PNEUMOMEDIASTINOGRAPHY IN CARCINOMA OF THE LUNG

BY

CYRIL ŠIMEČEK AND EMIL HOLUB

From the Department of Pulmonary Diseases and the Surgical Clinic, Palacký University, Olomouc, Czechoslovakia

(RECEIVED FOR PUBLICATION SEPTEMBER 2, 1960)

Carcinoma of the lung tends to metastasize to hilar and mediastinal lymph nodes. This is particularly true of small-cell carcinoma which usually involves the lymphatic glands at an early stage and in a high percentage of cases. The epidermoid type shows less tendency to early and widespread dissemination, even though it is somewhat less unfavourable from the surgical standpoint. Direct extension into the mediastinum or into the thoracic wall must be taken into consideration.

It is almost as difficult to assess operability as it is to diagnose bronchogenic carcinoma. In both cases our conclusion will be more or less probable and largely depend on the proper analysis and synthesis of the results of the different methods of examination. The more evidence and precision diagnostic methods offer, the greater is the possibility of an accurate conclusion.

The two local factors mentioned above, namely, metastatic involvement of the mediastinal lymphatic glands and direct extension into the mediastinum, largely determine the operability of a growth. Despite the serious efforts to detect these changes as early as possible, using accepted methods of investigation, no great success has been achieved. Percussion and auscultation remain indefinite in early cases, and radiography has its limits.

In conventional radiographs and tomograms the mediastinum has the appearance of a homogeneous density with more or less translucent areas due to the trachea and main bronchi. Pathological mediastinal lymph nodes are obscured unless they are enlarged to such an extent as to change the outlines of the mediastinum or the Y-shaped tracheobronchial translucency. The lymph nodes might be visible if their ability to absorb x-rays differed from the rest of the mediastinum; but this is rarely the case.

There is one means of investigation that we consider the most effective of the ancillary diagnostic methods. It provides information

about the local status in the mediastinal area, and, at the same time, enables us, in the majority of cases, to assess the operability of the patient. The method is diagnostic pneumomediastinography. This allows us to observe the details of mediastinal structures and some pathological changes. No patient who has suspected or established bronchial carcinoma should be denied the opportunity to benefit from its use. The first of the two methods developed by Condorelli (1936), retrosternal insufflation of gases, has been abandoned nowadays because of the possible danger of air embolism. Attention has recently been paid to the paravertebral method (Paolucci di Valmaggiore and Giacobini, 1951; Říha and Šimeček, 1956) and to Condorelli's transtracheal approach (1951), which was used recently by many specialists. But evidence is accumulating that suggests that pertracheal insufflation, performed during bronchoscopy, is a better technique (Pěgřim, Říha, and Šimeček, 1956; Šimeček, 1956). During the last six years we have used this method in more than 500 patients who had different pathological conditions of the mediastinum. Pertracheal diagnostic pneumomediastinography as used by us was found to be without discomfort for the patient; it was a reasonably safe procedure even when done in the out-patient department. It has proved to be especially useful in those patients who have bronchogenic carcinoma and in whom exploration of the chest has been planned.

PERSONAL OBSERVATIONS

In order to assess the importance of pneumomediastinography in carcinoma of the lung, we decided to review the results in 150 patients. The diagnosis was confirmed in all cases either histologically or by an identification of tumour cells in the material obtained when aspiration biopsy was carried out.

Epidermoid carcinoma was diagnosed in 74 patients, the small-cell type in 49 patients. In 22 the carcinomatous growth could not be properly

