Wine cup stoma anastomosis after extended sleeve lobectomy for central-type squamous cell lung cancer

Mitsunori Higuchi 1*
Masayuki Watanabe 1,2
Kotaro Endo 3
Ikuro Oshibe 3
Nobutoshi Soeta 3
Takuro Saito 3
Hiroshi Hojo 4
Hiroyuki Suzuki 2

Abstract
Background: Extended sleeve lobectomy is rarely applied to pulmonary surgery for primary lung cancer to avoid a pneumonectomy. As there is a size discrepancy between main bronchus and peripheral bronchus, ingenuity to improve anastomosis is required in the bronchoplasty. We report herein a case in which successful reconstruction of extended sleeve lobectomy with bronchial wall flap.

Case presentation: We report on a 64-year-old man suffering from hemoptysis, cough, mild fever and dyspnea. His computed tomography (CT) scan showed solid tumor of 40 mm in diameter in left lower bronchus, which obstructed the lower bronchus and caused obstructive pneumonia of left lower lobe and expanded to second carina and pulmonary artery. His bronchoscopy showed that tumor was exposed in the bronchial lumen and infiltrated to left main bronchus and upper bronchus even though the scope could pass through the exposed tumor of upper bronchus. Transbronchial lung biopsy showed squamous cell carcinoma. He had undergone left sleeve lingular segmentectomy and left lower lobectomy. Reconstruction was performed with bronchial wall flap. Pathological findings revealed pT3N0M0 stage IIB according to UICC 8th edition. Postoperative bronchoscopic findings showed no troubles at the anastomotic site. He has been well for eighteen months without recurrence after surgery.

Conclusions: We experienced a successful case who was reconstructed with bronchial wall flap (wine cup stoma) after extended sleeve lobectomy. This technique might be also useful for other types of extended sleeve lobectomy and lung transplantation to adjust caliber changes of bronchi.

Keywords: Extended sleeve lobectomy, Wine cup stoma, Bronchial anastomosis, Central-type lung cancer

Background
Central-type lung cancer sometimes invades bronchial openings and/or the pulmonary artery (PA). For these patients, lobectomy/segmentectomy with bronchoplasty or PA angioplasty is often preferred. This surgery sometimes requires simultaneous reconstruction of the airways and/or blood vessels. On the other hand, pneumonectomy for lung cancer is reportedly associated with significant morbidity and mortality [1–3], including postpneumonectomy lung edema, adult respiratory distress syndrome, bronchopleural fistula, and postpneumonectomy syndrome [3]. Previous reports have already shown that lobectomy with bronchoplasty or angioplasty is a more feasible surgery than pneumonectomy for central-type non-small cell lung cancer (NSCLC). An extended sleeve lobectomy is rarely attempted to avoid pneumonectomy for patients with primary lung cancer. This atypical bronchoplasty requires some technical skills because there is a large size discrepancy between the two bronchial stumps. Herein we report successfully implementation of an extended sleeve lobectomy with bronchial wall flap technique, “wine cup anastomosis”.

Case presentation
We report on a 64-year-old man suffering from hemoptysis, cough, mild fever and dyspnea. His
computed tomography (CT) scan showed solid tumor of 40 mm in diameter in left lower bronchus (Fig. 1-a), which obstructed the lower bronchus and caused obstructive pneumonia of left lower lobe and expanded to second carina and pulmonary artery (Fig. 1-b). The CT scan also revealed severe pulmonary emphysema and his pulmonary function test showed obstructive function pattern (Table 1). His bronchoscopy showed that tumor was exposed in the bronchial lumen and infiltrated to left main bronchus and upper bronchus even though the scope could pass through the exposed tumor of upper bronchus (Fig. 2-a, b). Transbronchial lung biopsy showed squamous cell carcinoma. He had undergone left sleeve lingular segmentectomy and left lower lobectomy. The details of the procedure were as follows: a posterolateral thoracotomy at the fourth intercostal space was performed. The left lower lobe and lingular division were dissected. The resection point of bronchus was determined with almost 1 cm of the distance from tumor. Intraoperative pathological findings showed free surgical margin of the bronchus. Reconstruction was performed with bronchial wall flap using 4–0 PDS stitches (Johnson and Johnson K. K., NJ, US) (Fig. 3 and Fig. 4). The anastomotic site was wrapped using a fourth intercostal muscle flap. Although he had been suffered from prolonged air leakage due to alveolopleural fistula, he could discharge from our hospital one month after surgery. Pathological findings revealed moderately differentiated squamous cell carcinoma of pT3N0M0 stage IIB according to UICC 8th edition. Postoperative bronchoscopic findings showed no troubles at the anastomotic site including stenosis or kinking (Fig. 2-c, d). He had received no adjuvant chemotherapy after surgery because of his low pulmonary function. He has been well for eighteen months without any recurrences after surgery.

