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Clinical Characteristics of Pediatric Cerebral Aneurysms

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ABSTRACT

Objective : The aim of this study was to define the clinical characteristics of pediatric cerebral aneurysms. **Methods** : During the past 30 years, among a total of 3,330 patients treated for cerebral aneurysms, 12 patients were under the age of 18. The authors reviewed the database and imaging studies as sources for identification and analysis. **Results** : Seven patients were male and 5 were female. The mean age was 12.9 years old (range: 3~18). Nine patients had ruptured lesions and the remaining 3 had unruptured lesions. Four patients presented with a subarachnoid hemorrhage, and the other 5 patients presented with an intracerebral hemorrhage (ICH). Five aneurysms were located at the posterior cerebral artery or vertebrobasilar artery, 4 at the middle cerebral artery, and 3 at the internal carotid artery, respectively. The giant aneurysm was observed in 2 (18%) patients. Eleven aneurysms were saccular, and 1 was serpentine in shape. No patient had multiple aneurysms. Rebleeding was observed in 3 cases (33%). No child suffered from clinical vasospasm. All but one patient showed a favorable outcome (good: 11, dead: 1). **Conclusions** : Pediatric cerebral aneurysms in this study showed a male predominance, a high incidence of presentation with ICH, a location on the distal circulation of the major arteries or on the posterior circulation, and a large or giant aneurysm, high rebleeding rate and a low incidence of vasospasm. The overall clinical outcome was excellent in 91.7% in this study. With the knowledge of these features, aneurysmal obliteration and active brain resuscitation can improve the clinical outcome and prognosis. **(Kor J Cerebrovascular Surgery 9(3):193-7, 2007)**

KEY WORDS : Pediatric cerebral aneurysm · Subarachnoid hemorrhage · Intracerebral hemorrhage

Introduction

Cerebral aneurysms are rare in the first two decades of life. Pediatric cerebral aneurysms occur at a rate of 0.17 to 4.6% in a population of patients who have undergone surgery for aneurysm.[9)11)] Gerosa et al reported some characteristics including male predominance and preferential location on the bifurcation of internal carotid artery(ICA) in the pediatric aneurysms.[3)] The location, size, presentation, and natural history in pediatric aneurysm are markedly different from those of adults. The different pathogenetic mechanisms and congenital factors contribute in the development of aneurysm in the pediatric group.[1)14)] The purpose of this study was designed to investigate clinical characteristics for pediatric cerebral aneurysm.

Patients and methods

Based on the medical records, radiologic imaging studies, and our aneurysm database, clinical analysis was carried out on 12 patients under age of 18, who were treated with cerebral aneurysms at our institute between September, 1975 and June, 2007. On admission, the neurologic status of patients with subarachnoid hemorrhage (SAH) was graded according to the Hunt and Hess classification. The volume of hemorrhage of brain computed tomography (CT) was

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assessed in accordance with the Fisher classification. In children with SAH, a diagnosis of rebleeding was determined to be the point at which new sudden headache had occurred or increased volume of hemorrhage of follow-up brain CT had been proven or newly developed neurologic deficit with headache had developed within 15 days of hospital treatment. After the diagnosis of SAH was established, all patients were treated according to a standard protocol. This included the following: comprehensive intensive care, prevention and management of vasospasm with the administration of calcium antagonist and perioperative '3 H' therapy, obliteration of aneurysm by surgery or coiling. The modified Glasgow Outcome Scales were assigned to the patients.[5] Average postoperative follow up period was 35.6 months (range: 2~112 months).

Results

Seven patients were male and 5 patients were female (ratio 1.4 : 1), and the mean age was 12.9 years old (range: 3~18). Nine patients had ruptured aneurysm and the remaining 3 patients had unruptured aneurysm. Five patients presented with SAH, and 4 patients presented with intracerebral hemorrhage (ICH). At the time of admission based on the Hunt and Hess clinical staging 2 were grade I, 2 grade II, 1 grade III, 1 grade IV and 3 grade V, respectively. Based on the Fisher classification, 2 grade II, 7 grade IV, respectively. Nine had a left side lesion and the remaining 3 on the right side. Based on the location of the lesion, 4 patients had middle cerebral artery (MCA) aneurysm, 3 with internal carotid artery (ICA) aneurysm, 3 with posterior cerebral artery (PCA) aneurysm, and 2 with posterior inferior cerebellar artery (PICA) aneurysm. The average diameter was 11.8 mm (range: 5~29 mm). Eight patients had small (diameter < 10 mm), 2 patients had large (diameter 10~24 mm), and 2 patients had giant aneurysms with a diameter of over 25mm. Eleven aneurysms were saccular and 1 was serpentine shape. One had mycotic aneurysm from infective endocarditis. One patient had unruptured aneurysm which was a recanalized giant thrombosed aneurysm. No patients had multiple aneurysms. We observed rebleeding in 3 cases (33%), which had occurred on admission, 2nd hospital day and 15th hospital day, respectively. Post-hemorrhagic hydrocephalus was developed in 2 patients. There was no patient with delayed cerebral ischemia. Three patients received early operation within 3 days after the first hemorrhage and 6 patients received delayed operation 7 days after the initial rupture. Seven patients underwent surgery and the remaining 5 patients were treated by coiling. Based on the surgical approach, 5 patients were treated with the pterional approach (including one patient with zygoma resection), 1 with cortical approach, and 1 with the lateral

