Thoracic Cancer ISSN 1759-7706

ORIGINAL ARTICLE

Utilization of the International Association for the Study of Lung Cancer and Wang's nodal map for the identification of mediastinum and hilar lymph nodes

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Keywords
Bronchoscopy; lymph node map; TBNA.

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Received: 13 September 2014;
Accepted: 31 October 2014.

doi: 10.1111/1759-7714.12206

Thoracic Cancer **6** (2015) 464–468

Abstract

Background: Transbronchial needle aspiration (TBNA), serving as a remarkably invaluable and minimally invasive technique, has been widely used for the diagnosis and staging of mediastinal adenopathy and masses. To date, the International Association for the Study of Lung Cancer (IASLC) and Wang's nodal map are two well-documented intrathoracic lymph node guidelines for the TBNA procedure.
Method: We characterized IASLC's and Wang's map, and interpreted the correlation of the two maps station by station.
Results: The pivotal role of IASLC map is to determine N descriptor in the tumor node metastasis (TNM) staging system of lung cancer, whilst Wang's map is employed to facilitate the localization of biopsy sites for bronchoscopists during TBNA performance. Furthermore, stations 1, 3 and 5 in Wang' map are equivalent to 4R station in IASLC' system, while stations 4 and 6 in Wang's account for IASLC station 4L as N2 stations. In addition, Wang's stations 2, 8 and 10 are correlated with station 7 in IASLC's. Wang's stations 7 and 9 are responsible for station 11R in IASLC's map.
Conclusion: Given their unique benefits and limitations, and the practical links between the two maps, it appears reasonable to highlight the significance of their complementary utilization upon TBNA performance and lung cancer staging.

Introduction

Transbronchial needle aspiration (TBNA), first described in the 1970s, is now well-accepted as a remarkably invaluable and minimally invasive procedure, which is used for the evaluation of intrathoracic lymph nodes (LNs) and the lesions adjacent to the tracheobronchial tree with highly effective accuracy.[1] Conventional TBNA (cTBNA) and the recent emerging endobronchial ultrasound (EBUS) TBNA have revolutionized the evaluation and management of benign and malignant diseases, ranging from lung cancer and lymphoma, to tuberculosis and sarcoidosis.[2–4] Interestingly, a very recent report showed that the diagnostic yield of TBNA for lung neoplasms is even higher than positron emission tomography (PET) in postoperative LN recurrence.[5] To date, although evidence from several studies exhibited a higher yield of EBUS TBNA in most intrathoracic LN sites with a lower complication rate compared to cTBNA,[6–9] the debate remains open.[10,11] Of note, a very recent study illustrated that the diagnostic yield of cTBNA could be improved after EBUS training.[12] Moreover, the authors concluded that cTBNA should remain in the armamentarium of every bronchoscopist and on the curriculum of all pulmonary fellowship training programs, even if EBUS technology is available. Actually, both techniques exhibit their own benefits and limitations. For example, EBUS TBNA demonstrates up to 90% of sensitivity[13] and sufficient specimens for molecular analysis,[14] but usually requires general anesthesia or conscious sedation,[15] a second survey scope, and higher expense.[16,17] In contrast, cTBNA requires lower cost and ease of performance and training,[17–19] while the diagnostic yield is extremely varied, spanning a wide range from 39–86%,[20] greatly depending on

