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Original Research Article

Sonomammography: Role of Various Ultrasonographic Features in Differentiating Benign from Malignant Breast Lesions

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ABSTRACT

Purpose:

- To evaluate breast masses in patients presenting with symptoms of breast disease.
- To find out general applicability of ultrasonographic (US) features in differentiating benign from malignant breast masses and whether this distinction could be definite enough to obviate fine needle aspiration cytology (FNAC).
- To compare the ultrasonographic (US) findings with the FNAC results.

Materials and methods: Fifty sonographically detected breast lesions were prospectively classified as benign or malignant. Benign nodules had no malignant characteristics and had either intense homogeneous hyperechogenicity or a thin echogenic pseudocapsule with an ellipsoid shape or fewer than four gentle lobulations. Sonographic classifications were compared with FNAC results. The sensitivity, specificity, and negative and positive predictive values of the classifications were calculated.

Results: Benign histologic features were found in 41 (82%) lesions; malignant histologic features, in 9 (18%). Of benign lesions, 28 had been prospectively classified as benign. One lesion classified as benign was found to be malignant at FNAC. Thus, the classification scheme had a negative predictive value of 96.5%. Of 9 malignant lesions, 8 were correctly classified as malignant (88.8% sensitivity).

Conclusion: Sonography can be used to accurately classify some breast lesions as benign, allowing imaging follow-up rather than FNAC.

Keywords: Fine Needle Aspiration Cytology (FNAC), Fibroadenoma, Malignancy, Spiculation, Hyperechogenecity, Angular margins.

INTRODUCTION

Diagnostic breast ultrasonography (US) can improve the specificity of clinically and mammographically detected abnormalities. In general, these lesions require fine needle aspiration or biopsy. Although well tolerated, these procedures do have some risk, induce patient discomfort and anxiety, and increase costs in terms of both patient recovery and overall health care expense. The emphasis on early detection of breast cancer, and the current medicolegal environment encourage an aggressive biopsy approach to breast problems. With such an approach, a large majority of the palpable

and mammographically detected nonpalpable breast lesions on which biopsies are performed will be benign. [(1)] Sonographic methods have been used in attempts to reduce the negative-to-positive biopsy ratio, and therefore, the cost to society. Investigators have evaluated the characteristics of individual sonographic, spectral Doppler, and color Doppler imaging for distinguishing benign from malignant lesions. [(2)] With marked improvement in the near-field imaging capability of sonographic equipment, we decided to evaluate various sonographic characteristics, combining both previously published [(3)] and new criteria, to determine our current ability to distinguish benign from malignant breast lesions with sonography. Despite the known overlap between benign and malignant features in some lesions, we were especially interested in determining whether we could identify a subgroup of breast masses with sonographic characteristics so definitively benign that their presence might obviate FNAC.

Indications of breast ultrasound:

Ultrasound examination of the breast currently follows several indications:

First examination (before mammography or MRI) for the evaluation of a palpable lump in women under age 30.

Evaluation of a mass demonstrated on mammography.

Evaluation of focal asymmetry or focal change in architecture on the mammogram when compared with previous study performed after complete mammographic workup (additional views).

Evaluation of suspicious finding requiring biopsy on MRI or a nuclear medicine study (in anticipation of ultrasound guided biopsy).

Guidance for intraoperative or percutaneous breast biopsy and aspiration.

Evaluation of breast implants.

Adjunctive examination to evaluate nipple discharge (after mammography).

Adjunctive examination to evaluate focal pain (after mammography).

Aims and objectives:

1. To evaluate breast masses in patients presenting with symptoms of breast disease.
2. To find out general applicability of ultrasonographic (US) features in differentiatin benign from malignant breast masses.
3. To compare the ultrasonographic (US) findings with the fine needle aspiration cytology (FNAC) results.

MATERIALS AND METHODS

This prospective study was conducted in the department of Radiodiagnosis and Imaging, Govt. Medical College Hospital Srinagar Kashmir.

Ultrasound equipment and technique: All US examinations were performed with (logic 500 Pro series GE) using a high frequency 7-10 MHz linear array transducer, which are focused at 1.5-2.0 cm, an ideal focal length for breast ultrasound, minimizing volume averaging. The scanning protocol included both transverse and longitudinal real time imaging of the breast masses with representative hard copy images acquired in each plane, particular attention was given to scanning patients in radial and antiradial planes.

