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Clinicopathological study of cerebellar astrocytoma in children

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ABSTRACT

Introduction: The first successful treatment of a pediatric brain tumor was in 1879 when Sir William Macewen successfully removed a meningioma from a 14-year-old girl. Brain tumors are the most common form of solid tumors and the leading cause of death from solid tumors in children (SEER program 1975–1999).

Materials and Methods: Study area: This study was conducted at Bangur Institute of Neuroscience (BIN) and S.S.K.M Hospital.

Study Population: Patients attending BIN OPD and admitting in BIN and S.S.K.M Hospital wards were selected.

Inclusion Criteria: The following criteria were included in the study: (a) Patients with the diagnosis of cerebellar astrocytomas after magnetic resonance imaging investigation, (b) patients giving consent to be included in the study, and (c) patient willing to come for follow up.

Study Period: The study period was 2 years (from September 1, 2010, to December 31, 2012).

Sample Size: All diagnosed cases of cerebellar astrocytoma during the stated period.

Exclusion Criteria: Patients not willing for the study were excluded from the study.

Study Design: This was a non-randomized prospective clinical study. Pilocytic astrocytomas are the most common pediatric brain tumors in our population and are most commonly located in the cerebellum.

Results: Most of the patients, 20 (90.9%), had neurological improvement on discharge. 1 patient (4.5%) died during the hospital course. The follow-up time period ranged from 3 months to 2 years, with a mean follow-up period of 1.5 years. Recurrence was observed in 5 patients (22.72%), but reoperation was done in 3 patients (13.63%). Of them, 1 patient (4.5%) received radiotherapy in spite of that recurrence was developed in 1.5 years. 2 patients (9.09%) have been kept under observation because these are asymptomatic. The solid consistency of tumors led to a poor prognosis, as it was associated with a greater number of ICU admissions, recurrence of tumors, and repeat surgeries (13.63%). The follow-up time period ranged from 3 months to 2 years, with a mean follow-up period of 1.5 years.

Conclusion: A "wait and see" strategy is justified in patients with non-progressive recurrent or residual cerebellar LGG after primary tumor resection (23.30) radiotherapy can be considered.

Key words: Cerebellar astrocytoma, solidtumor, radiotherapy

INTRODUCTION

The first successful treatment of a pediatric brain tumor was in 1879 when Sir William Macewen successfully removed a meningioma from a 14-year-old girl. Brain tumors are the most common form of solid tumors and the leading cause of death from solid tumors in children (SEER program 1975–1999). Advances in technology in neurosurgery, radiology, radiotherapy, and chemotherapy have led to a 73% 5-year survival rate for all pediatrics brain tumors combined.[1] Pediatric brain tumor differs from adult tumors. For example, common adult tumor such as meningioma, malignant glioma, schwannomas, and pituitary tumors are uncommon in children in whom low-grade gliomas and primitive - neuroectodermal tumors are seen more commonly. Besides, more than 50% of brain tumor in children above 1 year of age are seen in the infratentorial compartment.[2] Gliomas from the largest fraction of pediatric primary brain tumors, representing between 45% and 50% of most series. Majority of these tumors are low-grade astrocytomas, which form approximately 35–50% of all pediatrics brain tumors. In contrast, high-grade gliomas and glioblastomas are the common tumors in adults. Looking at infratentorial tumors, low-grade cerebellar astrocytomas (15%), low-grade brain stem gliomas (3%), and malignant gliomas (3%) form the common glial tumors.[3,4] Cerebellar low-grade astrocytomas are the most common tumor of the posterior fossa in children.[6] They have been universally accepted as benign tumors since Cushing's famous 1931 publication, and they are eminently curable either by surgery alone and/or in combination with radiotherapy.[5] The pilocytic astrocytoma described as a separate entity by Cushing

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in 1931. The posterior fossa tumors are the most common solid tumor in the children.

Cerebellar astrocytoma is predominantly a tumor of childhood, 75% occurring in the 1st and 2nd decade of life. The cerebellar astrocytoma may occur predominantly or solely in the cerebellar hemisphere.[6-8]

MATERIALS AND METHODS

Study area
This study was conducted at Bangur Institute of Neuroscience (BIN) and S.S.K.M Hospital.

Study population
Patients attending BIN OPD and admitting in BIN and S.S.K.M Hospital wards were selected.

Inclusion criteria
The following criteria were included in the study:
a. Patients with the diagnosis of cerebellar astrocytomas after magnetic resonance imaging (MRI) investigation.
b. Patients giving consent to be included in the study.
c. Patient willing to come for follow.

Study period
The study period was 2 years (from September 1, 2010 to December 31, 2012)

Sample size
All diagnosed cases of cerebellar astrocytoma diagnosed during the stated period.

Exclusion criteria
Patients not willing for the study were excluded from the study.

Sample design
To study the patient of cerebellar astrocytoma in children.

Study design
This was a non-randomized prospective clinical study.

Study tool
PERFORMA FOR HISTORY TAKING FOR THE THESIS TOPIC

"CLINICOPATHOLOGICAL STUDY OF CEREBELLAR ASTROCYTOMA IN CHILDREN"

PATIENT NO…… RG NO…… BED NO.....NAME…… AGE……..

