Intracranial tuberculoma – an increasing problem in Britain

J. M. ANDERSON AND J. J. MACMILLAN

*From the Midland Centre for Neurosurgery and Neurology,
Holly Lane, Smethwick, West Midlands*

SYNOPSIS Ten cases of intracranial tuberculoma are described. These were investigated and treated at one centre in a 20 year period. The last five cases have occurred in immigrant Asians in the last five years, suggesting an increasing incidence. Diagnostic pointers are discussed and the value of brain scanning emphasized.

Intracranial tuberculomata were formerly commonplace in Britain. Garland and Armitage (1933) found that of all intracranial space occupying lesions coming to necropsy in Leeds between 1910 and 1931 they constituted 34%. The introduction of antituberculous chemotherapy has been responsible for such a dramatic decline in frequency in Britain and Europe that a recent text states 'the incidence has steadily fallen to the extent that Olivecrona is reported by Higazi not to have seen one (a tuberculoma) in the last 20 years and that would be the experience of most neurosurgeons in Western Europe and North America' (Northfield, 1973). Unhappily, this statement is not true elsewhere. In India the incidence varies from region to region, ranging between 20% (Ramamurthi and Varadarajan, 1961) and 30.5% (Dastur and Desai, 1965). In Africa figures are 12.5% for Nigeria (Odeku and Adeboye, 1969) and 19% for Rhodesia (Levy and Axton, 1973), and in South America 15.9% (Asenjo *et al.*, 1951), largely reflecting poor socioeconomic conditions.

Our findings suggest that, although uncommon, intracranial tuberculomata are not as rare in Britain as one might expect. Indeed, if the experience of this neurosurgical centre is extrapolated on a national basis, brain tuberculomata are becoming more common, particularly in the past five years. A recent report by Thrush and Barwick (1974) confirms that our experience is not unique. The statement 'Tuberculosis of the

nervous system has become so uncommon in the United Kingdom that it is rarely the first diagnosis that comes to mind' (Lancet, 1970) is all too true as several were not recognized to be tuberculous before operation. To emphasize this increasing problem and to highlight diagnostic pointers the following cases are presented.

CASE 1

An Irish boy aged 19 years complained of impairment of vision in the temporal field of the left eye three months before admission to the Midland Centre for Neurosurgery and Neurology (M.C.N.N.). Two months later similar symptoms affected the right eye and he would collide with objects on either side which he had not seen. Three years previously tuberculous meningitis had been treated with streptomycin to good effect.

On examination the only abnormality was incomplete bitemporal hemianopia.

Investigation revealed, haemoglobin (Hb) 15.5 g/dl, white cell count (WBC) 5 900 per mm³, and erythrocyte sedimentation rate (ESR) 7 mm in 1 h. Radiography of the chest was normal and of skull showed small specks of calcification above a normal sella. Pneumoencephalography showed partial obliteration of the chiasmatic cistern. Cerebrospinal fluid (CSF) was normal in all respects. Preoperative diagnosis was chiasmatic arachnoiditis and tuberculoma and at craniotomy a small nodular tuberculoma was found approximately 1 cm in diameter adherent to the optic chiasma. As much as possible was removed but its intimate connection with the chiasma and left optic nerve precluded complete removal.

(Accepted 27 August 1974.)

Histology showed granulomatous tissue with tubercle formation but no acid fast bacilli were seen.

Immediately after operation the bitemporal hemianopia became complete but with continued streptomycin therapy it improved until he was discharged three months later with impairment of vision in the upper outer quadrant of the right visual field only, visual acuity being normal.

CASE 2

A 21 year old Irish woman developed left-sided fits nine days after giving birth. She became drowsy and her right pupil dilated, leading to admission to M.C.N.N. There was no significant previous history.

On examination she was conscious but drowsy. There was bilateral papilloedema, left homonymous hemianopia, and the right pupil was dilated and fixed but ocular movements were full. The neck was stiff and she had mild right hemiparesis with a right extensor plantar response.

Investigation showed Hb 12.4 g/dl, WBC 17 100 per mm³, and ESR 104 mm in 1 h. Skull radiographs were normal and a chest radiograph showed a tuberculous cavity at the left apex. A right carotid angiogram indicated a large intrinsic avascular occipital space occupying lesion. Pneumoventriculography confirmed this. At craniotomy an intrinsic firm tumour was removed by occipital lobectomy and was thought, on macroscopic appearance, to be an astrocytoma. Histology showed it to be a tuberculoma with characteristic lymphoid follicles and acid fast bacilli.

