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Definition of boundary lines with diagnostic importance for lung cancer staging, demonstrated with CT and MRI and based on AJCC/ATS regional lymph node classification: A comparative study with cross-sectional anatomy

WANG Zhen-huan[1], SUN Jing[2], HUANG Yu[3], QIN Deng-you[1]

[**Abstract**] **Objective**: To define several boundary lines with diagnostic significance for lung cancer staging, demonstrated with CT and MR imaging and according to ATS/AJCC regional lymph nodal classification. **Methods**: In 5 cadavers, intrathoracic lymph nodes were observed and classified using ATS and AJCC systems. Stations 4, 5, 6 and 10 were identified with 2 assisted lines and 2 imaging-based anatomic landmarks by comparing CT and MR images with 4 series of cross-sectional specimens. **Results**: In the segment from the superior border of aortic arch to the main pulmonary artery trunk, a coronal line through the sectional center of the ascending aorta divided Stations 5 and 6. The line between the centers of ascending and descending aorta separated Station 5 from Station 4 L(ATS, AJCC), or 10L(ATS) on axial images. The left pulmonary artery separated Station 5 from 10L(ATS), or 4L(AJCC) and the arch of azygos vein separated Station 4R from 10R (ATS), or superior and inferior subset of 4R(AJCC). **Conclusions**: The boundary lines between the stations designed in our study facilitate the application of ATS and AJCC classification system, which is helpful to lung cancer staging with CT and MR imaging.

[**Key words**] anatomy, comparative; lung neoplasms; mediastinal lymph nodes; sectional anatomy; tomography, X-ray computed; magnetic resonance imaging; neoplasm staging

Detection and classification of intrathoracic lymph nodes is decisive for both lung cancer staging[1-6] and interventional approach to nodal metastasis[7,8]. Both, ATS and AJCC classifications developed by the American Thoracic Society (ATS)[2] and the American Joint Committee on Cancer (AJCC)[3], respectively, are used extensively in classifying regional lymph nodes. ATS intrathoracic lymph nodes classification has been evaluated and compared with cross-sectional anatomy classification, and the CT imaging has been compared with the cross-sectional specimens in our previous study[9]. The different criteria used by ATS and AJCC to define certain node groups have made it difficult to locate some important nodes in CT scanning and MR imaging[1,5,6,9]. This study provides some anatomic basis for ATS and AJCC classification systems on CT scanning and MR imaging.

1 Materials and methods

The distribution of mediastinal lymph nodes was observed in 5 adult cadavers in accordance with ATS and AJCC intrathoracic lymph nodes classification systems. Four cadavers were frozen and sawed into transverse sections of 1.0 cm thickness, with a sawing wastage of 0.12cm. Ten typical serial routine spiral CT scan images and five serial MR T1WI images of the thorax were chosen and compared with the corresponding cross-sectional specimens. Two assisted lines and two imaging-based anatomic landmarks were designed to locate Stations 4, 5, 6 and 10 on the borderline sections through the aortic arch, arch of azygos vein, carina of trachea and the left superior lobar bronchus.

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[作者单位] 1. Department of Anatomy, Bengbu Medical College, Bengbu 233003, Anhui, China; 2. Department of Radiology, Bengbu Railway Central Hospital, Bengbu 233000, Anhui, China; 3. Department of Radiology, Bengbu Third People's Hospital
[作者简介] WANG Zheng-huan(1962—), male, Professor.

2 Results

2.1 *Borderline between stations* 4 *and* 10 *and their imaging division* Station 4 was given the name of the inferior paratracheal lymph nodes. These

nodes were (4R/L) distributed right/left to the midline of the trachea, which was superior to the superior border of aortic arch in both ATS and AJCC classification systems, but with a different inferior borderline in the two systems. In ATS, the superior border of azygos arch separated the inferior paratracheal lymph nodes (4R) from the right hilar lymph nodes (10R). The inferior right paratracheal lymph nodes distributed right to the midline of trachea in the thorax from the superior border of aortic arch to the superior border of azygos arch (Fig 1a, b) were adjacent to the right hilar lymph nodes distributed right to the midline of trachea (Fig 2a, b) and the right trunk of bronchus (Fig 3a, b) in the cross-sections from the superior border of azygos arch to the right bronchus. The carina of the trachea separated the inferior left paratracheal lymph nodes (4R) distributed left to the midline of trachea (Fig 1-2a, b) from the left hilar lymph nodes (10L) near the left trunk of bronchus (Fig 3-5a, b).

