INTRATHORACIC NEOPLASMS

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Primary neoplasms within the thorax fall into two main groups; those arising in the broncho-pulmonary system, which express themselves by the typical respiratory symptoms of cough, sputum and hæmoptysis; and mediastinal neoplasms, a heterogeneous group, which sooner or later draw attention to themselves by pressure on nerves or obstruction of veins, trachea or œsophagus.

Broncho-Pulmonary Neoplasms.

The growth usually starts in one of the larger bronchi. The outstanding symptoms are cough and hæmoptysis and the physical signs are due to bronchial obstruction. Practically speaking, all this group are carcinomas, but recently bronchial adenomas have been recognized as a group which were previously often classified as malignant. Other innocent tumours such as fibromas, chondromas and papillomas have been reported.

Bronchial Carcinomas are definitely on the increase; although some authorities still believe that this is only apparent owing to improved diagnostic methods, it is difficult to maintain this view when the post-mortem records also indicate an increase.

Our understanding of the gross pathology of these tumours is derived from the study of post-mortem material, when the condition has advanced to kill the patient; but by the use of X-rays, bronchoscopy, and exploratory thoracotomy, we are beginning to get a conception of the pathology in the living, which is an essential preliminary to treatment. The following types, arranged in order of frequency, may be recognized in the gross specimens and often during life.

I. A tumour arising in a primary or secondary bronchus which it sooner or later obstructs causing collapse and subsequent infection in the lung distal to it. The growth spreads inwards to the mediastinum and outwards into the lung substance. The invasion of the lung is along the peri-bronchial lymphatics and the advancing edge of the tumour may be seen to be more or less sharply defined, or appear as white streaks radiating outwards.

II. A tumour arising in one of the large bronchi and spreading to the mediastinum only, where with the glands it forms a massive tumour surrounding and compressing the trachea, bronchi and vessels and invading the heart wall. The so-called "mediastinal sarcomas" either belong to this group or are lympho-sarcomas.

III. A tumour arising in a tertiary bronchus and spreading outwards to invade the corresponding area of lung and producing a rounded massive tumour, often with central necrosis. Rabin and Neuhoff⁽¹⁾ have drawn attention to this group and called them the "peripheral" type because they spread outwards; they even invade the chest wall while the glands in the mediastinum remain free.

IV. A rounded tumour in the lung substance and not attached to the hilum—parenchymal type. These were called alveolar carcinomas, but they are now regarded as arising from a terminal bronchus. The spread to the mediastinal glands is late.

V. A localised tumour in a bronchus without obvious infiltration of either lung or mediastinum.

Histologically these tumours may be squamous celled, adenocarcinomas or undifferential in type. Barnard⁽²⁾ has pointed out that the so-called "oat celled" tumours are really carcinomas, and Maxwell⁽³⁾ has suggested that they probably arise from the basal cells of the bronchial mucosa. As the result of bronchial inflammation areas of squamous cells, due to metaplasia, may appear in the bronchi and it is from these that the squamous celled carcinomas probably arise. Different histological appearances may be found in different parts of the same tumour and owing to frequent metaplasia the histogenesis of the tumour cannot be predicted from the type of cells.

In the majority the *onset* is insidious, the patient having had a chronic cough for some time; in about a quarter of the cases symptoms follow an acute pulmonary infection, frequently called "influenza"; while in a third group the initial symptoms are not referable to the respiratory system at all but appear as pyrexia of unknown origin, anorexia with loss of weight and pain in abdomen suggesting a carcinoma of the stomach, or they may be those of a secondary tumour in the brain or spinal cord.⁽⁴⁾

The *symptoms* are a distressing cough with only a little frothy sputum, which sooner or later becomes blood-stained. The type of hæmorrhage is rather characteristic, being usually a small amount but persistent. Later, as the tumour begins to occlude the bronchus and infection appears in the lung distal to the obstruction, the sputum then increases in amount and becomes purulent. If the bronchus is completely occluded the symptoms are those of a closed abscess, namely pyrexia and cough with intermittent sputum. Symptoms of pain and loss of weight are present in most cases, but vary considerably in some being very marked and in others almost absent.

