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RESULTS OF IRRADIATION OF TUMORS IN THE REGION OF THE PINEAL BODY

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Tumors in the region of the pineal body are rare, occurring as 0.5 to 1.0 per cent of all intracranial tumors (ZÜLCH 1965). Young males are most often affected (DAYAN et coll. 1966, NISHIYAMA et coll. 1966, RUSSELL & RUBINSTEIN 1971). A presumptive diagnosis is usually made on clinical and neuroradiologic findings. Although treatment has varied from center to center, radiation therapy has usually been an integral part of the planned management. However, there have been a few long term survivors following only a shunting procedure (TORKILDSEN 1948).

Early reports of surgical excision were disappointing. DANDY (1936) reported seven consecutive deaths among 10 patients where radical extirpation was attempted. Subsequently, HORRAX (1950), RAND & LEMMEN (1953) and RINGERTZ et coll. (1954) each reported high operative mortality in their series. Due to an unfavorable experience with radical surgery, DAVIDOFF (1967), POPPEN & MARINO (1968) and RAND & LEMMEN (1953) suggested that the primary treatment for tumors in the region of pineal body should be radiation therapy without neurosurgical intervention other than a shunting procedure. MAIER & DEJONG (1967) and COLE (1971) each reported a significant number of long term survivors with radiation therapy as the primary treatment modality. Although there are a few recent reports showing that radical excision of pineal tumors may be accomplished with reasonable safety (STERN

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Table

Frequency of presenting signs and symtoms

	Per cent
1) Symptoms secondary to increased intracranial pressure	85
2) Spasticity	35
3) Ataxia	30
4) Parinaud's syndrome	25
5) Nystagmus (cerebellar type)	25
6) Syncope	20
7) Vertigo	20
8) Cranial nerve palsy (other than C.N. VI or VII)	20
9) Intention tremor	15
10) Scotoma	10
11) Tinnitus	10
12) Other	10

et coll. 1971 and SUZUKI & IWABUCHI 1965), the value of radiation therapy continues to be emphasized.

The effectiveness of irradiation in relieving symptoms and increasing survival at this center is now reported.

Material and Methods

Records of all patients with tumors in or about the third ventricle, sella, midbrain, and brainstem from the period 1950 through 1969 were reviewed. Among these patients, 20 previously untreated patients (15 males ranging in age from 2 months to 65 years, and 5 females from 22 to 58 years) had tumors in the region of the pineal body. The most common presenting symptom was that associated with increased intracranial pressure. The frequency of presenting signs and symptoms is given in the Table. The duration of symptoms ranged from 2 weeks to 3 years with 76 per cent of patients presenting within 6 months of the onset of symptoms.

Diagnosis was presumed on the basis of encephalography in one patient and on pneumoventriculography in the remaining patients. In addition, 5 patients had surgical exploration of the cerebellum and brain stem, although in no case was an attempt made to excise or biopsy the tumor. Radiologically, however, all patients had filling defects in the midline of the posterior part of the third ventricle consistent with pinealoma.

Throughout this review period, the treatment policy was decompression and ventricular shunting if necessary, followed by radiation therapy in all patients whose general condition allowed it. Of the 20 patients, 2 patients did not require a shunting

procedure. Among the 20 patients reviewed, 14 were accepted and received a planned course of radiation therapy. These 14 patients are thus available for analysis.

All patients were prescribed to receive a tumor dose of 4 000 rad or higher. Initially, 200 kV radiation with multiple portals was used, and later ^{60}Co teletherapy with parallel-opposed or three fields. Irradiation was administered with an average tumor dose of 200 rad per treatment 5 times per week, and all fields were treated daily. Field size was usually 25 cm^2 to 50 cm^2, although an occasional patient with an advanced tumor was treated with portals up to 100 cm^2. No prophylactic irradiation to the entire cerebro-spinal axis was given. Retreatment was attempted in 5 patients. Doses were then reduced to 1 000 to 2 000 rad.

Results

Among the 14 patients treated, signs and symptoms attributable to increased intracranial pressure such as diplopia, blurred vision and headache were relieved by a shunting procedure alone. Eleven patients (79 %) had significant improvement from the course of irradiation, as determined by relief of other neurologic signs and symptoms and by survival. Signs attributable to brain stem involvement were relieved in 7 of 8 patients. Cerebellar signs improved in one of 3 patients. In no case was Parinaud's syndrome relieved.

Six patients died or were lost to follow-up within 3 years. Eight patients survived more than 3 years with minimal residual neurologic deficit. One of these patients developed a spinal metastasis 3½ years after treatment. The remaining 7 patients (50 %) survived 5 years or more.

Visual abnormality and brain stem involvement occurred with approximate equal frequency among survivors as in the entire group. However, only one patient of 8 presenting with cerebellar signs in the entire group is among the long term survivors. This patient improved following radiation therapy and remained stable for 11 years with mild ataxia. She died without clinical evidence of recurrence though no autopsy was obtained. Hypothalamic involvement was present in one patient initially who later was in such poor condition as not to complete treatment, and occurred in a second patient as a terminal event.

