

Lobectomy with Bronchoplastic Procedures in the Treatment of Bronchogenic Carcinoma

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Thirty-four patients with primary bronchogenic carcinoma involving the orifices of the lobar bronchi were treated by lobectomy with bronchoplasty from 1969 through 1981. Sleeve lobectomy was accomplished in 19 cases and wedge lobectomy in the remaining 15. Squamous cell carcinoma was diagnosed in 24 patients, adenocarcinoma in 6, large cell carcinoma in 2, small cell carcinoma in one and combined epidermoid and adenocarcinoma in one. Hilar nodes were involved in 10 patients, and mediastinal nodes involved in 12. The results indicate that the bronchoplastic lobectomy has many advantages when compared with pneumonectomy.

Operative mortality rate of 8.8 % and a five-year survival rate of 17 per cent are recorded.

The authors conclude that the bronchoplastic lobectomy is a good procedure for preservation of lung tissue and control of lung cancer as well as for decreasing the mortality rate.

INTRODUCTION

The lobectomy with bronchoplasty has attracted special interest recently as the radical technique with preservation of pulmonary parenchyma for bronchial carcinoma situated at the level of the upper lobe orifices because of complications with obstructive lung disease such as pulmonary emphysema, growing old of lung cancer patients or the

appearance of cardio-pulmonary failure within a few years after pneumonectomy,¹⁾²⁾³⁾. Bronchoplastic lobectomy for lung cancer was first performed by Price-Thomas⁴⁾ as a compromise operation in patients whose pulmonary function was considered inadequate to permit pneumonectomy. Since then many authors have emphasized the safety and wider applicability of bronchoplasty. We have actively performed bronchoplastic lobectomy for the patients with bronchogenic carcinoma and studied its indication, operative procedures, prognosis, complications and pre-and post-operative pulmonary function⁵⁾⁶⁾. This report summarized our experience in lobectomy with bronchoplastic procedures.

PRESENT SERIES

Bronchoplastic lobectomies have been performed for 34 patients with bronchogenic carcinoma in our department from 1969 through 1981. Thirty patients were men and the remaining four were women. Their ages varied from 40 to 71, 18 were in the sixth decade (Table 1). Half of them showed evidence of associated lung disease such as chronic bronchitis or pulmonary emphysema. Chest radiography detected a lung mass involving the right upper lobe in 17 cases, the middle lobe in one, the right lower lobe in 5, the left upper lobe in 9 and the left lower lobe in 2 (Fig 1). In regards to the histological typing of 34 patients, squamous cell carcinoma was the most frequent cell type in 24 cases,

Table 1. Age-sex distribution of patients.

	40to49	50to59	60to69	70to79	Total
Males	6	15	7	2	30
Females		3	1		4
	6	18	8	2	34

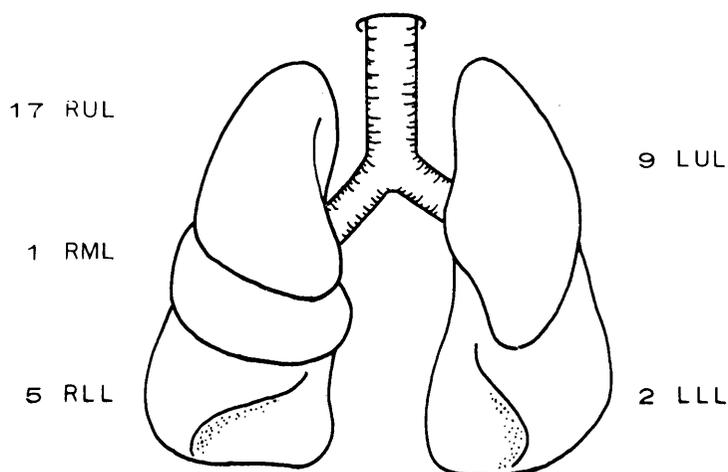


Fig. 1. Distribution of tumors.

Legend: RUL, right upper lobe. RML, right middle lobe. RLL, right lower lobe. LUL, left upper lobe. LLL, left lower lobe.

where-as 6 had adenocarcinoma, 2 had large cell carcinoma, one small cell carcinoma and one a combined type of epidemoid and adenocarcinoma. Hilar lymph nodes were involved in 10 patients and mediastinal nodes were found to be involved in 12 patients (Table 2). One third of them had advanced carcinoma. 19 patients were treated by lobectomy with sleeve resection and for four of them it was combined with a sleeve resection of the pulmonary artery. 15 patients underwent lobectomy with wedge resections (Fig 2, 3). In two cases, concomitant resection of diaphragm or pericardium was carried out respectively. Preoperative irradiation has not been used in these 34 patients.