SEX - M/F..... ……. OCCUPATION……

RELIGION…….. ADDRESS……

PHONE NO……..

CHIEF COMPLAIN-

1……

2……

3……..

4……..

TOTAL DURATION OF SYMPTOM……

CLINICAL SYMPTOMATOLOGY-

1. HEADACHE site - local……. radicular….
Onset - acute…. Insidious……

Duration……..

Course - progressive/stationary/regressive/waxing and vaning

Severity - mild/moderate/severe

Aggrevation……

2. VOMITING - projectile/non-projectile
Onset

Timing

Content

Association with headache…Y/N

3. ATAXIA - Truncal
Limb ataxia

4. DYSARTHRIA

5. HEADTILT

6. INVOLUNTARY MOVEMENT

PAST ILLNESS: Trauma/surgery/hospitalization/infection……..

COMORBID CONDITION - TB/Epilepsy

IMMUNISATION HISTORY-

FAMILY HISTORY-

EXAMINATION-

GE-

GC……BUILT…….PR….RR….TEMP…….

L/N…….PALLOR……ICTERUS……..

CYANOSIS……CLUBBING…….OTHERS…….

NEUROLOGICAL EXAMINATION:-

Higher function ……..

Cranial nerves……i
ii
iii, iv, vi
v
vii
viii
ix, x, xi
xii

CEREBELLAR SIGNS-

Dysmetria
Dysdiadochokinesia
Intention tremors
Rebound phenomena
Disturbance of speech
Nystagmus
Tone - hyper/hypo
Deep tendon reflexes-
Abnormal movements

SENSORY SYSTEM-

SYSTEMIC EXAMINATION- RESPIRATORY…….
CVS……
P/A……..

MRI/CT FINDINGS……

SURGICAL PROCEDURE……..

EXCISION - TOTAL/SUBTOTAL/BIOPSY

HISTOPATHOLOGY……

FOLLOW-UP - 3 MONTHS, 6 MONTHS, and 1 YEAR

1. 3 MONTHS……..
Headache
Vomiting
Dysarthria
Ataxia
HeadTilt
Involuntary movements
h/o radiotherapy
radiological findings……

2. 6 MONTHS……..
Headache
Vomiting
Dysarthria
Ataxia
HeadTilt
Involuntary movements
h/o radiotherapy
radiological findings……

3. 9 MONTHS……
Headache
Vomiting
Dysarthria
Ataxia
HeadTilt
Involuntary movements
h/o radiotherapy
radiological findings……

INVESTIGATION-

Routine hematological
CXR
ECG

TO diagnose the disease - MRI BRAIN PLAIN and CONTRAST

PARAMETERS TO BE STUDIED-

1. enumeration and evaluation of presenting symptoms and signs
2. different radiological parameters
3. different modalities of treatment
4. patients response to treatment
5. post-operative complication

Study techniques

This is a prospective study. Patients were admitted under seven consultants in three different units, the management techniques include midline suboccipital craniectomy and gross total, near total, subtotal, or partial excision of the tumor. Postoperatively, the patient will undergo outcome evaluation in terms of clinical and radiological improvement.

Plan for Analysis of Data

Data will be presented in forms of tables and charts, data collected will be plotted and tabulated to correlate and compare the outcome of study.

RESULTS

A total number of 22 cases of cerebellar astrocytoma constituted the material for the present study. The clinicopathological features have been recorded during the study period and thoroughly analyzed. The total number of brain tumors admitted and treated at BIN, during the study period was 146. Cerebellar astrocytoma numbered 22, out of these, i.e.,15% of all primary tumors [Table 1].

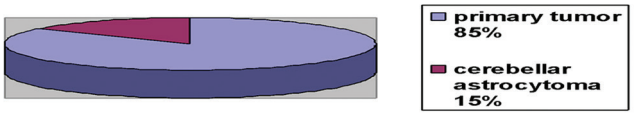
Maximum number of patients who were encountered was of primary tumor and 22 patients were of cerebellar astrocytoma which constituted study subjects.

The age-wise distribution of the patients is seen significant ($P \leq 0.05$), the maximum number of patients were the age group of 11–15 years, i.e., 54.54% [Table 2].

The sex-wise distribution of the enrolled patients is seen equally in both of sex so that *P* value is seen 1 and Chi-square test is found to be zero. of 22 cases of cerebellar astrocytoma, 11 were male and 11 were female, thus the ratio being 1:1 [Table 3 and Figure 1].

Table 1: Distribution of total cases as per the incidence of cerebellar astrocytoma among primary brain tumors

Type of tumor	Number of patients
Primary tumor	124
Cerebellar astrocytoma	22
Total	146



In case of relation of age with sex, it was seen that the proportion of number of cases is increased in the both of the sex as age is increased and maximum number of cases are seen in the age group of 11–15 years in both of the sex. In this study, in initial age group below 5 years, it is not common and incidence is equal in both sexes. In increasing age up to 10 years< It is more in female. However, later on, it is more common in male [Table 4].