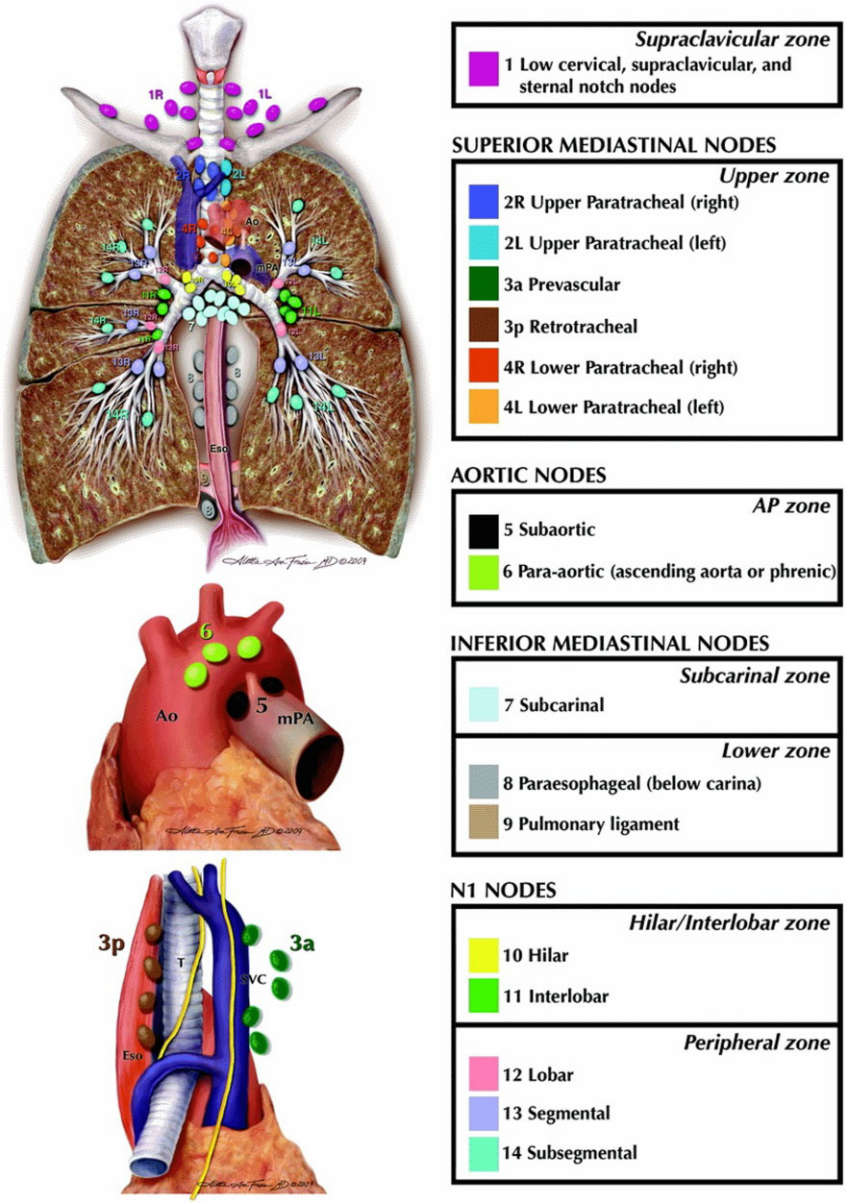

Figure 1 International Association for the Study of Lung Cancer lymph node map (Reproduced from Rush *et al*.[22] with permission).

the LN stations, and more importantly, the operator's competency and experience. Meta-analysis on the comparison of two TBNA techniques suggests that EBUS TBNA and cTBNA provide satisfactory diagnostic yield, whereas EBUS TBNA allows shorter aspiration time.[21] Nevertheless, it is noteworthy to mention that experts both of cTBNA and EBUS TBNA agree that only when we know the destination, can we talk about whether to use the "headlights" or "street view images." In other words, a thorough understanding about the anatomy and the relationship of mediastinal structures to landmarks, which could be visualized through light bronchoscope or ultrasound, is the most critical factor for TBNA performance. Hence, we highlight here the significance of LN stations and aim to probe the relations of currently widely used LN maps.

International Association for the Study of Lung Cancer (IASLC) nodal map

The precise estimation of LN involvement in lung cancer has been universally recognized as a pivotal component for staging and therapeutic strategy decision. The anatomy of intrathoracic LNs is virtually constant and the bronchial tree and/or vasculatures have been employed as the

