

EEG Findings of Posterior Fossa Tumors

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Electroencephalography has been a helpful diagnostic method for neurological problems since its discovery. It is an easy and safe method and its application for neurological problems is very wide even though the results are not fully dependable. One can find several reports related with EEG findings of hemispherical lesions. But the reports on posterior fossa are quite rare and never satisfactory as far as the number of probands are concerned. With this study we try to contribute more information for this rather unsettled problem.

Tumors of central nervous system in childhood are mostly located in the posterior fossa which includes medulla oblongata, pons, cerebellum, fourth ventricle and cisterns. It extends into the 3rd ventricle by aqueductus Sylvii and by the central canal and foramen magnum into the central canal.

Seventy five percent of all CNS tumors in infancy and fifty percent of all CNS tumors up to 15 years of age are located in posterior fossa. This rate goes down to thirty percent at the age of 30 and is much less around the older ages.

Topographically these tumors are divided into three categories:

1. Midline tumors: Vermis and fourth ventricle tumors and pontile tumors.
2. Hemispherical tumors of the cerebellum.
3. Cerebello-pontine angle tumors: Acoustic neuromas and meningiomas which are rarely seen among children.

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Pathologically, posterior fossa tumors are classified as follows:

1. Gliomas: Mostly medullablastomas, astrocytomas, oligodendrogliomas, ependimomas and reticulum cell sarcomas.
2. Neurinommas.
3. Menengiomas.
4. Vascular tumors: Angioreticulomas and vascular malformations.
5. Tuberculomas.
6. Abscesses.
7. Congenital and acquired cysts.

Materials and Method

Our study was made on the children admitted to Hacettepe Children's Hospital between the years 1965-1971, who were diagnosed as having posterior fossa tumors by clinical examination, radiological studies such as pneumoencephalogram, plain skull films and angiograms. Children of both sexes up to age of 16 were included into the study. EEG was obtained from most of these cases and 49 of them were chosen as probands of this study. Diagnosis of posterior fossa tumor was proved either by surgery or by autopsy in each case. Grass Type IV and Type VI EEG machines were used for the investigation. International 10-20 electrode placement system was employed for electrode placement. Hyperventilation and intermittent photic flashes were used for stimulation.

EEG abnormalities were classified as shown below:

1. Focal abnormalities in forms of slow, sharp waves or spikes.
2. Diffuse abnormalities in forms of slow and sharp waves which were mostly asymmetrical in location.
3. Bilateral focal and symmetrical abnormalities in forms of slow and sharp waves. These waves were located mostly on posterior head regions and were symmetrical in most cases.
4. Bilateral synchronous and paroxysmal abnormalities which occurred in forms of sharp waves and spikes and as paroxysmal discharges.

Findings

1. There were 49 cases between the ages of 16 months and 16 years. Among those there were 30 males and 19 females.
2. According to the topographical classification there were 28 vermis and 4th ventricle tumors, 4 pontil gliomas and ependymomas, al-

together 32 midline tumors. There were 17 cerebellar hemispherical tumors, 11 of which originated from the right, and 6 of them originated from the left cerebellar hemisphere.

3. The distribution of EEG findings of vermis and 4th ventricle tumors is shown on Table I.

TABLE I
DISTRIBUTION OF EEG FINDINGS OF MIDLINE TUMORS

	Normal tracing	Focal Abn.	Diffuse Abn.	Blt.Focal Abn.	Paroxysmal Abn.	Total
Meduloblastoma		2	3	1	4	10
Ependynoma	2	1	1	4	1	9
Glioblastoma			1	1	1	3
Astrocytoma		1	1	1		3
Pontil glioma	2		1	1		4
Unidentified	1		2			3
Percentage of	15.6	12.5	28.1	25	18.7	
Total abnormalities				84.4 %		

4. If the abnormal findings are to be divided among themselves there are:

Diffuse abnormalities: 85.2 %

Focal abnormalities : 15.2 %

5. Diffuse abnormalities also showed a fairly equal distribution among the group: Asymmetrical diffuse abnormalities 28.1 %, bilateral focal abnormalities 25 %, paroxysmal abnormalities 26 %. The figures in items 4, 5 and 6 clearly show that midline tumors have more tendency to cause generalized disturbances of brain function and diffuse abnormalities. The difference between focal and diffuse abnormalities is quite significant.

6. The distribution of EEG findings of cerebellar hemispherical tumors is shown on Table II.

Table II shows a high incidence (88.3 %) of abnormality among cerebellar hemispherical tumors. The rate of focal abnormalities among the total abnormalities goes up to 40 %. This figure is significantly higher than the midline group. On the other hand, the rate of diffuse abnormalities and paroxysmal abnormalities are relatively lower than the midline group. But, this was not found statistically significant.

