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A Triangular Intermuscular Space Sentinel Node in Melanoma: Association With Axillary Lymphatic Drainage

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Abstract

Background—Large centers have described triangular intermuscular space (TIS) sentinel nodes (SNs) for some melanomas of the back. However, their management remains controversial and poorly characterized, especially as related to the ipsilateral axillary node basin. The aim of this study was to summarize our experience with TIS SN, which may contribute to defining their appropriate surgical management.

Methods—We performed a retrospective review on surgical patients from January 1993 to April 2009. Among 293 patients with upper back melanoma, data were collected on those with TIS SN.

Results—Fourteen patients (5%) with melanoma of the upper back had a TIS SN, 6 of whom (43%) were incorrectly identified at lymphoscintigraphy as axillary, and 11 of whom (79%) had a concurrent axillary SN. Micrometastatic disease was identified in TIS SN in two patients (14%) and in an axillary SN in one (9%). We found direct lymphatic drainage independently to the TIS and to the axilla, as well as a more typical pattern of drainage first to the TIS node and then to axillary nodes.

Conclusions—We defined three patterns of lymphatic drainage to TIS and axillary nodes. The TIS and axilla are anatomically linked; patients with SN in both locations should undergo biopsies of both for optimal nodal staging. We recommend directed evaluation for TIS SN in patients with upper back melanomas and recommend clearing the TIS at the time of TIS SN biopsy. Melanoma can metastasize to TIS SN, and we discuss considerations for management of the axilla in patients with positive TIS nodes.

Melanoma accounts for only 4–5% of all skin cancers; however, it is responsible for most skin cancer deaths. After wide local excision of the primary tumor, the most common sites of recurrence are regional lymph nodes. Identification of a sentinel node (SN), which is any node that receives direct lymphatic drainage from a tumor site, improves the accuracy of staging and subsequently guides appropriate treatment.

Initially, clinicians relied on intradermal blue dye injections around the melanoma site to identify lymphatic drainage and to trace SNs.¹ That technique depended on an identification of the appropriate lymph node basin that was based on assumptions about lymphatic anatomy established by Sappey more than 150 years ago.² The introduction of lymphoscintigraphy revealed unexpected patterns of lymphatic drainage that differed from Sappey's classic description. In approximately 30% of patients, there is nonclassical lymphatic anatomy.¹ Lymphoscintigraphy studies demonstrated that lymphatic vessels

frequently cross the midline and that SNs are found in unexpected locations, sometimes in nodal fields not previously appreciated.^{3,4}

One of these poorly recognized lymph-node bearing areas is the triangular intermuscular space (TIS), which is located lateral to the scapula and which receives drainage from the back. This space is bounded by the teres major inferiorly, the infraspinatus, teres minor, and subscapularis superiorly, and the long head of the triceps laterally. Several studies have identified the TIS as a potential drainage basin for melanoma of the back. Uren et al described such drainage in approximately 11% of patients with melanomas on the back.¹ It has also been established that appropriate imaging requires not only anterior views, but also posterior and lateral views to identify SNs in the TIS on lymphoscintigraphy.²

Surgical management of SNs in the TIS has been reported from the Sydney Melanoma Unit, where 4 of 14 TIS SN contained metastatic melanoma.⁵ However, the association between TIS and axillary SNs has not been defined, nor is there a standard recommendation for definitive surgical management of patients with positive TIS SNs. We report here our experience with SNs in the TIS and the subsequent surgical management. We also report on the use of lymphoscintigraphy to clarify the anatomic relationship of the TIS and axillary nodes. These findings may provide guidance for developing recommendations for patient management.

METHODS

A retrospective chart and database review was completed of all patients with a surgically excised cutaneous melanoma treated by a single surgeon at the University of Virginia from January 1993 through April 2009. Patient demographics, lymphoscintigraphy results, operative reports, pathology reports, and postoperative follow-up data were collected from a prospectively collected database and hospital records. This study was reviewed and approved by our institutional review board.

Inclusion criteria included primary cutaneous melanoma of the upper posterior trunk with subsequent lymphoscintigraphy. The primary end point was the presence of a SN identified at the TIS. Exclusion criteria included nonmelanoma lesions, inconsistent operative findings, and incomplete data.

Search criteria within the database for TIS and back intransit nodes identified 17 patients. The operative reports and lymphoscintigraphy records for these patients were reviewed, and three were eliminated for operative reports inconsistent with TIS SNs. We subsequently reviewed the original lymphoscintigraphy films to define the patterns of drainage pathways to the TIS and to the axilla in the 11 patients with a concomitant axillary SN.