Treatment with antituberculous chemotherapy resulted in marked improvement. At follow-up four months later the only abnormal sign was left homonymous hemianopia.

CASE 3

Twelve years before admission a 27 year old Englishman suffered tuberculous meningitis which kept him in hospital for a period of 18 months. On discharge, both legs were slightly weak causing some difficulty with walking.

Eight weeks before admission he developed generalized headache followed two weeks later by interscapular pain induced by movement of the spine and head. His legs became weak followed by weakness of both arms. In the 10 days before admission headache increased accompanied by vomiting, and two grand mal convulsions precipitated referral to M.C.N.N.

On examination he was conscious and orientated. There was neck stiffness and a positive Kernig's sign. Early papilloedema was noted. There was mild bilateral deafness, slight global weakness of both arms,

FIG. 1 Case 3. Pneumoventriculogram showing ventricular dilatation from aqueduct obstruction due to calcified mass.

and marked paraparesis with general increase in tendon reflexes and bilateral extensor plantar responses. Sensation was normal as was general physical examination.

Blood haemoglobin concentration was 15.4 g/dl, WBC 10 800 per mm³ and ESR 7 mm in 1 h. Electroencephalogram (EEG) and chest radiograph were normal. Radiographs of the skull showed calcification in the anterior portion of the posterior fossa on the right. Carotid angiography showed no supratentorial space occupying lesion but there was evidence of hydrocephalus. Pneumoventriculography showed that both lateral and third ventricles were dilated due to aqueduct obstruction by a calcified mass at the posterior pole of the third ventricle to the right of the midline (Fig. 1). The CSF was clear, pressure was raised and constituents were normal.

Torkildsen's shunt was inserted after which headache subsided. After a week power in his legs decreased further and sensation gradually diminished on both sides below the first thoracic segmental level. Myelography showed extensive arachnoiditis below T5 vertebral level where there was complete obstruction to rostral flow. Because of the sensory level, laminectomy of C7 to T1 vertebrae was undertaken, and the only abnormality noted was extensive arachnoidal adhesions. After this there was no improvement in power. Antituberculous chemotherapy was continued throughout.

CASE 4

A Jamaican man aged 39 years was admitted to another hospital because of increasingly severe headache for a month and vomiting, lethargy, and confu-

FIG. 2 Case 4. (a) *Pneumoventriculogram showing right temporal space occupying lesion.* (b) *Same case after antituberculous chemotherapy for 10 weeks.*

sion for a few days. The only abnormal signs were pyrexia and neck stiffness and lumbar CSF contained 500 white cells per mm^3 , 85% of them polymorphs. Pressure was raised and the protein content was 125 mg/dl. Two days later papilloedema became evident and he was transferred to M.C.N.N.

Examination showed gross bilateral papilloedema and neck rigidity. His temperature was 38.3°C (101°F) and enlarged lymph nodes were found in the supraclavicular and inguinal regions.

Investigation of the blood showed haemoglobin 13.4 g/dl, white cell count 10 100 per mm^3 , and ESR 68 mm in 1 h. A right upper mediastinal mass was evident on chest radiography. Skull films were normal. Pneumoventriculography showed a right temporal space occupying lesion (Fig. 2a). Biopsy of a supraclavicular lymph gland showed typical tuberculous caseation.

Tuberculous meningitis with right temporal tuberculoma was diagnosed and treatment continued with antituberculous chemotherapy and he returned to the original hospital. Ten weeks later there were no abnormalities on examination, papilloedema had subsided, and there was no neck stiffness. ESR was now 20 mm in 1 h and a chest radiograph showed resolution of the mediastinal mass. Pneumoventriculography was normal with no

ventricular displacement (Fig. 2b) and CSF showed no abnormality.

