A British Medical Association Lecture

ON

THE SURGICAL TREATMENT OF INTRATHORACIC NEW GROWTHS*

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(With Special Plate)

Reports from the Continent and from the United States of America now contain a considerable number of cases of both benign and malignant tumours arising within the thoracic cavity. It is probable that the apparent increase in benign neoplasms is entirely due to improved methods of diagnosis, more especially the increased frequency of radiological examination, but there appears to be still some doubt as to whether there has been an absolute increase in the numbers of cases of malignant disease. In the latter, the relative increase is accepted by all observers. The most significant record as regards malignant neoplasms is that produced by Rosahn, who has collected records of a large number of total necropsies from varying sources. In 86,824 post-mortems performed during the period 1910-19, pulmonary carcinomas comprised 0.44 per cent. of all necropsies, and 4.39 per cent. of all cancers; whereas in 50,308 from 1920 to 1928, pulmonary carcinomas comprised 0.89 per cent. of all necropsies, and 6.98 per cent. of all cancers. From these figures Rosahn infers that the (post-mortem) incidence of primary carcinoma of the lung is steadily increasing, and this increase is real and absolute.

The intrathoracic tumours may be divided into three main groups—the pleural, the mediastinal, and the pulmonary—and, from the pathological point of view, these can be subdivided into benign and malignant types.

BENIGN PLEURAL TUMOURS

The great majority of tumours described as pleural arise in tissues adjacent, and, as they increase in size, tend to project into the pleural cavity, being covered by the parietal pleura. In this manner fibroma, lipoma, chondroma, ganglion-neurofibroma, and compound tumours of these types arise in the extrapleural tissues. These tumours are often symptomless until they have reached considerable size. Perhaps the most common symptom is pain, which is quite localized and persistent. Occasionally an irritating cough is present, but is rarely accompanied by expectoration. The physical signs consist of an area of localized dullness on percussion with relative diminution or absence of breath and voice sounds. In some cases there may be evidence of an external tumour of the chest wall, and this is most likely to occur in the chondromas and in the ganglion-neurofibromas. In the latter there may also be evidence of involvement of the sympathetic chain on the same side as shown by eye signs—enophthalmos, etc.—the so-called Horner's syndrome. Effusions are rare in the benign growths.

The diagnosis is confirmed by radiological examination, which will determine the extent of the tumour and will show well-defined outlines. The production of artificial pneumothorax will generally differentiate these tumours from those arising in the lung itself, as in the former case the lung will collapse and retract towards the hilum, leaving the tumour in its former position. Early surgical removal is advisable if the general condition of the patient permits. Naturally, the larger the tumour the more

serious the operative risks, but it is well to remember that benign tumours within the thorax tend to encroach upon vital structures and thereby destroy life, and that many of these tumours are potentially malignant.

MALIGNANT PLEURAL TUMOURS

Primary endothelioma and sarcoma occasionally arise from the pleura, or, again, from the structures immediately adjacent. Endotheliomata may be localized or diffuse, but the latter type is the more common, the growth forming either a large thick plaque fusing lung and pleura, or being spread over the visceral and parietal pleural surfaces, which are generally separated by a pleural effusion. This is serous in the early stages, but is almost invariably haemorrhagic later. In these cases the first symptoms to arise are either localized pain or marked dyspnoea. The former is more common in the localized tumour, and may give rise to suspicions of abdominal disease, owing to the reference of the pain along the intercostal nerves to the abdomen. In the diffuse type, dyspnoea, owing to the large effusions, is often the first evidence of chest disease. Secondary glands in these conditions may sometimes be felt in the supraclavicular area or on the inner wall of the axilla.

Aspiration of the fluid and its replacement by oxygen or air, followed by radiological examination, will then enable one to see the irregular growth on the surface of the pleura. In cases where this cannot be seen, introduction of a thoracoscope under local anaesthesia will enable one to visualize the growth. Sarcoma may arise as a localized mass in the chest wall, involving the pleura. It can only be distinguished from the localized endothelioma by histological examination.

Surgical treatment is only to be considered in the localized types, but, owing to late diagnosis, this is rarely possible. In one patient an endothelioma was localized sufficiently for radical operative treatment, but in this case the involvement of the mediastinal and supraclavicular glands negated operation. In the diffuse form, deep x-ray therapy or the application of a large radium plaque, or a combination of both methods, is the only means of treatment likely to offer any form of alleviation.

