital Fat-suppressed Contrast-enhanced 3D Fast SPGR MR Image (9.2/2.1) Of The Right Breast Showing Multifocal Areas Of Enhancement, Suggestive Of Carcinoma. B. Followed By A Strong Washout.

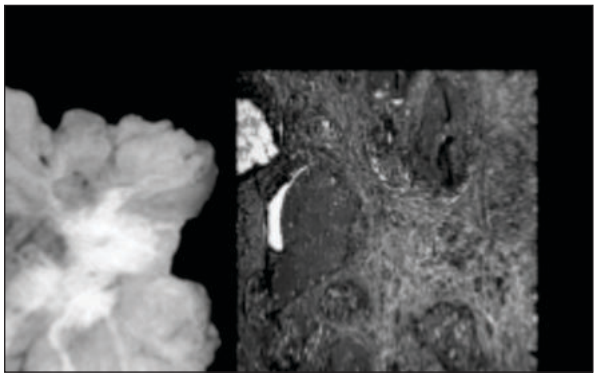

Figure 4. A. Macroscopic specimen shows multiple foci. B. Microscopic analysis of the isolated spicule showing heavy reactive fibrosis and tumor infiltration.

Table 4 : Characteristics Of The Patients In The Breast-MRI

Characteristic	MRI	N
Lesion type		
• Regular	14.3%	2/14
• Irregular	85.7%	12/14
Margins		
• Regular	21.4%	3/14
• Spiculate	35.7%	5/14
• Irregular	50%	7/14
Enhancement		
• Ring-like	7.1%	1/14
• Homogeneous	14.3%	2/14
• Heterogeneous	64.3%	9/14
• Central	14.3%	2/14
• Enhanced internal septations	64.3%	9/14
• Without enhanced internal septations	35.7%	5/14
Visual Kinetic pattern		
• Progressive	0%	0/14
• Plateau	21.4%	3/14
• Wash out	78.6%	11/14
Multicentricity/Multifocality	71.4%	10/14
Median of the greater diameter of the tumor size of the malignant foci (unifocal) identified in Mammography/Ultrasound	2±0.21	14
Median of the diameter of all malignant foci	3.5±0.6	14

Table 5 summarizes the diagnostic estimates for multifocal/multicentric tumors of both tests performed showing that MRI has greater sensitivity and better accuracy than mammography/ultrasound (100 vs. 42.9% $p < 0.05$ and 92.8 vs. 64.3% $p < 0.05$, respectively). Specificity was similar (85.7 vs. 85.7%, NS) between both tests.

Table 5. Characteristics Of Mastography/ Ultrasound And MRI For Multifocal And Multicentric Lesions

Characteristics	Mammography/ US (CI 95%)	MRI (CI 95%)	P
Sensitivity	42.9(35.5-50.2)	100.0(92.9-100.0)	<0.05
Specificity	85.7(78.4-93.01)	85.7(78.4-93.0)	NS
Positive predictive value	75.0(62.2-87.7)	87.5(81.1-93.9)	NS
Negative predictive value	60.0(54.8-65.18)	100.0(91.6-100.0)	<0.05
Accuracy	64.3(60.6-68.0)	92.8(89.2-96.5)	<0.05

DISCUSSION

MRI is a relatively recent diagnostic tool for breast cancer. Its role in the management of this pathology is still evolving. We conducted a prospective study comparing MRI vs. mammography and ultrasound for the detection of multifocal and multicentric disease, including only women with dense breast parenchyma, with clinical and radiological suspicion of cancer. Multifocal disease was suggested in three out of seven cases on mammography and ultrasound, with only one false-positive examination. MRI is known to detect multifocal and multicentric lesions that are occult on mammography.[19] Our results concur with those previously reported but the specificity that we found is higher for ultrasonography and mastography, in addition, there are no significant differences between the two maybe due to the fact that we studied patients with clinical and radiological suspicion of disease. Sardanelli reported a sensitivity of 66% for mammography and 81% for MRI to detect foci of multifocal, multicentric breast cancer in dense breasts,19 whereas Van Goethem reported 20 patients with multifocal carcinoma, where mammography detected the lesions in 35%, ultrasound in 30% and MRI in 100% with a false-positive rate of 12.5, 14 and 23% respectively.[20]

