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Research Article

Childhood cerebellar astrocytoma, surgical management

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Abstract

Background: Cerebellar astrocytomas account for approximately 12 to 17% of all CNS tumors in the pediatric age group and 25 to 35% of childhood posterior fossa tumors. The greatest incidence of cerebellar astrocytoma occurs between the age of 4 to 10 years with a peak at 6 years of age, with an almost equal number of males and females. **Methods**: This study was carried out on 26 cases of cerebellar astrocytoma in childhood. To come over the disturbed conscious level and bad general condition due to hydrocephalus which was found in all the cases; VP shunt was done in 21 cases prior to tumors excision. Total removal was achieved in 85% of the cases (22cases), while partial removal was carried for four cases out of the ten cases of midline cerebellar astrocytoma and they showed poor results, as two cases of them died before hospital discharge. **Results:** The percentage of excellent and good results in cases of total removal of the tumor was 91%. The cerebellar midline was the site of higher grade astrocytoma, as 70% of midline cerebellar astrocytoma were grade II and grade III astrocytoma. The grade III astrocytoma showed frustrating prognosis after radiotherapy followed by chemotherapy as the two cases of grade III cerebellar astrocytoma included in this study (7.7%) died by the end of the first year of follow-up. Grade II cerebellar astrocytoma showed different tumor behavior after radiotherapy, as in one of those three cases showed no recurrence after two years of follow up, the other case showed recurrence in the same cerebellar hemisphere and the third case showed scattered recurrence in both cerebellar hemispheres. **Conclusion:** The study clarifies that extend of tumor resection, the site of the tumor, and biological behavior of different histopathological type define the prognosis of cerebellar astrocytoma in childhood.

Keywords: cerebellar astrocytomas, childhood, tumor

Introduction

Cerebellar astrocytomas account for approximately 12 to 17% of all CNS tumors in pediatric age group, and 25 to 35% of childhood posterior fossa tumors[1]. The greatest incidence of cerebellar astrocytoma occurs between the age of 4 to 10 years with a peak at 6 years of age, with an almost equal number of males and females[2]. Cerabellar astrocytomas typically arise laterally in a cerebellar hemisphere, and have both cystic and solid components. The tumor obstructs the fourth ventricle as it grow, frequently causing hydrocephalus and non specific signs of increased intracranial pressure.

Surgical resection is the primary treatment for Childhood cerebellar astrocytoma[2,3].

Complete or near complete removal can be obtained in 90% to 95% of patients with juvenile polycystic tumors. Diffuse cerebellar astrocytomas may be less amenable to total resection, and this may account for the poorer outcome. The extent of resection necessary for cure is unknown because patients with microscopic and even gross residual tumor after surgery may experience long-term progression-free survival without post-operative therapy.

Following resection, a postoperative MRI is obtained. Surveillance scans are obtained periodically for totally resected tumors, although the value of this is uncertain [4]. The optimum use of radiation therapy is the subject of controversy. Some radiation oncologists advocate the treatment of patients with residual tumor, and others withhold treatment until tumor progression has been documented. Chemotherapy may be useful for delaying radiation therapy in very young child with unresectable, progressive cerebellar astrocytoma[5] Surgical resection is the treatment of choice as it is the readily resected tumor with the least-attendant morbidity in paediatric neurosurgery[6]. Ten years progression-free survival rates exceed 90% among patients whom undergo a gross total resection without other adjuvant therapy. [6].

Patients and Methods

This study carried out in the department of neurosurgery of Minia university hospital, on 26 cases of pediatric age (from 6months to 15 years old) who had intra-axial cerebellar tumors which proved histopatho-logically after surgery to be cerebellar astrocytoma of different grades.

Each patient was subjected to full clinical evaluation and neurological examination. All the cases performed both CT scan of brain with and without i.v contrast enhancement, and MRI of brain with and without gadolinium. The surgical management was varies as regard to insertion of V-P shunt prior to tumor attack, aspiration of cystic lesion, total excision, or subtotal excision of the tumor. All tumor resection were done through suboccipital craniectomy while the patient in a prone position. Continuation of treatment by radiotherapy and/or chemotherapy when needed.

Follow up of the patients were done for periods of 6 months to 2 years through regular visits to the outpatient clinic for clinical assessment (every 2 weeks in the first six months and every month after that) and radiological assessment were done by follow up brain CT scan every three months and MRI brain every six months. As regard to patient whom received adjuvant therapy (radiotherapy and or chemotherapy) additional tool of follow up were used in the form of MRI spectrometry of brain. All the 26 cases were categorized according to, age, sex, presenting symptoms and signs, radiological findings, tumor location, surgical procedure, post-operative status, adjuvant therapy, and follow up data for statistical studies to determine the prognostic factors in cerebellar astrocytoma.

