

Lobectomy for Non-Small Cell Lung Cancer after Coronary Artery Bypass Grafting Surgery

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ABSTRACT: **Background:** The efficacy of video-assisted thoracoscopic surgery lobectomy in patients with previous coronary artery bypass grafting (CABG) surgery is controversial.

Objectives: To investigate whether skeletonized left internal mammary artery (LIMA) mobilization contributes to the development of severe adhesions, which will affect what type of lung surgery (open or closed procedure) will be required in the future.

Methods: Eight patients (mean age 73.9 years) with previous CABG surgery using a LIMA to left anterior descending (LAD) graft underwent left-sided lobectomy for operable non-small cell lung carcinoma.

Results: The lobectomy by thoracotomy rate was 62.5% (5 patients), generally in patients with tumors in the left upper lobe or in patients post-neoadjuvant chemotherapy, while the video-assisted thoracic surgery lobectomy rate was 37.5% (3 patients). Mean hospital stay was 8.3 days. There was no mortality or major morbidity, apart from six minor complications in four patients (50%) (air leak, atrial fibrillation, atelectasis, pneumonia).

Conclusions: Patients with operable non-small cell lung carcinoma following CABG surgery who need left upper lobe resection do not benefit from the video-assisted thoracoscopic surgery technique due to significant adhesions between the LIMA to LAD graft and the lung. The method of preserving a small portion of the lung on the LIMA to LAD graft may help during left upper lobe resections. Adhesions in the left pleural space after LIMA mobilization appear to minimally affect left lower lobe video-assisted thoracoscopic surgery.

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cancer surgery [1-6]. Relative contraindications to VATS lobectomy include previous thoracic surgery, central hilar tumors, a history of neoadjuvant chemotherapy or radiation, or any other factor that might be associated with severe adhesions between the lung and other intrathoracic structures, which would in turn compromise the thoracoscopic procedure and predispose to conversion to lobectomy by thoracotomy. Previous coronary artery bypass grafting (CABG) using a skeletonized left internal mammary artery (LIMA) graft may also complicate pulmonary resection due to severe adhesions between the mediastinum and the lung, especially during left upper lobe lobectomy. We retrospectively evaluated the data of patients with previous CABG who underwent left-sided lobectomy due to non-small cell lung cancer during the period January 2009 to January 2013.

PATIENTS AND METHODS

The study population included eight male patients (mean age 73.9 years) with previous CABG surgery using a skeletonized LIMA to left anterior descending (LAD) coronary graft in whom lobectomy due to lung cancer was performed between January 2010 and January 2013.

Lobectomy was performed in the left upper lobe (LUL) in five of the eight patients and in the left lower lobe (LLL) in three. None of the patients had standard absolute contraindications to the thoracoscopic procedure (presence of T3 or T4 tumors, N2/N3 disease, or an inability to achieve single-lung ventilation) and were therefore eligible for VATS lobectomy. From all the relative contraindications to VATS lobectomy (central hilar tumors, tumors that were visible on bronchoscopy or necessitated sleeve resection, bulky mediastinal or hilar lymphadenopathy, and a history of neoadjuvant radiation or chemotherapy), only neoadjuvant chemotherapy was considered a contraindication to VATS surgery.

Preoperatively, complete cardiopulmonary evaluation by echocardiography and pulmonary function tests, computed tomography (CT) of the chest and upper abdomen, and positron-emission tomography-CT (PET-CT) was performed in all cases.

The clinical, pathologic and operative records of the eight patients were retrospectively reviewed and the tumors clas-

The potential benefits of video-assisted thoracoscopic lobectomy (VATS) include smaller incisions, faster patient recovery, a shorter hospital stay, less postoperative pain, and a lower incidence of postoperative arrhythmias and respiratory complications, without compromising the oncologic principles of lung

sified and staged preoperatively (including before and after neoadjuvant chemotherapy) and postoperatively according to the University of California Integrated Staging System (UISS) TNM classification of tumors [7]. Three patients who underwent neoadjuvant chemotherapy (2 due to T2N2 disease and 1 due to T3N2 disease) were down-staged postoperatively to T1N0, T1N1 or T2N1 disease [6]. Five other patients were staged preoperatively as T1N0 (3 patients) and T2N0 (2 patients), and only 2 of these patients were restaged postoperatively to T1N1 disease.

Regarding co-morbidities, all the patients were smokers with ischemic heart disease, three had chronic heart failure due to a myocardial infarction (ejection fraction of 45%, 35% and 30% respectively), one patient was post-mechanical ventilation due to pulmonary edema a year prior to the surgery, one had severe aortic stenosis, two had chronic obstructive pulmonary disease (COPD), two peripheral vascular disease, three non-insulin-dependent diabetes mellitus (NIDDM), one chronic renal failure, one obesity, one drug abuse, and one chronic atrial fibrillation.

