INTRACRANIAL TUBERCULOMAS
EXPERIENCE WITH TEN CONSECUTIVE CASES

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Tuberculomas are among the common expanding intracranial lesions. Their incidence varies according to their geographical distribution. Thus in a series reported from the United States, tuberculosis represented 1.4 per cent of all verified intracranial tumors, and in a report from Chile the incidence was 15.9 per cent. It is said that the incidence is higher in children than in adults and higher in males than females.

The symptoms and signs of this type of lesion do not differ from those caused by other kinds of intracranial tumors. Asenjo et al. have called attention to the high incidence of intracranial hypertension in their series of cases, but they do not state the criteria used for increased intracranial pressure and their graphs are hard to interpret. Even in the presence of extracranial tuberculous lesions it is quite difficult to make a preoperative diagnosis of tuberculoma; hence it is unwise to treat these patients by decompressive measures alone without knowing beforehand the pathological nature of the lesion.

Before the advent of streptomycin, the surgical treatment of cerebral tuberculomas was discouraging because of the common occurrence of postoperative tuberculous meningitis. The poor results from this dreaded complication led Cushing to recommend decompression followed by general medical care as the therapeutic method of choice, although he warned against the danger of overlooking nontuberculous lesions by this procedure. On the other hand, Dandy, Dott, and Smith and Daniel advocated total removal of the lesion whenever its anatomical location made it feasible. Dandy advised the same surgical extirpation en bloc as used in the treatment of a glioma with a margin of healthy cerebral tissue around it. Scattered reports have appeared in the literature on the results of surgical extirpation combined with streptomycin administration in the past 3 years. Sufficient follow-up observation was found only in the cases reported by Obradoy and Urquiza who emphasized that 1 out of 4 patients with cerebral tuberculomas survived the surgical extirpation alone, while in a series of 6 patients treated surgically and with streptomycin, 1 died postoperatively and 5 were well from 12 to 18 months after operation.

The purpose of the present communication is to discuss our personal experience in 10 consecutive cases of intracranial tuberculomas verified at operation or autopsy in our Department of Neurological Surgery. Emphasis will be placed on incidence, symptomatology, operative findings, treatment and end results.
ANTONIO GONZÁLEZ-REVILLA

INCIDENCE AND DURATION OF SYMPTOMS

In our series tuberculomas constitute 8 per cent of all intracranial tumors verified at operation or autopsy. From 1948 to 1951 there were 10 such cases. Females were affected more frequently than males in the proportion of 3:2. The average age at onset of symptoms was 21.5 years; the youngest patient was 3 years old, and the oldest 54. Fifty per cent of the tuberculomas occurred in children under 14 and the other 50 per cent in adults over 20. The duration of symptoms in 7 cases fluctuated between 2 and 3 months, while in the rest it was 7, 24 and 36 months respectively. There was no signif-

icant predilection for racial groups; 4 occurred in Indians and 3 each in white and colored individuals.

SYMPTOMS AND SIGNS

Of the 10 tuberculomas, 9 were intracerebral and 1 was epidural. Because of some difference in their symptomatology they will be discussed under separate headings.

(a) Intracerebral. Among the 9 cases in this group there was history of fever as the initial symptom in 3, the temperature fluctuating between 101° and 103° and lasting for 8 days. No symptoms or signs of meningitis could be obtained from their histories.

Headache was a prominent and constant symptom in every case. It was described as severe, intermittent and generalized, irrespective of the location of the lesion, and was associated with vomiting in 5 cases.

Convulsive seizures were present in 4 patients in whom the tuberculomas were invariably encountered at operation in one frontal lobe. The seizures were somatomotor, generalized grand mal, and had been treated with anti-

convulsants previous to admission to our service.

A history of unsteadiness in walking was elicited in the 4 cases of cere-

tbellar lesions.
Intracranial Tuberculomas

Signs of increased intracranial pressure were present in all cases. The criteria used for increased intracranial pressure were (a) papilledema and (b) x-ray evidence of widening of the cranial sutures in children and of erosion of the clinoid processes of the sella turcica in adults. Papilledema was usually severe, fluctuating between 3 and 6 diopters. It was associated with subhyaloid hemorrhages in 6 cases and with secondary optic atrophy and marked loss of vision in 3. There were no significant variations in the peripheral or central visual fields.