Results

This study carried out on 26 cases of cerebellar astrocytoma. The age distribution varied from 6 months (youngest case) to 15 years (the oldest case), only one case was at the age of 6 months, twelve cases were between 1 year to 5 years of age, 6 cases were between 5 to 10 years old, and seven cases between 10 to 15 years old. The peak incidence was at the age of 6 years, and the mean age was 6.1 years. The distribution of cases as regard sex was 16 males, and 10 females with a ratio of 1.6: 1 male to female.

The presenting symptoms were: vomiting/ nausea in 24 cases (92%), headache/crying in 22 cases (84.6%), squint/diplopia in 14 cases (54%), blurring of vision in 20 cases (77%), gait disturbances in 20 cases (77%), torticollis in 8 cases (30.8%). On examination, papille-dema of various degrees was found in 24 cases (92%), ataxia in 20 cases (77%), 6th nerve palsy in 14 cases (54%), nystagmus in 10 cases (38%).

Radiological studies showed that all the cases had a variable degree of hydrocephalus. In 16 cases out of the 26 cases (61.5%) tumors were hemispheric, while in other 10 cases (38.5%) tumors were in the midline. There were 5 solid tumours (19%), 9 cystic tumours (35%), and 12 mixed tumours (46%).

The laterally located tumors were 9 cystic, 5 mixed, and 2 solid tumors. The midline located tumors were 3 solid tumors and 7 mixed tumors. The tumor was isointense in MRI and the cystic part was more intense than CSF In 21 cases out of 26 cases, the patient treated with V.P shunt prior to tumor attack to come over the disturbed consciousness and bad general condition (11) hemispheric tumours, and all the 10 midline tumours. Total removal was done in 22 cases (85%) (9 cystic, 10 mixed, and 3 solid tumors) out of the 26 cases. Total excision archived in all the 16

laterally located tumors and in 6 of the midline line located tumors. While partial excision was done in the 4 cases (15%) of midline located tumors (2 solid, 2 mixed tumors, with medullocervica affection). In 20 cases out of the 22 cases treated surgicaIly by total removal of tumor showed excellent (17 cases) to good (3 cases) result, while 2 cases of the 4 cases treated surgically by partial removal showed fair to poor results, and two cases died (two midline mixed tumors proved to be astrocytoma grade II, in females aged 1.4 years and 2.3 years) within one week postoperatively and before hospital discharge. The percentage of excellent and good result in the cases of total removal was (20 cases of 22 cases) were 91%.

As regard to histopathology of the tumors, all 16 hemispheric tumors (lateral location) were grade I astrocytma (13 of the 16 were males), while the 10 midline tumors were 3 of grade I astrocytoma (30%) (two males and one female), 5 of grade II astrocytoma (50%) (two males and three females), 2 of grade III astrocytoma (20%) (all were female). It was noticed that malignant tumors predominate in midline and females.

The postoperative result was excellent in 17 cases (65.4%) in which the preoperative manifestations completely improved without any postoperative neurological deficits, 3 cases (11.5%) were good with minimal deficits, 2 case (7.7%) were fair with persistence or additional neurological deficits, 2 cases (7.7%) were poor with sever additional neurological deficits, and there were 2 cases of postoperative (within a week) death in this study.

Follow up of the patients (6 months to 2 years) showed that, cases of grade I cerebellar astrocytoma whom were treated by total removal were doing well all over the period of follow up study (6 months to 2 years). The cases of grade II cerebellar astrocytoma showed different tumor behavior (3 cases), although all received radiotherapy; one case showed no recurrence of tumor, and generally was good (female 8 years old), the other showed recurrence of the tumor in the same cerebellar hemisphere but not in the same location of the previous tumor which approximately disappeared, while the third case showed recurrence of the tumor in both sides of cerebellar hemispheres. MRI spectroscopy of brain showed decrease in the N-acetyl aspartate, which indicate cellular damage, increase of choline, which indicate excessive tumor cell activity, and a remarkable increase in lactate lipid ratio, which indicate presence of necrosis, (this occurred in the two cases of recurrence). As regard to the cases of grade III cerebellar astrocytoma of this study (two midline tumors in females aged 2.6 years, and 15 years), both the died after radiotherapy and chemotherapy by the end of first year of follow up.

