Lobectomy with Sleeve Resection in the Treatment of Tumors of the Bronchus*  


We evaluated the results of right upper lobectomy with a sleeve resection of the right main bronchus in 50 patients with a bronchial neoplasm. Four patients (8 percent) died during surgery or postoperatively. Eight of the 22 patients who underwent surgery for carcinoma between the years 1960 and 1974 had tumor-positive hilar lymph nodes. They died as a result of subsequent extension of the resected carcinoma. Fourteen of the 22 patients had no lymph node metastasis and nine of them (64 percent) were alive after five years without detectable recurrence. The finding of positive hilar lymph nodes contraindicates sleeve resection. In these cases, when pneumonectomy is impossible from a functional point of view, sleeve resection is to be regarded as a palliative procedure.

In the surgical management of carcinoma of the bronchus, the original treatment of choice was pneumonectomy. Later, lobectomy and bilobectomy were suggested as acceptable alternatives.1,2 In cases where for anatomic reasons a lobectomy was not entirely feasible, an attempt was made to limit the surgical procedure as much as possible by employing bronchoplastoic techniques. These bronchoplastic techniques were first used in cases of local stenotic changes in the bronchus, usually as the result of tuberculosis. In the so-called "sleeve resection," a complete sleeve-shaped bronchus resection was performed with subsequent restoration of the continuity by an end-to-end anastomosis.3-6

In 1959, Johnston and Jones7 described the first series of patients in whom carcinoma of the bronchus was treated by lobectomy with a sleeve resection of the main bronchus. Since then, many publications have appeared describing similar sleeve resections in the treatment of both carcinoma of the bronchus and carcinoid.8-18 This communication reports the result of right upper lobectomy with a sleeve resection of the right main bronchus in 50 patients with a bronchial neoplasm.

**Materials and Methods**

**Patient Group**

In the period 1960 to 1979, a right upper lobectomy with a sleeve resection of the right main bronchus was performed on 50 patients (48 men and two women) in the St. Antonius Hospital (Utrecht, the Netherlands). The indication in all cases for operation was a tumor, which, by virtue of its location and extent, could not be adequately resected by a simple lobectomy. As can be seen by the following, this operation was performed more frequently in recent years: 1960 to 1964, 4; 1965 to 1969, 3; 1970-1974, 18; and 1975-1979, 25. Distribution with regard to age was as follows: 21 to 30 years, 2; 31 to 40, 0; 41 to 50, 6; 51 to 60, 21; 61-70, 17; and 71-80, 4.

**Preoperative Investigation**

Apart from routine investigation, special attention was given to investigation of the bronchi and the estimation of lung function. An attempt was made to gain an impression of the actual anatomic relations within the bronchial tree by performing bronchograms. The operation site was subsequently closely inspected by means of bronchoscopy. Biopsy specimens were systematically taken from above and below the expected area of the sleeve resection (main bronchus medial and lateral; lobar bronchus, medial and lateral). In addition, biopsy specimens were taken from the tumor and from the carina of the right upper lobe. Fine-needle biopsy specimens were taken from the carina of the trachea and from the right upper lobe carina. In this way, the extent of the tumor could be accurately assessed preoperatively. Mediastinoscopy was not performed in cases of carcinoid or adenocystic carcinomas; in the remaining patients, mediastinoscopy was negative.

In the estimation of lung function, the functional reserve and separate lung functions were investigated. In 39 patients, the vital capacity was within normal limits. A reduced vital capacity (between 55 and 79 percent of the calculated normal values according to Baldwin et al × 1.1) was found in 11 patients. In eight of these patients, bronchopulmonary function investigation showed that this was the result of a loss in right-sided function owing to the tumor localization while three patients had generalized obstructive lung disease. The qualitative lung function as judged from the FEV1 maneuver gave the following results: 17 patients...
had a normal FEV₁ %VC; in 27 patients there was a moderate

duration between 51 and 65 percent, while in 6

patients the values were below 50 percent.

