

Ultrasound-guided Restaging and Localization of Axillary Lymph Nodes after Neoadjuvant Chemotherapy for Guidance of Axillary Surgery in Breast Cancer Patients: Experience with Activated Charcoal

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2018-04-05 GBCC

Introduction

- **Less-invasive approaches** to staging the axilla have been gaining popularity, aiming to improve the patients' quality of life
- Even for patients undergoing **neoadjuvant chemotherapy (NAC), sentinel node biopsy is considered**, because 40-75% of patients have negative nodes on final pathological examination after NAC
- However, there are **hurdles** for the implementation of sentinel node biopsy in patients undergoing NAC
 - **Variable identification rates of the sentinel node** were reported (63-100%)
 - Even when the sentinel node was successfully identified, **false-negative rates of 0-33%** have been reported

Introduction

- To overcome these problems, several techniques to localize the known metastatic node with a clip before NAC have been suggested to guide the axillary surgery
- However, the use of clip requires further specialized devices (radioactive seeds) to be identified intraoperatively
- There are multiple metastatic nodes in patients with NAC, **the response to NAC might differ among the nodes**

Purpose

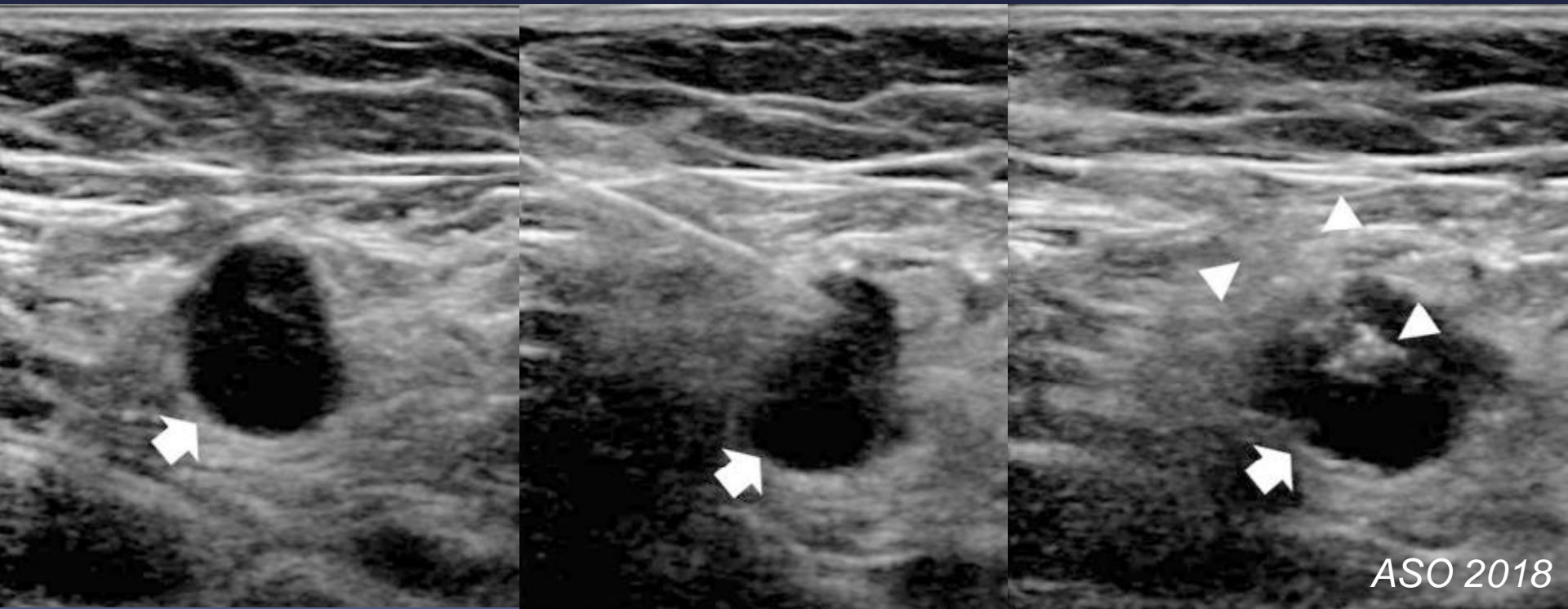
- Our institutional protocol currently includes **US-guided localization of the most suspicious node at restaging US after NAC using activated charcoal**
- This procedure allows the guidance of the axillary surgery even in cases of failed sentinel node biopsy and compensates for the potential false-negatives of sentinel node biopsy
- Herein, we reviewed our experience of US-guided localization of axillary lymph nodes with activated charcoal for guidance of axillary surgery after NAC in breast cancer patients