Involvement of other cranial nerves was unusual. The 6th, 7th, and 8th on the right were affected in Case 3, which with ipsilateral cerebellar signs led us to make a diagnosis of cerebellopontile tumor: at operation a tuberculoma of the right cerebellar lobe with projection into the cerebellopontile recess was disclosed. The other patient in whom cranial nerve involvement was found was Case 8, who showed a bilateral 6th nerve palsy, an absent left corneal, and a left peripheral facial with ipsilateral cerebellar signs and bilateral exaggeration of the deep reflexes. The diagnosis of an intrapontile glioma was made but at autopsy a huge tuberculoma involving the left cerebellum, pons, midbrain, cerebral peduncle and thalamus was found.

Contralateral hemiplegia was found in 4 patients with frontal lobe lesions (Cases 1, 2, 7 and 10). Ipsilateral cerebellar signs were present in all cases of cerebellar tuberculomas (Cases 3, 6 and 9) and in Case 8.

(b) Epidural. In the 1 case in this group the only symptom was a continuous dull pain localized over the right parietal region with occasional episodes of acute exacerbation. Exquisite tenderness over the right parietal bone, near the vertex, was the only positive sign. Plain x-rays of the skull revealed an irregular area of erosion in the right parietal bone, about the size of half a dollar, which was interpreted by the roentgenologist as a metastatic carcinoma. At operation an epidural tuberculoma was disclosed.

Diagnosis

In the cases under discussion the preoperative diagnosis of tuberculoma was made in 2: in Case 3, who gave a history of tuberculous contact in the family, and in Case 9, whose chest x-rays showed a small parenchymatous lesion in the left pulmonary base. In 7 of the cases the diagnosis of brain tumor was made and in 1 a brain abscess was suspected.

There was no x-ray evidence of calcification of the lesions in any of our cases. The only roentgenological abnormalities were those produced by intracranial hypertension, namely, marked separation of the sutures in children and erosion of the sella turcica or its processes in adults. Ventriculography was performed in all the cases of intracerebral tuberculomas and by this diagnostic aid their location was disclosed in every instance.

Tuberculin intradermal tests were done in 3 of the 5 children: a positive reaction was obtained in every instance.

The final burden of proof in the diagnosis of intracranial tuberculomas in our series lay on the histological verification of the lesions. As a whole,
a diagnosis of tuberculoma can not be made preoperatively, although one may suspect its presence. A tentative diagnosis may be entertained when there is an extracranial tuberculous focus, a history of contact with tuberculous individuals, or when signs of increased intracranial pressure are present during the course of or after an apparent clinical cure of tuberculous meningitis. In this last respect I may say that during the past 3 years we have been called in consultation by our local Children’s Hospital in 25 cases of tuberculous meningitis with signs of increased intracranial pressure. All these patients showed internal communicating hydrocephalus which at autopsy was found to be caused by obstruction of the cisterns at the base; no evidence of tuberculomas, gross or microscopic, could be disclosed in any of them.

In any event, I repeat, if the diagnosis of tuberculoma is made preoperatively, a conclusive and certain proof can not be obtained, even in the presence of extracranial tuberculosis, until the histological study of the lesion has been undertaken, as any true cerebral neoplasm may coexist with tuberculosis elsewhere.

**TABLE 2**

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Location and weight of tuberculomas</th>
<th>Weight (gm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Left frontal</td>
<td>19.0</td>
</tr>
<tr>
<td>2</td>
<td>Right frontal</td>
<td>113.5</td>
</tr>
<tr>
<td>3</td>
<td>Right cerebellar</td>
<td>16.0</td>
</tr>
<tr>
<td>4</td>
<td>Left temporal</td>
<td>46.0</td>
</tr>
<tr>
<td>5</td>
<td>Right cerebellar</td>
<td>10.0</td>
</tr>
<tr>
<td>6</td>
<td>Right anterior mesencephalothalamic</td>
<td>27.0</td>
</tr>
<tr>
<td>7</td>
<td>Right frontal</td>
<td>68.5</td>
</tr>
<tr>
<td>8</td>
<td>Right cerebellar</td>
<td>?</td>
</tr>
<tr>
<td>9</td>
<td>Right cerebellar</td>
<td>38.0</td>
</tr>
<tr>
<td>10</td>
<td>Right frontal</td>
<td>14.0</td>
</tr>
</tbody>
</table>

**LOCATION AND WEIGHT OF THE LESIONS**

In 9 cases the lesion was solitary. In Case 7 there were two tuberculomas: one disclosed and removed at operation and one found at autopsy. As has already been mentioned, there were 1 epidural, located over the right parietal region, and 9 intracerebral tuberculomas. Among the intracerebral lesions (Figs. 1 and 2) 3 were located in the right cerebellar lobe, 3 in the right frontal and 1 each in the left frontal and left temporal lobes. Autopsy in Case 8 disclosed a tuberculoma which extended from the left cerebellar lobe to the left pons and midbrain, left cerebral peduncle and thalamus.