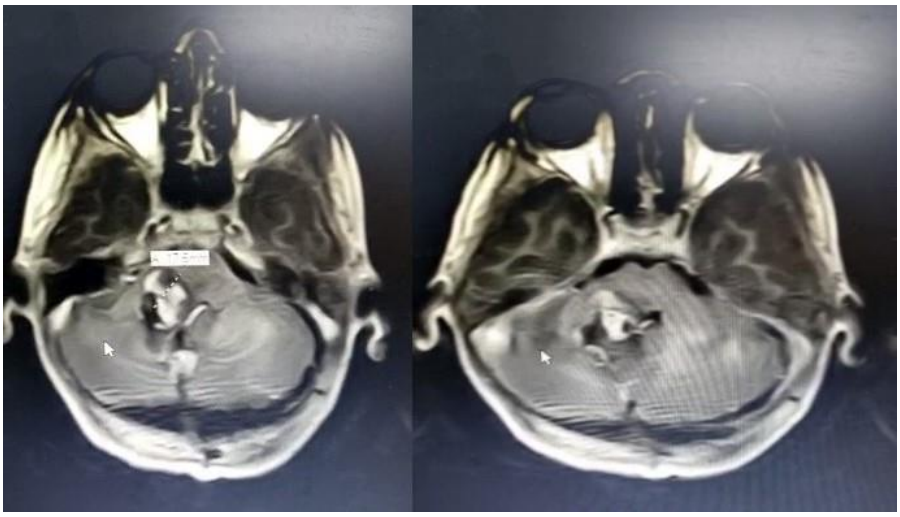

Fig 1a: preoperative MRI T1 weighted image showing post fossa lesion

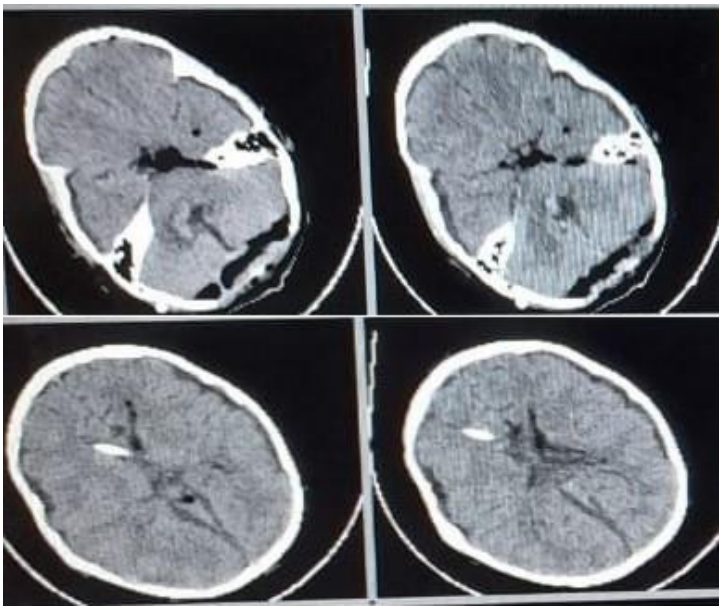

Fig 1b: postoperative CT brain showing excision of post fossa lesion and insertion of vp sshunt