**Discussion and conclusions**

Lung cancer is the leading cause of cancer-related death worldwide [4]. Surgical resection is one of the mainstays for treatment of NSCLC together with chemotherapy, radiation therapy, and recent immunotherapy. Surgical treatment of NSCLC involving the proximal bronchi or PA can be challenging. Pneumonectomy is the most extensive pulmonary resection with which to ensure complete resection for these patients. However, pneumonectomy is associated with high complication rates, especially for patients with compromised pulmonary function. In recent years, the resectability of locally advanced lung cancer has been improving with advances in perioperative care, surgical techniques [5–7], and induction therapy [8–10], which downstages the tumors to render them resectable. Thus, avoidance of pneumonectomy can be achieved in selected patients at an early disease stage. The first sleeve lobectomy was performed by Prince-Thomas in 1942 [11], and the oncologic value of lobectomy with pulmonary arterioplasty was initially reported by Vogt-Moykopf et al. [12] in 1986. These procedures have since been accepted as valuable options to avoid pneumonectomy in selected patients. Many retrospective analyses have evaluated the operative mortality and morbidity of pneumonectomy and pulmonary function-preserving surgeries such as

| Table 1 Pulmonary function test (PFT) before surgery |
|---------------------------------------------------|
| VC       | 3020 ml | FEV1.0 | 1990 ml |
| %VC     | 87.0 %  | FEV1.0% | 63.5 %  |

VC: Vital capacity
FEV1.0: Forced expiratory volume in one second

![Fig. 1](https://via.placeholder.com/150)

Fig. 1 Computed tomography (CT) scan showed solid tumor of 40 mm in diameter in left lower bronchus which involved lingular division bronchus (solid arrow) (a), which also obstructed the lower bronchus and caused obstructive pneumonia of left lower lobe (b)
sleeve lobectomy [1–3] or PA reconstruction [13] in patients with NSCLC.

Previously, Okada and colleagues classified fifteen patients who underwent extended sleeve lobectomy into three groups according to the surgical procedure of reconstruction [14]. And Miyoshi and colleagues also reported three types of anastomotic techniques [15]. One is to use two adjusting stitches in the membranous part of the larger stump. The second technique is a telescoping anastomosis. The third technique is to make a cuff on the smaller stump by trimming the bronchus. Comparing with these procedures, the latter technique requires some adjustment of making cuff without remnant cancer cells. Before surgery, radiographic and endoscopic evaluations are needed to make a success of anastomosis. In this case, we planned to make a cuff using head-sided left main bronchus, which was cancer free side. Of course we should confirm and indeed had confirmed the pathological free margin during surgery. Okada and colleagues [14] described that resection points were determined with at least 1 cm of the macroscopically unaffected distance of the bronchus. We followed the resection point of this case according to this report [14]. Amazingly, this cuff technique was termed “wine cup stoma” by Maeda and colleagues [16] almost three decades ago and we called this simple procedure same as the above. This technique is relatively simple and postoperative complications such as anastomotic stenosis or kinking are avoidable. Toyooka and colleagues [17] also recommended this bronchial cuff technique rather than adjusting stitches.

For the indication of extended sleeve lobectomy, previous reports showed that invasion of the bronchus with N0 and N1 disease were the most suitable indication [18, 19]. According this recommendation,
we performed type C extended sleeve lobectomy for this patient and achieved successful results to date.

In conclusions, we experienced a successful anastomosis of left sleeve lingular segmentectomy and lower lobectomy (type C extended sleeve lobectomy) with bronchial wall flap (wine cup stoma) for central-type lung cancer. This technique might be useful for other extended sleeve lobectomy and lung transplantation to avoid anastomotic complications.

Abbreviations
CT: Computed Tomography; NSCLC: Non-small cell lung cancer; PA: Pulmonary artery

Acknowledgements
None.

Competing of interest
The authors have no conflicts of interest to declare.

Funding
None.

Availability of data and materials
Data will not be shared because this is a case report and privacy of this participant should be protected.

Authors’ contributions
MH collected and assembled data, and drafted the article. MW, KE, IO, NS, TS, HH and HS helped to collect data. HS helped to draft the article and finally approved the article. All authors read and approved the final manuscript.

Ethics approval and consent to participate
This case report was not necessary to obtain ethical approval, however, written consent was obtained from the patient for the publication of this case report and accompanying images.

Consent for publication
Written consent was obtained from the patient for the publication of this case report and accompanying images.

