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The analysis of correlative factors affecting long-term outcomes in patients with Solid Cerebellar Hemangioblastomas

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ABSTRACT

Objective: Analyze the factors affecting postoperative outcomes in patients with solid cerebellar hemangioblastomas.
Patients and methods: We retrospectively analyzed the clinical data of 22 patients with sporadic solid cerebellar hemangioblastomas. Data regarding the clinical materials and imaging features, diameter of the lesion, operative approaches and postoperative complications were analyzed in all patients. The factors that may affect the recovery of postoperative patients were analyzed by univariate analysis and logistic regression multivariate analysis.
Results: All 22 patients were diagnosed with sporadic solid cerebellar hemangioblastomas; total resection was achieved in 21 of 22 patients (95.5%). Six patients with combined obstructive hydrocephalus received a ventricle-peritoneal shunt preoperatively. The mean duration of the follow-up period was 25.5 months (range, 6–72 months). Tumor recurrence occurred in two patients with poor prognosis at 12 months and 56 months after surgery. According to outcome, patients were divided into the poor group (4 of 22 patients, 18.2%), in which neurological symptoms persisted postoperatively, or were worse than preoperatively, and the good group (18 of 22 patients, 81.8%) with no neurological signs or improved symptoms postoperatively. After univariate analysis, the factor affecting the final outcome was postoperative hemorrhage ($P = 0.003$). Moreover, multiple logistic regression analysis via R software indicated that postoperative hemorrhage ($p = 0.008$) was correlated with outcomes.
Conclusions: Postoperative hemorrhage is a factor correlated with final outcomes of patients with sporadic solid cerebellar hemangioblastomas.

1. Introduction

Hemangioblastomas (HBs) are benign tumors classified as Grade I based on the World Health Organization (WHO) Classification of Tumors of the Central Nervous System [1,2]. They are highly vascularized and often occur in the posterior fossa and especially in the cerebellar hemispheres, accounting for 1–2.5% of all intracranial tumors in the posterior fossa [3]. Most hemangioblastomas are sporadic, but 20–30% of cases are hereditarily closely related to von Hippel-Lindau (VHL) disease [4].

The most common form of hemangioblastoma is cerebellar hemangioblastoma [5–7], which is divided into two types according to imaging features. A large sac or cyst and small nodules are the predominant features of cerebellar hemangioblastomas on MRI examination. A solid mass is a rare type of cerebellar hemangioblastoma that may be divided into two categories: the first features multiple solid tumors and exhibits homogeneous enhancement on MRI, the other is a solid tumor with single or multiple cysts, in which the solid portion is enhanced and the cystic region is non-enhanced [8,9].

Solid cerebellar hemangioblastomas are hypervascularized lesions that typically have a good prognosis after total resection [10]. However, complete removal of these solid masses is challenging; skillful microsurgical techniques are required to avoid disastrous intraoperative bleeding and new neurological deficits. To identify the factors affecting postoperative outcomes and discuss treatment strategies for solid cerebellar hemangioblastomas,

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we retrospectively analyzed the clinical data of 22 patients with solid cerebellar hemangioblastomas, including imaging findings, clinical manifestations, diameter of the lesion, surgical approaches and postoperative complications. Our aim was to determine the factors affecting postoperative outcomes and discuss treatment strategies for solid cerebellar hemangioblastomas.

2. Materials and methods

2.1. Patients

This study included 22 patients with solid cerebellar hemangioblastomas who were surgically treated by the senior neurosurgeon (the same group of physicians) from September 2005 to December 2015. All cases were histologically confirmed solid hemangioblastomas. Age ranged from 19 years to 77 years, with a mean age of 48 years; the male-to-female ratio was 2.1:1 (15:7). Clinical manifestations varied, with 15 patients (68.2%) presenting with varying degrees of intracranial hypertension symptoms: 15 patients with headache, 13 patients with dizziness and nausea/vomiting and 6 patients with papilledema; 13 patients (59.1%) presented with diplopia and 6 patients (27.3%) with lower cranial nerve dysfunction. Moreover, 6 patients presented with preoperative obstructive hydrocephalus. Only one patient required a second surgical procedure because of tumor recurrence. The patients' individual characteristics are detailed in Table 1.

