Arachnoid cysts in childhood with endocrinological outcomes

Hasan Önal[1], Erdal Adal[1], Atilla Ersen[2], Olcay Işık[1], Zerrin Önal[1], Gülseren Arslan[1]

Departments of Pediatrics, [1]Ministry of Health Bakırköy Maternity and Children Research and Training Hospital, and [2]Kasımpaşa Military Hospital, İstanbul, Turkey

SUMMARY: Önal H, Adal E, Ersen A, Işık O, Önal Z, Arslan G. Arachnoid cysts in childhood with endocrinological outcomes. Turk J Pediatr 2011; 53: 295-300.

Arachnoid cysts are mainly manifested with the consequent neurological disorders. Even though these cysts may interfere in many systems due to their localizations, there is little information concerning their involvement in endocrinological disorders. We emphasize endocrinological functions together with cyst localizations and neurological disorders in childhood. A total of 50 patients diagnosed with arachnoid cysts were screened for cyst localizations, neurological symptoms and endocrinological outcomes evaluated by pubertal and growth status and hypothalamopituitary insufficiency. We investigated the interactions of these parameters. Arachnoid cysts were localized mostly in the middle fossa (54%) and posterior fossa (26%). Middle fossa cysts had a strong predilection for male gender (66.7% male) and left hemispheric dominancy (77%). We detected growth hormone deficiency in six patients, obesity in six patients and central precocious puberty in one patient; cysts were in the temporal area in three of the obese cases. All patients in our study had normal levels of cortisol, thyroid hormones and prolactin.

In pediatric patients with arachnoid cysts, endocrinological follow-up is crucial as neurological outcomes and further evaluations are needed, mainly to confirm pubertal and growth status.

Key words: arachnoid cysts, endocrinological disorders, childhood.

Arachnoid cysts are benign accumulations of cerebrospinal fluid between the dura and the brain substance throughout the cerebrospinal axis in relation to the arachnoid membrane covered by arachnoidal cells and collagen[1]. They mostly have a congenital origin and typically present in the infancy period[2]. They may remain undiagnosed until adulthood, and traumatic brain injuries seem to be responsible in the etiology[3].

Arachnoid cysts account for about 1% of all atraumatic intracranial mass lesions on intracranial imaging[3]. Latest reports declared a 2.6% prevalence rate in children and 1.7% in adolescent males[4,5].

Arachnoid cysts localize intracranially or in the spinal cord. Intracranial arachnoid cysts are frequently near the arachnoid cisterna. Spinal arachnoid cysts may be seen extradurally, intradurally or around the dura, and they usually produce signs and symptoms of radiculopathy[6].

Presentation of these cysts may range in a broad spectrum, even as a life-threatening disease, or may be asymptomatic for many years with suspended diagnosis. Small cysts usually have no symptoms and are often discovered incidentally[3]. However, the large cysts may produce the following symptoms: cranial deformity and macrocephaly, hydrocephalus, seizures, increased intracranial pressure, hemiparesis and ataxia, and musical hallucinosis[2,3,7,8]. Attention deficits and learning disabilities may be associated with temporal fossa arachnoid cysts[9]. Additionally, a report including 78 cases with migraine or cluster headache stated that headache is not common with arachnoid cysts, at a rate of 2.6%10), whereas 18% of the patients with arachnoid cysts localized particularly in the temporal fossa were found to suffer nonspecific headache[11].

On clinical grounds, arachnoid cysts are mostly emphasized with neurological diseases. There is little information concerning their involvement in endocrinological disorders. Due to the localization of arachnoid cysts, the hypothalamus-hypophysial axis may be diminished and result in some endocrinologic disturbance. This theory is still a matter for debate; some have proposed that this is a rare condition, but in contrast, some authors observed a rate of endocrinologic problems with arachnoid cysts seen before the surgery of approximately 60% (12,13). In this report, we aimed to identify the localization of arachnoid cysts in our patients and highlight the neurological symptoms and the spectrum of endocrinological disorders in patients with arachnoid cysts in childhood.