The *physical signs* may be completely absent until a late stage in the disease and on this account a diagnosis in the early stages can only be made by the use of accessory methods. Examination should include the pupils for sympathetic paralysis, the neck and axillæ for enlarged lymph glands and the fingers for clubbing. In the chest the signs are those of bronchial obstruction, namely lack of movement, displacement of the mediastinum to the affected side, absent vocal fremitus, dullness on percussion and absent breath sounds. In the case of an upper lobe tumour distant bronchial breathing may be heard over it. When the obstruction of the bronchus is incomplete a high pitched rhonchus may be heard throughout the affected side. When the growth starts in the upper lobe bronchus, it tends to spread into the main bronchus and so obstruct the airway to the lower bronchus as well. An empyema may develop and if suspected the chest should be explored with a needle.

The X-ray appearances of Bronchial Carcinomas will be described in the five types:

(1) There is first a slight increase in one hilum shadow which is followed by bronchial obstruction. In the case of the upper lobe the trachea is displaced to the affected side, the lobe forms a dense wedge shaped opacity with concave lower margin (Fig. 1). A collapsed lower lobe is not so easy to see at first glance, being partly obstructed by the heart, it forms a right-angled triangle the hypotenuse of which runs from the hilum out to the costo-phrenic angle with a concave margin (Fig. 2). When a primary bronchus is obstructed the whole of that side is opaque (Fig. 3). If, however, the bronchus remains patent, radiating lines may be seen spreading out from the hilum.

(2) There is an increase of the whole mediastinal shadow especially in its upper half (Fig. 4).

(3) There is a more or less rounded shadow in one lung field touching the chest wall, and also making contact with the hilum (Fig. 5 and Fig. 14, Plate II).

(4) There is a round shadow in the lung distinct from the hilum (Fig. 6).

(5) There is usually no abnormality seen on X-ray examination.

FIG. 1
Obstruction right upper
lobe bronchus

FIG. 2
Obstruction left lower
lobe bronchus.

FIG. 3
Obstruction left primary
bronchus.

FIG. 4
Mediastinal type.

FIG. 5
Peripheral type.

FIG. 6
Parenchymal type.

Diagrams illustrating some of the different types of Bronchial Carcinoma.

Lipiodol is usefully employed in conjunction with X-rays, as it will demonstrate bronchial irregularity and obstruction. It is particularly useful as a diagnostic method when bronchoscopy is not available.

Bronchoscopy in experienced hands can be performed under local anaesthesia with practically no inconvenience to the patient. Its value as a diagnostic method is beyond dispute as by this means the growth can be seen and a piece taken for microscopy in about 75 per cent. of cases. In addition, bronchoscopy will give valuable information as to the degree of mediastinal involvement. Widening of the carina, peri-bronchial rigidity or deformity is highly suggestive of a neoplasm, and in the case of a growth in the left upper bronchus this may be all the information that one can obtain.

X-ray therapy may have to be used as a diagnostic method in the mediastinal type of carcinomas to distinguish it from Hodgkin's disease or lymphosarcoma, bronchoscopy being impossible in these cases owing to the narrowing of the trachea and rigidity of the bronchi. Rapid shrinkage of the lymphatic tumours under the influence of the X-rays is very characteristic.

Exploratory thoracotomy must be undertaken in the peripheral and parenchymal types after careful exclusion of other conditions.

Differential diagnosis.—The mediastinal type of carcinoma is distinguished from the lymphatic tumour of the mediastinum by the rapid response of the latter to X-ray therapy. The intra-bronchial type of carcinoma can only be distinguished from the innocent type of bronchial tumours by microscopy. When there is a rounded tumour in the lung field it presents the greatest difficulty in diagnosis, as it usually cannot be seen through a bronchoscope. First of all, tumours or swellings of the chest must be considered and excluded by careful screening under the X-ray. Sometimes an artificial pneumothorax will help as the lung drops away from the chest wall, a tumour of the chest wall remains behind. Secondary tumours of the lung will present the greatest difficulty when they are solitary. As hypernephromas are the most frequent, the kidneys must be very carefully examined. Finally, hydatid cysts must be borne in mind, and the dermal test applied.