Table 1. Clinical and aneurysmal characteristics of 12 pediatric patients with cerebral aneurysms

Case No.	Sex/ age	H&H Grade (rebleeding)	Fisher Grade	Location	Characteristics	ICH	timing of operation (days)	Treatment	Outcome
1	M/15	I	II	ICBIF		−	7	Op	good
2	F/13	V	IV	M4	Mycotic	+	0	Op	good
3	F/18	0	Ur	P2	Giant serpentine	−	−	Op	good
4	F/17	V(1)	IV	ICBIF		+	2	Op	good
5	M/15	I	II	VAPICA	Partially thrombosed	−	21	Op	good
6	M/3	IV(1)	IV	M1	Giant	+	3	Op	good
7	M/11	II	IV	P3−4		+	37	DCP	good
8	M/6	III	IV	M1(MCBIF)		+	19	Op	good
9	M/12	II	IV	VAPICA		−	12	DCP	good
10	F/17	0	Ur	M1	Lobulated	−	−	DCP/stent	good
11	F/18	0	Ur	Cavernous ICA		−	−	DCP	good
12	M/10	V(1)	IV	P2	pseudoaneurysm	−	15	DCP	dead

M, male; F, female; ICBIF, internal carotid artery bifurcation; M, middle cerebral artery; P, posterior cerebral artery; ICA, internal carotid artery

Ur, unruptured; VAPICA, vertebral artery−posterior inferior cerebellar artery; MCBIF, middle cerebral artery bifurcation; Op, microsurgical operation; DCP, Detachable coil packing

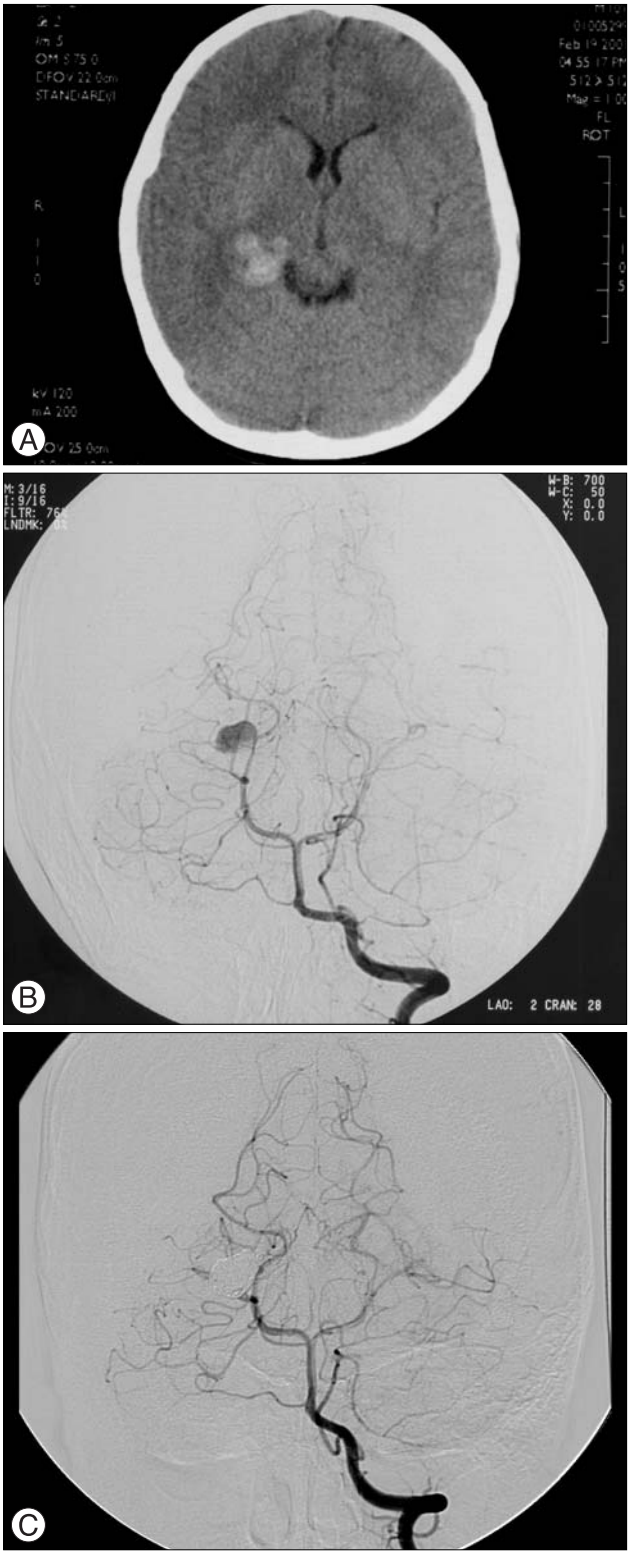

Fig. 1. In Case 7, 11 years old boy presented with severe headache, vomiting. A : Brain computed tomography scan revealed intracerebral hemorrhage on right thalamus. B : Vertebral angiogram revealed large aneurysm at right P3–4 junction. C : Postembolization vertebral angiogram reveal–ed complete obliteration of aneurysm.