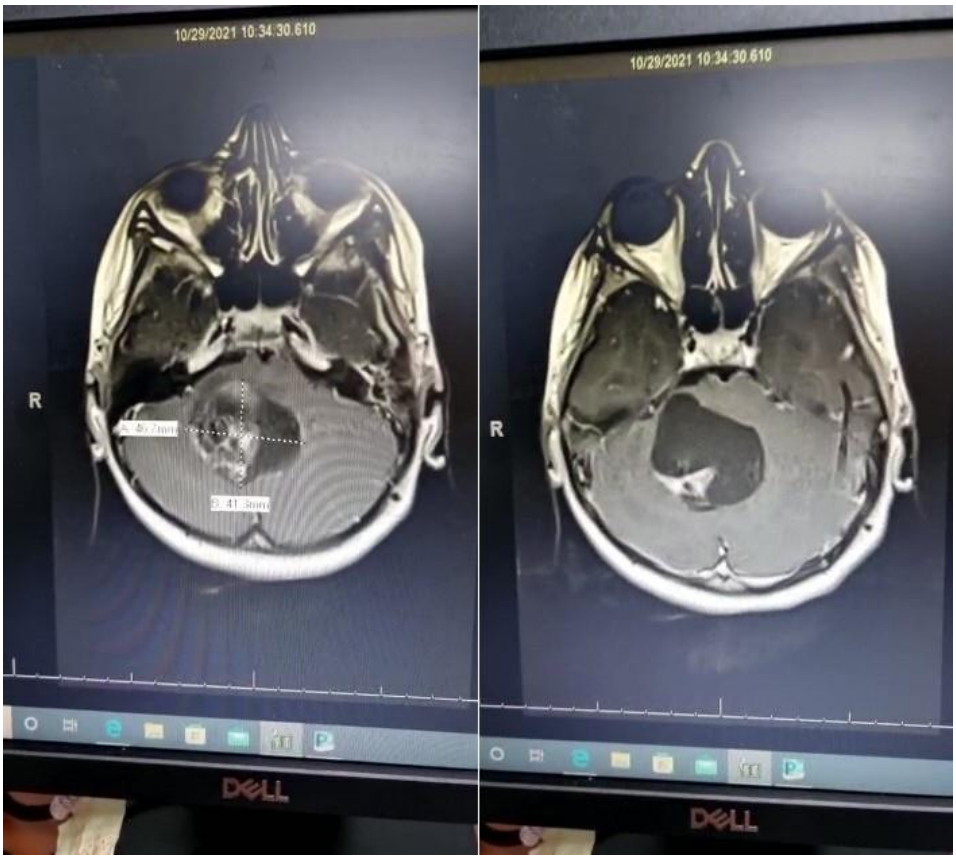

Fig 2a: T1 weighted image of MRI with contrast showing right sided post fossa lesion

