

# MALIGNANT OCCLUSION OF THE PULMONARY ARTERY IN BRONCHIAL CARCINOMA

## PRE-OPERATIVE DIAGNOSIS BY BRONCHOSPIROMETRY

BY

J. G. STEVENSON AND J. M. REID

*From the Thoracic Unit, Mearns Kirk Hospital, Renfrewshire*

(RECEIVED FOR PUBLICATION SEPTEMBER 2, 1957)

In 1932 Jacobaeus, Frenckner, and Björkman first described the technique of bronchospirometry as a practicable investigation of respiratory function in man. Its use was neglected in this country until comparatively recently, Donald (1952) being one of the first to stress its importance. Fleming and West (1954) reported the first large series of cases subjected to bronchospirometry in Great Britain, and found no serious sequelae from this examination.

Since January, 1955, until the present time (July, 1957) nearly 500 bronchospirometric examinations have been carried out in the Thoracic Unit at Mearns Kirk Hospital as a measure of the respiratory fitness of patients for thoracic surgery. Such assessment was considered to be of particular importance in lung cancer, and during the last 18 months over 100 patients suffering from this disease were examined. From those routine procedures a wealth of information concerning differential lung function has been gathered, but the purpose of the present paper is to describe a particular facet of the results not previously mentioned in the literature. In three patients, despite an adequate ventilation and vital capacity on the affected side, oxygen was not taken up. At operation the pulmonary artery was found to be occluded by malignant involvement in each instance. In Case 3, with an established awareness of the implications, confirmatory angiocardiology was performed.

### CASE REPORTS

CASE 1.—A woman, aged 47 years, was admitted to Mearns Kirk Hospital on July 24, 1956, with symptoms which dated from an attack of pneumonia one month previously. Loss of weight, productive cough, and left-sided chest pain were present. A radiograph

showed a left hilar mass with partial atelectasis of the left upper lobe. The only abnormality seen at bronchoscopy was in the left upper lobe bronchus, the superior wall of which appeared to be pushed down by external glandular pressure. Lung function tests revealed a combined vital capacity of 1,800 ml., with an M.V.C. of 45 l./min. Oxygen was not taken up by the left lung, although it contributed 20% of tidal air (50 ml.) and 36% of the total vital capacity (650 ml.).

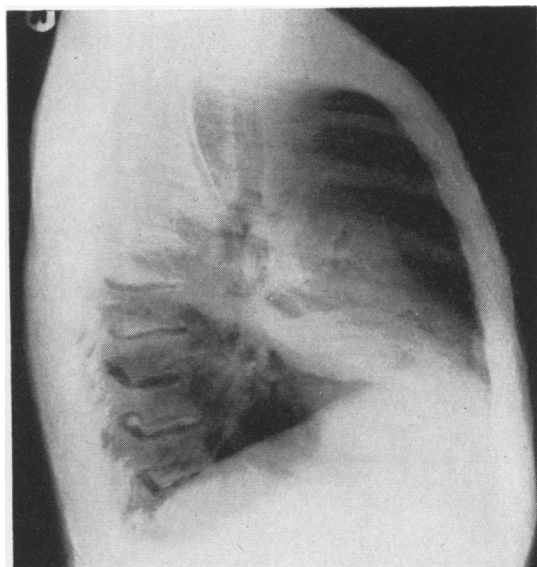
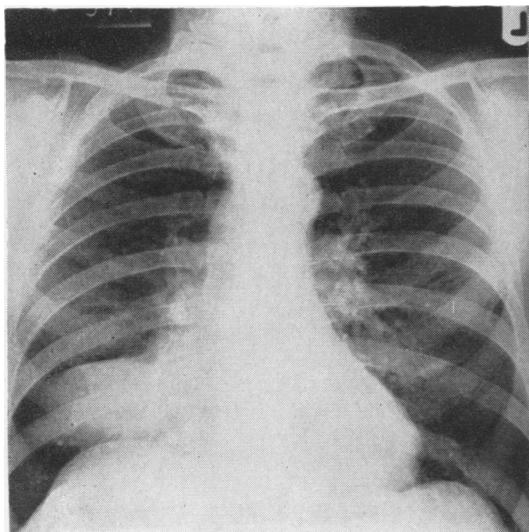
Thoracotomy was undertaken on August 10, and the left hilum was observed to be blocked with tumour and invaded lymphatic glands. The left main pulmonary artery was compressed from without by mediastinal and hilar glands, and there was little or no blood flowing through the vessel. A radical intrapericardial pneumonectomy was effected.

Post-operatively her course was smooth from a cardio-respiratory point of view, but she developed a prerenal azotaemia due to dehydration, necessitating intravenous therapy. She was discharged home on August 31 in a reasonably good general condition. Histopathology of the growth revealed it to be anaplastic in type.