Treatment will depend on the type of tumour. Broadly speaking, it is only in the three rarer types, localized intra-bronchial, parenchymal and peripheral, that an attempt at curative treatment is justified. Tudor Edwards⁽⁵⁾ has stated that if a neoplasm can be seen through a bronchoscope, then the removal of the growth by operation is impossible, and we feel that there are very few exceptions to this statement.

Bronchoscopic treatment is employed in the following types of cases:

(1) In the localised bronchial tumour, the tumour should be removed by means of forceps. If, however, it is highly vascular, preliminary treatment by inserting radon seeds will facilitate the subsequent removal. Following its removal a radon tube (see below) is inserted for a week.

(2) When a tumour is obstructing, or about to obstruct, a primary bronchus on either side, an attempt should be made to canalise the bronchus and thus maintain an airway to the lower lobe. Although this is only palliative it usually prolongs life and makes it pleasanter for the patient. Tudor Edwards has introduced a special radon tube for this purpose; it is a hollow tube with radon seeds

FIG. 13. Carcinoma right upper lobe obstructing right main bronchus, radon tube in position. (Over-exposed to show tube.)

FIG. 14. Peripheral type of carcinoma; right upper lobe successfully removed by lobectomy.

FIG. 15. Tumour arising in the lymphatic tissues of the mediastinum.

FIG. 16. Mediastinal dermoid.

in its walls, which is wedged tightly into the narrowed bronchus and kept *in situ* for a week. (Fig. 13, Plate II.)

Exploratory thoracotomy should be undertaken in those cases where no tumour can be seen through the bronchoscope, there is no evidence by X-ray examination or bronchoscopy of mediastinal involvement and when no secondaries can be found elsewhere in the body. The *operation* is performed under gas and oxygen anæsthesia, the chest being opened widely by a long inter-costal incision. In the parenchymal type of growth lobectomy may be possible, in the peripheral type lobectomy or pneumonectomy according to the state of the hilum. When invasion of the hilum prevents the possibility of a successful removal the tumour may be treated with radon seeds. These are inserted with J. E. H. Roberts' radon gun which greatly facilitates the rapid introduction of a large number of seeds and assists in their even distribution. Radon seeds are only palliative but the result in some cases has been the prolongation of life for several years.

If an *empyema* or large *pulmonary abscess* is present it should always be drained as the patient's general health will benefit and his life be made pleasanter through causing a diminution of the sputum.

The result of X-ray therapy in bronchial carcinoma is to produce a transient improvement in symptoms, but this line of treatment appears to have practically no effect on the progress of the lesion. It is contra-indicated when the growth is in the lower lobes, when there is suppuration in the lung, when a pleural effusion is present, and when there are obvious secondaries or their presence is suggested by rapid wasting of the patient.

Bronchial Adenomas arise from the mucous membrane of the large bronchi. *Histologically* they are easily mistaken for undifferentiated carcinomas, consisting of small oval or round cells of uniform structure and staining qualities; acini may be present or replaced by solid masses of cells, but there is a well defined basement membrane.⁽⁶⁾ They are usually found in patients under 40 years of age. *Clinically* the outstanding symptoms are large hæmoptyses, often at long intervals, and with all other symptoms conspicuous by their absence. Sometimes, however, bronchiectasis develops in the lung distal to the tumour and the patients have (in addition to the bleeding) symptoms characteristic of this disease. There are no physical signs and X-ray appearances are normal, the diagnosis being made by the bronchoscope. The treatment is the same as for the localized intra-bronchial carcinomas.

