Original Article

Dynamic lymphoscintigraphy in breast cancer patients: Feasibility and added value

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ABSTRACT

Introduction: Lymphoscintigraphy is imaging of the lymphatic system and has been integrated into the sentinel node mapping procedures. Lymphoscintigraphy usually encompasses early or delayed static images**.** However, immediate dynamic imaging of the lymphatic basins and tumors has also been used as an adjunct lymphoscintigraphy imaging. The aim of this study was to assess the role of early dynamic acquisition versus static lymphoscintigraphy images for sentinel node detection in breast cancer.

Methods: Seventy five women with proved breast cancer and clinically node negative axilla entered the study. For each patient 0.5 mCi Tc-99m-antimony sulfide colloid in the 0.2 cc volume was injected in periareolar region in an intradermal fashion. Immediately after injection dynamic imaging was started as 1 minute per frame for 15 minutes. Static anterior and lateral images (5min/image) was also taken 30 minutes post injection**.** Imaging data for each patient were evaluated blindly by two experienced nuclear physicians and early dynamic imaging data were assessed for its value in detection of sentinel nodes.

Results: Overall 75 patients entered the current study. Sentinel node(s) could be identified on the dynamic lymphoscintigraphy images in 65 patients (86.6%). In 4 patients, dynamic lymphoscintigraphy could differentiate the second visible sentinel nodes as second echelon or true sentinel nodes.

Conclusion: Dynamic lymphoscintigraphy immediately after radiotracer injection is feasible in breast cancer patients with a high detection rate. The added value of dynamic over delayed static imaging is the ability to differentiate between second echelon and secondary sentinel nodes.

Key words: Breast cancer; Lymphoscintigraphy; Dynamic; Second echelon nodes; Second tier nodes

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INTRODUCTION

Sentinel lymph node biopsy is an accurate and established method for axillary lymph node staging in early stages of breast cancer. This method has decreased the morbidity of axillary lymph node staging in early breast cancer as in patients with pathologically un-involved sentinel nodes, axillary lymph node dissection can be omitted from the treatment plan [1-3].

In addition to breast cancer, lymphatic mapping is gaining acceptance for lymphatic mapping in various solid tumors too [4-9].

Lymphoscintigraphy is imaging of the lymphatic system and has been integrated into the sentinel node mapping procedures. It can guide the surgeons before surgery regarding the location of sentinel nodes and also can identify the group of patients with sentinel node detection failure [10, 11].

In patients with negative lymphoscintigraphy in addition to gamma probe at the surgery, blue dye should be used for optimal localization of the sentinel nodes [5, 12, 13].

Lymphoscintigraphy usually encompasses early or delayed static images or SPECT/CT [14-16]. However, immediate dynamic imaging of the lymphatic basins and tumors has also been used as an adjunct lymphoscintigraphy imaging. Various groups have reported different results in this regard [17-24].

The aim of this study was to assess the role of early dynamic acquisition versus static lymphoscintigraphy images for sentinel node detection in breast cancer.

METHODS

Seventy five women with proved breast cancer by tissue biopsy and clinically node negative axilla entered the study (Feb 2008 to Jan 209). For each patient 0.5 mCi Tc-99m-antimony sulfide colloid in the 0.2 cc volume was injected in periareolar region in an intradermal fashion. Immediately after injection dynamic imaging was started as 1 minute per frame using a dual head variable angle gamma camera (E.CAM Siemens) in anterior and lateral views for 15 minutes (Tc-99m photopeak). Static anterior and lateral images (5min/image) was also taken 30 minutes post injection [25].

Imaging data for each patient were evaluated blindly by two experienced nuclear physicians and early dynamic imaging data were assessed for its value in detection of sentinel nodes.

Sentinel nodes were harvested intra-operatively using a portable gamma probe (Europrobe, France). Harvested sentinel nodes were sent for frozen section. Axillary dissection was done only in patients with pathologically involved sentinel nodes.

RESULTS

Overall 75 patients entered the current study with the mean age of 55±19 years. Table 1 shows their demographic data.

Table 1: Demographic data of the included patients.

Total number of patients	75
Age	55±19
Tumor histology	
Invasive ductal	50
Invasive lobular	20
Other	5
Number of patients with involved sentinel node	25
Size of the tumor	2±1.2 cm
Patients with intra-operative sentinel node detection failure	2
Patients with visible sentinel nodes on static lymphoscintigraphy	70
Patients with visible sentinel nodes on dynamic lymphoscintigraphy	65

Sentinel node(s) could be identified on the dynamic lymphoscintigraphy images in 65 patients (86.6%, Figure 1).

