TUBERCULOMAS OF THE BRAIN AND CEREBELLUM

P. DESCUNS, M.D.,* H. GARRÉ, M.D., AND C. PHÉLINE

Algiers, Algeria

(Received for publication November 2, 1958)

The results of the surgical removal of tuberculomas of the brain and cerebellum have been transformed in recent years by the judicious use of Streptomycin associated with other antibiotics. Formerly tuberculous meningitis was a common occurrence in the postoperative period, and almost all patients with tuberculomas of the cerebellum and the majority of those with a tuberculoma of the brain succumbed. Nowadays, by observing certain precautions the postoperative results are greatly improved.

A few years ago, some of the foremost neurosurgeons still performed a mere decompression associated with medical therapy. Now, under the protection of antibiotics, it is possible to remove, even piecemeal, all of the intracranial tuberculomas that are surgically accessible.

This complete change in prognosis was particularly appreciated in North Africa, where the incidence of intracranial tuberculomas is very high, chiefly among young people, and especially among natives.

INCIDENCE

Only 3 of the patients were European; 35 were natives.

Fifteen patients were under 16 years of age, and of the 23 adults, the majority were between 20 and 30 years of age. Our oldest patient was aged 60 years.

There were 12 females and 24 males.

Most of the intracranial tuberculomas appeared as primary lesions and there were only few cases in which there was an associated tuberculosis in the lung or elsewhere. But those patients usually lived in a badly infested family.

PATHOLOGY

Sixteen (42.1 per cent) of the tuberculomas were located in the posterior fossa: 7 in the right hemisphere, 7 in the left, 1 in the vermis, and 1 in the brain stem.

Contrary to what has usually been held, location in the cerebral hemispheres was more frequent. There were 22 (57.9 per cent), situated as follows: 10 in the right hemisphere; 10 in the left; and, in 1 instance, in both frontal lobes.

The lobes most frequently affected were in order: (1) the parietal lobe, (2) the occipital, (3) the temporal, and (4) the frontal.

* 3 Rue Lafayette, Algiers, Algeria.
Gross Pathology. When the bone flap is lifted, one may find that the dura mater has an unusual appearance. It is often rough, with small foci of bone metaplasia. The dura mater is often adherent to the tuberculoma. In some cases, tuberculous granulations on the pia mater make the diagnosis clear. The convolutions are flattened, and sometimes there is marked edema of the brain. The brain is yellowish and has a jelly-like consistency, because a certain amount of tuberculous encephalitis always exists around the tuberculoma. This is more marked with cerebral tuberculomas than with those of the cerebellum.

Antibiotics have a strong effect on this encephalitis and thus prevent infection of the meninges. One can easily remove the tuberculoma from the surrounding area of encephalitis. Usually the tuberculoma has few blood vessels. However, in 2 cases of parasagittal tuberculomas that were highly vascular, the diagnosis of meningioma was suspected.

The shape of the tumor may vary (Fig. 1). It is generally round, and often “bun like.” The size is usually greater than anticipated, especially in cases of tuberculoma of the posterior fossa. Most of those we operated on were bulky, their size varying between that of a walnut and a tangerine. A huge one weighed 210 grams; the smallest one was surrounded by an extensive area of tuberculous encephalitis. In one case a coating of multiple tuberculomas was found around the frontal lobe.

Some tuberculomas, though comparatively rarely, are not amenable to any form of surgical treatment. Classically, when sectioned, the tumor resembles a raw chestnut, although sometimes it has the appearance of a chronic tuberculous abscess because of calcification or caseification.
Cerebral and cerebellar tuberculomas behave like all intracranial tumors and give differing signs, according to their location. However, some peculiar points may be noted: First is the importance of intracranial hypertension, which progresses very rapidly and often obscures all other signs. Many patients (50 per cent) came to the hospital when they were already blind, with secondary atrophy and signs of compression of the brain stem (nuchal rigidity, mydriasis on one side only).

Though the natives are strongly fatalistic, that is not the only reason for their deferring any consultation. Another factor is the rapid increase in intracranial pressure, which is caused more by the tuberculous encephalitis than by the size of the tuberculoma.

When located in the posterior fossa, the high intracranial pressure is conspicuous and the cerebellar symptomatology is very poor, and in such instances among young natives, we often suspect a tuberculoma.

When located in the brain, they may cause but few more symptoms. We noted some Jacksonian fits (in 4 of 22 cases) and even less often, generalized epilepsy. Frequently, lateral homonymous hemianopsia and hemiplegia were the only signs associated with high intracranial pressure.

Roentgenograms of the skull revealed the syndrome of intracranial hypertension: "finger prints," separation of the sutures, and erosion of the sella turcica. Calcification of a tuberculoma was rarely seen.

Examination of the fundi revealed papilledema, and, in 50 per cent of the cases, secondary atrophy of the optic nerve.

X-rays of the chest were systematically performed and, in a few cases only, showed pulmonary tuberculosis associated with the brain lesions.