US Image review: Breast masses were evaluated with respect to shape (Oval, round, lobulated or irregular), margins (circumscribed, ill defined, spiculated or micro lobulated), width to anteroposterior dimension ratio, posterior echoes (enhanced, unaffected, decreased) and echogenicity (intensity of internal echoes).

Final assessment category for each case was established modeled on the American College of Radiology Breast Imaging Reporting and Data System (BIRADS). Each mass was categorized as

benign (negative, benign or probably benign) or malignant (showing a suspicious abnormality or highly suggestive of malignancy.

Cytopathology was done in the form of fine needle aspiration cytology (FNAC) in all the cases as it is less invasive.

Breast Imaging Reporting And Data System (BIRADS) Nomenclature and Lexicon [(4)]:

The sonographic BIRADS 1 category corresponds to sonographically normal tissues that cause mammographic or clinical abnormalities. The sonographic BIRADS 2 category corresponds to benign entities and includes intramammary lymphnodes, ectatic ducts, simple cysts and definitively benign solid nodules, such as lipomas. The sonographic BIRADS 3 category corresponds to probably benign lesions that have a 2% or less chance of being malignant and includes some complex cysts, intra ductal papillomas and fibroadenomas. The sonographic BIRADS 4 category is divided at 50% or greater risk into 4a and 4b subcategories. The sonographic BIRADS 5 category is termed malignant and indicates a risk of malignancy of 90% or greater.

Malignant Characteristics: [(1)]
Sonographic spiculation is similar to mammographic spiculation. It consists of alternating hyperechoic and hypoechoic straight lines that radiate perpendicularly from the surface of the solid nodule. In lesions surrounded by intensely echogenic fibrous tissue, only the hypoechoic spiculations are sonographically visible (Figs 1,2,3). In spiculated nodules surrounded by fat, only the echogenic spiculations are sonographically visible. A thick echogenic halo, best seen around the lateral edges of a malignant nodule, also represents hypoechoic spiculations.

Taller than wide indicates that a part or all of the nodule is greater in its anteroposterior dimension than in either the sagittal or transverse dimension. We considered this finding to be positive if any part of the nodule was taller than wide (Fig 3).

Angular margins refers to the junction between the relatively hypoechoic or isoechoic central part of the solid nodule and the surrounding tissue. These angles may be acute, obtuse, or 90*. Angular margins should be distinguished from round or gently lobulated borders of a solid nodule with the surrounding tissue (Figs 1, 2).

Markedly hypoechoic nodules are very black when compared with the surrounding isoechoic fat (Figs 1, 2, 3, 4).

Shadowing exists when an area has relatively less through-transmission of sound than is present in surrounding tissues. Shadowing is considered to be present even when it is mild or is found behind only part of the nodule (Fig 3).

Punctate calcifications that are sonographically visible within solid nodules are more likely to be associated with malignant than benign lesions (Fig 3).

Duct extension is a projection from the nodule that extends radially within or around a duct and courses toward the nipple (Fig 4).

Branch pattern is defined as multiple projections from the nodule within or around ducts extending away from the nipple.

Microlobulation is analogous to the mammographic finding and is recognized by the presence of many small (1-2 mm) lobulations on the surface of the solid breast nodule.

Only if there were no malignant criteria were benign criteria sought.

Benign Characteristics [(1)] **:** Markedly hyperechoic tissue (as compared with the echogenicity of fat) that is well circumscribed and of uniform echogenicity represents fibrous tissue (Fig 5).

Ellipsoid shape indicates that the sagittal and transverse dimensions are greater than the anteroposterior dimension (Fig 5). It is considered a benign finding.

Well-circumscribed lobulations that are gently curving, smooth, and number three or less and that occur in a nodule wider than it is tall are considered benign. They are distinguished from the more numerous and smaller (1-2 mm) microlobulations that increase the likelihood of malignancy.

A thin, echogenic pseudocapsule that is well-circumscribed suggests a slowly growing, noninfiltrating lesion typical of benign lesions.

Because some ellipsoid or gently lobulated malignant lesions do not have well-circumscribed, thin pseudocapsules and some purely intraductal malignant lesions have thin, echogenic walls, a combination of either an ellipsoid shape with a thin, echogenic pseudocapsule or gentle lobulation with a thin, echogenic pseudocapsule was required for benign classification.

