SIGNIFICANCE OF DOPPLER RI AND SYSTOLIC PEAK OF BREAST CARCINOMA LESIONS SEEN ON MAMMOGRAPHY

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ABSTRACT

Objective: To analyze the significance of doppler ultrasound and resistive index (RI) and systolic peak to find the breast Carcinoma lesions seen on mammography.

Study Design: Retrospective study.

Place and Duration of Study: Radiology Department of Doctor's Trust Teaching Hospital affiliated with Rai Medical College, Sargodha, from Oct 2018 to Apr 2019.

Methodology: The sample was the women observed with solid breast masses in clinical examination. Those women were 38 in number. The doppler ultrasound was performed on each patient after mammography. Resistive index and systolic peak was also evaluated. Pathology results were also categorized, analyzed and compared with Color Doppler ultrasound.

Results: From the results of Color Doppler ultrasound the vascularity in malignant breast lesions were more as compared to benign lesions. Presence of blood vessels in malignant lesions was 94% and in the benign lesions was 35%. Sharp systolic peak and high systolic velocity was in malignant lesions and low in benign lesions. The malignant lesions and benign lesions mean value of resistive index was 0.70 ± 0.092 and 0.64 ± 0.064. The short statistical difference was observed *p*-value 0.060.

Conclusion: The malignancy in ultrasound is predicted with the help of hyper vascularity of the breast lesion. Resistive index and systolic peak is helpful in identifying benign lesion from malignant cases. Mammography results in dense breast are not sensitive therefore doppler sonography is preferred in these cases.

Keywords: Carcinoma, Malignant, Mammography, Resistive index.

INTRODUCTION

Breast cancer in women is the most common cause of death in the globe and it accounts for 14% of the deaths due to cancer and 23% of deaths due to breast cancer only[1,2]. In Pakistan the breast cancer is common among women and is considered second largest reason of death among women. In Pakistan 90,000 cases are reported about breast cancer and is the cause of 40,000 deaths per annum. Every one woman out of 9 has a chance of getting breast cancer in her life[3].

Breast cancer primary screening option is mammography[4,5]. The mammography is not sensitive enough to diagnose the breast lesion in women. The results are associated with breast density. As the density of breast tissues increases the less sensitive results are observed in mammography up to 45%[6,7]. Ultrasounds are not routine screening tests for breast cancer but the cancer which is not diagnosed in the mammography can be detected in the Doppler ultrasounds[7,8]. Ultrasound results when performed with mammography can help to enhance the sensitivity of the results up to 78% where breast are dense and women are at higher risk of getting breast cancer. With the advancement in ultrasound technology and its diagnostic accuracy the application of color Doppler ultrasound has increased considerably in the oncology to predict the breast cancer among women accurately. The color Doppler ultrasounds show blood vessels distribution and presence of hyper vascularity in malignant breast

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lesions. The criterion which is used to differentiate the benign lesion from malignant is the systolic flow velocity, resistive index and pulsatility index. The studies are conducted to calculate the resistive index and based upon its value to compare benign lesions from malignant ones. Every study conducted has its own sensitivity, specificity, positive predictive value and negative predictive value. The color Doppler ultrasound diagnostic accuracy is highly specific and sensitive to identify the benign from malignant[15]. The objective of study was to analyze the color doppler ultrasound diagnostic accuracy by evaluating resistance index, systolic peak of the lesion of breast cancer observed in mammography in order to differentiate benign cancer from malignant.

METHODOLOGY

This study was conducted at Radiology Department of Doctor's Trust Teaching Hospital affiliated with Rai Medical College, Sargodha, from Oct 2018 to Apr 2019. Total 38 patients who were recommended breast biopsy, mammography and color Doppler ultrasound to diagnose the breast cancer either malignant or benign were included. Those patients were observed with clear solid breast mass. The age group of the women was from 24 years to 68 years. After clinical examination and mammography, the color doppler ultrasound was performed for every patient. All the examination of the patients was performed by senior radiologist by using the LN[5-12], linear transducer on Samsung Madison X8 machine. The parameters observed in the color doppler ultrasound images were, lesion size, vascularity presence or absence, comparison of normal tissue with the vascular tissue, resistance in the vessels of lesions and systolic peak. The patients biopsy output was also analyzed for comparing the results of pathology with the color doppler ultrasound. Statistical analysis of the results was performed in order to evaluate the significance of color doppler scans.

RESULTS

All the patients who participated in the study were divided into two main groups according to the nature of their cancer. Group A consist of 20 patients who have benign cancer. The group B consist of 18 patients who were diagnosed malignant lesions. The mean age group of the patients was calculated 40.66 ± 10.60. The mean age of the participants of both groups was same and there was found no statistical difference.

