TRANSVEREMIAN APPROACH VERSUS TELOVELAR APPROACH IN MEDULLOBLASTOMAS SURGERY

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ABSTRACT

Introduction: *Medulloblastoma, as a critical 4th ventricular tumor, represents a challenge to neurosurgeons because of severe deficits that occur following injury to delicate structures in the ventricular wall and floor. The two most common surgical approaches to medulloblastoma are the transvermian and telovelar approaches.* ***Aim of study:*** *This study was done to compare between the two previous approaches regarding the morbidity and mortality and also to study the different variables that may affect the final outcome of each approach and to define the different indications for each of them, as regards the site, the size and extension of the tumor.* ***Patients & Methods:*** *This is a prospective study done on 20 patients with posterior fossa midline primitive neuroectodermal tumors (medulloblastoma) who were operated upon in Ain Shams University Hospitals, Egypt, from February 2003 till August 2006. Two approaches had been used; transvermian and telovelar, which were selected on alternating basis so first patient had transvermian approach and the second had telovelar approach and so on. Intra-operative difficulties, complications and the final outcome were reported.* ***Statistical analysis:*** *All patients' data had been tabulated in two groups (each formed of ten patients); group I those who had transvermian approach and group II those with telovelar approach. Different variables that might have affected the final outcome were studied in each group and also the final outcome was compared between the two groups. Qualitative and quantitative statistical tests were used for statistical analysis of the patients' data.* ***Results:*** *Headache of increased intracranial tension was the most frequent symptom followed by ataxia (70 % and 65 %, respectively). Pre-operative radiological investigations showed presence of obstructive hydrocephalus in twelve patients (60 %). Regarding the tumors sizes, there were four patients with small tumors, eleven patients with medium tumors and five patients with large ones. There was increase in cerebellar signs in 100 % of patients in group I and in group II it was increased in only 40% of patients. But all patients had improved regarding the ataxia in long term follow-up. Lower cranial nerve affection occurred in one patient in group I. There were two patients with cerebellar mutism in group I and only one patient in group II. Disturbed level of consciousness had occurred in the patient with injured PICA in group II. There was one patient in group I with post-operative CSF leakage that was complicated by infection. This patient died one month after surgery from ventriculitis. Another patient with mortality had occurred in group II due to brain stem infarction from PICA injury. Total excision of the tumors was achieved in eleven patients; seven patients (70 %) in group I and four patients (40 %) in group II.* ***Conclusion:*** *Both transvermian and telovelar approaches were useful for excision of medulloblastomas. The unilateral telovalar approach seemed more suitable for small tumors. However, in practice, most of these tumors were large and reaching the aqueduct, so the extensive (bilateral) telovelar approach will be needed to achieve tumor resection with increased incidences of post-operative mutism and ataxia that might be similar to those associated with the transvermian approach.*

Key words: *Medulloblastoma, Transvermian, Telovelar.*

INTRODUCTION

Of all solid tumors in childhood, brain tumors are the most common and primitive neuroectodermal tumors (PNET), namely medulloblastoma, is the most common tumor in the posterior fossa and constituting about

20% of all intracranial tumors[15]. Approximately 85% of these tumors, in the cerebellar midline, typically arising from the inferior medullary velum as reddish-grey friable masses that frequently distend the vermis and protrude from the foramen of Magendi[38]. The two most common surgical approaches to medullo-blastoma are transvermian and telovelar approaches. The first involves incising the inferior vermis of the cerebellum and retracting the two halves of the vermis in opposite lateral directions[11,18]. In the second approach, the tela choroidae and inferior medullary velum, which form the lower half of the roof of the fourth ventricle, are opened and the lower vermis is retracted as a unit to provide exposure into the fourth ventricle[3,22,27]. The technical differences between the two approaches and the anatomical structures that limit the surgical view in each approach result in differences with regard to the exposure of the fourth ventricle floor, the lateral recess and the foramen of Luschka.

Aim of the study:

This study was carried out to compare between the two previous approaches regarding the morbidity and mortality and also to study the different variables that may affect the final outcome of each approach, so to define the different indications for each of them, as regards the site, the size and extension of the tumor.