Fig.1: Spiculated hypoechoic mass

Fig.2: Malignant mass with angular margins

Fig.3: Microcalcifications in malignant mass

Fig.4: Intrductal extension in malignant mass

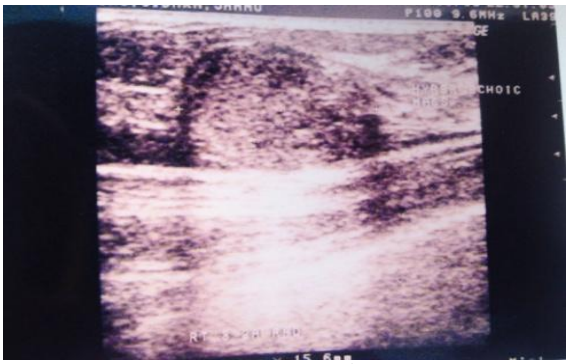

Fig.5: Hyperechoic benign fibroadenoma

RESULTS

The present study was carried out in the Department of Radiodiagnosis and Imaging Govt. Medical College Hospital Srinagar Kashmir over a period of one and a half year from May 2011 to September 2012.

The study was based on 50 patients who were referred to the Department of Radiodiagnosis and Imaging Govt. Medical College Hospital Srinagar Kashmir for evaluation of breast lesions.

Table – 1: Age Distribution Of Cases

Age (Yrs)	Number Of Patients	Percentage(%)
0 -9	0	0
10 - 19	8	16
20- 29	18	36
30 - 39	6	12
40 - 49	9	18
50-59	4	8
60-69	4	8
> 70	1	2
TOTAL	50	100

The highest incidence of breast lesions was found in the age group of 20-29 yrs containing (36%) of all cases. The second peak was seen in the age group of 40-49 yrs containing (18%) of all cases.

This type of bimodal distribution is due to the high incidence of benign breast lesions in younger age group. The second peak is due to the presence of malignant lesions in older age group.

Table – 2: Sex Distribution of Cases

Sex	Male	Female	Total
Patients (N=50)	1	49	50
Percentage (%)	2%	98%	100%

Most of the breast lesions were found in the females contributing (98%) of all cases.

Table – 3: Distribution As Per Site And Side

Site	Inner Upper Quad	Outer Upper Quad	Outer Lower Quad	Inner Lower Quad	Total
Left	8	16	2	1	27
Right	6	14	2	1	23

The left sided lesions were slightly more common than the right sided lesions, 27 0ut of 50 lesions were left sided. On both sides upper outer quadrant was the dominant site for the lesions. Two cases involved the whole breast and two lesions involved more than one quadrant.

Table – 4(A): Histological Diagnosis Of The Lesions

Benign	Malignant	Total
41	9	50
82%	18%	100%

41 (82%) Of lesions were proved to be benign whereas only 9 (18%) of lesions were proved to be malignant on histological diagnosis.

Table - 4(B): Histological Diagnosis Of Benign Lesions

Histological Diagnosis	No Of Cases	Percentage (%)
Fibroadenoma	25	60.9%
Fibrocystic Changes	13	31.7%
Inflammatory Lesions	2	4.9%
Others	1	2.5%
Total	41	100%

The most common benign histological diagnosis was fibroadenoma (60.9%), followed by fibrocystic changes (31.7%). Inflammatory lesions represented only (4.9%) of the benign lesions.

Table - 4(C): Histological Diagnosis Of Malignant Lesions

Histological Diagnosis	No Of Cases	Percentage(%)
Invasive Ductal Carcinoma	6	66.6%
InvasiveLobular Carcinoma	2	22.3%
Medullary Carcinoma	1	11.1%
Total	9	100%

The most common malignant histological diagnosis was Invasive Ductal Carcinoma (66.6%) followed by Invasive Lobular Carcinoma (22.3%) and Medullary Carcinoma (11.1%).

Table –5: Ultrasonography

Ultrasound	FNAC		Total
	Benign	Malignant	
Benign	28	1	29
Malignant	13	8	21
Total	41	9	50

Sensitivity - 88.8%, Specificity – 68.2%
Positive Predictive Value – 38.0%
Negative Predictive Value – 96.5%
Accuracy – 72%

Table – 6: Spiculation

Ultrasound	FNAC		Total
	Benign	Malignant	
Spiculation Absent	40	5	45
Spiculation Present	1	4	5
Total	41	9	50

Sensitivity–44.4%, Specificity – 97.5%

Positive Predictive Value – 80%
Negative Predictive Value – 88.8%
Accuracy – 88%

Spiculation was a feature of 4 out of 9 (44.4%) histologically proven malignant cases.