Material and Methods

The study population consisted of 50 outpatient children (31 male, 19 female) diagnosed with arachnoid cyst in the Pediatric Neurology Department of the Ministry of Health Bakırköy Maternity and Children Research and Training Hospital. We identified 10 cases with computerized tomography and 40 cases with magnetic resonance imaging. We had treated 8 individuals, and 42 cases were followed up as outpatients without treatment.

We categorized the location of arachnoid cysts into four groups: suprasellar, middle fossa, posterior fossa, and interhemispheric localizations. All individuals underwent a complete physical examination. Particularly, neurological symptoms were evaluated, and walking delay, convulsion and speech and hearing disturbance were noted. Association of neurological disorders with localization and etiology of arachnoid cysts was identified.

We investigated patients endocrinologically in consideration of growth, pubertal status and hypothalamic and pituitary functions as follows: Anthropometric measurements (weight, height) were obtained; the patient's height was recorded by a single observer. Target height and standard deviation scores (SDS) were calculated. Body height was measured in the erect position without shoes to the nearest 0.1 cm using a wall mounted stadiometer. The reference definitions used were those given by Neyzi et al.[14] for Turkish children.

The stage of puberty was defined according to Tanner and Whitehouse[15]. Pubertal signs before 8 years of age for females and before 9 years for males were described as precocious puberty. Testicular volume was determined using Prader orchidometer.

Blood analysis including whole blood count, blood urea nitrogen, creatine, sodium, potassium, calcium, phosphate, alkaline phosphates, thyroid hormones (TSH, T3, T4), luteinizing hormone (LH), follicular stimulating hormone (FSH), estrogen (E2), and basal cortisol level were obtained.

Skeletal maturity was assessed using the Greulich-Pyle technique. Growth hormone (GH) stimulation tests (L-dopa and clonidine) were performed in cases with height < -2SD of normal mean. Growth hormone response of <10 ng/ml in both tests was diagnosed as 'GH deficiency'.

The study protocol was approved by the Ethics and Research Committee of the Ministry of Health Bakırköy Maternity and Children Research and Training Hospital. Statistical analysis was summarized as number and percentage for qualitative variables. Means and standard deviations were used to summarize quantitative data.

Results

The study included 31 male (62%) and 19 female (38%) participants. Mean age was 7.44 ± 4.5 years, mean height was 119.30 ± 22.08 cm and mean weight was 27.39 ± 16.76 kg. Mean age at diagnosis of arachnoid cyst was 39 months. In the 31 males, the mean age was 7.21 ± 4.38 years, mean height was 117.95 ± 27.55 cm and mean weight was 27.67 ± 15.6 kg. Mean height and weight SDS were –0.34 ± 2.04 and 0.11 ±1.73, respectively. In the 19 females, mean age was 7.82 ± 4.89 years, mean height was 121.52 ± 29.54 cm and mean weight was 28.57 ± 18.88 kg. Mean height and weight SDS were –0.06 ±1.30 and –0.04 ±1.89, respectively.

Localization of arachnoid cysts was classified in 50 cases: 54% in middle fossa (n=27), 26% in posterior fossa (n=13), 18% in suprasellar (n=9) and 2% in interhemispheric (n=1) localizations (Table I). Left hemispheric localization rate was 77%. Apart from

Table I. Localization of Arachnoid Cysts in 50 Cases

Posterior fossa 26 % (n=13)		Middle fossa 54% (n=27)		Suprasellar 18% (n=9)		Interhemispheric 2% (n=1)	
Male	Female	Male	Female	Male	Female	Male	Female
46.2% (n=6)	53.8% (n=7)	66.7% (n=18)	33.3% (n=3)	66.7% (n=6)	33.3% (n=3)	2% (n=1)	–

endocrinologic dysfunctions, we observed the following symptoms: macrocephaly in 15 cases, headache, palsy, seizure disorders, ataxia and physicomotor retardation in 25 cases, and nystagmus, vision impairment or strabismus in 15 cases. We summarized clinical presentations of cases according to cyst localizations in Table II. We noted 35 of the 50 subjects had a history of traumatic brain injuries.

Pubertal symptoms were observed in 84.2% of females (n=16) and 41.9% of males (n=13).