Descriptive analyses comparing demographic data in patients with a melanoma of the upper posterior trunk was performed. Patients with and without a TIS node were compared by univariate analysis. Categorical variables were compared by Fisher's exact test, and continuous variables were compared by the Mann-Whitney *U*-test. Categorical data are reported as frequencies and percentages, and a statistical significance of $P < 0.05$ was used.

RESULTS

When we reviewed the database, we identified 293 patients with a primary cutaneous melanoma on the posterior trunk (Table 1). Among patients with a melanoma of the posterior trunk, 14 (5%) had a TIS SN identified, and there was no difference in demographics, tumor depth, and Clark's level when compared to patients without a TIS SN. An average of 1.64 (range, 1–3) SNs were excised from the TIS basin.

Of these 14 patients, 11 (79%) also had a concomitant axillary SN identified. These patients were further stratified on the basis of lateralization to the axilla. In such patients, 64% of disease lateralized to the ipsilateral axilla, 18% to the contralateral axilla, and 18% to bilateral axillae (Fig. 1), and 21% did not have axillary SNs. None of the patients had contralateral TIS SNs.

Identification of the TIS SN by lymphoscintigraphy was often not straightforward. In six patients, the radiologist's formal report incorrectly reported the TIS SN as an axillary node. In those cases, the surgeon identified the correct location of the TIS SN or nodes on the basis of review of the lymphoscintigraphy and intraoperative confirmation with the handheld gamma probe. As an example, in Fig. 2, the anterior views (Fig. 2a, b) show the injection site in the upper back to the left of midline and two SNs that seemed adjacent to each other, with the more superior one being much brighter than the more inferior one. It is easy to understand how these might both be believed to be in the left axilla. However, on lateral views (Fig. 2c, d), the more superior spot is evident anterior, in the true axilla. The second hot spot is not seen in the axilla, but instead is far posterior, directly lateral to the injection site. This more posterior hot spot seems connected to the axillary spot by a distinct lymphatic channel. Intraoperatively, this more posterior spot was in the TIS. It is noteworthy that the TIS node was more lateral than the axillary node (Fig. 2a), and also that it seemed less bright on the anterior view than on the lateral view, consistent with its posterior location.

Also, in Fig. 3, the anterior view (Fig. 3a) shows the injection site in the upper mid back and drainage to nodes in the right axillary area, but nothing is evident on the left. The right lateral view (Fig. 3b, c) confirms the right axillary nodes located more anteriorly, in the axilla. However, on the posterior view (Fig. 3d), a lymphatic channel is visualized to the left, which goes to a node as far to the left as to the right. However, on the left lateral view (Fig. 3e, f), it is apparent that the nodes on the left are more posterior than those on the right. The nodes on the left were in the TIS. The lateral view in these and other cases was critical to differentiating TIS nodes from axillary nodes. The findings of the lateral view are corroborated by the differences in relative intensity of the TIS node, in posterior versus anterior views.

Surgical Approach to the TIS Nodes

The surgical approach to the SN or SNs in the TIS was to make a transverse incision in the skin overlying the TIS hot spot, and then to dissect through the subcutaneous tissue, where the TIS node was identified superficially in the space bounded by the teres major, teres minor, and long head of the triceps. Though usually superficial, in one case there was a node deep to the TIS, and approximately halfway between the axilla and the TIS, along the path that is evident in Figs. 2d and 5c, d. Surgical clearance of the TIS required little more dissection than excision of a TIS node. The node-bearing tissue bordered by the teres major, teres minor, and long head of the triceps was excised with blunt dissection, and electrocautery with ligation of lymphatic-bearing tissue, when identified. A drain was not used in the TIS.

Metastases Identified in TIS SNs

Micrometastatic disease was identified in a TIS SN in two patients (14%) and in an ipsilateral axillary SN in one (9%) of these patients (Table 2). Both patients with positive TIS SN underwent completion lymph node dissections of the ipsilateral axilla, and both were negative for additional metastases in 22 and 28 nodes, respectively. Completion lymph node dissection of the TIS was performed in one of those patients and yielded one negative node. The other patient was followed at the TIS, without recurrence at last follow-up 4 years

later. These data are also presented according to disease stage (Fig. 4). A positive SN was found in one (33%) of three patients with T3 melanomas, one (20%) of five patients with T2 melanomas, and none (0%) of six with T1 melanomas. Similarly the one positive SN in the axilla was in a patient with a thicker melanoma (T3).