Table – 7: Angular Margins

Ultrasound	FNAC		Total
	Benign	Malignant	
Angular Margins Absent	39	2	41
Angular Margins Present	2	7	9
Total	41	9	50

Sensitivity – 77.7%, Specificity – 95%
Positive Predictive Value – 77%
Negative Predictive Value – 95%
Accuracy – 92%

Angular margins was a dominant feature in 7 out of 9 (77.7%) histologically proven malignant cases.

Table – 8: Width to Anteroposterior Dimension Ratio

Ultrasound	FNAC		Total
	Benign	Malignant	
Ratio > 1.4	40	5	45
Ratio < 1.4	1	4	5
Total	41	9	50

Sensitivity – 44.4%, Specificity – 97.5%
Positive Predictive Value – 80%
Negative Predictive Value – 88.8%
Accuracy – 88%

Width to Anteroposterior dimension ratio < 1.4 was a feature of 4 out of 9 (44.4%) histologically proven malignant cases.

Table – 9: Hypoechogenicity

Ultrasound	FNAC		Total
	Benign	Malignant	
Hypoechogenicity Absent	38	3	41
Hypoechogenicity Present	3	6	9
Total	41	9	50

Sensitivity – 66.6%, Specificity – 92.6%
Positive Predictive Value – 66%
Negative Predictive Value – 92.6%
Accuracy – 88%

Hypoechogenicity was a dominant feature in 6 out of 9 (66.6%) histologically proven malignant cases.

Table – 10: shadowing

Ultrasound	FNAC		Total
	Benign	Malignant	
Shadowing Absent	39	5	44
Shadowing Present	2	4	6
Total	41	9	50

Sensitivity – 44.4%, specificity – 95%
Positive predictive value – 66.6%
Negative predictive value – 88.6%
Accuracy – 86%

Posterior acoustic shadowing was a feature of 4 out of 9 (44.4%) histologically proven malignant cases.

Table – 11: Microlobulations

Ultrasound	FNAC		Total
	Benign	Malignant	
Microlobulations Absent	35	3	38
Microlobulations Present	6	6	12
Total	41	9	50

Sensitivity – 66.6%, Specificity – 85.3%
Positive Predictive Value – 50%
Negative Predictive Value – 92%
Accuracy – 82%

Microlobulations was a dominant feature in 6 out of 9 (66.6%) histologically proven malignant cases.

Table – 12: Calcification

Ultrasound	FNAC		Total
	Benign	Malignant	
Calcification Absent	40	6	46
Calcification Present	1	3	4
Total	41	9	50

Sensitivity – 33.3%, Specificity – 97.5%
Positive Predictive Value – 75%
Negative Predictive Value – 86.9%
Accuracy – 86%

Calcification was a feature of 3 out of 9 (33.3%) histologically proven malignant cases.

Table –13: Ellipsoid / oval shape

Ultrasound	FNAC		Total
	Benign	Malignant	
Ellipsoid shape Present	21	1	22
Ellipsoid shape Absent	20	8	28
Total	41	9	50

Sensitivity – 88.8%
Positive predictive value – 28.5%
Negative predictive value – 95.4%

Absence of Ellipsoid / oval shape was a dominant feature of 8 out of 9 (88.8%) histologically proven malignant cases.

Table – 14: Hyper Echogenicity

Ultrasound	FNAC		Total
	Benign	Malignant	
Hyper Echogenicity Present	2	0	2
Hyper Echogenicity Absent	39	9	48
Total	41	9	50

Sensitivity – 100%
Positive Predictive Value – 18.7%
Negative Predictive Value – 100%.

Absence of hyperechogenicity was a dominant feature of 9 out of 9 (100%) histologically proven malignant cases.

DISCUSSION

The study was based on 50 patients who were referred to the Department of Radiodiagnosis and Imaging, Govt. Medical College Hospital, Srinagar, Kashmir for evaluation of breast lesions.

Out of total fifty patients with breast lesions included in this study only 1 (2%) was male. The incidence is almost similar to observations by William (1907), [5] Harnett (1948) [6] in whose experience the incidence of male breast cancer varied from 0.5% to 3.3%.

