

Bronchoplastic procedure with pulmonary angioplasty for lung cancer

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ABSTRACT : Seventy-one patients with primary bronchogenic carcinoma underwent bronchoplastic procedures (48 sleeve lobectomies and 23 wedge resection) from 1969 to 1986. In 16 patients the bronchoplasty with concomitant resection of pulmonary artery was performed. There were 48 squamous cell carcinomas, 13 adenocarcinomas, six large cell and four small cell carcinomas. There was no nodal metastasis in 26 patients (36.6%), 27 patients (38.0%) had mediastinal nodes involvement. Pathological stages of the disease were as follows : Stage I, one patients ; Stage II, 13 patients ; Stage III, 41 patients ; and Stage IV, one patient. Five year survival rate was 25.4%. Survival rates on the basis of nodal involvement indicate 44.1% at five years for patients without nodal metastasis and 18.4% for those with nodal involvement.

Ten patients complained difficulty in expectoration after surgery, and frequent therapeutic bronchofiberscopy was necessary. Four patients had an early bronchial fistula. Bronchial stenosis or obstruction due to formation of suture granulation occurred in six patients, and local recurrence at bronchial suture line was observed in six patients. Three patients with resection of the pulmonary artery had vascular complications. In two patients obstruction of the pulmonary artery due to formation of thrombus occurred, and in one patient pulmonary artery was twisted.

Bronchoplastic procedure can be performed safely, but if angioplasty of the pulmonary artery was concomitantly performed, it should be done carefully to prevent vascular distortion or stenosis.

Since the description of bronchoplastic procedures by Paulson and Shaw in 1955 and Price Thomas in 1956, many reports have documented on the merits of these procedures. Sleeve lobectomy for lung cancer is an alternative to pneumonectomy, when the tumor extends into main bronchus. This operative procedure benefits the patients by conservation of lung tissues for whom pneumonectomy is not indicated because of poor pulmonary reserve.

This report summarized our 17 years' experience in lobectomy with bronchoplastic procedures and angioplasty of the pulmonary artery.

CLINICAL MATERIAL AND METHODS

Seventy-one patients underwent bronchoplastic procedures for lung cancer at Nagasaki University Hospital from January 1969 to October

1986. There were 62 males and nine females, with a mean age of 60.3 years. Among these patients, bronchoplasty with the pulmonary artery reconstruction was performed in 16 patients.

The cell types of lung cancer included squamous cell carcinoma in 48 patients, representing 67.6% of the entire series; adenocarcinoma in 13 patients (18.3%), large cell carcinoma in six patients (8.4%), and small cell carcinoma in four patients (5.6%). Among the patients undergoing pulmonary artery reconstruction, there were 11 patients (68.7%) with squamous cell carcinoma, three patients (18.7%) with adenocarcinoma, and two patients (12.5%) with small cell carcinoma.

According to the postoperative TNM staging, there were 16 patients (22.5%) with Stage I cancer, 14 patients with Stage II cancer, and 41 patients (57.7%) with Stage III disease. There were 29 patients in the Stage III group who had positive mediastinal lymph nodes. Among the patients undergoing pulmonary artery reconstruction, there were two patients with Stage I and II cancer as well as 14 patients (87.5%) with Stage III cancer. The majority of the patients in the Stage III group included 10 patients with positive mediastinal lymph nodes (Table 1).

Table 1. Staging of Bronchoplasty for Lung Cancer

Stage	Bronchoplasty	No. of patients (%)	
		Bronchoplasty+	PA-Reconstruction
I	16 (22.5)	1 (6.3)	
	T ₂ N ₀ M ₀	5	0
	T ₂ N ₁ M ₀	0	0
	T ₂ N ₀ M ₀	11	1
II	13 (18.3)	1 (6.3)	
	T ₂ N ₀ M ₀	13	1
III	41 (57.7)	14 (87.5)	
	T ₃ N ₀ M ₀	9	2
	T ₃ N ₁ M ₀	3	2
ANY T	N ₂ M ₀	29	10
IV	1	0	

The site of carcinoma was right upper lobe in 35 patients. There were 24 sleeve lobectomy and 11 wedge procedures. Right middle and lower lobectomy was performed on 13 patients

; nine patients underwent sleeve lobectomy and four patients wedge resection. Left upper lobe sleeve resection was done in 13 patients, and left lower sleeve lobectomy in three patients. The majority of the sites of cancers in 16 patients undergoing bronchoplasty with concomitant pulmonary artery reconstruction were left upper lobes. Sleeve resection of the pulmonary artery was conducted in 10 of the 11 left upper lobectomy cases and wedge resection was done in four of the five right upper lobectomy cases (Table 2)

