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Role of imaging guided wire localization of non-palpable breast lesions: Effect of localization accuracy on surgical outcome and histopathological safety margins

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ABSTRACT

Background: Metallic wire is the most commonly used method for localization of non palpable breast lesions; done under sonographic or mammographic guidance.
Aim of the study: To evaluate the role of metallic wire for localization of different non palpable breast lesions.
Patients and methods: The study was conducted on twenty female patients suggested as having non palpable breast lesions on mammographic or sonographic basis, referred to the breast unit of at Medical Research Institute of Alexandria University; and assigned for breast conserving surgery (BCS). Eighteen of these lesions were localized using ultrasound guidance; the remaining 2 procedures were done on mammographic guidance. Every specimen was subjected to mammographic assessment. Correlation with complete surgical data and histopathological findings of the excised specimen was carried out including the histopathological safety margins for judgment of the complete surgical excision.
Results: The study was conducted on 20 patients with complaints other than palpable breast lesions including: Most of the managed lesions were non palpable masses (17 patients), the remaining (3 patients) were suspicious calcifications, architectural distortion, and asymmetrical density. The managed lesions ranged from 0.7 to 22 mm in size. 50% of the lesions were localized for therapeutic indications and the remaining 50% were localized for diagnostic indications. Successful wire localization was achieved in 18 cases (90 %). Based on specimen mammographic findings,
Conclusion: wire guided localization is an effective method of preoperative localization of non-palpable breast lesions; however it is technically challenging and may pose significant difficulty; mammographic guidance done only for the lesions which can't be identified on US basis.

Key words: Wire localizations, non-palpable breast lesions, ultrasound guidance, mammographic guidance and breast conserving surgery.

INTRODUCTION

Non-palpable breast cancers constitute approximately one third of all diagnosed breast cancers; by the use of screening programs, the primary tumor detected in 28% of the analyzed patient is at its non palpable stage; moreover the increase in the use of screening examinations resulted in significantly more frequent use of breast-conserving surgeries (BCS) [1,2]

A successful BCS requires preoperative localization techniques of the non palpable breast lesions as wire-guidance, carbon marking, biopsy clips, radio-guidance, and frozen section analysis. However guided wire localization is the most widely used method for preoperative localization of non-

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palpable breast lesions. It is relatively simple and cost-effective. However, its difficulties include wire migration, inaccurate placement, and inadequate surgical margins.[3-5]

Preoperative ultrasound or mammographic guided wire localization is a procedure in which metallic hook wire is anchored in the non-palpable breast lesion so that it can be accurately excised. This would enable accurate removal of the malignant lesion with minimal removal of surrounding normal breast tissue and hence, better cosmetic results.[6]

Ultrasound is not sensitive for detection of certain types of lesions, especially micro calcifications; however mammography is very sensitive in terms of detecting suspicious calcifications, distortion of the surrounding tissue architecture, and asymmetrical density.[7,8]

Aim of the Work:

The study aims to evaluate the role of guided wire localization in different non palpable breast lesions of patients assigned for breast conserving surgery.

Patients and Methods

The study was conducted on 20 female patients suggested as having non palpable breast lesions on mammographic or sonographic basis, referred to the breast imaging unit of radiology department at Medical Research Institute of Alexandria University; and assigned for breast conserving surgery (BCS). All the cases had palpable or multicenteric lesions, metastatic or advanced breast cancer and associated breast infections were excluded from the study.

All the included patients were subjected to full history taking including personal, family, medical, operative, and menstrual history; and full clinical examination with complete radiological assessment of the breast by ultrasound and mammography.

All mammograms were obtained using a dedicated X-ray unit (Toshiba NGU-100A mammorex machine) having 0.5 target focal spot in a molybdenum anode. Technique used for a mammogram is low Kilo-voltage Peak (KvP) about 24 to 30. The milli-Ampere-seconds (mAs) was automatically selected by the machine. Four views were obtained; two for each breast, the cranio-caudal and the mediolateral oblique views.

All the patients were subjected to bilateral breast US using 7.5 MHz linear probe (Siemens Acuson X300 machine); the transducers were directly applied to the skin surface with the patient in the supine position to examine the inner quadrants of the breasts, and the supine oblique position to evaluate the outer quadrants. Scanning was performed in the radial and anti-radial planes in relation to the nipple. Both axillary regions were examined by longitudinal scanning. All nodes were examined in the longitudinal and transverse nodal planes that demonstrated the largest and smallest diameters of the node.