Total number of patients cannot be the sum of this series of cerebellar astrocytoma (n=22), patient presented with headache associated with vomiting in 86% of cases. In 77% cases, patient had ataxia and other cerebellar signs. Papilledema presents in 15 cases and optic atrophy in 22.7% cases. 6th nerve palsy presents in only 3 cases (13.6%). Hence, the distribution of cases according to S/S is also seen highly significant ($P \leq 0.001$) behavioral disturbances in the form of irritability, excessive crying presents in 36.3% of cases. Hydrocephalus was present in 68% of cases. Duration of symptoms - out of 22 patients, 1 patient diagnosed incidentally who was suffering from head injury and undergone computed tomography (CT) scan brain and detect a SOL in right cerebellar hemisphere. Two patients in emergency department in poor GCS state one was in GCS 5 and another was in GCS 7. In rest 19 patients, 1 patient was present within 1 month and others present within 2–20 months duration [Table 5].

The distribution of the cases according to the presence of HCP is also found to be significant ($P \leq 0.05$), maximum number of the patients, i.e., 68% having HCP present and only 32% of the patients having no HCP presence [Table 6].

Presentation of cerebellar astrocytoma was mainly lobar means either right or left lobe of cerebellum. It can present in midline vermis also in small number of cases. In this series, 36.3% of cases involve the right cerebellar hemisphere. 40.9% of cases involve the left cerebellar hemisphere. 22.7% of cases SOL were situated in midline vermis. The distribution of the cases as per the site of tumor was not found to be significant ($P \geq 0.05$) [Table 7].

In case of investigation, maximum number of the patients undergone for MRI, i.e., 81.8% and only 13.6% of patients have undergone MRS, and the distribution of cases as per mode of investigation was also found statistically significant ($P \leq 0.05$) [Table 8].

Of 22 patients, maximum patients, i.e., 21 underwent midline suboccipital craniectomy and only one patient having paramedian suboccipital craniectomy [Table 9].

Most of the patient underwent gross total resection (GTR) done in 10 cases (45.45%) which was maximum in numbers. The distribution of cases as per the type of operation also found statistically significant ($P \leq 0.05$) [Table 10].

In maximum number of cases, i.e., in 15 cases, there is no complication found and in case of patient having complication;

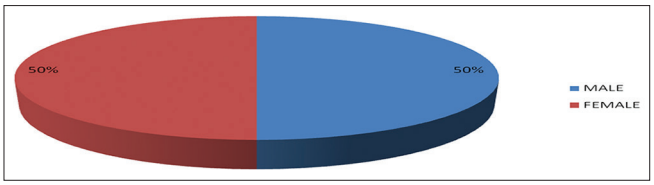


Figure 1: Sex distribution

Table 2: Distribution of cases as per age wise

Age of patients	Number of patients (%)
0–5 year	2 (9.09)
6–10 year	8 (36.36)
11–15 year	12 (54.54)
Total	22 (100)
Chi-square	10.36
Df	2
P value	0.005622

Table 3: Distribution of cases as per sex

Sex	Number of patients (%)
Male	11 (50)
Female	11 (50)
Total	22 (100)
Chi-square	0.00
Df	1
P value	1.000000

Table 4: Sex-wise distribution according to different age groups

Age group	Male (%)	Female (%)	Total (%)
0–5 years	1 (4.54)	1 (454)	2 (9.09)
6–10 years	2 (9.09)	4 (18.18)	6 (27.27)
11–15 years	8 (36.36)	6 (27.27)	14 (63.63)
Total	11 (50)	11 (50)	22 (100)

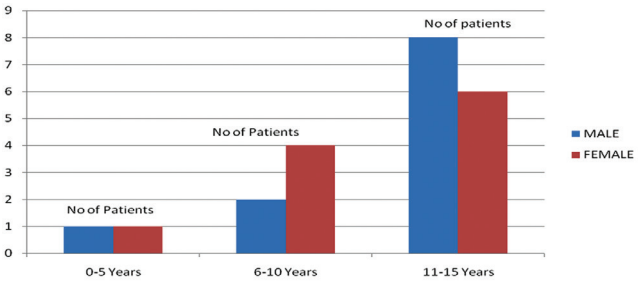


Table 5: Distribution of cases as per clinical - features

S/S*	Number of patients (%)
Headache	19 (86.3)
Ataxia	17 (77.27)
Papilledema	15 (68.18)
Optic atrophy	5 (22.7)
6th nerve palsy	3 (13.6)
Cerebellar signs	17 (17.27)
Behavior disturbances	8 (36.3)
Total	22** (100)
Chi-square	49.66
Df	6
P value	0.000001

*It means all S/S given by the patients are multiple responded, i.e., even single type of s/s is responded by many patients **so that the total is not the sum of all responses in terms of number or in terms of percentages of respondents.