suboccipital approach. According to the modified Glasgow Outcome Scale, most patients showed favorable outcome (good: 11) except one patient who died due to fatal rebleeding. There was no postoperative seizure. We experienced treatment-related complications in 2 patients (postoperative ICH, temporary oculomotor nerve palsy and hemiparesis) (Table 1) (Fig. 1).

Discussion

Epidemiology

Cerebral aneurysms in children are rare accounting for approximately 1~2% of all cases. The majority of our population was older than 10 years old and only two children were younger than 10. Aneurysm in children younger than 5 years of age are rare and the majority of these cases occur during the first 2 years of life. The male preponderance was contrary to the female predominance found in adult aneurysm series (0.6:1). The incidence of rebleeding in the pediatric population is significantly higher around the 52% than that of the adult population around 16 to 29%.[7] Three of 9 SAH patients showed rebleeding in our series. Despite a small series, this is compatible with a characteristic of the pediatric aneurysm.

Aneurysmal distribution

Cerebral angiography remains a gold standard for preoperative diagnosis for aneurysm, despite the advent of magnetic resonance imaging and magnetic resonance angiography. The distribution of aneurysmal sacs appears to be particular to the pediatric population. Henry et al. reported that posterior circulation aneurysms were more prevalent in children than adults by three-fold.[4] In our study, 7 (58.3%) aneurysms were situated at anterior circulation. Multiple aneurysms are less common in children (3~5%) than in adults (10~20%).[17] Ferrante et al. reported the prevalence of giant aneurysm in children to be 26.8% (compared to 2% in adults), and the prevalence of large aneurysm to be 50% compared with 27% in adults.[2] In our series, 7 (58.3%) aneurysms were situated at anterior circulation and 5 (41.7%) of aneurysm were situated at posterior circulation and 8.3% (1 case) of giant aneurysm situated at anterior circulation.

Pathophysiology

Pediatric cerebral aneurysms have been associated with a variety of systemic and intracranial disorders. The occurrence of aneurysm in these disorders is probably the result of an interaction between structural changes in vessel wall and hemodynamic stress.[16)18)] Lipper and colleagues suggested that a large congenital medial wall defect could be the initiating factor of aneurysms in early childhood.[8)] Inherited connective tissue disorders as Ehler-Danlos type IV, Marfan syndrome, neurofibromatosis type I, and autosomal dominant polycystic kidney disease are associated with intracranial aneurysms.[15)] A tear in the internal elastic lamina of cerebral vessel can occur in infectious diseases such as endocarditis and osteomyelitis.[19)] Head trauma can induce tears in the internal elastic lamina and create dissecting aneurysms in large cerebral arteries in pediatric groups.[3)] In only one case of our study, structural wall change was demonstrated in mycotic aneurysm, which was due to infective endocarditis in ventricular septal defect. Kaplan and Hahn stated that up to one third of aneurysms in children are infectious or traumatic with the rest being congenital.[6)]

Treatment and outcome

In our study of 12 treated children, we obtained a 91.7% rate of favorable outcome despite of poor neurologic grades(Hunt & Hess Grade IV, V) and high rebleeding rate(33%)(good: 11). Only one child expired owing to secondary brain damage which results from rebleeding although the ruptured saccular aneurysm on P2 segment of left PCA was successfully obliterated with coiling. In our study, any children did not suffer from clinical vasospasm which affects clinical outcome and prognosis. The morbidity and mortality is known to be low in children presumably due to less incidence of cerebral vasospasm, good recovery from brain damange which results from initial hemorrhage and underlying atherosclerotic disease which accelerates brain ischemia in vasospasm even though initial poor neurologic presentation.[10)13)] Cerebral vasospasm seems to be perfectly tolerated in children.[9)12)] It was probable that the abundant collateral circulation, which was functional in this age group, could have explained the better tolerance to the hypoperfusion through the distal territory related to arterial narrowing.[3)12)]

Conclusion

Our study for pediatric aneurysm revealed some clinical characteristics: male predominance, high incidence of presentation with ICH, location on distal circulation of major arteries or posterior circulation, large or giant aneurysm size, high rebleeding rate and low incidence of vasospasm. The overall clinical outcome was good because of low incidence of vasospasm despite of poor neurologic grades on admission, high rebleeding rate. With the knowledge about these features, aneurysm obliteration and active brain resuscitation can improve clinical outcome and prognosis.

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