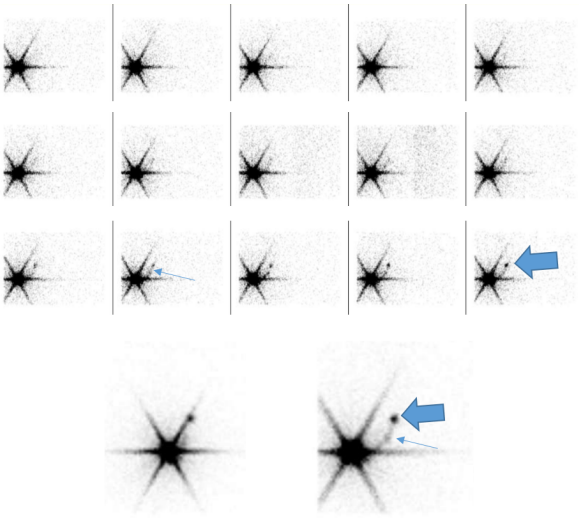

Fig 1. Dynamic (top) and static (bottom) lymphoscintigraphy of a patient. Lymph vessels (arrow) and sentinel node (large arrow) on both sets of images.

In 5 patients without a visible sentinel node on the dynamic lymphoscintigraphy, a sentinel node could be identified on the delayed static images.

In 4 patients, dynamic lymphoscintigraphy could differentiate the second visible sentinel nodes as second echelon (without any direct lymph vessel from the injection site) or true sentinel nodes (with a

direct lymph vessel from the injection site) (Figure 2 and 3). In these three patients, two sentinel nodes could be harvested during surgery.

Sentinel nodes could be harvested in 73 patients (1-3 sentinel nodes, median 1 node). Sentinel nodes were involved in 25 patients on frozen section examination. Axillary lymph node dissection was done for these patients.

DISCUSSION

Since the introduction of sentinel node mapping into the surgical oncology, lymphoscintigraphy has been integrated in this procedure. Lymphoscintigraphy can identify the patients with possible detection failure during surgery. In addition, by guiding the surgeons before surgery can decrease the time of surgery with less tissue manipulation [26].

Dynamic lymphoscintigraphy has been evaluated in several studies before with various results. One of the main advantages of dynamic lymphoscintigraphy imaging is differentiation between sentinel and second echelon nodes. Second echelon nodes are not directly connected to the tumor and their lymphatic drainage is through sentinel nodes.

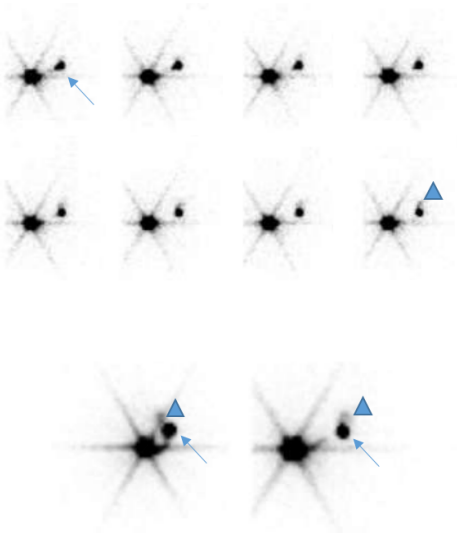

Fig 2. Dynamic (top) and static (bottom) lymphoscintigraphy images of another patient. The dynamic images showed a sentinel node (arrow). Another small second echelon node (arrow head) became visible after the sentinel node.

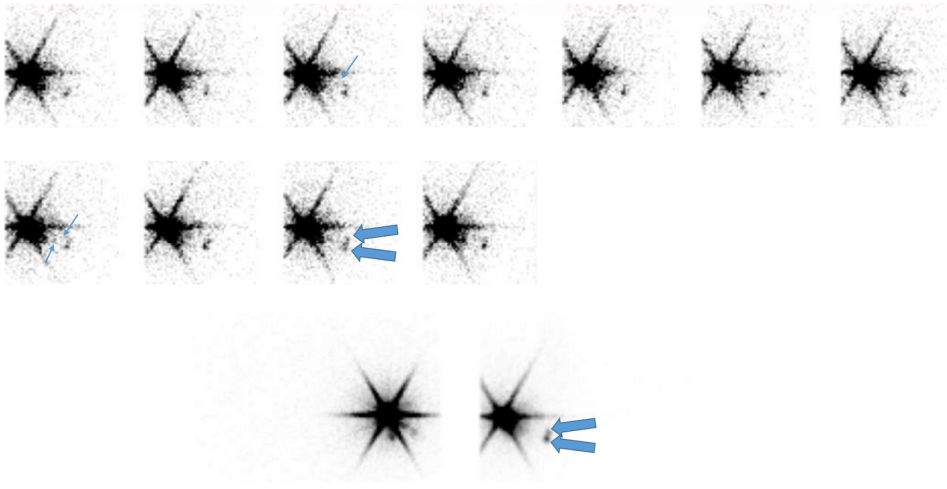

Fig 3. Dynamic (top) and static (bottom) lymphoscintigraphy images of another patient. The dynamic images showed two sentinel nodes (large arrows) which are connected to the injection site by lymph vessels (arrows).