BENIGN MEDIASTINAL TUMOURS

Benign tumours in the mediastinum consist of (1) the intrathoracic goitres, and (2) dermoids and teratomas.

In the superior mediastinum the *intrathoracic goitre* is the most common. It may be associated with an enlarged thyroid in the neck, or with an apparently normal thyroid gland in that situation; it may be solid or cystic, and is occasionally calcified. In some cases there may be a history of a goitre in the neck some years before, which has disappeared. These tumours, of course, are distinct from goitres which are sometimes situated in the neck and sometimes displaced into the mediastinum, and which have been termed "plunging" goitres.

The most characteristic symptom is dyspnoea, which may be persistent or intermittent. In two patients submitted to operation for this condition, asthma had been diagnosed and treated for several years. In the larger tumours there is often evidence of interference with the venous return to the heart, resulting in cyanosis of the skin of the head and neck, and considerable dilatation of the veins of the neck and of those overlying the sternum. This appearance often gives rise to suspicions of malignant disease of the mediastinum. Where the goitre is of the toxic type there will be superadded signs of hyperthyroidism. Physical signs consist in the presence of an area of dullness on percussion over the sternum, corresponding in extent to that of the tumour.

Radiological examination will show a well-defined opacity in the superior mediastinum. Lateral skiagrams

* Delivered before the Bath, Bristol, and Somerset Branch, February, 1932.

are of limited value only in this position, but an oblique view will help to localize the site of the mass. Almost invariably there is considerable deviation of the trachea from the normal position to one or other side, but in three cases marked forward deviation of the trachea by a retrotracheal mass has been seen. Screen examination may show movement of the mass upwards on deglutition, a sign which may distinguish this type of growth from other varieties of mediastinal tumour.

Mediastinal thyroids should invariably be removed by surgical operation as soon as they give rise to any symptoms. Haemorrhage into the tumour is quite likely to cause sudden respiratory obstruction, and therefore this danger should be avoided by early operation. The tumours are approached through the usual collar incision in the neck. After careful separation by blunt dissection with the finger from the surrounding tissues, they can be dislocated in the neck. In very large tumours, however, it may not be possible to obtain sufficient room to deliver them through the superior aperture of the thorax, and in such cases splitting of the sternum in the middle line down to the third space, together with a transverse incision outwards, will allow adequate exposure. In eleven cases of intrathoracic goitre, the sternum-splitting extension was necessary on three occasions.

ILLUSTRATIVE CASE I

Man, aged 42, admitted to hospital on May 11th, 1927, complaining of cough and shortness of breath, from which he had suffered for twenty years. A small amount of expectoration was present, with occasional haemoptysis. From January, 1925, to April, 1926, he was in one of the London infirmaries, where a diagnosis was first made of pleurisy, then of a malignant mediastinal tumour thought to be inoperable. He had gained nearly 2 st. in weight between his discharge from the infirmary and his admission to hospital. On examination he had a large mass of dilated veins overlying the upper chest, with congestion and cyanosis of the veins of the neck. The left pupil was larger than the right, but both were active. He had slight ptosis of the right eye, which was said to have been present for ten years.

Radiological examination showed tumour in the superior mediastinum (Figs. 1 and 2 on Plate).

Operation was performed on May 18th, 1927, the sternum being split in the middle line down to the third intercostal space and outwards into the intercostal space on each side. The tumour was carefully freed from the surrounding tissues and removed, the only trouble being a large vein in the posterior part of the capsule, which bled freely. The sternum was sutured with silk.

The subsequent history was uneventful, except that one of the silk sutures became infected, and had to be removed.