Patients

- Between April 2016 and April 2017, **45 consecutive patients** with invasive breast cancer treated by NAC who had less than two suspicious nodes at restaging US were scheduled for sentinel node biopsy
- All patients had **clinically node-positive disease at initial staging**
- They underwent axillary US for restaging preoperatively and US-guided localization of the most suspicious axillary lymph node with the thickest cortex using activated charcoal

US-guided Localization with Activated Charcoal (Tattooing)

- Tattooing of the axillary node was performed by **injection of 1-3 ml of Charcotrace™ black ink** into the cortex of the axillary node and adjacent soft tissue after local anesthesia
- The radiologist marked the location of the axillary node on the skin with an oil-based pen to guide the surgical incision



Axillary Surgery

- All radioactive axillary nodes, identified by a gamma probe, and/or nodes containing blue dye were removed as **sentinel nodes**
- **Tattooed nodes** were also identified through inspection of the axilla and subsequently removed
- Concordance between the tattooed node and sentinel node was documented in the surgical record
- All sentinel and tattooed nodes were submitted for intraoperative frozen sections
- Considering the pathological results from these frozen sections, the surgeon decided to perform further axillary surgery, including sampling or dissection

Results

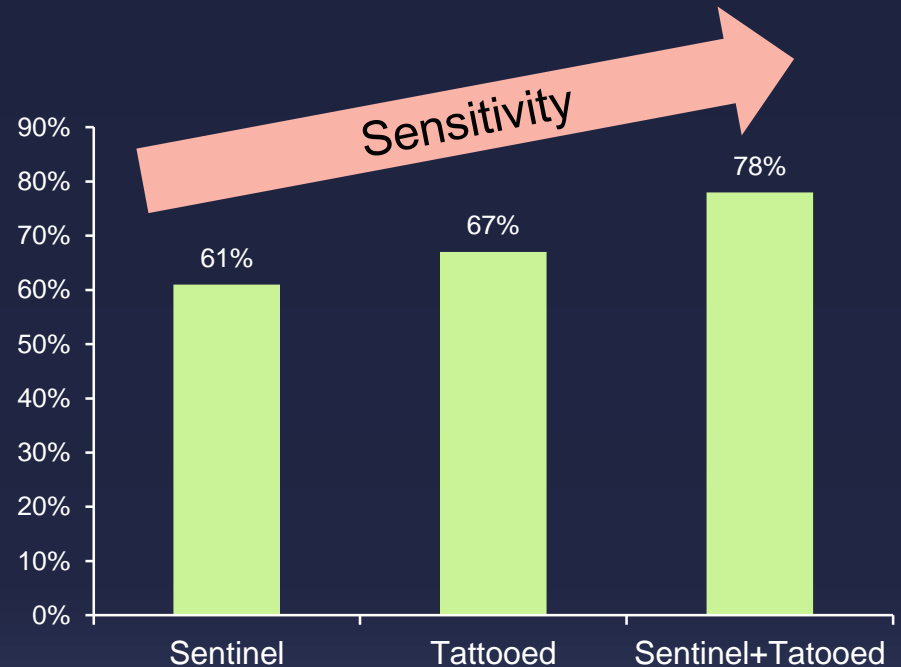
- In 40 (89%) of 45 patients, the sentinel node was successfully identified.
- **The sentinel node biopsy failed in five patients (11%)**
 - Invisible radioisotope uptake on lymphoscintigraphy (n=3)
 - Failure of detection of the sentinel node during axillary surgery despite faint radioisotope uptake on lymphoscintigraphy (n=2)
- **For these patients with failed sentinel node biopsy, axillary surgery was performed under the guidance of the tattooed node**

