ORIGINAL ARTICLE

DIAGNOSTIC ACCURACY OF US-FNAC OF AXILLARY LYMPH NODES IN PATIENTS WITH PRIMARY BREAST CANCER USING SENTINEL LYMPH NODE BIOPSY AS STANDARD REFERENCE

Muhammad Bilal Fayyaz, Imran Khalid Niazi
Shaukat Khanum Memorial Cancer Hospital & Research Centre, Lahore-Pakistan

Background: The advent of US guided FNAC in the investigation of adenopathy has become a suitable and commonly practiced minimally invasive procedure which is safe, simple, quick, highly cost effective and innocuous. Nowadays, in modern days FNAC is done in almost all cases due to its high specificity, Positive predictive value (PPV) and no complications resulting in fewer SNLB and directly proceeding with neo-adjuvant chemotherapy or ALND. **Methods:** A total of 160 females between ages 30–60 years who had clinical palpable breast lump, newly diagnosed cases of breast cancer with palpable axilla nodes were included. Patients who already received neoadjuvant therapy and whose biopsy does not yield enough specimens and needs repeat biopsy were excluded. All the patients were then undergoing ultrasound guided fine needle aspiration. Afterwards, all patients were gone through axillary surgery for the definite histopathology report. FNAC results were compared with pathology after SLNB. Results: Mean age was 46.61±8.75 years. In 67 FNAC positive patients, 61 were True Positive and 06 were False Positive. Among, 93 FNAC negative patients, 18 were False Negative whereas 75 were True Negative. Overall sensitivity, specificity, negative predictive value, positive predictive value and diagnostic accuracy of US guided FNAC of suspicious axilla nodes in patent with primary breast carcinoma was 77.22%, 92.59%, 80.65%, 91.04% and 85.0% respectively. **Conclusion:** This study concluded that US guided FNAC of suspicious axilla nodes in patient with primary breast carcinoma has quite acceptable diagnostic accuracy.

Keywords: Breast malignancy; Fine needle aspiration cytology; Axillary lymph node dissection; Aentinel lymph node biopsy; Sensitivity

Citation: Fayyaz M, Niazi IK. Diagnostic accuracy of US-FNAC of axillary lymph nodes in patients with primary breast cancer using sentinel lymph node biopsy as standard reference. J Ayub Med Coll Abbottabad 2019;31(2):242–7.

INTRODUCTION

Across the world, the leading cause of female mortality due to cancer is breast carcinoma. It accounts to approximately one third of all cancers with highest incidence among women. There are limited authentic sporadic reports available before year 2000 regarding incidence and prevalence of breast carcinoma in Pakistan.[1] In Pakistan, breast cancer comprises of 41% of female cancers whereas overall it accounts for 23% of all cancers.[2] The status of axilla nodes in the preliminary staging of recently diagnosed breast malignancy is crucial for management and prognosis. One also cannot undermine the role of immunohistochemistry, the growing list include determining subtypes of breast carcinoma, response to chemo/endocrine therapies and prognosis. Most important diagnostic markers in detecting breast cancers include hormone receptors like oestrogen receptor (ER), progesterone receptor (PR), oncogene (HER2-neu) and markers of cell proliferation (Ki-67).

Regarding axillary lymph node dissection (ALND), it is one of the most orthodox part of breast malignancy therapy, however, subsequent complications like lymphedema, paraesthesia and reduced shoulder mobility are frequently seen. Consequently, sentinel lymph node biopsy (SLNB) was invented over the years to reduce harmfulness and evade needless ALND.[3] The concept of Sentinel lymph node; which by definition is the first node to which the cancer cells spread; is vital regarding prognosis of breast cancer. Nonetheless, SLNB is a tedious, technique-dependent method with known complications.

The advent of US guided FNAC has developed as a suitable minimally invasive procedure which is safe, simple, quick, extremely economical and harmless. Nowadays, in modern days FNAC is done in almost all cases due to its high specificity, positive predictive value (PPV) and no complications resulting in fewer SNLB and directly proceeding with neo-adjuvant chemotherapy or ALND.[4] US-guided FNAC is highly practical and precise as initial investigative procedure with differentials comprising of granulomatous/reactive hyperplasia or malignancy which warrants further diagnostic tests, follow up or surgical interventions with reported 40–87% sensitivities and 56–100% specificities, respectively.[5]