Women with one area of proven breast cancer may harbor additional sites of cancer in the ipsilateral breast. Pathologic analyses of mastectomy specimens have shown sites of cancer other than the index lesion in 20-63% of tumors ≥ 2.5 cm and of these, 19-67% are invasive. Other series report that about 20-47% of mastectomy specimens show additional malignant foci in quadrants other than that of the index tumor.[19] The characterization of these lesions and an accurate staging are of great relevance to plan the therapeutic approach of breast cancer; 31 mainly with the increasing worldwide tendency for conservative surgery and neoadjuvant chemotherapy.[21] This is even more relevant in women with dense parenchyma and breast cancer, in whom mammography and ultrasound have the lowest sensitivity for detecting this pathology.[7] Saarenmaa found in a study with 557 patients that the sensitivity of mammography and ultrasound was inversely related to age and directly related with fattiness of the breast.[9] Besides, detection of multifocal and multicentric tumors in breast cancer does not only have implications when it comes to surgical planning, but also regarding the risk of recurrence and the presence of positive ganglia.[21] In 848 women, 11.1% had multifocal breast cancer, 52.1% had involvement of axillary's ganglia, whereas only 37.5% of the women with unifocal disease presented it. The sum of the dimensions of multifocal tumors, can reclassify the patients' disease into a more advanced stage.[21] We found that the greater diameter of the lesions identified by mammography and ultrasound was significantly minor than the median of multifocal tumors detected by MRI. This may deny patients the opportunity of neoadyuvant therapy if contribution of the smaller foci to the incidence of positive ganglia and survival is ignored.[22] These results show that MRI is significantly more sensitive than mammography for the detection of multiple malignant foci in scattered fibroglandular or heterogeneously and extremely dense breasts. Mammography misses more invasive and larger cancer foci than MRI.[23] The real clinical significance of malignant foci detected solely on MRI is still a matter for debate and further studies about its significance alone are required.[8] One of the limitations found in this study is that even though the surgical specimens had 5 cm margins free of disease, the breast was not evaluated in its totality. If combined with radiation therapy, breast-conserving surgery gives survival rates that are not significantly different from those obtained with mastectomy.[24,25]

Randomized studies comparing the outcome of patients undergoing

pretreatment MRI with a control group are needed to define the effects of a more precise evaluation of the extent of disease on relapse and survival rates and quality of life.[26-29] The detection of multiple malignant foci could identify patients who could benefit of a non-conservative surgical approach or neoadjuvant chemotherapy.[30]

CONCLUSION

MRI is more accurate in assessing multicentricity or multifocality in women with dense breast parenchyma, without an increase in false-positive tests.

MRI represents a better preoperative study tool in this group of patients.

