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Lymphatic drainage patterns from primary cutaneous tumours of the forehead: Refining the recommendations for selective neck dissection

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Summary *Background:* Recommended selective neck dissections for primary cutaneous tumours on the head and neck are based largely on clinical recurrence data acquired prior to the era of lymphatic mapping and sentinel lymph node (SLN) biopsy. This study aimed to examine lymphatic drainage patterns from the forehead in order to provide evidence upon which to base recommendations regarding the extent of neck dissection.
Methods: Data were collected prospectively from all patients undergoing lymphoscintigraphy following diagnosis of a primary cutaneous tumour on the forehead. The site of injection of radioisotope was documented using a co-ordinate-based mapping system. The forehead was divided into glabellar, supra-orbital and anterior temple zones. The location of all SLNs was recorded and drainage patterns were analysed.
Results: Between 1994 and 2006, 152 patients underwent lymphoscintigraphy for primary cutaneous tumours on the forehead. Drainage was to 3.0 SLNs in 2.1 lymph node fields (mean values). Drainage was to ipsilateral SLNs in 85% of cases. Between zones there were significant differences in drainage patterns and the frequency of bilateral drainage. From the glabellar zone, drainage was more frequently to a higher number of SLNs and SLN fields, and to level I nodes.
Conclusions: The forehead can be divided into zones with patterns of lymphatic drainage that vary significantly in terms of number of SLNs, number of SLN sites, likelihood of drainage to contralateral SLNs and predictability of drainage pattern. Drainage to level 1 nodes from

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the anterior temple is rare, suggesting that it may be safe to exclude this level when performing a selective neck dissection for tumours in this zone.

Introduction

In 1991, the patterns of regional lymph node metastasis in 111 patients with cutaneous melanomas of the head and neck were reported by Shah et al.[1] These authors used the information to make recommendations for the extent of elective and therapeutic neck dissections. The subsequent introduction of lymphoscintigraphy and intraoperative lymphatic mapping for sentinel lymph node (SLN) biopsy provided an opportunity for more precise study of lymphatic drainage patterns from primary cutaneous tumours.[2,3] Evaluation of these techniques for cutaneous tumours of the head and neck resulted in the region acquiring a perhaps undeserved reputation for unpredictable lymphatic drainage.[4–10] Lymphatic drainage from head and neck sites is particularly rich and complex, often to multiple SLNs, and it may be that predictable drainage patterns do exist but have been overlooked for a variety of reasons. For example, techniques used to demonstrate lymphatic drainage from the head and neck may not have sufficient "resolution", resulting in the identification of SLNs draining areas of skin larger than the area of interest.

Previous studies assessing the predictability of lymphatic drainage from cutaneous head and neck tumour sites have subdivided the region into areas that remain large and diverse, such as the entire face. The locations of SLNs from tumours within such areas have been compared with "clinically predicted" nodal drainage sites for those areas.[5,11] As a single subdivision of the head and neck, the face has typically been taken to comprise the forehead, anterior temples, eyelids, nose, mouth, cheeks and chin, and the recommended selective neck dissection for this entire area has been parotidectomy combined with clearance of Levels I–III or I–IV cervical lymph nodes.[12] The multi-disciplinary team, faced with a patient who has a positive SLN (or SLNs) or clinically detected nodal metastasis from a primary cutaneous tumour on the face, must decide on the type and extent of neck dissection to be performed and/or the lymph nodes to be targeted during radiotherapy. Any therapeutic intervention will fail if it does not include all potential sites of metastasis, but the routine inclusion of all possible sites e.g. total head and neck irradiation or bilateral parotidectomies + level I–V neck dissections would produce unacceptable morbidity and would clearly be inappropriate. It would be logical to subdivide an area as large and anatomically diverse as the face into smaller zones, with the expectation of demonstrating more predictable lymphatic drainage from these zones to fewer nodal sites. Evidence-based refinements could then be made to the existing recommendations for selective neck dissection and radiotherapy. To investigate this hypothesis, the forehead (including the anterior temple) was selected as an anatomically unremarkable subdivision of the face, in which to determine the variability (and thus unpredictability) of lymphatic drainage. No previously published reports focussing on patterns of lymphatic drainage from the forehead could be found on literature review, and so the first aim of the present study was to describe the lymphatic drainage patterns from the forehead. Additional aims were to document the frequency of drainage to contralateral SLNs, to subdivide the forehead itself into zones and assess variability of drainage between zones in the hope that refinements could then be made to existing recommendations for selective neck dissections for tumours located on the forehead.

Methods

Between March 1994 and July 2006 data were collected prospectively on all patients undergoing lymphoscintigraphy at the Sydney Melanoma Unit (SMU) for primary cutaneous tumours (melanomas and Merkel cell carcinomas). The location of each primary tumour was mapped using a co-ordinate-based system. For the present study the boundaries of the forehead were defined as shown in Figure 1. The forehead was further subdivided into a central glabellar zone, with supra-orbital and anterior temple zones laterally. These subdivisions were based on the vascular anatomy of the area (see Figure 1) and the assumption that the lymphatic drainage would be likely to follow a similar pattern. The central glabellar zone was based around the supra-trochlear vessels, the supra-orbital zone around the supra-orbital vessels and the anterior temple zone around the anterior branches of the superficial temporal vessels.

The technique of lymphoscintigraphy at our institution has been described in detail previously.[13] Briefly, it typically comprises two or four intra-dermal injections of ^{99m}technetium antimony sulphide colloid immediately adjacent to the primary tumour or on each side of the centre of the excision-biopsy site.[13] The volume of each injection is 0.05–0.1 ml and contains 5–20 MBq of tracer depending on when surgery is planned. A super-high resolution collimator is used, with dynamic imaging performed immediately following injection of tracer in order to identify and follow the lymphatic collecting vessels, thus allowing accurate identification of the SLNs. Delayed scans are performed at 1–2 h, with imaging of all regions that could possibly contain SLNs.

A SLN was defined as "any lymph node that received drainage directly from the primary tumour site".[13,14] The locations of all SLNs detected by lymphoscintigraphy were recorded and classified as levels *I–V*, pre-auricular (equivalent to parotid) and other sites (occipital, post-auricular and interval) that are not included within standard neck dissections.