In AJCC system, the superior border of bronchus superior lobe distinguished the inferior paratracheal from the hilar lymph nodes. The right and left inferior paratracheal lymph nodes (4R/L) were distributed right (Fig 1-2a, c) or left (Fig 1-4a, c) to the midline of trachea, respectively. The superior border of azygos arch divided the right inferior paratracheal lymph nodes into superior (4Rs, Fig1a, c) and inferior (4Ri, Fig2a, c) subsets. The right hilar lymph nodes were distributed right to the intermedius in the section through the carina of trachea and the subcarinal space (Fig 3-4a, c). The left hilar lymph nodes were located anterior and posterior to the terminal of left bronchus trunk, which gave rise to branches into the bronchus of the left superior lobe (Figs 5a, c).

2.2 *Borderline between the aorticopulmonary window nodes and the left inferior paratracheal lymph nodes, or the left hilar lymph nodes* The aorticopulmonary window nodes were called subaortic nodes and were located inferior to the inferior border of aortic arch and superior to the superior border of pulmonary artery trunk, lateral to the arterial ligament and medial to the origin of left superior lobe pulmonary artery. The results of our observation showed that the arterial ligament line was lateral to the midline of aortic arch. In the cross-section through the aorticopulmonary window, the line (Fig. 2) drawn from the center of ascending aorta to the center of descending aorta distinguished the aorticopulmonary window nodes (station 5) from the left inferior paratracheal nodes (4L).

According to ATS system, the left inferior paratracheal nodes and the aorticopulmonary window nodes were located medial and lateral to the line (Fig 2a, b), respectively, in thorax from the aortic arch to the carina of trachea and in the segment from the carina of trachea to the bronchus of left superior lobe. As a natural anatomic landmark, the left pulmonary artery separated the left hilar nodes lying medial to this landmark from the aorticopulmonary window nodes lying lateral to this landmark (Fig 3-4a, b). According to AJCC system, the left inferior paratracheal nodes (4L) distributed medial to the aortic arch in the cross-section through the aortic arch, to the assisted line in the cross-section through the aorticopulmonary window and to the left pulmonary artery in the cross-section through the left pulmonary artery, respectively. The aorticopulmonary window nodes (station 5) were lateral to these structures (Fig 1-4a, c).

2.3 *Borderline between the aorticopulmonary window nodes and the paraaortic nodes* The coronal line through the center of ascending aorta on axial images separated the aorticopulmonary window nodes (station 5) from the paraaortic nodes (station 6) in thorax from the superior border of aortic arch to the origin of ascending aorta. The aorticopulmonary window nodes were posterior to the assisted line, and the paraaortic nodes were anterior to the line (Fig 1-4).

3 **Discussion**

3.1 *Translation of AJCC and ATS classification systems* Although CT scanning based on cross-section is precise and widely applied in lung cancer diagnosis and staging, distinguishing Station 4 from Station 10 or Station 5, and Station 5 from Station 6 is not easy on CT scan or MR image. In particular, the inferior paratracheal nodes are not distinguished precisely from the hilar nodes because their definition in ATS system is

different from that of AJCC. The detection of these nodes is crucial for lung cancer staging and decisive for therapy choice. This study offers some suggestions on CT and MRI classification of intrathorcic lymph nodes. The suggestions are as follows: (1)Choose which system should be applied, ATS or AJCC. (2)After a diagnostic imaging of CT and MR, the borderline sections that separate the neighboring nodes should be focused on for locating nodes, then the nodes should be classified on the sectional images from superior to inferior borderline section. (3)The cross-sections through the aortic and azygos arches and the carina of trachea are crucial for ATS classification. (4)The cross-sections through the aortic arch, right superior lobe bronchus and the left superior lobe bronchus are crucial for AJCC classification. (5)The borderline sections should be obtained in thin section scanning.

