

## Comparative Efficiency of Resistive Index (RI), Pulsatility Index (PI) And Peak Systolic Velocity (PSV) in Differentiating Malignant And Benign Breast Lesions with Cytological & Histopathological Correlation

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### Abstract

**Objectives:** - To evaluate the comparative efficiency of resistive index (RI), pulsatility index (PI) and peak systolic velocity (PSV) in differentiating malignant and benign breast lesions with cytological & histopathological correlation.

**Materials and methods:** - A prospective study was conducted over a period 1 year 2 months in Bankura Sammilani Medical College among 150 patients with palpable breast lumps from inpatient and outpatient departments of surgery and Gynecology at B.S Medical College, Bankura. Gray scale ultra-sonography and Doppler was carried out on the patients using 7.5 MHZ transducer of Phillips HD-7 machine and RI, PI and PSV were recorded for each patient. Patients were followed up by cytological / histopathological examinations. Data were entered in Microsoft Excel & finally analyzed with Statistical Package for Social Sciences (version 19.0) software.

**Results:** - The selected patients were between 35 to 53 years of age. (Mean 42 years). Palpable mass was the commonest complaint (100%) followed by breast discomfort (80%) and pain (32%). Of the 150 patients 96 (64%) had histopathologically proven malignant lesions and 54 (36%) had benign lesions. [Malignant lesions included Ductal cell carcinoma (52), papillary carcinoma (12), Colloid carcinoma (10), medullary carcinoma (6), lobular carcinoma (8), and inflammatory carcinoma (8). Benign lesions included Fibro adenomas (34), Fibro cystic changes (8), Ductal papilloma (2) Abscess (4), Infected cyst (2) and Phyllode's tumor (4)]. 88 out of 96 malignant lesions (91.6%) had high RI (>0.8) while 12 out of 54 (22.2%) benign lesions had high R.I (>.8) Likewise 80 out of 96 (83.3%) malignant lesions showed high P.I (>1.6) and 3 out of 54 (5.5%) cases showed high P.I (>1.6). PSV was high (>20.8cm/s) in 76 out of 96 (79.1% %) malignant lesions and in 5 out of 54 benign lesions (9.2 %). Sensitivity of RI, PI and PSV for malignant lesions were 91.67%, 83.33% and 79.17and specificity of the same parameters were 77.78%, 94.44% and 90.74% respectively.

**Conclusion:** - In our study RI, PI and PSV – all parameters were significantly higher in malignant breast lesions than in benign lesions although some overlap exists. Although high RI (>0.8) and PSV (>18) is indicative of malignancy few benign lesions showed high RI and PSV whereas high PI values were mostly seen in malignant lesions.

**Keywords** - Breast; benign; malignant; Color Doppler; Resistive Index

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### I. Introduction

Female breast is a very common site of involvement by different pathological conditions due to its complexity of structure and sensitivity to endocrine influences. The lesions can be benign like fibrocystic disease accounting for as high as 40% and fibro adenomas accounting for 7 – 10% or malignant lesions. The sinister of all the breast malignancy is on the rise partially attributed to modern life style and environmental factors – i.e. obesity, nulliparity etc. and partially to improved methods of early detection by ultrasonography, including Doppler, mammography, and magnetic resonance imaging. Currently, the incidence of female breast cancer is slightly over 10%. Ultrasound with color Doppler imaging (CDI) has a definite role in detecting and characterizing palpable breast lesions as benign or malignant with a high degree of sensitivity and specificity. As a method of investigation, it has several advantages. It is easily available, non-invasive, relatively cheaper and does not provide any ionizing radiation. In this prospective study, we have attempted to evaluate the role of

different Doppler indices – i.e. resistive index (RI), pulsatility index (PI) and peak systolic velocity (PSV) in characterizing the palpable breast lesions as benign or malignant with cytological / histopathological correlation.

## II. Materials And Methods

An institution based observation and longitudinal study was carried out among 150 patients in the age group 35 – 53 years with palpable breast lumps from both inpatient and outpatient department of surgery and Gynecology of Bankura Sammilani medical college from January 2012 to December-2016. An informed consent was first obtained from the patient explaining the purpose of the investigation and its advantages in detail. A detailed history regarding her complaints were taken followed by physical examination with special emphasis on breast and axilla maintaining optimum privacy. Patients were then subjected to gray scale ultrasound and color Doppler imaging (CDI) using 7.5 MHZ transducer of Phillips HD 7 machine in Department of Radio-diagnosis, of Bankura Sammilani medical college and nearby tertiary care centers. Vascularity of the lesions were assessed with pattern of color uptake (central vs peripheral) and the values of different Doppler indices i.e. Resistive index (RI), Pulsatility index (PI) and Peak systolic velocity (PSV) were recorded and analyzed. The statistical Data were entered in Microsoft Excel & finally analyzed with Statistical Package for Social Sciences (version 19.0) software.

