

Mediastinoscopy and bronchial carcinoma: experience with 600 mediastinoscopies

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Lacquet, L. K., Mertens, A., van Kleef, J., and Jongerius, C. (1975). *Thorax*, 30, 141-145. Mediastinoscopy and bronchial carcinoma: experience with 600 mediastinoscopies. Of 600 mediastinoscopies carried out from 1966 to 1973, 479 were performed to assess the operability of a pulmonary carcinoma. Of these, 206 (43%) were positive and 273 (57%) were negative.

Of the 161 patients found positive during an initial period, 147 were refused operation; the remaining 14 were considered suitable candidates for operation, either because only one homolateral lymph node site was involved or because there was a concomitant osteoarthropathy. The tumour was irresectable in one of these 14 patients who died after 3.5 months; curative resection was possible in one and palliative resection in 12 patients. These 12 patients all died within a year.

Of the 184 patients found negative during an initial period, 149 were treated by operation. The tumour proved irresectable in seven (5%), while curative resection was possible in 113 (76%) and palliative resection in 29 (19%) patients.

Comparison with the period 1957-63, when in the same hospital resection was performed after a negative Daniels' (scalene node) biopsy, shows that the tumour was irresectable in 25 (20%) of the 124 patients with a negative biopsy, while curative resection was possible in 43 (35%) and palliative resection in 56 (45%) patients.

During a second period, patients with a positive mediastinoscopy were in principle refused operation. Of 89 negative patients, 81 were treated by operation. No tumour was found to be irresectable; curative resection was possible in 63 (78%) and palliative resection in 18 (22%) patients.

An operation for bronchial carcinoma was performed on 167 patients between September 1970 and September 1973 after a negative mediastinoscopy in 95, and without mediastinoscopy in 71 patients, either because of a peripheral tumour (70) or because of a tumour relapse after two years (1). The resection was palliative in 11% of the 71 cases, but in only one patient with a peripheral tumour could a mediastinoscopy have been positive. Finally, an operation was performed on one patient with a positive mediastinoscopy and a tumour relapse after six years. A survival study was made of the first 100 patients with pulmonary carcinoma, operated on between September 1970 and March 1972 and with a follow-up from a minimum of two years to a maximum of 3.5 years. The early mortality averaged 10% and was higher after pneumonectomy than after lobectomy. The late mortality was 16% after curative lobectomy, 38% after curative pneumonectomy, and 83% after palliative pneumonectomy. The survival after 2 to 3.5 years was 63%.

Of 600 mediastinoscopies carried out from January 1966 to September 1973, 479 were performed to assess the operability of a pulmonary carcinoma in patients who, according to other

methods of investigation, were suitable candidates for operation. Of these, 206 (43%) were positive and 273 (57%) were negative. The remaining 121 mediastinoscopies were performed as aids in the

diagnosis of obscure affections of the lungs and mediastinum. Of these, 70 (58%) were positive and 51 (42%) were negative.

Of the total of 600 mediastinoscopies, 276 (46%) were positive and 324 (54%) were negative.

The incidence of a positive mediastinal biopsy in mediastinoscopy ranges from 23% to 46% in the literature, and this difference must be ascribed to a difference in selection (Pearson, 1968).

Patients with bronchial carcinoma and a negative mediastinoscopy were regarded as operable and were in principle considered suitable candidates for operation. Patients with a positive mediastinoscopy were regarded as inoperable because of mediastinal metastases (Nohl, 1956; Reynders, 1964; Bergh and Schérsten, 1965; Pearson, 1965; Carlens, 1965). In emulation of Palva and Viikari (1961), Maassen (1962), Akovbiantz and Aeberhard (1964), Sarrazin and Voog (1965), and Freise and Rensch (1967), a small number of patients with a positive mediastinoscopy were nevertheless operated upon during an initial period from 1966 to 1969.

