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Author(s)	Ayabe, Hiroyoshi; Tomita, Masao; Tagawa, Yutaka; Hara, Shinsuke; Tsuji, Hiroharu; Oka, Tadayuki; Takahashi, Takao; Akamine, Shinji; Yamaguchi, Shinya; Matsumoto, Yoshihiro
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## Evaluation of Pulmonary Angioplastic Procedure with Bronchoplasty for Cancers

Hiroyoshi AYABE, Masao TOMITA, Yutaka TAGAWA, Shinsuke HARA, Hiroharu TSUJI, Tadayuki OKA, Takao TAKAHASHI, Shinji AKAMINE, Shinya YAMAGUCHI, Yoshihiro MATSUMOTO

The First Department of Surgery, Nagasaki University School of Medicine

Postoperative pulmonary function is essential for ensuring the quality of life for aged lung cancer patients who underwent pulmonary resection. The operative procedures of bronchoplasty and pulmonary angioplasty are reliable for maintaining pulmonary function. The values of this procedure were evaluated on the basis of clinical experience.

Pulmonary angioplasty which was concurrently performed in 28 patients with bronchoplasty (29.2%) and in eight with lobectomy was subjected to this study in relation to the survival and postoperative pulmonary function.

The operative procedure of pulmonary angioplasty was of great use to preserve the pulmonary function as well as to predict the favorable survival in the selected patients with localized hilar carcinoma of squamous cell carcinoma and with no nodal involvement. In addition, direct cancer infiltration to the wall of the pulmonary artery is better candidate rather than by way of metastatic nodes with respect to the survival.

In conclusion, pulmonary angioplasty should be widely used in combination with lobectomy and bronchoplasty to ensure high quality of life following pulmonary resection.

### Introduction

Bronchoplastic procedure for lung cancer is one of the preferable selections of the operative procedures for the treatment of patients with lung cancer to ensure the postoperative quality of life with respect to remained pulmonary function. Recently, the bronchoplastic procedure of choice has become prevalent for the treatment of a hilar type of lung cancers. At the same time, while the tumor is invading to the wall of the pulmonary artery, the procedure of concurrent pulmonary angioplasty is mandatory for enhancement of the operative curability as well as avoidance of great surgical insult such as pneumonectomy.

The purpose of this study is to elucidate the value of the pulmonary angioplastic operation with bronchoplasty for patients with a type of hilar lung cancer on the basis of a result of clinical experience.

### Patients and Methods

During the past 10 years from January, 1979 to December, 1988, a total of 28 patients with lung cancers underwent the pulmonary angioplastic operation with bronchoplasty which corresponded to 4.48% of the operated 625 primary lung cancer and 29.16% of the bronchoplasty-performed 96 patients during the same period of time at the First Department of Surgery, Nagasaki University School of Medicine. The pulmonary angioplasty with lobectomy was performed in eight patients (1.28%). The patients' ages were 14 in the 6th decade, 8 in 50 and 6 in 70, respectively. As for the location of the tumor masses, there were more frequently seen in the left upper lobe (63.9%), next in the right upper lobe. Histology showed squamous cell carcinomas in 26 (72.2%), adenocarcinomas in 8 and small cell carcinomas in two. The disease stage were stage IIIA in 24 (66.7%), mainly including advanced cases. In addition, the stage IIIB included the case of involving SVC and stage IV comprised a case of a combined resection with metastasizing adrenal gland.

The modality of involving the wall of the pulmonary artery was divided into the two types, direct invasion and by way of metastatic lymph nodes. In this series, in squamous cell carcinomas, direct invasion is the main involvement. On the other hand, in small cell carcinomas and adenocarcinomas, involvement via metastatic lymph nodes was seen in half.

The procedures of pulmonary angioplasty comprised of sleeve anastomosis in 20 (50%), wedge resection and transverse suture in 14 (38.9%) and window resection and patch plasty in 2 respectively.

