Comparison of SPECT/CT and Planar Lympho-scintigraphy in Sentinel Node Biopsies of Oral Cavity Squamous Cell Carcinomas

Abstract

Introduction: Evidence supporting the use of Sentinel node biopsy (SNB) for nodal staging of early oral squamous cell carcinomas (OSCC) appears to be very promising. Pre-operative lymphatic mapping using planar lymphoscintigraphy (PL) with or without SPECT/CT in the SNB procedure is useful in sentinel node localization and for planning appropriate surgery. Recently, a large prospective multi-centric study evaluating SNB in cutaneous melanoma, breast and pelvic malignancies, demonstrated that adding SPECT to PL leads to surgical adjustments in a considerable number of patients. Our aim of this study was to evaluate the incremental value of additional SPECT/CT over PL alone in SNB for OSCC. Materials and Methods: This was a retrospective analysis of 44 patients (40- tongue, 4- buccal mucosa) with T1-T2, clinically N0 oral cavity SCC who underwent sentinel node biopsy procedure. PL and SPECT lymphoscintigraphy images were compared for pre-operative mapping of sentinel nodes. Results: Using a handheld gamma probe, a total of 179 sentinel nodes were harvested, with a mean of 4.06 per patient. PL revealed 75 hotspots with a mean of 1.70 per patient, and SPECT/CT revealed 92 hotspots with a mean of 2.09 per patient. Additional hotspots were identified in 14 patients on SPECT/CT, which included 4 patients, where PL did not detect any sentinel nodes. Conclusion: Pre-operative SPECT/CT in addition to planar lympho-scintigraphy in sentinel node biopsies of oral cavity SCC detects more number of sentinel nodes compared to planar imaging alone. The higher sensitivity of SPECT combined with better anatomical localization using diagnostic CT may further improve the precision of SNB procedure.

Key words: Oral squamous cell carcinoma, OSCC, sentinel node biopsy, SNB, planar, SPECT, CT, SPECT/CT lymphoscintigraphy.

Introduction

Oral squamous cell carcinomas (OSCC) are a major health problem in India and account for about 30% of all cancer cases in the country.[1] As with other cancers, prognosis in OSCC depends upon the stage. The 5-year survival decreases from 82% (N0 disease) to 53% as a result of regional nodal involvement, highlighting the importance of early detection and treatment of nodal disease in OSCC. Patients with clinically negative neck (N0) disease after clinical examination/imaging still harbor occult disease within cervical nodes in about 30%. Current gold standard for management of "N0" disease is called selective neck dissection (SND), that is, by dissecting a small group of lymph nodes. The most commonly performed procedure for SND for stage I/II OSCC is the level I-III neck dissection.[2] Despite the advances in the surgical technique, the routine SND in all N0 neck is still considered invasive and probably an unwanted diagnostic procedure in more than 70% patients. About 22% patients have post-operative shoulder dysfunction, and time and financial constraints are some of other limitations. But a conservative “wait and watch” policy for the No neck may conversely lead to about 1/4th of patients eventually developing nodal metastasis. This would then require a more extensive surgery and adjuvant therapies, or worse, might even present as the non-salvageable

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Due to complexity in lymphatic drainage in head/neck, pre-operative lymphatic mapping under gamma camera is important and correlates well with the precision of the surgical procedure. Mapping lymphatics using single photon emission computed tomography/computed tomography (SPECT/CT) in addition to planar lymphoscintigraphy (PL) has been shown to be of additional clinical relevance in breast, melanoma of head/neck and trunk, and pelvic malignancies, leading to surgical adjustments in a considerable number of patients. This additional value of SPECT/CT in OSCC has been demonstrated in a few studies. The aim of this study was to assess whether the addition of SPECT/CT offers any incremental benefit over PL alone for pre-operative lymphatic mapping in SNB for OSCC.