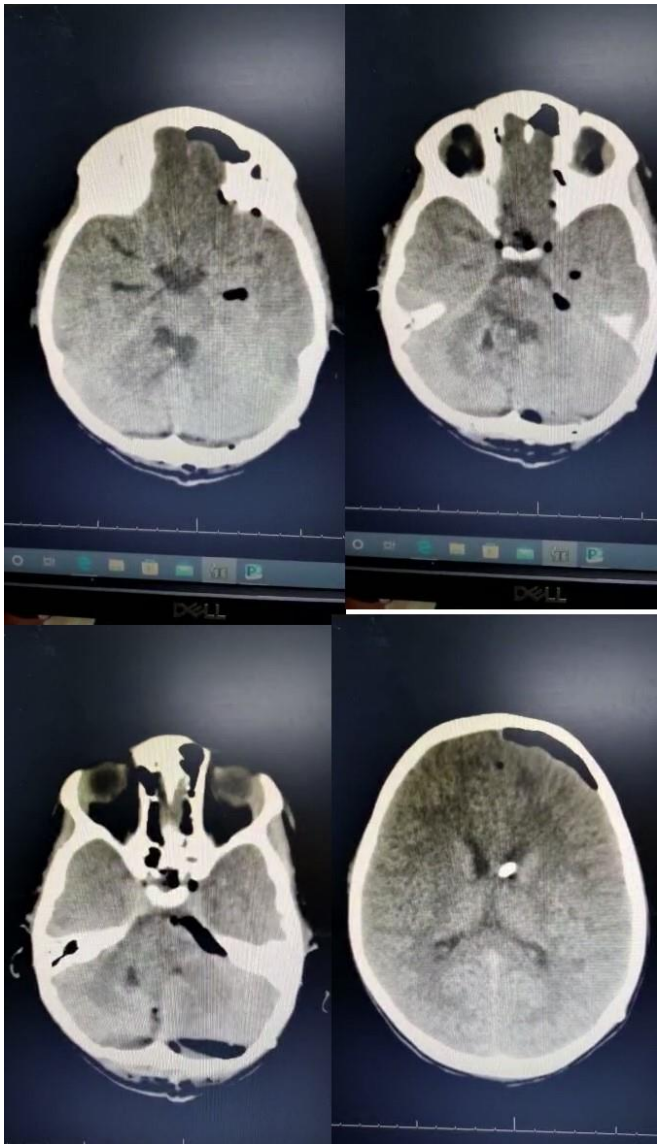

Fig 2b: postoperative CT brain showing total excison of posterior fossa lesion

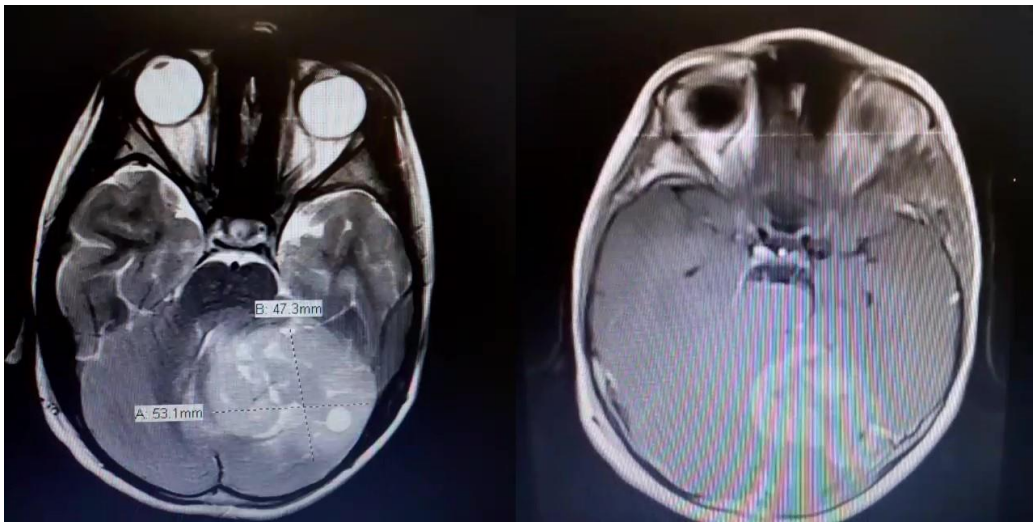

Fig 3a: T2 weight image showing lt sided posterior fossa lesion

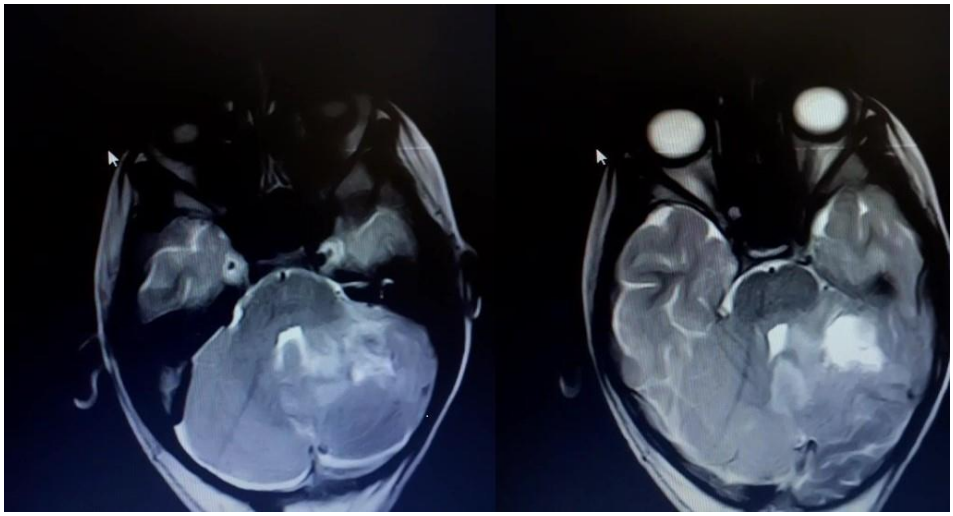

Fig 3b: T2 weighted image MRI showing excision of lt sided posterior fossa lesion