PATIENTS & METHODS

This is a prospective study done on 20 patients (fifteen males and five females) with newly diagnosed posterior fossa midline primitive neuroectodermal tumors (medulloblastoma) who were operated upon in Ain Shams University Hospitals, from February 2003 till August 2006. Their ages ranged from 3 to 25 years with a mean age of 13 years. Two approaches had been used; transvermian and telovelar. The approaches were selected on alternating basis so first patient had transvermian approach and the second had telovelar approach and so on. The intra-operative difficulties, complications and final outcome were reported.

Pre-operative evaluation:

All patients had full general and neurological examination. Pre-operative examination included brain CT and MRI for every patient. Routine pre-operative laboratory investigations were also done. On the MRI, the tumors size, site, extent and consistency were reported. According to sizes of the tumors, they were grouped into 3 groups; small in which tumors volume were less than 2cc, medium where tumors volumes were 2-4 cc and large with tumors volume more than 4cc.

CSF cytology for the detection of probability of spinal metastasis was done in every case either during shunt surgery or after opening the cisterna magna during tumor excision. Patients with symptoms or signs of cord lesion or positive CSF cytology (suggesting extracranial metastases) were also investigated by spine MRI.

Surgical technique and approach:

Cerebrospinal fluid diversion (ventriculo peritoneal shunt) was done as a primary surgery in patients with associated hydrocephalus that was not expected to be relived by excision of the tumor or when the clinical state of the patient was markedly affected primarily by the hydrocephalus.

After pre-medication and general anesthesia, all patients were operated upon in the fully prone position. C1 laminectomy may be added to the suboccipital craniotomy in large medulloblastoma that extended down

to C1. It was preferred to open the foramen magnum in every case. In patients with hydrocephalus that was not shunted pre-operatively, an occipital burr hole was prepared for ventricular taping to reduce the intracranial pressure if needed.

In the transvermian approach, the inferior vermis was incised and can be extended (in large tumors) up to the fastigium but did not extend into the inferior edge of the superior medullary velum as, functionally, the decussating fibers of the superior cerebellar peduncle lie deep in relation to the superior medullary velum, which is a thin lamina of white substance between the superior cerebellar peduncles[31].

Following the retraction of the vermis and tonsils laterally, it was possible to explore the lower pole of the tumor first and expose the tumor-lower brain stem interface then working around the tumor to delineate the tumor- cerebellum interface.

In the telovelar approach, the inferior medullary velum and the tela choroidae (both forming the caudal part of roof of fourth ventricle) were incised to enter the caudal part of the ventricle. To expose this part of the roof of the ventricle, the slit space between tonsil in one hand and medulla (cerebellomedullary fissure or medullotonsillar space) and uvula (uvulotonsillar space) on the other hand should be opened and the arachnoid membrane found should be dissected to visualize the inferior medullary velum rostrally and the tela choroidae caudally[34] (figure 1).