Materials and Methods

This was a retrospective analysis of 44 patients with clinically node negative oral cavity SCC who underwent sentinel node biopsy and subsequent selective neck dissection (levels I–IV). On the morning of surgery, with patient in supine position, using a tuberculin syringe, about 0.5mCi/15MBq 99mTc-labelled Human Serum Albumin Nanocolloid was injected at 2-4 sites on the edge of the tumor (i.e., peritumoral). No local anesthetic was used during injection. Mild bleeding was noticed at the injection site, which was controlled by local gauze pressing for few seconds and mouth rinse was given to minimize pooling of radiotracer in oral cavity. Using a dual head gamma camera, LEHR collimator, 10-20% energy window centered on 140 keV, dynamic imaging in the supine position was done immediately (20s/frame in 128 × 128 matrix) after injection was done in anterior–posterior projection for 20 minutes or till any draining node was visualized. After visualization of the lymph nodes on dynamic images, static lymphoscintigraphy in two planes (anterior and lateral) was done (for approximately 300 seconds with a 256 × 256 matrix) followed by SPECT/CT acquisition.
Results

The cohort consisted of 44 patients, 37 males and 7 females, with a mean age of 46. Site of primary disease was tongue in 91% (n = 40) and buccal mucosa in 9% (n = 4) [Table 1]. Final histopathology revealed occult nodal disease in 29.5% (n = 13) patients. Sensitivity, specificity, NPV, and PPV of SNB procedure was 76%, 100%, 91%, and 100%, respectively. No unsuccessful procedures were recorded. A total of 179 sentinel nodes were harvested, with a mean of 4.06 per patient. PL and SPECT/CT revealed hotspots in the ipsilateral neck in 95% (n = 42) and in contra lateral neck additionally in 9% (n = 4). PL revealed 75 hotspots with a mean of 1.70 per patient, and SPECT/CT revealed 92 hotspots with a mean of 2.09 per patient. Additional hotspots were identified in 14 patients on SPECT/CT, which included 4 patients, where PL did not detect any sentinel nodes. SPECT/CT identified 23 hotspots in ipsilateral IB, 24 in level II, 25 in level III, and 16 in level IV (all ipsilateral) [Table 2]. Contra-lateral hotspots were identified on planar and SPECT/CT, two in level IB and two in level IV. In two patients, where both PL and SPECT were negative, the sentinel node was identified in one patient only by the gamma probe, and in the other patient, no sentinel node could be identified intra-operatively. Based on the final histo-pathological results, the detection rate by PL, SPECT/CT, and gamma probe guidance was 93%, 95%, and 97%, respectively.

Discussion

The purpose of an additional SPECT/CT over PL in SNB is to (1) identify nodes closer to the injection site, (2) identify nodes that are small or below the spatial resolution of the PL, (3) identify any contra-lateral drainage that are not identified on PL, and (4) to precisely identify the anatomical level of sentinel nodes, which might aid the surgical procedure. The value of SPECT/CT over PL was assessed in a large prospective multicentre study in carcinoma breast, pelvic malignancies, and melanoma. The results of this study showed that SPECT/CT detected more sentinel nodes and lead to surgical adjustments in a considerable number of patients.  

Multiple studies have been done to explore this clinical utility of pre-operative SPECT/CT lymphoscintigraphy in sentinel node biopsies for oral cancers. In 2006, Khafif et al. evaluated the additional benefit of SPECT over PL in 20 patients with T1-T4 oral cavity SCC. The sensitivity of SNB for detection of nodal metastases was 87.5%. SPECT improved SN identification/localization in about 30% of the patients. In the same year, Bilde et al. compared SPECT with PL in 33 patients who underwent SNB and showed that SPECT/CT identified extra sentinel nodes compared to the PL in about 47% of patients. In 2009, a larger study was done by Haerle et al. in 58 patients with T1-T2 OSCC with a mean follow-up of 21 months. Although both SPECT/CT and PL identified the same median number of hotspots (two hotspots per patient), additional sentinel nodes were identified in about 18% of patients and in one patient, SPECT/CT identified sentinel nodes that were missed by PL. The authors acknowledged that both SPECT and PL had lower sensitivity in detection of level I nodes that were closed to injection sites. The authors concluded that adding SPECT/CT to PL alone should be routinely recommended as it detects more number of SLN, improves topographical orientation with surrounding structures, and reduces surgical time.  