TABLE I
PNEUMOMEDIASTINOGRAMS IN 150 PATIENTS WITH BRONCHIAL CARCINOMA

Type of Growth	No. of Cases	Patients Without Pathological Changes in Mediastinum	"Simple Hyperplasia" of Lymph Nodes	Metastatic Enlargement of Mediastinal Lymph Nodes	Metastatic Enlargement of Hilar Lymph Nodes	Direct Invasion of Mediastinal Structures	Pathological Changes in Mediastinum not Visualized in Pneumomediastinograms
Epidermoid carcinoma	74	25	10	36	21	30	8
Small-cell " " "	49	4	2	41	40	29	3
Large-cell " " "	2			1	1	1	
Adenocarcinoma " " "	3	2	1				
Unclassified carcinoma	22	6		15	8	13	
Total " "	150	37	13	93	70	73	11

classified histologically; this was due to the fact that in these patients biopsy was not performed for various reasons. In cases not operated on the material obtained by aspiration biopsy was found to be sufficient for the diagnosis of cancer but not for a precise classification of cell type. The striking predominance of epidermoid carcinoma in our series is due to the fact that pneumomediastinography was not performed in patients in whom the metastatic involvement was gross and obvious from the plain radiographs or from the tomograms.

The analyses of the pathological changes in our pneumomediastinograms are listed in Table I. In the third column, the enlarged lymph nodes due to reactive hyperplasia have been presented separately, for it is clear that even in the absence of malignant cells in aspiration biopsy micro-metastatic involvement of glands cannot be reliably excluded. We found carcinomatous cells in aspiration biopsy obtained from bifurcation lymph nodes in two patients who did not show lymph node enlargement in the pneumomediastinograms. We have not included these two patients under the heading of enlarged lymph nodes. The figures in Table I in columns 2 and 3 represent the findings on the pneumomediastinograms only and do not always correspond with metastatic involvement of the glands. In eight patients direct extension into the mediastinum did not show in the radiographs and, consequently, could not be recognized before thoracotomy.

Thoracotomy was only performed in 54 patients, so that the objection could be raised that our data are not reliable. This is not the case, for we performed thoracotomy only in patients fit for surgical treatment, i.e., in those in whom the pneumomediastinograms did not reveal evidence indicating that the growth had extended beyond the bounds of operability. In those patients in whom no thoracotomy was performed, the diagnosis of metastatic lymph node enlargement was verified by positive perbronchial aspiration

biopsy. Direct tumorous invasion of mediastinal structures escaped our attention in the eight patients who had epidermoid carcinoma and who have been mentioned in column 7.

The metastatic involvement by epidermoid and small-cell carcinoma of the individual groups of lymph nodes is presented in Table II. There is,

TABLE II
ENLARGEMENT OF PARTICULAR GROUPS OF LYMPH NODES IN PNEUMOMEDIASTINOGRAMS OF PATIENTS WITH EPIDERMOID AND SMALL-CELL CARCINOMA

Type of Growth	Type of Enlargement	Tracheo-bronchial Glands	Bifurcation Glands	Para-tracheal Glands	Aortal Glands
Epidermoid carcinoma	Metastatic "Simple hyperplasia"	20	17	7	6
	"Simple hyperplasia"	4	5	9	6
Small-cell carcinoma	Metastatic "Simple hyperplasia"	32	25	21	8
	"Simple hyperplasia"		1	6	4

both absolutely and relatively, a striking preponderance of small-cell carcinoma as judged by its dissemination into the lymphatic system. In cases of epidermoid and small-cell carcinoma the enlarged lymph nodes present in a characteristic fashion in the pneumomediastinograms. The former shows mostly outlines similar to those of hyperplasia, whilst in the latter the picture is of tumorous lymphoglandular involvement (Šimeček, 1960).

Direct invasion of carcinoma into the mediastinal structures with simultaneous absence of lymph node enlargement was found in 19 patients. Sixteen of those 19 patients had epidermoid cancer. Three patients had epidermoid lung carcinoma invading the thoracic wall.

DISCUSSION

Diagnostic pneumomediastinography markedly improves our diagnosis of the pathological changes in the mediastinum. This method does not detect all pathological changes. On correlating the pneumomediastinograms with the local findings

during thoracotomy we have found that satisfactory visualization of tumorous lesions in the mediastinum largely depends on their size and location. Some other factors, such as the proper choice of right planes or the amount of subcutaneous or mediastinal fat in the patient, are also of importance.