Results

- **Tattooed nodes were identified in the surgical field in 44 patients (98%)**
- In one patient (2%), the surgeon could not find the tattooed node, and the microscopic charcoal was not identified in the resected nodes
- Of the 44 tattooed nodes, 25 (57%) were concordant with the sentinel nodes and **19 (43%) were non-sentinel nodes, including the five nodes with failed sentinel node biopsy**

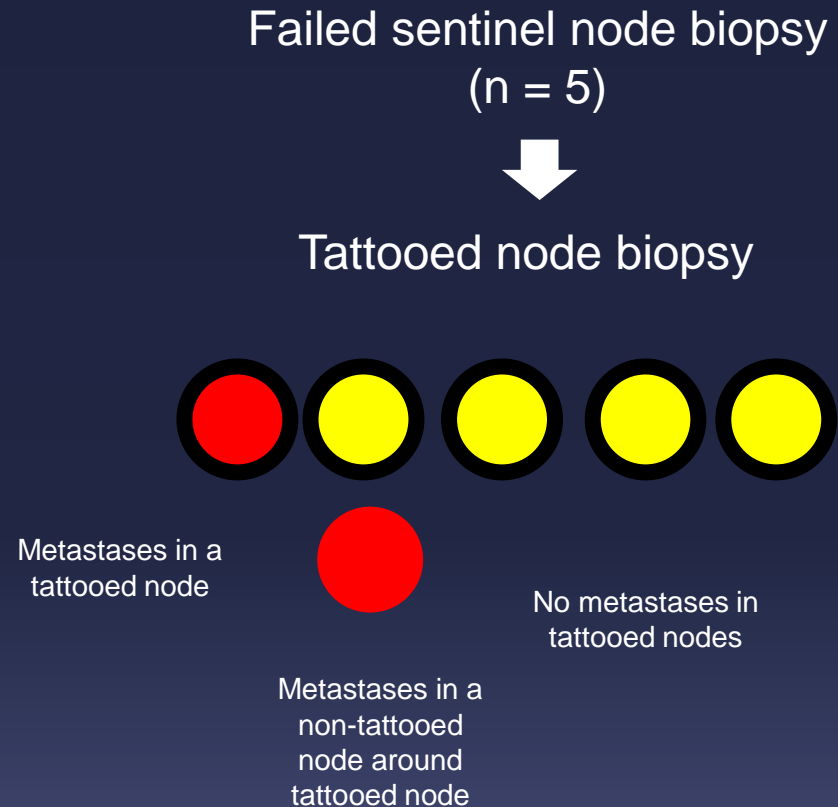
Results

- On pathological results, 18 patients (40%) had metastatic nodes
- Sensitivities of sentinel node biopsy for metastasis were 50% (9/18) in the frozen and 61% (11/18) in the permanent sections
- Sensitivities of tattooed node biopsy for metastasis were 61% (11/18) in frozen and 67% (12/18) in permanent section
- Sensitivities of sentinel and/or tattooed node biopsy were 72% (13/18) in frozen and 78% (14/18) in permanent section



Results

- In the five patients with failed sentinel node biopsy, two patients had metastatic nodes, including one patient with metastasis in her tattooed node and one with metastasis in a non-tattooed node around the tattooed node
- The other three patients with non-metastatic, tattooed nodes in the frozen section underwent axillary sampling, which revealed no further metastatic nodes in the final pathology



Conclusion

- We found that US-guided localization of axillary lymph nodes with activated charcoal is a useful technique to guide axillary surgery, with a high identification rate
- However, future studies should be conducted to validate the strategy of marking nodes with activated charcoal at restaging after NAC

Ann Surg Oncol (2018) 25:494–500
<https://doi.org/10.1245/s10434-017-6250-3>

Annals of
SURGICAL ONCOLOGY
OFFICIAL JOURNAL OF THE SOCIETY OF SURGICAL ONCOLOGY



ORIGINAL ARTICLE – BREAST ONCOLOGY

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