Original Article

A Comparative Study of Three Scoring Systems on Palpable Breast Aspirates at a Tertiary Health-care Center: A Cross-Sectional Study

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Abstract

Background: The cytological grading system in fine-needle aspiration of breast lumps helps the surgeons to decide the method of management and assess the survival rate. However, till date, no single cytological grading system for breast aspirates has been adapted in routine practice. Hence, a comparative study of three different grading systems was done. **Materials and Methods:** This is a retrospective study conducted from January 2016 to June 2018. The stained aspirated smears of breast lump were assessed for cytomorphologic features and graded as per the Modified Masood's Scoring Index (MMSI), National Cancer Institute (NCI) Cytological Grading System, and Robinson's cytological grading and compared with histological diagnosis (four categories) and modified Scarff–Bloom–Richardson's scoring system (carcinoma cases). **Results:** The MMSI system had a sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of 80%, 100%, 100%, 92.86%, and 94.44%, respectively. The NCI system had a sensitivity, specificity, PPV, NPV, and diagnostic accuracy of 60%, 97.44%, 90.0%, 86.36%, and 87.04%, respectively. The Robinson's cytological grading system had a sensitivity, specificity, PPV, NPV, and diagnostic accuracy of 100%, 84.62%, 71.43%, 100%, and 88.89%, respectively. **Conclusion:** Robinson's scoring system is the system with maximum sensitivity and is most effective in subcategorizing only malignant breast lesions. MMSI is the system with maximum specificity, PPV, and diagnostic accuracy, and can be considered as the standard grading system for both benign and malignant breast lesions on cytology.

Keywords: Breast cytology, breast lesions, modified Masood's Scoring Index, National Cancer Institute Cytological Grading System, Robinson's Scoring System

INTRODUCTION

The common diagnostic problem faced by most surgeons in their daily practice is a palpable breast lump. They always follow the triple assessment (clinical examination, radiological findings, and cytological findings) in any case of a palpable breast lump. The basic and initial method of pathological assessment in a case of breast lump is the fine-needle aspiration (FNA).[1] Although breast biopsy and histopathological grading system is the gold standard, the scope of FNA is gradually increasing particularly in developing countries as it gives an accurate cytological categorization.

The first cytological scoring system to diagnose and distinguish breast disease was introduced by Masood *et al.,* which had a high concordance rate among the cytological and histopathological diagnoses.[2,3] The most common cytological grading system used in routine practice for breast carcinoma cases, the Robinson Scoring System, was introduced by Robinson *et al.* in 1994, where the scoring was given based on architectural arrangement, cellular details, and nuclear characteristics.[4] Nandini *et al.* modified the original Masood's Scoring Index (MSI) by bringing a change in the scoring range which helped in improving the diagnostic accuracy in particular in Group I and Group II of MSI. This scoring system is called Modified Masood's Scoring System (MMSI).[5] The cytological

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grading system has also been recommended by the National Cancer Institute (NCI) and Bethesda.[6]

The cytological grading system in FNA of breast helps the surgeons to decide the mode of management and assess the survival rate. However, till date, no single cytological grading system for breast aspirates has been adapted in routine practice.

Hence, the present study was conducted to evaluate three (MMSI, NCI, and Robinson's cytological grading systems) different cytological grading systems to determine a simple and most reliable system of cytological grading on breast aspirates considering histopathology diagnosis and Scarff–Bloom–Richardson's (SBR) grading system as gold standard.

Materials and Methods

This retrospective study was conducted at the department of pathology in a tertiary health-care center after obtaining approval from the institutional ethical committee for a period of 2.5 years from January 2016 to June 2018. The objectives of the study were to evaluate fine-needle aspiration cytology (FNAC) of breast lumps by three different cytological grading systems and then to compare the diagnostic accuracy and concordance of these three cytological grading systems with the standard histopathology grading system.

All FNAC smears of palpable breast lumps having corresponding histopathology slides were included in the study. Any FNAC smear which had inadequate material, broken slides, or unlabeled slides were excluded from the study. Patients' sociodemographic details and clinical details were collected from the hospital's record section. The cytology and histopathology slides were retrieved from the archives of pathology department and were screened by two pathologists.