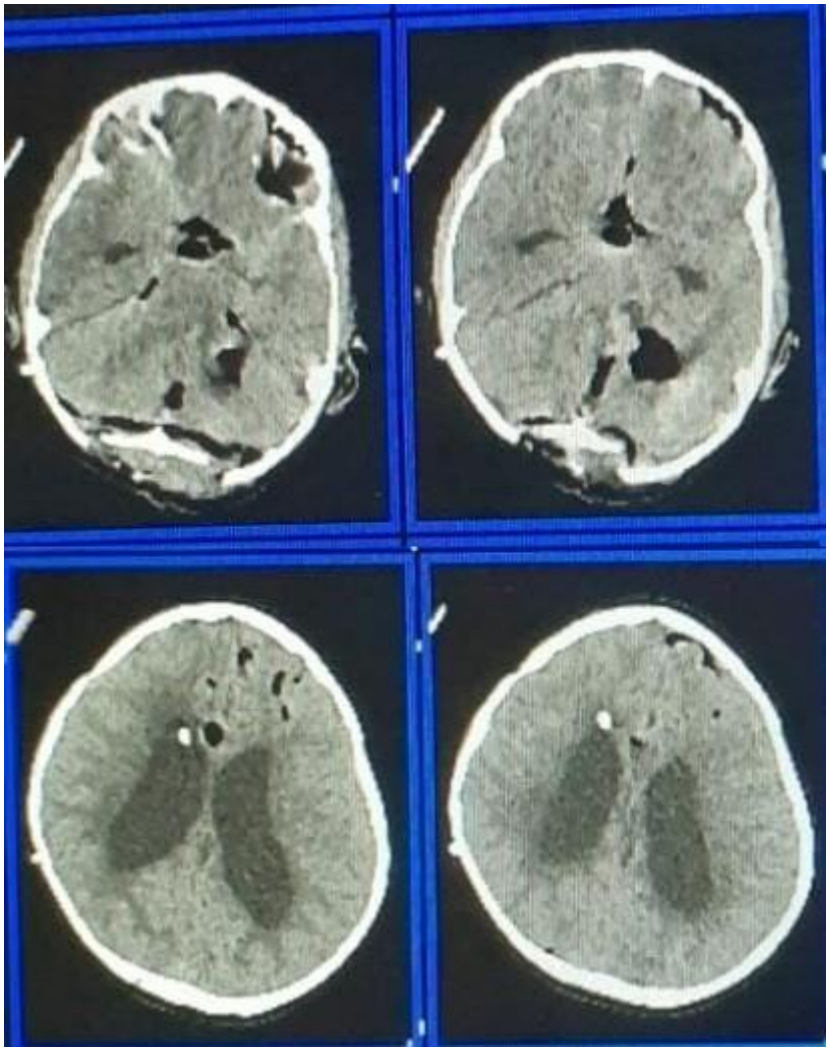

Fig 3c: Postoperative Ct brain showing Excision of Posterior fossa lesion

Discussion

Brain tumors are the most common solid neoplasm in children, second only to leukemias in their overall frequency. The frequency of brain tumors by histo-pathological type and location differ greatly between pediatric and adult tumors. Histological, a large percentage of pediatric brain tumors are gliomas, mainly astrocytoma, representing 40% to 65% of brain tumors in most childhood series[7]. Cerebellar astrocy-toma is the second most common posterior fossa tumors after medulloblastoma[8]. A counting for approximately 12 to 17% of all CNS tumors and 25 to 35% of childhood posterior fossa tumors[9]. They have the prognosis of any intracranial tumors in childhood[3].

In this study the age of the patients ranged from 6 months to 15 years, with peak at the age of 6 years, and the mean was 6.1 years. which goes with the study of Gracia. et al.,[10]. in which the peak was at age of 6 years, while the mean age was 8 years. In other study the peak was at the age of 8 years [6].

In the presenL study, male predominance than female was noticed as males were l6 cases and female were 10 cases, with male female ratio of 1.6:1. Predominance of male over female in cerebellar astrocytoma was reported in other studies, but it was about 1.2:1[9,11].

In his study in 2008 Duffner reported that cerebellar astrocytoma typically arises laterally in a cerebellar hemisphere, and have both cystic and solid components[12]. While the present study showed that, the cerebellar astrocytomas may have midline location, as there were l0 cases (38.5%) out of the 26 cases were located in the midiine. Yasue, et al., reported that, hemispheric cerebellar astrocytoma showed good prognosis than the midline located cerebellar astrocytoma[13]. All the late rally located tumors (16 cases) included in this study were pilocytic astrocytoma (grade I) and associated with good prognosis In those 16cases laterally located tumors, 9 cases were cystic tumors, 2 cases were solid tumours, and 5 cases were mixed tumors. Ilgren and Stiiller; found that cystic cerebellar Astro-cytomas tend to be located in the hemisphere[13,14]. The midline located tumors in this study were l0 cases, 7 cases had mixed components and 3 cases had solid component. They were pilocytic, fibrillary, and anaplastic astrocytomas of grade I (30%), grade II (50%) and grade III (20%). In the studies of Sgouros, et al., (2005), and Steinbok and Mutat (2009). they reported that the solid cerebellar astrocytoma may be completely solid, or solid with cystic degene-ration, and 90% of the solid tumors are located in the vermis with or without extension into one or both hemisphere [15,16].

In the study of Yasue. et.al. (2007), 7 out of 8 cases that developed recurrence after sub-total removal were in the midline location. and 6 out of 7 cases that did not show any recurrence were cystic in nature. From the above-mentioned studies and the present study, the lateral, cystic, cerebellar astrocytoma has a better outcome than, the midline solid, cerebellar astrocytoma[17].

The main presenting symptom in the present study was headache/crying baby in 22 of the cases (84.6%), which goes with the published studies that reported percentage from 82 to 97[18]. Vomiting nausea was the presenting symptom in 24 cases (92%) out the 26 cases included in this study, blurring of vision in 20 cases (77%), gait disturbance in 20 cases (77%), and squint/diplopia was in 14 cases (54%) all go with reviewed report[11,19,20], while the recorded signs were, papilledema of various degrees in 20 cases (92%), ataxia in 20 cases (77%), 6th nerve palsy in 14cases (54%), and nystagmus in 10 cases (38.5%). Stienbok and Mutat (2009), found that, ataxia presented in 84%, more than papilledema in 73%[21]. Gupta, et.al., (2006), reported five cases torticollis as the initial sign of posterior fossa tumors. A head tilt and nuchal rigidity may be observed due to 6th cranial nerve palsies, or due to tonsillar herniation the 6th nerve was the most commonly involved cranial nerve (usually bilaterally) in 57 of his cases[21] .

