

PRIMARY INTRATHORACIC NEURAL TUMOURS

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Primary intrathoracic neural tumours are the commonest lesion of the posterior mediastinum, and, next to retrosternal goitre, they are the commonest form of mediastinal neoplasm. Most are benign and most are chance radiographic findings. The terminology of these tumours and their clinical features are briefly reviewed, and 30 new cases are reported.

TERMINOLOGY

Each axon cylinder is encased in a sheath of Schwann cells, and the tumour arising from this, the specific nerve sheath, is the Schwannoma or neurilemmoma. Groups of axon cylinders comprising a peripheral nerve are enmeshed in a non-specific sheath of fibrous tissue, and tumours arising from this non-specific nerve sheath are neurofibromata. In some nerve sheath tumours clear histological distinction between a neurilemmoma and a neurofibroma may not be possible, and mixed forms of these tumours are common. Malignant change in either of these tumours will give rise to a sarcoma, a neurosarcoma if the neural origin of the malignant tumour can be verified.

The tumour which arises from a peripheral nerve cell is called a ganglioneuroma, and it is recognizable by its content of ganglion cells. When this tumour undergoes malignant change and ganglion cells are still recognizable it is called a ganglioneuroblastoma. The less differentiated malignant nerve cell tumour is called simply a neuroblastoma. Tumours arising from "potential" nerve tissue are called chromaffin tumours and may be either hormonally active, the phaeochromocytoma, or hormonally inactive, the paraganglioma or chemodectoma (Schlumberger, 1951).

INCIDENCE

Reviews of mediastinal cysts and tumours in the literature rarely include retrosternal goitre, which is generally accepted as the commonest tumour in the mediastinum, but its incidence in comparison with that of neural tumours is difficult

to assess. Excluding retrosternal goitre, benign neural tumours are the commonest mediastinal abnormality, comprising 30–35% of mediastinal cysts and tumours. Malignant neural tumours are very much less common and constitute just over 1% of mediastinal tumours (Ringertz and Lidholm, 1956). Benign neural tumours constitute more than 75% of abnormalities in the posterior mediastinum (Curreri and Gale, 1949), their predilection for the posterior mediastinum being presumably related to the occurrence in this situation of most of the intrathoracic neural tissue, especially ganglia.

The neurofibroma is the commonest variety of intrathoracic neural tumour, and more than 60% of all neural tumours in the chest are of nerve sheath origin, either specific or non-specific (Cruickshank, 1957).

More than 75% of malignant neural tumours present during the first four years of life. The nerve sheath tumours are found most frequently during the third, fourth, and fifth decades, and benign nerve cell tumours are found most commonly in the second and third decades. About 10% of intrathoracic neural tumours collected by a variety of authors have been found to be malignant (Cruickshank, 1957).

Neural tumours in the chest other than in the posterior mediastinum are rare. Cruickshank (1957) found that of 150 anterior mediastinal tumours four were neural, of 31 pulmonary tumours other than bronchial carcinoma three were neural, and of 35 tumours of the diaphragm three were neural. Neural tumours of the anterior chest wall, while rare, are usually malignant (Efskind and Liavaag, 1950).

Intrathoracic neural tumours are found in females more commonly than in males in the ratio M/F:1/1.79. This ratio is reversed in the present series.

CLINICAL FEATURES

More than half the cases reported in the literature are chance radiographic findings in symptomless patients submitted to routine chest

radiography. Malignant neural tumours, allowing for their smaller incidence, are as often chance radiographic findings as are benign tumours.

The commonest symptoms are respiratory, especially dyspnoea and persistent cough (Parish, 1957). Neural tumours have been found during the course of investigation of patients with pleural effusion, empyema, recurrent pneumothorax, and recurrent pneumonia. Parish (1957) records a patient with a neural tumour and hypertrophic pulmonary osteo-arthritis; finger changes of any degree are rare with neural tumours. Neural symptoms are also rare and are not necessarily a manifestation of malignancy. Horner's syndrome, alone or as part of Pancoast's syndrome, has been found with both benign and malignant neural tumours. Intercostal neuralgia is an occasional presenting feature, but again is not indicative of malignancy.