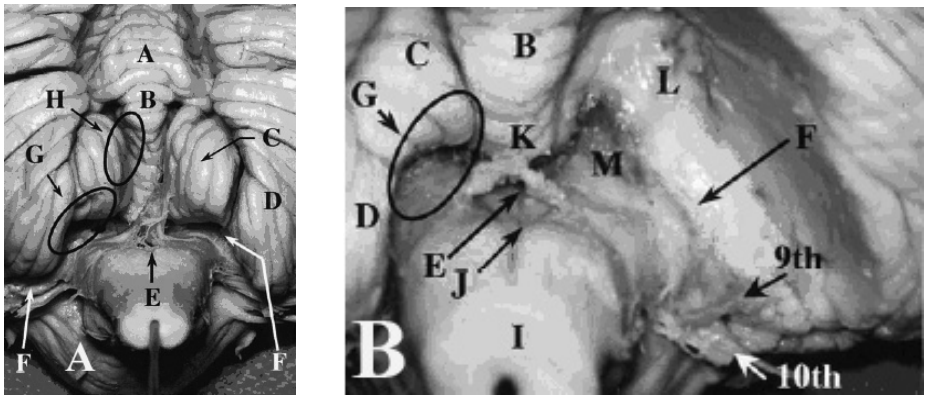

Figure (1): Anatomy of the spaces around the tonsils. A: Posterior view of the cerebellum showing the spaces around the tonsils and uvula. The medial and the inferior surfaces of the tonsils are free and the encircled uvulotonsillar (H) and medullotonsilar (G) spaces can be seen on both sides. B: Exposure of the caudal roof of the fourth ventricle. After removing the tonsil on the right side, the roof of the ventricle (inferior medullary velum (L) and tela choroidae (M)) is visible. The tela choroidae (M) is attached to the medulla oblongata by the taenia (N), and superolaterally extends to form the roof of the lateral recess. The medullotonsillar space, which is encircled, is clearly seen on the left side. A = pyramid; B = uvula; C = tonsil; D = biventral lobule; E = foramen of magendie; F = lateral recess; G = CMF (medullotonsillar space); H = uvulotonsillar space; I = medulla; J = obex; K = choroid plexus; L = inferior medullary velum; M = tela; N = taenia; P = superior medullary velum; Q = lateral wall; R = flocculus; T = middle cerebellar peduncle; 9th = ninth cranial nerve; 10th = 10th cranial nerve[34].

Then the telovelar incision can be done. It can be divided into two parts. The first part opens the tela choroidae (within the medullotonsillar space extending upward to the level of the junction of the tela with the inferior medullary velum). The second part involves extending the incision superiorly through the inferior medullary velum (within the uvulotonsillar space) [34] (figure 2).

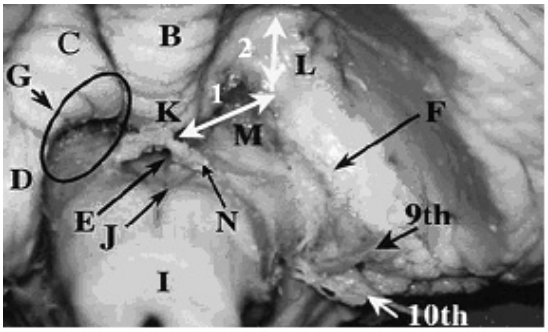

Figure (2): Same figure (1-B) with adding the incision lines within the tela choroidae (line 1) and within inferior medullary velum (line 2).

Using the telovelar approach, the portion of the fissure that is opened depends on the location and the extension of the lesion. Therefore, the methods used to open the fissure can also be classified into three types. First, the lateral recess type which used in lesions only in the lateral recess and it constitute only lateral recess opening by cutting the epsilateral tela choroidae leaving the inferior medullary velum. Second, is the lateral wall opening that used if lesions reaches the cerebellar peduncle and it includes opening the uvulotonsillar and medullotonsillar spaces and incise both the inferior medullary velum and tela choroidae on one side. Finally, the third type is the extensive opening that used in lesions reach aqueduct and it is as the previous opening (lateral opening) but in both sides with retraction of vermis superior[(34)] (figure 3) .

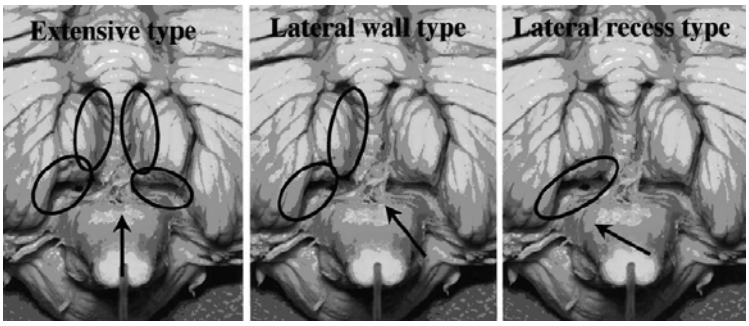

Figure (3): The three different opening procedures for the telovelar approach. The space to be dissected around the tonsil and the part of the ventricle roof to be incised in each type are indicated by a circle[(34)].

All procedure difficulties, complications and mortality were reported and compared between the two groups of patients.

Follow-up and adjuvant therapy:

All survived patients were followed-up clinically and radiologically by CT immediately before discharge from the hospital. MRI follow-up was done for all patients as soon as possible. Also, out patient clinical follow-ups were done monthly for the first 6 months and every 3 months for next year then every 6 months for another year then on yearly basis with a minimum two years of follow-up.

Extent of surgical excision was classified into four groups (table 1). All patients survived had post-operative adjuvant cranio-spinal radiotherapy. The posterior fossa dose was 55 Gy and for the rest of the neuro axis, it was 18-30 Gy.

Table (1): Different grades of surgical excision of the tumor applied in this study.