### 2.1 Inclusion criteria

1. Any female patient coming with a palpable breast lump.

### 2.2 Exclusion criteria

1. Patient unwilling to be a part of the study.
2. Patients having history of breast irradiation, trauma and any type of intervention.

## III. Figures And Tables

The breast lesions were classified as either benign or malignant based on criteria set up by a study on color Doppler flow criteria of breast lesions by Madjar H et al. <sup>[1]</sup>

**Table 1:** Showing histological nature of the breast lump

Histological nature	Number	Subtype	Number
Benign(36%)	54	Fibro adenoma	34
		fibrocystic changes	08
		Abscess	04
		Phyllode tumor	04
		Duct papilloma	02
		Infected cyst	02
		Infected breast cyst	
Malignant (64%)	96	Duct cell carcinoma	52
		Papillary carcinoma	12
		Medullary carcinoma	06
		Colloid carcinoma	10
		Lobular carcinoma	08
		Inflammatory carcinoma	08

The patients were grouped into 4 groups according to imaging (Doppler indices) and histopathology study.  
GROUP 1: Malignant by imaging + malignant by histopathology No. of patients: 88

**Table 2:** Malignant by imaging + malignant by histopathology

Doppler Indices	Mean	Maximum	Minimum
PSV cm/sec	13.92	21	5.9
PI	2.58	10	1.1
RI	0.83	0.9	0.7

GROUP 2: Malignant by imaging + benign by histopathology  
No. of patients: 12

**Table 3:** Malignant by imaging + benign by histopathology

Doppler Indices	Mean	Maximum	Minimum
PSV cm/sec	32.35	36.3	28.4
PI	1.1	1.3	0.9
RI	0.6	0.6	0.6

GROUP 3: Benign by imaging +benign by histopathology  
No. of patients: 42

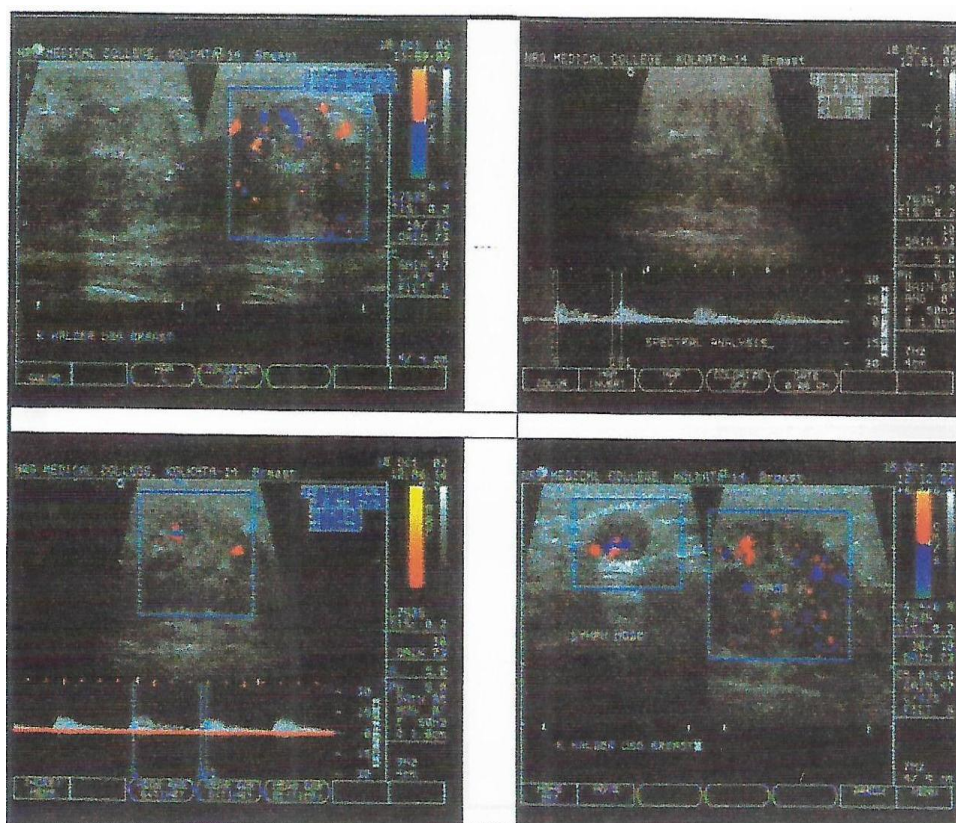
**Table 4: Benign by imaging +benign by histopathology**

Doppler Indices	Mean	Maximum	Minimum
PSV cm/sec	10.84	16.1	7.13
PI	0.58	1.15	0.3
RI	0.4	0.6	0.3

GROUP 4: Benign by imaging + malignant by histopathology  
No. of patients: 8

**Table 5: Benign by imaging + malignant by histopathology**

Doppler Indices	Mean	Maximum	Minimum
PSV cm/sec	17.23	22.9	5.91
PI	1.23	2.2	0.6
RI	0.76	0.9	0.7