CASE 2.—A man, aged 42 years, who had a history of left-sided chest pain of about six months' duration was admitted to the Thoracic Unit on January 4, 1957. A chest radiograph demonstrated a left hilar mass. Bronchoscopy showed that the left upper lobe orifice was occluded by external pressure. Lung function tests were carried out, and the combined vital capacity was 2,250 ml., the M.V.C. 49.5 l./min. The left lung failed to absorb oxygen; but it contributed 31% of the total vital capacity (700 ml.) and 54% of the combined ventilation (350 ml.).

Thoracotomy was carried out on January 28 and a huge tumour mass was found at the hilum anteriorly, and invading the left main pulmonary artery. Pneumonectomy was performed successfully.

His post-operative course was completely uneventful, and he was discharged home on February 23.



FIGS. 1 and 2.—Radiographs of Case 3 showing consolidation in the right middle lobe with associated hilar adenopathy.

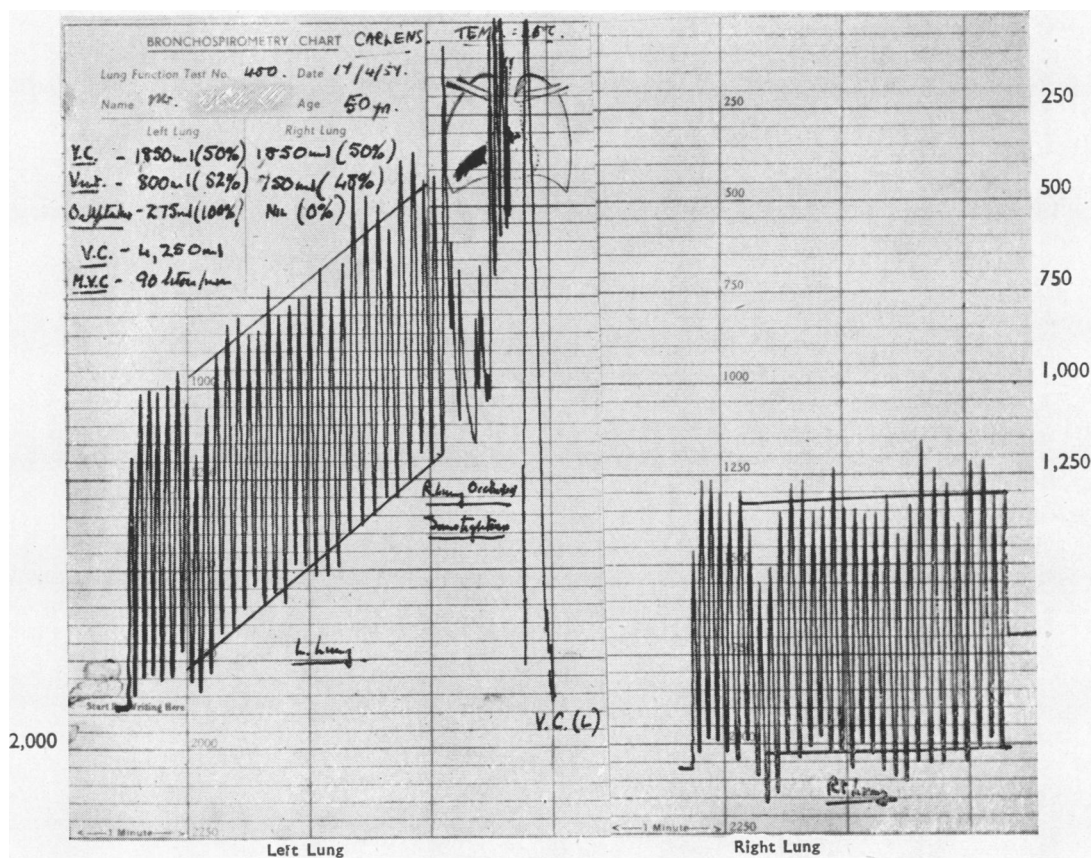


FIG. 3.—Bronchspirometric tracings.



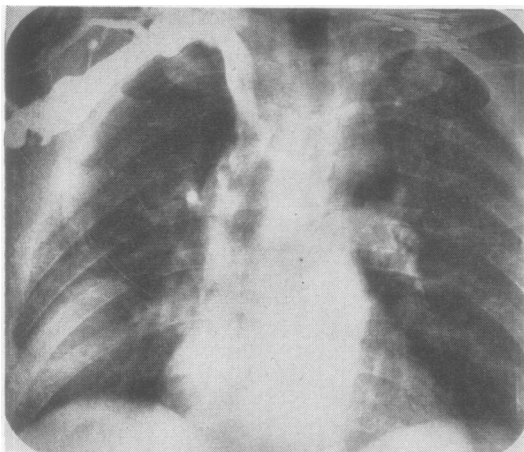


FIG. 4.—Angiocardiograph of Case 3 showing absence of pulmonary artery filling in the right lung.