According to one study, US guided FNAC was performed in 1,152 cases. 821 patients had malignant lymph nodes which resulted in avoiding 11.7% of patients to undergo needless SLNB. All 331 patients having abnormal US but benign results on FNAC were

subjected to t SLNB for staging purposes. After combining ultrasound with FNAC the accuracy, sensitivity, PPV and specificity were 80.3%, 52.4%, 100% and 100% as compared to diagnostic accuracy, sensitivity, PPV, and specificity of 76.7%, 58.6%, 79.6% and 89.4% when only ultrasound was performed. The study proved that in newly diagnosed breast cancer patients, US-FNAC was an effective and feasible triage during axillary nodal staging.[6]

The rationale of this study is to evaluate the diagnostic accuracy of US-guided FNAC by keeping SLNB as reference standard in establishing axillary lymph node metastasis in Pakistan since there is only one study found in the local literature which determines the role of US-guided FNAC which mainly compares it with ALND and correlates it with primary tumour size.[7] Purpose of study will also include use of FNAC to avoid unnecessary diagnostic axillary node surgery and its related complications.

Operational Definitions:

1. Suspicious axillary Lymph node: Eccentric lymph node with cortical thickness > 3 mm ± loss of fatty hila on ultrasonography is labelled as suspicious lymph node. Figure-1
2. US guided Fine needle aspiration cytology: It is a diagnostic tool used for investigation of superficial masses or lumps that are just underneath the skin. A hollow 23/25-gauge hypodermic needle is introduced into the targeted mass. Cells are sampled/stained and evaluated under a microscope.
3. Sentinel lymph node biopsy: The first lymph nodes into which a tumour drains is named a sentinel node. It includes injecting 39 MBq of Tc-99m Nano-Colloid tracer injected intradermally at 2 sites around the areola which aids surgeons trace the sentinel nodes during surgery. Images are acquired at 45 minutes post injection.
4. Positive lymph nodes: Specimen which reveal cells having high N/C ratio, overlapping, pleomorphic, vesicular to hyperchromatic nuclei suggestive of metastasis.
5. Negative/Reactive lymph nodes: Specimen which reveal benign cells or granulomatous appearance.
6. Inclusion criteria would consist of all females between age 30-60 years who have clinical palpable breast lump, palpable axillary lymph nodes and who has received no prior chemo/radiotherapy.
7. True Positive: Positive on both ultrasound guided FNAC and SNLB.
8. True Negative: Negative on both ultrasound guided FNAC and SNLB.
9. False Positive: Positive on ultrasound guided FNAC but negative on SNLB.
10. False Negative: Negative on ultrasound guided FNAC but positive on SNLB.
11. Sensitivity = TP/ TP + FN x 100
12. Specificity = TN/ TN + FP x 100
13. Positive predictive value (PPV) = TP/ TP + FP x 100
14. Negative predictive value (NPV) = TN/ TN + FN x 100

MATERIAL AND METHODS

This was a retrospective study. Patient population largely belonged to the North West/North East of Pakistan, patients accepted through Walk-In Clinic at Shaukat Khanum Hospital facilities located in Peshawar, Lahore, Multan and Karachi. The duration of the study was 2 months with sample size of 160 case, calculated with 95% confidence level, 7% margin of error for 87% sensitivity, 6% margin of error for 89.4% specificity of US guided FNAC in the diagnosis of suspicious axillary lymph nodes and taking expected percentage of breast cancer, i.e., 41% by taking sentinel lymph node as gold standard. Non-probability, consecutive sampling technique was used. Inclusion criteria included females of aged 30–60 years as per operational definition and patients who had initially being diagnosed as invasive ductal carcinoma (IDC) on core/excisional biopsy of breast lump.

Exclusion criteria included patients who had already received neoadjuvant therapy outside the hospital before surgery, patients who had other cancers apart from breast cancer which involve lymph nodes i.e. lymphoma, lung cancer etc., patients whose biopsy does not yield enough specimens requiring re-biopsy and a benign breast disease diagnosis in the biopsy report.

After approval from Institutional Review Board, patients fulfilling the inclusion criteria were enrolled who are referred to Radiology Department for assessment of breast lumps with suspicious axillary lymph nodes. After Informed consent, demographic profile (name, age, address contact) was obtained. All this information was recorded on proforma (attached). Subsequently, US guided FNAC was performed by one radiologist who has done fellowship in woman imaging. Using Toshiba Xario Prime machine with high frequency probe, the fine needle aspiration cytology was performed using 25-gauge needle and sample sprayed on a slide.

