Detection of mediastinal, hilar, and intrapulmonary lymphadenopathy is crucial for staging lung cancer. Precise staging is essential for determining treatment options and assessing patient response to therapy. Definitions of the lymph node locations used in staging have been based on surgical landmarks relevant to mediastinoscopy and thoracotomy [1] (Fig. 1). These surgical landmarks are not always easily translated to cross-sectional imaging. Cross-sectional diagrams at six levels accompanied the original American Thoracic Society nodal staging system [2], but, to our knowledge, correlation with CT scans has not previously been done. Because mediastinoscopy is not always performed for staging [3], CT may be the only procedure used for evaluation of intrathoracic lymph nodes. This pictorial essay provides cross-sectional definitions of regional intrathoracic lymph node stations, depicts them on CT, and describes recent changes in the lymph node staging system for lung cancer.

Classification of Regional Intrathoracic Lymph Nodes

Nodal metastases in lung cancer staging are classified as N1, N2, or N3, on the basis of the location of the nodes in relation to the primary lung cancer. N1 refers to local spread to intrapulmonary peribronchial and ipsilateral hilar nodes. N2 refers to more distant spread, including ipsilateral mediastinal and subcarinal nodes. N3 is defined as even more distant spread to contralateral mediastinal or hilar nodes or to ipsilateral or contralateral supraclavicular nodes. N1 nodes lie within the visceral pleura, and N2 nodes lie within the mediastinal or parietal pleural reflection, also termed the mediastinal pleural envelope.

To identify nodal location more precisely, nodes are assigned to one of 14 numbered stations. These stations are defined by adjacent anatomic structures. Stations 1–9 are within the mediastinum. Metastatic nodes are classified as N2 disease if ipsilateral or N3 disease if contralateral to the primary tumor. Stations 10–14 are within the hila or along the bronchi in the lung parenchyma. Involved nodes are classified as N1 disease if ipsilateral or N3 disease if contralateral to the primary tumor. Metastatic supraclavicular nodes, which are also N3 disease, are extrapleural and do not receive a station designation. The descriptor “R” or “L” is added if a node is right- or left-sided, respectively.

Anatomic Definitions of Stations with CT Correlation

The nodal stations defined in this section are shown in the figures. Both enlarged and normal nodes in various nodal stations were colored on CT scans to maximize clarity of the figures and to facilitate correlation with the popular reference diagram introduced by Mountain and Dresler [1] in 1997 (Fig. 1). Nodal enlargement is commonly defined as greater than 1 cm in short-axis diameter.

Station 1: Highest mediastinal nodes. These nodes lie cranial to the superior aspect of the left innominate or brachiocephalic vein where the vein crosses the trachea (Figs. 2A and 2B).

Station 2: Upper paratracheal nodes. These nodes are located below the inferior boundary of station 1 nodes and cranial to the superior aspect of the aortic arch (Figs. 2C, 2D, and 3).

Station 3: Prevascular and retrotracheal nodes. Prevascular nodes are anterior to the great vessel branches and cranial to the superior aspect of the aortic arch (Figs. 2A and 2B). Retrotracheal nodes are posterior to the trachea (Fig. 4), inferior to the thoracic inlet, and cranial to the inferior aspect of the azygos vein.

Station 4: Lower paratracheal nodes. The lower right paratracheal nodes (4R) lie to the right of the trachea’s midline. They are caudal...
Fig. 1.—Regional nodal stations for lung cancer staging. (Modified and reprinted with permission from [1])

A and B. Drawings show revised nodal staging system. Mediastinum is viewed from frontal (A) and left anterior oblique (B) projections. Heart and proximal great vessels have been cut away in both drawings. Trachea and bronchi, aortic arch (Ao), and main pulmonary artery (PA) are anatomic landmarks used to define various nodal stations. In these diagrams, nodes occupying nodal stations are assigned colors, and nodes on CT scans have been colored to correspond to assigned colors. Some colors have been changed from original drawing [1] for greater contrast on CT scans.