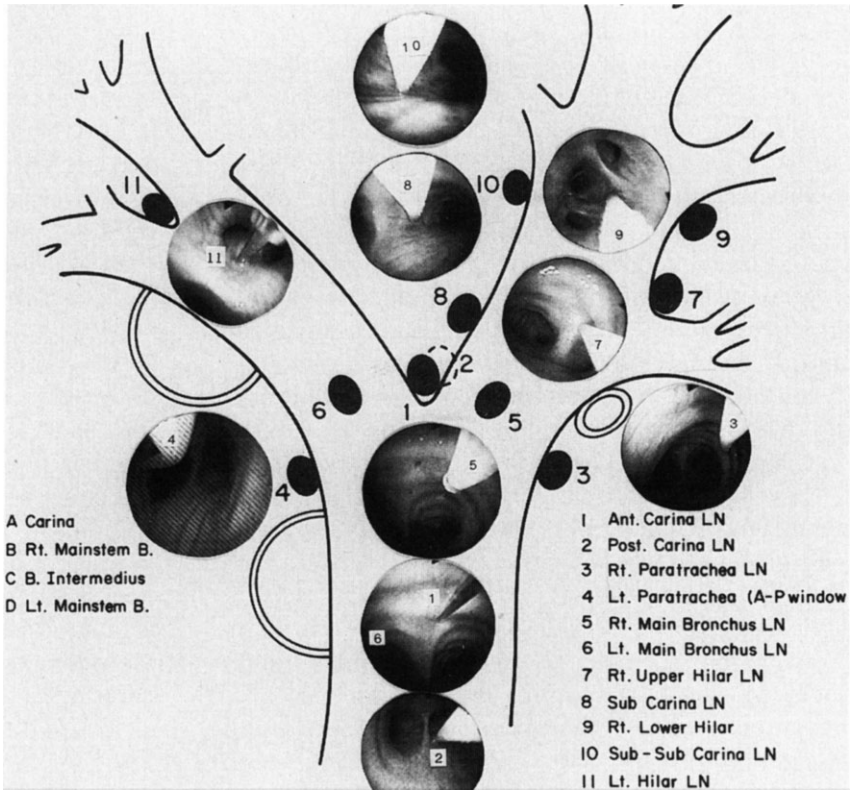

Figure 2 Wang's lymph node map (Reproduced from Wang[23] with permission).

landmarks in current widespread nodal maps. The latest LN map of the International Association for the Study of Lung Cancer (IASLC) was revised from the Naruke map and the Mountain-Dresler modification of the ATS map in 2009, and refined the definitions of the anatomic boundaries of each LN station.[22] As indicated in Figure 1, a total of 14 stations are divided into five groups: supraclavicular zone, superior mediastinal nodes, aortic nodes, inferior mediastinal nodes, and N1 nodes. Superior mediastinal nodes consist of upper paratracheal (station 2R & 2L), prevascular and retrochacheal (station 3a & 3p), and lower paratracheal (station 4R & 4L); aortic nodes include the subaortic (station 5) and para-aortic (station 6); inferior mediastinal nodes account for subcarinal (station 7), paraesophageal (station 8), and pulmonary ligament (station 9); and N1 nodes contain hilar (station 10), interlobar (station 11), and peripheral areas (station 12–14). The IASLC map is used to determine N descriptors in the tumor node metastasis (TNM) staging system of lung cancer. However, the principle for the definition of different stations is based mainly on extra-bronchial landmarks, including the aorta, pulmonary vein, clavicle, and esophagus, which can only be identified via radiographic imaging or surgery. From this standpoint, the concept used to create the map makes it less useful for guiding the puncture site during TBNA performance.

Wang's lymph node map

Wang's nodal map is another well documented and widely accepted system, which was first proposed by Dr Ko-pen Wang in 1994, identifying 11 LN stations.[23] Different from the IASLC map, visualized structures through the bronchoscope, including the carina, main right/left bronchus, both upper lobes, and the bronchus intermedius were introduced as the landmarks to identify the stations. This conception of constituting the map would facilitate the localization of biopsy sites for bronchoscopists, which is usually the very step linking to eventual diagnostic yield. A detailed depiction of the locations and puncture sites for the 11 LN stations has been well-characterized previously.[23] Briefly, the carina region consists of stations 1 (anterior carina), 3 (right paratracheal), 4 (left paratracheal or AP window), 5 (right main bronchus), and 6 (left main bronchus); the sub-carina region includes station 2 (posterior carina), 8 (sub-carina, right upper lobe bronchus level), and 10 (subsub-carina, right middle lobe bronchus level); and the hilar region accounts for station 7 (right upper hilar), 9 (right lower hilar), and 11 (left hilar) (Fig 2).

Table 1 Conversion of Wang's map and the IASLC map

Wang's map	IASLC map	Stage of LN
Station 1,3,5	4R	N2
Station 4,6	4L	N2
Station 2,8,10	7	N2
Station 7,9	11R	N1
Station 11	11L	N1

IASLC, International Association of the Study of Lung Cancer.

Obviously, it is absolutely imperative for pulmonary physicians to fully understand both nodal maps so as to improve TBNA yield and to allow proper alignment of TNM staging.