The aspirated fluid was dried in air, fixed with Cytotec solution and processed according to May-Grunwald-Giemsa method. After informed consent, all patients were undertaking axillary surgery for the definite histopathology including grade of the tumour according to the reporting Pathologist using modified Bloom–Richardson–Elston grading. The technique of surgery was decided by the surgeon's preference. The patient's demographics, preoperative axillary lymph node features, clinicopathological features including

FNAC, surgical lymph node findings and final pathologic staging were reviewed. FNAC result was compared with pathology after SLNB.

SPSS-15 was used for statistical analysis. Inferences were drawn and where possible charts and graphs were provided. Sensitivity, specificity, positive/negative predictive value and diagnostic accuracy of US guided FNAC by generating 2x2 table taking SNLB as gold standard. Quantitative data like age and grade of tumour were presented in the form of mean±S.D. Qualitative data like suspicious axilla node on US guided FNAC and on sentinel lymph node biopsy were presented in the form of frequency and percentages. Data was stratified for age & grades of tumour to report the effect modifier. Post-stratification Chi-square test was applied with *p*-value <0.05 as significant.

RESULTS

Age range in this study was from 30–60 years with mean age of 46.61±8.75 years. Majority of the patients 89 (55.62%) were between 46–60 years of age as shown in Table-1. Percentage of patients according to grades of tumour is shown in table-2 with mean grade of 2.07±7.62.

All the patients were subjected to US guided FNAC of suspicious axillary lymph nodes. FNAC supported the diagnosis of positive axillary lymph nodes in 67 (41.88%) patients. SNLB confirmed positive axillary lymph nodes in 79 (49.38%) cases where as 81 (50.62%) patients revealed negative axillary lymph nodes. In 67 FNAC positive patients, 61 (True Positive) had positive axillary lymph nodes and 06 (False Positive) had negative axillary lymph nodes on SNLB. Among, 93 FNAC negative patients, 18 (False Negative) had positive axillary lymph nodes on SNLB whereas 75 (True Negative) had negative axillary lymph nodes on SNLB as shown in table-3.

Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of US guided FNAC of suspicious axillary lymph nodes in patent with primary breast cancer was 77.22%, 92.59%, 91.04%, 80.65% and 85.0% respectively. Figure-2

Stratification of diagnostic accuracy with respect to age groups has shown in table 4 and 5. Stratification of diagnostic accuracy with respect to grades of tumour has shown in table-6 to 8.

Table-1: Percentage of patients according to age distribution.

Age (years)	No. of Patients	%age
30–45	71	44.38
46–60	89	55.62
Total	160	100.0

Mean±SD=46.61±8.75 years

Table-2: Percentage of patients according to grades of tumour.

Grades	No. of Patients	%age
1	41	25.62
2	67	41.88
3	52	32.50

Mean±SD=2.07±7.62

Table-3: Summary of Results.

	Positive result on FNAC	Negative result on FNAC	*p*-value
Positive result on SNLB	61 (TP)*	18 (FN)***	0.178
Negative result on SNLB	06 (FP)**	75 (TN)****	

TP=True positive FP=False positive FN=False negative

Table-4: Stratification of age 30–45 years (n=71).

	Positive result on FNAC	Negative result on FNAC	*p*-Value
Positive result on SNLB	37 (TP)	07 (FN)	0.495
Negative result on SNLB	03 (FP)	24 (TN)	

Sensitivity: 84.09% Specificity: 88.89% Positive Predictive Value (PPV): 92.50%. Negative Predictive Value (NPV): 77.42% Diagnostic Accuracy: 85.98%

Table-5: Stratification of age 36–60 years (n=89).

	Positive result on FNAC	Negative result on FNAC	*p*-Value
Positive result on SNLB	24 (TP)	11 (FN)	0.208
Negative result on SNLB	03 (FP)	51 (TN)	

Sensitivity: 68.57% Specificity: 94.44% Positive Predictive Value (PPV): 88.89% Negative Predictive Value (NPV): 82.26% Diagnostic Accuracy: 84.27%

Table-6: Stratification of grade 1 (n=41).

	Positive result on FNAC	Negative result on FNAC	*p*-Value
Positive result on SNLB	12 (TP)	05 (FN)	0.651
Negative result on SNLB	03 (FP)	21 (TN)	

Sensitivity: 70.59% Specificity: 87.50% Positive Predictive Value (PPV): 80.0%. Negative Predictive Value (NPV): 80.77% Diagnostic Accuracy: 80.49%

Table-7: Stratification of grade 2 (n=67).