CASE 5

A 15 year old Pakistani boy developed sore throat and pyrexia followed by swelling of his neck. One month later vision of his right eye deteriorated and soon after the left eye was similarly involved. He developed diplopia on left lateral gaze and was troubled by dysphagia. He was admitted to M.C.N.N. where examination showed him to be debilitated and pyrexial with cervical lymphadenopathy. The fundi were normal; the right eye was completely blind and a nasal hemianopia was found on the left. There was partial third nerve and complete sixth nerve palsy on the left. Palatal movement was impaired bilaterally. He was grossly dysarthric and dysphonic and his tongue would not move to either side. There was no other abnormality.

Blood haemoglobin was 11.6 g/dl, WBC 10 000/ mm^3 , and ESR 87 mm in 1 h. Radiographs of the chest were normal, while those of the skull showed osteolysis of the sphenoid involving the sella turcica and sphenoidal sinus. The soft tissues of the posterior nasopharynx were judged to be enlarged. These were examined and a biopsy sample

taken. As this was being done, frank pus escaped and was found to contain numerous acid fast bacilli which proved to be tuberculous on culture. Antituberculous chemotherapy was instituted resulting in marked improvement in subsequent months. Two years later the only abnormalities were slight diminution in visual acuity, more marked on the left than on the right, and right hypoglossal palsy.

CASE 6

A 24 year old Indian male was admitted to another hospital for removal of a knee cartilage. He was noted to be pyrexial and had enlarged cervical lymph nodes which proved to be tuberculous on biopsy. Appropriate chemotherapy was given. Four weeks later focal sensory epilepsy affecting the left hand and arm occurred followed in another four weeks by motor epilepsy in a similar distribution, resulting in left hemiparesis involving face, arm and leg which occasioned his admission to M.C.N.N.

He was conscious and alert with moderate left hemiparesis maximal in the arm, with spasticity, hyperreflexia, and extensor plantar response. Joint position sense was impaired on the left. Fundi and visual fields were normal as was general physical examination.

The haemoglobin was 14.7 g/dl, WBC 6 000/mm³, and ESR 31 mm in 1 hr. Right paratracheal gland enlargement and an opacity in the upper lobe of the right lung were evident on chest radiography. X-ray studies of the skull were normal. A right carotid arteriogram revealed an intrinsic avascular space occupying lesion in the parietal area. Since this was likely to be a tuberculoma, craniotomy was

decided against, and antituberculous chemotherapy continued. Eight months later when reviewed his neurological status had improved considerably. Left hemiparesis had entirely resolved but he retained a postural deficit in these limbs and suffered infrequent attacks of left focal sensory epilepsy controlled by anticonvulsants.

CASE 7

A 31 year old Pakistani man developed headache after a 'flu-like' illness four months before admission. This became increasingly severe and localized to the left. One month later vision in the left eye became blurred. Referral to an ophthalmologist resulted in the discovery of papilloedema and he was sent to M.C.N.N. for further investigation. Three years previously he had suffered pulmonary tuberculosis which had responded to appropriate chemotherapy.

The only abnormal findings on examination were left anosmia, bilateral papilloedema more severe on the left, and slight weakness of the right face and arm.

Blood haemoglobin was 15.5 g/dl, WBC 4 000 per mm³ and ESR 9 mm in 1 h. Left frontal delta activity was seen on EEG and a technetium isotope scan showed increased uptake in this region. Radiographs of skull and chest were normal. Left carotid

FIG. 3 Case 8. Right lateral view technetium brain scan showing occipitoparietal uptake.

FIG. 4 Case 8. Right carotid arteriogram showing occipitoparietal avascular space occupying lesion with meningeal supply (arrows).

arteriography demonstrated an avascular, intrinsic frontal space occupying lesion.

At craniotomy a firm avascular tumour adherent to the dura mater and occupying the left frontal pole was completely removed. Histology showed massive central caseation with surrounding tubercle formation, active tubercles within attached dura mater and scanty acid fast bacilli. Antituberculous chemotherapy achieved resolution of the papilloedema and at follow-up eight months later he was symptom free.

CASE 8

A 25 year old Kenyan Indian woman suffered a single non-focal grand mal convulsion immediately after childbirth nine years before admission. Six years later similar attacks recurred with increasing frequency. Investigation at another hospital revealed no focal abnormality and fits continued despite anti-convulsant medication. Increasing bilateral headache and continuing fits led to admission to M.C.N.N. There was no prior history of tuberculosis.

Examination showed bilateral chronic papilloedema, mild left hyperreflexia and no other abnormality. General physical examination was normal.

