The Factors Required for V-P Shunting in Children with Posterior Fossa Tumors

Posterior Fossa Tümörü Olan Çocuklarda V-P Şant Takılmasını Gerektiren Unsurlar

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Abstract: The factors for recommending postoperative V-P shunt insertion in twenty-eight pediatric patients, previously operated on for posterior fossa tumor, without V-P shunt preoperatively are investigated in this study. Age, sex, the preoperative duration for high intra-cranial pressure (ICP) signs, the preoperative hydrocephalic index, tumor size, tumor location, the extent of tumor resection, the use of external ventricular drainage (EVD) and its duration, postoperative ICP records, complications and histopathological diagnosis between the groups with and without V-P shunt are collected and compared. In 8 (28.57 %) of cases, V-P shunt was inserted in the postoperative period. Young age at diagnosis, the extent of tumor resection, prolongation in EVD duration and postoperatively high ICP levels are found to be statistically significant factors for shunt insertion in the postoperative period.

Key Words: Pediatric, posterior fossa tumor, V-P shunt

Özet: Bu çalışmada, posterior fossa tümörü nedeniyle opere edilmiş ve preoperatif V-P şant takılmamış yirmisekiz çocuk hastada, postoperatif dönemde V-P şant takılmasını gerektiren faktörler araştırılmıştır. V-P şant takılan ve takılmayan gruplar yaş, cinsiyet, preoperatif intrakranial basınç (İKB) artımı belirtilerinin süresi, preoperatif hidrosefalik indeks, tümör büyüklüğü, tümör lokalizasyonu, tümör çıkarımının miktarı, eksternal ventriküler drenaj (EVD) kullanımı ve süresi, postoperatif İKB kayıtları, komplikasyonlar ve histopatolojik tanı yönünden karşılaştırılmıştır. Sekiz (% 28.57) olguda postoperatif dönemde V-P şant yerleştirilmiştir. Postoperatif dönemde şant yerleştirilmesinde istatistiksel faktörler olarak tanı yaşının küçük olması, tümör çıkarımının genişliği, EVD süresinde uzama ve postoperatif yüksek İKB seviyeleri önemli bulunmuştur.

Anahtar Sözcükler: Çocuk, posterior fossa tümörü, V-P shunt

INTRODUCTION

In contrast to adults, the majority of central nervous system tumors of childhood are located infratentorially (9). The proximity to the fourth ventricle, and therefore, the cerebrospinal fluid (CSF) pathways, predisposes children with posterior fossa tumors to the development of obstructive hydrocephalus (7, 15, 18). Therefore, there are chronic or acute signs of raised intracranial pressure due to obstructive hydrocephalus in most of the pediatric patients with a tumor in the posterior fossa. As a result, some patients with posterior fossa tumors will require a CSF diversion procedure at some time during the course of their illness (1, 2, 3, 7, 10, 13, 16). Various treatments have been reported including multiple ventricular taps, insertion of external ventricular drains, internal CSF shunts for initial therapy of hydrocephalus. It has also been reported that precraniotomy CSF shunting with a waiting

period of one or two weeks between the insertion of the shunt and the removal of the posterior fossa tumor (PFTm) results in a better operative field and a lower level of morbidity and mortality (2, 14).

However, permanent CSF shunting prior to tumor resection is not without complication. Upward transtentorial herniation, tumour haemorrhage, shunt malfunction, infection, abdominal problems, and systemic metastases due to shunting are known complications. (4,8,11,12). Additionally, an important problem, precraniotomy shunting resulted in all of the patients becoming either shunt dependent or at least having a permanently inserted shunt after undergoing surgery for PFTms (14, 17).

It is well known that a resolution of hydrocephalus occurs after PFTm resection in most pediatric patients. Therefore, precraniotomy shunting in all patients with PFTm is not necessary. An alternative method for treatment of hydrocephalus is to find the patients' group that will require shunting. The approach taken at our clinic has been to avoid the placement of a permanent preoperative shunt. Thus, we have analyzed for pre-, intra-, and postoperative factors that are predictive for permanent shunt requirement.