### Results

The postoperative deaths were encountered in three (8.3%) of which the causes were intrathoracic bleeding, tension pneumothorax and massive hemoptysis due to bronchopulmonary fistula. Postoperative arrhythmia occurred more frequently as the postoperative compli-

**Table 1.** The incidence of adopting pulmonary angioplasty among the patients who underwent surgical treatment for lung cancers.

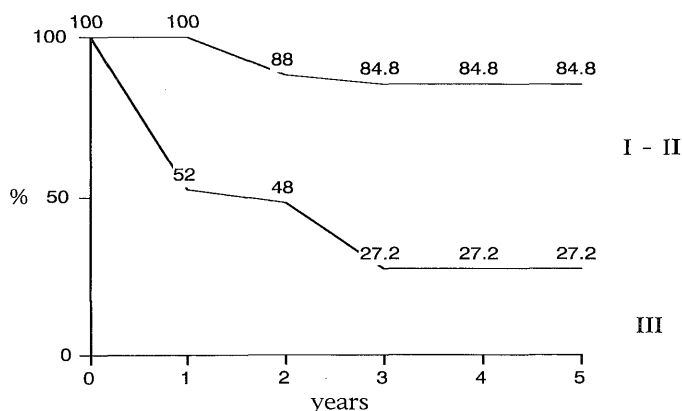
Operative procedure.	No. of patients	Angioplasty
Pneumonectomy	60 ( 9.6 %)	
Bilobectomy	58 ( 9.3 %)	
Lobectomy	365 (58.4 %)	8 ( 2.2 %)
Bronchoplasty	96 (15.4 %)	28 (29.2 %)
Segmentectomy	46 ( 7.4 %)	
<b>Totall</b>	<b>625</b>	<b>36 ( 5.8 %)</b>

**Table 2.** Cell types and Disease stage in patients who underwent pulmonary angioplasty.

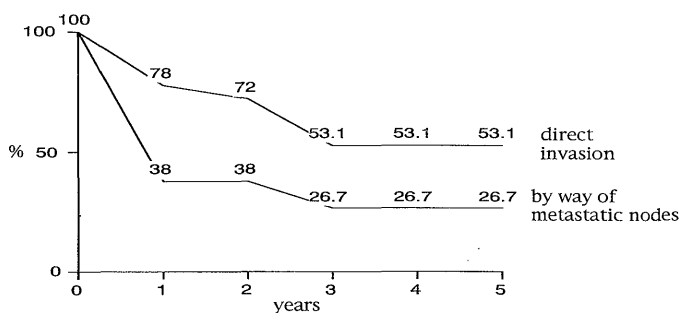
Cell types	Stage					Total
	I	II	III A	III B	IV	
Squamous cell carcinoma	3	5	17	1	1	26
Adenocarcinoma	1		5	1		8
Small cell carcinoma			2			2

cations. In contrast, the common pulmonary complications were atelectasis in four, stenosis at bronchial anastomosis in two.