C. Color legend for A and B correlates nodal colors with station numbers and descriptors.

D. Lines placed on drawing in A reveal cross-sectional levels shown on subsequent figures in this article.
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Fig. 2.—68-year-old man with small cell lung carcinoma. 
A and B, Contrast-enhanced CT scan (A) and same scan with nodes colored (B) show station 1 highest mediastinal node (light green, B). Node is in left paratracheal region between left common carotid artery and left subclavian artery. This level is cranial to brachiocephalic vein where it crosses trachea. Note that station 3 prevascular node (bright pink, B) lies anterior to and left of major arterial vessels. More peripheral part of brachiocephalic vein is unopacified (arrow), medial to station 3 node.
C and D, Contrast-enhanced CT scan (C) and same scan with nodes colored (D) show station 2 upper paratracheal node (dark purple, D), which is extension of station 1 node in A. Brachiocephalic vein (arrows) crosses midline anterior to trachea and demarcates station 1 nodes from station 2 nodes. Station 3 prevascular node (bright pink, D) is again seen.

Fig. 3.—65-year-old man with small cell lung carcinoma and superior vena cava syndrome.
A, Contrast-enhanced CT scan shows station 2 upper paratracheal node.
B, Same scan with node colored dark purple shows station 2 upper paratracheal node, which is below top of left brachiocephalic vein but above top of aortic arch. IV contrast injection was made through left brachiocephalic vein. Note reflux into anterior chest wall collaterals (curved arrows) and both internal mammary veins (straight arrows).
Fig. 4.—38-year-old man with B-cell lymphoma.

A, Contrast-enhanced CT scan shows 1-cm station 3 retrotracheal node.
B, Same scan as A with node colored bright pink shows station 3 retrotracheal node, which is posterior to trachea at midline between esophagus (straight arrow) and azygos vein and arch (curved arrow). Azygos vein is opacified by retrograde contrast material from superior vena cava.
C, Unenhanced CT scan 4 months later than A shows decrease in size of lymph node (arrow) as result of therapy.

Fig. 5.—65-year-old man with small cell lung carcinoma and superior vena cava syndrome.

A and B, Contrast-enhanced CT scan (A) and same scan with nodes colored (B) show station 4 lower paratracheal nodes (bright orange, B). Station 4 lower paratracheal nodes can be separated into superior and inferior subsets. Nodes shown are in superior subset, meaning they are inferior to top of aortic arch and above azygos vein. Along with other mediastinal nodes, these station 4 superior lower paratracheal nodes can be separated into those to right (4R) (curved arrow) or left (4L) (straight thick arrow) of midline, as seen in Figures 1B and 1D. Midline nodes (thin arrow) are considered to be on same side as primary lung tumor. Therefore, in this patient with right lower lobe mass, midline nodes anterior to trachea are categorized as station 4 superior lower paratracheal nodes. Enhancing chest wall venous collaterals are again shown.
C and D, Contrast-enhanced scan (C) and same scan with nodes colored (D) illustrate station 4 inferior lower paratracheal nodes (bright orange, D), which are below horizontal line drawn at superior aspect of azygos vein. Nodes are contiguous with station 4 superior lower paratracheal nodes in A and B.
to the superior aspect of the aortic arch and cranial to the superior aspect of the right upper lobe bronchus. The lower left paratracheal nodes (4L) lie to the left of the trachea’s midline. They are caudal to the superior aspect of the aortic arch and cranial to the superior aspect of the left upper lobe bronchus. Nodes designated 4L are medial to the ligamentum arteriosum (Figs. 5 and 6).

The lower paratracheal nodes are further divided into superior (Figs. 5A and 5B) and inferior (Figs. 5C and 5D) subsets. Station 4 superior nodes are cranial to the superior aspect of the azygos arch, whereas station 4 inferior nodes are caudal to the superior aspect of the azygos arch.

Station 5: Subaortic or aortico-pulmonary window nodes. These nodes lie lateral to the ligamentum arteriosum and are medial to the origin of the first branch of the left pulmonary artery (Figs. 6–8).