MEDIASTINOSCOPY, RESECTABILITY, AND OPERABILITY OF BRONCHIAL CARCINOMA INITIAL PERIOD (1966–69)

(A) Of the 161 *positive patients* in the initial period, 147 were refused operation. But the remaining 14 were accepted for operation either because only a single homolateral lymph node site was involved, without extranodal involvement and with a cell type histologically considered not to be unfavourable, or because there was a concomitant hypertrophic osteoarthropathy. In one of these 14 patients the tumour was irresectable and death occurred after 3.5 months; in one of the 13 remaining patients a curative resection was possible (faulty histological diagnosis at mediastinoscopy), and palliative resection was possible in 12—five with involvement of a single lymph node site, six with involvement of several sites, and one with involvement of one lymph node site and the bronchial stump.

We use the term curative resection when the mediastinal glands and the surrounding organs are unaffected. We describe a resection as palliative when either the mediastinal glands are involved or adjacent organs show tumour invasion. If involved intersegmental or interlobar glands are removed along with the resected specimen, we still regard the resection as curative.

Death occurred within a year of each of the 12 palliative resections (after 10 days in one, after 12 months in one, but after three months in the

majority). The conclusion was that patients with a positive mediastinoscopy derive little benefit from operation. This confirmed our earlier experience in the surgical treatment of patients with a positive mediastinoscopy (Lacquet and van der Schaar, 1965, 1966; Lacquet, 1966).

(B) Of the 184 *negative patients* during the initial period, 149 were treated by operation. Operation was not performed in the remaining 35, either because the patient did not consent to it, or because other methods of investigation led to a suspicion of inoperability after mediastinoscopy, or because there were relative contraindications.

The tumour was irresectable in seven (5%) of the 149 operations, while curative resection was possible in 113 (76%) and palliative resection in 29 (19%) patients (Table I). Lymph node involvement was present in 16 of these 29 cases. The nodes had been accessible to the mediastinoscope in seven and inaccessible in nine. This implies that false-negative mediastinoscopic findings had been obtained in seven cases. Other organs were involved in 13 of the 29 cases. This was established by microscopic examination of the specimen obtained by extended resection, which had suggested that all macroscopically suspect tissue had been removed. Comparison with the period 1957–63, when in the same hospital (Table I) resection was performed only after a negative Daniels' biopsy, reveals an improvement of results. Of 124 patients with a negative Daniels' biopsy, 25 (20%) proved to have an irresectable tumour; curative resection was possible in only 43 (35%) and palliative resection in 56 (45%) patients (van den Bergh, Dierickx, and Buyssens, 1964). The conclusion was that patients with a negative mediastinoscopy were very likely to have a resectable lesion and that the resection was likely to be curative. With the introduction of mediastinoscopy as an alternative to a Daniels' biopsy, it has become possible to avoid numerous useless thoracotomies.

The superiority of mediastinoscopy to a Daniels' biopsy in assessing the operability of pulmonary carcinoma was also demonstrated by Nachbur (1966) in a comparative study, and by Lavigne, Lejeune, and Desai (1970) in a series in which both methods were used simultaneously.

Moreover, we confirmed the superiority of mediastinoscopy to a Daniels' biopsy on the basis of the large number of positive contralateral nodes found at mediastinoscopy.

We found 4% positive contralateral nodes in tumours of the right lung and 18% positive contralateral nodes in tumours of the left lung.

In the series of Maassen *et al.* (1965), the percentages for contralateral metastases were even larger, 8% for tumours of the right, and 25% for tumours of the left lung.

SECOND PERIOD (SEPTEMBER 1970 TO SEPTEMBER 1973)

(A) During the second period patients with a *positive mediastinoscopy* were in principle refused operation.

(B) Of the 89 *negative patients*, 81 were treated by operation. Operation was not performed in eight, either because the patient did not consent (3), or because distant metastases were suspected after mediastinoscopy (3), or because lung function was insufficient (1), or because tracheal infiltration became apparent after mediastinoscopy (1). In the 81 operations the lesion was always found to be resectable (100%). Resection was curative in 63 (78%) cases and palliative in 18 (22%) (Table I). In 13 of these 18 cases the operation was palliative because of involvement of mediastinal lymph nodes, and in five this was due to

phrenic nerve, and bronchial stump in one case. This involvement was elicited at microscopic examination of a specimen obtained by extended resection, which had usually suggested that all macroscopically suspect tissue had been removed.

