

## Pre-operative Localization of Non-Palpable Lesions in Breast Cancer by Charcoal Suspension

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### Abstract

**Purpose:** evaluate of preoperative charcoal localization of primary non palpable lesions, Encourage the policy of screening & early detection among asymptomatic women especially who are at risk and increase the rate of breast conservative surgery (BCS) in management of breast cancer. **Methods:** The present prospective study included 30 patients with nonpalpable breast mass. A mean Age of  $50.83 \pm 15.72$  years. 30 patients underwent lumpectomy modified radical mastectomy (MRM) and BCS. From Nov 2019 to May 2022. **Results:** included 30 patients their age ranged from 21 to 77 years with mean age 50.83 years, 36.7% of the studied patients had positive family history, 50% of the studied patients have no complain, 23.3% of the studied patients complained of breast lump, 13.3% had breast pain, where bleeding per nipple, nipple discharge, nipple retraction and complained of nipple ulceration had 3.3% to each, Regarding site of lesion, 40%, 20%, 16.7%, 13.3%, 6.6%, 3.3% had lesions in upper outer quadrant, areola, lower outer quadrant, and upper inner quadrant, central, lower inner quadrant respectively, 50%, and 43.3%, had right-sided and left sided lesions respectively. Bilateral lesion was present in two patients (6.7%), 53.3% of patients had benign lesions while fourteen patients (46.7%) had malignant lesions, the patient underwent lumpectomy 54%, BCS 10 patients 33% while 4 patients (13%) had MRM, 56.7% patients had no inflammatory response, 13 patient had acute inflammatory response. Of them, 30% had mild response while 13.3% had moderate inflammation. No of them had severe inflammatory response with abscess formation. Only one specimen of them showed severe inflammatory response, **Conclusion:** US Guided Injection of Charcoal Suspension for non-palpable breast lesions is a very simple, safe and accurate method. After localization by this method.

**Keywords:** Nonpalpable Lesions, Breast Cancer, Charcoal Suspension, Preoperative Localization, Breast.

### 1. Introduction

Breast cancer (BC) is a malignant growth in any part of the breast and the most common diagnosed cancer among women worldwide. <sup>[1,2]</sup> Early detection is usually done through screening, and screening methods include breast self-examination (BSE), clinical breast examination (CBE), and mammography. <sup>[3]</sup>

The BIRADS acronym stands for Breast Imaging-Reporting and Data System, which is a widely accepted risk assessment and quality assurance tool in mammography, ultrasound or MRI. Part of the initial implementation was to make the reporting of mammograms more standardized and comprehensible to the non-radiologist reading the report. <sup>[4]</sup> More than 25% of radiologically detected suspicious breast lesions are non-palpable, so preoperative localization followed by adequate surgical excision presents challenging technical problems because the shape and position of the breast during compression mammography may be quite different from that seen by the surgeon in the operating room. This had led to the development of several methods for preoperative localization of non-palpable lesions. <sup>[5]</sup>

When invasive cancer is diagnosed, the extent of the disease should be assessed. The currently used TNM (Tumour, Nodes and Metastases) system depends on clinical measurements and clinical assessment of lymph node status. <sup>[6]</sup> An US guided charcoal localization is rapid and technically easy to perform with minimal patient discomfort. The charcoal

suspension stability over time is one of its major advantages. <sup>[7]</sup>

Treatment of breast cancer has changed over the years, both surgically and medically. The intention of surgical treatment is to achieve local control, prevent locoregional recurrence and improve survival. <sup>[8,9]</sup>

### 2. Patients and methods

Prospective descriptive study that was included a convenient sample of about 30 female patients with breast cancer who were treated at the Benha university hospital, Oncology Center Mansoura University and Meet Ghamr Oncology Center, followed by surgery as well be recommended by multidisciplinary team

#### 2.1. Inclusion criteria

Patients with non-palpable suspicion breast lesion (BIRADS IV and V) and Patient who showed a good clinical response to NACT.