CASE 3.—A man, aged 50 years, was admitted to Mearns Kirk Hospital on April 12, 1957. Twelve weeks previously he had developed right-sided chest pain with productive cough, and this, in association with a loss of 2 stones in weight during the previous two months, led to his being radiographed. This showed a consolidative process in the right middle lobe with associated hilar adenopathy (Figs. 1 and 2). At bronchoscopy the only abnormality found was a pouted middle lobe orifice, from which a generous biopsy was taken. Histopathology of this specimen confirmed the diagnosis of bronchial carcinoma, epidermoid in type.

Lung function tests revealed a combined vital capacity of 4,250 ml., M.V.C. 90 l./min., and the right lung absorbing no oxygen at all. The right lung still contributed 50% of the total vital capacity (1,850 ml.) and 48% of the ventilation (750 ml.) (Fig. 3).

Awareness now of the underlying condition from the previous two cases prompted angiocardiography. This demonstrated the absence of pulmonary artery filling in the right lung (Fig. 4).

On May 23 thoracotomy was performed. The middle lobe tumour was dwarfed into insignificance by the massive lymphatic invasion, which involved the subcarinal area and the paratracheal zone up to the root of the neck. An attempt was made to deal with the situation, and glands were cleared and a pneumonectomy performed. A considerable mass of tumour, however, was left on the invaded posterior pericardium running over the posterior surface of the main pulmonary artery. Fig. 5 shows the hilar aspect of the right lung with the pulmonary artery lumen reduced to a vertical slit due to encircling tumour tissue. Histological examination of a section of the pul-

monary artery demonstrated involvement of the external arterial coat, but no extension to the intima.

The patient's condition after operation remained very poor and the course was inexorably downhill till his death on May 25.

## DISCUSSION

The noteworthy point about the three cases reported here is that there was nothing to indicate either clinically or radiologically absence of pulmonary circulation in the affected lung. But in all three cases the lack of pulmonary blood flow diagnosed at bronchspirometry was confirmed by operative findings. In addition angiocardiography was confirmatory in Case 3.

The incidence of pulmonary artery involvement in bronchial carcinoma is extremely difficult to assess, as few reports on this aspect are available. Abbey Smith (1957), in a review of 147 cases of lung cancer subjected to thoracotomy, found no instance of involvement of the right pulmonary artery in right-sided growths, but mentioned the vulnerability of the left pulmonary artery to such obstruction. In his series and in the three cases quoted here, invasion of the pulmonary artery by growth did not preclude successful removal of the lung, though in Case 3 the tumour was in retrospect virtually inoperable.

In Case 3, too, we found angiocardiography useful in confirming the absence of pulmonary blood flow. Slessor, Britt, and Freer (1954) have already described the use of dye injection to outline obstruction of the superior vena cava and pulmonary artery by malignant glands in lung cancer. In 31 patients on whom this procedure was conducted, eight showed deformity of the main pulmonary artery and these cases were found to be inoperable at thoracotomy. Smart and Pattinson (1956) utilized both angiocardiography and bronchspirometry to demonstrate a congenitally absent pulmonary artery. In their case lack of oxygen absorption in the bronchspirometric tracing gave them a valuable pointer.

## SUMMARY AND CONCLUSIONS

Three cases of bronchial carcinoma with absent pulmonary circulation on the affected side, diagnosed by bronchspirometry and confirmed at operation, are described. There are no previous references to this finding.



FIG. 5.—Specimen from Case 3 showing hilar aspect of the right lung.

The authors wish to express their thanks to Mr. R. S. Barclay, thoracic surgeon, in whose wards the patients were treated. They also acknowledge the assistance afforded by Mr. R. S. Barclay and Mr. T. M. Welsh, who operated on the three patients.

#### REFERENCES

- Donald, K. W. (1952). *Postgrad. med. J.*, **23**, 171.  
 Fleming, H. A., and West, L. R. (1954). *Thorax*, **9**, 273.  
 Jacobaeus, H. C., Frenckner, P., and Björkman, S. (1932). *Acta med. scand.*, **79**, 174.  
 Slessor, B. V., Britt, R. G., and Freer, J. L. (1954). *Thorax*, **9**, 91.  
 Smart, J., and Pattinson, J. N. (1956). *Brit. med. J.*, **1**, 491.  
 Smith, R. Abbey (1957). *Thorax*, **12**, 79.