In a study by Taylor et al on 16 melanoma patients, dynamic lymphoscintigraphy could identify a second echelon node in one patient. They concluded that the static imaging may not be complete without dynamic imaging and the nearest node to the tumor is not necessarily the sentinel node [27]. Tartaglione et al also reported the same findings in oral cavity tumors of 22 patients. They recommended dynamic lymphoscintigraphy imaging in order to identify second tier nodes as their incidence in head and neck tumors can be high [28]. In a 2013 study by Martinez-Rodriguez et al, dynamic imaging had added value over static images in 10.5% of their patients and they recommended routine dynamic imaging in all lymphatic mapping study [18]. In a 2014 study, Miura et al recommended dynamic lymphoscintigraphy to decrease the extent of surgery during lymphatic mapping of melanoma patients as second tier nodes are very common in this tumor [17].

Another advantage of dynamic lymphoscintigraphy is localization of aberrant sentinel nodes which can be very difficult to identify in static images. In a study by Kretschmer et al, dynamic lymphoscintigraphy could identified aberrant nodes in the pelvis in 20 out of 51 lower extremity melanoma patients. However the aberrant nodes were sentinel nodes only in 6 patients based on the dynamic imaging results [24].

In our study, dynamic lymphoscintigraphy also showed its advantage over static imaging in order to identify the second tier nodes. In 4 patients (5.3%), second axillary visible nodes could be correctly attributed as second tier or true sentinel nodes (Figures 2 and 3).

It is worth mentioning that second tier nodes are more commonly observed with small particle radiotracers such as Tc-99m antimony sulfide colloid [29, 30]. So, dynamic lymphoscintigraphy would be of more use in these tracers as second tier nodes could be readily identified.

The surgeons usually harvest all hot sentinel nodes as differentiation of second tier nodes from true sentinel nodes is not possible. Dynamic lymphoscintigraphy is promising for this purpose. However without larger multicenter studies to document the usefulness of dynamic imaging for sure, harvesting all hot nodes in the axilla seems to be prudent [31, 32]. A major disadvantage of dynamic lymphoscintigraphy is the high detection failure in some studies. This is attributed to the slow movement of the radiotracer in the lymphatic system especially by large-particle sized tracers. For example, Chen et al reported visualization of the sentinel nodes in only 48% of their patients on dynamic lymphoscintigraphy. They used Tc-99m Sulfur colloid which has a large particle size [23]. Another study by Doting et al reported even lower detection rate by dynamic lymphoscintigraphy (38%). They concluded that, the only advantage of dynamic lymphoscintigraphy over static delayed imaging is identifying second echelon nodes. They didn't recommend dynamic imaging due to very low incidence of second echelon nodes [22]. Another study by Toubert also reported the same finding with 22% of their melanoma patients with slow lymphatic drainage. They also concluded that there was no relation between the time of sentinel node visualization and sentinel node involvement [21]. The same findings was also reported by Petersen et al as they had only 39% detection rate on dynamic imaging versus 97% on the static ones. They also concluded that delayed static lymphoscintigraphy imaging is sufficient for sentinel node mapping in breast cancer patients [19].

We performed sentinel node mapping using Tc-99m Antimony sulfide colloid which has a very small particle size. This is the reason of high sentinel node detection rate on dynamic imaging (86.6%). Previous studies of our group also corroborated the fast movement of Tc-99m antimony sulfide colloid in the lymphatic system [14, 16, 33-36]. Overall, it seems that the especial advantage of dynamic lymphoscintigraphy is only apparent in lymphatic mapping using small particle size tracers. The particle size of Tc-99m antimony sulfide colloid is at most 20 nm. On the other hand the particle size of Tc-99m Phytate is at least 150 nm [37, 38]. We can expect that dynamic lymphoscintigraphy would be of limited value for large particle size tracers such as Tc-99m Phytate which is widely used in Iran.

A very peculiar Nakashima et al, showed another advantage of dynamic imaging. They reported abnormal accumulation of the radiotracer close to sentinel nodes in breast cancer patients with sentinel node involvement on pathological examination [20]. However, their findings have not been reproduced in other studies thus far. We didn't find any abnormal accumulation of the radiotracer next to sentinel nodes in our patients either.

CONCLUSION

Dynamic lymphoscintigraphy immediately after radiotracer injection is feasible in breast cancer patients with a high detection rate. The added value of dynamic over delayed static imaging is the ability to differentiate between second echelon and secondary sentinel nodes.

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