Operative Management

During anesthesia, a 32-cm long tube was introduced

into the trachea. The thorax was opened through the

upper margin of the bed of the fifth rib on the right

side. The size and extent of the tumor was then estimated,

and the lymph nodes in the hilum of the lung and the

lobe were inspected. The azygos vein was dissected, divi-
ded, and closed on both sides with vascular sutures.
The mediastinal pleura was opened along the tracheas, and any

lymph nodes encountered were resected. During the operation,
possible metastases or tumor extension was ex-
cluded by frozen section examination. The arteries and

veins of the upper lobe were dissected and ligated, while

the vessels to the middle lobe were carefully identified

and spared. The right main bronchus was dissected up to

the tracheal carina, and the lobar bronchus was dissected to
the bifurcation in the middle lobe bronchus and the

apical bronchus of the lower lobe. The bronchial vessels

were ligated. The pulmonary artery was centrally sur-
rounded as was the inferior pulmonary vein after division
of the pulmonary ligament. The long endotracheal tube was

then advanced into the left main bronchus whereby the

patient was ventilated exclusively via the left lung. The

right pulmonary artery was temporarily occluded to avoid

a shunt of deoxygenated blood into the main circulation.
The right main bronchus was then divided at the level of
the tracheal carina and the lobar bronchus immediately
proximal to the level of the middle lobe bronchus.
The resection borders were submitted for frozen section exa-
namination to check that they were free of tumor. In this case,
an anastomosis was made between the lobar bronchus and
the practically lateral defect in the trachea. Originally,
anastomosis was closed, using an extramucosal 4 × 0
Prolene-suture and later with a continuous Tevdeck 4 × 0
suture interrupted at three places. Since 1977, it was gen-
erally changed to upward extramucosal sutures with
Prolene 4 × 0 and later to Vycryl 4 × 0atraumatic.
The Vycryl sutures were inserted posteroanteriorly and tied
anteroposteriorly. The difference in diameter between the

ostium of the lobar bronchus and the ostium of the main

bronchus was corrected by spacing out the sutures on the

proximal side. The lobar bronchus was therefore sutured into

the proximal ostium in a somewhat trumpet-shaped

fashion. The long endotracheal tube was then pulled back

into the trachea. The anastomosis was carefully surrounded

with a pleura flap and checked for air-leaks. The clamp

on the pulmonary artery was removed, and two thorax
drains were inserted. The wound was closed in layers.

Postoperative Management

Apart from the usual postoperative care, repeated bron-
choscopic examination with histologic control of the re-
section area played an important role in the postoperative
management. By doing this, the condition of the sleeve
could be controlled and bronchial secretions and granu-
lation tissue could be removed.

Results

Of the 50 patients in this series, four died either
during operation or in the direct postoperative

period. The causes of death were as follows: cardiac

arrest during operation; cardiorespiratory insuffi-

ciency ( nine days postoperatively); staphylococcal

septicemia resulting from a staphylococcal bron-

chus infection ( ten days postoperatively); hemor-

rhage from the pulmonary artery, which, at nec-
opsy, was found to be involved in the anastomosis

(20 days postoperatively).

Histopathologic examination revealed the follow-
ing tumor types: carcinoid, 4; adenocystic carci-

noma, 1; large cell anaplastic carcinoma, 1; adeno-
carcinoma, 2; and squamous cell carcinoma, 42.

Definitive pathologic investigation showed that the

resection border was positive for tumor in the large

cell anaplastic carcinoma and in 2 of the squamous
cell carcinomas. Tumor tissue was also found in the

anastomosis of one patient at bronchosopic control.

With the exception of the large cell anaplastic carci-
noma which followed a rapid and fatal course, the

above findings led to three repeat thoracotomies
during which the remaining lobes were resected.

Tumor-positive lymph nodes were found in the hilar
region of either the lobe or the lung itself in one

patient with adenocarcinoma and 12 with squa-

mous cell carcinoma.

Resection of the remaining lobes was performed in

four cases as a result of stenosis with repeated

episodes of collapse or bronchial infections. In three

of these four patients, the anastomosis had been

stitched with a continuous Tevdeck 4 × 0 suture in-

terrupted at three places. This technique led to

severe constriction of the ostium of the middle

lobe bronchus in four other patients. This led to the

abandonment of this suture technique in 1977 after

which both complications were largely avoided.

All four patients with carcinoid ( one in 1974;
two in 1975; one in 1978) and the patient with

adenocystic carcinoma ( one in 1978) are alive

without any evidence of recurrence. The patients

who underwent surgery for carcinoma between the

years 1960 and 1974 ( n = 22) could be con-

sidered for the estimation of the five-year survival

rates. Apart from three patients from this group

who died either during the operation or directly

thereafter, eight additional patients died as a result

of subsequent extension of the resected carcinoma.