Anatomy of the TIS

Lymphoscintigraphy permits study of patterns of lymphatic drainage (Fig. 5). The TIS is an anatomical space formed by the teres major inferiorly, the infraspinatus, teres minor, and subscapularis superiorly, and the long head of the triceps laterally. The circumflex scapular vessels pass through this anatomic space (Fig. 5b). Lymphatic channels pass from the TIS lymph node field to the axillary lymph node basin following the course of the circumflex scapular and then the subscapular vessels.^{2,6} Figures 5c and d demonstrate that lymphoscintigraphy may be useful in identifying the lymphatic draining pathways from the TIS lymph node basin to the axillary lymph node basin. This may be useful in identifying the best surgical management of these patients. As seen in Fig. 3a, an anterior view may not be sufficient to detect a TIS SN. Posterior and lateral views are valuable to identify SNs at this atypical location.²

We reviewed the number of drainage pathways from the primary melanoma site to the TIS or axilla in the 11 patients with concomitant axillary nodes. In these patients, seven (64%) had one drainage pathway, three (27%) had two drainage pathways, and one (9%) had three or more drainage pathways. We also evaluated the drainage patterns to the TIS or the axilla in those nine patients (64%) with an ipsilateral axillary SN, two of whom also had contralateral axillary node drainage. All nine had channels that seemed to travel to and through the TIS node to one or more axillary nodes. In addition, four of them had separate lymphatic channels that traveled to the axilla directly, bypassing the TIS node. Thus, for all 14 patients with TIS SN, 5 had no ipsilateral axillary SN (pattern 1), 5 had lymphatic channels that drained first to the TIS node, then to an ipsilateral axillary node (pattern 2), and 4 had lymphatic channels that drained to the TIS and then the axilla as well as separate channels that drained to the axillary nodes and bypassed the TIS nodes (pattern 3). Interestingly, none of these patients had channels that went separately to ipsilateral TIS and axillary nodes unless there was also a channel from the TIS to the axilla.

DISCUSSION

The upper back is a common location for melanoma, which classically is expected to metastasize to posterior cervical or axillary nodes. However, the TIS is now appreciated as a common alternative lymph node area for nodes at risk for metastasis from melanoma of the upper back. Approximately 5% of our patients with melanoma of the upper back had a SN in the TIS. This rate is comparable to the 11% rate reported by investigators from the Sydney Melanoma Unit.^{1,7} Our data, and data from others, support the impression that TIS nodes may be regarded and managed as regional nodes in other area.^{1,2,6-8} In 36% of our patients, the TIS node was the only ipsilateral SN. The TIS may harbor the only SN or nodes; therefore, it is important to be cognizant of its existence and the potential for metastasis to nodes in that location. Also, all patients with SNs in the TIS and the axilla had drainage through the TIS to the axilla, demonstrating that the TIS nodes and axillary nodes are closely linked. Because the TIS nodes are likely upstream of the axillary nodes, it is not adequate to perform biopsy only on the axillary nodes when a TIS SN exists. Regional nodal recurrences in the TIS have been observed (unpublished clinical experience).⁹

The TIS can be difficult to identify by lymphoscintigraphy, especially in the anterior view. Also, the TIS node may be close to the site of the primary tumor, and the injection-site radioactivity may obscure the TIS hot spot if not carefully sought on posterior and lateral

views. Oblique views may also aid in their identification. Any melanoma on the upper back should be evaluated carefully for SNs in the TIS. We recommend several steps to ensure identification of the TIS node: for any patient with an upper back melanoma, include lateral and posterior views as well as anterior views, and recognize that the TIS node will overlap the axillary space on anterior and posterior views but will be posteriorly located whereas axillary nodes are anterior. Finally, the surgeon should specifically evaluate the TIS with the handheld gamma probe intraoperatively.

In the present study, 14% of patients had micrometastatic disease in a TIS SN. These findings support the very real potential for metastasis to the TIS, as has also been reported by Thompson and Uren et al.^{5,6,10} The TIS nodes are usually few in number and very localized. Our patients had an average of 1.64 (range, 1–3) SNs removed from the TIS. Also, their removal is not expected to cause lymphedema of an extremity or other morbidity. Thus, a complete dissection at the TIS at the time of TIS SN biopsy would eliminate the potential need to reoperate at the TIS if micrometastatic disease were present on the SN biopsy. We now routinely clear the entire TIS space when we remove a SN from there.