Grade of surgical excision	Description
Total excision	Gross total intra-operative excision with tumor free post-operative CT and MRI
Near total excision	< 100 - 75 %
Subtotal excision	< 75 - 50 %
Partial excision	< 50 %

Statistical analysis:

All patients' data had been tabulated in two groups (each formed of ten patients); group I those who had transvermian approach and group II those with telovelar approach. Comparison between the two previous approaches, regarding the morbidity and mortality, was carried out and also studying the different variables that may affect the final outcome of each approach. Qualitative data are summarized and analyzed by using qualitative and quantitative statistical tests.

RESULTS

Pre-operative clinical state:

There was male predominance (15 males and 5 females) and ages of patients ranged from 3 to 25 years. The mean age for all patients in both groups was 13 years. Duration of the symptoms before presentation ranged from three months to two years with mean of 8 months (table 2).

Table (2): Age, sex and duration of symptoms distribution

Groups	Age (years)		Sex		Duration of symptoms (months)	
	Range	Mean	Male	Female	Range	Mean
Group I	8 - 25	15	6	4	3 - 18	6
Group II	3 - 19	11	9	1	6 - 24	12

Headache of increased intracranial tension was the most frequent symptom followed by ataxia. There were no signs suggesting spinal seedling. Other symptoms and signs were reported in table (3).

Table (3): Clinical findings in both groups

Clinical findings	Number of patients		
	Group I	Group II	Total number
Headache	6	8	14
Vomiting	4	3	7
Ataxia	6	7	13
Cranial nerve affection			
Papilloedma	5	7	12
6^{th} Nerve palsy	0	1	1
Motor deficit			
Hemiparesis	0	1	1

Pre-operative imaging studies:

Pre-operative radiological investigations showed presence of obstructive hydrocephalus in twelve patients. The tumors were totally solid in nineteen patients while there was a small cystic component (mostly due to degeneration) only in one patient. All tumors were isointense to slightly hyperintense to cerebellum in MRI with nearly uniform enhancement. Regarding the tumors sizes, there were four patients with small tumors, eleven patients with medium tumors and five patients with large ones (table 4 and figure 4).

Table (4): Different tumor sizes that found in the study.

Tumor size	Number of patients		
	Group I	Group II	Total number
Large (> 4cc)	1	4	5
Medium (2 - 4cc)	7	4	11
Small (< 2cc)	2	2	4

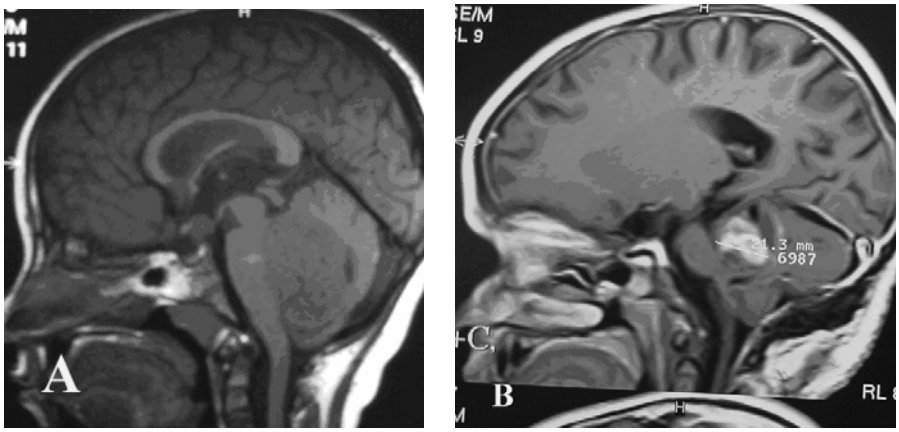

Figure (4): Different tumor sizes encountered in the present study.