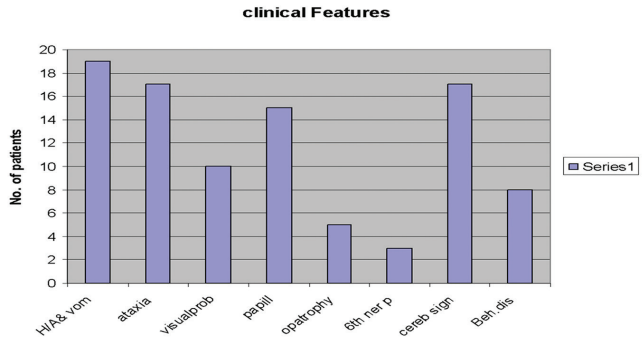
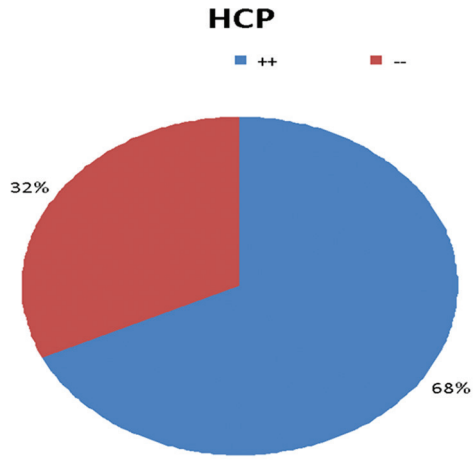


Table 6: Distribution of cases as per the HCP +/- NCE status

S. No	Number of patients	HCP	Percentage
1	15	++	68
2	7	-	32
Total	22		100
Chi-square			5.70
Df			1
P value			0.016942



in maximum cases (9.09%), wound site infection was found and death report was found in 4.44% cases. The overall distribution of cases was found statistically highly significant ($P \leq 0.001$) [Table 11].

Histopathological examination - out of 22 patients, 20 patients are having pilocytic astrocytoma on histology, and 2 patients are having diffuse astrocytoma. The distribution of cases as per the histopathological type is also found statistically significant ($P \leq 0.05$) [Table 12].

In the histopathological details of all the tumors, Rosenthal fibers were present in 16 (72.72%) cases, and microcysts were identified in 12 (54.5%), which were also associated with eosinophilic bodies. Fibrillary background was found in 17 (77.3%) of the tumors, but 5 (22.7%) were found to have a myxoid background. Other features were apparent only in a few cases: Necrosis in 3 (13.6%), vascularity in 5 (22.7%), and mitoses in 3 (13.6%)

Table 7: Distribution of the cases according to the site of tumor

Lobe	Number of patients (%)
Right	8 (36.36)
Left	9 (40.90)
Middle	5 (22.7)
Total	22 (100)
Chi-square	1.78
Df	2
P value	0.411225

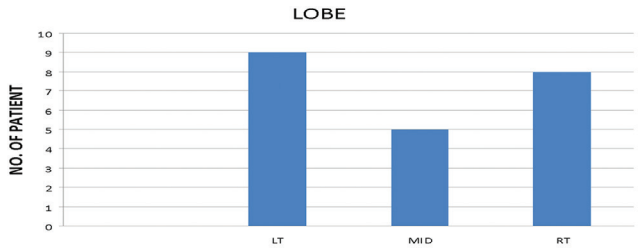
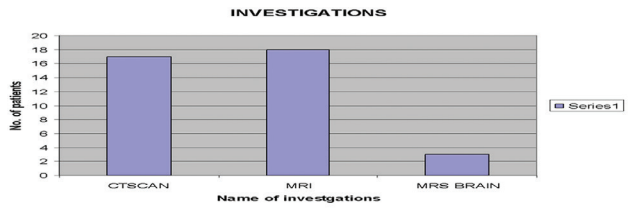


Table 8: Distribution of cases according to mode of investigation done

Investigation*	Number of patients (%)
CT	17 (77.27)
MRI	18 (81.8)
MRS	3 (13.6)
Total	22 (100**)
Chi-square	26.19
Df	2
P value	0.000002

*It means multiple choice options; hence, **total cannot be the sum of individual responses.



of the cases. The distribution of all cases as per the histological finding also found statistically highly significant ($P \leq 0.05$) [Table 13].

Overall outcome of cases

Most of the patients, 20 (90.9%), had neurological improvement on discharge. 1 patient (4.5%) died during the hospital course. The follow-up time period ranged from 3 months to 2 years, with a mean follow-up period of 1.5 years. Recurrence was observed in 5 patients (22.72%), but reoperation was done in 3 patients (13.63%). Of them, 1 patient (4.5%) received radiotherapy in spite of that recurrence was developed in 1.5 years. 2 patients (9.09%) have been kept under observation because these are asymptomatic. The solid consistency of tumors led to a poor prognosis, as it was associated with a greater number of ICU admissions, recurrence of tumors, and repeat surgeries (13.63%).

Table 9: Distribution of cases according to type of craniotomy done

Craniotomy type	Number of cases (%)	%
Suboccipital	21 (95.45)	95.45
Paramedian suboccipital	1 (4.54)	4.54
Total	22 (100)	100

Table 10: Distribution of cases as per the type of operation undergone

Operation type	Number of patients (%)
GTR	10 (45.45)
NT	6 (27.27)
ST	4 (18.18)
Partial	2 (9.09)
Chi-square	8.48
Df	3
P value	0.037005