Patients with alimentary symptoms suggestive of peptic ulceration are common. Investigation of these dyspeptic symptoms usually includes a barium meal, and the chest is usually screened as part of this examination. When a neural tumour is discovered during such screening and no radiological abnormality is found to account for the dyspepsia, there would still appear to be no justification for attributing the dyspepsia to the neural tumour, as is frequently done in the literature. Support for this contention is provided by two cases in the present series in which

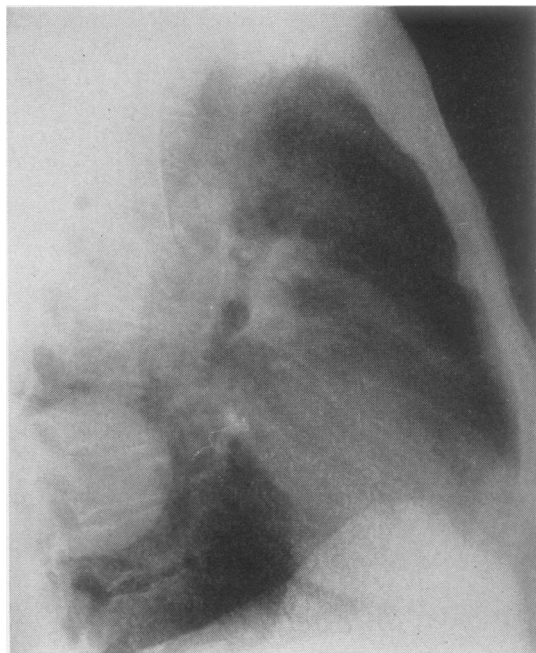


FIG. 2.—The opacity in Fig. 1 is seen to lie posteriorly and to have a straight border where it abuts on the chest wall, giving it a typical D shape.

dyspepsia was not relieved after the neural tumour had been resected.

Intrathoracic neural tumours may be found as one of the manifestations of von Recklinghausen's disease.

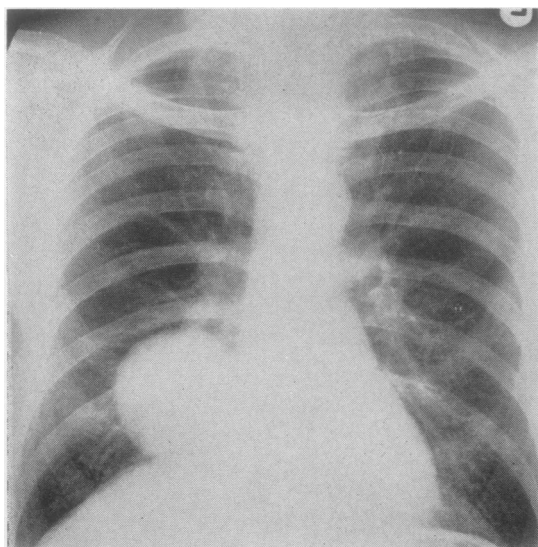


FIG. 1.—A uniformly dense opacity with a hairline outline making an acute angle with the mediastinum which was identified as a neurofibroma.

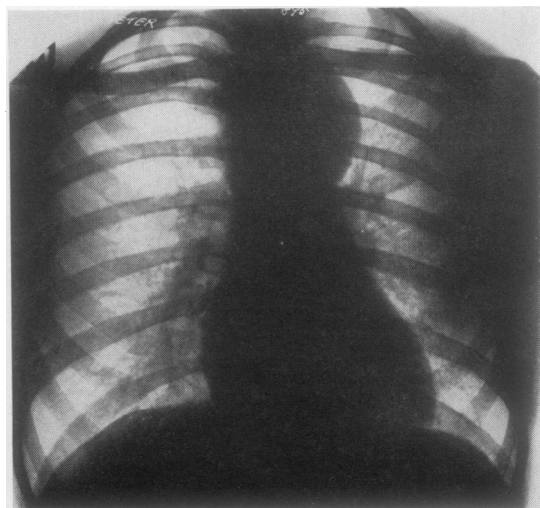


FIG. 3.—The fusiform outline of a chemodectoma is seen in this radiograph.

