Lymph Node Dissection

20

Alper Toker

Introduction

A major determinant of survival in non-small cell lung cancer (NSCLC) patients is nodal status. Positron emission tomography and CT are the most commonly used imaging methods to assess the status of mediastinal lymph nodes. However, the surgeon plays a critical role in the accurate assessment of nodal involvement during thoracotomy and resection through videothoracoscopic surgery (VATS).

The guidelines of the European Society of Thoracic Surgeons (ESTS) define intraoperative lymph node assessment as follows: *Selective sampling* involves biopsy of one or more suspicious lymph nodes believed to be abnormal. *Systematic mediastinal lymph node sampling* means that the pleura overlying each ipsilateral node station is opened and explored, and predetermined lymph node biopsies are obtained. *Systematic nodal dissection* refers to systematic dissection and removal of all mediastinal lymph nodes within given anatomic landmarks. For left-sided tumors, division of the ductus arteriosus and mobilization of the aortic arch may be added to allow access to high and low paratracheal nodes. It is recommended that at least three mediastinal stations, which should include the subcarinal nodes, be excised. *Lobe-specific systematic node dissection* involves the excision of mediastinal tissue based on the lobar location of the primary tumor. Finally, *extended lymph node dissection* includes bilateral mediastinal and cervical lymph node dissection through median sternotomy and cervicotomy (Lardinois et al. 2006).

The accuracy of mediastinal staging seems to improve with diligent intraoperative attention to staging. Relative to selective sampling, studies have shown that systematic sampling approximately doubles the rate of discovery of N2 node involvement, although essentially the same number of patients with pN2 involvement are detected with systematic sampling as with systematic nodal dissection. This is because systematic nodal dissection detects more patients with multilevel N2 involvement. Systematic node dissection also may be defined as complete mediastinal lymph node dissection (MLND; indicating the dissection of at least ten mediastinal lymph nodes from at least three stations) (Whitson et al. 2007).

The therapeutic role of systematic MLND has been addressed in five randomized trials, but this remains controversial (Detterbeck 2008).

Systematic Mediastinal Dissection Technique

Although the technique of systematic mediastinal node dissection was originally described for open thoracotomy (however, not until the early 1990s), it also may be performed using a VATS approach. This procedure is technically more demanding but provides results comparable to those of earlier methods. Although it is common practice to perform dissection of the lymph nodes after pulmonary resection, I recommend performing the dissection prior to resection. Multilevel positivity on frozen section analysis may help avoid potential morbidity and mortality associated with pneumonectomy. In practice, the hilar (level 10) and interlobar (level 11, superior and inferior) nodes are dissected first to evaluate the type of resection. Often, a sleeve lobectomy may be accomplished in patients instead of a pneumonectomy. Performing a hilar and interlobar lymph node dissection prior to the resection makes the procedure easier.

Right-Sided Lymph Node Dissection

Systematic mediastinal dissection is carried out beginning with the superior or inferior mediastinal nodes, depending on the type of resection to be performed and the need for

A. Toker, MD
Department of Thoracic Surgery,
Istanbul Medical School, Istanbul University, Capa,
Istanbul, Turkey
e-mail: atoker@istanbul.edu.tr

H.C. Dienemann et al. (eds.), *Chest Surgery*, Springer Surgery Atlas Series,
DOI 10.1007/978-3-642-12044-2_20, © Springer-Verlag Berlin Heidelberg 2015

intraoperative frozen section evaluation. It is a common practice to begin with the superior mediastinum in upper lobe resections and the inferior mediastinum and subcarinal area in lower lobe resections.

