

SUBJECTIVE AND OBJECTIVE CRITERIA IN THE DIAGNOSIS OF
MENINGIOMAS OF THE BRAIN, WITH REMARKS AS TO
MORTALITY AND USEFUL SURVIVAL*

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BECAUSE OF THEIR BENIGN NATURE and surgical accessibility, the meningiomas both above and below the tentorium constitute a group of brain tumors which are among the most favorable of all intracranial new growths. With rare exceptions, they are capable of complete surgical removal and the patients are restored to normal health. At times, the diagnosis of such a tumor, as well as its site, is comparatively easy, but in some instances the insidious onset and slow progression of symptoms may be misleading and the lesions may then attain such large size that their removal is difficult and hazardous. It is for this reason that the initial symptomatology in a considerable group of these tumors has been studied and certain special diagnostic features reviewed in order that the presence of such a growth might be suspected at as early a stage as possible.

A word as to the frequency of meningiomas: In a series of 1146 verified brain tumors seen between the years 1933 and 1946 at the Lahey Clinic, the various tumor types were as shown in Table I.

It will be seen from the table that the 168 meningiomas represented 14.6 per cent of

all tumors in the present series. This is somewhat less than the proportion reported from a smaller total series in 1939, when meningiomas formed 19 per cent of all our verified tumors up to that year.⁴ The present percentage compares roughly with the 13.5 per cent in Cushing's series² and is almost the same as the 14.8 per cent cited by Grant,³ but somewhat less than the 18.4 per cent of Olivecrona.⁶ This higher figure is doubtless to be accounted for, as the author states, because, owing to the long waiting list, "we naturally try to weed out the glioblastomas and give precedence to patients who, judging from their case history and other circumstances, are likely to have lesions where surgery may be useful."

DIAGNOSTIC FEATURES

In so far as symptomatology and diagnostic measures are concerned, the present study deals only with the first consecutive 115 patients having meningiomas whose records have been reviewed for this purpose. For mortality and survival statistics, the entire group of 168 have been utilized.

Initial Symptoms and Their Duration.

1. *Headache.* In 37 patients, or 32.1 per cent, headache was the initial complaint.

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The average duration of headache was 16 months, the longest being six years in a left frontal tumor. It should be emphasized that headache as a rule occurs in the later stages of the growth of brain tumors. It is the result of pressure which may be caused directly by the size of the growth or indirectly from internal hydrocephalus pro-

should be a routine part of every physical examination. Experience has shown that an appreciable number of patients have visual field defects of which they have been unaware. The location of tumors producing visual disturbances as the initial symptom is shown in Table III. As might be expected, all the sphenoid wing tumors which cause early unilateral exophthalmos came into this category as well as the tumors arising from the tuberculum sellae which produce pressure upon the optic nerves and chiasm. It

TABLE I.—*Verified Brain Tumors, 1933–1946.*

Astrocytoma.....	236
Cerebral.....	204
Cerebellar.....	32
Glioblastoma multiforme.....	176
Meningioma.....	168 (14.6%)
Pituitary adenoma.....	111
Chromophobe.....	85
Chromophil.....	24
Basophil.....	2
Acoustic neuroma.....	95
Metastatic.....	75
Hemangioblastoma.....	58
Cerebral.....	27
Cerebellar.....	31
Craniopharyngioma.....	33
Pinealoma.....	22*
Oligodendroglioma.....	22
Angioma.....	21
Medulloblastoma.....	18
Spongioblastoma.....	17
Ependymoma.....	9
Cholesteatoma.....	9
Colloid cysts (third ventricle).....	4
Miscellaneous and unclassified.....	72
Total.....	1146

* Eight verified by ventriculogram.

duced by blockage of the circulation of cerebrospinal fluid. The onset of persistent headache in an adult, or recurring bouts of headache, should never be dismissed lightly. The location of tumors producing headache as the initial symptom is shown in Table II.