MATERIAL AND METHODS

Between 1992 (January) and 1996 (April), the pediatric patients (< 16 years old) who underwent surgery for PFTms were evaluated to find which factors were associated with the necessity for post-operative ventriculo-peritoneal (V-P) shunt placement. The patients who had brain stem tumors and placed V-P shunt prior to tumor resection were excluded from this study. Twenty-eight pediatric patients with PFTms were included in the study.

The cases were assessed in two groups. 1. The patients that had a V-P shunt placed after tumor resection or 2. The patients that did not have a V-P shunt placed. Clinical studies included analysis of the following parameters: Age at diagnosis, gender, presence and duration of raised intra-cranial pressure symptoms in the pre-operative period, pre-operative hydrocephalic index and tumor size (Fig. 1), tumor location (midline or hemispheric), extent of tumor resection [according to operative reports and/or computed tomography (CT) scan findings carried out during the first post-operative 72 hours or at one month; subtotal tumor resection had a visible tumor remaining, and gross total resection had no visible residual tumor], application and duration (days) of external ventricular drain (EVD), post-operative intra-ventricular pressure (IVP) course, hystopathologic diagnosis and post-operative complications. The Mann-Whitney U test and the t test were used for statistical analysis.

All patients had a CT scan on admission. Additionally, five patients had magnetic resonance imaging. The CT scans were reviewed to assess the

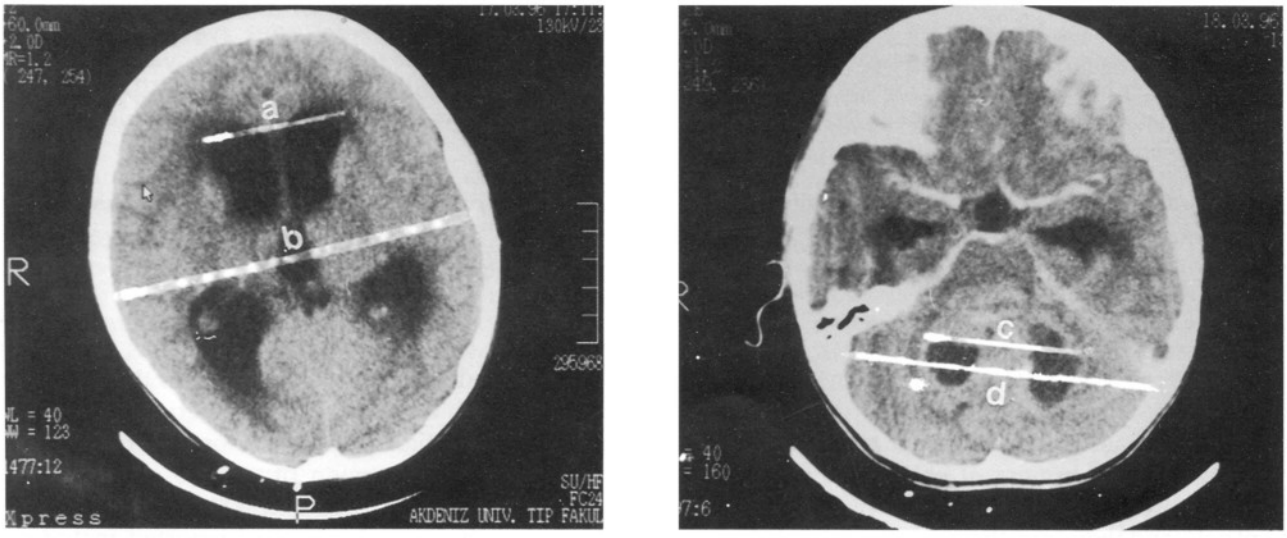

Figure 1: Left: Method for measuring the preoperative hydrocephalic index on computerized tomography scans. We calculated the maximum distance of the tips of the frontal horns (a) as a percentage of the maximum parenchymal diameter (b-a) (Hydrocephalic index: a / b-a). Right: Method for measuring tumor size ratio. We calculated the maximum lateral diameter of the tumor (c) as a percentage of the maximum width of the inner diameter of the posterior fossa (d) (Tumor size ratio: c / d).