Dissection of the Paratracheal Area

An incision is made with cautery parallel and superior to the azygos vein. In lymph node dissections, note that the electrocautery setting should be half that used for thoracotomy and pleurolysis. A second incision with cautery is made parallel to the vagus nerve. A triangle is formed by the azygos vein, vagus nerve, and phrenic nerve. I do not find it necessary to encircle and retract the phrenic and vagus nerves, but extreme caution is needed to avoid injuring them. Level 3p nodes are dissected between the esophagus and membranous portion of the trachea. Sweeping off the lymph nodes from the trachea and posterior portion of the superior vena cava with a sponge or blunt-tipped aspiration cannula collects all the lymph nodes and fatty areolar tissue as one packet of tissue (Fig. 20.1). This packet is bordered by the superior vena cava anteriorly, trachea posteriorly, brachiocephalic artery cranially, truncus anterior of the pulmonary artery inferiorly, and lateral wall of the aorta medially. There always are one or two venous tributaries to the superior vena cava, and these tributaries are clipped without electrocautery. Dissection by electrocautery is con-

Figure 20.1

Dissection of paratracheal lymph nodes from right thoracotomy. All fatty areolar tissue is dissected from the superior vena cava (*SVC*), aorta, and trachea. Gentle traction and dissection with a blunt tipped aspiration cannula help mobilize the tissue packet

tinued on the lateral aspect of the pericardium of the ascending aorta and aortic arch. Ring forceps are used to pull the fatty areolar tissue. Blunt dissection with a sponge enables the surgeon to both pull the lymph nodes inferiorly and dissect from the innominate artery without cautery near the right recurrent laryngeal nerve where it emerges from the vagus nerve. Further dissection on the left side of the trachea with gentle traction of the nodal packet helps in the dissection of level 2L nodes. At this point, the surgeon should be careful not to harm the left recurrent laryngeal nerve, because it is impossible to recognize it from this exposure. Further dissection of the left anterolateral part of the trachea and tracheobronchial angle makes it possible to dissect level 4L nodes. Dissection in the superior and medial direction near the right main pulmonary artery makes it possible to resect level 4R inferior nodes. These nodes are passed under the azygos vein to keep them together with the aforementioned paratracheal tissue packet. After this dissection, both innominate veins, the superior vena cava, the aorta, and the trachea are exposed. The patient should be checked at this point for chylous leakage (Fig. 20.2). The azygos vein does not need to be divided unless the primary tumor or an involved node has invaded the area.