The stained FNAC smears of breast lump were assessed for detailed cytomorphologic features and were graded as per the MMSI [Table 1], NCI cytological grading system [Table 2], and Robinson's cytological grading [Table 3].[5,7,8]

The tissue sections of the respective breast excision specimens stained with hematoxylin and eosin were analyzed, and histological diagnosis of each case was categorized into four categories to correlate with MMSI and NCI scores [Table 4].[9] The cases diagnosed as carcinoma breast were graded according to the modified SBR scoring system [Table 5] and compared with the Robinson's cytological grading.[10]

At the end of the study, correlation and concordance between cytological and histological categories were analyzed.

The data collected were of categorical type, and the statistics of all these data were shown as proportions and/or percentages. The diagnostic accuracy of individual cytological scoring and the overall diagnostic accuracy were assessed by sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). To assess the agreement between cytological scoring systems and histological diagnostic categories, Cohen's kappa coefficient was estimated.

Results

In the 2.5-year study period, a total of 64 breast FNA cases were included in the study. Of these, ten cases were excluded from the study as nine cases had no histopathology slides and one breast aspirate case had inadequate material.

The remaining 54 cases were included in the study which were then assessed and graded as per the MMSI, NCI, and Robinson's scoring systems based on cytology diagnosis. The excision specimens diagnosed as carcinoma on histopathology were histologically classified and given a score/graded as per the modified SBR scoring system.

All the breast aspirate cases were only female who were in the age range of 18–72 years. Among these 54 cases, 20 cases each were in the middle age group, i.e., 30–39 years and 40–49 years, with a mean age of 39.5 years. Those cases which were diagnosed as carcinoma were all above the age of 40 years.

There was one case which was a bilateral lesion, and among the remaining 53 cases, 31 cases were of right breast lump and 22 cases were of left breast lump. Among the specimens received for histopathology, 53 cases were excision specimens (mastectomy), whereas 1 case was tru-cut biopsy. The results obtained after grading all the 54 breast aspirate cases were tabulated.

As per the MMSI, 21.42% of cases showed concordance between cytology and histopathology diagnoses in nonproliferative breast disease and 75% of cases showed concordance proliferative breast disease without atypia.

Cellular arrangement	Cellular pleomorphism	Anisonucleosis	Nucleoli	Chromatin clumping	Myoepithelial cells	Score
Monolayer	Absent	Absent	Absent	Absent	Many	1
Nuclear overlapping	Mild	Mild	Micronucleoli	Rare	Moderate	2
Clustering	Moderate	Moderate	Micronucleoli and/or rare macronucleoli	Occasional	Few	3
Loss of cohesion	Conspicuous	Conspicuous	Predominantly macronucleoli	Frequent	Absent	4

Table 1: Modified Masood's Scoring Index for interpretation of fine-needle aspiration cytology[5]

Total score: Scores 6-8: Nonproliferative breast disease, scores 9-14: Proliferative breast disease without atypia, scores 15-18: Proliferative breast disease with atypia, scores 19-24: Carcinoma *in situ*/carcinoma

In category 3, i.e., proliferative breast disease with atypia, only 16.6% of cases showed concordance and 50% of cases were confirmed as malignancy on histopathology. There was 100% concordance in category 4, which was carcinoma *in situ* (CIS)/carcinoma [Table 6].

Based on the results obtained, a 2 × 2 table was done, and diagnostic accuracy, sensitivity, specificity, PPV, and NPV were calculated [Table 7]. The diagnostic accuracy was calculated which was 94.44% with a sensitivity and specificity of 80% and 100%, respectively. The PPV and NPV were 100% and 92.86%, respectively.

As per the NCI grading system, breast aspirates were categorized from C1 to C5 [Table 3], and the corresponding histopathology diagnoses were also categorized accordingly into four categories excluding C1 (insufficient material). In this grading system, there was 100% concordance in C2 category (benign) and one case (20%) showed concordance in C3 category, but the remaining four (80%) cases were all benign breast lesions. In C5 category, there was 90% concordance and one case, i.e., 10%, showed discordance. This case was diagnosed as suspicious of lobular carcinoma on cytology and on histopathology, it was diagnosed as benign phyllodes tumor [Table 8].