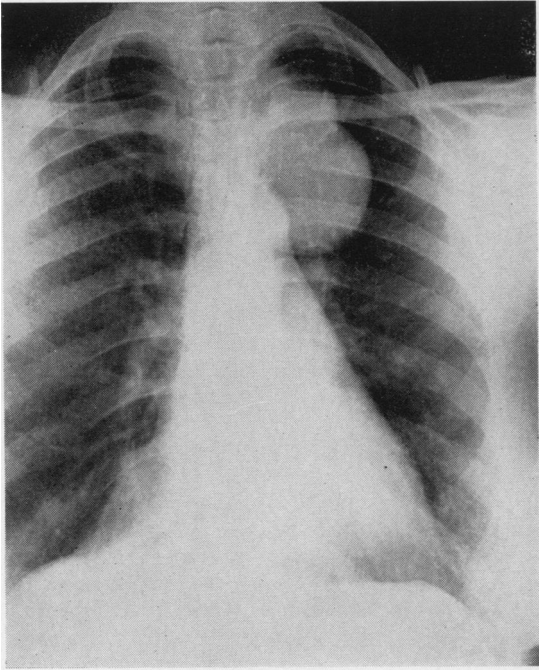


FIG. 4

FIGS. 4 and 5.—This left posterior lobulated mediastinal opacity was a neurilemmoma; rib deformity was recognizable on special views and was confirmed at thoracotomy.

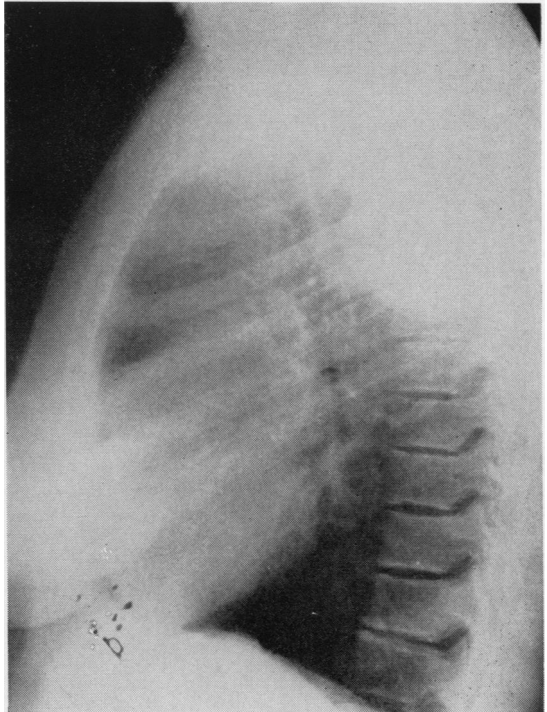


FIG. 5

FIGS. 6 and 7.—Forward displacement of the barium-filled oesophagus is shown; resection of this apical neural tumour was followed by Horner's syndrome and sympathectomy of the left arm.