The full sonomammographic assessment revealed non palpable breast lesions for all of the included cases of the study, further metastatic work up, laboratory assessment, and histopathological correlation were also done.

All the breast lesions included in the study were localized under sonographic or mammographic guidance by using breast localization needle (ALM SET V 21G x 100 MM via A. Vacchi 23/25 Aprillia LT. Italy).

A. Guide wire localization under sonographic guidance: Done for localization of requested lesions which was seen on sonographic basis. The lesion requested for wire localization was re-examined, adequate positioning of the patient was done; as the patient in the supine position if the lesion was in the inner quadrants and the patient in supine oblique position if the lesion was in outer quadrant, with the arms abducted 90 degrees. The entrance point of the wire was chosen to acquire the shortest distance to the lesion; then local anaesthesia was introduced by initial superficial injection of lidocaine followed by deeper injection into the tissues surrounding the requested lesion. Then the needle wire complex was introduced under real-time guidance in a maximum 20 degrees form the vertical plane along the lateral margin of the transducer proceeding to the central portion of the examined field. This procedure fulfill two advantages; the first one was acquiring accepted visualization of the whole wire under sonographic guidance, and the second was passing the hook in the shortest distance before reaching the lesion; hence enabling the surgeon to excise the least amount of breast tissue. The freehand method was applied in all procedures; this includes holding the transducer by the non dominant hand, the breast localization needle by the other hand. Ideally the tip of needle wire is positioned 1 cm beyond the lesion, and once position is determined to be satisfactory, the wire was advanced over and the needle withdrawn gently taking care not to withdraw the wire with the needle.

B. Guide wire localization under mammographic guidance: Done for localization of suspicious calcifications, architectural distortions, or focal asymmetry that couldn't be identified on sonographic basis. Direct 90 degrees mediolateral and craniocaudal mammograms were used to judge the position of the lesion. Anaesthesia was introduced by initial superficial injection of lidocaine followed by deeper injection into the tissues surrounding the requested lesion. All procedures were performed using the parallel-to-the-chest-wall approach and using the Swiss cheese compression paddles. The patient was standing with her breast placed horizontally on the film cassette and compression applied by Swiss cheese compression paddle with craniocaudal film taken, then the needle wire was introduced in the numbered hole that is opposite to the targeted lesion by the parallel to chest wall approach. Then compression applied by compression paddle in complete medio-lateral oblique view and films taken, this allows better adjustment of the needle into the targeted lesion; so the needle position is adjusted based on these two views. Once this is satisfactory, the wire is advanced so that the hook wire anchors to the tissue and the needle is gently withdrawn.

After localization either by sonographic or mammographic guidance, two view mammograms with wire in satisfactory position were obtained and sent to the surgeon. Successful wire localization was judged by the confirmatory post localization mammograms. The ideal successful wire localization had to be transfixing the lesion and passing through its posterior aspect and extended beyond the lesion not more than 1 cm depth. Then the wire is taped firmly in position with a full descriptive report about the process of wire localization including: the description of the site , shape, size of the localized lesion ; the position of the patient during wire localization; and the direction , distance that the wire introduced through the breast tissue to reach the lesion. [9] Then lumpectomy specimen with its contained wire transferred to mammography unit and imaged; with the patients kept anaesthetized and the wound unsutured until radiological confirmation of complete surgical removal was done. This allowed confirming that the lesion and the wire are adequately removed with no residual margins. [10] Finally, the specimens were placed in formalin and sent to the pathology laboratory department where it was sectioned, pinned out to confirm safety margins of the specimen and determine the histopathology of the excised lesion. **(Figure 1)** [11,12]

Results

The study included 20 patients with complaints other than palpable breast lesions including: 8 patients examined for routine follow up, 6 patients complained of mastalgia, 2 patients complained of swelling and lesion discovered at the contra lateral breast , 2 patients complained of nipple discharge, 1 patient complained of multiple breast lumps, 1 patient presented by axillary lump; their age ranged from 29-68 years old (mean age 48.45 years) (SD +/- 9.86).The most commonly affected age group was (>50-60) years.