All patients underwent standard anesthesia using a double-lumen endotracheal tube and perioperative thoracic epidural analgesia, and lung surgery was performed by complete anatomic dissection proceeded by hilar and mediastinal lymph node dissection according to the European Society of Thoracic Surgeon Guidelines [8]. Attempted VATS lobectomy was performed in five patients through three or four incisions without rib spreading as follows: (i) 1.0 cm incision in the 8th intercostal space in the mid/post axillary line for the 0 grade thoracoscope, (ii) 1.0 cm utility incision in the 6th intercostal space in the mid-clavicle line, (iii) 2.5–3.0 cm working incision in the 4th/5th intercostal space just anterior to the latissimus muscle, and (iv) 1.0 cm incision beneath the tip of the scapula for thoracoscopic upper lobectomies [6]. Lobectomy by thoracotomy was performed in three patients using a standard serratus muscle-sparing posterolateral thoracotomy incision in the 5th or 6th intercostal space [9]. During four LUL lobectomies, a thin lung parenchymal strip was created on the LIMA to LAD graft utilizing thoracoscopic endogastrointestinal anastomosis stapling. Two 36 French chest drains (one curved and one straight) were inserted in each case.

RESULTS

All the patients included in our study had non-small cell lung cancer operable via lobectomy and underwent CABG with a skeletonized LIMA to LAD graft.

VATS lobectomy was performed in five of the eight patients, and a lobectomy by thoracotomy was performed in three patients post-neoadjuvant chemotherapy (two with an LUL lesion and one with an LLL lesion). In three of the five patients in the VATS group (two with an LLL lesion and one with an LUL lesion) VATS lobectomy was successful. Conversion to lobectomy by thoracotomy occurred in the remaining two

patients because of severe adhesions between the LUL and the mediastinum in the region of the LIMA to LAD graft.

Postoperatively, the patients were staged as T1N0-4, T1N1-2, T2N0-1, or T2N1-1. Final pathologic examination revealed four adenocarcinomas, three squamous cell carcinomas and one neuroendocrine carcinoma. Mean hospital stay was 8.3 days. There was no major morbidity or mortality. Complications were encountered in four patients: an air leak in two, atrial fibrillation in two, atelectasis in one and pneumonia in one.

At follow-up today, all the patients are alive, seven in good general health and disease free, and the patient with neuroendocrine cancer underwent systemic treatment due to disease relapse.

DISCUSSION

The intraoperative conversion to lobectomy by thoracotomy rates range from 2% to 20% [10-12]. McKenna et al. [6] document the reasons for conversion during VATS pulmonary resection as vascular injury (generally to pulmonary artery branches and less to pulmonary veins), dense adhesions, failure to progress, and poor visualization. Gazala et al. [13] developed the vascular, anatomic, lymph node, technical (VALT) “open” classification system to allow assessment of reasons for conversion from VATS to open surgery. They found that with increased experience, conversion for anatomic reasons of vascular injury is declining, but that the rate of conversion in patients undergoing VATS after previous thoracic surgery still remains high.

During our VATS lobectomies, we used an anterior approach that involves individual ligation of the lobar vessels and bronchus and hilar dissection, followed by mediastinal lymph node dissection. In the present study, we retrospectively studied the possibility of performing VATS lobectomy in patients with previous CABG using a skeletonized LIMA to LAD graft. Five of the patients were scheduled for LUL lobectomy and 3 for LLL lobectomy.

One of the challenging technical situations in thoracic surgery is resection of the LUL due to cancer in patients with previous CABG using the LIMA. The presence of dense adhesions between the LIMA and the apical anterior part of the LUL and the chest wall presents the surgeon with the challenge of performing LUL lobectomy without injuring the LIMA. Complete dissection of the LUL from the LIMA may be associated with a high risk of LIMA rupture and potential myocardial ischemia/infarction, which could prove lethal.

Various technical methods have been reported in the literature, all preserving a small strip of lung parenchyma adjacent to the LIMA by utilizing multiple firings by an endogastrointestinal anastomosis stapling device [14] or LigaSure™ technology (Covidien Co., USA) [15].

During VATS surgery, adhesions between the lung and mediastinum following CABG surgery render the left-side tho-

racoscopic approach impossible and the open approach difficult because the LUL containing the tumor must be mobilized carefully to minimize the possibility of LIMA compromise [16]. The small strip of lung parenchyma that is left adherent to the internal mammary artery preserves graft continuity and enables lung resection without endangering the patients. The authors also reported that leaving a strip of the LUL lung parenchyma attached to the LIMA pedicle is safe with only minimal oncologic compromise.

Moreover, according to the results of our study skeletonized LIMA mobilization contributes to the development of significant adhesions generally between the LIMA to LAD graft and the lung, compromising the performance of left-sided VATS lobectomies. In four or our five LUL lobectomy cases, we also successfully used gastrointestinal anastomosis stapling, leaving a thin lung parenchyma strip on the LIMA to LAD graft.