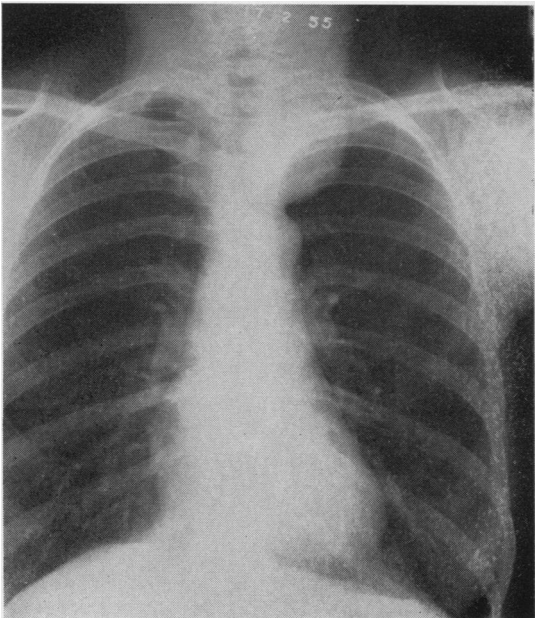


FIG. 6

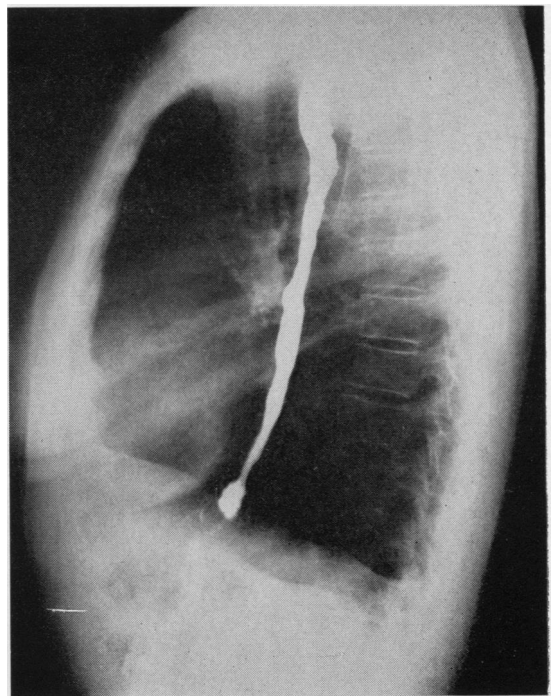


FIG. 7

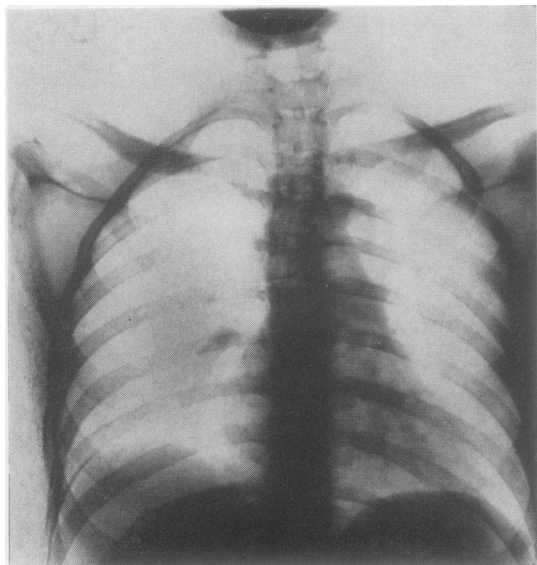


FIG. 8.—Vertebral deformity in relation to a mediastinal neural tumour.

RADIOGRAPHIC FEATURES

The radiographic opacity nearly always lies in the posterior mediastinum; it is of uniform density and its outline is well-defined, indeed hairline in its clarity (Fig. 1). In the lateral view (Fig. 2) the opacity lies against the posterior chest wall, and that aspect of the lesion abutting on the chest wall is flattened, giving the opacity a D shape. Gregg (1957) suggests that when the angle between the tumour and the mediastinum in the postero-anterior view is obtuse the lesion is more likely to be a ganglioneuroma, and when it is acute a neurofibroma is more likely. The rare chromaffin tumours (Fig. 3) have been found to have a markedly fusiform shape (Morrison, 1958). Lobulation of the opacity (Figs. 4 and 5) is common and is not necessarily indicative of malignancy, but irregularity of the outline and loss of hairline definition does suggest malignancy.

Large tumours and those in the pleural dome may be shown to displace the barium-filled oesophagus (Figs. 6 and 7). Rib deformity and rib erosion are common, and are usually manifestations only of pressure and not of malignancy. Vertebral anomalies and deformities (Fig. 8) also occur in relation to benign neural tumours.