	Positive result on FNAC	Negative result on FNAC	*p*-Value
Positive result on SNLB	**29 (TP)**	**06 (FN)**	**0.604**
Negative result on SNLB	**03 (FP)**	**29 (TN)**	

Sensitivity: 82.86%, Specificity: 90.63% Positive Predictive Value (PPV): 90.63%. Negative Predictive Value (NPV): 82.86% Diagnostic Accuracy: 86.57%

Table-8: Stratification of grade 3 (n=52).

	Positive result on FNAC	Negative result on FNAC	*p*-Value
Positive result on SNLB	20 (TP)	07 (FN)	0.168
Negative result on SNLB	00 (FP)	25 (TN)	

Sensitivity: 74.07%, Specificity: 100.0%, Positive Predictive Value (PPV): 100.0%, Negative Predictive Value (NPV): 78.13%, Diagnostic Accuracy: 86.54%

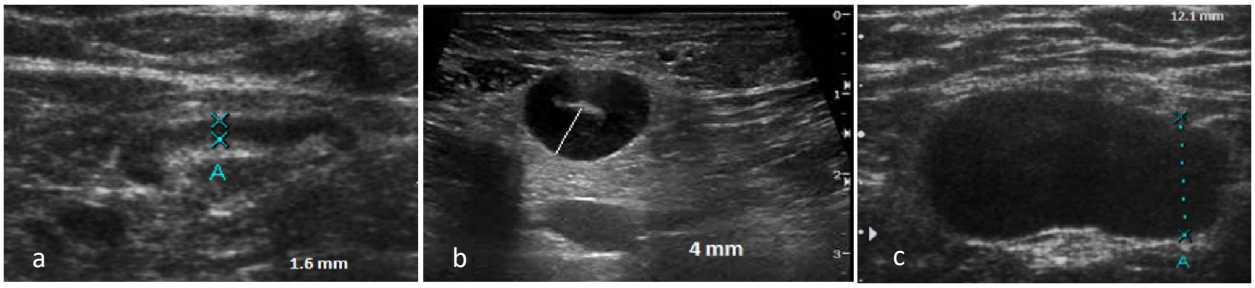

Figure-1: Sonographic features of axillary lymph nodes; a) benign lymph nodes with oval/elongated shape, ≤3 mm cortical thickness and preserved fatty hilum. (b & c) suspicious lymph nodes with circumscribed/enlarged sizes, > 3 mm cortical thickness and loss of fatty hila

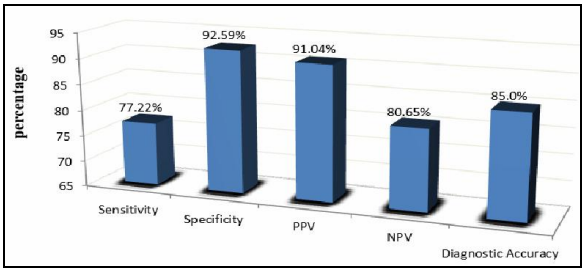

Figure-2: Diagnostic accuracy of US guided FNAC of suspicious axillary lymph nodes in patent with primary breast cancer

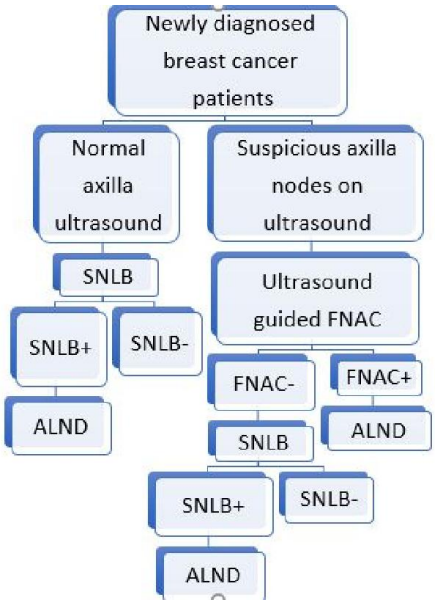

Figure-3: Management algorithm of axillary nodes in newly diagnosed breast carcinoma patients.