Bronchoplastic procedures were performed for direct tumonus invasion to the main bronchus in 26 patients, where as in 8 patients this procedure was done for the cancer invasion to the main bronchus from the metastatic hilar lymph nodes (Fig 4).

Table 2. Analysis of tumors by hisistologic typing and nodal metastasis.

cell type	Number of patients	Node involved	
		Hilar	Mediastinal
Squamous cell	24	9	6
Adeno	6	1	4
Large cell	2		1
Small cell	1		1
Adeno-squamous	1		
	34	10	12

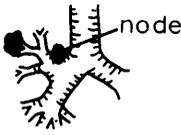
		No.of patients
Direct invasion		26
Invasion from nodes		8

Fig. 2. Type of cancer invasion to major bronchus.

Sleeve resection		Wedge resection	
Type of procedure	No. of patients	Type of procedure	No. of patients
	10		6
 Pul. art.	1		2
	2		1
	1		

Fig. 3. Diagrammatic illustration of bronchoplastic procedures (right).

Sleeve resection		Wedge resection	
Type of procedure	No. of patients	Type of procedure	No. of patients
	1		5
 Pul. Art.	3		1
	1		

Fig. 4. Diagrammatic illustration of bronchoplastic procedures (left).

SELECTION OF PATIENTS

Our main indication for bronchoplastic lobectomy are the presence of a tumor at a major lobar orifice (especially, upper lobar orifice), the presence of localized cancerous invasion in the major bronchus from the metastatic hilar nodes, and the need for conservation of lung tissue.

However, proximal tumorous spread in the bronchial wall was observed in the microscopic examination of resected specimens of lung cancer. The length of invasion was found to have extended as much as 2 centimeters, and the invasion was mainly observed in the outer layer of the bronchus⁷⁾⁸⁾. Therefore, bronchoplastic lobectomy should be done in some cases where malignant tumor is found at the segmental bronchial orifice or when, while operating, carcinomatous spread is observed in the outer layer of the major bronchus in the sense of radical operation for lung cancer.

Extension of lung cancer in the proximal bronchial wall is diagnosed preoperatively by the findings of bronchoscopy, bronchography and bronchial-arteriography. Particularly, it is important that the change of bronchial mucosa should be observed carefully with a bronchoscope.

Of course, the patients with poor pulmonary function, cardiac disease or older age require bronchoplasty.

Nevertheless, we are actively performing the bronchoplastic lobectomies even for the patients with normal cardiopulmonary function, because of its safety, radicality and merit of conservation of lung parenchyma.

OPERATIVE TECHNIQUE

The use of lateral position on the healthy side is chosen for bronchoplasty. Skin incision is carried out in postorolateral incision to expose anterior and posterior hilar areas widely and thoracotomy is performed through the fifth intercostal space.

The extent of tumor invasion in the anterior and posterior hilus, the metastasis to the hilar and mediastinal lymph nodes, metastasis or direct carcinomatous infiltration to the lobe for preservation are carefully examined and the feasibility of resection and bronchoplasty are determined. When the decision for resection and bronchoplasty is made, pulmonary vein and arteries to the lobe to be removed are ligated and cut after the complete dissection of mediastinal lymph nodes. As intraoperative respiratory control, the endobronchial spiral tube is proceeded into the left main bronchus for the bronchoplastic procedures done on the right side. For bronchoplastic procedures done on the left side, transitory occlusion of the proximal bronchus is carried out by clamping or a tampon of sponges.

At first proximal bronchotomy is made and then distal incision is made. It is important that peripheral bronchial orifice should not have double lumen. Deciding the cutting line of the bronchus, it is important to observe carefully the state of cancerous

invasion into the bronchial wall as well as to refer to preoperative findings of bronchoscopy. As above mentioned, it is sufficient to divide the bronchus at the distance of 2cm from the main tumor.