Figure 20.1

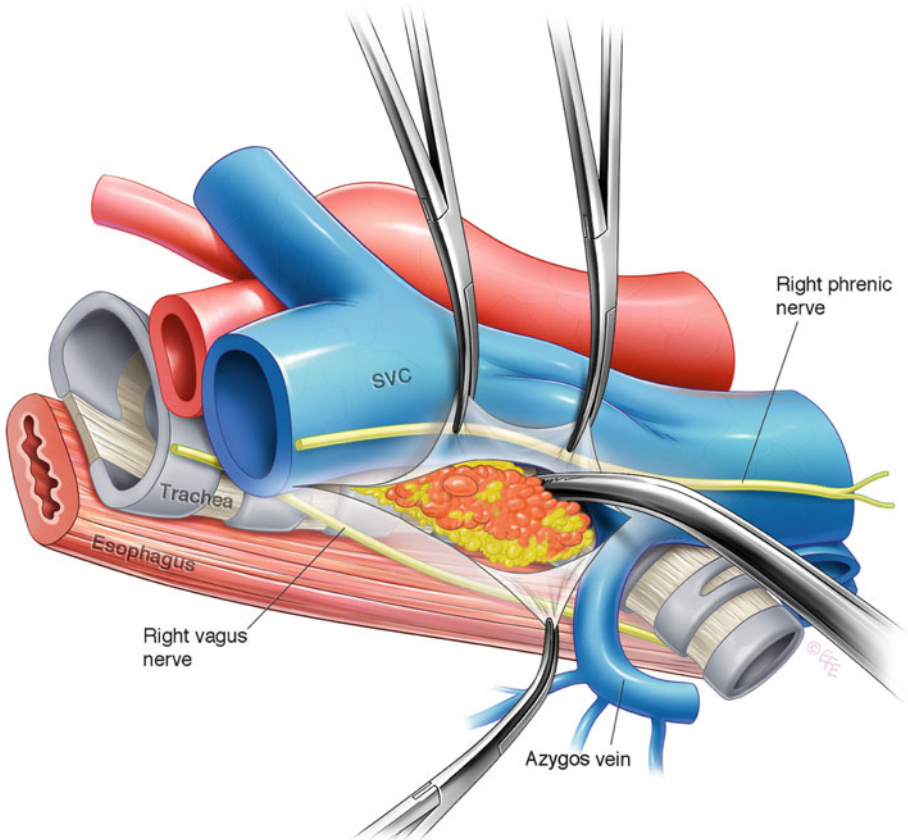
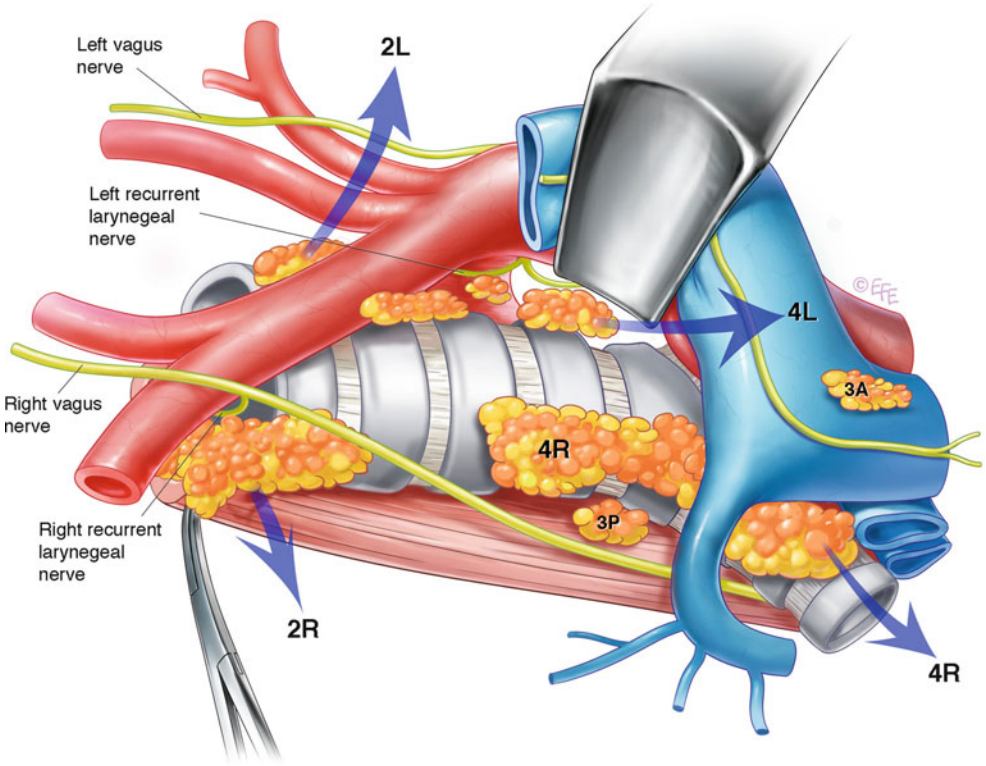


Figure 20.2

The packet is removed en bloc. Both innominate veins and the SVC, aorta, trachea, right subclavian artery, and truncus anterior of the right pulmonary artery form the borders

Figure 20.2


Left vagus nerve
2L
Left recurrent laryngeal nerve
4L
3A
Right vagus nerve
4R
3P
Right recurrent laryngeal nerve
2R
4R

Dissection of Subcarinal and Inferior Mediastinal Nodes

Hyperinflation of the contralateral lung pushes the carina toward the surgeon. The bronchus intermedius is retracted in the anterior direction to widen this area. An incision with cautery is made parallel to the esophagus all the way from the azygos vein to the inferior pulmonary vein; caution should be used not to harm the vagus nerve, although branches of the vagus nerve coursing to the lung are divided. The esophagus is retracted posteriorly with a sponge. Subcarinal nodes are dissected by dividing the bronchopericardial ligaments and capsule surrounding the level 7 nodes. First, the nodes are dissected and a plane is created from the intermediate bronchus with cautery. By developing a space for the dissection of level 7 nodes that is inferior and anterior to the intermediate and