Based on the results obtained, a 2 × 2 table was done, and diagnostic accuracy, sensitivity, specificity, PPV, and NPV were calculated [Table 9]. The sensitivity and specificity calculated based on the 2 × 2 table were 60% and 97.44%, respectively. The diagnostic accuracy came to be 87.04%. The PPV was 90% and NPV was 86.36%.

Robinson's grading system is used for all breast aspirates diagnosed as carcinoma on cytology, and it correlates with modified SBR's scoring system. Fifteen (27.77%) cases out of the total 54 cases were diagnosed as carcinoma on both cytology and histopathology. In Grade 1, three cases out of four showed discrepancies which were benign breast parenchyma, ductal hyperplasia, and benign phyllodes tumor.

Whereas in Grade 2, two cases out of six cases showed discrepancy, i.e., on histopathology, these were diagnosed as benign breast parenchyma and ductal hyperplasia with atypia. Grade 3 had maximum number of cases,[11] where one case was tru-cut biopsy diagnosed as carcinoma and one case showed discrepancy which was diagnosed as benign breast lesion [Table 10].

Based on the results obtained, a 2 × 2 table was done, and diagnostic accuracy, sensitivity, specificity, PPV, and NPV were calculated [Table 11]. The diagnostic accuracy calculated for Robinson's grading system was 88.89%, with a sensitivity of 100% and a specificity of 84.62%. The PPV was 71.43% and NPV was 100%.

The sensitivity, specificity, PPV, NPV, and diagnostic accuracy of all the three cytological grading systems were compared to assess the best grading system which could be used in routine practice [Table 12].

In order to calculate the overall diagnostic accuracy, a 2 × 2 table was done based on the total number of carcinoma cases diagnosed both on cytology and histopathology [Table 13]. The overall diagnostic accuracy calculated was 88.8% (confidence interval: 79.70%–96.92%) with a sensitivity and specificity of 71.42% and 100%, respectively. The PPV was 100% and NPV was 72.0%. Based on the overall presence or absence of carcinoma, Cohen's Kappa coefficient was estimated to assess the agreement between cytological scoring systems and histopathology diagnostic categories, which was 0.786 (approx. 80%).

DISCUSSION

FNA of breast lumps is one of the initial methods of diagnosis in order to assess the mode of treatment and also helps in knowing the prognosis of disease. FNAC also helps the clinicians to take decision and discuss the management and prognosis of disease in surgery outpatient clinic.

As a uniform approach to breast FNAC, tumor grading has to be mentioned in breast aspirate reports, which will help in prognostication, and this has been recommended by the NCI.[6] The cytological grading helps in diagnosing the tumor *in situ* so that appropriate management is given to the patient and the morbidity associated with overtreatment of low-grade tumors could be avoided. Correlating cytological diagnosis with histopathological diagnosis helps in getting a feedback and also increases the efficiency of the cytopathologist in reporting the FNA of breast lumps.

Table 2: National Cancer Institute scoring system for the interpretation of fine-needle aspiration cytology[7]

Category	Cytomorphology
C1	Insufficient material
C2	Benign
C3	Atypia, probably benign
C4	Suspicious, probably *in situ* or invasive carcinoma
C5	Malignant

Table 3: Robinson's cytology grading for interpretation of carcinoma cases on fine-needle aspiration cytology[8]

Cell dissociation	Cell uniformity	Nuclear size	Nuclear margin	Nucleoli	Chromatin pattern	Score
Mostly clusters	Monomorphic	1-2 times the size of RBCs	Smooth	Indistinct/small	Vesicular	1
Single cells, clusters	Mildly pleomorphic	3-4 times the size of RBCs	Slightly irregular/fold	Noticeable	Granular	2
Mostly single cells	Pleomorphic	>5 times the size of RBCs	Buds, clefts	Abnormal	Clumping/clearing	3