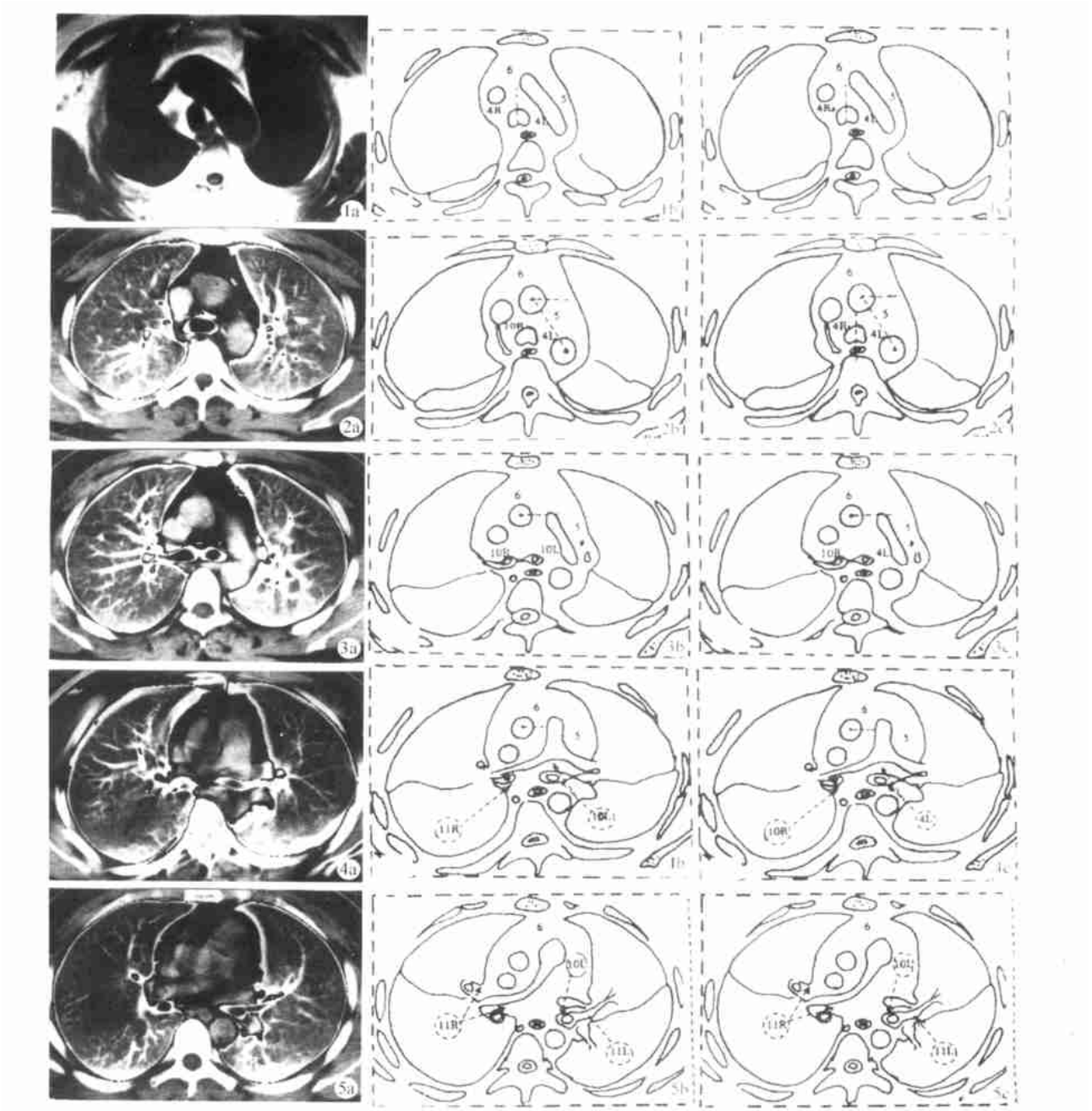

Fig. 1a T_1WI MR imaging of thorax Fig. 2a-5a CT scan of thorax Fig. 1b-5b Section-based mediatstinal lymph nodes classification of ATS correlated with CT scan and MR imaging(Fig. 1a-5a) Fig. 1c-5c Section-based mediastinal lymph nodes classification of AJCC(1997) correlated with CT scan and MR imaging(Fig. 1a-5a) Fig. 1a-c The cross-section through aortic arch Fig. 2a-c The cross-section through azygos arch Fig. 3a-c The cross-section through carina of trachea and right upper lobar bronchi Fig. 4a-c The cross-section through subcarinal space Fig. 5a-c The cross-section through left upper lobar bronchi

These suggestions and the associated lines are provided to facilitate the translation of ATS and AJCC classification systems for their clinical application.