Table 2. Site of Carcinoma in Patients Undergoing Bronchoplasty

Site	Procedure			
	Bronchial Resection		PA Resection	
	Sleeve	Wedge	Sleeve	Wedge
Right upper lobe	24	11	1	4
Right middle + lower lobe	9	4	0	0
Left upper lobe	13	6	10	1
Left lower lobe	3	1	0	0

The patients undergoing bronchoplastic procedures were selected by the bronchoscopic appearance of the tumor, which extended to the lobar orifice and toward the mucosa of the adjacent main bronchus. When the tumor extended to the pulmonary artery, sleeve or wedged resection of the main artery was performed. Occasionally, bronchoplastic procedures were indicated for the patient who had metastatic nodes invading to the main bronchus.

The technique of bronchoplastic procedure has been well documented. However, certain points deserve further emphasis.

Techniques of ventilation and anesthesia have undergone evolutionary change. We originally used the single lumen tube for bronchoplastic procedure and atraumatic clamp or tampons to occlude the proximal main bronchus. Since the obstruction at the left main bronchus by the tumor migration had occurred in three patients in whom the single lumen tube was used for right sided bronchoplasty, we have recently used double lumen tube on the both sides, or an univent tube on the left side.

The suture material originally used for bronchial anastomosis was 3-0 Nylon. Long-term

follow-up of patients in whom Nylon was used revealed that the suture knots became covered with granulation tissues. We now perform the anastomosis with 3-0 coated polyglycolic suture. This material can be absorbed entirely, and we have yet to identify an excess of any associated granulation tissue formation.

The anastomosis is routinely covered by circumferential pleural flap that may prevent a bronchopleural fistula or bronchovascular fistula.

Routine postoperative bronchofiberscopy is done at bedside to remove any secretion at the anastomosis.

RESULT

The cumulative five-year survival rate among the 16 patients with Stage I disease was 46.7%, 27.8% in the 13 patients with Stage II disease, and 26.1% in the 41 patients with Stage III cancer, while there were no one-year survivor in the Stage IV group (Fig. 1)

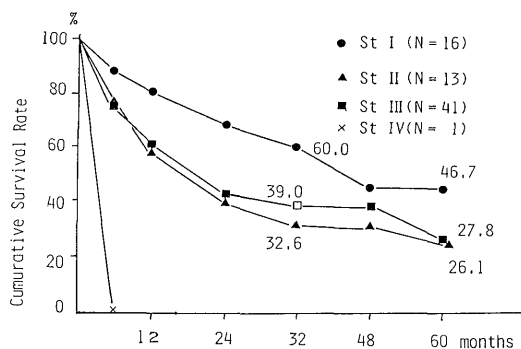


Fig. 1 Survival curves by Stage of disease

No lymph node metastasis were found in 26 patients. Among these patients, five-year survival rate was 44.1%. The 45 patients with positive lymph nodes had five-year survival rate of 18.4% (Fig. 2)

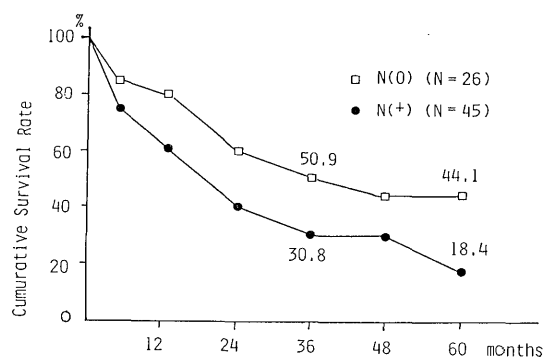


Fig. 2 Survival curves by nodal involvement

Five-year survival rate among the 48 patients with squamous cell carcinoma was 41.2%. Three-year survival rate was 20.3% in the 13 patients with adenocarcinoma, and 16% in the six patients with large cell carcinoma. Furthermore, in small cell carcinoma there were no patients surviving over years.

