Tuberculoma of the Brain
A Clinical and Angiographic Study

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At present, tuberculoma of the brain is so rare in some countries as to be a curiosity when it is encountered. A master surgeon of exceptionally wide experience saw no tuberculoma of the brain during the last 20 years of an active career. This statement was made by him when he failed to recognize the characteristic appearance of a tuberculoma of the brain he was operating upon recently.

At the turn of the present century, tuberculoma of the brain was so common as to constitute about 50 per cent of all space-occupying lesions.

With the extension of neurological surgery to some countries, whose standards of living will allow the development of tuberculous infection, tuberculoma of the brain once more is assuming great importance.

It is common for those neurosurgeons working in localities where tuberculoma of the brain presents real problems, to have received their training, as we have had ours, at foreign centers where this lesion is seldom met with. Accordingly, when they go back to their own countries, they have to develop their personal experience with little guide from literature or their previous training.

It is with this type of neurosurgeon in mind that we put on record our experience with 16 cases of tuberculoma of the brain seen in the last 10 years. With the exception of 1 case, all have been studied angiographically. A review of literature revealed that in no previous series was the angiographic aspect dealt with except in the series of Ramamurthi and Varadarajan reported recently.

The incidence of tuberculoma of the brain in different countries varies greatly and is, as to be expected, related to their social standards (Table 1).

The recent introduction of the potent antituberculosis remedies, far from diminishing the incidence of tuberculoma of the brain, is more likely to increase it. Patients who used to succumb to tuberculous meningitis will live now, under antituberculous therapy, to have development of localized tuberculoma of the brain. The situation is not unlike that of pyogenic brain abscess after the introduction of penicillin in the treatment of otitis media.

A few cases of tuberculoma of the brain will now be described, each one presenting some interesting feature.

Case Reports

Case 1. A 30-year-old woman complained of headaches and right jacksonian fits for 6 months. Her first fit started 1 week after delivery. Four weeks later she had a painless swelling of the right wall of the chest which was incised by a local physician. It refused to heal and left a discharging sinus.

Examination. There was right hemiparesis, hemihypesthesia and astereognosis of the right hand. There was no papilledema and the visual fields were normal. Plain roentgenograms were normal.

Left carotid angiography was done. The lateral view was within normal limits. The frontal view showed moderate displacement of the anterior cerebral artery towards the opposite side. No vascularity or excessive hypertrophy of the vasculature were noticed.

Operation. A small circumscribed swelling situated superficially in the cortex, 4 × 3 cm. in size, was removed completely with little loss of blood. The brain was not under tension.

Course. The diagnosis was made only when the pathological report was received 1 week later. Intensive antituberculous treatment then was started but the patient succumbed to tuberculous meningitis 5 weeks later.
Tuberculoma of the Brain

### TABLE 1

*Incidence of intracranial tuberculoma in some countries*

<table>
<thead>
<tr>
<th>Author</th>
<th>Country</th>
<th>Year</th>
<th>Percentage</th>
<th>Comment</th>
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<tbody>
<tr>
<td>Starr&lt;sup&gt;3&lt;/sup&gt;</td>
<td>England</td>
<td>1889</td>
<td>50</td>
<td>Mostly postmortem findings in children</td>
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<tr>
<td>Bernstein <em>et al.</em>&lt;sup&gt;4&lt;/sup&gt;</td>
<td>America</td>
<td>1950</td>
<td>1-3</td>
<td>All space-occupying lesions are treated as tuberculoma before other possibilities are considered</td>
</tr>
<tr>
<td>ASENJO <em>et al.</em>&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Chile</td>
<td>1951</td>
<td>15.9</td>
<td></td>
</tr>
<tr>
<td>González-Revilla&lt;sup&gt;7&lt;/sup&gt;</td>
<td>Panama</td>
<td>1952</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Arseni&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Rumania</td>
<td>1958</td>
<td>8</td>
<td>Emphasizes the high incidence in the young-age group</td>
</tr>
<tr>
<td>Obrador&lt;sup&gt;8&lt;/sup&gt;</td>
<td>Spain</td>
<td>1959</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Ramamurthi &amp; Varadaranjan&lt;sup&gt;12&lt;/sup&gt;</td>
<td>India</td>
<td>1961</td>
<td>20</td>
<td></td>
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<tr>
<td>Higazi</td>
<td>Egypt</td>
<td>1963</td>
<td>5</td>
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**Comment.** 1. This was our first tuberculoma of the brain. The tumor was superficial and adherent to the dura mater and we thought it was a meningioma. The loss of this case made an indelible impression on our minds. In all subsequent cases the diagnosis either was made or strongly suspected preoperatively or the correct diagnosis was made during the operation. The significance of a discharging sinus in the wall of the chest in a patient with fits was missed entirely.