Dermoids and Teratomas

These are tumours which rarely cause symptoms due to their mediastinal position, but tend to dissect outwards between the lobes of the lung. They may arise in the anterior or the posterior mediastinum, and in the latter case tend to pass up in close relationship with the superior vena cava on the right or the arch of the aorta on the left. Two groups of symptoms may be encountered in these tumours. In the first group, symptoms are absent until the mass reaches the parietal pleura, whereupon they give rise to pain and dyspnoea similar to that encountered at the onset of an attack of simple pleurisy. The associated physical signs will be dullness on percussion and absence or diminution of breath sounds. In the second group the symptoms are associated with irritation of the bronchus due to the pressure upon, and possibly, later, to rupture of the cyst into the bronchus. Irritation of the bronchus causes a non-productive cough, often with few physical signs. Later, perforation of the bronchus may result and portions of the cyst contents (that is, hair or sebaceous material) be expectorated. Secondary infection of a ruptured cyst

will result in fever and expectoration of offensive purulent sputum. Continued pressure on the bronchi will lead to partial obstruction and the development of secondary bronchiectasis.

Radiological appearances will vary in accordance with the size of the tumour, but in most cases, except those infected, the outline of the tumour is clearly defined, often rounded or oval, while in a certain proportion teeth and bone may show as denser opacities. After pneumothorax, skiagrams will show the tumour buried in the collapsed lung.

The treatment is the same as that in other benign tumours—that is, operative removal. Apart from the results of pressure on bronchi, vessels, and nerves, secondary malignant changes occasionally supervene. In certain instances the diagnosis can only be made by exploratory thoracotomy, and in two cases in which carcinoma was diagnosed previous to operation teratomata have been successfully removed with complete recovery of the patients. These tumours should be explored by transpleural incision, either anteriorly or posteriorly, according to the site of the tumour. Of twelve patients operated upon for these tumours complete recovery followed removal of the tumour in eight. One case showed malignant changes at operation, although it was known that the patient had had a tumour in the mediastinum for several years previous to operation. Judging from examination of the skiagrams, the alteration in this tumour had occurred within the previous few months.

ILLUSTRATIVE CASE II

Girl, aged 19, admitted to hospital on May 27th, 1929, with a history of cough, headache, substernal pain, and shortness of breath, which had been present for two years. There was no expectoration. Examination showed an area of dullness over the right chest posteriorly and anteriorly, with weak breath sounds over the same area.

Radiological examination showed a dense homogeneous opacity at the upper part of the right apex. In the lateral plane the opacity appears to lie posteriorly (Fig. 3). After pneumothorax, the upper border of the opacity was well defined, and the tumour was shown to be extrapulmonary (Fig. 4).

An exploration was carried out posteriorly. At this operation, June 12th, 1929, a posterior incision was made between the fifth and sixth ribs, a very small portion of each being removed. A large, thin-walled cystic tumour was then seen to be lying in the upper post-medial part of the pleural cavity and extending into the posterior mediastinum. The wall of the cyst was completely covered with a network of dilated veins. On account of this the cyst was marsupialized and drained.

At the second operation, September 11th, 1929, the chest was reopened, and it was found that the cyst wall was much less vascular. The whole of the cyst wall was then separated by a careful dissection and removed as a complete sac. Apart from the aspiration of about 10 ounces of blood-stained fluid from the pleural cavity three days later, convalescence was steady. On November 12th, 1929, an excision of the wound edges was performed, and two little pockets, apparently lined with smooth membrane, were dissected free, and a third, which was in close contact with the vessels, was swabbed with pure carbolic in order to destroy the lining membrane. Drainage was carried out, and after several months healing took place. The patient is now free from symptoms.

MALIGNANT MEDIASTINAL TUMOURS

Lymphosarcoma and lymphadenoma are encountered in the mediastinum. The former disease is much more rapid in onset and growth and in development of symptoms. In both conditions enlarged glands are often found in the neck and axillae. In the case of lymphadenoma, enlargement of the spleen and occurrence of Pel-Ebstein temperature crises may serve as diagnostic factors. Enlarged glands, when present, should be removed for histological examination. Operation on these cases is rarely possible

or advisable, and in only one case has it been possible to remove a large mass in this situation. This subsequently proved to be a primary lymphadenoma of the thymus, and the patient died fourteen months later from generalized lymphadenomatosis. In these cases, both lymphadenoma and lymphosarcoma, deep x-ray therapy appears to be definitely indicated, and in many cases the mass completely disappears following this treatment. In many recurrence takes place, and appears to be much more resistant to the action of the rays than does the original tumour.