Correlation of IASLC and Wang's Nodal Map

In extension, we pinpoint the correlation of the two maps and reconcile the differences between these (Table 1). The 4R region in the IASLC map is frequently involved in a metastatic tumor with an upper border at the intersection of the caudal margin of the innominate vein and trachea, a lower border at the bottom of azygos vein, covering right paratracheal nodes, and pretracheal nodes extending to the left lateral border of trachea.[24] Though important, the IASLC map fails to point out the specific puncture site for biopsy in this "broad area." Station 4R/4L in the IASLC map, which is called the paratracheal node, is virtually present in the tracheal bronchial area. Furthermore, 4R correlating with station 1, 3, and 5 in Wang's map, is the most commonly involved group in metastatic tumors of lung cancer, whose biopsy spots have been clearly indicated at the first intercartilaginous space anteriorly for station 1, the second to the fourth tracheal inter-cartilagious space above the carina antilaterally for station 3, and the first two right bronchial cartilage anteriorly for station 5, respectively. Moreover, as the lower border of 4R is the azygos vein, the proximal portion of 10R also belongs to station 5 in Wang's map. Clinically, a case of solitary enlargement of the 10R LN is fairly rare and the determination of an N descriptor would not be interrupted in lung cancer staging for 10R alone or combined involvement with 4R. Accordingly, strict separation of 4R from 10R is likely less meaningful. Besides, the identical concept could be applied regarding 2R, 4R, and station 3 in Wang's map. Importantly, what we need to highlight here is station 5 and 6 in Wang's map. They are equivalent to lower 4R with proximal 10R and lower 4L with proximal 10L, respectively, which are the mediastinum, while the rest of 10R/10L up to 11 in the IASLC map are considered hilar nodes. Concomitantly, station 4 in Wang's map, as presented by 4L adjacent with 5 in the IASLC map, is located in the aorta-pulmonary (A-P) window region with a ligamentum arteriosum boundary, and could be divided into inner, mid, and outer window groups. The outer window is usually beyond the reach of regular TBNA and requires an extended needle, esophageal ultrasound-guided fine needle aspiration (TENA) or percutaneous needle aspiration (PCNA). As a matter of fact, 4L and 5 are commonly involved simultaneously, thus we recommend the use of 4L/5 nodes synonymously as station 4, as indicated in Wang's map.[23] In addition, region 7 in the IASLC map starts from the carina and ends with the upper border at the lower lobe bronchus, covering station 2 and 8, as well as a proximal part of station 10 in Wang's map, where more specific puncture sites of these stations for TBNA have been verified[23] (station 2: exactly opposite to station 1, is at about 5 to 6 o'clock in the posterior tracheal wall; station 8: the medial wall of the right main bronchus, proximal to the right upper lobe orifice; station 10: the medial posterior wall of the bronchus intermedius below the right upper lobe bronchus). Furthermore, the LN in region 8 of the IASLC map are defined by the one lying adjacent to the wall of the esophagus from the lower lobe bronchus to the diaphragm. The proximal portion of region 8 is actually correlated with the distal part of station 10 in Wang' map. Recent clinical trials suggest that TENA combined with TBNA significantly improved the sensitivity of diagnostic yield because of the complementary reach of different mediastinal nodes.[25,26] The particular strength lies in the detection of LNs around the esophagus and A-P window. However, the fact that no region 8 or 9 nodes of the IASLC map contributed to an increase in diagnostic yield by TENA or TBNA ubiquitously hints that LNs at stations 8 and 9 are not a prominent determinant in lung cancer diagnosis and staging.

Conclusions

In general, using vasculatures as landmarks serve a clear margin under EBUS. However, we are resecting the bronchus with a portion of the lung rather than the vessels. It is more important to fully understand the exact relationship of the LNs and bronchial tree inside and outside of the mediastinum. Although there is rapid progress of instruments, techniques, and concepts, as interventional pulmonologists we must keep conscious and insightful, judging cautiously what to accept and what to maintain. Although EBUS is efficient in the detection of LNs, the LN map is also a significant tool, exhibiting at least comparable value for the identification of LNs.

Acknowledgment

This work was supported by Medical and Health Technology Program of Zhejiang Province to Dr. Yang Xia (2015KYB165). [Correction added on 3 July 2015, after first online publication: Acknowledgment has been added.]

Disclosure

No authors report any conflict of interest.

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