Mediastinal Tumours.

This is a heterogeneous group and consists of:

- (1) tumours arising in lymphatic tissue,
- (2) intra-thoracic goitre,
- (3) fibromas and fibroneuromas,
- (4) dermoids.

(1) **Tumours arising from Lymphatic Tissue** of the mediastinum are the tumours of the thymus and lymphosarcomas, but lymphadenoma and leukæmic enlargement of the glands may well be included in this group although not true neoplasms.

The *symptoms* common to this group are a sense of tightness in the chest or a dull persistent pain, shortness of breath or even severe dyspnoea associated with weakness and lassitude; there may also be cough with mucoid expectoration, swelling of the neck, face or arms, and dysphagia.

On examination there is pallor or even cyanosis but rarely is there any wasting. Dilated veins may be noticed in the neck or even extreme venous engorgement and oedema due to obstruction of veins in the superior mediastinum. Enlargement of lymph glands in the neck and axillæ is frequently associated with the disease in the thorax and the removal of one of them for microscopy may settle the diagnosis.

In the thorax there are usually no abnormal signs except that retrosternal dullness may be detected if the tumour is large. *Radiograms* will show a widening of the mediastinal shadow especially in its upper two thirds (Fig. 15, Plate II); in both hila, glands may be seen as rounded opacities (Fig. 7). In lymphadenoma the disease sometimes goes further, breaking through the lymphatic glands and invading the lung and spreading outwards in a fan shaped manner on both sides (Fig. 8).

FIG. 7

Tumour arising in lymphatic tissue of mediastinum.

FIG. 8

Lymphadenoma involving lung.

The response of this group to "Deep X-rays" is one of their characteristics and forms the only method of treatment. Although at first there is rapid disappearance of the tumour, it tends to recur and to become more radio-resistant after each treatment; sooner or later a fatal result ensues in practically all cases.

(2) *Intra-Thoracic Goitre* may be part of a general enlargement of the gland or be solely confined to the thorax. The latter type is usually an adenoma arising from the inferior pole of the gland on one side and enlarging downwards into the thorax. The symptoms, when present, are those of tracheal pressure, namely an audible wheezing sound on breathing, difficulty of breathing with the head in certain positions, and sometimes there are severe attacks of suffocation. In the cases of malignancy there will be the added symptoms and signs of venous obstruction and dysphagia.

Examination in the intrathoracic type of adenoma reveals deviation and rotation of the trachea while the radiogram shows an oval shaped tumour in the root of the neck with the trachea curving round one side of it. In the diffuse type the trachea is not displaced but pushed backwards against the spine and the radiogram shows a symmetrical V-shaped shadow at the root of the neck. The treatment of these cases should always be operative because they tend to increase in size, cause tracheal atrophy and death by suffocation. They can be removed, with very few exceptions, through a collar incision in the neck. The fingers are worked down round the sides of the tumour which is lifted out with the fingers below and delivered to the surface; it is then resected by the usual technique.

(3) **Fibromas and Fibroneuromas** always arise in the posterior mediastinum and most frequently in the upper half of the thorax. They are spherical solid tumours situated outside the pleura and as they enlarge they project forwards into the thoracic cavity. Sometimes a projection is found entering and dilating the inter-vertebral foramen, while an even rarer type is the dumb-bell shaped tumour which has an intra-spinal and intra-thoracic portion.

Clinically they are found in middle aged subjects. Sometimes these tumours attract attention while still small by causing neuralgic pains in the neck, arms or chest; usually they remain symptomless for years until the large size of the tumour in the narrow superior mediastinum embarrasses the patient's respiration and causes him to seek advice. On examination of the chest there are usually no abnormal signs and the diagnosis is made from the X-ray appearances which are characteristic. In the antero-posterior view the tumour is seen projecting from the mediastinum as a circular dense opacity with sharp outline (Fig. 9). In the lateral view it is seen lying posteriorly and is still the same circular opacity as in the anterior view (Fig. 10). If an artificial pneumothorax is induced in these cases the lung will fall away, leaving the tumour attached to the chest wall, which distinguishes it from an intra-pulmonary tumour.