2. *Visual disturbances.* Thirty-two patients, or 26.9 per cent, complained initially of some difficulty in their visual apparatus. These complaints included blurred vision, double vision, failing vision and protrusion of an eye. The average duration of visual disturbance was 36 months. The longest was 20 years in a sphenoid wing tumor with protrusion of the eye. Without this case the average duration was 26 months. A rough test of the visual fields by confrontation

TABLE II.—*Headache.*

Location	Number of Cases
Frontal.....	13
Parasagittal.....	6
Temporal.....	4
Cerebellar.....	4
Sphenoid ridge.....	2
Frontotemporal.....	2
Occipitoparietal.....	2
Parietal.....	1
Ventricular.....	1
Postoptic chiasm.....	1
Incisura.....	1
Total.....	37

Average duration of headache preoperatively = 16 months

is in the latter group that an early diagnosis is of the utmost importance so that the tumor may be removed while of relatively small size and before irreversible damage has been done by long-continued pressure on the structures mentioned. Cushing and Eisenhardt¹ called attention to the symptomatology of these growths in 1929, making it clear that they should be suspected in adults with slowly failing vision and in whom a tendency to bitemporal hemianopsia and optic atrophy, along with a normal sized sella turcica, could be demonstrated. A few patients complained of headache and blurred vision simultaneously as their first symptoms, so they have been included in both groups.

3. *Convulsions.* One or another form of convulsive seizure was the initial symptom in 25 of the 115 patients, or 21.7 per cent,

but convulsions occurred at some time in the course of their illness preoperatively in 44 patients, or 38.2 per cent. The average length of time that seizures had been present was 28 months. The longest was 11 years in a parieto-occipital tumor, and it should be noted that this patient had no attacks after the tumor was removed. It is

TABLE III.—Visual Disturbances.

Location	Number of Cases
Sphenoid ridge.....	11
Frontal.....	6
Suprasellar.....	6
Olfactory groove.....	2
Cerebellar.....	2
Postoptic chiasm.....	1
Occipitoparietal.....	1
Occipitotemporal.....	1
Parasagittal—bilateral.....	1
Temporoparietal.....	1
Total.....	32

Average duration preoperatively = 36 months

likewise of interest that in women, seizures resulting from brain tumors may occur for the first time during pregnancy.

In speaking of convulsions it should be noted that 32 patients, (27.8 per cent of the 115) had one or more convulsions at some time postoperatively, either in the immediate postoperative period or subsequently during the years they have been followed. However, more than half of the 32 have been adequately controlled by medication, that is, they were averaging less than two seizures a year. This aspect of meningiomas has been dealt with in some detail elsewhere by the present authors.⁸

Table IV shows the location of tumors causing convulsions as the initial symptom. It will be seen that the vast majority were in either the parasagittal or frontal area.

4. *Localized or unilateral weakness.* Eight patients, or 6.9 per cent, complained of local weakness of one side or of one extremity as the initial symptom. A distinction should be made between weakness or paresis and paralysis. Paresis is most

often the result of pressure and may greatly improve following removal of pressure, while paralysis is usually due to destruction of nervous tissue and carries a poor prognosis for ultimate complete recovery. The average duration of one-sided weakness in these cases was 15 months. The longest was two years, with weakness of the right leg associated with a left parasagittal tumor.

5. *Loss of sense of smell.* Four patients—all olfactory groove meningiomas—complained of loss of the sense of smell as the

TABLE IV.—Convulsions.

Location	Number of Cases
Parasagittal.....	10
Frontal.....	9
Temporal.....	2
Occipitoparietal.....	1
Frontotemporal.....	1
Olfactory groove.....	1
Parietal.....	1
Total.....	25

Average duration preoperatively = 28 months

initial symptom. This had been present on an average of seven and one-half years, with the longest 24 years.

6. *Ataxia.* Four patients complained of loss of balance or staggering as the initial symptom. The average duration of ataxia was only seven months, so it appears these patients are seen by a neurosurgeon sooner after onset than patients with other types of complaints.