Nine tuberculomas were completely removed at operation. The epidural tuberculoma looked grossly like a nonspecific granuloma en plaque secondary to a destructive tuberculous lesion of the parietal bone. It was adherent to the dura, showed no subdural or intracerebral invasion and had a total weight.
of 10 gm. The 8 intracerebral tuberculomas presented a uniform appearance: all of them projected into the brain substance, just a small area appearing over the cortex, and only 3 were adherent to the inner surface of the overlying dura mater.

The color of the lesions varied from a dirty yellow to a reddish-gray. The consistency was hard. The neighboring cerebral or cerebellar cortices presented uniformly a widespread edema, unlike that encountered with gliomas and abscesses. This type of edema gave the neighboring convolutions a water-logged appearance, glassy-like, as if one could actually see through them, and it was so constant that a diagnosis of tuberculoma could be made invariably at the operating table upon opening the dura. The average weight of the tuberculomas was 43 gm., the smallest 14 gm., and the largest 112.5 gm. It is noteworthy that the patients with the largest tuberculomas (Cases 2 and 7) had a duration of symptoms of 24 and 36 months respectively.
COEXISTENCE WITH CLINICAL EVIDENCE OF EXTRACRANIAL TUBERCULOSIS

Among these cases there was only 1 in which a diagnosis of a suspicious extracranial active focus could be made. This was Case 9, in which the roentgenologist diagnosed a well-defined parenchymatous lesion in the left pulmonary base which cleared up completely after operation with the administration of streptomycin and paraaminosalicylic acid. Three patients died postoperatively and no gross evidence of extracranial tuberculosis was found at autopsy. This, however, does not mean that an active focus was not present as serial sections of the tracheobronchial and mesenteric lymph nodes were not made. Of these 3 patients, only 2 received adequate streptomycin therapy.

TREATMENT

All 10 patients were operated upon. An immediate postoperative diagnosis of tuberculoma was made in 9 cases. In Case 8 the diagnosis of an intrapontile glioma with invasion to the left cerebellopontile recess was made but no tumor at the angle was disclosed through a left suboccipital craniectomy. The autopsy findings are discussed elsewhere in this paper. This particular patient was subjected to intensive deep x-ray therapy, e.g., 10,000 r.n. postoperatively, but died 3 months later from the effects of intracranial hypertension.

As already mentioned, a complete extirpation of the lesion was performed in 9 cases. In the treatment of the intracerebral tuberculomas particular emphasis was placed on resecting about 1.5 cm. of uninvolved cerebral tissue at the edges. Frozen sections were made as we proceeded with the operative closure and as soon as the diagnosis of tuberculoma was established, dihydrostreptomycin, 0.50 gm., was given intramuscularly and 0.050 gm. intrathecally by the lumbar route while the patient was on the operating table. The intrathecal streptomycin was continued every other day for a total of 3 doses. The subsequent treatment in every case, regardless of the patient’s age, consisted of dihydrostreptomycin, 0.50 gm., intramuscularly twice a day for 1 month and 0.50 gm. intramuscularly daily for 6 additional weeks. Case 9 received in addition paraaminosalicylic acid for the first 6 weeks postoperatively. Cases 2 and 7 showed evidence of tuberculous meningitis on the 29th and 48th postoperative day respectively. These two patients were given dihydrostreptomycin, 0.050 gm., intrathecally every other day in addition to 0.50 gm. intramuscularly twice a day until their time of death. Promin, 5.0 gm. intravenously, was given daily for 4 weeks to Case 2. General supportive measures were administered in every instance.

No permanent sequelae from the use of dihydrostreptomycin were noticed in any of the 7 survivors. In Case 1 dihydrostreptomycin, 0.50 gm., was given intrathecally by mistake on the 2nd postoperative day. Fifteen minutes after its administration the child became deeply unconscious, with dilated and fixed pupils, absent corneal and deep reflexes, and urinary reten-
INTERCRANIAL TUBERCULOMAS

