Time frame of sentinel node visualization in early breast cancer patients using intradermal injection of Tc-99m phytate: Imaging beyond 45 minutes does not yield more information

Original Article

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ABSTRACT

Introduction: One of the major problems of lymphoscintigraphy is the time of patient presence in the nuclear medicine wards. The operating room schedule can be compromised if the patients stay longer than usual in the nuclear medicine departments. However, too early imaging can be falsely negative for sentinel node visualization and delayed imaging may be required. The aim of the current study is to determine a time beyond which lymphoscintigraphy imaging does not yield more information and imaging can be terminated.

Methods: One hundred and fifty women with proven clinically axillary node negative breast cancer entered the study For each patient 0.5 mCi Tc-99m phytate in the 0.2 cc volume was intradermally injected in periareolar region to raise a wheal. Lymphoscintigraphy imaging was done in the following time intervals: 5, 10, 30, 45, 60, 90 minutes post injection. In case of sentinel node visualization at any time, the imaging was terminated.

Results: Sentinel nodes were first detected on 5, 10, 30, 45, 60, and 90 minute images in 31 (20.6%), 45 (30%), 46 (30.6%), 15 (10%), 1 (0.6%), and 0 patients. Median number of the detected sentinel nodes per patient was 1. At least one hot sentinel node could be identified in all 138 patients with observed sentinel nodes of whom, 45 had pathologically involved sentinel nodes and axillary lymph node dissection was done. In 12 patients, no sentinel node was visualized even on the 90 minute images. All of these patients had axillary node involvement and no sentinel node could be harvested intra-operatively either.

Conclusion: Considering the rather slow movement of Tc-99m phytate in the lymphatic system, lymphoscintigraphy imaging of the breast cancer patients should be continued for 45 minutes in case of sentinel node detection failure. On the other hand imaging beyond 45 minutes does not seem to be necessary as the diagnostic yield is very low.

Key words: Phytate; Particle size; Breast cancer; Lymphoscintigraphy; Delayed imaging

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INTRODUCTION

Sentinel lymph node mapping is the standard method for axillary staging in early breast cancer patients which can decrease the morbidity of complications of breast cancer surgery [1-6]. Sentinel node mapping is an evolving procedure in surgical oncology and has been applied to almost all solid tumors such as gynecologic, urologic, skin tumors, etc. In addition to breast cancer, lymphatic mapping is gaining acceptance for lymphatic mapping in various solid tumors too [7-14].

Imaging of the lymphatics and sentinel nodes (lymphoscintigraphy) has also been integrated in to the lymphatic mapping procedure. In addition to the location of the sentinel nodes, lymphoscintigraphy can predict intra-operative sentinel node mapping failure [15, 16]. In case of sentinel node non-visualization on lymphoscintigraphy images, intra-operative blue dye injection should also be strongly considered [17, 18].

One of the major problems of lymphoscintigraphy is the time of patient presence in the nuclear medicine wards. The operating room schedule can be compromised if the patients stay longer than usual in the nuclear medicine departments and lymphoscintigraphy imaging should be terminated as soon as possible. However, too early imaging can be falsely negative for sentinel node visualization and delayed imaging may be required [19-21]. Delayed imaging beyond a certain time may not be necessary and would only delay the patient transfer to the operating theater [22]. However, the velocity of lymphatic mapping material in the lymphatic system is dependent on the particle size of the radiotracer, and depth of injection [23-26].

In our country, many center use Tc-99m phytate for sentinel node mapping for which time frame of sentinel node visualization has not been determined [20]. The aim of the current study is to determine a time beyond which lymphoscintigraphy imaging does not yield more information and imaging can be terminated.

METHODS

One hundred and fifty women with proven clinically axillary node negative breast cancer entered the study (Jan 2014 to Jan 2017). All patients were scheduled to undergo surgery the same day of radiotracer injection. For each patient 0.5 mCi Tc-99m-phytate in the 0.2 cc volume was injected in periareolar region intradermally to raise a wheal. Gentle massage was applied to the injection site for 30 seconds in each patient.

Lymphoscintigraphy imaging was done using a variable angle dual head gamma camera in anterior and lateral views (Tc-99m photopeak, 128×128 matrix, low energy high resolution collimator, 5 min/image sets). Timing of imaging was as follows 5, 10, 30, 45, 60, 90 minutes post injection. In case of sentinel node visualization at any time, the imaging was terminated [27].

Lymphoscintigraphy images were evaluated blindly by two experienced nuclear medicine specialists for number and location of sentinel nodes, and lymphatics.

Sentinel nodes were sought intra-operatively using a portable gamma probe (Europrobe, France). Sentinel nodes were pathologically assessed by frozen section. Axillary dissection was not performed for patients with negative frozen section samples.

RESULTS

Overall 150 early breast cancer patients were included with the mean age of 56±21 years. Demographic data of the included patients is shown in Table 1. At least one sentinel node could be identified in 92% (138) of the patients.

Table 1: Demographic data of the included patients.