BENIGN PULMONARY TUMOURS

These are relatively very rare, and it is probable that tumours described as chondroma and osteoma of the lung are really teratomata which have arisen in the mediastinum and subsequently insinuated themselves between the lobes, becoming firmly adherent to the lung tissue. One or two cases of fibroma, arising in the bronchi, have also been described. Hydatid cysts are relatively common in the lung in certain countries, and surgeons in Australia and the South American States have recorded considerable numbers. These cysts are either single or multiple, and may be completely silent as regards symptoms or signs. Patients with hydatid disease run the risk of rupture of the cysts into the pleura when they are peripheral, or into the bronchi when they are central. In the former case, there is a very acute local and general reaction, whereas in the latter the sudden flooding of the bronchi by the cyst fluid may result in drowning of the patient. If the immediate rupture is survived the cyst tends to become infected, and gives rise to signs similar to pulmonary abscess.

Radiological examinations show a characteristic appearance—a rounded or oval shadow, with practically no reaction in the form of consolidation in the surrounding lung. The diagnosis can be confirmed by the cutaneous and complement-fixation reactions.

The peripheral cysts should be removed, and this can be done in one or two stages. If done in one stage the surrounding lung should be marsupialized to the chest wall before the cyst is opened and removed. Where the cysts are central, unless complications supervene, operations are contraindicated.

MALIGNANT PULMONARY TUMOURS

Primary carcinoma may originate in the large bronchi, the bronchioles, or the alveoli. It is most commonly encountered in the larger tubes, the primary bronchi, and these neoplasms are mainly of two histological types—squamous-celled, and cuboidal acinar type. The former probably arise as a result of metaplasia of the lining cells, and the latter often show mucoid changes, suggesting their origin from the mucus-forming cells of the mucosa. The more peripheral carcinomas are commonly squamous-celled, but, rarely, endotheliomata appear to arise in the lung, possibly from cells lining the small vessels or lymphatics. Lung carcinomas appear to be symptomless, often for considerable periods, but dyspnoea seems to be one of the earliest and most predominant symptoms. In other cases, a small haemoptysis may be the earliest sign, to be followed by a febrile attack often diagnosed as influenza. The later symptoms vary. In some patients an effusion develops, in others symptoms of bronchiectasis, such as cough and expectoration. Occasionally pain may predominate in the picture. In those carcinomas arising in the larger bronchi, atelectasis of a portion or a whole lobe may be the cause of such physical signs as are present. The diagnosis may be confirmed by the introduction of lipiodol, which will show an irregular obstruction, partial or complete, in the involved bronchus, in the skiagram subsequently taken. In obstructions of the main bronchi, bronchoscopy, with

removal of a portion of the growth, will make the diagnosis certain. In the more peripheral carcinomata, haemoptysis may be the only evidence of any abnormality in the lung. In other cases a persistent cough may be present.

Radiological examination shows an irregular opacity in the lung without evidence of any surrounding lung reaction, or a fan-shaped shadow, apex at the hilum, corresponding to the atelectatic area. In the more advanced cases enlarged glands may be present in the neck or axillae. These, when present, should be removed under local anaesthesia for histological examination.

Carcinoma arising in the larger bronchi rarely allows of radical extirpation, owing to its position and to the common involvement of mediastinal glands at the time when the condition is diagnosed. Papillomata, showing early malignant changes, have been successfully removed through a bronchoscope. On two occasions it has been possible, following thoracotomy, successfully to remove tumours arising in the larger bronchi. One of these arose in the upper lobe of the left lung, and proved to be a low columnar-celled carcinoma; the other, a squamous-celled carcinoma arising in the main bronchus to the middle lobe of the right lung. (In this patient the middle lobe was removed.) Both patients are completely free of symptoms, one two years, the other thirteen months, after operation.

Carcinoma arising in the alveoli and smaller bronchi offers greater opportunity for radical operation, but these tumours are more rare than the previous type.

The treatment of primary carcinoma by deep x-ray therapy is disappointing, and it is doubtful if even temporary improvements can be obtained. Similarly, radium as a massive application, or in the form of a plaque applied to the surface, has been disappointing. The most encouraging results have been obtained by the use of radon seeds introduced into the growth or in its neighbourhood. In those carcinomas arising in the main bronchi, the seeds have been placed in a special container, and this has been introduced into the affected bronchus through the bronchoscope. It is retained *in situ* for varying periods between five and eight days. By these means complete disappearance of the intrabronchial growth has resulted in several cases, but the ultimate result is yet to be determined, as this method has only been used for about three years.