7. *Other symptoms.* Two patients complained of difficulties in speech as the initial symptom, with an average duration of 15 months. One case was a left parasagittal tumor—the other a left temporal tumor. One patient complained initially of noise in the ear; another of aching in his neck; a third of lack of concentration; only one complained of a “lump on my head” which had been present three years. The fact that only one patient in the series had such a protrusion is rather unusual, since it is a

FIG. 1



FIG. 2

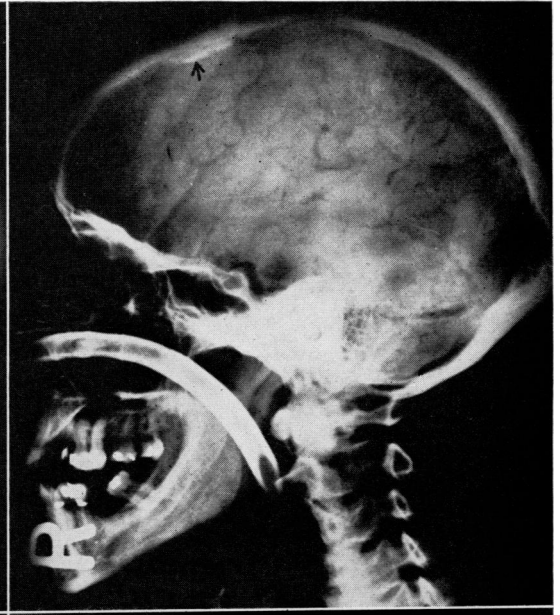


FIG. 3

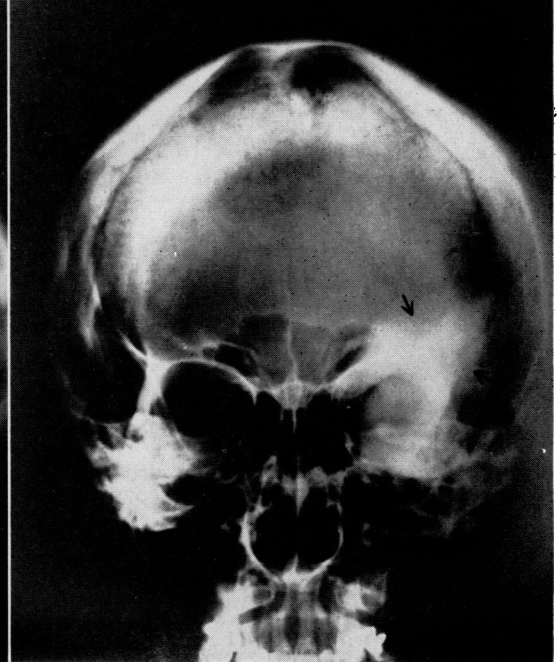


FIG. 4

- FIG. 1.—Meningioma of right parietal area shown by overvascularity.
FIG. 2.—Frontal enostosis (arrow) with increased vascularity, indicating the site of a meningioma.
FIG. 3.—Localized thickening of skull (arrows) overlying a meningioma.
FIG. 4.—Sphenoid wing meningioma causing great thickening of bone (arrows).

fact that meningiomas not infrequently produce external hyperostosis of the skull.

SPECIAL DIAGNOSTIC AIDS

In addition to a careful study of the symptomatology of meningiomas, together with the results of a neurologic examination,

the tumor (Fig. 5) and erosion or deformation of the sella turcica (Fig. 6).

In 55 cases, or 47.8 per cent of this series, stereoscopic roentgenograms of the skull suggested the tumor localization accurately. In one case the roentgenogram was misleading. Our percentage is similar to that