Grade 1: 6-11, Grade 2: 12-14, Grade 3: 15-18. RBCs: Red blood cells

With respect to the MMSI in the present study, out of the total 54 breast aspirate cases, 25 (46.29%) cases showed concordance with histopathology diagnosis. Category II and category IV of MMSI showed higher concordance rate of 75% and 100%, respectively, with histopathology diagnosis. Maximum number of discordant cases (83.3%) was seen in category III which included two cases of nonproliferative breast disease and three cases of carcinoma on histopathological diagnosis. Similar observation was also made by Cherath et al. in category II and category IV, while the author had a higher concordance in category I and category III as compared to the present study.[9] In the present study, category IV had 100% concordance with histopathological diagnosis, which was similar to studies done by Masood et al. and Nandini et al.[2,3,5]

As per the NCI cytology grading system, 39 out of 54 (72.2%) cases showed concordance between cytological grading and histopathology diagnosis. There was 100% concordance in category II (C2) and 90% concordance in category V (C5). Majority of the discrepant cases were seen in category III (C3 – CIS/invasive carcinoma) of 85.7%. However, five out of seven cases were confirmed as malignancy on histopathological diagnosis. There are no published studies in English literature which compare the NCI breast cytological grading system with histopathological categories defining concordance or discordance.

With respect to the Robinson's grading system in the present study, out of the total 54 cases, 21 cases (38.8%) were diagnosed as carcinoma on FNAC. Out of the 21 cases, four (19.04%), six (28.57%), and 11 (52.38%) cases were graded as Grade I, Grade II, and Grade III, respectively. Out of which only 14 (66.6%) cases were diagnosed as malignant on excision specimens and one was diagnosed as malignant on tru-cut biopsy. Majority of the cases were

Table 4: Classification of histopathological lesions of breast[9]

Category	Lesions included
Nonproliferative lesions	Fibrosis
	Cysts
	Adenosis (nonsclerosing)
	Duct ectasia
	Benign lumps or tumors (lipoma, hamartoma, hemangioma, hematoma, and neurofibroma)
Proliferative lesions without atypia	Usual ductal hyperplasia
	Fibroepithelial proliferative lesions (fibroadenoma, benign phyllodes tumor)
	Sclerosing adenosis
	Multiple papilloma or papillomatosis
	Radial scar
Proliferative lesions with atypia	Atypical ductal hyperplasia
	Atypical lobular hyperplasia
CIS/carcinoma	CIS (all types)
	Carcinoma (all types)

CIS: Carcinoma *in situ*

Table 5: Modified Scarff-Bloom-Richardson grading system of histopathology of carcinoma breast[10]

Tubule formation	Nuclear pleomorphism	Mitotic counts (per 10 HPF)	Score
Majority of the tumor (>75)	Small, uniform cells	0-5	1
Moderate degree (10%-75%)	Moderate increase in size/variation	6-10	2
Little or none (<10%)	Marked variation	>11	3

Grade 1: Well differentiated (score 3-5), Grade 2: Moderately differentiated (score 6-7), Grade 3: Poorly differentiated (Score 8-9), HPF: High-power field

Table 6: Comparison of Modified Masood's Scoring Index with histology diagnosis

Cytology		Histology			
Category	Number of cases (%)	NPBD (%)	PBD without atypia (%)	PBD with atypia (%)	CIS/carcinoma (%)
NPBD	28 (51.85)	6 (21.42)	22 (78.57)	-	-
PBD without atypia	8 (14.81)	1 (12.5)	6 (75)	1 (12.5)	-
PBD with atypia	6 (11.11)	2 (33.33)	-	1 (16.66)	3 (50)
CIS/carcinoma	12 (22.22)	-	-	-	12 (100)
Total	54	9	27	2	15

NPBD: Nonproliferative breast disease, PBD: Proliferative breast disease, CIS: Carcinoma *in situ*

Table 7: A 2×2 table of carcinoma cases categorized by fine-needle aspiration cytology (Modified Masood's Scoring Index) and histology

FNAC	Excision biopsy	
	Positive	Negative
Positive	12	0
Negative	3	39

FNAC: Fine-needle aspiration cytology

Table 8: Comparison of National Cancer Institute cytological grading system with histology diagnosis

	Cytology	Histology			
Category	Number of cases (%)	Benign (%)	Atypical, probably benign (%)	CIS/invasive carcinoma (%)	Malignant (%)
C1	4 (7.40)	4	-	-	-
C2	28 (51.85)	28 (100)	-	-	-
C3	5 (9.25)	4 (80)	1 (20)	-	-
C4	7 (12.96)	-	1 (14.28)	1 (14.28)	5 (71.42)
C5	10 (18.51)	1 (10)	-	-	9 (90)
Total	54	37	2	1	14