With Pearson (1968) we regard as inaccessible the anterior mediastinal nodes or paraphrenic nodes, according to Nohl (1956), the subaortic nodes and the posterior subcarinal nodes, which we prefer to describe as paraoesophageal nodes, according to Nohl (1956).

The conclusion for the second period is that irresectability can be reduced with increasing experience in performing extended resections and in performing mediastinoscopy.

With the increased reliability of mediastinoscopy, exploratory thoracotomy is probably avoided in a number of patients with positive accessible mediastinal nodes and infiltration of vital organs, which precludes resection. Moreover the number of curative resections has risen from 76% to 78%. However, the number of palliative resections has likewise increased, from 19% to 22%, due to increased resectability (or decreased irresectability).

We therefore disagree with Hajek and Homan van der Heide (1970), who found no significant decrease in the rate of exploratory thoracotomies. This rate is 14% after negative mediastinoscopy, and 15.5% without mediastinoscopy. They expect only a further increase in the number of curative resections. Labeeu and Vanderhoeft (1970) still reported 20% irresectability after negative mediastinoscopy, and 50% after positive mediastinoscopy. Honoré *et al.* (1971) reported 33% irresectability after negative mediastinoscopy. The decrease in irresectability after introduction of routine mediastinoscopy has also been demonstrated in several earlier series. It amounts to 9% according to Reynders (1964), 7% according to van der Schaar and van Zanten (1965), 6.7% according to van der Schaar and Lacquet (1965), and 6% according to Pearson (1968).

TABLE I
BRONCHIAL CARCINOMA: RESECTABILITY AND OPERABILITY

	1957-63 124 Negative Daniels	1966-69 149 Negative Mediastinos- copy	1970-73 81 Negative Mediastinos- copy
Irresectable	25 (20%)	7 (5%)	0 (0%)
Resectable	99 (80%)	142 (95%)	81 (100%)
Curative	43 (35%)	113 (76%)	63 (78%)
Palliative	56 (45%)	29 (19%)	18 (22%)

involvement of other organs. The mediastinal lymph nodes involved had been accessible to the mediastinoscope in four cases, and in these four cases mediastinoscopy had therefore given false-negative results. Nodes involved in these four cases were: only the carinal nodes in one case; the carinal (accessible) and subaortic (inaccessible) nodes in two cases; the left tracheobronchial nodes in one case. These four false-negative results were due to failure of mediastinoscopic technique. In nine of the 13 cases, however, the mediastinal lymph nodes involved had not been accessible to the mediastinoscope, and mediastinoscopy had therefore been rightly negative. Nodes involved in these nine cases were: paraoesophageal nodes in two cases; paraoesophageal and subaortic nodes in one case, subaortic nodes in five cases, and subaortic nodes as well as the nodes along the inferior pulmonary vein with additional involvement of the pericardium,

MEDIASTINOSCOPY AND SURVIVAL AFTER OPERATION FOR BRONCHIAL CARCINOMA

From September 1970 to September 1973, resection was performed for bronchial carcinoma in 167 cases, and in 81 of these cases the operation followed negative mediastinoscopy.

As reported above, the resection was curative in 63 (78%) and palliative in 18 (22%) of these 81 cases. In 14 cases the operation was performed after negative mediastinoscopy elsewhere, the

resection being curative in 10 (71%) and palliative in four (29%) of these 14 cases.

In 71 cases an operation was performed without preceding mediastinoscopy: for a peripheral tumour in 70 cases and for a tumour relapse after two years in one patient who survived only six months. We consider a tumour to be peripheral when it is either invisible at bronchoscopy or is localized distal to the second bronchial bifurcation. However, in the case of a peripheral oat-cell tumour, diagnosed by sputum cytology, brush material or transthoracic puncture, mediastinoscopy is performed.