GTR: Gross total resection

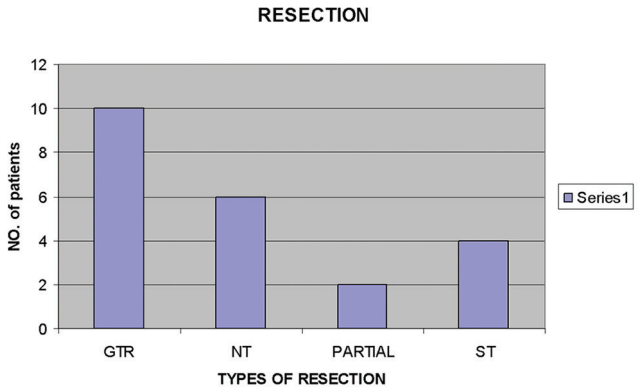


Table 11: Distribution of cases as per the complication

Type of complication	Number of patients (%)
Nil	15 (68.18)
Wound site infection	2 (9.09)
RTI	1 (4.54)
UTI	1 (4.45)
Cerebellar mutism	1 (4.45)
Pseudomeningocele	1 (4.45)
Death	1 (4.45)
Total	22 (100)
Chi-square	61.22
Df	6
P value	0.000001

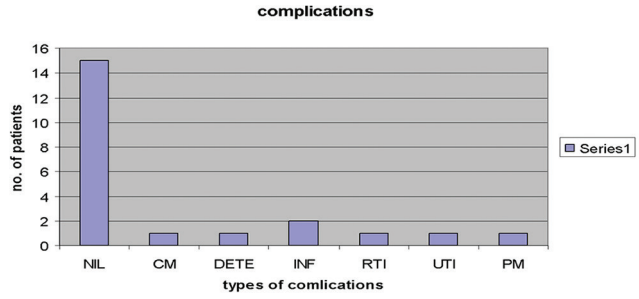


Table 12: Distribution of cases as per the histopathological type of tumor

Type of HPE	Number of patients (%)
Pilocytic	20 (81)
Diffuse	2 (9)
Total	22 (100)
Chi-square	23.04
Df	1
P value	0.000002

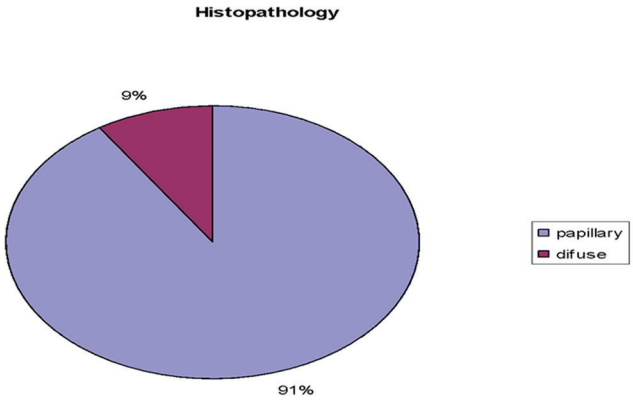
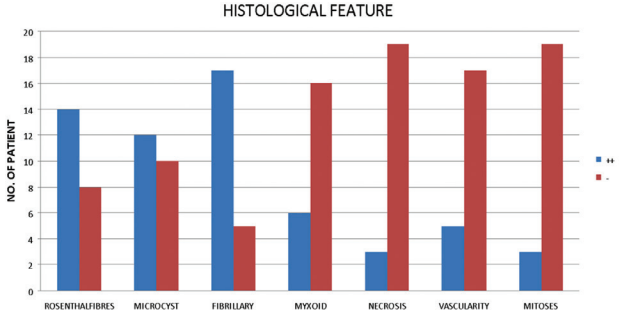


Table 13: Distribution of cases as per the histological features

Histological feature*	Number of patients (%)
Rosenthal fibers	16 (72.72)
Microcyst	12 (54.5)
Fibrillary	17 (77.3)
Myxoid	5 (22.7)
Necrosis	3 (13.6)
Vascularity	5 (22.7)
Mitosis	3 (13.6)
Total	22** (100**)
Chi-square	42.90
Df	0.000001

*It means multiple responded choices, ** it means the total cannot be the sum of each response because same type of histological features can be given by many patients having astrocytoma.



The follow-up time period ranged from 3 months to 2 years, with a mean follow-up period of 1.5 years [Figures 2-7].

At post-operative period, none of the patients required surgical treatment for hydrocephalus.