Electroencephalographic Findings. Of 11 patients who had electroencephalography, 8 suffered from cerebral tuberculomas, and 3 from cerebellar tuberculomas. The basic rhythm was often slowed (7-9 c/sec. in the cerebral location of the pathological process). Diffuse fast activity was recorded in 4 cases: 2 tuberculomas of the left cerebellar hemisphere, 1 tuberculoma which damaged both frontal lobes, 1 which was deeply located in a cerebral hemisphere. This fast activity in cases of tumors of the posterior fossa and lower brain stem and, lately, of tumors of the cerebral hemispheres, has been previously described by others.

It seems of interest to emphasize the great number of spiky abnormalities with this kind of tumor (recorded in 6 out of our 8 cerebral cases). These abnormalities consist of sporadic or continuous fast spikes, sharps, spike and waves which were closely localized to the area of tumor or lateralized to the injured side; they might also appear as random discharges of rhythmic sharps or spikes, in the opposite side, or diffuse. One of our patients showed paroxysmal activity of rhythmic temporal spikes which resolved clinically in a psychomotor fit.

These changes might be the only sign of the tuberculoma or be associated with localized slow activity (delta-téta waves); one must observe that this
spike activity agreed partially with clinical data, since these tracings were found among the 3 epileptic patients we were able to record.

_Ventricular puncture_ may be sufficient when a tuberculoma of the posterior fossa is involved. It reveals the hydrocephalus with hypertension which corroborates the diagnosis of the location. When a tuberculoma of the cerebrum is concerned, it can be met by the ventricular needle.

_Ventriculography_ (Fig. 2) is not free from dangers. It can increase the cerebral edema which is always important because of the tuberculous encephalitis and may cause serious accidents, such as squeezing of the brain stem. The tuberculomas of the posterior fossa give a threefold ventricular expansion which can vary in importance. The X-ray appearance of the tuberculomas of the brain is much the same as that of brain tumors: dislocation or

---

**Fig. 2.** Ventriculograms in cases of tuberculoma. Note signs of intracranial hypertension and squeezing of the temporal lobe.
indentation of the ventricular system; a shift in the ventricles denotes frequently a temporal lobe squeezing.

*Angiography* (Fig. 3) is the preferred means of localization of a tuberculoma of the hemisphere. The vessels are pushed aside by the tumor and disappear in its locality.

![Angiogram in a case of tuberculoma of the right parietal lobe.](image)

**TREATMENT**

Until these last years, brain surgeons had the constant fear of tuberculous meningitis when they tried to remove a tuberculoma, especially when the lesion was in the cerebellum. Indeed, infection of the spinal fluid occurred when piecemeal removal of the tuberculoma had to be made (particularly in the posterior fossa). But tuberculous encephalitis also aggravated the condition. Though the spinal fluid often was under shelter because of the adherence of the cortex to the meninges, this was too frail and small a defense to allow a dry operation. Tuberculosis of the meninges occurred in the postoperative course in most cases of tuberculoma of the brain, and always after removal of a tuberculoma of the cerebellum. Therefore it became Cushing's custom when a cerebellar tuberculoma was surgically disclosed to leave the operation as a decompression and to prescribe heliotherapy.

Today, through the use of Streptomycin, the problem is quite different and when the diagnosis has been established, treatment must be instituted as soon as possible. The method of extirpation varies according to whether the tuberculoma is in the brain or cerebellum.

*Tuberculomas of the Brain Hemispheres.* Once we know by angiography the exact location of the tuberculoma, the flap is cut where needed. Usually the dura mater is very tight because of an underlying cerebral edema; when it is opened, the brain protrudes, and one can see the convolutions, flattened
just as they are over a cerebral tumor. In some cases, small granulations, typical of tuberculosis, have formed, especially along the vessels.

A tuberculoma may reach the level of the cortex, and in that case the dura mater and cortex are adherent. If not, brain puncture with Cushing’s needle locates the lesion and an approximate estimation of its size may be made. A cortical incision identifies the nature of the tumor. A cap of the cortex that covers the encephalitic zone is resected. It is not absolutely necessary to remove all of this parenchyma, especially when it is close to a highly functional area.

The tuberculoma is easily extirpated. It usually has few vessels and these are coagulated as the surgical removal proceeds. The ventricle should not be opened if possible. The cerebral edema gradually disappears and the brain slackens after a careful check of bleeding. Streptomycin powder (1 gm.) is left in the cavity. The wound is then closed as usual in brain surgery.

When the tuberculomas are located in the frontal, occipital or right temporal lobes, a typical lobectomy can be performed with removal of the tuberculoma and the surrounding zone of encephalitis.

_Tuberculomas of the Cerebellum_. We use a “cross-bow”-like incision on one side only; then make a permanent resection of the occipital, which gives a wide exposure of the posterior fossa.