Resection was curative in 63 (89%) and palliative in 8 (11%) of these 71 cases. In only one patient with a peripheral tumour could mediastinoscopy have been positive. In the other 69 cases of peripheral tumour mediastinoscopy would have been useless. Finally, an operation was performed on one patient with positive mediastinoscopy and a tumour relapse after six years; this patient survived for two years.

Of these 167 patients, 136 (82%) underwent a curative resection and 31 (18%) a palliative resection. The 167 resections included three segmentectomies, 93 (bi)lobectomies, and 71 pneumonectomies. The early mortality (within 30 days of operation) was 14 (8·3%), that is, five (5·2%) of 96 segmentectomies/lobectomies and nine (12·6%) of 71 pneumonectomies. Causes of death in the first group were: pneumonia (3), myocardial infarction (1), and intrapulmonary bleeding during anticoagulant therapy (1); those in the second group were: cardiac cause (3), pulmonary embolism despite anticoagulants (3), metastases (1), pneumonia (1), and unknown cause (1). In March 1974 a study was made of the survival of the first 100 patients with pulmonary carcinoma treated by resection: 62 lobectomies and 38 pneumonectomies performed between September 1970 and March 1972, that is, with a follow-up from a minimum of two years to a maximum of 3·5 years (Table II).

The early mortality in these 100 cases was 10%—five out of 62 lobectomies and five out of 38 pneumonectomies. The late mortality was different for lobectomies (57) and pneumonectomies (33) and also different for curative (21) and palliative pneumonectomies (12).

All except one of the 57 lobectomies were curative. The late mortality was nine (16%) of 57, the survival being 48 (84%) of 57. The only patient with a palliative lobectomy was among the survivors. This patient had a positive mediastinal lymph node, inaccessible at mediastinoscopy.

TABLE II
BRONCHIAL CARCINOMA: MORTALITY AND SURVIVAL AFTER OPERATION

100 cases: 62 (bi) lobectomy; 38 pneumonectomy			
Follow-up: min. 2 years, max. 3·5 years			
Early mortality (30 days after operation):			
5/62 lobectomy; 5/38 pneumonectomy: 10/100 (10%)			
Late mortality		Survival	
Lobectomy			
Curative	9/56 (16%)	> 9/57 (16%)	47/56 (84%)
Palliative	0/1 (0%)		1/1 (100%)
Pneumonectomy			
Curative	8/21 (38%)	> 13/21 (62%)	13/21 (62%)
Palliative	10/12 (83%)	> 2/12 (17%)	15/33 (45%)
Total late mortality 27/90 (30%)		Survival 63/90 (70%)	
Total early + late mortality 37/100 (37%)		Survival 63/100 (63%)	

Of the 33 pneumonectomies, 21 were curative and 12 were palliative. The late mortality for curative pneumonectomy was eight (38%) of 21 cases, with a survival of 13 (62%) of 21. The late mortality for palliative pneumonectomy was 10 (83%) of 12 cases, with a survival of two (17%) of 12. One survivor had a positive mediastinal lymph node, inaccessible at mediastinoscopy, and the other had a spread to pericardium and phrenic nerve. The late mortality for the pneumonectomies was therefore 18 (55%) of 33 cases, with a survival of 15 (45%) of 33. The total late mortality was 27 (30%) of 90 cases, and the survival totalled 63 (70%) of 90 cases. The mean survival time of patients with palliative pneumonectomy was 16 months with involved glands, 11 months with spread to other organs, and 8·4 months with involved glands and spread to other organs.

The total mortality (early and late) was 37 (37%) of 100 cases, and the survival was 63 (63%) of 100 cases during a follow-up period from a minimum of two years to a maximum of 3·5 years.