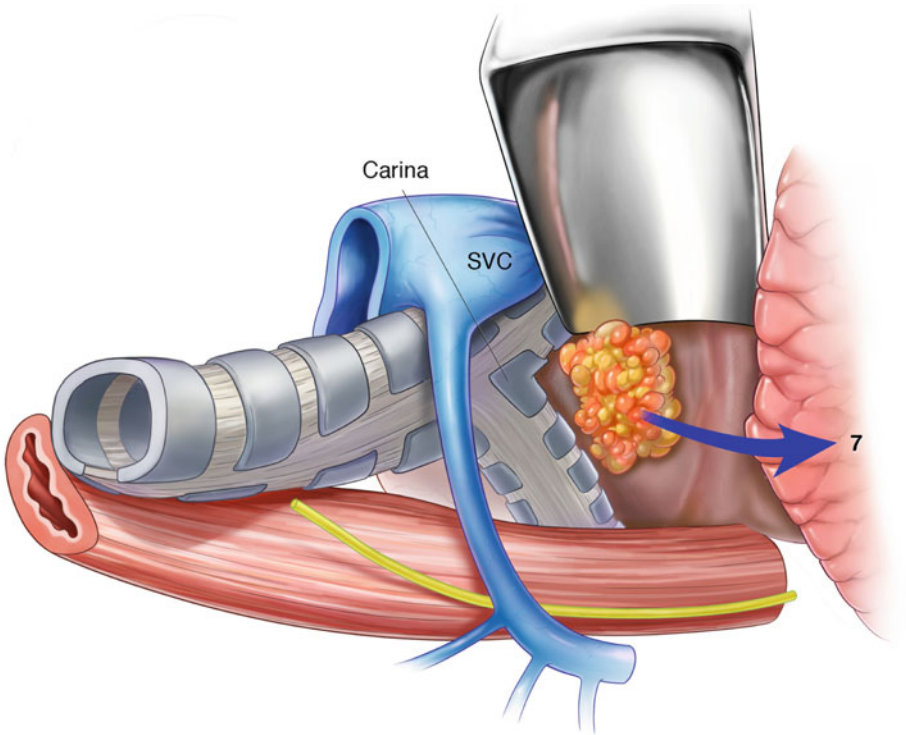
Figure 20.3

Dissection around the main bronchus and subcarinal space from the right side. The inferior pulmonary vein and left and right bronchi form the borders of the dissection

main bronchi, the pericardium of the left atrium becomes visible. The nodes are dissected starting at the lower rim. Dissection near the pericardium releases half the subcarinal nodes, although these nodes are still attached to the tracheal carina and left main bronchus. Generally, at least one bronchial artery arising from the aorta feeds the nodes. Careful management, typically ligation, or a clip is needed to prevent postoperative bleeding. Dissection of the triangle formed by the left and right main bronchi and the right inferior pulmonary vein can be seen in Fig. 20.3.

Level 8 nodes are dissected over the esophagus behind the inferior pulmonary vein. Level 9 nodes are included in the pulmonary ligament.

Figure 20.3



Left-Sided Lymph Node Dissection

Dissection of Stations 4L to 6

An inverse T-shaped incision similar to that used on the right side is made over the left hilum, and a vertical incision between the vagus and phrenic nerves above the aorta is used to remove level 5–6 nodes. In patients with cancer in the left upper lobe, it is extremely important to dissect the para-aortic (level 6) and subaortic lymph nodes (level 5) (Fig. 20.4). The left-sided tracheobronchial lymph nodes (level 4L) are located medial to the subaortic lymph nodes, and these nodes can be dissected easily with or without Botallo's ligament division by giving extreme care to the left recurrent laryngeal nerve branch. A bronchial artery almost always arises from the aorta in that window (Fig. 20.5).