REFERENCES

1. Parkin DM, Bray F, Ferlay J, Pisani P. Global cancer statistics, 2002. CA Cancer J Clin 2005, 55: 74-108, WHO 21 March 2021.
2. Veronesi U, Boyle P, Goldhirsch A, Orecchia R, Viale G. Breast cancer. Lancet 2015; 365: 1727-41.
3. Holland R, Veling SMJ, Mravunac M, Hendriks JHCL. Histologic multifocality of Tis, T1, T1-2 breast carcinomas: implication for clinical trials of breast-conserving surgery. Cancer 2005; 56: 979-90.
4. Ghossein NA, Alpert S, Barba J, Pressman P, Stacey P, Lorenz E, et al. Breast cancer. Importance of adequate surgical excision prior to radiotherapy in the local control of breast cancer in patients treated conservatively. Arch Surg 2012; 127: 411-5.
5. Osteen RT. Selection of patients for breast-conserving surgery. Cancer 2014; 74: 366-71.
6. Silverstein MJ, Skinner KA, Lomis TJ. Predicting axillary nodal positivity in 2282 patients with breast carcinoma. World J Surg 2001; 25: 767-72.
7. Mandelson MT, Oestreicher N, Porter PL, White D, Finder CA, Taplin SH, White E. Breast density as a predictor of mammographic mammographic detection: comparison of interval- and screen-detected cancers. J Natl Cancer Inst 2000; 92: 1081-7.
8. Kolb TM, Lichy J, Newhouse JH. Comparison of the performance of screening mammography, physical examination, and breast US and evaluation of factors that influence them: an analysis of 27,825 patient evaluations. Radiology 2002; 225: 165-75.
9. Saarenmaa I, Salminen T, Geiger U, Heikkinen P, Hyvarinen S, Isola J, et al. The effect of age and density of the breast on the sensitivity of breast cancer diagnostic by mammography and ultrasonography. Breast Cancer Res Treat 2001; 67: 117-23.
10. Morris EA, Liberman L, Ballon DJ, Robson M, Abramson AF, Heerdt A, Dershaw DD. MRI of Occult Breast Carcinoma in a High-Risk Population. Am J Roentgenol 2003; 181: 619-26.
11. Deurlo EE, Peterse JL, Rutgers EJ, Besnard AP, Muller SH, Gliluis KG. Additional breast lesions in patients eligible for brest-conserving therapy by MRI: impact on preoperative management and potential benefit of computarised analysis. Eur J Cancer 2005; 41: 1393-401.
12. Kriege M, Brekelmans CT, Boetes C, Besnard PE, Zonderland HM, Obdeijn IM, et al. Efficacy of MRI and mammography for breast-cancer screening in women with a familial or genetic predisposition. N Engl J Med 2004; 351: 427-37.
13. Wiener JI, Schilling KJ, Adami C, Obuchowski NA. Assessment of suspected breast cancer by MRI: a prospective clinical trial using a kinetic and morphologic analysis. Am J Roentgenol 2005; 184: 878-86.
14. Hylton N. Magnetic resonance imaging of the breast: opportunities to improve breast cancer management. J Clin Oncol 2005; 23: 1678-84.
15. Liberman L, Menell JH. Breast Imaging Reporting and Date System (BI-RADS). Radiol Clin North Am 2002; 40: 409-30.
16. Amat S, Penault-Llorca F, Cure H, Le Boudec G, Achard JL, Van Praagh I, et al. Scarff-Bloom-Richardson (SBR) grading: a pleiotropic marker of chemosensitivity in invasive ductal breast carcinomas treated by neoadjuvant chemotherapy. Int J Oncol 2002; 20: 791-6.
17. Fernandez-Sanchez M, Gamboa-Dominguez A, Uribe N, Garcia-Ulloa AC, Flores-Estrada D, Candelaria M, Arrieta O. Clinical and pathological predictors of the response to neoadjuvant anthracycline chemotherapy in locally advanced breast cancer. Med Oncol 2006; 23(2): 171-83.
18. Sardanelli F, Giuseppetti GM, Panizza P, Bazzocchi M, Fausto A, Simonetti G, et al. Sensitivity of MRI Versus Mammography for Detecting Foci of Multifocal, Multicentric Breast Cancer in Fatty and Dense Breasts Using the Whole-Breast Pathologic Examination as a Gold Standard. Am J Roentgenol 2004; 183: 1149-57.
19. Van Goethem M, Schelfout K, Dijckmans L, Van Der Auwera JC, Weyler J, Verslegers I, et al. MR mammography in the preoperative staging of breast cancer in patients with dense breast tissue: comparison with mammography and ultrasound. Eur Radiol 2004; 14: 809-16.
20. Van Goethem M, Schelfout K, Dijckmans L, Van Der Auwera JC, Weyler J, Verslegers I, et al. MR mammography in the preoperative staging of breast cancer in patients with dense breast tissue: comparison with mammography and ultrasound. Eur Radiol 2004; 14: 809-16.
21. Egan RL. Multicentric breast carcinomas: clinical-radiographic- pathologic whole organ studies and 10-year survival. Cancer 1982; 49: 1123-30.
22. Luciani A, Dao TH, Lapeyre M, Schwarzinger M, Debaecque C, Lantieri L, et al. Simultaneous Bilateral Breast and High-Resolution Axillary MRI of Patients with Breast Cancer: Preliminary Results. Am J Roentgenol 2004; 182: 1059-67.
23. Liberman L, Morris EA, Lee MJ-Y, Kaplan JB, LaTrenta LR, Menell JH, et al. Breast Lesions Detected on MR Imaging: Features and Positive Predictive Value. Am J Roentgenol 2002; 179: 171-8.
24. Veronesi U, Salvadori B, Luini A. Conservative treatment of early breast cancer: long-term results of 1232 cases treated with quadrantectomy, axillary dissection and radiotherapy. Ann Surg 1990; 211: 250-9.
25. Harris JR, Recht A, Connolly J. Conservative surgery and radiotherapy for early breast cancer. Cancer 1990; 66: 1427-38.
26. Hlawatsch A, Teifke A, Schmidt M, Thelen M. Preoperative assessment of breast cancer: sonography versus MR imaging. Am J Roentgenol 2002; 179: 1493-501.
27. Kneeshaw PJ, Turnbull LW, Drew PJ. Current applications and future direction of MR mammography. Br J Cancer 2003; 88: 4-10.
28. Esserman L, Hylton N, Yassa L, Barclay J, Frankel S, Sickles E. Utility of Magnetic Resonance Imaging in the management of breast cancer: evidence for improved preoperative stanging. Am J Clin Oncol 1999; 17: 110-9.
29. Vaidya J, Vyas J, Chinoy R, Merchant N, Sharma O, Mittra I. Multicentricity of breast cancer: whole-organ analysis and clinical implications. Br J Cancer 1996; 74: 820-4.
30. Drew PJ, Chatterjee S, Turnbull LW, Read J, Carleton PJ, Fox JN, et al. Dynamic Contrast Enhanced Magnetic Resonance Imaging of the Breast Is Superior to Triple Assessment for the Pre-Operative Detection of Multifocal Breast Cancer. Annals of Surgical Oncology 1999; 6: 599-603.
31. Coombs NJ, Boyages J. Multifocal and Multicentric Breast Cancer: Does Each Focus Matter. J Clin Oncol 2005; 23: 7497-502.