When no exact location has been determined, we begin by a midline incision and open sideways as needed. We almost always have to perform a ventricular puncture. The meninges are then opened, the posterior occipital vein is ligatured and the cerebellum is freed by opening the cisterna magna.

As soon as we suspect a tuberculoma, we protect the cisterna magna _constantly by a piece of cotton moistened with Streptomycin_, so that the operation is done under a continuous flow of antibiotic.

The tuberculoma sometimes reaches the cortex, but more often we have to puncture to locate it. A flap of cerebellar cortex is then lifted up so that the lesion is best exposed.

But, unless it is a very small one, it is very difficult to remove it whole. Its size is often huge, so that we have to proceed by piecemeal extirpation, first emptying the tuberculoma. This is not without danger because of the brain stem which is often displaced and crushed, and, in the postoperative course, the patient often has to be left in the same position for several days. After a careful check of the bleeding, Streptomycin (1 gm.) is left _in situ_. Most of the tuberculomas can be totally removed.

**PRE- AND POSTOPERATIVE COMPLICATIONS**

We seldom met with complications in cases of tuberculomas of the brain, although in a few instances severe postoperative edema occurred and one of our patients succumbed. The latter had a medium-sized tuberculoma with an extensive zone of encephalitis. Before the operation, a high degree of edema of the brain had been successfully treated; 3 days later under a second acute surge, the patient died in spite of our endeavour. At autopsy a squeezing of the temporal lobe was found.
### TABLE 1

*Results of surgical treatment of intracranial tuberculomas*

<table>
<thead>
<tr>
<th></th>
<th>No. of Cases</th>
<th>No. Healed</th>
<th>Died</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before use of Streptomycin</td>
<td>10</td>
<td>2</td>
<td>8*</td>
</tr>
<tr>
<td>Since use of Streptomycin</td>
<td>28</td>
<td>15†</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>17</td>
<td>21</td>
</tr>
</tbody>
</table>

According to location

<table>
<thead>
<tr>
<th>Location</th>
<th>No. of Cases</th>
<th>No. Healed</th>
<th>Died</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain</td>
<td>22</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Cerebellum</td>
<td>14</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Brain stem</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Vermis</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>17</td>
<td>21</td>
</tr>
</tbody>
</table>

* All 8 patients had tuberculous meningitis.
† One patient is still being treated.

As far as tuberculomas of the cerebellum are concerned the accidents come from the shifting of the brain stem after the tumor is extirpated. In one of our cases marked cerebral edema occurred, such as was described by Clovis Vincent as an exceptional and fatal accident. The patient was a woman with a very large tuberculoma of the right hemisphere that had to be freed from the fourth ventricle, and the edema occurred at that time. Leaving part of the tumor, we closed the wound as quickly as possible. The patient lived, and 15 days later in a second operation we were able to remove the rest of the tumor. This patient did not have any Streptomycin until later, and that did not stop a tuberculous meningitis from appearing 20 days after the first operation. She died 2 months later.

This brings us to the problem of the postoperative treatment. On the same day when the removal is done, the patients are treated with large doses of Streptomycin, as well as with vitamins, calcium and so on.

On the next day, we give two injections of Streptomycin by lumbar puncture. The fluid is checked regularly, so that the least accident is noted; this treatment is continued daily for about 1 month. Successful healing can be expected only at such a cost.

If the ventricle happens to be opened, ventricular puncture is necessary for a few days, leaving 0.05 gm. of Streptomycin.

**PARTICULAR CASES**

Some locations are not surgically accessible, and in such cases only palliative operations are performed, such as third ventriculostomy for a tuberculoma of the brain stem (protuberance for instance), or the Torkildsen procedure when the tumor is in the thalamus, the pineal body, and even extends to the third ventricle, so that a third ventriculostomy would not be effective.

After these palliative operations we have seen many patients live much longer than expected and even heal completely when Streptomycin acted well.
RESULTS

One has to remember that most of our patients were admitted to the hospital with a marked increase in intracranial pressure; 50 per cent were blind when operated upon, which accounts for the high mortality (Table 1).

In a single case of posterior fossa tuberculoma the patient died of meningitis. The other patients had huge tumors, and some of them were nearly beyond the hope of any surgical treatment.

CONCLUSIONS

The prognosis of tuberculomas of the brain and cerebellum has been greatly improved since the use of antibiotics during and after operation.

These tumors hitherto caused many deaths. They can be healed now but especially in North Africa, one realizes that an earlier diagnosis would allow operation on moderate-size tuberculomas in contrast to the huge neoformations that are seen in these blind patients we usually operate upon.

Finally, three points should be emphasized in the treatment of tuberculomas of the brain and cerebellum: (i) When the meninges are opened above a tuberculoma of the cerebellum a continuous flow of Streptomycin is needed. (ii) Streptomycin (1 gm.), must be poured into the bed of the tumor. (iii) Early in the postoperative course, treatment with Streptomycin, vitamins, calcium and so on is necessary by general and local measures.