#### 2.2. Exclusion criteria

Patients refusing surgery, Patients unfit for surgery, refuse to continue in this study, who escape during the follow up period.

Severe comorbidity, (Metastatic, Inflammatory, Recurrent, Unplanned excised, Multicentric or multifocal) breast cancer, Stable and progressive disease on NACT.

#### 2.3. Preoperative localization of the breast mass

##### 2.3.1. Preparation of sterilized charcoal suspension:

A sterilized 3% aqueous suspension of activated charcoal granules was prepared as; 3 gm. of activated charcoal was added to 100 ml of distilled water. The

preparation was sterilized with 120° steam over a period of 20 minutes then distributed in 5 ml bottles.

**2.3.2. Localization of the breast mass:** Charcoal injection will be done under ultrasonic guidance for suspicious lesion and after detection of good response for neoadjuvant chemotherapy.

**2.3.3. Localization of Non-Palpable Lesions in Breast Cancer by Charcoal Suspension:** After a breast radiologist identifies the lesions by US by, 2 cc 1% lidocaine was injected into the skin directly over the lesion. Approximately 1- 3 cc of the charcoal suspension was aspirated using a 10 ml syringe and the needle was inserted into the lesion vertically. The point of the needle entry was selected carefully and individually tailored according to the location and depth of the suspicious lesion in order to facilitate the choice of skin incision and surgical procedure. After appropriate localization the charcoal aqueous suspension was injected slowly at the superficial border of the suspicious lesion forming a track between the suspicious lesion and the point of needle entry in the skin.

**2.3.4. Operative timing:** One day up to 3 months after localization by active charcoal suspension.

### 3. Results

The present prospective study included 30 patients with non-palpable breast lesions underwent localized of their lesions by charcoal suspension. A mean Age was  $50.83 \pm 15.72$  years Ranged between (21\_77 years) [table 1]. From Nov 2019 to May 2022.

36.7% of the studied patients had positive family history[table 2], 50% of the studied patients have no complain, 23.3% of the studied patients complained of breast lump, 13.3% had breast pain, where bleeding per

nipple, nipple discharge, nipple retraction and complained of nipple ulceration had 3.3% to each[table 3], Regarding site of lesion, 40%, 20%, 16.7%, 13.3%, 6.6%, 3.3% had lesions in upper outer quadrant, areola, lower outer quadrant, and upper inner quadrant, central, lower inner quadrant respectively[table 4], 50%, and 43.3%, had right-sided and left sided lesions respectively[table 5]. BIRADS staging of sonomammography revealed that 56.6% BIRADS III. BIRADS IVa were present 26.6% of patient. BIRADS IVb were present in 10% of patients, BIRADS IVc were present in 3.3% of patients and BIRADS V were present in 3.3% of patients. BIRADS I, II not concluded in our study, reassured and asked for follow up by BSE [table 7].

Regarding TNM staging, 6 patients (42.8%) had T1, 3 patients (21.4%) had T2, T3 presented in 7.1% of patients while T4 were 4 patients (28.5%). 11 patients had no lymph nodes involvement (78.5%), 2 patients had N1(14.2%), one patient (7.1%) N2 and on patient presented by palpable level III LN and all of them had no distant metastasis [table 7].

Bilateral lesion was present in two patients (6.7%), 53.3% of patients had benign lesions while fourteen patients (46.7%) had malignant lesions [table 8], the patient underwent lumpectomy 54%, BCS 10 patients 33% while 4 patients (13%) had MRM [table 9], 56.7% patients had no inflammatory response, 13 patient had acute inflammatory response. Of them, 30% had mild response while 13.3% had moderate inflammation. No of them had severe inflammatory response with abscess formation [table 10]. Only one specimen of them showed severe inflammatory response [table 11].