It is advisable to examine for residual carcinoma of transected bronchial margin by frozen tissue section. As suture material, we are using 3-0 nylon and dextron. Anastomosis is carried out with whole layer suture by a single row of interrupted sutures. Any inequality in diameter is adjusted by cutting and enlarging the membranous part of peripheral bronchus in the shape of V letter or by making stitches at proximal side and narrow stitches at distal side. Lastly, endobronchial tube is again pulled into trachea, reconstructed lung is re inflated and the air leak from anastomosis is checked. Additional sutures are added for excessive air leak, but the bronchoplastic site is covered with pleura or pericardium for adjustment of small air leak. Covering the bronchoplastic site by pleura or pericardium is also useful for the protection of broncho-vascular fistula and anastomotic leakage.

In the early postoperative period, we perform the aspiration of blood and secretion, observing the anastomotic site by fiberoptic bronchoscopy.

POSTOPERATIVE COMPLICATIONS

Of the 34 patients, 3 died in the hospital within 30 days. First, a 58-year-old man died suddenly with tension pneumothorax on the twelfth day after left upper sleeve lobectomy and segmental resection of the pulmonary artery. Autopsy revealed that the bulla of the left lower lobe was ruptured. Second, a 71-year-old man died with postoperative bleeding and cardiopulmonary failure on the first day after left upper sleeve lobectomy combined with segmental resection of left pulmonary artery. The other patient, a 70-year-old man died suddenly of myocardial infarction on the twenty-fourth day after left upper lobectomy with wedge resection.

The early postoperative complications were shown in Table 3. Difficulty of expectoration of sputum developed in 4 patients, all patients recovered by aspiration of tracheo-bronchial secretion under fiber-optic bronchoscopy accompanied with nebulization. Atelectasis was found in 3 patients and well controlled by frequent aspiration of sputum under broncho-fiberscopy. Hemothorax occurred in 2 patients who were treated with percutaneous aspiration of blood. Bronchial fistula developed in one patient.

This complication was caused by the recurrent nerve paralysis which was damaged during the dissection of mediastinal lymph nodes with left upper lobectomy with wedge resection. Aspiration due to recurrent nerve paralysis caused the leakage in the site of bronchial anastomosis. Left pneumonectomy was performed on the fourth postoperative but he died from pneumonia on the 44th day after operation. Empyema occurred in one patient. After partial decortication was performed, there was no evidence of anastomotic leakage.

The later complication were summarized in Table 4. Bronchial stenosis were ob-

Table 3. Early complications of bronchoplastic procedures.

	No. of patients
Difficulty of expectoration	4
Atelectasis	3
Hemothorax	2
Bronchial fistula	1
Empyema	1
Pneumonia	1

Table 4. Late complications of bronchoplastic procedures.

	No. of patients
Stenosis	4
Suture granulation	3
Tumor recurrence	1
Bronchial ectatic change	2
Atelectasis	1
Broncho-pulmonary artery fistula	1

served in 4 patients which were base on granulation formation in anastomotic site in 3 and local recurrence of cancer in one. Stenosis with granulation were relieved by the removal of sutures and granulation tissue in three of four patients. In one patient, complete obstruction due to cicatricial scar formation occurred in the second month after the right middle and lower lobectomy with anastomosis of upper bronchus and main bronchus. Completion pneumonectomy was performed. Bronchiectatic change was found in 3 patients and in one of them bronchopneumonia developed several times following a sleeve resection of the intermediate bronchus with middle lobe lobectomy.

A 59-year-old men died suddenly with massive pulmonary hemorrhage in the fourth month after right upper sleeve lobectomy. Autopsy revealed bleeding from a broncho-pulmonary artery fistula. Only one patient with local recurrence of carcinoma was observed. This patient suffered a squamous cell carcinoma of right upper bronchus and showed positive bronchial margin by permanent section after right upper sleeve lobectomy.

RESULTS

The 5 year survival rate of 34 patients undergoing bronchoplastic procedures is 17.0 per cent calculated by actuarial method. This rate is a little lower than that of simple lobectomy and higher than that of pneumonectomy as shown in Figure 5. Comparison of survival on the basis of nodal involvement indicates 30 per cent survival at 5 years without nodal involvement, and 11 per cent survival at 5 years with nodes involved. On the basis of histological typing, 3 of the 22 patients with squamous cell carcinoma are alive after more than 5 years, and one of the 6 patients with adenocarcinoma is alive after more than 5 years. There was no difference in the 5 year survival rate between lobectomy with sleeve resection and lobectomy with wedge resection. Three of 26 patients undergoing a bronchoplasty for direct cancer invasion lived more than 5 years, whereas one of 8 patients, undergoing a bronchoplasty for bronchial wall invasion from metastatic lymph nodes lived in 5 years.