Figure 20.4

Dissection of stations 5 and 6. Careful dissection in this station enables a place for dissection of station 4L

Dissection of Subcarinal and Inferior Mediastinal Nodes

The posterior and anterior portions of the fissure are completed to permit dissection of the interlobar lymph nodes (level 11). Suspected lobar nodes (level 12) may be resected from each lobe for frozen section analysis. The lung is then retracted in the anterior direction, and dissection of the hilar (level 10) and subcarinal (level 7) nodes is started. The descending aorta and esophagus are retracted posteriorly, and the bifurcation of the trachea is exposed. All the lymph nodes around the upper and lower lobe bronchus (i.e., the "lymphatic stump of the left lung") are removed. By increasing the ventilation pressure and pulling the lung up and anteriorly, the right main bronchus may be dissected (Fig. 20.6). The endobronchial tube may dislodge during this maneuver. All the level 7 nodes are resected free from the pericardium and both main bronchi. It generally is necessary to divide the left bronchial artery. The left pulmonary ligament lymph nodes (level 9L) and paraesophageal lymph nodes (level 8L) are dissected continually upward as far as the inferior pulmonary vein.

Figure 20.4

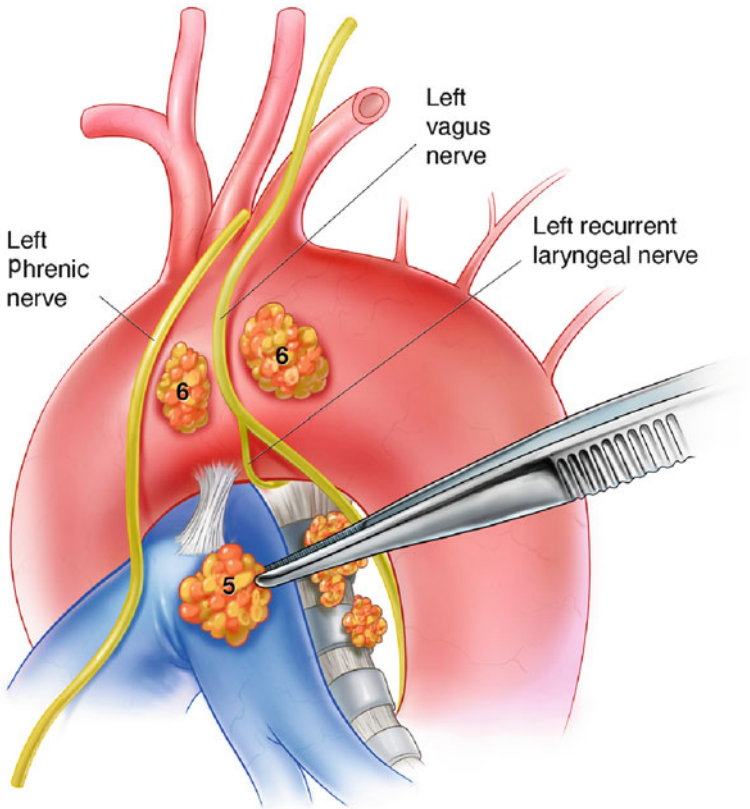


Figure 20.5

Dissection of station 4L. The left tracheobronchial angle and inferior part of the trachea and esophagus are dissected. A bronchial artery may be seen

Figure 20.6

Dissection of subcarinal space from the left side. Both bronchi are dissected. The lymph nodes are removed en bloc