REFERENCES

- Akovbiantz, A. and Aeberhard, P. (1964). Mediastinoskopie in der Diagnostik und Operabilitätsbeurteilung bei Lungenerkrankungen. *Thoraxchirurgie und vasculäre Chirurgie*, **12**, 193.
- Bergh, N. P. and Schersten, T. (1965). Bronchogenic carcinoma. A follow-up study of the surgically treated series with special reference to the prognostic significance of lymph node metastases. *Acta Chirurgica Scandinavica*, Supplement 347, p. 1.
- Carlens, E. (1965). La médiastinoscopie dans le carcinome bronchogénique. *Les Bronches*, **15**, 486.
- Freise, G. and Rensch, H. (1967). Ergebnisse der Skalenuslymphknotenbiopsie nach Daniels und der Biopsie des oberen vorderen Mediastinums nach Carlens. *Thoraxchirurgie und vaskuläre Chirurgie*, **15**, 133.

- Hajek, M. and Homan van der Heide, J. N. (1970). Early detection of mediastinal spread of pulmonary carcinoma by mediastinoscopy. *Thorax*, **25**, 720.
- Honoré, D., Lavigne, J., Lejeune, G., and Desaive, C. (1971). La médiastinoscopie. Etude clinique de 225 cas. *Lyon Chirurgial*, **67**, 401.
- Labeuu, F. and Vanderhoeft, P. (1970). Analyse de 500 médiastinoscopies. *Acta Chirurgica Belgica*, **69**, 365.
- Lacquet, L. K. (1966). Mediastinoscopie bij de operabiliteitsbeoordeling van het longcarcinoom. *Tijdschrift voor Geneeskunde*, **22**, 240.
- and van der Schaar, P. J. (1965). Ervaring met 275 mediastinoscopieën. *Acta Chirurgica Belgica*, **64**, 236.
- and — (1966). Médiastinoscopie: technique et résultats. *Le Scalpel*, **119**, 671.
- Lavigne, J., Lejeune, G., and Desaive, C. (1970). Valeurs diagnostiques comparées de la biopsie préscalénique et de la médiastinoscopie dans les affections pulmonaires ou médiastinales. *Revue Médicale de Liège*, **25**, 60.
- Maassen, W. (1962). Die Mediastinoskopie (Biopsie nach Carlens), eine neue diagnostische Methode bei Thoraxerkrankungen. *Deutsche medizinische Wochenschrift*, **87**, 2004.
- , Kirsch, M., Specht, G., Thummler, M., and von Windheim K. (1965). Médiastinoscopie et cancer bronchique. *Les Bronches*, **15**, 492.
- Nachbur, B. (1966). Mediastinoskopie und präscalénäre Drüsenbiopsie. *Schweizerische medizinische Wochenschrift*, **96**, 486.
- Nohl, H. C. (1956). An investigation into the lymphatic and vascular spread of carcinoma of the bronchus. *Thorax*, **11**, 172.
- Palva, T. and Viikari, S. (1961). Mediastinoscopy. *Journal of Thoracic and Cardiovascular Surgery*, **42**, 206.
- Pearson, F. G. (1965). Mediastinoscopy. A method of biopsy in the superior mediastinum. *Journal of Thoracic and Cardiovascular Surgery*, **49**, 11.
- (1968). An evaluation of mediastinoscopy in the management of presumably operable bronchial carcinoma. *Journal of Thoracic and Cardiovascular Surgery*, **55**, 617.
- Reynders, H. (1964). Mediastinoscopy in bronchogenic carcinoma. *Diseases of the Chest*, **45**, 606.
- Sarrazin, R. and Voog, R. (1965). Contribution de la médiastinoscopie au diagnostic d'opérabilité des cancers bronchiques. *Annales de Chirurgie Thoracique et Cardiovasculaire*, **4**, 515.
- van den Bergh, O., Dierickx, R., and Buysens, N. (1964). Over de prescalenische biopsie volgens Daniels. *Acta Tuberculosea et Pneumologica Belgica*, **55**, 298.
- van der Schaar, P. J. and Lacquet, L. K. (1965). Notre expérience de la médiastinoscopie. *Annales de Chirurgie Thoracique et Cardiovasculaire*, **4**, 538.
- and van Zanten, M. E. (1965). Experience with mediastinoscopy, *Thorax*, **20**, 211.

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