In this study age of the patients ranged from 14 years to 76 years. The highest incidence was in age group 20–29 (36%) and second highest in 40–49 years (18%). The percentage 36% in this study corresponds with that of Khanna (1998). [7] The second peak seen in 40 – 49 year age group is caused by high incidence of cancer. This finding is consistent with the study by Brethold (1906), [8] Black (1923). [9]

In our study left side involvement was seen in 27 (54%) and right side 23 (46%) which is similar to the previously conducted studies by Reddy & Reddy (1962) [10] 52.6% and Tyagi (1982) [11] 47.8%.

In our study Benign histological diagnosis was seen in 82% of the lesions and malignant diagnosis was seen in 18% of the cases. The most frequent benign lesions were fibroadenomas (60.9%). Among malignant lesions invasive ductal carcinoma was seen in (66.6%). Similar results have been reported by other authors.

AUTHOR	Benign (%)	Malignant (%)	Fibroadenoma (%)	Invasive Ductal Carcinoma (%)
This study	82.0	18.0	60.9	66.6
Stavros et al (1995) [1]	83.0	17.0	54.0	81.6
Buchberger et al (1999) [12]	87.2	12.7	41.1	60.0
Paulinelli et al (2005) [13]	74.0	26.0	73.0	90.0
Calas et al (2007) [4]	81.8	18.2	43.1	72.7

AUTHOR	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy(%)
This study	88.8	68.2	38.0	96.5	72
Stavros et al (1995) [1]	98.4	67.8	38.0	99.5	72.9
Buchberger et al (1999) [12]	92.9	76.3	25.3	99.2	_
Chao et al (1999) [14]	86.1	66.1	44.1	93.9	70.8
Calas et al (2007) [4]	90.2	_	_	97.8	95.0
Nascimento et al (2009) [15]	82.3	55.2	45.1	87.5	63.6

It is our experience and the experience of others, that breast US is an essential problem-solving tool in the breast radiologist's armamentarium Calas et al (2007). [4] This study reinforces that belief by demonstrating that high-resolution US of the breast can successfully help distinguish many benign from malignant solid nodules. In our study the sensitivity, specificity, positive predictive value, negative predictive value and accuracy for ultrasonography were 88.8%, 68.2%, 38.0%, 96.5% and 72% respectively. Similar results have been reported by other authors.

Among the sonographic findings of malignancy, the one with the highest positive predictive value is spiculation.

In our study spiculation was seen in 44.4% of the histologically proven malignant lesions, similar findings have been reported by other authors.

AUTHOR	(%) of malignant lesions with spiculation
This study	44.4%
Stavros et al (1995) [1]	36%
Buchberger et al (1999) [12]	42.8%
Chao et al (1999) [14]	58%
Rahbar et al (1999) [16]	67%
Singh et al (2008) [17]	47%

It has been reported that nodules that are taller than they are wide are likely to

be malignant Paulinelli et al (2005). [13] This is a worrisome finding because it suggests growth across normal tissue planes. In this study we considered this finding as positive, if any part of the nodule was taller than wide rather than requiring the entire nodule to be taller than wide.

In our study 44.4% of the histologically proven malignant lesions were taller than wide (width to anteroposterior dimension ratio < 1.4). Similar results have been reported by other authors.

AUTHOR	(%) of malignant lesions that were taller than wide
This study	44.4%
Stavros et al (1995) [1]	41.6%
Rahbar et al (1999) [16]	40%
Calas et al (2007) [4]	52.3%
Singh et al (2008) [17]	39%

Our angular margins characteristic is similar to what has previously been described as jagged or irregular margins. Historically this has been the most frequently reported finding and one of the most reliable findings for malignancy Paulinelli et al (2005). [13]

In our study angular margins were seen in 77.7% of histologically proven malignant lesions, similar findings have been reported by other authors.

Markedly hypoechoic nodules should be defined as being much less echogenic than the relatively homogeneous medium-level echogenicity of fat.

AUTHOR	(%) of malignant lesions with angular margins
This study	77.7%
Stavros et al (1995) [1]	83.2%
Paulinelli et al (2005) [13]	93%
Calas et al (2007) [4]	92.7%

In our study 66.6% of histologically proven malignant lesions were hypoechoic, similar findings have been reported by other authors.