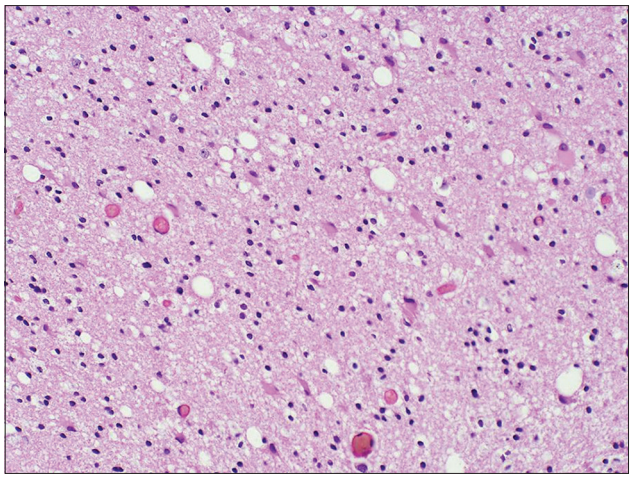


Figure 2: Diffuse astrocytoma of cerebellum

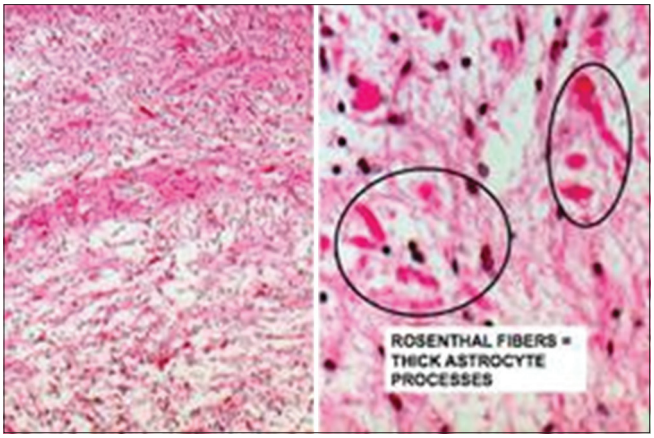


Figure 3: Rosenthal fibres

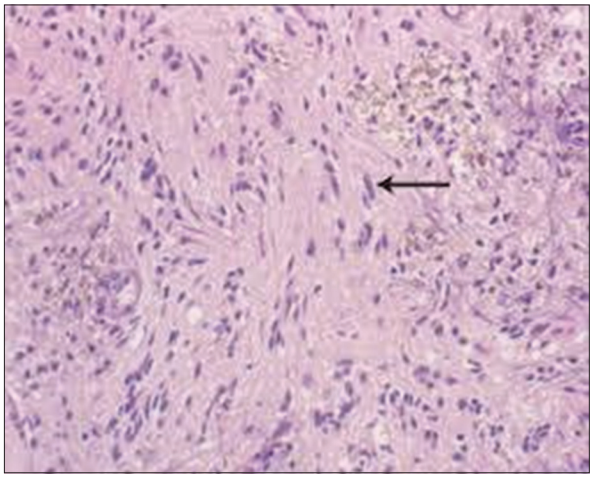


Figure 4: Bipolar cell (arrow)

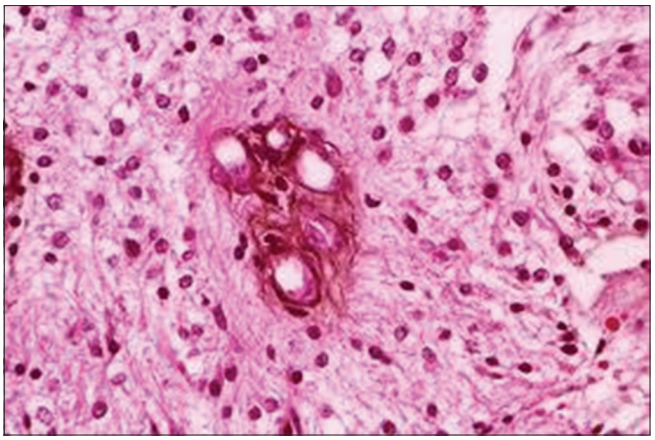


Figure 5: Diffuse astrocytoma

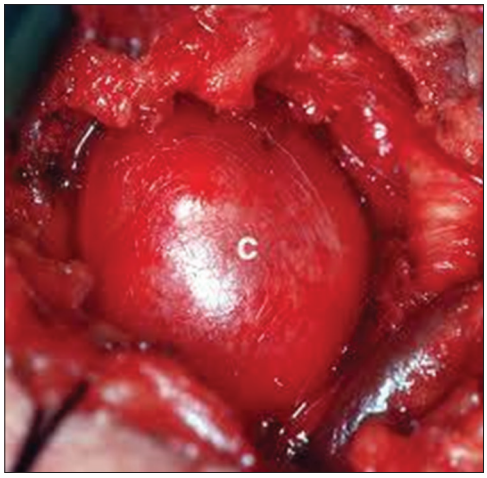


Figure 6: Operative Photograph of cerebella astrocytoma

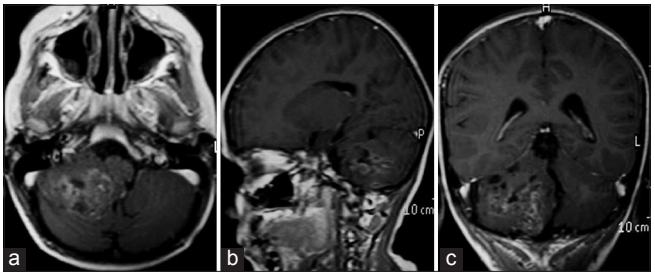


Figure 7: Operative photograph: An inhomogeneous solid mass in the right cerebellar hemisphere with indistinct margins is observed on axial (a), sagittal (b), and coronal (c) postcontrast T1W images. The right foramen of Luschka is obliterated by the mass. Note that the lateral ventricles are of normal size