**Table (1) Demographic data.**

	N=30
<b>Age (year):</b>	
<b>Mean <math>\pm</math> SD</b>	50.83 $\pm$ 15.72
<b>Range</b>	21 – 77

**Table (2) Distribution of the studied patients according to family history of breast cancer:**

	N=30	%
<b>Family history:</b>		
<b>Negative</b>	19	63.3%
<b>Positive</b>	11	36.7%

**Table (3) Distribution of the studied patients according to complaint**

	N=30	%
<b>Screening</b>	15	50%
<b>Nipple discharge</b>	1	3.3%
<b>Nipple retraction</b>	1	3.3%
<b>Nipple ulceration</b>	1	3.3%
<b>Bleeding per nipple</b>	1	3.3%
<b>Breast pain</b>	4	13.3%
<b>Lump</b>	7	23.3%

Table (4) Distribution of the studied patients according to site of lesion

	N=30	%
<b>Site of lesion</b>		
Areola	6	20%
Central	2	6.6%
Lower inner	1	3.3%
Lower outer	5	16.7%
Upper inner	4	13.3%
Upper outer	1 <sup>†</sup>	40%

Table (5) Distribution of the studied patients according to side of lesion

	N=30	%
<b>Side of lesion</b>		
Bilateral	2	6.7%
Left	13	43.3%
Right	15	50.0%

Table (6) Distribution of the studied patients according to BIRADS:

	N=30	%
<b>BIRADS</b>		
IVa	20	66.7%
IVb	3	10%
IVc	1	3.3%
V	1	3.3%

Table (7) Distribution of the studied patients (14malignant cases) according to TNM staging:

	N=14	%
<b>T:</b>		
1	6	42.8%
2	3	21.4%
3	1	7.1%
4	4	28.5%
<b>N:</b>		
0	11	78.5%
1	2	14.2%
2	1	7.1%
3	0	0%
<b>M:</b>		
0	14	100%
1	0	0%

Table (8) Distribution of the studied patients according to pathology:

	N=30	%
<b>Pathology:</b>		
Benign	16	53.3%
Malignant	14	46.7%

Table (9) Distribution of the studied patients according to operation type:

	N=30	%
<b>Operation type:</b>		
lumpectomy	16	54% %
BCS	10	33%
MRM	4	13%

**Table (10)** Distribution of the studied patients according to acute inflammatory response.

	N=30	%
<b>Acute inflammatory response</b>		
<b>No</b>	17	56.7%
<b>Mild</b>	9	30.0%
<b>Moderate</b>	4	13.3%
<b>Severe with abscess formation</b>	0	0.0%

**Table (11)** Distribution of the studied patients according to chronic inflammatory response

	N=30	%
<b>Multicentric macrophages with Intracytoplasmic charcoal</b>	30	100%
<b>Lymphocyte content:</b>		
<b>Mild</b>	23	76.7%
<b>Moderate</b>	6	20%
<b>Severe</b>	1	3.3%

#### 4. Discussion

This is a randomized controlled study for patients who are admitted for surgical treatment of breast lesions and includes 30 patients:

Carbon localisation results was reported as regard as patient age, family history and complain, lesion side, site, type, level (BIRADS, TNM), charcoal distribution and inflammatory response and surgical operation type.

The increasing number of non-palpable breast lesions detected during screening of the breast has increased the need for preoperative accurate localization. Wire guided localization is the most popular method used. However, there is a recorded rate of complications and Operation Room (OR) scheduling difficulties. [10]

More than 25% of radiologically detected suspicious breast lesions are non-palpable, so preoperative localization followed by adequate surgical excision presents challenging technical problems because the shape and position of the breast during compression mammography may be quite different from that seen by the surgeon in the operating room. [5]

This is a randomized controlled study includes 30 patients for patients who are admitted for surgical treatment of breast lesions:

Carbon localisation results was reported as regard as patient age, family history, timing, complain, lesion side, site, type, stage (BIRADS, TNM), inflammatory response and surgical operation type.

In this study the ages ranged from 21 to 77 years with mean age 50.83 years similar to these 2 studies *Isaac, et al. (2019)* [11] study the mean age was 52.2 years old and *Canavese, et al (1995)* [12] study the mean age was 53 years old.