The side or size of the breast mass has no developed link in the malignant and benign lesion. The *p*-value about the size and side of the mass was calculated 0.74. The tumor height and width (size) mean in benign group was 155.56 ± 70.5mm^2. The size of the tumor (height, width) in malignant group was 264.72 ± 152.72mm^2. The size of the lesion in benign and in malignant cancer was different and the difference was significant in the statistical analysis (*p*-value 0.011). The correlation co efficient of the lesion benign group was calculated as r=0.132 and the *p*-value 0.78 and the lesions of malignant group correlation coefficient were calculated as r=0.32 and *p*-value was 0.25.

Table-I: Vessels vascularity.

Indicators	Condition	Benign (%)	Malignant (%)
Vascularity	Normal	1 (5%)	-
	Decreased	3 (15%)	-
	Increased	3 (15%)	17 (94.6%)
Blood Vessel	Yes	7 (35%)	17 (94.6%)
	No	13 (65%)	1 (5.6%)

Table-II: Resistive index range.

Statistical Indicators	Benign Lesions (n=20)	Malignant Lesions (n=18)
Resistance Index Mean	0.650 ± 0.065	0.72 ± 0.092
Mean ± SD	0.56 ± 0.74	(0.50 ± 0.88
p-value	0.05	0.060

Table-III: Analysis of malignancy

Malignant Group Analysis	Values
Positive predictive value	70%
Negative predictive value	92%
Specificity of RI	57%
Sensitivity of RI	88%

The two groups benign and malignant were evaluated in the color Doppler ultrasounds, vas-

cularity in the malignant group was enhanced and observed in 94.4%[17] of the cases.

In tumors the blood flow is enhanced which increases the velocity and lower the resistance from normal tissue. Waveform in pulse Doppler can help to differentiate the benign lesions from malignant lesions by differentiating the blood flow pattern in central blood flow and peripheral blood flow, resistive index and peak systolic velocity. In benign lesions the peripheral and central blood flow pattern is same with low resistive index and low systolic peak and velocity.

While in malignant lesions the central and peripheral blood flow pattern is different. The central blood flow pattern has high resistive index, systolic velocity is high and systolic peak is sharp. The difference in wave form pattern is a strong indicator to predict malignant lesions.

The malignant tissues were hyper vascular in nature when they were compared with the normal tissue in the breast. When benign lesions were observed and evaluated in the color doppler ultrasounds vascularity was present in 7 (35%) of the cases and the remaining cases showed no vascularity. The difference between the two groups was significant in nature and it was found $p<0.05$.

The resistive index range in benign lesions was 0.50 ± 0.89 and the mean value calculated of resistive index in benign lesions was 0.650 ± 0.065. Resistive index range in malignant lesions was 0.56 ± 0.76 and the mean RI calculated was 0.72 ± 0.092. The significant difference between the two groups was 0.06 which is considered statistically significant as shown in table-II.

The positive predictive value of vascularity was 70% for identifying the malignancy among the lesions and the negative predictive value of vascularity was 92% for predicting the malignant lesions. The resistive index threshold value was 0.625. Based upon this resistive index RI value the sensitivity was 88% and the specificity was 57% to diagnose the malignancy. The pathological results also confirmed fibro adenoma in benign lesions and in malignant lesions there was confirmed invasive ductal carcinoma with enhanced vascularity.

DISCUSSION

In malignant cases the neoplasm is observed and with the help of angiogenesis the metastasis and growth occur. Therefore, color Doppler ultrasound is very helpful in identifying the blood vessels and vascularity in order to differentiate the benign cancer from malignant. The purpose of the study was to differentiate the malignant cancer from benign cancer with the help of resistive index while using color Doppler sonography. The finding of the study confirmed that the vascularity in malignant cases are enhanced and is helpful to diagnose the cancer for better treatment plan. Blood vessels were observed in 94.6% cases of malignant group and 35% in the benign group. The age group in both the defined groups was almost same and it means it can happen in any age group. Different screening and awareness programs can help to identify the cancer at early stages and hence can help to reduce the mortality and morbidity among women. Giuseppetti *et al*[14], reported in his study that in the young age the vasculairty is because of fibro adenoma and in older age degeneration cause the vascular fibro adenoma in benign cancer. But in our study the age group was indifferent to malignant and benign cancer. Enhanced vascularity was observed in malignant cancer as compared to the benign cases.

The studies conducted by Sehgal *et al*, Ozdemirv *et al* and Mc Nicholas *et al*[10,11,13], have also confirmed that the size of lesions in malignant cases are large as compared to benign cases. This is because the growth is at fast rate in malignant cases and hence the size increases at fast rate. RI was high in malignant group 0.625 and the sensitivity was 88% in diagnosing the malignant cases. Choi *et al*, Lee *et al*, Peters-Engl *et al*, Konishi *et al*, Madjar *et al*, and Schmillevitch *et al*[12,15-19], have confirmed in their respective studies that RI was high in malignant cases and sensitivity was also high in identification of malignant cases from benign cases.