We determined that 12% of cases (n=6) had height < -2 SDS during their clinical follow-up period and all of them were in the prepubertal stage. We performed GH stimulation test in these cases and found GH deficiency (Table III). None of the patients was detected to have panhypopituitarism.

Six patients with GH deficiency were paired according to the arachnoid cysts/diagnosis age, localization, and accompanying neurological disorder. Two cases had traumatic brain injury history (Table IV).

One of the female cases was diagnosed as central precocious puberty and arachnoid cyst at 4 years of age in our department. Her thelarche stage was Tanner 2 on admission. We determined LH level of 0.2 mIU/mL, FSH of 3.5 mIU/mL and E2 of 27 pg/ml, and verified our diagnosis as central precocious puberty with luteinizing hormone-releasing hormone test. Hence, luteinizing hormone-releasing hormone analogue medication was initiated. She was 9 years old with height SDS = 0.52 and weight SDS = 0.06, and arachnoid cyst was localized in the middle fossa.

Obesity was evaluated; 12.9% of males (n=4) and 11.1% of females (n=2) had weight SDS > +2SD (Table V). Moreover, two patients in the obesity group had height SDS > + 2SD.

All patients in our study had normal levels of cortisol, thyroid hormones and prolactin.

Discussion

Arachnoid cysts, one of the congenital developmental anomalies of the brain, are associated with various clinical characteristics and long-term outcomes.

In the literature, arachnoid cysts are mostly declared to localize in the middle fossa and left hemispheric localizations. Moreover, males are observed to have middle fossa cysts as much as 4-fold more frequently than females[16-18]. In 1999, a study composed of 126 cases with arachnoid cysts reported the rates of localizations as 86 cases (65.2%) in the middle fossa, 15 (11.4%) in the frontal area, 13 (9.8%) in the posterior fossa, and 12 (9.1%) in various areas in the neurocranium (19). Our results were also consistent with the literature;

Table II. Localization of Arachnoid Cysts in 50 Cases and Clinical Presentations According to Cyst Localizations

Middle fossa cyst, n=27 (54%)	**Interhemispheric cyst, n=1 (2%)**
Neurological symptom (n=10)	Hydrocephalus (n=1)
Visual symptom (n=15)	Craniomegaly (n=1)
Craniomegaly (n= 14)	
Short stature (n=2)	
Precocious puberty (n=1)	
Suprasellar cyst, n=9 (18%)	**Posterior fossa cyst, n=13 (26%)**
Neurological symptom (n=5)	Neurological symptom (n=6)
Visual symptom (n=5)	Hydrocephalus (n=1)
Short stature (n=3)	Short stature (n=1)

Table III. Characteristics of Arachnoid Cyst Patients with GH Deficiency

Patient	Gender	Diagnosis age (month)	Chronological age (year)	Height SDS	Weight SDS	Bone age (year)
E.Ö.	M	96	8.49	-3.02	-1.82	6
S.B.	M	168	17	-4.87	-3.07	14
H.H.A.	M	9	4.85	-4.13	-0.21	4.33
B.U.	M	9	6.01	-4.62	-0.68	4.33
E.G.	F	6	2.93	-2.17	-4.27	2.66
B.T.	F	5	6.81	-2.44	-1.91	4.16

particularly, arachnoid cysts in 27 patients (54%) were in the middle fossa among our 50 cases (Table II). Additionally, left hemispheric localization (77%) showed dominance in middle fossa patterns in our data. A significant male dominancy in arachnoid cysts patients (92 males/34 females) was reported. This difference was exclusively in middle fossa cysts (66 males/14 females; ratio, 4.7:1) (19). In our sex distribution, 31 cases (62%) were male and 19 cases (38%) were female. The cysts had a strong predilection for the middle fossa, and middle fossa cysts had a strong predilection for male gender (66.7% male, 33.3% female) (Table I). These results may support the meningeal maldevelopment theory.