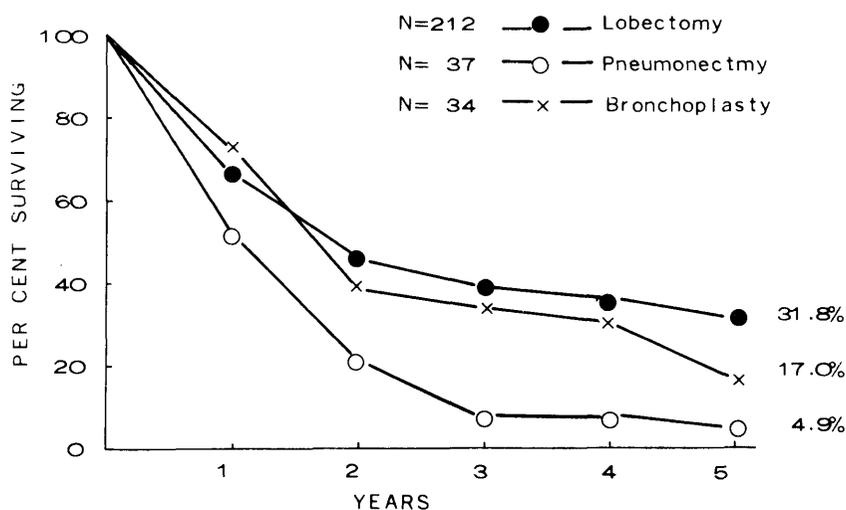


Fig. 5. Survival curves for bronchoplastic lobectomy.

The operative mortality rate is 8.8 per cent which is lower than the rate of pneumonectomy, which is 13.5 per cent in our hospital.

DISCUSSION

Pneumonectomy has been performed for the patient with lung cancer of the upper lobar orifice for a long time. However, in the management of the patients with poor respiratory or cardiac reserve and older age, lung cancer located at the lobar bronchial orifice is occasionally assumed to be inoperable because of high rate of occurrence of cardio-pulmonary failure after pneumonectomy.

The bronchoplastic lobectomy is very useful for these patients as the procedure for preservation of lung parenchyma and control of lung cancer¹⁾²⁾⁹⁾. The theoretical basis for limited resection has been confirmed pathologically. Nohl¹⁰⁾ stressed that the lymphatic drainage from each lobe was constant and metastases from the upper lobe were unlikely in lymph nodes below the fissure and concluded that lobectomy is provided that the hilar lymphatic nodes is excised.

Bronchoplasty is considered to be a limited operation, but it is frequently reported that 5-year survival rates after bronchoplastic lobectomy for lung cancer are higher than those of pneumonectomy, and approximate to those of lobectomy¹⁾⁹⁾. 5 year survival rate of our patients with bronchoplasty was 17 per cent which was lower than 30% of 5 year survival rate of simple lobectomy. But there was only one patient with local recurrence. This result testifies to the fact that the bronchoplasty has adequate radicality as lung cancer operation.

Paulson¹⁾ and Jensik⁹⁾ said that preoperative irradiation contributed to control the local recurrence and increase 5 year survival rate. But at present we do not perform irra-

diation as the trouble such as occurrence of postoperative bronchial anastomotic complications and vascular injury during the operation are anticipated.

The operative mortality of bronchoplasty is lower in comparison with pneumonectomy⁹⁾. Specific complications of bronchoplastic lobectomy are stenosis of anastomotic site and broncho-vascular fistula¹⁾. Most of stenosis are based on the formation of granulation, and are curable by removable of granulation tissue and sutures exposed in lumen. The use of monofilament sutures or absorbable sutures is also important to prevent this complication¹⁾. The broncho-pulmonary artery fistula is a rare but serious complication in this operation. To prevent this complication, it is advisable to protect the anastomotic site with parietal pleura or pericardium.

Bronchoplasty is indicated for the patients with invasion to the major bronchus from metastatic hilar node. This procedure is considered to be useful, as two of 8 patients survived for 4 years and one of eight lived more than 5 years in our series. Pulmonary function study after bronchoplasty revealed that the function of reconstructed lung was well and recovered early after operation¹⁰⁾¹¹⁾. Nevertheless, since Wood¹²⁾ reported that the gas exchange of reconstructed lung was not sufficient in the immediate postoperative period after bronchoplasty in the dogs, it is necessary to perform carefully the postoperative management of bronchoplastic patients.

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