In the present study, it was noticed that the characteristic presentation of cerabellar astrocytoma depends on the location of the tumor. Midline tumor tended to cause symptom and signs of increased intra-cranial pressure early in the course of the disease. The duration of symptoms was usually less than five months prior to diagnosis. The predominated sign was trunk ataxia, and 6th

nerve patsy was also frequently observed. While hemispheric cerebellar astrocytoma, tends to be characterized by limb ataxia and unsteadiness. Headache and vomiting occurred late in the course of the disease[22].

Brain tumors can be diagnosed with CT imagmg or MR imaging. The MRI generally has become the study of choice for suspected tumors because of its greater sensitivity in detecting some low-grade gliomas not evident on contrast-enhanced CT scans, and its far better resolution and ability to demonstrate the tumor in three plans. This is helpful to the surgeon for operative planning as well as for best assessment of tumor status after surgery, and other adjuvant therapies [18,23].

All patients in the present study were investigated by both CT scans with and without contrast enhancement and MRI with and without gadolinium enhancement. Ten cases (38.5%) out of the 26 studied cases of cerebellar astrocytoma showed mixed component, either in midline location (7 cases) or hemispheric location (3 cases). Five cases presented with solid tumors (19.2%), either in midline (3 cases) or hemispheric location (2 cases), which agree with the study of Sgouros, et al., (2005), who proved that between 17% and 56% of cerebellar astrocytomas were reported to be solid[22]. In 9 out of 26 studied cases (34.5%) of cerebellar astrocytoma were cystic, with hemispheric location which disagrees with the study of Vettorio, et al., (2011), who proved that 85% of cerebellar astrocytoma were cystic[24].

Cystic cerebellar astrocytoma on CT scan and MRI appears as a large sharply margined cyst with a solid mass attached to the wall (called mural nodule). On CT scan the cyst is hypodense relatively to brain but it is denser than CSF. The solid mass (mural nodule) is either slightly hypodense or isodense, relatively to the adjacent cerebellum. On the T1 MRI weighted image, the cyst is hypo-intense, and the nodule is hyperintense. With contrast the nodule enhances on both CT scan and MRI. Occasionally, the rim of the cystic portion of the astrocytoma may be shown to enhance in ring-like fashion. The tumor is usually surrounded by slight brain edema, and hydrocephalic changes are present in all cases. The tumor on T2-MRI appears larger than the TI-MRI, this is explained by Epstein and Wisofr, (2005), in which the T2 image reflects the infiltrating edge of the tumor and they reported that. the MRI characteristically shows a neoplasm more extensive than what a CT scan would Suggest, and is much more consistent with the clinical examination[25,26].

Colosimo, et al., (2008), reported the superiority of MRI over the CT scan. In his series (52 patients of posterior fossa tumors), CT scan allowed the correct diagnosis in 48% of the cases, with questionable finding in 40%, and misdiagnosis in 12%, while MRI allowed the correct diagnosis in 83% of the cases, with questionable finding in 17%, and no misdiagnosis occurred [8].

The extension of resection plays a very favorable role in prognosis. The patients whom had undergone radical excision of the tumor, doing better than those of partial resection. In this study total removal of the tumors was achieved in 22 cases (85%) of cerebellar astrocytoma with excellent to a good prognosis. In the study of Pencaet, et al., (2012), complete surgical excision was possible in 88.7% of cases with cerebellar astrocytoma, and mortality rate was 4.2[27]. Partial removal of the tumors in the present study was done in 4 cases (15%) (2 soIid and 2 mixed midline tumor), and there were grade II, (2 cases). and grade III (2 cases) cerebellar astrocytoma, Recurrence occurred in both cases of grade II astrocytoma after radio-therapy (two years later). In the study of Yasue, et al., (2007), 42 patients with cerebellar astrocytoma underwent total resection and 16 patients underwent partial resection. The recur-ence rate in partial resection group was much higher than the group of total resection as the percentage of recurrence was 53.3% in partial removal, and 9.8% in total removal [27].