TREATMENT

It is customary to resect these tumours whether they are found by chance or present with symptoms for three reasons: The uncertainty of

the diagnosis, the possibility of these tumours being malignant, and the possibility, should they achieve large proportions, of pressure effects and the usurpation of space needed by respiratory tissue. When a neural tumour is found to be malignant and of a less differentiated type, such as neuroblastoma, resection followed by irradiation will probably prolong life. The maturation of metastases from a ganglioneuroblastoma to a benign form has been reported and is believed by some to be encouraged by treatment with vitamin B₁₂.

The experience of neural tumours in the Regional Thoracic Unit in Edinburgh is shown in Tables I and II. All the tumours (30) were resected. Twenty of these were nerve sheath tumours. Of the remainder three were malignant. One of these (Case 29, Fig. 9) was a neuroblastoma in a child who was irradiated post-operatively and who remains well four years later. The second malignant tumour (Case 28) was resected five years before the patient returned with evidence of metastasis, from which she has since died. At the time of resection this tumour was considered to be a ganglioneuroma. The metastasis showed the histological features of a

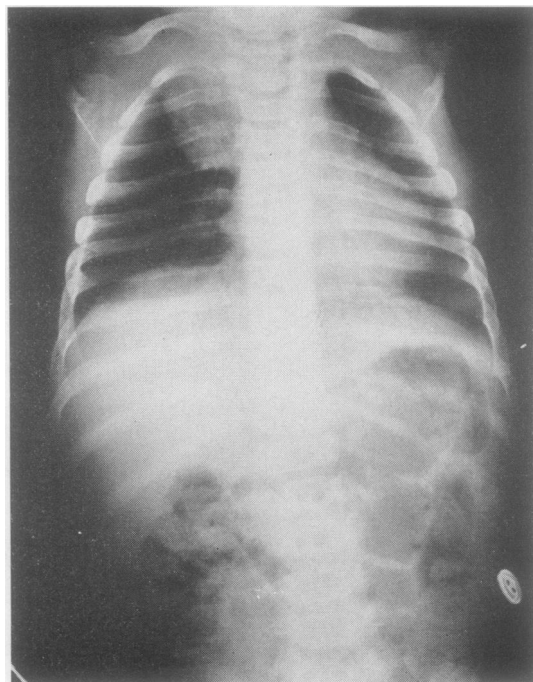


FIG. 9.—A neuroblastoma in the dome of the right pleura producing Pancoast's syndrome; this tumour was incompletely resected and then irradiated, and the child is well four years later.