DISCUSSION

Cerebellar astrocytoma is most commonly benign and arises from astrocytes (glial cells). They are a fascinating and challenging group of brain tumor and at times cause major problems for patients and doctors in decision-making and management. It is the most common tumors of posterior fossa in children in some series and the second most common in another series. These characteristics of cerebellar astrocytoma in children that attracted me to undertake the present study of examining its clinicopathological aspect on cases admitted at BIN and S.S.K.M. Hospital (IPGMER) from August 2010 to December 2012. Cerebellar astrocytoma in children has been reported to constitute between 14% and 16% of all infratentorial tumors. Mostly they are benign and correspond to Grade 1 of the WHO histopathological examination. In the population-based clinical study at tertiary care hospital in Pakistan from 1995 to 2007, 22%

of all intracranial tumors in children are pilocytic astrocytoma of them 50% located in cerebellum.[34] However, in the present study, the incidence of cerebellar astrocytoma in children is 15% of all primary tumors in children. In the study by Bilginer *et al*., cerebellar astrocytomas are there present 10% of all pediatric intracranial brain tumors[16] and 30% of all pediatric posterior fossa tumors, especially in the first two decades of life. In the study by Grun *et al*., incidence of cerebellar astrocytoma in all infratentorial tumors was 15%. In the study by Desai *et al*., the age of the patients at presentation varied from 10 months to 12 years. The mean age at presentation was 7 years–11 months. In the present study, minimum age at presentation was 4–15 years. The mean age at presentation was 10.9 years. Burkhard *et al*. were diagnosed 987 astrocytic and oligodendroglial tumors, of which 55 (5.5%) were pilocytic astrocytomas.[29] The incidence rate, adjusted to the World Standard Population, was 4.8/1 million per year. The mean age at clinical diagnosis was 19.6 ± 12.7 years, and the male/female ratio was 1.12. The most frequent tumor sites were the cerebellum (40%), followed by supratentorial locations (35%), the optic pathway and hypothalamus (11%), and the brainstem (9%). The mean follow-up period was 12 years. In the study by Khan *et al*.,[34] the male-to-female ratio in Pakistani population was 1:1, which was comparable to 1.12 according to Burkhard *et al*., and the general trend of no gender predilection observed in PAs. In our study, overall, there is no gender predilection which was comparable to other study. The most common symptoms are headache, vomiting, and with or without nausea. Initially, it is because of local dural stretching because it is a very slow-growing tumor. Later on, hydrocephalus was developed. In the study by Desai *et al*.,[16] the average duration of symptoms was 5.8 months. In the study by Bilginer *et al*.,[18] the most common presenting symptom was headache (67,7%). Other clinical symptoms at presentation included vomiting (64.5%), and other cerebellar signs present in 77% of cases. Hydrocephalus was present in 24 (77.5%) patients preoperatively. Papilledema was present in 22 patients (70.9%) in the study by Desai *et al.* The average duration of symptoms was 5.8 months.[16] The clinical features were predominantly related to intracranial hypertension and the location of the tumor. 26 tumors (25.4%) were located in the vermis and 76 (74.5%) in the cerebellar hemisphere. The brain stem was involved in 20 (19.6%) patients. All 102 patients had a pre-operative contrast-enhanced CT scan midline vermian tumors were predominantly solid and enhancing, while the hemispheric tumors were cystic and non-enhancing. In our study, the most common presentation was symptoms of raised ICP (headache associated with vomiting 86.3% cases) and development of cerebellar signs depending on involvement of cerebellar region which was comparable to study of Desai *et al.* and Johan *et al*.[16] In this study, HCP was present in 15 patients (68.18%) which was comparable to others studies.[18] Papilledema was also present in 15 patients (68.18%) in the study of Hoyt and Baghdassarian pilocytic astrocytoma is associated with neurofibromatosis 1 (NF1). Patients with NF1 usually have PA in the optic nerve and thus about 30% of patients with optic nerve PAs have NF1. NF1-associated tumors grow slowly or remain stable. In the study of Mueller and Chang, although the cause of PA remains uncertain, people with NF1, Li-Fraumeni syndrome, and prior radiation to the brain carry a higher risk of PA development. In our study, no patient is suffering from NF1. In the study by Khan *et al*.,[34] the MRI and CT scan showed a cystic component in 40.9% of the patients and contrast enhancement in 68.2%. PAs appearing solid on the MRI were presumed to be more aggressive. In the study by Bilginer *et al*.,[18] 25.8% tumors are solid and rest 74.19% were cystic; in our study, 6 patients (27.27%) were solid and rest (72.72%) were cystic. Our study also showed differences in the outcome of solid and cystic PAs, but these were not statistically significant. Strong *et al*.[21b] evaluated the radiological images of PAs with regard to tumor distribution, size, morphological appearance, calcification, and degree of contrast enhancement, in their study, but we were unable to distinguish tumors that would follow an aggressive course from the tumors that would behave in a more benign manner. Thus, they concluded that imaging features were unreliable in predicting clinical behavior. Maximum resection was attempted in 15 patients; 7 (46.7%) of them had no residual tumor, 5 (33.3%) had residual tumor, and 3 (20%) did not have any post-operative imaging. Studies showed that direct neurosurgical evaluation of the extent of resection was surprisingly unreliable, and post-operative, contrast-enhanced, cross-sectional imaging, preferably MRI was essential for definitive assessment.[13,14,20,22] Complete resection led to a better outcome, with most of the patients showing clinical improvement, and there was no inpatient or late mortality. This showed the curative potential of resection, with no identifiable tumor left behind, as shown by other studies.[7,9] However, 3 (42.9%) of the seven patients in our study showed recurrence, even though there was no evidence of a post-operative residual tumor on imaging. This could be correlated with the findings of Strong *et al*.,[21] which stated more than one-third of their patients with PAs followed an unusually aggressive course, with progression, or a recurrent tumor identified despite concurrent treatment. Pilocytic astrocytoma appears solid on the MRI was presumed to be more aggressive. Our study also showed differences in the outcome of solid and cystic pilocytic astrocytomas, but there was not statistically significant. Strong *et al*.[21b] evaluated the radiological images of pilocytic astrocytomas with regard to tumor distribution, size, morphological appearance, calcification, and degree of contrast enhancement, in their study, but we are unable to distinguish tumors that would follow an aggressive course from the tumors that would behave in a more benign manner. Thus, they conclude that imaging features were unreliable in predicting clinical behavior.