Keywords: Sentinel lymph node biopsy SNLB, Axillary lymph node dissection ALND

DISCUSSION

Nodal disease relapse in the axilla is reported around 3% in early stage breast carcinoma and 1.7–15.9% with any breast cancer stage.[8] Patient quality of life and cost effectiveness are the main factors when it comes to the examinations for detecting lymph node metastasis.[9] It is a major clinical challenge in order to lessen the unnecessary interventions, complications and costs, thereby decreasing too much anxiety in patients.[10]

In recently diagnosed breast carcinoma, axilla lymph node assessment is generally achieved preoperatively by clinical evaluation, ultrasound and lymph node excisional biopsy. Nevertheless, ultrasound-guided fine needle aspiration cytology (FNAC) and core needle biopsy (CNAB) have developed into probable substitutes.[11,12] Regarding recently diagnosed breast cancer patients; FNAC can accomplish high accuracy, sensitivity and specificity to establish nodal metastases.[13-15] In this study, we have determined the diagnostic accuracy of US guided FNAC of suspicious axilla lymph nodes in patent with primary breast cancer using sentinel lymph node biopsy as standard reference.

Age range in my study was from 30–60 years with mean age of 46.61±8.75 years. Majority of the patients 89 (55.62%) were between 46–60 years of age. All the patients were subjected to US guided FNAC of suspicious axilla lymph nodes. FNAC supported diagnosis of positive (malignant) axillary lymph nodes in 67 (41.88%) patients. SNLB confirmed positive axillary lymph nodes in 79 (49.38%) cases whereas 81 (50.62%) patients revealed negative axillary lymph nodes. In 67 FNAC positive patients, 61 (True Positive) had positive axillary lymph nodes and 06 (False Positive) had negative axilla lymph nodes on SNLB. Among, 93 FNAC negative patients, 18 (False Negative) had positive axilla lymph nodes on SNLB whereas 5 (True Negative) had negative axillary lymph nodes on SNLB. Overall sensitivity, specificity, PPV, NPV and diagnostic accuracy of ultrasound guided fine needle aspiration cytology of suspicious axilla lymph nodes in patent with primary breast carcinoma was 77.22%, 92.59%, 91.04%, 80.65% and 85.0% respectively.

In a local study, out of 449 patients, the total sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of US/US FNAC were 69.1%, 100%, 100%, 67.2%,

and 81.1%, respectively. Sensitivity of US criteria for axillary node staging increases with tumour size.[7]

Rao *et al*[16] retrospectively compared the accuracy of FNAB and CNB in separate patient populations, comparing group of 22 patients who underwent FNAB to another group of 25 patients who underwent CNB. The sensitivities for CNB and FNAB were 82% and 75%, respectively ($p = .11$). Small patient sample size, unrelated biopsy populations, selection, and potential operator bias might have influenced their final result. Krishnamurthy *et al*[17] reported high sensitivity for FNAB after one or two passes through cortical tissue of interest and an immediate evaluation of sample adequacy by a cytopathologist. Sampling was repeated when necessary; thus, no inadequacy was reported. Nevertheless, 12 (11.6%) false-negative findings were reported. Koelliker *et al*[18] reported a low 4% inadequacy rate yet had sensitivity similar to that in our study. The authors used a multiple three-sample pass biopsy technique from each LN, depending on the level of suspicion for malignancy. False-negative findings were consequently reported in 12 (24%) cases, mostly those with small metastatic deposits.

According to one study, US guided FNAC was performed in 1,152 cases. 821 patients had malignant lymph nodes which resulted in avoiding 11.7% of patients to undergo needless SLNB. All 331 patients having abnormal US but benign results on FNAC were subjected to t SLNB for staging purposes. After combining ultrasound with FNAC the accuracy, sensitivity, PPV and specificity were 80.3%, 52.4%, 100% and 100% as compared to diagnostic accuracy, sensitivity, PPV, and specificity of 76.7%, 58.6%, 79.6% and 89.4% when only ultrasound was performed. The study proved that in newly diagnosed breast cancer patients, US-FNAC was an effective and feasible triage during axillary nodal staging.[6]

False negative rates of FNAC have been reported by Diepstraten *et al*[19] as 25% and by Leenders *et al*[20] as 31%. Small metastasis size has been reported as the most frequent reason of false negative results. SLNB is currently the most widely accepted procedure in patients with axillary US negative or US positive but FNAC negative. Positive and no found SLNs indicate formal axillary dissection. The routine use of ultrasound is justified due to its adequate sensitivity; however, it does not omit metastases to the axillary nodes.[21] In patients with US negative and US positive but FNAC negative, SLNB is the procedure of choice for pathology of lymph nodes. SLNB (+) was performed in 20.8% (16/77) of our patients who had indication of SLN dissection. In Ibrahim-Zada *et al*'s study [22], the rate was 12.6%.