TABLE I

No.	Sex	Side	Age	Cause of Investigation	Unusual Investigations	Unusual Radiological Features	Date of Resection	Operative Findings	Result
<i>Neurofibroma</i>									
1 (J. H.)	M	R	17	Abnormal mass radiologically	—	—	6.11.49	Pedicated on second intercostal nerve which was divided	Post-operative Horner's syndrome; well in 1958
2 (E. McN.)	F	R	32	„ „	—	—	11.2.53	One very wide intervertebral foramen; one intercostal nerve divided	Well in 1958
3 (E. Y.)	F	R	54	„ „	—	Oesophageal displacement	23.11.55	First and second intercostal nerves divided	„ „ 1959
4 (A. R.)	F	R	56	Left pleural effusion—not related	—	—	31.10.55	Three intercostal nerves divided; C.S.F. leak from ninth intervertebral foramen	„ „ 1960
5 (W. C.)	M	L	52	Pain and cough	—	—	2.5.56	Fourth intercostal nerve divided	„ „ 1959
6 (J. T.)	F	L	63	Dyspnoea	Pneumothorax induced—lung fell away	—	26.10.49	First intercostal nerve divided	Post-operative Horner's syndrome and loss of ulnar sensation; well in 1959
7 (A. H.)	M	R	43	Wheeze	Pneumothorax induced—lung adherent	Deformed third and fourth ribs	10.4.50	Two intercostal nerves divided; part of third and fourth ribs resected	Well in 1960; wheeze unchanged
8 (M. L.)	F	L	31	Abnormal mass radiologically	Also had von Recklinghausen's disease	—	26.12.56	Seventh intercostal nerve divided	Well in 1960
9 (J. J.)	M	R	55	Dyspepsia	—	Eroded ribs; opacity known to be present for five years	7.12.56	Tenth and eleventh intercostal nerves divided	„ „ 1960; dyspepsia unchanged
10 (W. L.)	F	L	52	Abnormal mass radiologically	—	—	11.4.56	Fifth intercostal nerve divided	Well in 1960
11 (E. J.)	F	L	67	„ „	—	Oesophageal displacement	2.4.58	Two intercostal nerves divided	„ „ 1960
12 (C. B.)	F	L	12	„ „	—	—	27.2.50	Fourth and fifth intercostal nerves divided	„ „ 1959
13 (W. M.)	M	R	32	„ „	—	—	26.3.52	Sixth intercostal nerve divided	„ „ 1960
<i>Neurilemmoma</i>									
14 (J. W.)	M	R	42	Pancoast's syndrome	A.P. induced—lung fell away	—	14.12.42	Origin from contribution to brachial plexus from T2	„ „ 1960
15 (M. S.)	F	L	55	Pain	—	Lobulation and rib erosion	23.5.56	Fifth and sixth intercostal nerves divided; one wide intervertebral foramen	„ „ 1960
16 (M. M.)	F	R	25	Abnormal mass radiologically	—	Azygos lobe	12.11.58	One intercostal nerve divided	„ „ 1960
17 (A. M.)	F	R	52	„ „	—	Lobulations	28.4.58	Sixth to ninth intercostal nerves divided	„ „ 1960
<i>Mixed Nerve Sheath Tumours</i>									
18 (T. B.)	M	L	46	Dyspepsia	—	—	17.3.52	Two intercostal nerves divided; small separate tumour	„ „ 1960; dyspepsia unchanged
19 (A. L.)	F	R	27	Abnormal mass radiologically	—	—	17.11.53	One intercostal nerve divided	Well in 1959
20 (J. F.)	M	L	31	„ „	—	Opacity present in 1948	15.11.54	Two intercostal nerves divided	„ „ 1958
<i>Ganglioneuroma</i>									
21 (W. H.)	F	R	31	„ „	—	Rib erosion	6.10.52	Two intercostal nerves and sympathetic chain divided	Post-operative Horner's syndrome; arm sympathetomized; well in 1958
22 (A. H.)	M	R	10	„ „	—	—	23.4.52	Sixth to eighth intercostal nerves and sympathetic chain divided	Well in 1960
23 (J. G.)	F	L	50	„ „	—	Oesophageal displacement	30.3.55	Sympathetic chain divided	Post-operative Horner's syndrome; arm sympathetomized; well in 1959

TABLE I—*contd.*

No.	Sex	Side	Age	Cause of Investigation	Unusual Investigations	Unusual Radiological Features	Date of Resection	Operative Findings	Result
<i>Ganglioneuroma—contd.</i>									
24 (J. W.)	M	R	22	Weak legs	Previous laminectomy for cord compression	—	7.8.58	Widely infiltrating mass (700 g.) of tumour resected	Still well in 1960
25 (R. S.)	M	R	26	Abnormal mass radiologically	—	Rib erosion	1.2.50	Sympathetic chain divided; two wide intervertebral foramina	Well in 1959
26 (M. M.)	F	R	20	„ „	—	—	31.10.49	Sympathetic chain and two intercostal nerves divided	Pulmonary tuberculosis in 1954, well in 1960
<i>Ganglioneuroblastoma</i>									
27 (A. A.)	M	L	1½	Abnormal routine radiograph	—	—	4.7.57	Four intercostal nerves divided	Well in 1960
28 (B. W.)	F	R	15	Abnormal mass radiologically	—	—	3.10.49	One intercostal nerve divided	Cord compression, 1954, died from metastasis in 1958
<i>Neuroblastoma</i>									
29 (M. R.)	F	R	7/12	Pancoast's syndrome	—	Oesophageal displacement	26.6.56	Incomplete excision	Post-operative radiotherapy; well in 1960
<i>Chemodectoma</i>									
30 (P. M.)	M	L	19	Abnormal mass radiologically	—	Rib and vertebral deformity	27.6.49	No nerve divided	Well in 1960