In this study, maximum resection was attempted in 15 patients (68.18%), 7 of them had no residual tumor, 5 had residual tumor, and 3 did not have any post-operative imaging. Studies showed that direct neurological evaluation of the extent of resection was surprisingly unreliable.

In the study by Bilginer *et al*.,[17-19] maximum resection was attempted in 23 (74%) cases and subtotal resection was done in 8 (26%) patients. Kayama *et al*.[24-27] concluded that GTR resulted in the best prognosis, i.e., no recurrence during a 10-year follow-up period. Radiation treatment after surgery suppressed the best treatment for pilocytic astrocytoma is as follows:

1. Total resection, if possible, followed by
2. Irradiation of any residual tumor to suppress recurrence.

In our study, we referred the patients for radiotherapy if complete resection is not possible. 6 patients have received RT after partial or subtotal resection and none of them found recurrence in 2-year follow-up.

Burkhard *et al*.[29] were studied the 55 cases of pilocytic astrocytoma. Of which 7 patients (13%) received post-operative radiotherapy, but this did not significantly affect survival. In all patients, the tumors were histologically classified as the WHO Grade I, except in two patients who had anaplastic pilocytic astrocytoma (Grade III), one of whom died after 7 years, whereas the other was still alive after 10 years.

Johan *et al*. studied the 110 cases of pilocytic astrocytoma and concluded that spontaneous regression of residual tumor is frequently encountered, allowing for observation of residual tumors instead of performing a second resection in cases where a second resection carries a high risk of neurological sequelae.[28]

Saunders *et al*.[31] were observed spontaneous tumor regression in five children out of 84 children (5.9%) with residual disease. Similar numbers of children have been described in a study by Due-Tønnessen *et al*., and others report individual cases. 9, 11, 23, 26 This observation supports the option of always considering a policy of surveillance imaging in children with residual disease after their initial surgery as well as in those with recurrences detected after what was hoped to have been a complete (curative) resection to establish the biological activity of these unpredictable tumors and, hopefully, avoid the potentially deleterious effects of radiotherapy (and possible chemotherapy) on the young brain. In this study, we also observed two patients. Of 22 patients (9%), spontaneous regression which was comparable to study by Saunders *et al*. and Due-Tønnessen *et al*.[28,31] In the study of Bilginer *et al*., ataxia (16%), dysphagia (9.6%), mutism (9.6%), and CSF fistula (6.4%) were seen as an early post-operative complications.

In this study, dysphagia developed in 2 patients (9.09%) which were recovered gradually in 2–3 months. Cerebellar mutism was developed in 1 patient (4.5%).

CONCLUSION

Pilocytic astrocytomas are the most common pediatric brain tumors in our population and are most commonly located in the cerebellum.

Complete surgical resection is the best treatment option for Pas.

Cerebellar astrocytomas, as a group, carry a more favorable prognosis than most other brain tumors, because these neoplasms generally are histologically benign and amenable to extensive resection. However, it is clear that a number of factors have an impact on prognosis. In particular, resection extent has been strongly associated with progression-free survival.[26a] A "wait and see" strategy is justified in patients with non-progressive recurrent or residual cerebellar LGG after primary tumor resection.[23,30,32,33] This study of clinicopathological features has been undertaken at the Department of Neurosurgery, BIN from August 2010 to December 2012. Although the sample size of this study is small (22 patients) and study period is also small, following observation has been made and certain conclusion drawn from them:

1. Incidence of cerebellar astrocytoma in children has been found to be 15% of all primary brain tumors, more in synchrony with all India figure.
2. There is no sex predilection in all overall study.
3. Incidence is more common in 1st and 2nd decade and more common in 5–15 years.
4. Headache associated with vomiting has been the most common clinical presentation.
5. MRI brain was the investigation of choice. However, in case of emergency, CT scan brain was sufficient.
6. Complete surgical resection is the treatment modality of choice.
7. Pilocytic variety was the most common histology.
8. In cases of residual or recurrence, it should be followed until symptomatic.
9. Radiotherapy can be considered.[35-39]

This study on cerebellar astrocytoma, in children, though the sample size of this study is small (22 patients) and study period is also limited duration certain changing trends has been observed, in management and outcome. However, it needs a continuing study with a larger sample size and dedicated follow-up protocol, to understand better the cerebellar astrocytoma in children, especially its pathological radiological and management protocol. More research is needed to determine the biological behavior of the pilocytic astrocytoma, to find optimal treatment, and to decide whether or not particular patients might be helped by radiotherapy.

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