Most of the managed lesions were masses 17/20 (85%); the remaining 3/20 (15%) were non mass lesions represented as suspicious calcifications, architectural distortion, and asymmetrical density represented by one patient for each.

Successful wire localization was achieved in 18/20 cases (90%); on the other hand the technique was considered as a failure of adequate localization in 2/20 (10%) as the wire tip stopped within the core of the lesion and didn't transfix its posterior margin. Nevertheless non of the localization techniques failed to hit the lesion in all 20 patients

Only one patient developed vaso vagal attack during the process of wire localization; with no other complications documented including: bleeding, visceral intra thoracic injuries, nor deep wire insertion. Delayed complications after wire localization were detected in 3 patients including: one for wire dislodgement, one for wire fragmentation, and the last one developed wire migration. However no iatrogenic wire transection occurred. **(Figure 2,3).**

In the current study; only ACR a, b, and c mammographic patterns were detected; the most common type of breast density was ACR b detected in 9 cases (45%), while ACR a was detected in (8 cases) 40%. ACR c was represented by 3 cases (15%), while no patient was categorized as ACR d. Failure of localization occurred in 1/9 cases of ACR b, and in 1/3 cases of ACR c mammographic patterns; no failure rate of localization occurred at the 8 patients of ACR a category.

The smallest lesion in the study was 7 mm and the largest one was 22 mm. Most of the lesions were in the size group of >15-20 mm (Mean size of the lesions was 14.50 mm) (SD was +/-5.01). Failure of wire localization occurred in 1/5 cases (20%) in the cases ranging from 10-15mm. Another failure occurred in 1/7 cases (14.3%) ranging from 15-20mm.

Ultrasound was the guidance method of localization in 18/20 cases (90%), while mammographic guidance was used remaining 2/20 cases (10%; one of them was architectural distortion, the other had asymmetrical density. Failure of adequate wire localization occurred in 1/18 (5.5%) of the lesions localized under sonographic guidance; and in 1/2 cases (50%) of the lesions localized under mammographic guidance. (Figure 4).

Lesions were localized at the upper breast quadrants in 14/20 (70%), the inferior breast quadrants lesion locations were present in 6/20

(30%). Failure of wire localization increased at inferior breast lesions (1/6 cases) 16.6%; in comparison to (1/14 cases) 7.14% at the upper breast lesions. **(Figure 3).**

All lesions included in the study were deeply located within the breast parenchyma by not less than 3 cm from the skin surface and 2cm from the retro mammary fascia. No lesion associated with skin or chest wall infiltration was included in the study.

Based on specimen mammogram; the complete surgical excisions was detected in 12/20 (60%) of the cases. All of them showed free histopathological margins (100%). Incomplete excisions were mammographically suggested in 8/20 (40 %) patients. 4 of them (50%) of them proved to have histopathological marginal infiltration and the remaining 4 lesions showed free safety margins. The total accuracy of specimen mammogram in detection of histopathological marginal condition was 80%.

Failure of adequate localization was experienced in only 1/12(8.9%) of the completely excised lesions based upon specimen mammogram; another localization failure had been detected in 1/8(12.8%) of the incompletely excised lesions based on specimen mammogram.

The final histopathological assessment showed malignant lesions in 13 of 20 (65 %) and benign lesions in 7 of 20 (35%).

According to histopathological safety margins; 16 / 20 specimens (80 %) showed free safety margins, the remaining 4 / 20 (20 %) showed infiltrated margins. 14/16 (87.5%) of the specimens with free safety margins were been adequately localized.

DISCUSSION

Most of the managed lesions included in the current study were masses (85%); lower incidence of mass lesions (55%) has been reported in the study of Nadeem[13] which can be attributed to larger size of his study group. Suspicious calcifications, architectural distortion, and asymmetrical densities were represented in the current study as well as Nadeem[13] with different incidences. The larger incidences of Nadeem[13] study is also attributed to the larger size of his study group.

Abrahamson[14] reported that the radiologist performing wire localization must place the wire only within 5 mm of the lesion to increase the probability of success; while Saguatti[15] reported that the guide wire should ideally transfix the breast lesion in both projections of post localization mammogram with no more than 1 cm depth; In the current study we followed the criteria suggested by Saguatti[15].