2. This is the only patient in the series who had had no increased intracranial tension. Undoubtedly the fits forced the patient to seek advice before papilledema had time to develop.

3. Intensive antituberculous treatment started 1 week postoperatively failed to avert the development of tuberculous meningitis. This shows the extreme importance of starting antituberculous therapy either preoperatively or on the operating table.

4. The fits started 1 week after confinement. It is a common observation that tumors of the brain and spinal cord are stirred into activity by pregnancy and delivery.

**Case 2.** A 16-year-old boy complained of headaches, prominence of the right eye and progressive deterioration of its vision of 3 months' duration.

His symptoms started with fever which lasted for 8 days. Two weeks later he began to have headaches followed in a short time by diplopia, blurring of vision and progressive protrusion and visual deterioration of his right eye. It became completely blind in the course of 2 months. There was a feeling of numbness in the upper two-thirds of the right face.

**Examination.** His right eye was protruded (exophthalmometry difference of 4 mm.) and was pushed forwards and downwards. The right eye was completely blind and its pupil was dilated and fixed. There was primary optic atrophy on the right side with papilledema of D5 on the left. The ocular movements were restricted in every direction. The corneal reflex was present but diminished. There was painless swelling of the right temple (Fig. 1).

**Course.** He remained in hospital for 3 weeks prior to his operation. His temperature chart showed frequent bouts of fever ranging from 37.5°-38.5°C.

Plain roentgenograms showed destruction of the outer two-thirds of the right sphenoidal ridge. The right optic foramen was enlarged with indefinite margin.

Angiography showed remarkable dilatation of middle and anterior cerebral arteries. The sylvian group of vessels are shown in the lateral view (Fig. 2) pushed markedly upwards, and in the frontal view pushed upward and medially (Fig. 3). The anterior cerebral artery was displaced to the opposite side (Fig. 3). The site of the tumor was virtually avascular.

**Operation.** The temporal muscle was found swollen, boggy and infiltrated but not vascular. The line of the outer wall of the temporal fossa was thickened but not excessively vascular. The
Case 2. Tuberculoma of right anterior and middle fossae. Proptosis of right eye and fullness of temple. The brain was under considerable tension. The tip of the right frontal lobe was removed for better exposure. There was a tumor, yellowish-white, hard, and poorly vascularized, occupying the anterior part of the middle fossa but overflowing to the anterior fossa as well. Subtotal resection, using the electric loop, was done. It was felt safer to leave the most medial part of the tumor.

Course. He made good recovery. His headaches disappeared but his right eye remained blind.

Comment. 1. This case simulates so closely that of a sphenoidal ridge meningioma that diagnosis of the latter would have been inescapable were it not for the fact that it came shortly after Case 1, at a time when we were ultrasensitive to the possibility of tuberculoma. The history of fever prior to his illness as well as the frequent rises of his temperature during his preoperative stay in hospital were further warnings. During the operation we leaned towards the diagnosis of tuberculoma by the naked-eye appearance of the tumor. To be on the safe side, we thought it was advisable to start chemotherapy immediately. The pathological examination confirmed our suspicions.