In Khout *et al'*s study,[23] 49 of 219 patients (21.5%) had metastatic nodes of which 22 patients (45%) were preoperatively diagnosed by FNAC. US-guided positive FNAC allows patients to be triaged to ALND, thereby avoiding potentially unnecessary SLNB.[24] In other words, diagnosing axillary metastases before surgery aids the surgical team to move directly to ALND.[25] So, our study established that US guided FNAC of suspicious axilla lymph nodes in patients with primary breast carcinoma has revolutionized the diagnosis and consequently management of primary breast cancer. So, it should be used routinely for screening and accurate pre-operative identification of suspicious axilla lymph nodes in patients with primary breast cancer in order to reduce morbidity and mortality.

CONCLUSION

This study concluded that US guided FNAC of suspicious axilla nodes in patients with primary breast carcinoma has quite acceptable diagnostic accuracy. So, it should be used routinely for screening and accurate pre-operative identification of suspicious axilla nodes in patient with primary breast carcinoma in order to reduce morbidity and mortality.

AUTHORS' CONTRIBUTION

MBF: Contributed in all parts of research. AKN: Discussion and Conclusions.

REFERENCES

1. Raza S, Sajun SZ, Selhorst CC. Breast Cancer in Pakistan: Identifying Local Beliefs and Knowledge. J Am Coll Radiol 2012;9(8):571–7.
2. Khokher S, Qureshi MU, Riaz M, Akhtar N, Saleem A. Clinicopathologic profile of breast cancer patients in Pakistan: ten years data of a local cancer hospital. Asian Pac J Cancer Prev 2012;13(2):693–8.
3. Krag DN, Anderson SJ, Julian TB, Brown AM, Harlow SP, Ashikaga T, *et al*. Technical outcomes of sentinel-lymph-node resection and conventional axillary-lymph-node dissection in patients with clinically node-negative breast cancer: results from the NSABP B-32 randomised phase III trial. Lancet Oncol 2007;8(10):881–8.
4. Koo V, Lioe TF, Spence RA. Fine needle aspiration cytology (FNAC) in the diagnosis of granulomatous lymphadenitis. Ulster Med J 2006;75(1):59–64.
5. Mansel RE, Fallowfield L, Kissin M, Goyal A, Newcombe RG, Dixon JM, *et al*. Randomized multicenter trial of sentinel node biopsy versus standard axillary treatment in operable breast cancer: the ALMANAC Trial. J Natl Cancer Inst 2006;98(9):599–609.
6. Feng Y, Huang R, He Y, Lu A, Fan Z, Fan T, *et al*. Efficacy of physical examination, ultrasound, and ultrasound combined with fine-needle aspiration for axilla staging of primary breast cancer. Breast Cancer Res Treat 2015;149(3):761–5.
7. Manzoor MU, Bashir U, Irshad A, Yousaf I, Din NU, Faruqui ZS, *et al*. Role of Ultrasound and Ultrasound-Guided