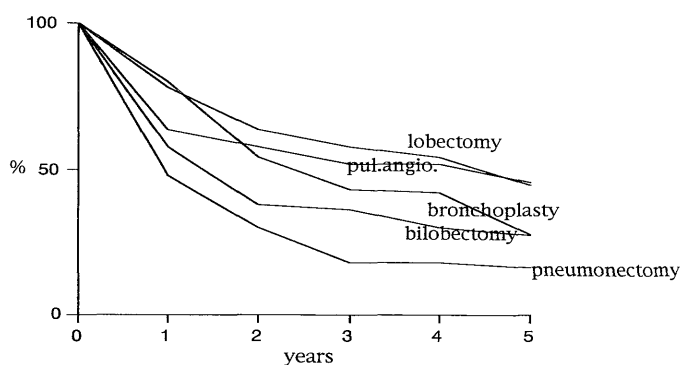
Bronchial anastomosis insufficiency in two and tension pneumothorax, bronchopulmonary fistula, bleeding of the thoracic cavity in one, respectively. The incidence of adoption of pulmonary angioplasty was as many as 5.8 percent in this series. In addition, the high frequency of 29.2% was observed while bronchoplasty had been attempted (Table 1). The operative procedure of pulmonary angioplasty was more frequently used in squamous cell carcinomas in addition to the stage III (Table 2). It is reflected that a good candidate for pulmonary angioplasty was squamous cell carcinoma which demonstrated local growth of carcinoma of the hilar type. The surgical outcome of bronchoplasty with pulmonary angioplasty was satisfactory in stage I and II lung cancer patients (Fig 1). According to the disease stage, both of the 3-year and the 5 year survivals were 84.6% in stage I + II patients in contrast to 27.2% in stage IIIA+B (Fig 1). On the other hand, the 3-and 5-year survivals in squamous cell carcinomas were 46.9%. In contrast, the 3-year survival rate disclosed 28.6% in adenocarcinomas and only one survival 3 years and 4months without any survivors more than four years. In small cell carcinomas, one survived five years with chemotherapy and irradiation. According to the operative procedure of pulmonary angioplasty, the 3-and 5-year survivals of angioplasty after sleeve resection were 24.5% in contrast to 54.1% after wedge resection. Furthermore, the 5-year survival in those who have direct



**Fig. 1** survival curve according to the disease stage.



**Fig. 2** survival curve according to the nodes of invasion to the wall of the pulmonary artery.



**Fig. 3** survival curve according to the operative procedures.

invasion to the wall of the pulmonary artery was 53.1% although that by way of metastasizing lymph nodes was 26.7% (Fig 2). The surgical outcome of patients with pulmonary angioplasty with bronchoplasty was satisfactory, indicating 45.7% in the 5-year survival which was similar to that of lobectomy and superior to that of pneumonectomy accordance with operative procedures (Fig3).

Postoperative forced expiratory volumes at one second as a percent of preoperative values revealed a similar changes among lobectomy, bronchoplasty and pulmonary angioplasty groups, showing favorable value as compared with those of pneumonectomy (Fig. 4). It was reflected that bronchoplasty and pulmonary angioplasty were worthy of preserving pulmonary function (Fig. 4). On the other hand, the pulmonary ventilation and perfusion tests by using pulmonary scintigrams resulted in the same uptakes as the preoperative one, indicating that satisfactory function was maintained on local pulmonary function test (Fig. 5).

Fig 6 revealed partially involved wall of the pulmonary artery on the histological examination in reflection of ensuring oncologically surgical radicality.

**Discussion**

Bronchoplastic procedure is a useful measures of preserving the pulmonary function and also the surgical outcome is recognized to be clinically accepted<sup>1-3)</sup>. The indication of pulmonary angioplasty is limited to a case of a localized carcinoma originated in the hilar portion. It is applied for concurrent bronchoplasty in the majority of patients in this series. However, at present a few patients have been reported including six by Fujimura<sup>4)</sup>, eight by Ogawa<sup>5)</sup>, seven by Bennett<sup>6)</sup> and six by Belli<sup>7)</sup> and in eighty by Vogt-Moykopf<sup>8)</sup>. Except for the cases of Vogt-Moykopf, much experience should be accumulated to evaluated the value of this procedure. Vogt-Moykopf clarified that the indications are in the cases with direct invasion to the wall of the pulmonary artery from a localized hilar type of lung cancer and cancer infiltration to the pulmonary artery by way of hilar and/or mediastinal lymph nodes.

Squamous cell carcinomas are more suitable for this procedure in reference with histological findings. The technically favorable location was the left main bronchus which was anatomically characteristic of the length. The pulmonary artery travels, wrapping up long left main bronchus and anatomic characteristics assures complete access of cancer infiltration to the wall of the pulmonary artery. The surgical outcome of pulmonary angioplasty is not necessarily satisfactory. Toomes and Vogt-Moykopf<sup>8)</sup> reported the operative deaths were 11.0 % in contrast to 17.0 % of bronchoplasty alone. The 5-year survival was reported to be 14 % in broncho-angioplasty and 19 % in angioplasty alone. An explanation for the reason for a low 5-year survival in combination with broncho-angioplasty is provided by the fact that this procedure is selected in advanced cancer patients.