FIG. 9
Fibroma.

FIG. 10
Fibroma.

Treatment.—They should always be removed, because it is the only way to relieve the symptoms, and is a comparatively safe operation in expert hands. In the case of small tumours the chest may be entered behind by resecting part of two ribs over-lying the tumour, but when it is large the best approach is by a long incision through the fifth inter-costal space and spreading of the ribs. The pleura is opened and the tumour with its capsule are carefully dissected out. The capsule is exceedingly vascular and considerable hæmorrhage may occur necessitating a blood transfusion on the table. The chest is closed without drainage. In the case of dumb-bell tumours the intra-spinal portion must be removed by laminectomy at a separate operation.

(4) **Dermoids and Teratomata.** These tumours arise in the middle or anterior mediastinum and, as they enlarge, they project laterally into the pleural cavity. They usually contain fluid and sebaceous material; the inner wall of the cyst is lined with skin and long hair; teeth and other solid structures are sometimes present. They may communicate with a bronchus, become infected or take on malignant changes. *Clinically* they are found in adults, and unless they communicate with a bronchus symptoms are usually absent until the tumour has reached a large size. The patient then develops some shortness of breath and a little pain in the chest. On examination of these patients they are usually healthy, and when the tumour is large there will be an area of impaired percussion note and absent breath sounds over the front of the chest. If there is a bronchial communication hairs may be found in the sputum and are diagnostic of dermoid. The X-ray appearance is characteristic: in the antero-posterior film a circular opacity with sharp outline is seen projecting out from the mediastinum into the lung field (Fig. 11 and Fig. 16, Plate II). It may even be so large as to touch the chest wall on one side and produce a bulge on the mediastinal surface of the opposite side. In the lateral film the circular opacity can be seen situated just behind the sternum (Fig. 12).

FIG. 11

Dermoid.

FIG 12

Dermoid.

The *treatment* is operative: in the case of large tumours, removal in one stage is inadvisable, and it is best at the first stage to marsupialize the cyst and drain it, then (if necessary) at a later date, when the lung has expanded and the cyst shrunk, to remove it. Small cysts should be removed in one stage: the best approach is made by resection of the anterior end of the overlying rib and costal cartilage, if necessary enlarging this opening by dividing cartilages above and below and "spreading" the wound. The wall of the cyst must be excised with extreme care as it is frequently attached to large vessels in the mediastinum.

Pleural Neoplasms. ⁽⁷⁾

These tumours may be diffuse, or localized, the former being four times as frequent as the latter. The *localized* tumours arise from the sub-pleural layers; those on the parietal side are best considered as tumours of the chest wall: those arising on the visceral side are the so-called giant sarcomas; they are, however, pedunculated and do not infiltrate or metastasize. If diagnosed early they can be removed, otherwise they cause death owing to the gigantic size to which they grow. The *diffuse* type are the so-called endotheliomas or mesotheliomas. They arise diffusely throughout the pleural cavity. Clinically the outstanding symptom is severe persistent pain in the chest. On examination they present the signs of a pleural effusion: on aspiration this is found to be blood stained, rapidly re-forms and the patient's symptoms are not relieved. X-ray examination shows a diffuse unilateral opacity and the mediastinum may be shifted to the opposite side. In the two cases I have seen multiple fluid levels were observed in the vertical X-ray picture taken after aspiration. The differential diagnosis is between tuberculosis or bronchial carcinoma. Exploration may sometimes be justified to settle the diagnosis. No form of treatment is of any avail and they usually die quickly.

Conclusion.

Although a general description of intra-thoracic tumours has been given, it is only the bronchial carcinomas that are at all common; they are ten times more frequent than all the rest of the intra-thoracic tumours put together: but only about 10 per cent. of the carcinomas, even if diagnosed early, are amenable to surgical treatment.

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