AUTHOR	(%) of malignant lesions that were hypoechoic
This study	66.6%
Stavros et al (1995) [1]	68.8%
Buchberger et al (1999) [12]	67.9%
Chao et al (1999) [14]	59.6%

Shadowing has previously been reported to be present in a variable percentage of malignant nodules. Shadowing is the result of attenuation of the sound beam by desmoplastic host response to breast cancer rather than being due to the tumour itself. In our study shadowing was seen in 44.4% of histologically proven malignant lesions, similar findings have been reported by other authors.

AUTHOR	(%) of malignant lesions with shadowing
This study	44.4%
Stavros et al (1995) [1]	48.8%
Buchberger et al (1999) [12]	64.3%
Chao et al (1999) [14]	52.8%
Paulinelli (2005) [13]	45%

US are less sensitive for demonstration of microcalcifications than is mammography. However, the currently used high-frequency transducers can show a higher percentage of mammographically visible calcifications than could the previously used lower-frequency transducers.

AUTHOR	(%) of malignant lesions with calcification
This study	33.3%
Stavros et al (1995) [1]	27.2%
Chao et al (1999) [14]	32.9%

In our study calcification was seen in 33.3% of histologically proven malignant lesions. Similar findings have been reported by other authors.

In our study microlobulation was seen in 66.6% of histologically proven malignant lesions. Similar findings have been reported by other authors.

AUTHOR	(%) of malignant lesions with microlobulations
This study	66.6%
Stavros et al (1995) [1]	75.2%
Buchberger et al (1999) [12]	71.4%
Rahbar et al (1999) [16]	67%

The benign characteristic with the highest negative predictive value, marked hyperechogenicity, represents normal fibrous tissue or focal fibrous change. None of the malignant lesions in our study was hyperechoic so the negative predictive

value for hyperechogenicity was 100%. Similar findings have been reported by other authors Calas et al (2007). [4] The classical fibroadenoma has smooth margins and is ellipsoid or oval in shape. In our study negative predictive value for ellipsoid shape was 95.4%, similar results have been reported by Murad et al (2004). [18]

Furthermore, 67% of the malignant lesions did not have involvement of the axillary lymph nodes. Thus, most of the sonographically detected and correctly classified lesions in this series were potentially curable.

SUMMARY AND CONCLUSION

This prospective study was carried out with the aim to show that certain Ultrasonographic features can be helpful in differentiating benign and malignant breast lesions.

Following conclusions were drawn from the study:

- Majority of patients were females (98%).
- The maximum incidence of lesions was observed in 20 - 29 yrs age group (36%).
- The majority of lesions were left sided 27 out of 50 (54%).
- Benign histological diagnosis was seen in 41 (82%) of the cases, and malignant diagnosis in 9 (18%) of the cases.
- Among benign lesions most common histological diagnosis was Fibroadenoma (60.9%) and Invasive ductal carcinoma was the most common histological diagnosis among malignant lesions (66.6%).
- The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of Ultrasonography were (88.8%), (68.2%), (38.0%), (96.5%) and (72%) respectively.
- Spiculation was seen in (44.4%) of histologically proven malignant lesions.
- Angular margins were seen in (77.7%) of histologically proven malignant lesions.
- Shadowing was seen in (44.4%) of histologically proven malignant lesions.
- Microlobulations were seen in (66.6%) of histologically proven malignant lesions.
- Width to antero posterior dimension ratio (<1.4) was seen in (44.4%) of histologically proven malignant lesions.
- (66.6%) of Hypoechoic lesions proved to be malignant on histological diagnosis.
- Calcification was seen in (33.3%) of histologically proven malignant lesions.
- Negative predictive value of Hyperechogenicity was (100%).
- Negative predictive value of Oval / Ellipsoid shape was (95.4%).

Thus to conclude, this study shows that sonography is useful in the characterization of some breast masses. Sonography improves the specificity of the diagnosis for the majority of both malignant and benign breast nodules. It must be reemphasized that these results are predicated on valid targeted indications; excellent sonographic technique (including radial and antiradial scanning); optimal machine and transducer characteristics; and strict adherence to the criteria for a benign lesion, which require the absence of even a single malignant finding. With this approach, a population of benign solid breast lesions that does not require biopsy can be accurately defined. This could result in improved care and reduction of patient discomfort, morbidity, and health care cost.

Declarations

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee.

Abbreviations: MRI- Magnetic resonance imaging, US- Ultrasonography, FNAC- Fine needle aspiration cytology, BIRADS- Breast Imaging Reporting and Data System

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