CONCLUSION

From the study it can be concluded that color doppler ultrasound is an effective tool to identify the malignant breast cancer in women. The hyper vascularity observed in the breast masses can be accurate diagnostic parameter for malignancy prediction. RI value and systolic peak is good predictor of malignancy.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

REFERENCES

1. Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. Global cancer statistics. CA Cancer J Clin 2011; 61(2): 69-90.
2. Akbari ME, Khayamzadeh M, Khoushnevis SJ. Five and ten years survival in breast cancer patients. Mastectomy vs. breast conserving surgery, personal experience. Iran J Cancer Prev 2008; 1(1): 53-58.
3. Mandelson MT, Oestreicher N, Porter PL, White D, Finder CA, Taplin SH, et al. Breast density as a predictor of mammographic detection: comparison of interval and screen-detected cancers. J Natl Cancer Inst 2000; 92(13): 1081-78.
4. Kolb TM, Lichy J, Comparison of the perform-ance 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(1): 165-75.
5. Smith RA, Saslow D, Sawyer KA, Burke W, Costanza ME, Evans WP, et al. American Cancer Society guidelines for breast cancer screening: update 2003. CA Cancer J Clin 2003; 53(3): 141-69.
6. Bevers TB, Anderson BO, Bonaccio E, Buys S, Daly MB, Dempsey PJ, et al. NCCN clinical practice guidelines in oncology: breast cancer screening and diagnosis. J Natl Compr Canc Netw 2009; 7(10): 1060-96.
7. Berg WA, Zhang Z, Lehrer D, Jong RA, Pisano ED, Barr RG, et al. Detection of breast cancer with addition of annual screening ultrasound or a single screening MRI to mammography in women with elevated breast cancer risk. J Am Med Assoc 2012; 307(13): 1394-04.
8. Berg WA, Blume JD, Cormack JB, Mendelson EB, Lehrer D, Böhm-Vélez M, et al. Combined screening with ultrasound and mammography vs mammography alone in women at elevated risk of breast cancer. J Am Med Assoc 2008; 299(18): 2151-63.
9. Cura JL, Elizagaray E, Zabala R, Legórburu A, Grande D. The use of unenhanced doppler sonography in the evaluation of solid breast lesions. AJR Am J Roentgenol 2005; 184(6): 1788-94.
10. Sehgal CM, Arger PH, Rowling SE, Conant EF, Reynolds C, Patton JA. Quantitative vascularity of breast masses by Doppler imaging: regional variations and diagnostic implications. J Ultrasound Med 2000; 19(7): 427-40.
11. Mc Nicholas MM, Mercer PM, Miller JC, Mc Dermott EW, O'Higgins NJ, MacErlean DP, et al. Color Doppler sonography in the evaluation of palpable breast masses. AJR Am J Roentgenol 1993; 161(4): 765-71.
12. Choi HY, Kim HY, Baek SY, Kang BC, Lee SW. Significance of resistive index in color Doppler ultrasonogram: differentiation between benign and malignant breast masses. Clin Imaging 1999; 23(5): 284-88.
13. Ozdemir A, Ozdemir H, Maral I. Differential diagnosis of solid breast lesions: contribution of Doppler studies to mammography and grey scale imaging. J Ultrasound Med 2001; 20(10): 1091-101.
14. Giuseppetti GM, Baldassarre S, Marconi E. Color Doppler sonography. Eur J Radiol 1998; 27(Suppl-2): S254-58.
15. Lee SW, Choi HY, Baek SY, Lin SM. Role of color and power doppler imaging in differentiating between malignant and benign solid breast masses. J Clin Ultrasound 2002; 30(8): 459-64.
16. Peters-Engl C, Medl M, Leodolter S. The use of colour-coded and spectral Doppler ultrasound in the differentiation of benign and malignant breast lesions. Br J Cancer 1995; 71(1): 137-39.
17. Konishi Y. Clinical application of color Doppler imaging to the diagnosis of breast disease. Med Rev (Toshiba) 1992; 42(3): 12-27.
18. Madjar H, Sauerbrei W, Prompeler HJ. Color Doppler and duplex flow analysis for classification of breast lesions. Gynecol Oncol 1997; 64(3): 392-03.
19. Schmillevitch J, Guimara˜es GF, He´lio A. Utilization of vascular resistance index in the differentiation between benign and malignant breast nodules. Radiol Bras 2009; 42(4): 241-14.