degree of hydrocephalus and tumor size. After the diagnosis was established, dexamethasone was given to all patients in the study. During PFTm surgery, immediately prior to opening the posterior fossa dura, the ventricular catheter was inlet into the lateral ventricle of the patients that had ventricular dilatation by a right occipital burr-hole. The ventricular catheterisation and IVP monitoring were carried out in 24 patients. The ventricular catheter was connected with a three-way connector associated with EVD and IVP monitoring device (Transpaque-1, Siemens, Sirecust-730, Germany). Initially, 10-20 ml of CSF was removed intra-operatively for a slack posterior fossa. We attempted a total tumor resection using a microsurgical technique and an ultrasonic aspirator. Internal shunts such as aquaductus canulation or ventriculo-cisternal catheterisation were not used. The type of dural closure was water tight with or without autogen dural greft. Proflactic antibiotic was used in all cases. Antiepileptic drugs were not used. Dexamethasone was gradually diminished in the post-operative period and was cut off depending on the clinical condition of the patient. Between 2-7 days in the post-operative period, CSF was drained by EVD, and IVP was also monitored.

Our criteria of V-P shunt placement following PFTm resection included EVD dependence (if prolonged IVP increases in spite of intermittant CSF drainage and if it continues as clinical and radiological hydrocephalus in the post-operative period) or persistant pseudomeningocel.

RESULTS

Characteristics of the 28 patients are listed in Table I. The mean age was 9.8 ± 3.9. In 15 (53.57 %) of the cases, the tumor was in midline and in 13 (% 46.02) of the cases in hemispheric localisation. Gross total resection was done in 67 % of the cases and subtotal resection was done in 32 % of them. Medulloblastoma in 39 % and astrocytoma in 35 % of the cases were the final histopathological diagnosis.

Eight (28.57 %) of the cases were shunted postoperatively. Statistically significant factors between the groups, which were either shunted or not, are listed in Table II. In Table III other factors which were not statistically significant are listed. Young age at diagnosis, prolongation in EVD time and high ICP levels postoperatively (EVD dependent group) and subtotal resection were found as properties in shunted group with the statistically significant results.

Table I: Characteristics of 28 Pediatric Patients with Posterior Fossa Tumors subjected to Statistical Analysis.

Characteristics	values
Age (years)	9.8 ± 3.9
Gender	
Female	10 (35.72 %)
Male	18 (64.28 %)
Duration of high ICP symptoms (weeks)	6.03 ± 3.26
Tumor size ratio (tumor/cerebellum)	0.38 ± 0.10
Pre-operative hydrocephalic index	0.50 ± 0.13
Tumor location	
Midline	15 (53.57 %)
Hemispheric	13 (46.42 %)
Extent of resection	
Gross total	19 (67.85 %)
Subtotal	9 (32.14 %)
Perioperative external ventricular drainag	24 (85.71 %)
(No. Of cases)	
Duration of EVD (days)	2.66 ± 1.71
Post-operative complications	
pseudomeningocele	5 (17.85 %)
infection	4 (14.28 %)
pseudobulbar palsy	1 (3.57 %)
cerebellar mutism	1 (3.57 %)
Histopathological diagnosis	
Medulloblastoma	11 (39.28 %)
Astrocytoma	10 (35.71 %)
Other type tumors	7 (25 %)

Table II: Significant Characteristics in the Comparison of Patients with and without V-P Shunt.

	Shunted	Nonshuntec	p
Age (years)	6.31 ± 2.81	11.3 ± 3.38	< 0.01
Extent of resection			
Total	3 (15.78 %)	16 (84.20 %)	< 0.05
Subtotal	5 (55.55 %)	4 (44.44 %)	
Duration of EVD* (days)	4 ± 2.64	2.05 ± 0.55	< 0.01
IVP** records (mmHg)	22.7 ± 5.7	9.4 ± 2.6	< 0.01

* External ventricular drainage
** Intraventricular pressure

DISCUSSION

With the posterior fossa tumor associated hydrocephalus, we may be faced with two different conditions; the clinical-pathological signs of the tumor itself and/or the hydrocephalus (14). In most of the cases as hydrocephalus might cause the initial

Table III: Non-significant Characteristics in the Comparison of Patients with and without V-P Shunt.