**Fig 1** Malignant breast mass (cytology proved ductal cell carcinoma) showing high vascularity and high resistance spectral pattern with axillary lymph nodes (arrow)

#### IV. Results

The Selected Patients Were Between 35 To 53 Years Of Age. (Mean 42 years). Palpable mass was the commonest complaint (100%) followed by breast discomfort (80%) and pain (32%). Of the 150 patients 96 (64%) had HP proven malignant lesions and 54 (36%) has benign lesions. [Malignant lesions included Ductal cell carcinoma (52), papillary carcinoma (12), Colloid carcinoma (10), medullary carcinoma (6), lobular carcinoma (8), and inflammatory carcinoma (8). Benign lesions included Fibro adenomas (34), Fibro cystic changes (8), Ductal papilloma (2) Abscess (4), Infected cyst (2) and Phyllode's tumor (4)]. 88 out of 96 malignant lesions (91.6%) had high RI (>0.8) while 12 out of 54 (22.2%) benign lesions had high R.I (>.8) likewise 80 out of 96 (83.3%) malignant lesions showed high P.I (>1.6) and 3 out of 54 (5.5%) cases showed high P.I (>1.6). PSV was high (>20.8cm/s) in 76 out of 96 (79.1% %) malignant lesions and in 5 out of 54 benign lesions (9.2%). Sensitivity of RI, PI and PSV for malignant lesions were 91.67%, 83.33% and 79.17and specificity of the same parameters were 77.78%, 94.44% and 90.74% respectively.

## V. Conclusion

Ultrasound of breast has proved to be an important method of examination. Doppler has additional advantage of narrowing the spectrum to come to a conclusive diagnosis. Different Doppler indices have been evaluated to differentiate the benign and malignant breast lesions. In our study RI, PI and PSV – all parameters were significantly higher in malignant breast lesions than in benign lesions however some overlap exists. Although high RI (>0.8) and PSV (>18) is indicative of malignancy few benign lesions showed high RI and PSV whereas high PI values were mostly seen in malignant lesions. The present study showed color Doppler is a good diagnostic adjunct over gray scale sonography in characterizing breast masses and among all the flow velocimetry criteria, resistive index (RI) is the most significant one.

## VI. Discussion

Interrogation of a solid breast lesion by Doppler aids significantly in differentiating a benign mass from a malignant one. It serves as a useful adjunct to clinical examination, mammography and ultrasonography as well as increases the confidence of a radiologist to report a case to be benign or malignant. The three most commonly used Doppler parameters for this purpose are peak systolic velocity (PSV), resistive index (RI) and pulsatility index. Sehgal CM et al showed in their study that malignant breast lesions were more vascular than their benign counter parts in 14 – 54% cases.<sup>[2]</sup> While benign lesions also show some vascularity, the surrounding normal tissue is even less vascular thereby providing a useful trend in vascular pattern as Malignant > benign > normal breast tissue. Benign masses were 2.2 times more vascular than normal tissue whereas malignant masses were about 5 times more vascular. Mukta J et al conducted a study and reached an important conclusion regarding distribution of color flow in benign and malignant breast lumps. In their study 55.5% patients showed central vascularity and 44.4% patients showed peripheral vascularity in malignant lesions. Benign lesions did not show appreciable vascularity. Thus, central vascularity served as an important criterion to declare a lesion to be malignant with greater degree of confidence.<sup>[3]</sup> Medd et al conducted a study on 87 women with mammographically suspicious breast lesions. They performed color Doppler on all the patients. Those with RI value of > 0.7 turned out to be malignant and < 0.7 were benign.<sup>[4]</sup> Mehri sirous et al conducted a study on a large group of population covering 1110 patients with BIRADS 3 or more breast lesions. In their study PI of 1.6 or more has 70% sensitivity and 98% specificity for malignant lesion while benign lesions showed PI value of 1.4 or less.<sup>[5]</sup> In our study, high RI value in 88 out of 96 (91.6%) malignant lesions and 12 out of 54 (22.2%) benign lesions, suggests that RI value > 0.8 is a reliable cut off point to differentiate malignant from benign breast lesions. 80 out of 96 (83.3%) malignant lesions and 3 out of 54 (5.5%) benign lesion showed PI value of >1.6. Thus, we drew a conclusion that cut off value of PI for differentiating malignant from benign breast lesions can be set at 1.6. Similarly, 76 out of 96 (79.1%) malignant lesions and 5 out of 54 (9.2%) benign lesions showed PSV value above 20.8. Thus, we reached a conclusion that most malignant breast lesions show high RI (>.8), PI (>1.6) and PSV (>20.8%) and can reliably but not definitely differentiate from benign breast lesions. It also suggests RI is the most sensitive parameter followed by PI and PSV.

## References

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