Figure 20.5

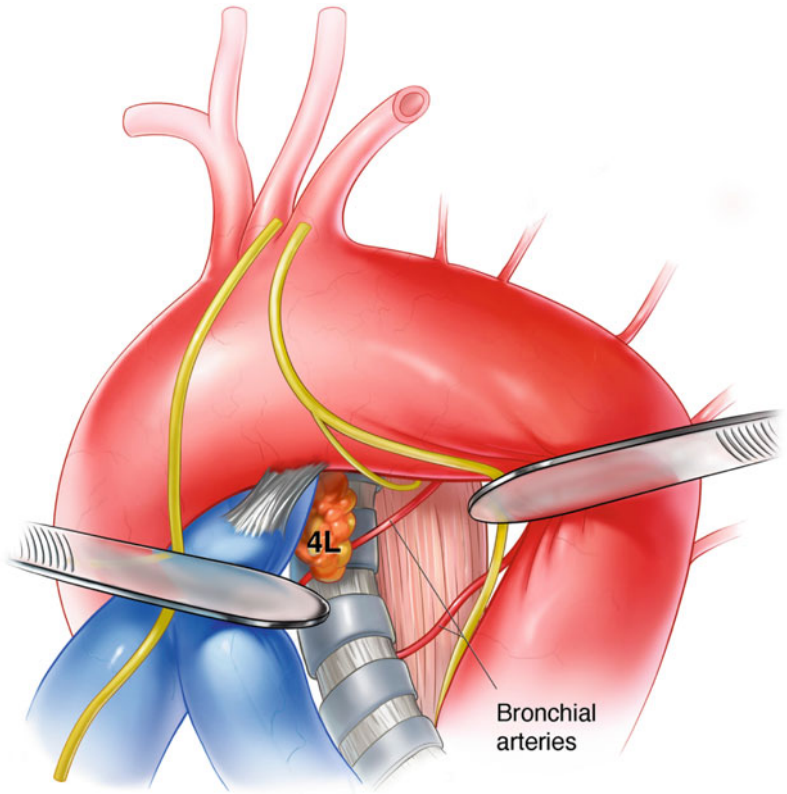
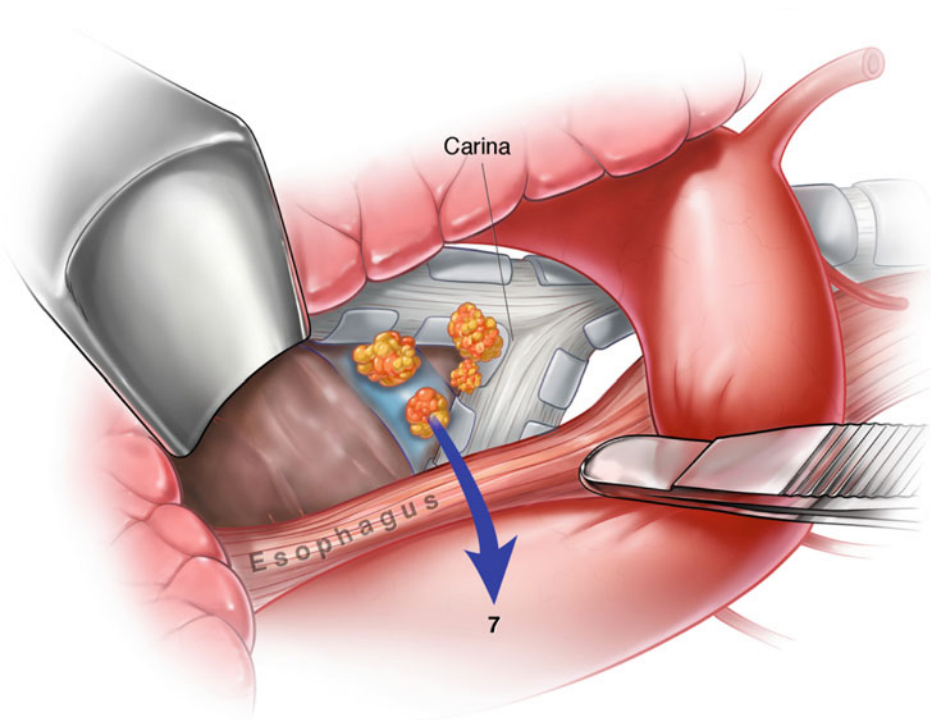


