

# The efficacy of Tc-99m sestamibi for sentinel node mapping in breast carcinomas: comparison with Tc-99m antimony sulphide colloid

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## Abstract

**BACKGROUND:** To study the value of periareolar intra-dermal injection of Tc-99m sestamibi (MIBI) for sentinel node mapping in breast carcinoma.

**MATERIAL AND METHODS:** Fifty patients with early-stage breast cancer were included in our study. 17.5 MBq Tc-99m-MIBI was injected intradermally to 25 patients and the remainders were injected with the same dose of Tc-99m-antimony sulphide colloid. Anterior and lateral static images were taken at 2 minutes. If sentinel lymph node was not detected, delayed imaging by up to 180 minutes was carried out. The patients were operated on

2–4 hours post-injection. Sentinel lymph node biopsy was performed by the aid of gamma probe and blue dye during surgery. **RESULTS:** In the Tc-99m-MIBI group, 23 patients had lymph nodes on scintigraphy images, and sentinel nodes were detected during surgery in all 23 patients. In the Tc-99m-antimony sulphide colloid group, 24 patients had lymph nodes on scintigraphy images, and sentinel nodes were identified during surgery in 24 patients.

**CONCLUSIONS:** We concluded that 99mTc-MIBI is a suitable radiopharmaceutical for sentinel node detection.

**Key words:** breast cancer, lymphoscintigraphy, sentinel lymph node, Tc-99m-MIBI, Tc-99m-antimony sulphide colloid, intradermal injection

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## Introduction

Sentinel lymph node (SLN) biopsy has become the standard for axillary lymph node staging in breast cancer. To date, several randomized trials [1–5] have confirmed that SLN biopsy is a feasible, accurate, and safe staging technique with minimal morbidity.

The concept of SLN biopsy technique is simple: Since lymphatic metastasis generally commences from the SLN and tumour cells disseminate sequentially to other lymph nodes, the status of the SLN is a good predictor of regional lymphatic basin involvement [1–7].

The SLN can be identified by either radiotracer or blue dye approach, or a combination of both. For the radiotracer approach, a gamma detection probe (GDP) is being used during surgery [7–12]. The combined approach of isotope and blue dye mapping is the recommended technique, which is practiced at our institution.

Several radiopharmaceuticals have been used for SLN mapping with lymphoscintigraphy, such as Tc-99m-sulfur col-

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loid, Tc-99m-nanocolloid, Tc-99m-antimony sulphide colloid, and Tc-99m-phytate, with successful results [13–15].

Tc-99m-methoxyisobutylisonitrile (MIBI) is a widely used myocardial perfusion agent, which can be accumulated in tumours as well as some inflammatory lesions [16–18]. A few studies have reported successful application of peritumoural injection of this radiotracer for SLN biopsy [19–21], but no study has tested its efficacy for superficial periareolar approach as a single injection, which is a widely practiced technique worldwide.

Our study was designed to evaluate the efficacy of periareolar injection of Tc-99m-MIBI for SLN detection in clinically early-stage breast cancers and to compare the results with Tc-99m-antimony sulphide colloid.

## Material and methods

During the period from April 2006 to September 2008, 50 female patients with a clinical diagnosis of stage I or II breast cancer were included in our study. None of the patients had previous surgery or radiotherapy at the site of primary breast tumour, and none had received chemotherapy before surgery. The pre-operative diagnosis of breast cancer was established with a combination of physical examination, mammography, fine needle aspiration cytology, or core biopsy.

We allocated the patients into two groups randomly. Group one: 25 patients who were injected with 17.5 MBq/0.2 ml of 99m-Tc-MIBI into the periareolar area intradermally 2–4 hours before surgery. Group two: 25 patients who were injected with 99m-Tc-antimony sulphide colloid using the same activity and technique.

After injection of the tracer, gentle massage was applied to the injection site for one minute. Anterior, anterior oblique, and lateral spot views were acquired 2 minutes after the injection (3 minutes/image, 64 × 64 matrix) using a dual-head gamma camera (E.CAM, Siemens, Erlangen, Germany) equipped with a parallel hole low energy high resolution (LEHR) collimator (Figure 1). An energy window of 15% centred over the 140 keV photopeak of

99mTc was selected. If SLN was not visualized, delayed imaging by up to 180 minutes was obtained.

In the operating room, 2 ml patent blue V dye was injected in a subdermal and periareolar fashion to all patients. All operations were performed by the same surgeon who was trained in London, and his results were validated as equivalent to the UK standard. Sentinel node biopsy was performed guided by both the gamma probe (RMD navigator GPS system) and the appearance of blue dye in the lymphatic vessels and nodes. A sentinel node was defined as any hot node with an ex-vivo count rate of five times the background activity, a blue tract leading to a blue node, or a combination of the above.

All patients underwent standard axillary lymph node dissection after sentinel node biopsy as part of the validation of our technique.