The longer survivors after pulmonary angioplasty were reported as a result of a resection of involved pulmonary artery by many investigators<sup>6)7)</sup>. The most favorable

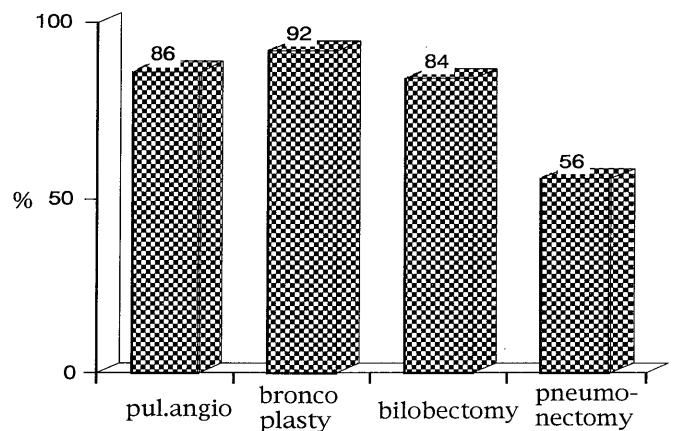


Fig. 4 The decrease rates in FEV1.0 as compared with preoperative values.

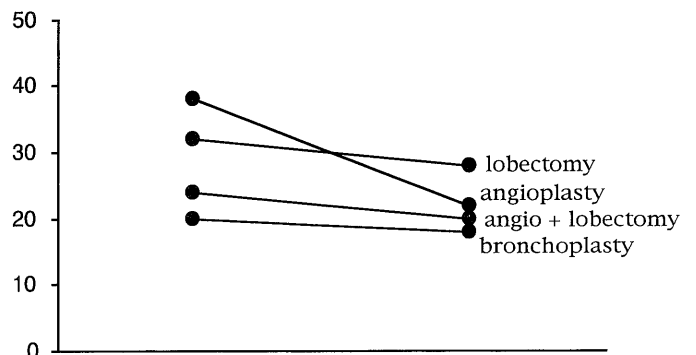


Fig. 5 comparison in uptake of isotope between pre-and postoperation on pulmonary perfusion scintigram in accordance with operative procedures.



Fig. 6 Histologic pattern of partly involved wall of the pulmonary artery.

candidates were squamous cell carcinoma and localized cancer-growth around the bronchus and the pulmonary artery in addition to no involvement of lymph nodes. Fujimura<sup>4)</sup> pointed out that worse prognosis was represented by the depth of histological cancer invasion to the media and the intima.

The postoperative assessment of pulmonary function is scanty in numbers of investigation. Fujimura<sup>4)</sup> reported a decrease rate of 15 percent in forced expiratory volume at one second as a percent of preoperative values in the analysis of repeated measurements every 2 to 7 months in 5 patients. It is indicated that postoperative reduction of pulmonary function corresponds to that after lobectomy as already reported by Ali<sup>9)</sup>. Perfusion scintigram is the best for assessment of local pulmonary function following performing angioplasty as evaluated by Deleuries, J. et al<sup>10)</sup> and Brusasco V et al.<sup>11)</sup> In this series, scintigram revealed an excellent local blood flow after pulmonary angioplasty as reported by Belli<sup>7)</sup>.

In conclusion, pulmonary angioplasty is of great use to preserve pulmonary function and to maintain oncological radicality in lieu of pneumonectomy in the selected patients with squamous cell carcinoma, no involvement of lymph nodes and not deeply involved wall of the pulmonary artery.

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