As regards the extension of the tumor, there were five patients with tumors extension below the foramen magnum, seven patients till the foramen and the rest (eight patients) above the foramen. There was one case with positive CSF cytology and also radiological evidence of CSF seedling supratentorial (table 5 and figure 5)

Table (5): The tumors consistency and extension

Groups	Number of patients				
	Tumors extension to foramen magnum			Tumors consistency	
	Above	At	Below	Solid	Mixed
Group I	5	4	1	10	1
Group II	3	3	4	9	0
Total	**8**	**7**	**5**	**19**	**1**

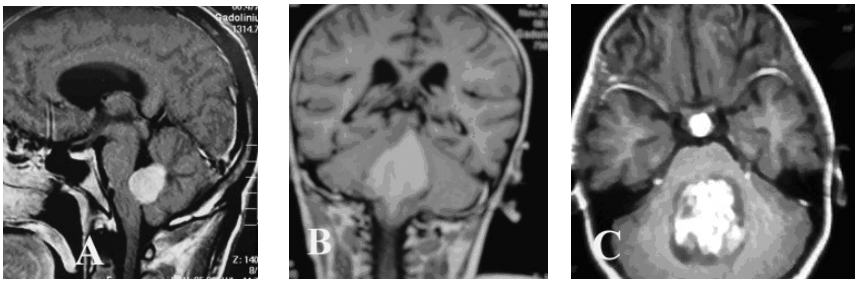

Figure (5): MRI brain T1 with gadolinium sagital, coronal and axial cuts shows: A: small midline posterior fossa intra-axial enhancing lesion above the foramen magnum. B: Large posterior fossa intra-axial enhancing lesion extending from aqueduct to foramen magnum. C: Large posterior fossa intra-axial enhancing lesion with suprasellar seedling.

Operative procedures and early follow-up:

In the twelve patients who had hydrocephalus, ten patients had ventriculo-peritoneal shunt before tumor excision (figure 6). In telovelar approaches, the lateral wall incision was sufficient in three patients where the tumors were not reaching the aqueduct, while in the other 7 patients bilateral telovelar dissection was required.

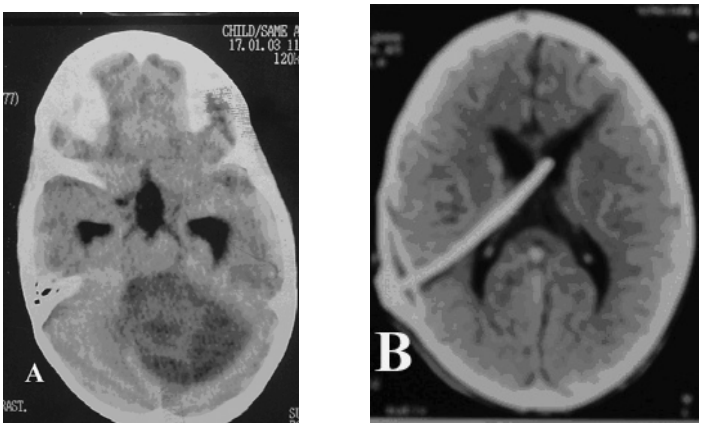

Figure (6): Non-contrasted CT brain axial cut shows was: A: Posterior fossa midline intra-axial lesion causing obstructive hydrocephalus. B: After shunt insertion.

Intra-operative difficulties encountered in this study included markedly shifted posterior inferior cerebellar artery (PICA) by the tumor that was extended down to C1 and this was happened during two of the telovelar procedures and in one of them PICA was injured intra-operatively. Reaching the upper pole in large tumors that extended till aqueduct even with bilateral telovelar dissection was another difficulty encountered and at the end of the surgery, the upward retracted vermis was contused in most of patients.

In transvermian procedures in all patients, tonsils were easily retracted apart even in large tumors "exposing the lower pole of the tumor" without the need to expose the PICA and hence the hazards of its injury. But in these procedures, there were difficulties in going around the lateral part of the tumor that reach the lateral recess without major traction on the two halves of vermis and the two cerebellar hemispheres.

Post-operative morbidity included increase in the pre-operative cerebellar ataxia in six patients in group I and in three patients in group II. Newly developed ataxia had been found in the rest of patients in group I (four patients) while in group II, those

patients who had no pre-operative ataxia (three patients) only one developed post-operative ataxia. Lower cranial nerve affection had been encountered in one patient in group I and also there were two patients with cerebellar mutism in group I and only one patient in group II. Disturbed level of consciousness had occurred in the patient with injured PICA (in group II) and two weeks after surgery, this patient died from brain stem infarction. There was one patient in group I with post-operative CSF leakage that was complicated by infection. This patient died one month after surgery from ventriculitis. All patients with deteriorated cerebellar manifestations had been improved gradually in long term follow-up (table 6).