The mortality rate in this study was 7.7% (2 cases out of 26 cases) died before hospital discharge within one week of the postoperative period, but there were no intraoperative deaths in this study. Among the mortality, the two cases were midline cerebellar astrocytoma. The mortality rate in other studies Was 18% or much higher [2,9].

Pan, et al., (2013) reported that, hydro-cephalus was the common finding in patients with cerebellar astrocytoma[15]. In the present study, all the patients (26 cases) had hydrocephalus, which is often associated with increased intracranial pressure. AI-berght and Reigel; stated that CSF shunting in patients with hydrocephalus secondary to posterior fossa tumor is a safe procedure that significantly lessens the morbidity and mortality of subsequent tumor removal.

In this study VP shunt was advocated as the method of choice for treating hydrocephalus in 21 cases. In this series 19 patients (73%) had been treated surgically without need for postoperative adjuvant radio or chemotherapy; those cases were cerebellar astrocytoma grade I, and there was no recurrence during follow up period for 6 months to 2 years. In the other 7 cases (27%) cerebellar astrocytoma were Grade II in 5 cases and Grade III in two cases, but two cases of grade II astrocytoma died before hospital discharge. 3 cases of grad II astrocytoma had been given adjuvant radiotherapy, while the grade III astrocytoma (2 cases) had been treated by adjuvant radiotherapy followed by chemotherapy. The two cases of grade III astrocytoma died by the end of the first year of follow up, while the grade II astrocytoma cases showed different behaviour, as one case was doing well for more than two years, another case showed recurrence in the same cerebellar hemi-sphere, and the third case showed scattered recurrence in both cerebellar hemi-spheres. The results of adjuvant therapy were frustrating among grade III cerebellar not promising among grade II cerebellar astrocytoma in childhood.

Vittorio, et al., (2009), stated that. there were no benefit of radiation therapy in treating any posterior fossa astrocytoma[23]. Rappaport, et al., (2006), pointed out that. radiation therapy was not without risk, there were cases of reports of malignant development many years after radiation therapy of low grad cerebellar astrocytomas, and the late development of meningiomas in the radiation field of treatment has been reported[17]. The most frequent postoperative neurological sequel was deterioration in the cerebellar function, with increase in limb or trunk ataxia. In this study marked cerebellar ataxia was observed in 4 cases (15%) after surgery and resolved gradually within weeks to several months. The same was reported in the early postoperative period and improved over weeks to months[20].

Cranial nerve affection occurred post-operatively in two cases in the form of lower cranial nerve palsies, which required long period of rehabilitation, but in this study the described mutism syndrome as postoperative sequel was not encountered[3]. Pneumocephaly was noticed in 4 cases in this study (15%) following surgery and they were more lethargic than expected in the postoperative period. The reported incidence of tension pneumocephalus was 23% or more[20]. Steinbok and Mutat, stated that one of the most common complication after removal of a cerebellar astrocytoma is pseudomeningocel; which may disrupt suture line. resulting in CSF leak[23]. This complication occurred in two (7.7%) of this study and complicated by bacterial meningitis. While aseptic meningitis was reported in four (15.4%) cases of this study, and it was self-limiting after systemic steroid therapy. Gowwer and Polay report steroid administration in the subarachnoid space has been suggested as mode of therapy [10].

Follow up was carried out to 24 cases in this study, 2 cases died by the end of the first year follow up, those were grade III cerebellar astrocytoma (midline tumor) treated by partial removal of the tumor and adjuvant radiotherapy followed by chemotherapy. The other 22 patients completed periods of follow up between 6 months to two years and all were doing well except 2 cases of recurrence occurred by the end of second years in two patients suffered from cerebellar astrocytoma grade II treated postoperatively by adjuvant radiotherapy, while the third case of grade II astrocytoma showed no recurrence. The incidence of recurrence in grade II cerebellar asrtocytoma was 66% after two years. In one case, the recurrence was in the same cerebellar hemisphere, while in the other there were scattered recurrences in both cerebellar hemispheres. Both types of recurrence were reported in previous reports[2].

Conclusion

Total removal is the cornerstone in treating cerebellar astrocytoma, which can be achieved in all the late rally located tumors and the non-infiltrating midline tumors with excellent and good results of 91% of cases of total removal. There was female predomination in midline cerebellar astrocytoma which had a high percentage of malignancy to the value of 70% While the results of adjuvant radiotherapy and chemotherapy in treating Grade III cerebellar astrocytoma in childhood were frustrating. The results of radiotherapy alone in grade II cerebellar m childhood were non-promising. Studies of novel therapeutic approaches in high-grade juvenile cerebellar astrocytoma should be considered although they are still a subject of controversy by oncologists.

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