TABLE II
DISTRIBUTION OF EEG FINDINGS OF CEREBELLAR HEMISPHERAL TUMORS

	Normal tracing	Focal Abn.	Diffuse Abn.	Blt.Focal Abn.	Paroxysmal Abn.	Total
Astrocytoma	2	4	1	2	1	10
Medulloblastoma		2		1		3
Ependymoma					1	1
Glioblastoma				1		1
Hemangioblastoma			1			1
Unidentified				1		1

7. Table III shows distribution of EEG findings among all the posterior fossa tumors:

The figures on this table follow the previous figures in Table I and II. Normality is 14.2 % in the total group whereas it is 15.6 % in the midline and 11.7 % in the hemispherical group. Altogether focal abnormalities are 20.4 % whereas diffuse abnormalities are 65.3 %. Paroxysmal discharges constituted 16.3 % of all the series. The figures in this table are in favor of diffuse abnormalities among posterior fossa tumors paroad a whole. On the other hand, the incidence of normal tracings and xysmal discharges are relatively high and sometimes can be quite misleading for the correct diagnosis.

TABLE III
DISTRIBUTION OF EEG FINDINGS OF ALL POSTERIOR FOSSA TUMORS

Normal tracing	Focal Abn.	Diffuse Abn.	Blt.Focal Abn.	Paroxysmal Abn.	Total
7	10	11	13	8	49
% 14.2	20.4	22.4	26.5	16.3	
Total abnormalities 85.8 %					

8. Table IV gives a comparison of the findings in midline and cerebellar hemispherical tumors, on a percentage basis.

This table gives the clear evidence of high rate of focal abnormalities among cerebellar hemispherical tumors. Conversely, diffuse abnormalities had higher rate among midline tumors. As far as the laterality of the cerebellar hemispherical tumors is concerned, most of them showed

ipsilateral abnormalities. Cerebellar hemispherical tumors which had focal EEG abnormalities showed 81.8 % (9 out of 11) ipsilateral, 18.2 % (2 out of 11) contralateral abnormal findings.

TABLE IV
COMPARISON OF EEG FINDINGS IN MIDLINE AND
HEMISPHERAL TUMORS

	Normal tracing	Focal Abn.	Diffuse Abn.	Blt. Focal Abn.	Paroxysmal Abn.
Midline tumors %	15.6	12.5	28.1	25	18.7
Cerebellar Hemispherical tumors %	11.7	35.2	11.7	29.0	11.7
Total group %	14.2	20.4	22.4	26.0	16.3
Percentage	11.7	35.2	11.7	29.4	11.7
Total abnormalities 88.3 %					

9. Abnormality was confined to the posterior head regions at a rate of 78.2 % (17 out of 23), to the anterior head regions at a rate of 31.8 % (6 out of 23). Projection of the abnormalities to the anterior head regions was considered to be an important EEG finding.

Discussion

The abnormalities in our study can be classified in three major groups:

1. Diffuse abnormalities: These showed a high rate among all abnormalities (85.2 %). Specifically, midline tumors had a higher share of diffuse abnormalities than the cerebellar hemispherical tumors. Most of these cases were accompanied with increased cranial pressure and it was difficult to differentiate them clinically from other intracerebral lesions giving similar signs.

2. Focal abnormalities: These were more common among cerebellar hemispherical tumors, up to 40 %. About 75 % were on the ipsilateral hemisphere, 25 % on the contralateral hemisphere. Bagchi also pointed out this fact and stated that an alteration in the circuits of cortico-ponto-cerebellar and cerebello-rubro-thalamocortical could be an explanation for this problem. The projection of abnormalities to the anterior head regions was also quite common.

3. Paroxysmal abnormalities were included among diffuse abnormalities. Nevertheless, a rate of 16.3 % is not negligible. Explanation of this can be the same as diffuse abnormalities: Increased intracranial pressure, its effect on centrencephalon and disturbance of thalamic cells.

Hill and Ingraham reviewed this problem and showed that EEG abnormalities of posterior fossa tumors are negligible or mostly normal.^{3 4} The rate of abnormality varied between 2.5 - 31 % in the works of other researchers. In that case our figures are more in line with Bagchi's work where he showed a high rate of abnormal recording: over 50 %. There is great difference between ours, Bagchi's work and other works.

It is our opinion that this difference originates from the interpretations of the recordings as well as the severity of the pathogenicity of the tumors at the time of admission and EEG investigation. It is obvious that EEG tracing of an early case will give different results than an advanced one.

The difference of normality among EEG findings should alert the physician that a normal tracing on a suspected patient can not rule out the possibility of a posterior fossa tumor. The same is true for the paroxysmal findings. With a high rate of 18.1 %, paroxysmal findings may resemble the findings of intraventricular tumors. The occurrence of diffuse abnormalities among midline tumors can arise the doubts of other etiological factors which cause increased intracranial pressure.

Conclusions

1. Posterior fossa tumors have a high incidence of abnormal EEG recording.

2. Midline tumors have more diffuse type of abnormalities, whereas cerebellar hemispherical tumors have a high rate of focal findings.

Those findings were mostly ipsilateral and had inclined to project to the anterior head regions.

3. Paroxysmal abnormalities were seen in considerable number of cases.

4. EEG can be a useful diagnostic method for posterior fossa tumors even though the results are not certain in every case.

Summary

EEG obtained from 49 cases with posterior fossa tumors showed a high incidence of abnormality. Diffuse abnormalities were found in EEG's

of cases with midline tumors whereas in those with hemispherical tumors were mostly ipsilateral focal findings which inclined to project to the anterior head regions. EEG was found to be a helpful diagnostic method for posterior fossa tumors.

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