Table (6): Morbidity and mortality

Morbidity and Mortality	Number of patients	
	Group I	**Group II**
Ataxia	(6 pre-operative)	(7 pre-operative)
Improved	0	0
Stable	0	6 (4 stable ataxia)
Deteriorated	10 (100%)	4 (40 %)
Mutism	2	1
Disturbed consciousness	0	1
Lower cranial nerve	1	0
CSF leakage	1	0
Infection	1	0
Mortality	1	1

Total excision of the tumor was achieved in eleven patients (seven patients in group I and four patients in group II). Table (7) shows the extent of tumor excision in all patients with respect to the group of patients and the size of the tumor (figure 7) .

Table (7): Extent of tumor excision in relation to the approach used and the pre-operative tumor sizes

Tumor size and number	Total excision (11 patients)		Near total (4 patients)		Subtotal (2 patients)		Partial (3 patients)	
	Group I	**Group II**	**Group I**	**Group II**	**Group I**	**Group II**	**Group I**	**Group II**
Large (5)	1	0	0	1	0	1	0	2
Moderate (11)	4	2	2	1	1	0	0	1
Small (4)	2	2	0	0	0	0	0	0
Total	**7**	**4**	**2**	**2**	**1**	**1**	**0**	**3**

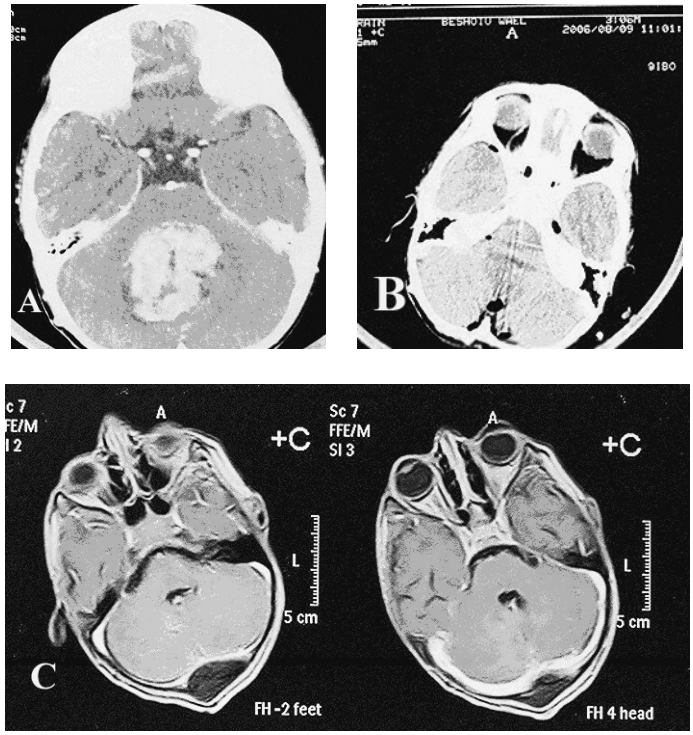

Figure (7): A: Contrasted CT brain axial cut showed enhanced midline vermian tumor with obstruction of fourth ventricle. B: Early post-operative contrasted CT brain axial cut for the same patient (group I) showed no enhancing lesion in the tumor bed. C: Late follow-up for the same patient by contrasted MRI brain T1 sequence. The axial cut shows no recurrence in the tumor bed.

Late follow-up and final outcome:

All survived patients (eighteen patients) had post-operative adjuvant radiotherapy as the youngest child in this study was three years old and the radiotherapiest felt comfortable in giving him radiotherapy for the residual he had in the follow-up MRI. Also, re-do surgery for patients with tumor residual in the follow-up MRI was not offered at this early stage (before radiotherapy) as it was thought that the difficulties that prevent gross total excision in the first instance would be the same in the second attack. Final outcome was assessed after at least two years follow-up.

As mentioned before, all patients (in both groups) with post-operative deterioration in the ataxia were improved to their pre-operative state with physical therapy. Moreover, gait returned to normal in all patients except three (two patients in group I and one patient in group II). Regarding the three patients who developed mutism, two of them (one in each group) had normal speech after 2 and 4 months and the third one did not improve till the last follow-up. Also, the patient with post-operative bulbar was able to get rid of the nasogastric tube feeding after three months. Patients who had hydrocephalus and were not shunted before excision of the tumor (two patients) had normal ventricular size in the follow-up investigations. The patient who had hemiparesis before surgery was the patient who did not recover from the surgery and later died.