Fine-Needle Aspiration Cytology for Axillary Lymph Node Evaluation in Breast Cancer Patients: Correlation with Primary Tumor Size and Positive Lymph Node Number. Breast Care 2012;7(5):403–6.
8. Moon HJ, Kim MJ, Kim EK, Park BW, Youk JH, Kwak JY, *et al*. US surveillance of regional lymph node recurrence after breast cancer surgery. Radiology 2009;252(3):673–81.
9. de Bock GH, Bonnema J, van der Hage J, Kievit J, van de Velde CJ. Effectiveness of routine visits and routine tests in detecting isolated locoregional recurrences after treatment for early-stage invasive breast cancer: a meta-analysis and systematic review. J Clin Oncol 2004;22(19):4010–8.
10. Genta F, Zanon E, Camanni M, Deltetto F, Drogo M, Gallo R, *et al*. Cost/accuracy ratio analysis in breast cancer patients undergoing ultrasound-guided fine-needle aspiration cytology, sentinel node biopsy, and frozen section of node. World J Surg 2007;31(6):1155–63.
11. Ahn HS, Kim SM, Jang M, La Yun B, Kim SW, Kang E, *et al*. Comparison of sonography with sonographically guided fine-needle aspiration biopsy and core-needle biopsy for initial axillary staging of breast cancer. J Ultrasound Med 2013;32(12):2177–84.
12. Wang XW, Xiong YH, Zen XQ, Lin HB, Liu QY. Diagnostic accuracy of ultrasonograph guided fine-needle aspiration cytologic in staging of axillary lymph node metastasis in breast cancer patients: a meta-analysis. Asian Pac J Cancer Prev 2012;13(11):5517–23.
13. Gilani SM, Fathallah L, Al-Khafaji BM. Preoperative fine needle aspiration of axillary lymph nodes in breast cancer: clinical utility, diagnostic accuracy and potential pitfalls. Acta Cytol 2014;58(3):248–54.
14. García Fernández A, Fraile M, Giménez N, Reñe A, Torras M, Canales L, *et al*. Use of axillary ultrasound, ultrasound-fine needle aspiration biopsy and magnetic resonance imaging in the preoperative triage of breast cancer patients considered for sentinel node biopsy. Ultrasound Med Biol 2011;37(1):16–22.
15. Oz A, Demirkazik FB, Akpinar MG, Soygur I, Baykal A, Onder SC, *et al*. Efficiency of ultrasound and ultrasound-guided fine needle aspiration cytology in preoperative assessment of axillary lymph node metastases in breast cancer. J Breast Cancer 2012;15(2):211–7.
16. Rao R, Lilley L, Andrews V, Radford L, Ulissey M. Axillary staging by percutaneous biopsy: sensitivity of fine-needle aspiration versus core needle biopsy. Ann Surg Oncol 2009;16(5):1170–5.
17. Krishnamurthy S, Sneige N, Bedi DG, Edieken BS, Fornage BD, Kuerer HM, *et al*. Role of ultrasound-guided fine-needle aspiration of indeterminate and suspicious axillary lymph nodes in the initial staging of breast carcinoma. Cancer 2002;95(5):982–8.
18. Koelliker SL, Chung MA, Mainiero MB, Steinhoff MM, Cady B. Axillary lymph nodes: US-guided fine-needle aspiration for initial staging of breast cancer--correlation with primary tumor size. Radiology 2008;246(1):81–9.
19. Diepstraten SC, Sever AR, Buckens CF, Veldhuis WB, van Dalen T, van den Bosch MA, *et al*. Value of preoperative ultrasound-guided axillary lymph node biopsy for preventing completion axillary lymph node dissection in breast cancer: a systematic review and meta-analysis. Ann Surg Oncol 2014;21(1):51–9.
20. Leenders M, Richir M, Broeders M, Moormann G, Mollema R, Lopes Cardozo A, *et al*. Axillary staging by ultrasound-guided fine-needle aspiration cytology in breast cancer patients. Still up to date? Breast J 2013;19(6):637–42.
21. Lee B, Lim AK, Krell J, Satchithananda K, Coombes RC, Lewis JS, *et al*. The efficacy of axillary ultrasound in the detection of nodal metastasis in breast cancer. AJR Am J Roentgenol 2013;200(3):W314–20.
22. Ibrahim-Zada I, Grant CS, Glazebrook KN, Boughey JC. Preoperative axillary ultrasound in breast cancer: safely avoiding frozen section of sentinel lymph nodes in breast-conserving surgery. J Am Coll Surg 2013;217(1):7–15.
23. Khout H, Richardson C, Toghyan H, Fasih T. The role of combined assessment in preoperative axillary staging. Ochsner J 2013;13(4):489–94.
24. Houssami N, Turner RM. Staging the axilla in women with breast cancer: the utility of preoperative ultrasound-guided needle biopsy. Cancer Biol Med 2014;11(2):69–77.
25. Ecanow JS, Abe H, Newstead GM, Ecanow DB, Jeske JM. Axillary staging of breast cancer: what the radiologist should know. Radiographics 2013;33(6):1589–612.

Submitted: 17August, 2018	*Revised: 31 December, 2018*	*Accepted: 11 January, 2019*

Address for Correspondence:

Muhammad Bilal Fayyaz, Senior Instructor Radiology, Shaukat Khanum Memorial Cancer Hospital & Research Center, Lahore-Pakistan
Cell: +92 42 35905000 Ext: 4157
Email: mbf1986@hotmail.com