Recently, sub-analysis of the SENT study done to assess the impact of image acquisition techniques for pre-operative lymphoscintigraphy revealed that best results were obtained with a combination of dynamic scans and SPECT/CT.

In our study, occult nodal metastases were seen in 29.5% of patients (n = 13). A total of 179 sentinel nodes were harvested, with a mean of 4.06 per patient. This high number of nodes per patients may be attributed to the long time interval between the injection of tracer and probing.
and probably contributed by a long SPECT acquisition time. SPECT/CT identified 92 sentinel nodes with a mean of 2.09 per patient (range 0-14). Compared to PL, SPECT identified additional sentinel nodes in 31% of patients (14/44) [Figure 1 and 2]. Among this, SPECT/CT identified sentinel nodes in four patients, where planar imaging was negative. Out of these four patients, in three patients, SPECT identified sentinel nodes in ipsilateral level IB, and in one patient, sentinel nodes were identified in ipsilateral level III. The increased detection of ipsilateral level IB nodes shows the incremental benefit of SPECT over PL in identifying nodes adjacent to the injection site [Figure 1]. In one patient, where both SPECT and PL did not show any drainage, the sentinel node was identified intra-operatively, showing the added value of gamma probe exploration even in patients where no sentinel nodes are identified on pre-operative lymphatic mapping. The long-term follow-up of low-risk T1–T2 oral cancers have shown that contra-lateral neck recurrence accounts for about 40% of the treatment failures. In 9% (4/44) of patients, contra-lateral drainage was seen on both planar and SPECT, demonstrating the incremental value of pre-operative mapping. SPECT identified more number of contra-lateral nodes than PL. In our study, however, contra-lateral neck dissection was obviated as these tumors were small (T1) and unilateral. These patients had no evidence of any contra-lateral nodes on follow-up. Contra-lateral drainage would be of clinical significance especially for midline tumors or large unilateral tumors that might obstruct the ipsilateral lymphatic drainage.

The routine use of SPECT/CT lymphoscintigraphy in sentinel node biopsies does have its limitations. These include longer acquisition times, low spatial resolution with conventional SPECT/CT systems, and susceptibility for imaging artifacts. Recent technological advances in SPECT instrumentation highlight the constant efforts toward overcoming these limitations. These include availability of newer semiconductors technology, replacing photon multiplier tubes with position sensitive PMTs and avalanche photodiodes, better collimator design, development of diagnostic quality hybrid SPECT/CT systems, and sophisticated software for scatter corrections with noise compensations.

There are a few limitations in our study. First, the study is a retrospective cohort. Second, all the tumors were T1-T2 and predominantly involving the unilateral tongue. As discussed earlier, lack of large tumors or midline tumors in our study could possibly attribute to the less incidence of contra-lateral drainage seen in our study. Also, our study lacked more heterogeneous tumor locations (such as those from the palate/floor of mouth), which would be a better representative sample for the study than tumors that were located only in tongue. Lastly, we used a low mA CT that was of non-diagnostic quality. This could decrease the spatial resolution and can alter the overall diagnostic accuracy of SPECT/CT lymphoscintigraphy. In perspective, state-of-the-art SPECT/CT imaging with newer systems will truly reflect its additional clinical benefit over the combined use of PL and intra-operative gamma.

**Conclusion**

Pre-operative SPECT/CT in addition to planar lymphoscintigraphy in sentinel node biopsies of oral cavity SCC detects more number of sentinel nodes and detects sentinel nodes that are likely to be missed on planar imaging alone. Along with better anatomical localization, this higher sensitivity of SPECT/CT will probably further improve the precision of the surgical procedure. Routine recommendation of SPECT in SNB for oral cavity SCC, however, awaits larger, prospective, controlled studies with newer SPECT/CT systems that would be better to demonstrate its true clinical value.

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**Conflicts of interest**

There are no conflicts of interest

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