Although there was no increase in the tumor size in all the eighteen patients at the end of two years follow-up period, yet there were recurrences in two patients after 27 and 40 months from surgery. These two patients had large tumors that were partially excised in the first surgery (both were in group II). Redoing the surgery was offered

for both patients but one refused, so chemotherapy was tried with him. Regarding the patient who agreed with doing another surgery, it was tried first to go through the same corridor as the first surgery (telovelar) to avoid manipulation on the vermis that was previously irradiated and hence probability of post-operative major cerebellar deficit might be high but there was extensive arachnoidal scaring that prevented clear identification of PICA so, the procedure was shifted to the transvermian approach and fortunately the patient did not developed mutism post-operative .

Statistical data:

When the relation between the extent of the tumor excision (regardless the approach) and the tumor size was studied, it was found that there was significant relationship (Chi square = 13.4 and P = 0.036). The combined effect of the size of the tumor and the approach on the extent of tumor removal, which in the preliminary analysis seemed to be relevant, was analyzed. The approach add non-significant effect on this relationship (Chi square = 3.8 and P = 0.282).

DISCUSSION

Medulloblastomas represent approximately 4% of all brain tumors, 18.2% of intracranial tumors in children and 30% of pediatric posterior fossa tumors[(5)]. The demographic data of the population of patients in this study were comparable with that in other studies only in gender distribution as it shows the male predominance that was recorded by other studies[(2,27)]. The mean age at presentation was the 2nd decade in this study while it was the 1st decade in most of the similar studies[(20)]. Also, the mean of the duration of pre-operative symptoms was longer in this study than other studies (8 months versus less than 3 months in the majority of studies) [(17)].

Hydrocephalous was found in much higher incidence in this study (60%) in comparison to similar studies (average 21%)[(20)]. This had led to a higher incidence of symptoms of increase intracranial tension than those reported in other studies (70% versus 50 %)[(15,22)]. This may point to the importance of emphasizing early detection of minimal symptoms such as unsteadiness especially by pediatrician.

Moreover, the two patients, who had pre-operative hydrocephalus and were not shunted before excision of the tumors, needed no CSF divergence at any stage during the follow-up. This in addition to the fact that total excision was achieved in this study in eleven patients (7 patients in group I and four patients in group II with total 55%), so, one should try to delay using pre-operative ventriculo-peritoneal shunts except in emergency bases. It was reported that patients with medulloblastoma who eventually needed permanent CSF divergence was only in 22.5% of patients. In the present study, shunt was inserted before tumor excision in 50% of patients and some of these patients had clear CSF pathway after excision of the tumors[(20)].

Regarding the size of the tumor, in this study, the majority of tumors (16/20) were larger than 2cc while in other studies, most of the tumors (13/21 and 11/20) were of small size[(15,22)].

There was no vascular insult in the group of patients with transvermian approach (group I) and this was also found in other studies[(33)]. The PICA injury with telovelar approach was observed in one patient in this study. Exposure of PICA and hence

possibility of its injury was emphasized by other studies[15,22,33]. Antonio and Rhoton[3] stated that the PICA is frequently exposed during approaches directed through the tela choroidae or inferior medullar velum. Occlusion of branches of the PICA, that are distal to the medullary branches at the level of the roof of the fourth ventricle, avoids the syndrome of medullary infarction but produces a syndrome resembling labyrinthitis, which includes rotatory dizziness, nausea, vomiting, inability to stand or walk unaided, and nystagmus without appendicular dysmetria.

Cerebellar mutism syndrome (CMS) is a unique post-operative syndrome typically arising 1 to 2 days after resection of a midline posterior fossa tumor. It consists of diminished speech progressing to mutism, emotional labiality, hypotonia and ataxia[29]. In the present study, the CMS was observed in 20% of patients with transvermian approach and in 10% with telovelar approach. In reviewing the studies regarding the incidence of cerebellar mutism after transvermian approach, it was found that it varies from 7.5 % to 29%[7,15,20,22,25,35].