Optimal management of the axilla in the event of a positive TIS SN remains less certain. In 64% (9 of 14) of patients with a TIS node, an ipsilateral axillary SN was also identified. The TIS communicates with the axilla by intervening lymphatic channels, so it is not surprising that melanomas draining to the TIS may drain also to the axilla. In the nine patients with a TIS node and concomitant ipsilateral axillary node, we found that 100% had at least one lymphatic channel that drained through the TIS and on to the axilla. Therefore, in those cases, the TIS lymph node is a SN and concomitant axillary lymph nodes may be secondary nodes. It is possible, on the other hand, that a lymphatic channel to the axilla may travel beside a channel to a TIS node but may bypass the TIS node, in which case the axillary node could be also be a SN. If the axillary node is “hotter” than the TIS nodes, as shown in Fig. 5c, it is harder to be sure that the axillary node is secondary. On the other hand, if there are separate channels to the TIS and to the axilla, there can be confidence that they are both sentinel.

In summary, our current recommendation for treating patients with a melanoma on the upper back is to evaluate specifically for a TIS SN by lateral and posterior views in addition to anterior views, plus intraoperative assessment with the gamma probe at the TIS. In patients in whom a TIS SN is identified, we recommend performing a complete dissection of the TIS. In patients with a positive axillary SN, we recommend performing a completion lymph node dissection of the axilla. However, if the TIS node contains micrometastatic disease, no non-SNs in the TIS are positive, and the axillary SN is negative, then we consider it reasonable to observe the axilla. However, if non-SNs in the TIS contain metastatic disease, or if the TIS SN contains a large metastatic deposit and no ipsilateral axillary SNs were sampled, then it may be reasonable to perform a complete ipsilateral axillary dissection. Further data on these clinical scenarios will ultimately be informed by the ongoing Multicenter Selective Lymphadenectomy Trial II.

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FIG. 1.
Lateralization to the axilla after identifying a TIS sentinel node

FIG. 2. Left axillary and triangular intermuscular space (TIS) sentinel nodes. Lymphoscintigraphy from an upper mid back melanoma included anterior views without (a) and with (b) posterior transillumination from a gamma source, and left lateral views without (c) and with (d) transillumination

FIG. 3.

Right axillary sentinel node (SN) and left triangular intermuscular space (TIS) SN.

Lymphoscintigraphy from an upper mid back melanoma included an anterior view (a), right lateral views with (b) and without (c) gamma transillumination, a posterior view (d), and left lateral views with (e) and without (f) transillumination

FIG. 4.
Distribution of triangular intermuscular space (TIS) and axillary lymph node micrometastatic disease based on tumor staging

FIG. 5. Example of lymphoscintigraphy of melanoma of the back with triangular intermuscular space (TIS) node. **a** Anterior view, triangle at melanoma injection site, *curved arrow* at axillary node. **b** Anatomical diagram of TIS. Reprinted with permission from Uren et al.⁶ **c**, **d** Lateral view with *triangle* at melanoma injection site, *arrows* at TIS nodes, *curved arrow* at axillary lymph node and *dashed line* outlining drainage pathway from the TIS to the axilla

TABLE 1

Characteristics of patients with melanoma of the upper posterior trunk according to presence or absence of TIS node

Characteristic	Patients with TIS node (<i>n</i> = 14)	Patients without TIS node (<i>n</i> = 280)	<i>P</i>
Age (yrs) (SEM ± SD)	54.7 ± 20.9	52.3 ± 15.2	0.39 ^a
Male sex, <i>n</i> (%)	8 (57)	190 (68)	0.39 ^b
Race, <i>n</i> (%)			0.88 ^b
White	14 (100)	274 (98)	
African American	0	1 (0.36)	
Other	0	4 (1.4)	
Tumor depth (mm)	1.46 ± 1.16	2.15 ± 3.6	0.26 ^a
(SEM ± SD)			
Clark level, <i>n</i> (%)			0.65 ^b
1	0	14 (5.4)	
2	0	29 (11.3)	
3	4 (30.7)	79 (31)	
4	9 (69.3)	129 (50.4)	
5	0	5 (2)	

TIS triangular intermuscular space

^a Mann–Whitney *U*-test

^b Fisher's exact test

TABLE 2

Characteristics of patients with melanoma of the upper posterior trunk according to presence of TIS or concomitant axillary node

Characteristic	TIS node (<i>n</i> = 14)	Concomitant axillary node (<i>n</i> = 11)
Melanoma in sentinel node biopsy	2 (14%)	1 (9%)
CLND performed	1 (7%)	2 (18%)
Melanoma in CLND	0	0

TIS triangular intermuscular space, *CLND* completion lymph node dissection