2. The remarkable dilatation of the intracranial vessels is all the more noticeable.

Case 3. A 12-year-old boy complained of headaches, progressive deterioration of vision and clumsiness in using his right hand for 3 months. His present illness started with a sharp attack of fever which was severe enough to necessitate his admission to a fever hospital for 5 days. Shortly after his discharge, he started to have severe headaches, occasionally accompanied by vomiting. His parents noticed he dropped objects from his right hand and became dysphasic.
Examination. There was marked enlargement of the head with a positive Macewen's sign. Fundi showed advanced bilateral papilledema with commencing optic atrophy. Visual acuity of the right eye was limited to perception of light; that of the left eye was 6/60. There was bilateral palsy of the 6th nerve. He had right hemiparesis and central facial palsy.

Roentgenograms showed marked separation of sutures (Fig. 4). Angiography in the lateral view (Fig. 5) shows the Sylvian vessels pushed downwards and straightened. The anterior cerebral artery is pushed forwards and describes the curve of advanced hydrocephalus. In the mid-parietal region there is a small stain with irregular margins situated above the sylvian vessels (Fig. 5).

In the frontal view (Fig. 6) there is marked deviation of the anterior cerebral artery to the contralateral side.

Operation. The brain was under considerable tension. A tumor, 5 X 6 cm. in size, was enucleated completely with little difficulty.

Course. Recovery was uneventful.

Comment. This case is reported mainly because of the vascularity of the tumor, which evidently is present in only part of the tumor. Contrary to the experience of other authors, this tumor was deep yet vascular.

This vascularity is peculiar in that it appears early enough to show in the arterial phase. It differs from other tumor stains in that it is homogeneous with no individual vessels in it or in its vicinity.

The usual increase in the dimensions of the intracerebral vessels is well shown.

Case 4. An 8-year-old boy complained of headaches, vomiting and unsteady gait of 3 months'
brain tissue rather than penetrate it. It is unlike the feeling of other benign lesions, including meningiomas. When pushed by the brain needle it gives the impression of a "floating" mass inside the softened brain tissue somewhat similar to the sensation imparted by a fibroadenoma pushed aside by the examining fingers in a voluminous breast, though the degree of excursions is much less.

The writer has described this point in detail because we are convinced that once it is felt it is not easy to forget.

Our suspicions were amply justified when the tumor was exposed to daylight, and were later confirmed pathologically.

Case 5. An 11-year-old boy complained of headaches, progressive visual deterioration and occasional vomiting of 2 months' duration. He had a history of fever for 1 week 3 months prior to onset of his present illness. His father suffered from pulmonary tuberculosis and he had to go into a sanatorium for some time.

Examination. He had an enlarged head with a positive Macewen's sign. The head was tilted towards the right shoulder (Fig. 7). Gait was ataxic with a tendency to fall to the right side. There was generalized hyporeflexia. Intention tremors on finger-to-nose test were present, more on the left side. Plantar reflexes were equivocal on both sides. There was bilateral advanced papilledema.

In view of the rather definite cerebellar signs it was thought advisable to do ventriculography. In trying to hit the left ventricle through the usual occipital burr-hole, the needle touched a tumor about 2 cm. below the surface of the brain. The tumor imparted to the needle a peculiar sensation of a hard, craggy mass.

Operation was performed immediately. A hard poorly vascularized tumor was removed totally without difficulty. Its size was 6×5 cm. and its color was whitish-yellow.

Course. Antituberculous therapy was started immediately. Recovery was uneventful.

Comment. This is the only case in the series not investigated by angiography. We feel this was a rather fortunate incident. It enabled us to know the feeling imparted to a needle by a tuberculoma of the brain. The feeling is that of a hard, craggy mass, so hard indeed that the needle will move it en masse inside the surrounding soft and infiltrated
hoping to make further investigations in the future for the cause of this swelling.

*Court*. The patient made a smooth recovery. Angiography done postoperatively proved the absence of any other lesion and the site of the bone defect became flat a few days after the operation.

*Comment.* The study of this case will show two important points.

1. Massive edema, out of all proportion to the size of the tumor, might be produced by a small tuberculoma.

2. Intensive antituberculous therapy for a sufficiently long time prior to operation is not always of help to reduce the difficulty or risk of the operation. Asenjo believes that 5 days of treatment is enough to prove or disprove the presence of a tuberculoma of the brain. The angiogram showed that the rich vascularity of the brain is not confined only to the involved side but may also affect the contralateral side.