Demonstration of "enlarged lymph nodes" on the pneumomediastinograms depends to a large extent on the site of the glands. They are best outlined in the upper mediastinum, especially on the right side. A less favourable situation is the bifurcation. In addition to the possibility of evaluating the size of different enlarged lymph nodes, the radiological characteristic of the glands has allowed us an approximate differentiation between metastatic glandular enlargement and lymph node hyperplasia or enlargement due to systemic diseases (Šimeček, 1959, 1960).

Pneumomediastinography has other advantages. The correct localization of the tumour has allowed us to obtain material by pertracheal aspiration biopsy. Such cytological material is as a rule diagnostic, and usually sufficient for the assessment of the type of cancer concerned.

The data listed in Tables I and II stand in support of the fact that oat-cell carcinoma spreads early, and in a high percentage of cases, into hilar and mediastinal glands; while epidermoid carcinoma tends to invade the mediastinal structures or the thoracic wall directly. We assume that, in epidermoid cancer, proper radiological investigations and experience in the interpretation of the films are of the utmost importance. Malignant cells were also found in microscopically intact lymph glands, and one-third of aspiration biopsies obtained from bifurcation lymph nodes in carcinomatous patients were microscopically positive; subsequently it has been thought reasonable to perform perbronchial aspiration biopsies routinely in all patients in whom the diagnosis of cancer is not entirely clear or when there is some doubt as to whether the patient would be suitable for radical surgery. Cytology effectively completes pneumomediastinography, and thus these methods represent basic pillars for establishing therapy. As these methods can be used in out-patient departments without discomfort or risk to the patient, it is suggested that they be introduced as an integral part of diagnosis.

CONCLUSIONS

We submit that diagnostic pneumomediastinography is indicated in patients who suffer from bronchogenic carcinoma and in whom radical

surgery is contemplated. In addition to its importance in regard to the prognosis of malignant disease it has a diagnostic value in that it may define the cause of obscure lymph node enlargement. As the absence of enlarged lymph nodes in the pneumomediastinograms does not exclude the possibility of their presence (though these cases are relatively rare), it is also useful from the standpoint of cytology. Pneumomediastinography and aspiration biopsy from bifurcation glands taken together often produce important evidence in patients who appear to have no abnormality in the mediastinum.

Direct invasion of carcinoma into the mediastinal structures may be easily overlooked on radiographs. Therefore it is wise, especially in epidermoid carcinoma, to use a sufficient number of films taken in the proper planes and projections.

Lymph node enlargement in itself does not mean inoperability. A contraindication to radical surgery on the basis of pneumomediastinography may be established only where the typical outlines of large metastatic lymph nodes can be seen: that means in the presence of a number of large nodes that merge into clusters and do not separate from the great vessels or from the tracheobronchial tree; and a reduced translucency of the mediastinum in the neighbourhood of a cancerous growth or of enlarged glands. If the radiographic evidence obtained indicates tumorous invasion in the mediastinal structures, this is tantamount to inoperability. In direct tumorous invasion, the local findings at thoracotomy have shown us that the lesion is more advanced than could be assumed from the radiographs.

From the foregoing it is concluded that pertracheal pneumomediastinography is a simple, easy, and helpful diagnostic method that should be used where radical surgical treatment is contemplated in cases of suspected or clinically clear bronchogenic carcinoma. This method causes no discomfort to the patient, and, because of its safety, it can be carried out in out-patient departments. Its positive value in the diagnosis and prognosis of lung cancer places it among the most useful of clinical aids in handling carcinomatous patients.

REFERENCES

- Condorelli, L. (1936). *Minerva med. (Torino)*, **27**, 81.
- Paolucci di Valmaggiore, R., and Giacobini, E. (1951). *Presse méd.*, **59**, 1222.
- Pěgřim, R., Řiha, V., and Šimeček, C. (1956). *Poumon*, **12**, 765.
- Řiha, V., and Šimeček, C. (1956). *Rozhl. Chir.*, **35**, 401.
- Šimeček, C. (1956). *Acta Univ. Palackianae Olomouensis*, **11**, 199.
- (1959). *Rozhl. Tuberk.*, **19**, 642.
- (1960). *Ibid.*, **20**, 589.