Total number of patients		150
Age		56±21
Tumor histology	Invasive ductal	95
	Invasive lobular	45
	Other	10
Tumor location	Upper outer	62
	Upper inner	30
	Lower outer	21
	Lower inner	11
	Central	26
Size of the tumor (cm)		2±1.8
History of excisional biopsy	No	14
	Yes	136
Time of first sentinel node visualization	5	31
	10	45
	30	46
	45	15
	60	1
	90	0
	Not visualized	12

Sentinel nodes were first detected on 5, 10, 30, 45, 60, and 90 minute images in 31 (20.6%), 45 (30%), 46 (30.6%), 15 (10%), 1 (0.6%), and 0 patients (Figure 1 and 2). Median number of the detected sentinel nodes per patient was 1 (1-3 sentinel nodes in each patient). At least one hot sentinel node could be identified in all 138 patients with observed sentinel nodes of whom, 45 had pathologically involved sentinel nodes and axillary lymph node dissection was done.

In 12 patients, no sentinel node was visualized even on the 90 minute images. All of these patients had axillary

node involvement and no sentinel node could be harvested intra-operatively either.

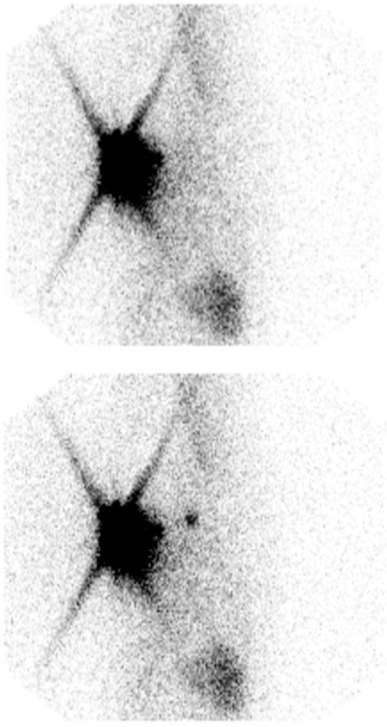

Fig 1. Early (5 min, above) and delayed (30 min, below) left lateral lymphoscintigraphy of a patient. Note sentinel node visualization at 30 minute post injection.

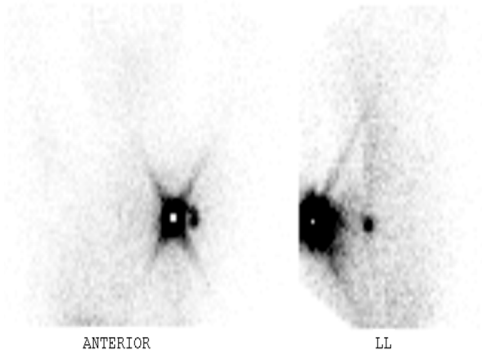

Fig 2. Early (5 min) anterior and lateral lymphoscintigraphy images of another patient. Note the visualization of the sentinel node in these early images.

DISCUSSION

Sentinel node mapping as the standard procedure for axillary lymph node staging is being used in many surgical oncology centers worldwide including many centers in our country [20, 28, 29]. Speed of radiotracer movement in the lymphatic system is largely determined by the size of the radiotracer particles, and depth of injection. Superficial injection and small particle size hasten the radiotracer movement in the lymphatic system [30, 31]. In our previous study using Tc-99m-antimony sulfide colloid, we have shown very rapid movement of the tracer in the lymphatic system and sentinel nodes were identified on the immediate lymphoscintigraphy imaging in more than 73% of the patients. Actually imaging beyond 30 minutes didn't yield any additional information or increase the detection rate [32]. Other reports of our center also concur with these results and most patients had rapid visualization of sentinel nodes [19, 32].

However, in the current study we used a different radiotracer with larger particle size: Tc-99m phytate. The particle size of Tc-99m antimony sulfide colloid is less than 20 nm. On the other hand the particle size of Tc-99m phytate has particle size of 150 nm and more [26, 33]. This is the reason of delayed sentinel node visualization in most patients in the current study. More than 40% of the patients had their sentinel node visualized after 30 minutes post radiotracer injection. These results show that imaging may be prolonged in lymphoscintigraphy imaging using Tc-99m phytate.

This should be kept in mind especially in patients who are scheduled for the same day protocol (injection and surgery in a same day) in order not to interfere with the operating room schedule. Considering the comparable efficacy and success in same and two day protocols [16, 21, 34], we recommend two day protocol (injection and surgery in two consecutive days) for sentinel node mapping using Tc-99m phytate (even 45 minutes imaging can interfere with operation room scheduling). In case of same day protocol, should the sentinel node is not visualized on the early images, imaging needs to be continued for 45 minutes post injection.

On the other hand, our study also showed that imaging beyond 45 minutes does not yield additional information regarding sentinel node visualization as only in one patient, sentinel node was first seen on 90 minute lymphoscintigraphy.

CONCLUSION

Considering the rather slow movement of Tc-99m phytate in the lymphatic system, lymphoscintigraphy imaging of the breast cancer patients should be continued for 45 minutes in case of sentinel node detection failure. On the other hand imaging beyond 45 minutes does not seem to be necessary as the diagnostic yield is very low. Beyond 45 minutes, sentinel node non-visualization is most likely due to axillary node involvement.

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