Many studies investigated the risk factors for developing cerebellar mutism and found that the type of tumor, midline localization and vermal incision were significant single independent risk factors. In addition, an interdependency of possible risk factors (tumor >5 cm, medullo-blastoma) was observed[6]. This might explain the high incidence of mutism in group I of patients in this study as the tumor size was moderate to large in 80% of patients with transvermian approach and also total excision (representing more cerebellar manipulation) was achieved only in 70% of patients. Although in telovelar approach, no vermal splitting had been done yet there was 10 % of patients who developed post-operative cerebellar mutism and this was reported in up to 15% of patients in other similar series especially in doing bilateral telovelar approach (which was used in seven patients out of ten in this study) in large tumors reaching the aqueduct as in most of the patients seen[34].

Pollack[25] suggests that cerebellar mutism after a midline surgical approach to the tumor is caused by excessive paravermal manipulation of tissue and subsequent bilateral damage to the dentate and interpositus nuclei rather than by damage to the vermis. Moreover, recent studies were pointed to the relation of brain stem insult either by tumor invasion or excision as the only significant risk factor in the development of cerebellar mutism rather than vermian splitting[8].

Actually, the pathophysiology of cerebellar mutism syndrome is controversial and both functional and organic theories have been considered. The functional hypothesis is supported by the normal higher cortical functions and the absence of deficits of the cranial nerves and of the organs of phonation in the mute patients[26,30]. The organic hypothesis is based on the presence of cerebellar dysartheria during resolution of mutism[37]. The cerebellum is involved in speech and the anatomical basis of the cerebellar role in speech is related to the superior cerebellar hemisphere-dentatonuclei-thalamus cortex pathway. The vermian and paravermian region also receive information from the motor and sensory cerebral cortex, as well as subcortical areas responsible for initiation of speech[7,10]. Neurophysiological studies have identified the cerebellar areas that are responsible for the control of phonation in the paravermian zone[1,21].

It has proposed that post-operative edema or ischemia, produced by spasm of the cerebellar vessels, can cause dysfunction of these areas with subsequent mutism[7,9]. Nishikawa et al.[24] even reported this syndrome after occlusion of the basilar artery.

Many studies investigated the cerebral perfusion in cerebellar mutism and found that during the period of mutism, a marked reduction of the perfusion and normalization after regaining of the speech were observed[13,16,24], so, mutism may be happened regardless the approach in medulloblastoma surgery because the vermian splitting is not the only underlying cause of mutism but also vascular ischemia which may be occurred with higher incidence with telovelar approach due to exposure of PICA bifurcation near the inferior end of the uvulotonsillar space around the telovelar junction[33].

In the current study, all patients with transvermian approach developed transient increase in the ataxia post-operative but this was also the case in 40% of patients with telovelar approach. In study by Toshio et al.[34], the transient cerebellar ataxia was observed in 15% of patients with telovelar approach.

In the present study, total excision was achieved in eleven patients (55%). Although the majority of these patients (7 patients) were approached transvermian, there was non-significant relation between the approach and the extent of tumor removal.

Vivek et al.[36] stated that the transvermian approach was better than the telovelar approach for the vertical angle to the rostral aspect of the fourth ventricle, and removal of the C1 posterior arch is needed to obviates this sole advantage of the transvermian approach. Also, Necmettin et al.[23] reported that the transvermian approach provides slightly better visualization of the medial part of the superior half of the roof of the fourth ventricle and the telovelar approach, which lacks incision of any part of the cerebellum, provides an additional exposure to the lateral recesses and the foramen of Luschka.

The extent of tumor removal has been reported as one of the most significant variables affecting survival and it has also been shown that radical tumor removal of a medulloblastoma carries lower operative mortality and morbidity rates[4]. However, other study found that the extent of tumor removal is not an independent prognostic factor and others did not find differences in long term survival between those with total or subtotal/partial resection[12]. Although our series appeared to suggest some benefit of total tumor removal, as recurrence had occurred in two patients without complete excision yet the difference was statistically non-significant.

In other similar studies, the rate of recurrence was higher as reported by Karoly et al.[20] who found that 46% had recurrence of their tumor and the median time to recurrence was 14.6 months (range 2.3-74.7 months), so, longer follow-up may lead to more recurrent cases.

CONCLUSION

Both transvermian and telovelar approaches were useful for excision of medulloblastomas. The unilateral telovalar approach seemed more suitable for small tumors. However, in practice, most of these tumors were large and reaching the aqueduct, so the extensive (bilateral) telovelar approach will be needed to achieve tumor resection with increased incidences of post-operative mutism and ataxia that

might be similar to those associated with the transvermian approach.

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