ILLUSTRATIVE CASE IV

Woman, aged 50, admitted to hospital on September 19th, 1930, with a history of bronchitis in January of the same year, and with cough persisting subsequently. Some pain in the left chest, and one small haemoptysis early in the present year. Some dyspnoea, and 1 st. loss in weight. Examination showed dullness and bronchial breath sounds over the upper two-thirds of the left lung.

Radiological examination showed the right lung to be normal and the left lung to be densely opaque in all zones (Fig. 7). Lipiodol showed almost complete obstruction of the left descending bronchus. Bronchoscopy was performed, and the growth was seen immediately below the bifurcation of the trachea in the left main bronchus. A portion removed for examination showed it to be a squamous-celled carcinoma. On December 3rd, 1930, a radon container was inserted holding eight 1.8 millicurie seeds. This was retained for eight days. The patient was admitted on February 11th for further examination. Bronchoscopy on this date showed the mucous membrane at the site of the previous growth to be smooth and of normal colour, there being no obvious diminution of the lumen, but a small valvular flap located 1 inch below, which was easily dilated with a bougie. X-ray appearances of the patient afterwards are shown in the skiagram (Fig. 8).

Where the growth cannot be seen by the bronchoscope, open exploration of the chest is undertaken, and the radon seeds are inserted into the growth under direct vision. By this means, also, several satisfactory results have been obtained.

ILLUSTRATIVE CASE III

Woman, aged 65, seen on November 19th, 1931, with a history of feeling run down and "poorly" since November, 1930. In August, 1931, she had an attack of bronchitis, associated with pain in left side of chest and shoulder; pain becoming much more severe. Physical examination was negative.

Radiological examination showed a tumour extending outwards from the mediastinum (Fig. 5). The lateral view showed this tumour to be occupying the region of the costo-vertebral groove. Malignant disease was diagnosed, and operation was carried out on November 26th, 1931. A portion of the eighth rib was resected, and the growth was found in the costo-vertebral groove. It was attached to the lung, and had spread out from it. A small portion was excised, and fifteen 1.5 millicurie radon seeds were inserted as evenly as possible throughout the growth. The chest was sutured. The post-operative reaction was slight, and convalescence uninterrupted.

Histological examination of the growth showed that the tumour was a squamous-celled carcinoma. Further x rays showed the growth to have largely disappeared (Fig. 6). Pain has now completely gone, and the general condition of the patient is improved, while there has been a gain in weight.

OTHER MALIGNANT CONDITIONS

Endothelioma appears to arise as a more peripheral growth, and it has been possible on two occasions completely to extirpate the growth by removing the lower lobe. One of these cases is still living and well three years after operation.

Sarcoma is more rare in the lung itself. Only one case has been encountered, and in this the sarcoma was ossified. It was removed, but the patient unfortunately succumbed from pneumonia in the opposite lung nine days later.

Secondary malignant disease will rarely justify operation, as in the majority of cases the secondary deposits in the lung are multiple and bilateral. However, one patient, in whom a partial pneumectomy was performed for a secondary deposit, has survived for four and a half years without further symptoms.

CONCLUSIONS

Modern methods of investigation enable a much earlier and more correct diagnosis of intrathoracic growths to be made, and often assist one to determine the exact nature of these tumours. These methods entail:

1. Careful radiological examination of the chest from the antero-posterior, lateral, and oblique aspects.
2. Further radiological examination after the induction of artificial pneumothorax, or gas replacement of effusions.
3. The delineation, where indicated, of the bronchial tree by lipiodol.
4. The introduction of the thoracoscope into a pneumothorax cavity, where this is possible, for visual examination of the superficial surface of the lung and pleura, and determination of the superficial characters of the tumour—projection into the pleura.
5. Bronchoscopic examination where lipiodol gives evidence of bronchial obstruction, or in cases where haemoptysis is a prominent feature, and in which the sputum is negative for tubercle bacilli after several examinations.