Blood haemoglobin was 14.0 g/dl, WBC 5 000 per mm³, and ESR 62 mm in 1 h. The blood film was normal. An old calcified tuberculous focus at the left lung base was evident on chest radiography. Radiographs of the skull showed slight erosion of the sellar floor. An EEG showed a focal abnormality in the right hemisphere and an isotope brain scan showed a lesion in right occipitoparietal region (Fig. 3). A right carotid arteriogram showed a large avascular space occupying lesion in that area with enlarged meningeal arteries (Fig. 4). At craniotomy the dura mater was adherent to a white granuloma 6 cm in diameter which had intimate relationship to the sagittal and lateral sinuses. Most of it was removed and the area treated with streptomycin. Antituberculous chemotherapy was given and her convalescence was complicated by jaundice attributed to sodium aminosalicilate (PAS). Subsequent recovery was uneventful.

CASE 9

A Pakistani man aged 39 years complained of occipital headache particularly severe in the morning, associated with vomiting of six weeks' duration. There was no significant previous history. He went into another hospital where examination was quite normal apart from anaemia.

FIG. 5 Case 9. Posteroanterior view technetium brain scan showing abnormal uptake on left side of posterior fossa.

The blood haemoglobin level was 7.7 g/dl, WBC 9 000 per mm³, ESR 52 mm in 1 h and abnormal nucleated cells, possibly metastatic carcinoma, were seen on examination of sternal marrow. At lumbar puncture the CSF was under increased pressure. No cells were seen; protein concentration was 110 mg/dl and chloride and sugar were normal. After this, headache worsened and transfer to M.C.N.N. was arranged.

Examination failed to demonstrate abnormality. Radiographs of the skull showed early sellar erosion and chest films were normal. Technetium isotope scan showed abnormal uptake 6 × 4 × 3 cm in diameter in the left side of the posterior fossa (Fig. 5). A left carotid angiogram indicated enlargement of the lateral ventricle. Vertebral arteriography confirmed a large avascular space occupying lesion in the left cerebellar hemisphere.

Over the several days necessary for the performance of these investigations he developed papilloedema in both eyes and bilateral sixth nerve palsy. Pneumoventriculography confirmed obstructive hydrocephalus and deviation of the aqueduct to the right. Posterior fossa craniotomy was undertaken and a large granular tumour adherent to the dura mater replaced the left cerebellar hemisphere and invaded the lateral recess of the fourth ventricle. Biopsy was taken from the centre of this mass, which was thought to be malignant, and complete removal was not attempted.

Histology of the biopsy specimen showed numerous Langhan's giant cells, epithelioid follicles, central caseation, and tubercle bacilli. Postoperatively no

deficit was noted, antituberculous chemotherapy was given, and he made an uninterrupted recovery.

CASE 10

A 50 year old Indian woman complained of intermittent twitching of the left side of her face for eight weeks before admission culminating in facial weakness. For a similar period headache had been present, more often on the right. For two years she had been troubled by intermittent, involuntary, urinary incontinence without convulsive manifestations. There was no significant previous history.

The only abnormality on examination was mild left facial weakness.

Blood haemoglobin was 13.3 g/dl, WBC 6 000/mm³, and ESR 23 mm in 1 h. Radiographs of skull and chest were normal. An EEG showed right frontal slow wave activity. Technetium isotope brain scan revealed right posterior frontal uptake. An intrinsic avascular right frontal space occupying lesion was demonstrated by carotid angiography.

Craniotomy was undertaken and a hard mass found 3 cm below the surface in the right frontal area. This easily shelled out from surrounding brain. Histology showed a granulomatous mass with central caseation and tubercles around the periphery. Acid fast bacilli were seen.

Postoperatively she had a dense left hemiparesis which improved over the next two weeks but on discharge there was moderate weakness of the arm. Antituberculous chemotherapy was given.

DISCUSSION

The 10 cases described represent the total experience of intracranial tuberculoma diagnosed and treated at one neurosurgical centre in the West Midlands since 1954. The annual number of admissions is in the region of 1,400, so that these comprise a very small proportion of cases investigated and treated. Several points are worthy of emphasis (Table 1).