Figure 20.6



Dissection of the Paratracheal Area

Dissection of the superior mediastinum from the left chest is advocated by some surgeons in case one of the level 4–7 nodes is found to be positive. In this procedure, it is recommended to pass a tape around the subclavian artery, incise the pleura at the posterior edge of the aorta, ligate and divide a few intercostal arteries, and pass a tape around the descending aorta. The left subclavian artery and aorta are retracted anteriorly, and the left wall of the trachea and esophagus are exposed (Naruke 1994). The upper paratracheal (level 2L), lower paratracheal (level 4L), pretracheal (level 3), and retrotracheal (level 3p) nodes are removed. A second option is to perform a median sternotomy after the chest is closed. A third option involves an alternative paratracheal lymph node dissection (without division of the ductus arteriosus and mobilization of the arcus aorta) via application of gentle retraction to the structures in the mediastinum (Toker et al. 2011).

Conclusion

Proponents of the mediastinal dissection technique claim the procedure is safe, improves the accuracy of staging, and may provide a survival benefit. On the other hand, opponents are concerned about an increased length of hospital stay, morbidity, blood loss, and operative time as well as a higher incidence of recurrent laryngeal nerve injury, chylothorax, and bronchopleural fistula (Izbicki et al. 1994; Allen et al. 2006). Micrometastatic disease has been diagnosed more accurately using this procedure (Izbicki et al. 1994; Keller et al. 2000). Some nonrandomized comparative studies showed a survival benefit for the MLND technique (Keller et al. 2000). However, in the most recent report describing the American College of Surgeons Oncology Group trial ACOSOG Z00030, MLND did not improve survival in patients with early-stage NSCLC. Although these results are not generalizable to patients with higher-stage tumors (Darling et al. 2010), it still is clear that many researchers have found a significantly higher rate of N2 disease after systematic nodal dissection compared with mediastinal lymph node sampling.

References

Allen MS, Darling GE, Pechet TT et al (2006) Morbidity and mortality of major lung resections in patients with early stage lung cancer. Initial results of the randomized, prospective ACOSOG Z0030 trial. Ann Thorac Surg 81:1013–1019

Darling GE, Allen MS, Decker P, Ballman KV, Landrenau RJ, McKenna RJ, Jones DR, Inculet RI, Rusch VW, Putnam JB (2010) Randomized trial of mediastinal lymph node sampling versus complete lymphadenectomy during pulmonary resection in patients with N0 or N1 (less than hilar) non small cell carcinoma: results of the ACOSOG Z0030 trial. In: 90th annual meeting of the American Association for Thoracic Surgery, Toronto, 1–5 May

Detterbeck F (2008) What to do with "surprise" N2? Intraoperative management of patients with non-small cell lung cancer. J Thorac Oncol 3(3):289–302

Izbicki JR, Thetter O, Habekost M et al (1994) Radical systematic lymphadenectomy in non-small cell lung cancer patients. A randomized controlled trial. Br J Surg 81:229–235

Keller SM, Adak S, Wagner H, Johnson DH (2000) Mediastinal lymph node dissection improves survival in patients with stage II and IIIa non-small cell lung cancer. Eastern Cooperative Oncology Group. Ann Thorac Surg 70:358–365

Lardinois D, De Leyn P, Van Schil P, Porta RR, Waller D, Passlick B, Zielinski M, Lerut T, Weder W (2006) ESTS guidelines for intraoperative lymph node staging in non-small cell lung cancer. Eur J Cardiothorac Surg 30:787–792

Naruke T (1994) Mediastinal lymph node dissection. In: Shields TW (ed) General thoracic surgery, 4th edn. Williams and Wilkins, Baltimore, pp 469–491

Toker A, Tanju S, Ziyade S, Kaya S, Erus S, Yılmazbayhan D (2011) Alternative paratracheal lymph node dissection in left-sided hilar lung cancer patients: comparing the number of lymph nodes dissected to the number of lymph nodes dissected in right-sided mediastinal dissections. Eur J Cardiothorac Surg 39(6):974–980

Whitson BA, Groth SS, Maddaus MA (2007) Surgical assessment and intraoperative management of mediastinal lymph nodes in non-small cell lung cancer. Ann Thorac Surg 84:1059–1065