C1: Unsatisfactory, C2: Benign, C3: Atypia, probably benign, C4: Carcinoma *in situ*/invasive carcinoma, C5: Malignant, CIS: Carcinoma *in situ*

Table 9: A 2×2 table of carcinoma cases categorized by fine-needle aspiration cytology (National Cancer Institute) and biopsy

FNAC	Excision biopsy	
	Positive	Negative
Positive	9	1
Negative	6	38

FNAC: Fine-needle aspiration cytology

Table 10: Comparison of Robinson's scoring system with Modified Scarff-Bloom-Richardson grading system of histopathology

	Cytology	Histology					
Category	Number of cases (%)	Grade 1 (%)	Grade 2 (%)	Grade 3 (%)	Benign (%)	Atypia (%)	Carcinoma on tru-cut biopsy (%)
Grade 1	4 (19.04)	1 (25)	-	-	2 (50)	1 (25)	-
Grade 2	6 (28.57)	3 (50)	1 (16.6)	-	1 (16.6)	1 (16.6)	-
Grade 3	11 (52.38)	3 (27.27)	3 (27.27)	3 (27.27)	1 (9.09)	-	1 (9.09)
Total	21	7	4	3	4	2	1

Cytology - Grade 1: Low grade, Grade 2: Intermediate, Grade 3: High. Histology - Grade 1: Well differentiated, Grade 2: Moderately differentiated, Grade 3: Poorly differentiated

Table 11: A 2×2 table of carcinoma cases categorized by fine-needle aspiration cytology (Robinson's) and biopsy

FNAC	Excision biopsy	
	Positive	Negative
Positive	15	6
Negative	0	33

FNAC: Fine-needle aspiration cytology

Table 12: Comparison of statistical analysis of all the three scoring systems

Variables	MMSI	NCI	Robinson's scoring
Sensitivity (%)	80	60	100
Specificity (%)	100	97.44	84.62
PPV (%)	100	90	71.43
NPV (%)	92.86	86.36	100
Diagnostic accuracy (%)	94.44	87.04	88.89

MMSI: Modified Masood's Scoring Index, NCI: National Cancer Institute, PPV: Positive predictive value, NPV: Negative predictive value

71.2%, 64%, 63.3%, 77.19%, and 72.2% of concordance, respectively.[4,11-15] In the present study, the low concordance could be due to less number of cases included in the study. Maximum discordance was seen in Grade 3 where three cases each were undergraded by two grades and one grade on histopathology grading (SBR).

Most of the cytology grading systems used in scoring the breast aspirates help in categorizing only the breast carcinoma cases. The MMSI and NCI scoring systems help in categorizing breast aspirates into benign and malignant lesions. In the present study, Robinson's scoring system which had a sensitivity of 100% was most effective in subcategorizing breast lesions, whereas MMSI with both specificity and PPV of 100% and diagnostic accuracy of 94.44% [maximum among the three scoring systems – Table 12] could be considered as the standard grading system for the breast lesions on cytology.

Further studies with more number of cases should be done in order to standardize the cytology grading system, which helps in categorizing both benign and malignant breast lesions. This standardization will further help the surgeons to plan the management and also in predicting the prognosis of the disease.

in Grade III. The overall concordance among the 14 cases was 35.71%. Robinson *et al.* had a concordance of 57%, whereas similar studies done by Das *et al.*, Lingegowda *et al.*, Srivastava *et al.*, Saha *et al.*, and Phukan *et al.* had

Table 13: A 2×2 table of carcinoma cases categorized by fine-needle aspiration cytology and biopsy

FNAC	Excision biopsy	
	Positive	Negative
Positive	15	6
Negative	0	33

CONCLUSION

Robinson's scoring system is the system with maximum sensitivity and is most effective in subcategorizing only malignant breast lesions. MMSI is the system with maximum specificity, PPV, and diagnostic accuracy, and can be considered as the standard grading system for both benign and malignant breast lesions on cytology.

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Conflicts of interest
There are no conflicts of interest.

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