In spite of these methods exact diagnosis will be impossible in certain cases, and it is in these that exploratory thoracotomy should be advised with certain precautions.

The operation is of no greater severity than exploratory laparotomy, and, in fact, the convalescence is often shorter. By this means tumours which were apparently malignant have been proved to be benign, and have been successfully removed, while others, definitely malignant, have been found operable.

The hope of satisfactory treatment of all types of intrathoracic new growths, benign or malignant, depends upon early diagnosis.

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A CASE OF PORENCEPHALIC IMBECILITY

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(With Special Plate)

There recently died in Stoke Park Colony an adult female imbecile, whose case presents some interesting features, apart from the developmental errors revealed in the nervous system at the post-mortem examination.

CASE RECORD

R. B., born in or about the year 1905—exact date unknown—was admitted to this institution on October 26th, 1920. She was certified as a "macrocephalic feeble-minded patient of low mentality, unable to settle down for any length of time to any occupation, and not to be depended upon to do any work properly." The certifying medical man returned her physical condition as "normal," and, as she was a guardians' case of apparently unknown parentage, was unable to furnish any family or social history. The then medical officers of this institution regarded her as a "retrograde imbecile, quiet, well-behaved, dull, apathetic, without any interests." The matron in charge stated that she was small for her age, of pale, unhealthy complexion, with no signs of wasting or paralysis of any of the limbs, and with no deafness or dimness of vision. She was stated to be lively at times, with occasional attacks of bad temper. She had practically no educational attainments, and was only able to do a little simple sewing under supervision.

The patient's health remained generally good until January 27th, 1930, when, during drill in the afternoon, and coincident with a menstrual period, she was suddenly taken ill, and had a fit of twitching and jerking of the face and arms. She was put to bed; whereupon she had a second attack, with loss of consciousness. On examination the same night she was found to have a flaccid paralysis of the right arm and leg. The next day, while still unconscious, the patient was removed to hospital, and apparently recovered consciousness the day after admission. The notes state that six days after admission she was restless, excited, and sometimes incontinent, but was now able to move her right leg, though not her right arm. The urine was loaded with albumin, and continued so throughout the illness. The patient was treated in hospital for chronic nephritis until April, 1931, but as she had been walking with a special boot since January, 1931, she was then returned to the care of her own house matron, but remained under regular medical observation.

In September, 1931—that is, about twenty months after her seizure—she came under the care of the present medical staff of the institution. She was then found to be suffering from advanced renal disease, with a systolic blood pressure of 150, and signs of renal failure. She was therefore readmitted to hospital. The old right hemiplegia was still apparent, and there had been very little improvement in the upper limb. She complained of dimness of vision in the right eye, and examination of the fundi showed that the optic disks were pale and the retinal blood vessels greatly engorged. The urinary output was diminished in amount, and in December the patient had three uraemic convulsions. The general condition became steadily worse, subcutaneous and submucous haemorrhages appeared in the beginning of January, and the patient died on January 21st in uraemic coma. Clinically, therefore, the case appeared to be one of imbecility complicated by chronic nephritis. Post-mortem macroscopic examination seemed to confirm this, as the kidneys were reduced to half their normal size, and showed advanced chronic nephritis. There was also fibrinous pericarditis, and what appeared to be the remains of an old cerebral haemorrhage over the lower half of the central sulcus in, or about, the Sylvian fissure, as well as a cyst-like structure on the left cerebral hemisphere in the vicinity of the parieto-occipital fissure. Subsequent examination showed, however, that the

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FIG. 1.—Case I, *a*: Large mediastinal goitre. Note high diaphragm on right.

FIG. 2.—Case I, *b*: After removal of tumour.

FIG. 3.—Case II, *a*: Mediastinal dermoid cyst.

FIG. 4.—Case II, *b*: The same case after induction of artificial pneumothorax. Note change in position.

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FIG. 5.—Case III, *a*: Intrapulmonary carcinoma.

FIG. 6.—Case III, *b*: Three weeks after introduction of seeds. Note disappearance of growth.

FIG. 7.—Case IV, *a*: Carcinoma of main bronchus. Radon seed container *in situ*.

FIG. 8.—Case IV, *b*: One month later. Note clearing up of lung field