Only these eight patients had had tumor-positive

hilar lymph nodes on definitive postoperative patho-

logic examination! Two patients died from unre-

lated causes ( accident and myocardial infarction).

Nine patients ( 40.9 percent ) were alive and without

detectable recurrence after five years. No lymph

node metastasis had been found in these patients.

Postoperative spirometry was performed in 32
patients. After taking into account the amount of resected lung tissue, the vital capacity was found to be normal in 25 patients. Expiration rate was unchanged from the preoperative values.

**Discussion**

An intraoperative and postoperative mortality rate of four out of 50 patients (8 percent) can be considered to be reasonably good. It falls into the same range as a simple lobectomy (Belcher and Anderson,18 6 percent; Leroux,20 8 percent) and is less than with a pneumonectomy (Belcher and Anderson,19 14 percent; Leroux,20 12 percent). Pneumonectomy can be considered as an alternative form of treatment in these cases. When compared with other studies in which a sleeve resection was performed, the intraoperative and postoperative mortality in the present study can be considered as within acceptable limits (Table 1).

A five-year survival of nine out of 22 patients (40.9 percent) is in keeping with the survival figures after lobectomy (Belcher and Anderson,19 29 percent; Paulson,21 45 percent; Ashor et al,22 41 percent). The present survival rate also corresponds with other reports on sleeve resections for carcinoma of the bronchus (Table 1). Only Weisel et al18 reported a much lower survival rate, but they operated upon a completely different group of patients, which included, for example, patients with a tumor-positive mediastinoscopy. The five-year survival is clearly related to the presence or absence of lymph node metastases. The patients with lymph node involvement (eight out of 22 patients) in the resected specimen showed a five-year survival of 64 percent (nine out of 14 patients). The literature (Table 1) also shows obviously different survival rates between patients with and without lymph node metastases. These findings, in our opinion, contraindicate sleeve resection as an operative treatment where lymph node involvement is present. Under these circumstances, pneumonectomy is the only acceptable form of treatment. Only in those cases where, for functional reasons, a pneumonectomy is not feasible, does the sleeve resection have value, and can then only as a palliative measure.

The bronchial anastomoses were regularly controlled, both functionally and bronchoscopically. The middle lobe proved to be atelectatic on four occasions owing to narrowing of the ostium. In all of these cases, the anastomoses had been made using a continuous suture interrupted at three places. This was also the case in three of the four patients in whom stenosis led to resection of the remaining lung. These complications have not been encountered since the introduction of atraumatic interrupted sutures with Vycryl 4 × 0. The large number of resections of the remaining lobes can, therefore, largely be explained by an inadequacy in the surgical technique employed. The frequency of reexection following stenosis is higher than that reported by other authors (Rees and Paneth,19 one in 46 patients; and Jensik et al,12 one in 57 patients). Not all authors are in favor of repeated postoperative bronchoscopic control of the sleeve anastomoses, but in our opinion, it is essential in order to remove bronchial secretions and granulation tissue. This is certainly the case in patients with a less

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*Ten-year survival.
†Poor lung function.
‡Good lung function.

Table 1—Survey of the Recent Literature on Sleeve Resections
adequate lung function (severely disturbed expiration, dyskinetic bronchial system) where favorable operative result can be dependent upon this procedure. One of the four patients who underwent excision of the remaining lung because of stenosis, and where the partially interrupted continuous suture technique had not been used, had a severely disturbed expiration and a severely dyskinetic bronchial system. This probably contributed to the poor functional result through difficulties in expectoration. It was especially important in these patients that reported bronchial toilet was essential.

In conclusion, we can say that right upper sleeve lobectomy can be a good alternative to total pneumonectomy. The operative mortality (8 percent) and the survival over five years (nine out of 14, or 64 percent in patients without lymph node involvement) can be considered to be reasonably good. Hilar node involvement precluded sleeve lobectomy unless pneumonectomy would not be tolerated.

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12 Jensik RJ, Faber LP, Milloy FJ, Amato JJ. Sleeve lobectomy for carcinoma, a ten year experience. J Thorac Cardiovasc Surg 1972; 64:400-12