In contrast to 4 studies, *Farouk, et al (2021)* [180] study The median age was 43 years, *Rose, et al (2003)* [14] study The median age was 59.5 years old, *Tran, et al (2019)* [15] study The median age was 63.5 years old, *Lucca, et al (2018)* [16] study The median age was 59.4 years old.

In dead age has no significant affection on our study

Regarding amount and concentration of injected charcoal suspension similar to *Canavese, et al (1995)* [12] study the concentration of injected suspension of a 3% sterile charcoal suspension into the site of the lesion and *Farouk, et al (2021)* [13] study the concentration of injected suspension had 1-3 ml of sterilized 3% aqueous suspension of activated charcoal granules slowly injection under ultrasound guidance at the superficial margin of the suspicious lesion.

Not similar to *Rose, et al (2003)* [14] study the concentration of injected suspension had 4% using 1.0–2.0 ml of sterile carbon suspension, *Tran, et al (2019)* [15] study the concentration of injected suspension had inject 0.2- 0.4 ml of sterile 4% carbon suspension into or adjacent to the lesion, *Lucca, et al (2018)* [16] study the concentration of injected suspension had US-guided marking used a sterile 4% charcoal-suspension (40 mg of activated charcoal in 1 mL of physiological saline, 0.9%), Approximately 0.7 mL of the suspension was injected when reaching the external edge of the lesion, spreading around it and leaving a trail in the parenchyma.

The more concentrated solution the more colour stability.

Regarding family history of breast cancer in this study, 36.7% of the studied patients had positive family history. Similar to what reported by *Farouk, et al (2021)* [13] study 29.41% presented with positive family history of breast cancer.

In contrast, *Rose, et al (2003)* [14] study showed 20.3% positive family history of breast cancer.

Family history has no major effect in our study

About 15 patients (50%) discovered during screening program with no complain, 23.3% complained of breast lump, 13.3% had breast pain, 3.3% had bleeding per nipple, 3.3% had nipple discharge, 3.3% had nipple retraction and 3.3% complained of nipple ulceration no enough study explain patient complain before breast cancer management.

Regarding site of lesion, 40%, 20%, 16.7%, 13.3%, 6.6%, 3.3% had lesions in upper outer quadrant, areola, lower outer quadrant, and upper inner quadrant, central,

lower inner quadrant respectively, similar to what reported by *Kanat, et al (2016)* [17] where suspicious lesions observed on mammography and US were mostly located in the upper-outer quadrant.

In our study Cases who offered US Guided Injection of Charcoal Suspension as a localization method underwent surgical excision at the same days up to 6 months. This time interval between localization procedure and surgical excision gave chance for radiologist, surgeon and pathologist to manage their time tables properly.

*Tran, et al (2019)* [15] study underwent surgery on same day of localization and *Isaac, et al. (2019)* [11] study localization was A day or an hour before surgery.

Regarding TNM staging, 6 patients (42.8%) had T1, 3 patients (21.4%) had T2, T3 presented in 7.1% of patients while T4 were 4 patients (28.5%). 11 patients had no lymph nodes involvement (78.5%), 2 patients had N1(14.2%), one patient (7.1%) N2 and on patient presented by palpable level III LN and all of them had no distant metastasis.

Ability of lesion palpation depends on many factors other than size of lesion such as size of the breast and depth of the lesion. In our study mean size of the lesion was 10.9 mm (4-20 mm) depending on lesion maximal diameter.

In *Ko, et al (2007)* [18] study. reported that mean size of non-palpable lesions was 10 mm (4-32 mm).