	shunted	non-shunted
Gender	3 F* (27.20 %)	8 F (72.70 %)
	5 M** (29.10 %)	12 M (70.58 %)
Duration of high ICP*** symptoms (weeks)	4.5 ± 2	6.65 ± 3.19
Tumor size	0.34 ± 0.11	0.40 ± 0.09
Tumor location		
midline	6 (40 %)	9 (60 %)
hemispheric	2 (15 %)	11 (75 %)
Hydrocephalic index	0.52 ± 0.18	0.49 ± 0.11
Hystopathological diagnosis		
Medulloblastoma	5 (45 %)	6 (55 %)
Astrocytoma	3 (30 %)	7 (70 %)
Postoperative complications		
Yes	4 (50 %)	4 (50 %)
No	4 (20 %)	16 (80 %)

* female
** male
*** intracranial pressure

signs and symptoms, the choice of therapy policy was firstly directed towards hydrocephalus. V-A shunt application in posterior fossa tumor surgery was first used by Abraham and Candy in 1963 (1). It was stated that waiting for a period of about 1-2 weeks between the posterior fossa tumor resection and shunting allowed decompression of the ventricles and a better operative field. Albright and Reigel (2) reported that preoperative shunting reduced postoperative mortality and morbidity. However, 80-100 % of the cases resulted in shunt dependence. Hoffmann et al. (11) reported that fourty-one patients with medulloblastoma were treated in this fashion and of these, four metastasized through the shunt and died of systemic metastases without any evidences of recurrent tumour in their central nervous system. Epstein and Murali (8) pointed out upward migration and intratumor bleeding following preoperative shunt insertion in pediatric patients with posterior fossa tumor. They merely suggested preoperative shunting for the cases with acute ICP elevations and with no response to pharmacologic therapy.

That in most of the cases with posterior fossa tumor, there appeared regression in hydrocephalus following tumor resection has previously been reported (7,14,15,16). Early diagnosis with computed tomography/magnetic resonance imaging, perioperative use of corticosteroid and total tumor removal may result in avoiding unnecessary shunt insertion and reducing complications related to the shunting. In this respect, to detect the shunt-dependent patient group first of all and to use shunting for them afterwards may be an alternative method particularly for the therapy of hydrocephalus following posterior fossa tumor surgery.

In our study, young age at diagnosis was found as a significant predictor for postoperative shunting. Nevertheless, young age correlates with shunting in previously reported literatures (6, 13). Lee et al. (13) stated that the parallelism with young age and shunting is related to the high grade of the tumor in most of the cases. Additionally, congenital tumors causing alternation in CSF dynamics and, thus, damaging CSF pathways which were found in younger age with high incidence could be another explanation.

In this study, postoperative EVD dependence is found to be a determining factor for permanent shunt insertion. Intra-post-operative EVD, IVP monitoring and the use of corticosteroid are known as effective factors for the treatment of hydrocephalus following posterior fossa tumor surgery (15, 18). IVP monitoring maintains a safe postoperative period and also determines EVD dependence which has proved to be a reliable factor for subsequent shunt insertion in previous literatures. IVP monitoring can reduce EVD duration and its possible complications in patients who do not require shunt. Besides this, intermittent CSF drainage via EVD can avoid aseptic menengitis and subsequent hydrocephalus by purifying blood and blood products from the ventricular system.

Another factor which predicts postoperative shunt insertion following posterior fossa surgery is the subtotal tumor removal. In our study, 84 % of the patients did not need shunt insertion following gross total tumor removal. Two physiopathologic mechanisms are responsible for subsequent hydrocephalus after surgery in spite of total tumor removal and/or observation of release in obstruction of CSF pathways (5). Existence of abnormal fibrinogen and its transformation to fibrin at the level of Pacchioni bodies in CSF at the initial term could cause resistance to CSF flow and may result in communicating hydrocephalus. Subarachnoid adhesion formation may be another probable predis position factor for hydrocephalus in delayed term. Another explanation is that when the ependymal surface of the fourth ventricle, particularly in the

region of the aquaduct, is disturbed during tumor removal, the risk of postoperative hydrocephalus requiring a shunt is significant (10).

In conclusion, young age at diagnosis, postoperative EDV dependence and high ICP records, and subtotal tumor removal are found as predictor factors for shunt insertion. Therefore, radical resection should be performed especially in midline tumors and dura mater should be tightly closed. Furthermore, during the postoperative period, EVD dependence could be easily determined by IVP monitoring via EVD.

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