Feasibility Analysis for Treatment of Giant Intracranial Benign Tumor by Delayed Operation in Infancy

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■ OBJECTIVE: **The survival rate and prognosis in infants with giant intracranial tumors are significantly worse than in older children. This study aimed to analyze the feasibility of delayed operation for infants with giant intracranial benign tumor by evaluating the initial clinical presentations, expectant treatment measures, perioperative vital signs, and recuperation after surgery.**

■ PATIENTS AND DATA: **We reviewed 3 infant patients (average age, 9.33 months; range, 5–12 months) with giant intracranial benign tumors during January 2015 and April 2016. The maximum sections of tumors were 38 × 50 mm, 57 × 39 mm, and 55 × 67 mm, respectively. All clinical presentations, neuroimaging, and laboratory examinations were recorded.**

■ RESULTS: **Obstructive hydrocephalus was observed in 2 infants; ventriculoperitoneal shunts were placed in both before the delayed tumor resection. The disease progressed rapidly in the infant with teratoma and surgery was performed 4 months after placement of the ventriculoperitoneal shunt. The other 2 patients had experienced a 12-month growth and developmental phase and later underwent operations. Gross total resection was achieved in all patients. The pathologic results were consistent with the preoperative diagnosis. During a period of high-quality postoperative care, they remained stable and were discharged without any complications or neurologic deficits, and continued to improve toward their baseline.**

■ CONCLUSIONS: **Delayed operation enabled infant patients to gain a better physical state, with a stage of full preoperative preparation that may reduce intraoperative/postoperative morbidity and mortality.**

INTRODUCTION

Giant intracranial benign tumors in younger infants, typically accompanied by a gradual increase in intracranial pressure (ICP) and compression of surrounding normal brain tissue, cause epileptic seizures, irritability, nausea, vomitus, somnolence, and limb movement disorder.[1] The management of giant intracranial benign tumor in infant patients has always been a challenge for neurosurgeons, anesthesiologists, and the paramedic team. Although early detection, timely diagnosis, advancing microsurgery techniques, and adjuvant therapy have decreased mortality and morbidity,[2-4] infants younger than 1 year[2] still have a higher risk of massive blood loss[5] and easily respond to stress with bradycardia, and their overall survival rate is worse than that of older children.[6,7]

To avoid operative morbidity and mortality, it is important to develop an improved protocol to treat intracranial benign tumors in infants. A good physical state with a stage of full preoperative preparation is important to decrease the risk of surgical complications; therefore, we considered postponing the surgical treatment for a period and named this period the temporary growth and developmental phase. This report aims to study and analyze the feasibility of delayed operation and the best stage to tailor

Key words
- Delayed operation
- Giant benign brain tumors
- Growth and developmental phase
- Infant craniotomy

Abbreviations and Acronyms
CSF: Cerebrospinal fluid
CT: Computed tomography
GTR: Gross total resection
ICP: Intracranial pressure
MRI: Magnetic resonance imaging
VP: Ventriculoperitoneal

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Table 1. Patients' Clinical Presentation at First Visit

Patient	Age at First Visit (months)/Sex	Symptoms and Signs	Disease Duration	Lesion Site	Tumor Size (mm)
A	12/female	Vomiting, irritability, bilateral limb seizures	3 days	Posterior third ventricle	38 × 50 × 37
B	11/male	Lower limb weakness	1 month	Third ventricle, septum pellucidum, or bilateral ventricle	57 × 39 × 59
C	5/male	Skull changes, right limb weakness	5 months	Left frontal, paraventricular, lateral ventricle trigone	61 × 45 × 60
				Right occipital, cornu frontale ventriculi lateralis	24 × 27 × 20

surgery to the individual in this age grade patients (especially those aged <1 year).

PATIENTS AND DATA

According to previous reports in the literature,[8-11] an intracranial tumor was classified as giant when the maximum diameter of the tumor was ≥5 cm. We report 3 infant cases of giant intracranial benign tumors in infants aged 9.33 months on average (range, 5–12 months), who were consulted in our center between January 2015 and April 2016 and were admitted for surgical treatment (Table 1).

Computed tomography (CT) and magnetic resonance imaging (MRI) scans before and after the growth and developmental phase as well as before and after operation were obtained for all patients. The diagnosis was confirmed by postoperative pathology. All clinical presentation and laboratory examinations were collected (Tables 1 and 2). The work was carried out in accordance with local and national guidelines and with the code of ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. Informed consent was obtained from the legal guardians of the children.

Patient A: A 12-Month-Old Girl with Intracranial Mature Teratoma

This patient presented at the first visit with vomiting and irritability and bilateral limb seizures subsequently. Her weight was only 8.9 kg. There were no significant neurologic deficits, sluggishness, or asthenocoria. CT showed a well-defined marginal giant (38 × 50 mm) heterogeneous mass with predominantly fatty tissue and partial calcification in the posterior third ventricle, which resulted in obstructive hydrocephalus with paraventricular edema (Figure 1A). MRI showed that the tumor mainly had hypointense signals on T1-weighted images and slightly hyperintense signals on T2-weighted images and was partially T1-hyper and T2-hypo. Gadolinium contrast enhancement showed peripheral ring enhancement; the solid lesion appeared to have irregular enhancement, and there was no enhancement of the cystic lesion (Figure 1B–D). No increased levels of α-fetoprotein or β-human chorionic gonadotropin were found on blood serum or cerebrospinal fluid (CSF) examinations (Table 2). Analysis of the medical history integrated with the positive physical neuroradiologic changes and laboratory examination suggested an initial diagnosis of mature teratoma.

Table 2. Change of α-Fetoprotein and β-Human Chorionic Gonadotropin

	Serum		
	First Time	Before Operation	Cerebrospinal Fluid (During Ventriculoperitoneal Shunt)
α-Fetoprotein (ng/mL)	2.34	3.24	<0.605
β-Human chorionic gonadotropin (mIU/mL)	<0.1	<0.1	<0.100

Reference level of α-fetoprotein, 0.00–7.00 ng/mL; β-human chorionic gonadotropin, 0.00–5.00 mIU/mL.

Patient B: An 11-Month-Old Boy with Choroid Plexus Papilloma

A 11-month-old boy presented with weakness of the lower extremities for 1 month. His weight was 9.1 kg and he had no significant other neurologic deficits. A head CT scan showed a large (60 × 39 mm) irregular hypointense lobulated mass in the third ventricle, septum pellucidum, and bilateral ventricle with calcification along the boundary of the tumor accompanied with hydrocephalus (Figure 2A). On serial MRI pulse sequences, the tumor showed an irregular mixed signal mass with partial lobulation; gadolinium contrast enhancement showed a slightly heterogeneous solid lesion and was obviously enhanced (Figure 2B–D).

Patient C: A 5-Month-Old Boy with Cavernous Angioma

A 5-month-old boy was detected with an abnormal cranial structure by his parents after birth. Ultrasonographic examination showed that there were simultaneous patent ductus arteriosus and patent foramen ovale. During his first 4 months, his parents had gradually observed that the activity level of the baby's right limbs decreased distinctly. However, there was no convulsion of the face or limbs or disturbance in consciousness. Later, a head CT examination showed 2 mass lesions 55 × 59 × 67 mm and 24 × 27 × 20 mm involving part of the left frontal, paraventricular, and right occipital with unevenly nonhomogeneous signals, the right cornu frontale ventriculi lateralis, and the left lateral ventricle trigone with small patchy hyperdensity images (Figure 3A). The