In summary, patients with operable left-sided non-small cell lung cancer after CABG with a LIMA to LAD graft may benefit from thoracoscopic surgery with a rate of 37.5% (VATS lobectomy) vs. 62.5% for thoracotomy lobectomy. LIMA to LAD graft surgery may complicate thoracoscopic lobectomy because of pleural adhesions occurring after skeletonized LIMA mobilization. Lobectomy by thoracotomy may be the best approach for patients with severe mediastinal adhesions. Since a VATS approach is occasionally feasible, we recommend that surgery begin with the VATS technique, with contingency plans for conversion to thoracotomy if significant adhesions are found during surgery. The method of preserving a small portion of the lung on the LIMA to LAD graft may help during left upper lobe resections. Adhesions in the left pleural space after left internal mammary artery mobilization would generally minimally affect left lower lobe video-assisted thoracoscopic surgery.

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References

1. Ilonen IK, Räsänen JV, Knuutila A, Salo JA, Sihvo EL. Anatomic thoracoscopic lung resection for non-small cell lung cancer in stage I is associated with less morbidity and shorter hospitalization than thoracotomy. *Acta Oncol* 2011; 50: 1126-32.
2. Paul S, Altorki NK, Sheng S, et al. Thoracoscopic lobectomy is associated with lower morbidity than open lobectomy: a propensity-matched analysis from the STS database. *J Thorac Cardiovasc Surg* 2010; 139 (2): 366-78.
3. Scott WJ, Allen MS, Darling G, et al. Video-assisted thoracic surgery versus lobectomy for lung cancer: a secondary analysis of data from the American College of Surgeons Oncology Group Z0030 randomized clinical trial. *J Thorac Cardiovasc Surg* 2010; 139: 976-81, discussion 982-3.
4. Yan TD, Black D, Bannon PG, McCaughan BC. Systematic review and meta-analysis of randomized and nonrandomized trials on safety and efficacy of video-assisted thoracic surgery lobectomy for early-stage-non-small-cell lung cancer. *J Clin Oncol* 2009; 27: 2553-62.
5. Whitson BA, Andrade RS, Boettcher A, et al. Video-assisted thoracoscopic surgery is more favorable than thoracotomy for resection of clinical stage I non-small cell lung cancer. *Ann Thorac Surg* 2007; 83: 1965-70.
6. McKenna RJ Jr, Houck W, Fuller CB. Video-assisted thoracic surgery lobectomy: experience with 1,100 cases. *Ann Thorac Surg* 2006; 81: 421-5, discussion 425-6.
7. Brambilla E, Travis WD, Colby TV, Corrin B, Shimosato Y. The new World Health Organization classification of lung tumours. *Eur Respir J* 2001; 18: 1059-68.
8. Lardinois D, De Leyn P, Van Schil P, et al. ESTS guidelines for intraoperative lymph node staging in non-small cell lung cancer. *Eur J Cardiothorac Surg* 2006; 30: 787-92.
9. Anraku M, Keshavjee S. Lung cancer: surgical treatment. In: Selke FW, del Nido PJ, Swanson SJ, eds. Sabiston & Spencer Surgery of the Chest. 8th edn. Philadelphia: Elsevier, 2009: 254-5.
10. Walker WS, Codispoti M, Soon SY, Stamenkovic S, Carnochan F, Pugh G. Long-term outcomes following VATS lobectomy for non-small cell bronchogenic carcinoma. *Eur J Cardiothorac Surg* 2003; 23: 397-402.
11. Gharagozloo F, Tempesta B, Margolis M, Alexander EP. Video-assisted thoracic surgery lobectomy for stage I lung cancer. *Ann Thorac Surg* 2003; 7: 1009-14, discussion 1014-15.
12. Nomori H, Horio H, Naruke T, Suemasu K. What is the advantage of a thoracoscopic lobectomy over a limited thoracotomy procedure for lung cancer surgery? *Ann Thorac Surg* 2001; 72: 879-84.
13. Gazala S, Hunt I, Valji A, Stewart K, Bédard ER. A method of assessing reasons for conversion during video-assisted thoracoscopic lobectomy. *Inter Cardiovasc Thorac Surg* 2011; 12: 962-4.
14. Halkos ME, Sherman AJ, Miller JI Jr. Preservation of the lima pedicle after cardiac surgery in the left upper lobectomy. *Ann Thorac Surg* 2003; 76: 280-1.
15. Santini M, Fiorello A, Vicidomini G, Laperuta P. The use of LigaSure for preservation of a previous coronary artery bypass graft by using the left internal thoracic artery in a left upper lobectomy. *J Thorac Cardiovasc Surg* 2008; 136: 222-3.
16. Singhatanadgige S, Sindhvanada W, Kittayarak C. Left upper lobectomy after CABG with the left internal mammary artery graft. *J Med Assoc Thai* 2006; 89: 887-9.