Two patients developed metastases. One had seeding within the third ventricle on presentation and is presently alive at 5 years with no evidence of disease. The other developed a local recurrence and spinal metastasis 3½ years after treatment, dying shortly thereafter.

In the 5 patients where retreatment was attempted it was successful in one and palliative in two.

Discussion

Malignant tumors in the midline and posterior part of the third ventricle may be distinguished by neuroradiologic methods and include tumors of the pineal body,

colliculate plate, and aqueduct (GREITZ 1972). Differentiation among these sites is difficult, and was not attempted in this series. However, benign tumors (colloid cysts) are reliably excluded by proper neuroradiologic assessment (CUMMINGS et coll. 1966), and many series presume the diagnosis of pineal tumors short of surgical exploration of the third ventricle.

The histories of 20 previously untreated patients fitting this criteria and presenting from 1950 to 1969 have been reviewed. Six were in such poor general condition that a course of irradiation was not possible. The remaining 14 patients completed a course of radiation therapy. Fifty per cent of these have survived 5 years or more.

A review of the literature shows that the surgical mortality may be high and that most survivors have received radiation therapy following radical extirpation. Decompression, when necessary, followed by radiation therapy has produced equal or improved survival without the morbidity or mortality of extirpation.

An analysis of the frequency of presenting signs and symptoms was made to predict prognosis, and to evaluate the response to radiation therapy. Visual disturbance is a frequent initial presenting symptom. Classically, there is a paresis of upward gaze (Parinaud's syndrome). Insofar as paresis of upward gaze is secondary to a destructive process in the midbrain tegmentum (BALTHASAR 1968), it might not be expected to be relieved by treatment and was not relieved in any of the patients demonstrating it in this series. Other visual disturbances such as diplopia and blurred vision are not uncommon and were mainly improved by decompression. Evidence of brain stem involvement including cranial nerve paresis and spastic hemiparesis were frequent presenting findings and were improved in most cases with treatment. The presence of visual disturbance or brain stem involvement was not unfavorable prognostic findings in this series. They occurred with equal frequency among survivors as in the entire group.

Eight patients in the entire group presented with evidence of cerebellar dysfunction (ataxia or intention tremor). Only 3 of them were able to undergo a course of irradiation and one survived. Although the numbers are small, this suggests that cerebellar signs or symptoms unfavorably affect prognosis, possibly due to greater tumor size.

Disorders of hypothalamic and neurohypophyseal function may also be initial findings, and were found in one patient in this series (diabetes insipidus) who died before treatment. A second patient developed diabetes insipidus terminally. No prognostic interpretation can be made, although most other reported cases continue to require exogenous hormonal replacement following irradiation (PUSCHETT & GOLDBERG 1968).

Failure to achieve a satisfactory response to radiation therapy in some of these patients may be due to the variety of histologic types in this region. RUSSELL & RUBINSTEIN (1971) divide tumors of the posterior part of the third ventricle into four categories: (1) pinealoma, (2) teratoma, (3) glioma and (4) cysts. True pinealomas (pineocytoma and pineoblastoma) of pineal parenchymal origin account for only 20 per cent of all tumors of the pineal body (MCGOVERN 1949). They are stated to have

no sex or age predominance (RUSSELL & RUBINSTEIN) and may contribute to the broad age distribution in this as well as other series. Teratomas may be typical and include all three germ layers, or atypical, closely resembling seminoma or dysgerminoma. The atypical group comprises the majority of tumors in this region (ALBRECHTESEN et coll. 1972, FRIEDMAN 1947 and RUSSELL & RUBINSTEIN), is predominantly found in males and has a peak incidence in the second decade of life. Its microscopic similarity to radiation sensitive tumors of the testicle and ovary may account for successful treatment with radiation (NISHIYAMA et coll. 1966). Due to the variety of possible histologic types, it appears that a dose around 5 000 rad using conventional fractionation is optional for treatment (EL-MAHDI et coll. 1972). The incidence of spinal metastases seems sufficiently low to justify treating with small fields, sparing as much normal tissue as possible (MAIER & DEJONG 1967).

SUMMARY

The clinical findings and results of radiation treatment in 14 patients with tumors in the region of the pineal body are presented. The neurologic signs and symptoms improved significantly in 11 patients (79 per cent). The survival rate for five years or more was 50 per cent. Radiation therapy as the primary method of treatment is discussed.

ZUSAMMENFASSUNG

Die klinischen Befunde und Ergebnisse der Strahlentherapie von 14 Patienten mit Tumoren im Gebiet des Corpus pineale werden dargestellt. Die neurologischen Zeichen und Symptome waren bei 11 Patienten (79%) signifikant verbessert. Die Überlebensrate für fünf Jahre oder länger betrug 50%. Die Strahlentherapie als primäre Behandlungsmethode wird diskutiert.

RÉSUMÉ

Les auteurs présentent les tableaux cliniques et les résultats du traitement par les radiations chez 14 malades atteints de tumeur de la région pinéale. Les signes neurologiques et les signes fonctionnels ont été améliorés de façon importante chez 11 malades (79%). Le taux de survie à 5 ans ou plus a été de 50%. Les auteurs étudient le traitement par les radiations comme méthode de traitement primaire.

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