Successful wire localization in the current study was (90%) cases; a nearly similar percentage was reported by Ngo. [16] in whose report 67/70 (95.5 %) were successfully localized inspite of using the localization criteria proposed by Abrahamson[14] ; subsequently we can suggest similar efficacy of applying both criteria.

The current study showed the occurrence of many complications including: vaso vagal attack (5%), wire dislodgement (5%), wire fragmentation (5%), and wire migration (5%). Similar complications have been reported by Symmonds [17] who encountered vasovagal reaction in 1/500 cases (0.2%) , Owen.[18] Who reported 3 migrations of 158 cases (1.9 %), and Medina-Franco[19] who reported migration in 1 / 50 cases (2 %).

In the current study; mammographic breast densities were ACR a (40%) , and b, (45%) and ACR c (15%), and no case was categorized as ACR d; this differs from the incidences reported by Abrahamson[14] in whom study all patterns were represented; this difference can be attributed to the large size of his study group (202 patients).

Failure of localization occurred only in 2/20 cases (10%) in the current study. Both of them were at the mammographic densities of ACR b, and c; no failure rate of localization occurred at ACR a category. This agrees with Abrahamson[14] who reported increased failure incidence at the dense breasts.

Mazouni[20] and Abrahamson[14] reported that the size of the managed lesions were no a significant predictor for success or failure of the localization process.; similarly the lesion size doesn't affect the success of wire localization in the current study as failure occurred in relatively sizeable lesions ; one lesion in 10-15mm , and one lesion in 15-20 mm.

In the current study most of localization procedures (90%) were done under sonographic guidance, and only 10% were done under mammographic guidance, this attributed to that the study location was a diagnostic imaging department; which doesn't perform screening programs. On the other hand Giacalone[21] reported a higher percentage of mammographic guidance 31 of 86 cases (36%) of his cases ;as his cases were included in a screening program; showing more percentage of breast abnormalities; that can only be localized under mammographic guidance.

Sonographic guidance also shoed real time advantages of examination and interventional processes; it was easier, safer with real time needle monitoring. It could detect some lesions with better diagnostic accuracy notably in dense mammograms.

Failure of adequate wire localization occurred in 1/18 (5.5%) of the cases localized under sonographic guidance; and in 1/ 2 (50%) of the cases localized under mammographic guidance as it didn't transfix the lesion. But Toft[22] reported that 33/45 (74%) of mammographically guided lesions were transfixed by the wire, 10/45 (22%) of the cases showed the wire within 1cm of the lesion, and the wire missed the lesion in 2/45 (5%) of the cases.

The current study showed (70%) of the localized lesions were located at the upper breast quadrant; while (30%) of the localized lesions were located at

inferior breast quadrants. Failure of wire localization increased at inferior breast lesions (1/6 cases) 16.6%; in comparison to (1/14 cases) 7.14% at the upper breast lesions. This agreed with Evans [23] who reported that the most difficult lesions to be localized using the wire technique located at the inferior breast quadrants.

Based on the specimen mammogram; (12/12) 100% of the completely excised lesions showed free histopathological margins, and 50% of the remaining 8 incompletely excised lesions were histopathologically infiltrated; with total accuracy 80% in assessment of histopathological condition of the margins; this agreed with Lee[24] who reported complete excision with safety margins (44 of 79) 56 % and incomplete with indeterminate excision with marginal infiltration in (32 of 46) 69.5 % with accuracy about 62 %.

Based on specimen mammographic findings, (91.1%) of the completely excised lesions were localized adequately, and the remaining (8.9%) of the completely excised lesions were inadequately localized. This agreed with Abrahamson[14] who also stated that precise wire localization increase the probability of surgical success.

Conclusion

Wire localization is one of the most wide spread localization techniques; considered essential step for lumpectomy of non-palpable breast lesions. Accuracy of wire insertion is high predictive factor for accuracy of lesional excision. Moreover the status of specimen mammogram is predictive for condition of histopathological margins. Success of the technique is influenced by breast density but not by the lesion's size. The inferior lesions are comparatively difficult to be localized compared to the superiorly located ones. Although sonographic guidance appears to be easier, safer, with real time visualization; it may inapplicable in many circumstances at which mammography is the only technique demonstrating the abnormality.

Conflict of Interests:

The authors declare that there is no conflict of interests regarding the publication of this paper.

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