*Case 6.* An 11-year-old boy was admitted to the hospital complaining of severe unsteadiness on his feet that rendered him bed-fast, deviation of the corner of his mouth to the right side and dropping objects when using his left hand. His trouble started 5 months previously. The first thing noticed was deviation of the corner of the mouth to the right side. Inability to close his left eye followed in 2 days. After 1 more week he noticed loss of hearing in the left ear. Then he became progressively unsteady on his feet and dropped objects when using his left hand. He had bitemporal headaches, usually accompanied by vomiting in the morning.

*Examination.* The patient was weak, underweight and anemic. His speech was staccato in character. Positive neurological findings were: bilateral palsy of the 6th nerve; advanced bilateral papilledema; nystagmus, slower and of wider amplitude when looking to the left side; diplopia; and loss of corneal reflex on the left. Caloric test was negative on the left side. There was left facial palsy of peripheral type. Hearing was lost completely in the left ear. He was unable to walk because of his severe ataxia. There was marked ataxia in the left upper limb on finger-to-nose test. Hypotonia was more marked in the left upper limb. There was dysphagia. The uvula deviated to the right side. Deep tendon reflexes were diminished to absent on the right side, and present on the left. The plantar response was extensor on the right side. There were no sensory changes.

There was a discharging sinus on the inner side of his left foot which started as a painless swelling 6 months prior to the onset of his present illness. This swelling opened spontaneously and since then refused to heal. Plain roentgenograms showed caries of the metatarsal bone (Fig. 9). At
conscious, with widely dilated and fixed pupils and rigid neck. He recovered almost completely from this episode in 3 hours. Next morning the same type of episode developed but to this he succumbed in 8 hours. It is to be regretted that no autopsy was made on this patient.

Comment. There could be little doubt that this patient was suffering from a tuberculous affection of the angle and this for two good reasons. Firstly, the presence of a tuberculous caries of his metatarsus, as proved by pathological examination, and secondly, because of the dramatic improvement on antituberculous therapy.

What sort of tuberculous lesion and what actually happened will remain a matter for conjecture. It is, however, reasonable to presume that the lesion started as a diffuse cerebellar tuberculous infiltration which gave rise to the full-blown syndrome of the cerebellopontine angle. Under antituberculous therapy most of the surrounding edema had resolved, hence the dramatic improvement. The surrounding edema subsided, only to leave behind a tuberculous abscess, obviously not large. It was not large enough to obstruct the aqueduct because of the disappearance of the headaches and papilledema. This abscess had leaked in the first episode with temporary recovery. On the second occasion it ruptured into the 4th ventricle with consequent fatal result. Admittedly, a tuberculous abscess is uncommon, but we have learnt a big lesson from that case. A patient suspected of having a tuberculoma of the brain and who improves, even as markedly as did our patient on antituberculous treatment, should be followed by air study or angiography to determine the local condition. This is analogous to the ordinary pyogenic abscess which, after the first aspiration and treatment with penicillin, might not resolve completely or even enlarge while the general condition of the patient is improving. Of course, the latter condition is easier to follow if pyograms are done after the first aspiration.

Discussion and Impression

A tuberculoma of the brain is a space-occupying lesion and it is to be expected that
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it will behave generally as other space-taking affections. There is no single sign or symptom, clinical or radiological, which will with certainty identify a tuberculoma of the brain. However, there is a symptomatology which, if taken together, will, in the great majority of cases, lead to a presumptive pre-operative diagnosis. If such a diagnosis is acted upon pre-operatively, there is little doubt that the result, already improved by modern anti-tuberculous therapy, will improve still further. The study of the present series will reveal certain common features.

1. Tuberculoma of the brain is a disease of the young-age group. Fifteen of our 16 patients were below the age of 15 years (95 per cent).

2. The history of the disease is usually short: 6 months or less.

3. Intracranial tension is increased greatly in almost all the cases. The only exception was Case 1, who had jacksonian fits and had to seek medical help before the intracranial tension could increase.