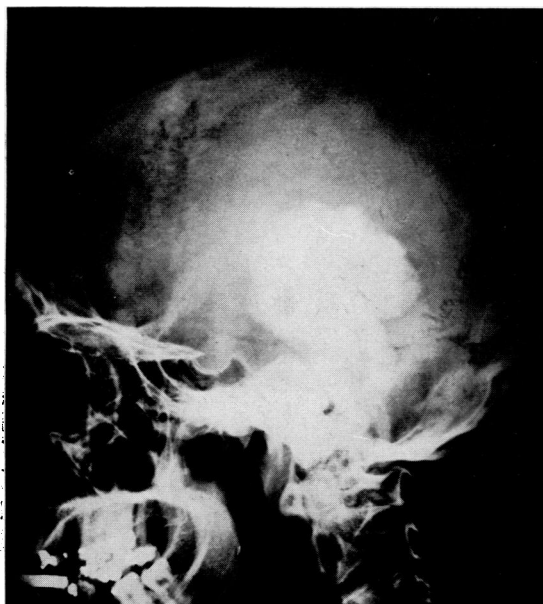


FIG. 5

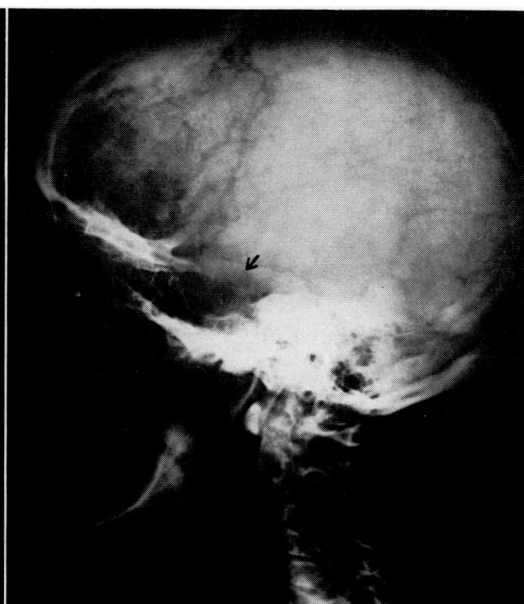


FIG. 6

FIG. 5.—Large calcified meningioma.

FIG. 6.—Destruction of posterior clinoid processes and enlargement of sella due to meningioma.

there are a number of special studies that are useful and often essential in making the correct diagnosis, not only of the presence or localization of the tumor but, in many instances, of its pathology. Among these, the following may be mentioned:

1. *Roentgenograms of the skull.* In a considerable proportion of cases meningiomas betray their presence by certain features which may be seen in the usual roentgenograms of the skull. These include abnormal vascular channels (Fig. 1); hyperostoses or enostoses (Fig. 2); general thickening of the bone (Fig. 3) or of one sphenoid wing (Fig. 4); calcification within

reported by Sosman and Putnam in 1925⁷ from Cushing's clinic (50 per cent) and to that reported by Grant in 1947 (54.2 per cent). Olivecrona, however, (1947) found that only 52 of his 205 patients with parasagittal meningiomas showed characteristic roentgenographic changes (25.3 per cent).

Another roentgenologic feature, which is helpful for lateralization but not for localization, is the "pineal shift" as described by Naffziger.⁵ Such a displacement to one side or the other of the pineal calcification was present in six out of 23 cases in our series in which such calcification could be visualized. In Grant's series of 149 patients, such

a shift was noted in 20 cases. This finding, of course, is not diagnostic of a meningioma as distinct from other brain tumors, but is helpful when such a tumor is suspected.

2. *Protein content of the cerebrospinal fluid.* A protein determination above 50 mg. per 100 Gm. for cerebrospinal fluid obtained from the lumbar region and above 20 mg. per 100 Gm. from the ventricles, has been considered abnormal in our laboratories. In 37 patients, fluid from one of these sources, ventricular in most cases, was examined for protein and in 24 instances (68 per cent of the 37 cases) the protein was abnormally elevated. It may be added in this connection, that in our clinic, lumbar puncture is never done in the presence of choked disks or other evidence of increased intracranial pressure or when a brain tumor is suspected even in the absence of these findings. It is unfortunate that lumbar puncture continues to be carried out rather promiscuously in many clinics and hospitals throughout the country on any patient who is thought to have a neurologic lesion, no matter what its nature, and every year a certain number of deaths occur after this procedure in tumor cases because of respiratory failure. In the few patients with meningiomas in our series who had lumbar punctures, a tumor was either not suspected or the patient did not have evidence of increased intracranial pressure.