TABLE 3
Treatment and end results

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Operation</th>
<th>Streptomycin</th>
<th>PAS</th>
<th>Promin</th>
<th>Follow-up</th>
<th>End Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Craniotomy</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>36 mos.</td>
<td>Good</td>
</tr>
<tr>
<td>2</td>
<td>Craniotomy</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>3 mos.</td>
<td>Died. Tbc. meningitis</td>
</tr>
<tr>
<td>3</td>
<td>Craniectomy</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>36 mos.</td>
<td>Good</td>
</tr>
<tr>
<td>4</td>
<td>Craniotomy</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>36 mos.</td>
<td>Good</td>
</tr>
<tr>
<td>5</td>
<td>Craniectomy</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>24 mos.</td>
<td>Good</td>
</tr>
<tr>
<td>6</td>
<td>Craniectomy</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>18 mos.</td>
<td>Good</td>
</tr>
<tr>
<td>7</td>
<td>Craniotomy</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>3.5 mos.</td>
<td>Died. Tuberculoma, left temporal</td>
</tr>
<tr>
<td>8</td>
<td>Craniectomy, exploratory</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>3.5 mos.</td>
<td>Died from hydrocephalus</td>
</tr>
<tr>
<td>9</td>
<td>Craniectomy</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>16 mos.</td>
<td>Good</td>
</tr>
<tr>
<td>10</td>
<td>Craniotomy</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>12 mos.</td>
<td>Good</td>
</tr>
</tbody>
</table>

tion, and he was irresponsible even to painful stimuli. His respirations were 8 per min. and his pulse rate was 48. Supportive measures were instituted. The child recovered consciousness 72 hours later and made an ultimate recovery without sequelae.

END RESULTS

There were 3 deaths and 7 survivals in our small series of cases. The postoperative deaths will be analyzed under a separate heading. The 7 survivors have been followed periodically from 12 to 36 months and all are living and well up to the time of this communication. Cases 1, 3 and 4 are in good health after 36 months. Cases 5, 6, 9 and 10 are living and well after 24, 18, 16 and 12 months respectively. No clinical evidence of extracranial tuberculosis has been disclosed in any of these patients during the specified periods of time. The children included in this series are among the survivors.

ANALYSIS OF POSTOPERATIVE DEATHS

The 3 patients who died were adults. In Case 8 the true nature of the lesion was discovered at autopsy which showed, as already mentioned, a sausage-shaped tuberculoma which extended from the left cerebellar lobe to left pons, midbrain, cerebral peduncle and thalamus. The cisternae pontis and interpeduncularis were occluded by the tumor. If the true nature of the growth had been established at operation, a decompressive measure to relieve the hydrocephalus combined with streptomycin therapy, could possibly have given this patient a better chance for survival.
The other postoperative deaths occurred in Cases 2 and 7 from tuberculous meningitis. Both patients were given dihydrostreptomycin, and Case 2 received in addition intravenous Promin. Case 2 showed evidence of tuberculous meningitis on the 29th and died on the 87th postoperative day. Autopsy confirmed the diagnosis of tuberculous meningitis. In Case 7 meningitis developed 48 days and death occurred 101 days after operation. Autopsy showed in addition to the tuberculous meningitis, a tuberculoma in the left temporal lobe, 3.5 cm. in diameter. Because of signs of increased intracranial pressure on the 50th postoperative day, ventriculography had been performed, which showed only an internal hydrocephalus without evidence of a supratentorial space-occupying lesion.

There are certain common features in these 2 cases. Both patients were Indians, and had had the longest duration of symptoms. Both came into the hospital hemiplegic and in extreme emaciation. The intracranial pressure was so great and the loss of vision so advanced that in order to preserve vision and life we had to operate upon them within the first 24 hours following admission. And finally, both of these patients had the largest tumors. In Case 7 it is conceivable that the meningitis might have come from the additional tuberculoma while in Case 2 it was a direct sequela of the operative procedure. Case 7 has demonstrated the futility of using streptomycin alone in the treatment of intracranial tuberculomas.

CONCLUSIONS

From the presentation of these cases we may draw the following conclusions:

1. Tuberculomas are among the common intracranial expanding lesions.
2. They are more prevalent in the first two decades of life.
3. The duration of symptoms may fluctuate from 2 to 36 months.
4. A history of fever may be obtained at the onset of symptoms.
5. Headaches and early signs of increased intracranial pressure are the most constant clinical features.
6. The water-logged, glassy appearance of the surrounding brain may help in the gross diagnosis of the lesion at the operating table.
7. A definite diagnosis can not be made until the histological examination of the lesion is undertaken.
8. A complete surgical removal of these lesions, whenever feasible, combined with adequate streptomycin therapy should be the method of choice in their management.
9. Children seem to have a better chance of survival than adults.

SUMMARY

1. Our experience in the surgical treatment of 10 consecutive cases of intracranial tuberculomas has been presented.
2. Their incidence, symptomatology, operative findings and end results are discussed.
3. Complete surgical extirpation with adequate streptomycin therapy was performed in 9 cases.

4. Of these 9 patients, 2 died from tuberculous meningitis and 7 are living and well for a period ranging between 12 and 36 months.

REFERENCES