4. In the majority of cases there is a history of fever, contact with a tuberculous relative or some demonstrable tuberculous lesion such as caries of the rib or caries of a metatarsus. Twelve patients out of 15 (75 per cent) had had such a helpful history.

5. No report of an angiographic study of tuberculomas of the brain was found on review of the literature, with the exception of one article.12 This is understandable because tuberculoma of the brain ceased to be a common disease long before angiography was introduced.

In this article Ramamurthi and Varadarajan12 recognized two types of tuberculoma of the brain: 1) A superficial, vascular type which produces early focal signs, usually with no increased intracranial tension. It responds favorably to medical treatment and does not, usually, need operative intervention. 2) A deep, avascular type, accompanied by increased intracranial tension, which does not respond to medical treatment and requires operation.

On most of those points the writer agrees, but with some qualifications. A superficial tuberculoma is not always vascular and it does not always respond to medical treatment. In Case 1 there was a hard, nodular craggy tumor which was superficial but avascular and its character would make it most unlikely to resolve on medical therapy. A deep tuberculoma, on the reverse, may be vascular (Case 3, Fig. 5).

6. A presumptive diagnosis of tuberculoma of the brain will be of help since it will lead to pre-operative administration of anti-tuberculous treatment. Such a treatment will, in most cases, reduce the difficulty and risk of operation. That such a favorable result does not always occur is illustrated by Case 5. In this patient adequate antituberculous therapy was administered for 3 weeks prior to his operation, yet the intracranial tension was so great as to force us to discard the bone flap. The tumor was such a tiny one as to make it unbelievable that it would produce that much edema. We had to presume the presence of another larger and deeper tuberculoma which had defied our search. That there was no other lesion was demonstrated by angiography, which was done shortly after the operation, as well as by the smooth postoperative recovery.

7. Plain roentgenograms of the skull will show the usual advanced signs of increased intracranial tension with marked separation of sutures. In no case of ours was there calcification.

Angiographically there was rich vascularity which was not confined only to the involved side, but also was present in the contralateral hemisphere. In all the cases, with the exception of Case 1, there was remarkable dilatation and hypertrophy of the main cerebral vessels.

8. Perhaps the most clear-cut observation the writer would like to put forward in this communication is the practical availability of naked-eye diagnosis of tuberculoma of the brain when seen and handled on the operating table or when felt by a brain needle.

A tuberculoma of the brain has distinctive characteristics. It is hard, usually nodular, and yellowish-white in color. It is comparatively avascular and easy to shell out. The
cut surface may show caseation in the center. The surrounding brain tissue is edematous.

When felt by the exploring brain needle, it feels hard, so hard as to be unpenetrable by the needle. When pushed by the needle, it will make a to-and-fro “rocking” movement because of displacement of the hard tumor within the surrounding soft and infiltrated brain tissue.

The author is sure that the naked-eye diagnosis of tuberculoma of the brain is as accurate as that of a scirrhous carcinoma of the breast. So distinctive are those characteristics as to render a trained eye able to spot the diagnosis during watching an operation, as happened to us on two occasions.6,10

If presumptive diagnosis of a tuberculoma of the brain is made at operation and adequate antituberculous therapy is started immediately, the patient can almost always be saved from tuberculous meningitis.

9. Should it be deemed advisable to try medical treatment on a tuberculoma of the brain, improvement, however remarkable, should not lull one into a false sense of security. The patients should always be followed by ancillary diagnostic methods to determine the local situation. Case 6 was of considerable instructive value in this respect.

10. Neurosurgeons with wide experience in treatment of tuberculomas of the brain advocate a trial, for a few days, of antituberculous therapy to prove or disprove the presence of a suspected tuberculoma of the brain.2,12 We feel treatment should, with advantage, be extended to 3 weeks (Cases 5 and 6).

11. In the localities where tuberculomas of the brain are reasonably common, the neurosurgeon should cultivate a high sense of suspicion, without which most of the cases are apt to be missed.

References
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10. OLIVECHONA, H. Operating at Cairo, 1962.