The frequency of occurrence of this condition is increasing. Of these 10 cases, the first five were seen between 1958 and 1967. The last five have been seen since 1969, one per year for the past five years. It seems likely that this reflects the recent increase in immigration to Great Britain from the Indian subcontinent. Of the 10, in chronological order of presentation, two were Irish, one English, one Jamaican, and the rest

Indian, Pakistani, or Kenyan Indian. Three other patients described recently were of Asian origin (Thrush and Barwick, 1974).

Clinical features are in no way specific. In common with other reports (Dott and Levin, 1939; Sibley and O'Brien, 1956; Arseni, 1958; Ramamurthi and Varadarajan, 1961; Berlin, 1963; Dastur and Desai, 1965), we find that presentation is that of an expanding intracranial lesion the symptomatology of which depends on the site involved. Signs of raised intracranial pressure are common, particularly papilloedema. In seven cases the lesion was supratentorial and in three infratentorial, which accords with other experience, supratentorial tuberculomata being more common in adults, infratentorial in children.

A past history of tuberculosis or evidence of current tuberculosis is common, occurring in about 50% of cases (Ramamurthi and Varadarajan, 1961; Berlin, 1963; Dastur and Desai, 1965). Three of our cases had suffered tuberculosis before; four had evidence of active disease elsewhere in the body and three had neither.

Haematological features also are in no way specific. Sedimentation rate was raised in seven patients, grossly in five, but remained normal in three, so that a normal ESR in no way excludes the diagnosis.

Radiological features deserve further comment. A commonly held tenet that intracranial tuberculomata usually calcify is untrue. Two of our cases showed calcification but this is unusual, quoted figures for large series being 1.4% (Castro and Lepe, 1963), 4.7% (Dastur and Desai, 1965), 5.5% (Arseni, 1958), and 6% (Ramamurthi and Varadarajan, 1961). More common on plain skull films is evidence of raised intracranial pressure. Angiographic abnormalities are no more specific, showing evidence of space occupation, usually avascular. In one of our cases, enlarged meningeal arteries leading to the lesion gave rise to the erroneous diagnosis of meningioma. This may reflect the tendency of tuberculomata to involve overlying meninges. Angiographic similarity to meningioma has been commented on by Ramamurthi and Varadarajan (1961) and Dastur and Desai (1965).

Isotope brain scan has proved a most useful diagnostic aid. Each of the four cases so investigated here had an unequivocally positive scan

TABLE
DETAILS OF CASES

Natio	Age (a)	Sex	Previous tuberculosis	Current tuberculosis	Site of tuberculoma	Clinical features					Radiological features					Provisional diagnosis
						Papilloedema	Epilepsy	Focal limb signs	Cranial palsies	ESR (mm/hr)	Brain scan	Calcification	Raised ICP	Avascular space occupying lesion	Angiogram	
Irish	19	M	Meningitis	—	Optic chiasm	—	—	—	+	7	ND	+	—	—	ND	Tuberculoma
Irish	21	F	—	Lung	Occipital Stem/cerebellum	+	+	+	+	104	ND	+	—	+	—	Astrocytoma
English	27	M	Meningitis	—	—	—	—	—	—	7	ND	+	—	—	Hydrocephalus	Tuberculoma
Jamaican	39	M	—	Lung nodes and Pharynx	Temporal	+	—	—	—	68	ND	—	—	—	ND	Tuberculoma
Pakistani	15	M	—	—	Skull base	—	—	—	+	87	ND	Osteolysis skull base	—	—	ND	Tuberculoma
Indian	24	M	—	Lung nodes	Parietal	—	+	+	—	31	ND	—	—	+	—	Tuberculoma
Pakistani	31	M	Lung	—	Frontal	+	—	+	+	9	+	—	—	+	—	Glioma
Kenyan	25	F	—	—	Parieto-occipital	+	+	+	—	62	+	—	+	+	Meningeal supply	Meningioma
Indian	39	M	—	—	Cerebellum	+	—	—	+	52	+	—	+	+	—	Glioma
Pakistani	50	F	—	—	Frontal	—	—	+	—	23	+	—	—	+	—	Metastasis

ND: Not done.

and this was true of the two cases of Maurice-Williams (1971) and of the two of Thrush and Barwick (1974) submitted to scanning, giving a positive uptake in 100%.