Publisher’s Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Author details
1Department of Thoracic Surgery, Aizu Medical Center, Fukushima Medical University, Aizuwakamatsu 969-3492, Japan. 2Department of Chest Surgery, Fukushima Medical University School of Medicine, Fukushima 960-1295, Japan. 3Department of Surgery, Aizu Medical Center, Fukushima Medical University, Aizuwakamatsu 969-3492, Japan. 4Department of Pathology, Aizu Medical Center, Fukushima Medical University, Aizuwakamatsu 969-3492, Japan.

Received: 13 August 2018 Accepted: 6 February 2019

Published online: 12 February 2019

References
1. Bernard A, Deschamps C, Allen MS, et al. Pneumonectomy for malignant disease: factors affecting early morbidity and mortality. J Thorac Cardiovasc Surg. 2001;121:1076–86.
2. Ferguson MK, Lehman AG. Sleeve lobectomy or pneumonectomy: optional management strategy using decision analysis techniques. Ann Thorac Surg. 2003;76:1782–8.
3. Ferguson MK, Karrison T. Does pneumonectomy for lung cancer adversely influence long-term survival? J Thorac Cardiovasc Surg. 2000;119:440–8.
4. Surveillance, Epidemiology, and End Results (SEER) Cancer Statistics Review, 1975-2010. http://seer.cancer.gov/csr/1975_2010. Accessed 14 June 2013.
5. Ohta M, Sawabata N, Maeda H, Matsuda H. Efficacy and safety of tracheobronchoplasty after induction therapy for locally advanced lung cancer. J Thorac Cardiovasc Surg. 2003;125:96–100.
6. Lausberg HF, Graeter TP, Wendler O, Demertzis S, Ukena D, Schafers HJ. Bronchial and bronchovascular sleeve resection for treatment of central lung tumors. Ann Thorac Surg. 2000;70:367–71.
7. Tedder M, Anstadt MP, Tedder SD, Lowe JE. Current morbidity, mortality, and survival after bronchoplastic procedures for malignancy. Ann Thorac Surg. 1992;54:387–91.
8. Roth JA, Fossella F, Komaki R, et al. A randomized trial comparing perioperative chemotherapy and surgery with surgery alone in resectable stage IIIA non-small cell lung cancer. J Natl Cancer Inst. 1994;86:673–80.
9. Roberts JR, Eustis C, Devore F, Carbonbe D, Choy H, Johnson D. Induction chemotherapy increases perioperative complications in patients undergoing resection for non-small cell lung cancer. Ann Thorac Surg. 2001;72:885–8.
10. Matsubara Y, Takeda S, Mashimo T. Risk stratification of lung cancer surgery: impact of induction therapy and extended surgery. Chest. 2005;128:3519–25.
11. Prince-Thomas C. Conserving resection of the bronchial tree. J R Coll Surg Edinb. 1942;1056:169–86.
12. Vogt-Moykopf I, Fritz TH, Meyer G, Bužerbruck H, Daskos G. Bronchoplastic and angioplastic operation in bronchial carcinoma: long-term results of a retrospective analysis from 1973 to 1983. Int Surg. 1986;71:211–20.

13. Ma Q, Liu D, Guo Y, et al. Surgical techniques and results of the pulmonary artery reconstruction for patients with central non-small cell lung cancer. J Cardiothorac Surg. 2013;8(219).

14. Okada M, Tsubota N, Yoshimura M, Matsuoka H, Satake S, Yamagishi H. Extended sleeve lobectomy for lung cancer: the avoidance of pneumonectomy. J Thorac Cardiovasc Surg. 1999;118:710–4.

15. Miyoshi S, Tamura M, Araki O, Yoshii N, Karube Y, Seki N, Umezou H, Kobayashi S, Ishihara H, Nagai S, Sawabata N. Telescoping bronchial anastomosis for extended sleeve lobectomy. J Thorac Cardiovasc Surg. 2006;132:978–80.

16. Maeda M, Nanjo S, Nakamura K, Nakamoto K. Tracheo-bronchoplasty for lung cancer. Int Surg. 1986;71:221–8.

17. Toyooka S, Soh J, Oto T, Miyoshi S. Bronchoplasty to adjust mismatches in the proximal and distal bronchial stumps during bronchial sleeve resection of the left lower lobe and lingual division. Eur J Cardiothorac Surg. 2013;43:182–3.

18. Nruke T. Bronchoplastic and bronchovascular procedures of the tracheobronchial tree in the management of primary lung cancer. Chest. 1989;96(Suppl):S35–65.

19. Mehran RJ, Deslauriers J, Piraux M, Beaulieu M, Guimont C, Brisson J. Survival related to nodal status after sleeve resection for lung cancer. J Thorac Cardiovasc Surg. 1994;107:576–83.