Station 6: Para-aortic (ascending aortic or phrenic) nodes. These nodes are anterior and lateral to the aortic arch at levels caudal to the superior aspect of the aortic arch (Fig. 8).

Station 7: Subcarinal nodes. These nodes are caudal to the tracheal carina between the main bronchi (Figs. 9 and 10).

Station 8: Paraesophageal nodes. These nodes are adjacent to the wall of the esophagus and to the right or left of the trachea’s midline (Figs. 8 and 11). The anterior paraesophageal nodes are considered generally caudal to the subcarinal nodes, but no explicit boundary exists.
Station 9: Pulmonary ligament nodes. These nodes are within the pulmonary ligament (Fig. 12).

Station 10: Hilar nodes. These nodes are the proximal lobar nodes. As opposed to the lower paratracheal nodes that are cranial to the superior aspect of the right upper lobe bronchus, right hilar nodes are caudal to the superior aspect of the right upper lobe bronchus and lie adjacent to the right main bronchus and the proximal bronchus intermedius (Figs. 9, 10A, and 10B). Similarly, the left hilar nodes are caudal to the superior aspect of the left upper lobe bronchus adjacent to the left main bronchus.
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Fig. 11.—38-year-old man with lymphoma.
A, Contrast-enhanced CT scan shows station 8 paraesophageal node. B, Same scan with node colored tan shows station 8 paraesophageal node, which is anterior to azygos vein (curved arrow) and lateral to esophagus (straight arrow).

Fig. 12.—66-year-old woman with adenopathy.
A and B, Contrast-enhanced CT scan (A) and same scan with nodes colored (B) show station 12 lobar nodes (light pink, B) that are adjacent to distal lobar bronchi. Level is just inferior to right middle lobe bronchus near branching of medial basal bronchus (arrow) that is bifurcating from truncus basalis. Station 9 inferior pulmonary ligament node (dark blue, B) lies medially within inferior pulmonary ligament.
C, Same scan as A and B viewed with lung window settings shows inferior pulmonary ligament (white arrows) adjacent to node (black arrow). Pulmonary ligaments course caudally from inferior hilum to diaphragm. Nodes in inferior pulmonary ligaments are contained in four pleural reflections and therefore are in mediastinum.

Station 11: Interlobar nodes. These nodes are between lobar bronchi and are adjacent to the proximal lobar bronchi (Figs. 10C and 10D).
Station 12: Lobar nodes. These nodes are located adjacent to distal portions of the lobar bronchi (Fig. 12).
Station 13: Segmental nodes. These nodes are adjacent to the segmental bronchi (Figs. 9, 10A, 10B, 13A, and 13B).
Station 14: Subsegmental nodes. These nodes are adjacent to the subsegmental bronchi in the lung parenchyma (Figs. 13C and 13D). Stations 12, 13, and 14 cannot always be differentiated.

Recent Changes in Nodal Station Classification

The Naruke lymph node map was introduced in the 1970s and was adopted by the American Joint Committee on Cancer [4]. An adaptation of this lymph node map was accepted by the American Thoracic Society and the North American Lung Cancer Study Group in 1981 and was reported in 1983 [2]. In 1996, a new classification unifying features of both systems was accepted by the American Joint Committee on Cancer and the Prognostic Factors Committee of the Union Internationale Contre le Cancer, and a report was issued by Mountain and Dresler [1] in 1997. The new classification differs from the preceding one because it designates the azygos node as station 4 rather than station 10. Therefore, an azygos node is considered an N2 rather than an N1 node. Other changes involve the retrotracheal and prevascular nodes, but these changes do not alter nodal staging.

In conclusion, this pictorial essay illustrates with cross-sectional imaging the recently revised nodal classification system for lung cancer. The ability to identify these nodal stations on thoracic CT and a working knowledge of their significance in the staging of lung cancer are important for accurate communication among radiologists, oncologists, and surgeons.

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References