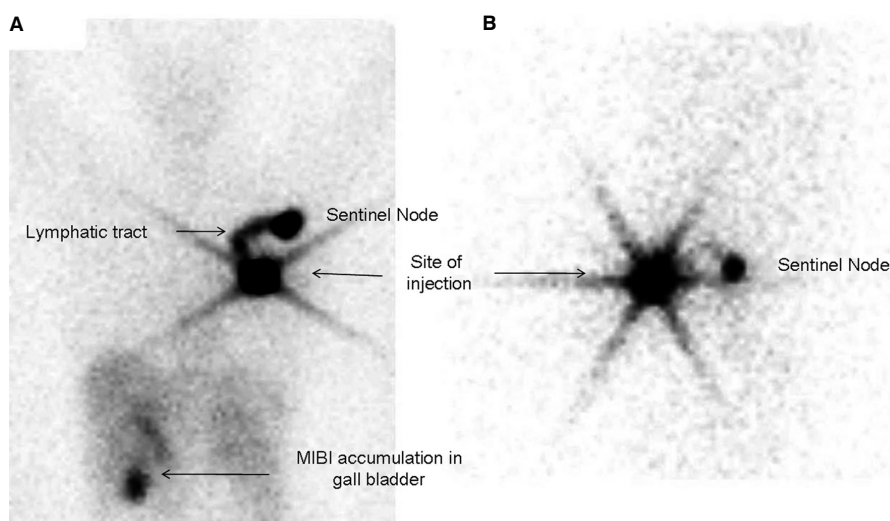
Excised SLNs underwent step sectioning at three levels (2 mm apart) followed by standard haematoxylin and eosin (H & E) staining.

Continuous variables are described by the mean value ± SD. Fisher's exact test,  $\chi^2$  test, and Student's t test were used to compare the two groups according to the variable type.  $P < 0.05$  was considered significant.

## Results

The characteristics of the patients in the two groups are shown in Table 1. These general characteristics were not significantly different between the two groups ( $P > 0.05$ ).

The results of the 99m-Tc-MIBI and 99m-Tc-antimony sulphide colloid groups are compared in Table 2. The SLN detection rate and number of detected SLNs were not significantly different between the two groups ( $P = 0.792$ ). No SLN was detected with blue dye alone. SLNs were stained by the blue dye in only 60% of the patients in each group. In two patients in group I and 1 patient in group II, SLN could not be detected. All these three patients had axillary lymph node metastasis. The false negative rate (negative SLN and positive axillary nodes) for both groups was 0%.



**Figure 1.** Anterior views of two patients injected with Tc-99m-MIBI (A) and Tc-99m antimony sulphide colloid (B). Note significant background activity in the Tc-99m MIBI image.

**Table 1. Patient characteristics**

	Group I	Group II
Total number of patients	25	25
Age	37 ± 7	35 ± 6
Tumour size	2.5 ± 1	2.4 ± 0.9
Tumour location		
Upper outer	11	12
Upper inner	5	4
Lower outer	3	4
Lower inner	2	3
Central	4	2
Histological type		
Invasive ductal	21	22
Invasive lobular	4	3
Axillary lymph node metastasis	11	9

SLN count by probe investigation was not different between the groups ( $P = 0.189$ ); however, the axillary count was significantly higher in group I ( $P < 0.05$ ).

## Discussion

Accurate staging of breast carcinoma is very important for management planning and is a significant prognostic determinant. SLN biopsy is an integral part of breast cancer staging, especially for stages I and II. In many patients with early breast cancer, axillary lymph node dissection can be avoided by this technique [22]. Radiotracer and blue dye approaches, as well as a combination of both techniques, are frequently used for detection of SLN [7–12]. In our study we used the combined technique. The detection rate with dye injection was 60% in both groups of our patients; however, the detection rate with dye alone was 0%, which means there was no blue/cold SLN. In other words, dye injection did not contribute much to SLN harvesting in our patients. Although a combination of radiotracer and blue dye is increasingly used, some authors consider blue dye injection optional due to the “marginal benefit” of this approach [7, 23, 24]. Our results also support these findings.

99m-Tc-MIBI is a cationic lipophilic myocardial perfusion agent [16] which has been used with high success in SLN biopsies [19–21]. In this study the SLN detection rate in group I (99m-Tc-MIBI) was high (92%) and was not significantly different from that in group II (99m-Tc-antimony sulphide colloid) (96%). 99m-Tc-antimony sulphide colloid is a commonly employed radiotracer which is used in Canada and Australia. This tracer is available in our country, and we used it for comparison with 99m-Tc-MIBI [25]. In our country, 99mTc-MIBI is available in over 85% of nuclear medicine centres for myocardial perfusion scans, which are the most common nuclear medicine imaging test performed. Adequate doses of this tracer can be easily saved in each working day for other applications without any additional cost [26].

SLN detection rate was higher in our patients compared to previous studies (92% and 83.3%, respectively). In contrast to the previous studies in which peritumoural injection was utilized,

**Table 2. Comparison of results of sentinel lymph node biopsies between the two groups in the study**

	Group I	Group II
Total number of patients	25	25
Detection rate		
Dye alone	0%	0%
Radioisotope alone	32% (8/25)	36% (9/25)
Both methods	60% (15/25)	60% (15/25)
Total radioisotope success rate	92% (23/25)	96% (24/25)
Total dye success rate	60% (15/25)	60% (15/25)
False negative rate	0%	0%
Number of detected lymph nodes	1.24 ± 0.43	1.28 ± 0.61
Sentinel lymph node count (c/s)	413 ± 123	365 ± 131
Axillary background count (c/s)	64 ± 28	18 ± 8

we used intra-dermal periareolar injection. This might explain the higher SLN detection in our patients [27, 28].

The only difference between group I and II in our study was a significantly higher background activity in group I. This finding is in agreement with the previous studies performed with 99m-Tc-MIBI [19–21]. Systemic absorption of 99m-Tc-MIBI from the injection site is the most likely explanation. In our experience, due to high background activity and significant myocardial uptake, SLN detection can be problematic for inexperienced surgeons (Figure 1).

In conclusion, the SLN detection rate for intra-dermal periareolar injection of 99m-Tc-MIBI is comparable to 99m-Tc-antimony sulphide colloid. We concluded that the 99m-Tc-MIBI is a suitable radiotracer for SLN detection.

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