2.2. Imaging examination

Preoperative computed tomography (CT) and magnetic resonance imaging (MRI) was performed in all patients. Twelve patients were evaluated by CTA, while eight patients simultaneously underwent digital subtraction angiography (DSA). Examinations of gemstone spectral imaging were performed in patients with postoperative recurrence (Fig. 1a–f). Tumors were classified into two types according to their imaging features: 1) solid tumors exhibited homogeneous enhancement on MRI (group SS); and 2) solid tumors with single or multiple cysts in which the solid area is enhanced and the cystic portion is non-enhanced on MRI (group SC). Tumors were also classified according to size: 1) type I – largest diameter of the lesion less than 14 mm; 2) type II – largest diameter of the lesion ranged from 15 mm to 49 mm; and 3) type III- largest diameter of the lesion greater than 50 mm. Patients were further assigned into three groups according to tumor location: 1) group L-tumor located in the left cerebellar hemisphere; 2) group R – tumor located in the right cerebellar hemisphere; and 3) group V – tumor located in cerebellar vermis. Group L included 9 patients, group R included 6 patients and group V included 7 patients. In group R/V, the tumor extended to the cerebellopontine angle in two patients. Secondary obstructive hydrocephalus was identified in 6 patients (27.3%).

2.3. Surgical procedure

Preoperative embolization was performed in 9 patients, and no related complications were observed in these patients after the procedure. The prone position and a suboccipital midline approach were used for tumors located in the superior vermis or inferior vermis. For lesions located in the cerebellar hemispheres and extending toward the cerebellopontine angle, a lateral prone position and lateral suboccipital approach were used. Based on this criterion, 15 and 7 patients had the suboccipital middle line approach and lateral suboccipital approach, respectively. Ventricular drainage was performed before tumor resection in 6 patients with secondary obstructive hydrocephalus. All patients underwent a microsurgical procedure using a surgical microscope (OPMI PENTERO from Carl Zeiss, Oberkochen, Germany); total resection was achieved in 21 of 22 patients.

2.4. Follow-up

The mean duration of the follow-up period was 25.5 months (range, 6–72 months). Tumor recurrence was confirmed by clinical manifestations and imaging features, with the MRI and CT scans showing tumor growth in the primary site and neurological symptoms remaining or deteriorating postoperatively. Based on the neurological symptoms evaluated before surgery and during the follow-up period, the prognoses were classified into two groups. The patients with persistence of neurological symptoms postoperatively or worse than preoperatively were assigned to the poor group. Conversely, the patients without neurological signs or improved symptoms postoperatively were assigned to the good group. Follow–up began at discharge and terminated either at the end of the study (June 2016) or until the patient's death. No patients were lost to follow-up.

2.5. Statistical analysis

SPSS Statistics version 23 (IBM Corporation, Armonk, New York, USA) and R software version 3.3.0 were used for data analysis. R is available as free software under the terms of the Free Software Foundation's GNU (GNU's Not Unix) General Public License in source code form. Memory management, speed, and efficiency are probably the biggest challenges R faces. In this study, we edited code and read data in R software, then performed binary logistic regression analysis. Clinical data, including patient age/sex, duration of history, preoperative tumor size (type I, type II, type III), tumor location (group L, group R, group V), tumor characteristics (SS/SC), preoperative embolization (Y/N) secondary obstructive hydrocephalus (Y/N) and postoperative hemorrhage (Y/N), were considered in this study. All of the independent factors may have affected the outcomes of both the univariate and multivariate logistic regression analyses. To assess the statistical significance of numerical data, parametric *t*-test was used, while categorical variables and those without a normal distribution were analyzed using the Mann-Whitney *U* test. The chi-square test and Fisher's exact probability test were also used in this study. $P < 0.05$ were considered statistically significant.

3. Results

3.1. Clinical manifestations

The duration of history ranged from 2 to 96 months (mean 22.5 months) in all patients. Initial symptoms varied among patients (Table 2). Headache, the most common symptom, was reported in 15 patients (68.1%), nausea or vomiting in 13 patients (59.1%), 6 patients (27.3%) with papilledema, vertigo in 13 patients (59.1%), ataxia in 13 patients (59.1%), and 2 patients (9.1%) presented with neck pain. Moreover, other neurological symptoms included nystagmus (10 patients, 45.5%), diplopia (13 patients, 59.1%), and visual disturbances (1 patient, 4.5%). At follow-up, 18 patients either recovered or improved after surgery, while 4 patients had residual or deteriorated neurologic symptoms postoperatively. Two groups (Good and Poor) were formed using this standard (Table 2).

3.2. Pathological findings

Gross total tumor resection was achieved in 21 of 22 patients (95.5%). In 1 patient, a subtotal resection was achieved because the tumor was located close to the lower cranial nerves; the tumor