TABLE II
CLINICAL AND HISTOLOGICAL SUMMARY OF 30 CASES

Histology		Sex		Side		Age (Years)	How Discovered		Result
		M.	F.	R.	L.		M.M.R.	Symptoms	
Neurofibroma ..	13	8	5	7	6	12, 17, 31, 32, 32, 43, 52, 52, 54, 55, 56, 63, 67	8	Cough and pain (1) Dyspnoea (1) Wheeze (1) Dyspepsia (1) Pleurisy (1) Pain (1) Pancoast's syndrome (1) Dyspepsia (1)	All well
Neurilemmoma ..	4	3	1	3	1	25, 42, 52, 55	2		
Mixed nerve sheath tumours	3	1	2	1	2	27, 31, 46	2		
Ganglioneuroma ..	6	3	3	5	1	10, 20, 22, 26, 31, 51	5	Cord compression (1)	
Ganglioneuroblastoma	2	1	1	1	1	18 months, 15	2	None	One dead from metastasis
Neuroblastoma ..	1	—	—	1	—	7 months	—	Pancoast's syndrome	
Chemodectoma ..	1	—	1	—	1	19	1	None	Well
Total ..	30	17	13	18	12	7 months to 67 years	20	10	29 well and one dead

ganglioneuroblastoma, and when the original specimen was reviewed it was recognized as malignant. The third patient with a malignant tumour (Case 27) is well, without evidence of metastasis, three years after resection. One of the patients with a nerve cell tumour (Case 24) is believed on histological grounds to have a ganglioneuroma despite macroscopic evidence at thoracotomy of extensive infiltration.

Twenty-nine of the patients are well. The first resection in the series was undertaken in 1942. The other resections were undertaken during the 10-year period 1949–59. An average of two or

three new cases is seen each year in this thoracic unit, which serves a relatively closed population of about 1½ million. The year 1956 was unusual, six new cases being seen, and 1958 was the year of a mass x-ray campaign in Edinburgh from which five cases emerged; perhaps, as a consequence, none presented the following year.

All the patients who were found to have posterior mediastinal opacities during this decade were submitted to thoracotomy. No patient was found at thoracotomy to have a neural tumour when this diagnosis had not been suggested pre-operatively as the most likely cause for the

opacity. No neural tumour was found unexpectedly during thoracotomy for other purposes.

Two patients presented with Pancoast's syndrome—Horner's syndrome, pain in the arm, wasting of the small muscles of the hand, an opacity at the pleural dome, and bone deformity in the vicinity of the lesion found at thoracotomy. With benign tumours the deformity of bone consequent upon pressure is usually recognizably different from that produced by infiltration by malignant tumours. One of these two tumours was benign and the other malignant. In four patients without pre-operative neurological abnormality resection of a neural tumour produced a Horner's syndrome. In addition, in two of these four patients the arm on the side of thoracotomy was found to be sympathetomized, and in a third an ulnar palsy had been induced by resection of the tumour. Weakness of the legs was found post-operatively in one patient, but lasted for only a few days; in this patient three intercostal vessels had been divided. In only two instances (Cases 14 and 30) was resection of the mediastinal neural tumour unaccompanied by division of nerves. As many as four nerves required division, and as many as three intercostal arteries.

The age range, sex incidence, and incidence of the different histological types of tumour are

detailed in Table II. Table I gives details of individual cases.

During the period in which these neural tumours were resected, a man of 48 years, without symptoms, was submitted to left thoracotomy because of a spherical opacity in the apex of the left lower lobe. The opacity had been found at mass radiography. At thoracotomy an obviously benign tumour was shelled out of the lung and was shown histologically to be a neurilemmoma. This is the only neural tumour found other than in the posterior mediastinum during the same period.

SUMMARY

The terminology and clinical and radiographic features of intrathoracic neural tumours are outlined, and a review of 30 new examples of these tumours is presented.

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