Five-year survival rate in the patients receiving concomitant pulmonary artery reconstruction were 49.1%, which is a favorable result compared with results of our entire series (Fig. 3)

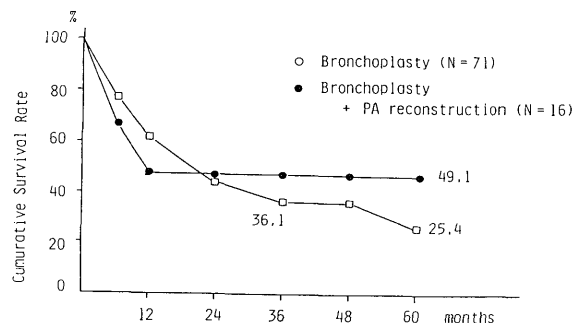


Fig. 3 Survival curves of patients undergoing bronchoplasty for lung cancer

The most common postoperative complication was difficulty in expectoration, which occurred in 10 patients (14.0%) and there were two cases of atelectasis. Routine postoperative bronchofiberscopy was conducted with the aim of preventing these complications. Granulation of the bronchial anastomosis was found in 11 patients (8.4%) and severe stenosis in six (5.6%) patients. To deal with these complications,

the complete pneumonectomy was finally done in two cases, but as far as the absorbable suture is used, anastomotic granulation and stenosis were not yielded. Anastomotic deficiency was observed in four cases (5.6%). Therefore pneumonectomy was attempted in one patient. Bronchovascular fistula was noted in three patient (4.2%). All three patients were suffocated. Tumor recurrence at the bronchial anastomosis was found in six patients (5.6%). The obstruction of the pulmonary artery at the anastomosis was found in three patients. In two of the three patients obstruction due to thrombus occurred on the 4th postoperative day and pneumonectomy was performed immediately. In one of the three patients distortion of the pulmonary artery occurred.

Eight patients who underwent sleeve lobectomy with concomitant resection of pulmonary artery are still surviving and their period of observation ranged from one year and five months to 13 years. Three of these cases have demonstrated tumor recurrence in the lung or bronchial anastomosis. In our series there were 6 operative deaths (8.4%): four patients underwent bronchoplasty alone, and two patients, bronchoplastic procedure in combination with pulmonary angioplasty. However, these were early cases and none of the 12 recent cases undergoing pulmonary angioplasty have died from surgery. The causes of death were intrapleural hemorrhage in one patient and obstruction of the pulmonary artery accompanying ruptured pulmonary cyst in another patient. The cause of death in patients who survived over 30 days after surgery were recurrent cancer in three patients (recurrence in the residual stump with metastasis to the lung in one patient, and pleural metastasis in two patients), pyothorax in two patients and heart failure in one patient.

COMMENT

Bronchoplastic procedures for lung cancer is an alternative pneumonectomy. Weisel and coworkers reported no difference in the actual survival of the patients undergoing sleeve lobectomy compared with a group of patients receiving pneumonectomy. In our previous

study the patients undergoing bronchoplastic procedures for lung cancer had better prognosis than the patients receiving pneumonectomy, and revealed similar prognosis as the patients undergoing a conventional lobectomy for bronchogenic carcinoma.

The survival data tabulated by Lowe and colleagues for all series reported in the literature revealed five-year survival rate of 33% and 10-year survival rate of 21%. Our entire series had a five-year survival rate of 24%, which was not necessarily favorable data than that of the literature. The reason can be considered that most of our patients had Stage III disease when compared with the cases previously reported in the literature.

Faber and colleagues reported that 59 patients (58.4%) with Stage I bronchogenic carcinoma revealed five-year survival rate of 36%. The probability of surviving five years in the stage II patients was 18% and that in the stage III patients, 15%. Our data are similar as stage I disease revealed five-year survival rate of 46.7%, Stage II cancer, 27.8%, and Stage III cancer 26.1%.

It seems that Stage I patients have improved survival compared with Stage III patients. Faber emphasized that positive lobar or mediastinal nodes identified at the time of the operation do not contraindicate bronchoplastic procedures for bronchogenic carcinoma. Five-year survival rate of 18.4% in patients with positive nodes and of 26.1% of Stage III patients indicates that bronchoplasty can be a satisfactory procedure when the disease is advanced. The majority of resected carcinomas were the squamous cell type. It was also included in 67.6% of our patients.

If the tumor or metastatic nodes extend to the pulmonary artery, an angioplasty should be considered. The blood flow of the pulmonary artery is needed for nourishing the constructed bronchus in which the bronchial arteries inevitably interrupted. Therefore, the surgeon must take care to avoid the stenosis or distortion at the anastomosis of pulmonary artery.

In conclusion, bronchoplastic procedures with concomitant pulmonary angioplasty are a safe operation, if careful anastomosis and appropriate postoperative care were ensured.

The results were not inferior to those obtained by conducting bronchoplasty alone, as demonstrated by our survival data.

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