3. *Air Studies.* In 65 (56.5 per cent) of the 115 patients with whom we are dealing, it was felt that some form of air study was necessary, either to make the diagnosis of tumor as distinguished from some other type of lesion, or more frequently, to obtain a more accurate idea of the tumor's location than could be gained by neurologic findings or the roentgen examination before air had been introduced. In 60 instances ventriculograms were performed, while five patients had air encephalograms—the latter almost without exception when a condition other than tumor was suspected.

4. *Angiography.* Up to the year 1946, which was the date taken in order to give a five-year or more follow-up study of our series, only one arteriogram had been performed on a patient having a meningioma. Up to that time, Diodrast or, occasionally, Thorotrast had been injected for diagnostic purposes only in patients suspected of having aneurysms or a purely vascular intracranial lesion. During the last five years, however, the frequency and usefulness of this procedure has increased greatly and has to some extent, replaced ventriculography as a diagnostic measure.*

MORTALITY AND USEFUL SURVIVAL STATISTICS

As noted previously, there have been 168 verified meningiomas of the brain in our series from 1933 through 1946, the latter year having been chosen for this study in order that a minimum follow-up of at least five years would be possible. All the patients, with one exception, had craniotomies for the removal of their tumors. The exception was a patient who had a ventriculogram only and died following this procedure. Of the total, the tumors were completely removed, so far as could be told, at the time of operation in 152 patients. In the remaining 15, growth had extended widely into bone at the base or was densely adherent to important structures in the cerebellopontile angles or elsewhere, so that subtotal extirpations only could be accomplished with safety.

Twenty-three patients died in the hospital after operation (including the patient who died after the ventriculogram), thus giving an operative mortality of 13.6 per cent. It should be noted, however, that among the 63 patients who were operated upon during the last five years of this study, that is, from

* It should be noted that the electro-encephalogram is a further diagnostic measure which may be helpful in the localization of meningiomas as well as of other types of tumor. We have not taken up this feature, however, in the present study.

1942 through 1946, there were only five deaths, making the operative mortality for this period 7.9 per cent.

However, mortality statistics, although obviously important, are by no means the only criteria by which operations on patients having brain tumors should be judged. The further course of the patients after leaving the hospital, and more especially, their ability to return to their usual occupations or at least to some form of useful activity, are the features in which we are all interested.

Of the 145 patients who survived their operations and left the hospital, 114, or 78.6 per cent, are known to have lived five years or more. Eight of these patients died from five to 18 years subsequently, three from tumor recurrence and five from other causes. On 15 other patients, we have received follow-up data of from one to four years only, and all of these were living. Eight patients are known to have died within four years after leaving the hospital, six from recurrent tumor and two from other causes. We have had no report on the remaining eight patients.

Our final consideration concerns the number and percentage of patients who have been living useful lives since the removal of their tumors. This, in some instances, is a difficult matter to judge, but in going over the records of the 114 who survived five years or longer, it was found that two patients were blind and 15 others had either some major disability, such as a hemiparesis, or were having fairly frequent convulsions. Eliminating these 17 cases, there were 97, or 85 per cent, of the 114 five-year survivors who had either returned to some useful activity or, if not employed, had remained in good or excellent health.

SUMMARY

The incidence and duration of the initial symptoms of patients having meningiomas of the brain have been reviewed, the most frequent features being headaches, visual disturbances and convulsions.

In making the diagnosis of meningiomas, we have studied the value and usefulness of such diagnostic aids as roentgenograms of the skull, both with and without air injections.

The operative mortality for meningiomas of the brain at the Lahey Clinic from 1933 through 1946 was 13.6 per cent, but during the five-year period from 1942 to 1946 inclusive, this mortality was reduced to 7.9 per cent. Seventy-eight per cent of the patients surviving their operations have lived from five to 18 years and of the five-year survivors, 85 per cent were living useful lives up to the time of their last report or until their death.

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