Pathology of specimens in this study revealed that 53.3% of patients had benign lesions while 14 patients (46.7%) had malignant lesions similar to what was reported by 3 studies: *Farouk, et al (2021)* [13] study with 44.4% malignant lesions and 55.6% benign lesions; 15 Fibroadenosis with epitheliosis, 3 Fibroadenomas, one fibroadenomatoid hyperplasia, and one sclerosis adenosis, *Cavalcanti, et al (2012)* [19] study Of the 135 cases analyzed, 35 were malignant lesions (26.66%), 97 benign lesions (71.85%), one case consisted of malignancy associated with benign lesions (0.74%), and in two specimens (1.48%) no lesion was observed and *Kanat, et al (2016)* [17] Study with histopathological evaluation revealed a malignant lesion in 36% and a benign lesion in 64% of the patients.

Different with 4 studies: *Canavese, et al (1995)* [12] study with 21.7% were malignant disease, 9.1% were borderline and 69.2% were benign. The benign/malignant/borderline ratio is 3:2:1. In *Rose, et al (2003)* [14] study, 40.9% cases were invasive cancer, 16.8% cases were DCIS while 41.9% were benign. The benign diagnoses included radial scar, atypical ductal hyperplasia, fibrocystic change, benign calcification, fat necrosis and intraductal papilloma. There was one lymphoma (0.2%) and one angiosarcoma (0.2%). *Tran, et al (2019)* [15] study, 22% were benign lesions, while malignant lesions were found in 78%, *Kanat, et al (2016)* [17] Study with Histopathological results were reported as malignant in 63.6% and benign in 36.4% of the patients.

Concerning type of operations in this study, the patient underwent BCS 23 patients 76.7% while 7 patients (23.3%) had MRM similar to what reported by *Farouk, et al (2021)* [13] study with 16 malignant lesions (in 15

patients) were managed as the following; 9 (60%) patients had BCS with free all surgical margins, 5 (33.3%) patients had MRM and one (6.6%) patient had Nipple Sparing Mastectomy with immediate breast reconstruction by Latissimus Dorsi flap, due to failure to achieve free safety margins in conservation.

From the point of complication, the use of the radio isotopes exposes patient and health care worker to radiation so it is heavy controlled by legislation. the blue dye injection can obscure the surgical field and frequently leaves a blue skin staining. Wire guided localization is limited by poor patient satisfaction, technical difficulties such as migration, high reoperation rate, diathermy burn. [20]

In our study, Needle blockage occurred during US guided Charcoal injection in two cases, one of them was managed by needle replacement and repositioning, while other was managed by using the spinal needle trocar. The only complication encountered was a needle tip blockage caused by a large charcoal particle, this problem was solved in all 8 cases by strong pressure to the blocked needle *Ko, et al (2007)* [18] study

*Ko, et al (2007)* [18] study. concluded that an expert surgeon with this procedure could confuse the tattoo with the foci of bleeding or diathermy cautery effect. *Ko, et al (2007)* [18] study in our study we noticed that diathermy usage can mask charcoal mark so we used scissors in surgical excision and after lesion extraction we used diathermy for hemostasis.

Among the studied specimens, thirteen patient had acute inflammatory response. Of them, not observed in 17 (56.7%) cases, 30% had mild response, 13.3% had moderate inflammation while No of them had severe inflammatory response with abscess formation. similar to what reported by *Cavalcanti, et al (2012)* [19] study the acute inflammatory response, on its turn, was not observed in 58 (42.96%) cases, was mild in 57 (42.23%), moderate in 15 (11.11%) and Disagree with severe and abscess formation in five cases (3.7%).

Among the inflammatory response in studied specimens, showed chronic inflammatory response with intracytoplasmic charcoal. According to severity of inflammation, 76.7% had mild response while 20% had moderate inflammation. Only one specimen of them showed severe inflammatory response disagree with *Cavalcanti, et al (2012)* [19] study with chronic inflammatory process, there were multinucleated macrophages with intracytoplasmic coal particles in all cases (100%). With respect to lymphocyte component, (82.22%) showed mild response.

## 5. Conclusion

This study finding indicated that US Guided Injection of Charcoal Suspension for non-palpable breast lesions is a very simple, safe and accurate method.

Time interval between localization and surgical excision gave chance for better preparation and cooperation between radiologist, surgeon and pathologist.

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