Appearances of tuberculomata at craniotomy are not diagnostic and may mimic other intracranial lesions. Cases 2, 7, and 9 were thought to be gliomas, case 8 a meningioma, and case 10 a metastasis when the skull was opened. In these five cases it was only when frozen sections or subsequent histology became available that the correct diagnosis was made.

Once the correct diagnosis has been reached and anti-tuberculous chemotherapy given, prognosis is excellent. Only case 3 did not derive lasting benefit from treatment and he showed some unusual features. Initial presentation was with raised intracranial pressure from aqueduct obstruction due to a calcified mass, presumed tuberculous because of previous tuberculous meningitis. After a Torkildsen's shunt, raised intracranial pressure was relieved but signs of spinal cord damage developed. Arachnoiditis was found on myelography and at operation. It seems likely that alteration in cerebrospinal fluid dynamics in some way tipped the balance against an already compromised spinal cord. Although failure to make the correct diagnosis pre-operatively led to no adverse features in this series, it is desirable that accurate diagnosis be made since this may render craniotomy unnecessary as in cases 4 and 6. If it is thought likely that a tuberculoma may be found further dissemination of tuberculous infection may be avoided.

A high index of suspicion is a prerequisite to accurate diagnosis. On present evidence, at this neurosurgical centre, the incidence of intracranial tuberculomata is rising, and this is entirely confined to immigrant Asians. We would emphasize that this diagnosis should be considered in any immigrant patient presenting with signs of raised intracranial pressure or focal

neurological deficit, particularly if there is evidence of tuberculous infection, past or present, if the erythrocyte sedimentation rate is raised or if the brain scan is positive.

Thanks are due to Dr E. R. Bickerstaff, Dr I. A. Guest, Mr J. G. Hamilton, and Mr J. M. Small for permission to publish details of cases under their care, to Dr L. Langton for comments on the radiographs, and to Miss Margaret Ledington for typing the manuscript.

REFERENCES

- Arseni, C. (1958). Two hundred and one cases of intracranial tuberculoma treated surgically. *Journal of Neurology, Neurosurgery, and Psychiatry*, **21**, 308–311.
- Asenjo, A., Valladares, H., and Fierro, J. (1951). Tuberculomas of the brain. *Archives of Neurology and Psychiatry (Chic.)*, **65**, 146–160.
- Berlin, L. (1963). Tuberculoma of the brain. *American Journal of Roentgenology, Radium Therapy and Nuclear Medicine*, **90**, 1185–1192.
- Castro, M., and Lepe, A. (1963). Cerebral tuberculoma. *Acta Radiologica. Diagnosis*, **1**, 821–827.
- Dastur, H. M., and Desai, A. D. (1965). A comparative study of brain tuberculomas and gliomas. *Brain*, **88**, 375–396.
- Dott, N. M., and Levin, E. (1939). Intracranial tuberculoma. *Edinburgh Medical Journal*, **46**, 36–41.
- Garland, H. G., and Armitage, G. (1933). Intracranial tuberculoma. *Journal of Pathology and Bacteriology*, **37**, 461–471.
- Lancet* (1970). Neurological complications of tuberculosis, **1**, 1094–1095.
- Levy, L. F., and Axton, J. (1973). Neurosurgery in Rhodesia. In *Tropical Neurology*, p. 226. Edited by J. D. Spillane. Oxford University Press: London.
- Maurice-Williams, R. S. (1972). Tuberculomas of the brain in Britain. *Postgraduate Medical Journal*, **48**, 678–681.
- Northfield, D. W. C. (1973). *The Surgery of the Central Nervous System*, p. 461. Blackwell: Oxford.
- Odeku, E. L., and Adeyoye, A. (1969). Cerebral tuberculomas in Nigerian patients. *Tropical and Geographical Medicine*, **21**, 293–304.
- Ramamurthi, B., and Varadarajan, M. G. (1961). Diagnosis of tuberculomas of the brain. *Journal of Neurosurgery*, **18**, 1–7.
- Sibley, W. A., and O'Brien, J. L. (1956). Intracranial tuberculomas. *Neurology (Minneapolis)*, **6**, 157–165.
- Thrush, D. C., and Barwick, D. D. (1974). Three patients with intracranial tuberculomas with unusual features. *Journal of Neurology, Neurosurgery, and Psychiatry*, **37**, 566–569.