3.2 *Location of the nodes close to borderlines* The intrathoracic nodal classification based on anatomical landmarks was designed initially for mediastinoscopy and thoracotomy. The borderline separating neighboring nodes is a two-dimensional plane that is difficult to differentiate. However, both CT and MRI are the sectional images of three-dimensional structures. Therefore, the nodes close to the borderline are difficult to locate and classify. According to the principle of CT scanning and MR imaging, the following suggestions are offered: (1) The paratracheal nodes which appear in the cross-sectional images should belong to inferior nodes group, and not to superior nodes group. For example, as suggested by ATS and AJCC respectively, in the section through the azygos arch (Fig 2), the right paratracheal nodes should be located in the right hilar nodes (10R) rather than in group 4R, and in the inferior subset of right inferior paratracheal nodes (4Ri) rather than in the superior subset (4Rs), because the inferior plane of this section is inferior to the superior border of the azygos arch. (2) Inferior to the bifurcation of trachea, the bronchopulmonary nodes in cross-section through the boundary structures should be located in the distal rather than the proximal group. For example, in the section through the superior lobe bronchus (Fig 5), the nodes placed anterior and posterior to the superior lobe bronchus have been located in the left interlobar nodes (11R), not in the left hilar nodes (10L).

The assisted lines and suggestions about the nodes classification are to facilitate the translation of ATS/AJCC classification systems for their clinical application.

[参 考 文 献]

[1] Mountain CF. Revisions in the international system for staging lung cancer[J]. *Chest*, 1997, 111(6): 1 710~1 717.

[2] Frideman PJ. Lung cancer: Update on staging classifications[J]. *AJR*, 1988, 150(2): 261~264.

[3] Naruke T, Suemasu K, Ishikawa S. Lymph node mapping and curability at various levels of metastasis in resected lung cancer[J]. *J Thorac Cardiovasc Surg*, 1978, 76(6): 832~839.

[4] Mountain CF, Dresler CM. Regional lymph node classification for lung cancer staging[J]. *Chest*, 1997, 111(6): 1 718~1 723.

[5] The Canadian Lung Oncology Group. Investigation for mediastinal disease in patients with apparently operable lung cancer[J]. *Ann Thorac Surg*, 1995, 60(5): 1 382~1 389.

[6] Ko JP, Drucker EA, Shepard JAO, *et al*. CT depiction of regional nodal stations for lung cancer staging[J]. *AJR*, 2000, 174(3): 775~782.

[7] 王震寰. 介入放射学的挑战及解剖学的对策[J]. 中国临床解剖学杂志, 2001, 19(1): 5~7.

[8] Cattelani L. CT-Guided transthoracic needle biopsy in the diagnosis of chest tumors[J]. *J Cardiovasc Surg*, 1997, 38(5): 539~542.

[9] 王震寰, 黄 瑜, 秦登友. 胸内淋巴结美国胸科协会分区的断层影像解剖学研究及对肺癌分期的意义[J]. 中国医学影像技术, 2001, 17(11): 1 058~1 061.

AJCC/ATS 胸内淋巴结影像分区中某些重要界线的确定——断层解剖与 CT、MRI 对照研究

王震寰[1], 孙 静[2], 黄 瑜[3], 秦登友[1]

(1. 蚌埠医学院 解剖学教研室; 2. 蚌埠铁路中心医院 MRI 室; 3. 蚌埠市第三人民医院 CT 室, 安徽 蚌埠 233003)

[摘要] **目的**: 确定 ATS/AJCC 胸内淋巴结 CT、MRI 分区中一些重要界线。 **方法**: 在 5 具尸体上观察胸内淋巴结分布, 用胸部横断层标本(4 套)与 CT(50 例)、MRI(20 例)图像对照观察。 确定了 2 条辅助线和 2 个影像解剖标志来区分 4、5、6 及 10 区淋巴结。 **结果**: 在主动脉弓上缘至肺动脉干区段, 经升主动脉断面圆心的冠状线分开 5 区与 6 区, 升、降主动脉断面圆心间连线分开 5 区与 4L(ATS、AJCC)或 10L 区(ATS)。 左肺动脉分开 5 区与 4L 或(AJCC)10L 区(ATS)。 奇静脉弓分开 4R 区与 10R 区(ATS)或 4R 上、下组(AJCC)。 **结论**: 文中设计的组间界线使 ATS 和 AJCC 分区系统易于使用, 有利于肺癌准确的影像学分期。

[关键词] 解剖学, 比较; 肺肿瘤; 纵隔淋巴结; 断层解剖学; 体层摄影术, X 线计算机; 磁共振成像; 肿瘤分期

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