Arachnoid cysts mostly have a congenital origin, and traumatic brain injuries were not distinctive in their presentation[3]. Galassi et al.[20] reported six cases of traumatic brain injuries in their 25 patients with arachnoid cysts of the middle fossa treated surgically and determined that the trauma had developed a few days before in three cases. Herein, we found the history of traumatic brain injury in 35 patients (70%) of 50 cases. Only two of six GH deficiency patients had traumatic brain injury, and no birth trauma history was detected.

The clinical manifestations of these patients range across a spectrum. It is proposed that an increased rate of central precocious puberty is seen with suprasellar cysts. However, this idea is controversial since there are only sporadic cases reported in the literature[13,19,21-23]. Herein, we documented a four-year-old case with the complaint of premature thelarche diagnosed as precocious puberty and determined a middle fossa cyst in the magnetic resonance investigation. These data may indicate that these cysts could under certain conditions be an additional trigger for precocious puberty[24]).

Arachnoid cysts may cause aqueductal compression and consequent obstructive hydrocephalus and result in hypothalamopituitary insufficiency (25). This theory is also debatable since this presentation is reported to be an extremely rare condition (26,27). In our study, we determined six patients with GH deficiency. We also evaluated the localizations of cysts in these cases. One patient with posterior fossa cyst presented with hydrocephalus, two cases with middle fossa cysts presented with convulsion and growth retardation, and two cases with suprasellar cysts had symptoms of growth retardation and speech and walking disturbance (Table IV). We propose that further investigation is needed to confirm GH deficiency and accompanying disorders in any potential clinical findings in arachnoid cyst patients.

Table IV. Arachnoid Cyst Localization, Trauma History and Neurological Disorder with GH Deficiency Patients

Patient	Gender	Cyst area	Symptom	Trauma
E.Ö.	M	Suprasellar	Growth retardation	+
S.B.	M	Middle fossa	Gro wth retardation	-
H.H.A.	M	Suprasellar	Speech disturbance	-
B.U.	M	Posterior fossa	Hydrocephalus	-
E.G.	F	Left temporal	Convulsion	+
B.T.	F	Middle fossa	Walking disability	-

GH: Growth hormone.

Table V. Obesity Group in Arachnoid Cyst Patients

Patient	Gender	Diagnosis age (month)	Chronological age (year)	Weight (SDS)	Cyst area	Trauma
M.Ç.	M	6	9.31	5.23	Right temporal	+
K.K.	M	48	8.82	3.18	Posterior fossa	+
A.K.	M	48	6.13	2.73	Middle fossa	-
O.K.	M	1	4.89	3.6	Left temporal	-
B.D.	F	144	14.5	3.86	Right temporal	-
A.U.	F	48	4.42	2.67	Suprasellar	+

SDS: Standard deviation score.

There is a lack of data in the literature regarding the obesity association with arachnoid cyst. We diagnosed obesity in six of our 50 patients, and surprisingly, localizations of the cysts in three of them (50%) were in the temporal area (Table V). Two patients in the prepubertal period had weight and height SDS > +2 SDS and had cysts in the left temporal and suprasellar area. We thought that rather than indicate a condition characterized by the coincidence of obesity and arachnoid cyst, presumably it could be expressed as an outcome of arachnoid cysts.

We suggest that some of the neuroanatomical anomalies coexisting with arachnoid cysts may cause disorders of growth, puberty and possibly other hypothalamopituitary dysfunction. Our study provided evidence that effective follow-up of the patients with arachnoid cysts seems to be urgent in our clinical practice. Endocrinological outcomes as pubertal and growth status are crucial in the identification of children with arachnoid cysts by periodic and complete follow-up of every patient.

REFERENCES

1. Ariai S, Koerbel A, Bornemann A, Morgala M, Tatagiba M. Cerebellopontine angle arachnoid cyst harbouring ectopic neuroglia. Pediatr Neurosurg 2005; 41: 220-223.
2. National Institute of Neurological Disorders and Stroke. NINDS Arachnoid Cysts Information Page. Updated June 2007. Available at: http://www.ninds.nih.gov/disorders/arachnoid_cysts/arachnoid_cysts.htm.
3. Gelabert-Gonzalez M. Intracranial arachnoid cysts. Rev Neurol 2004; 39: 1161-1166.
4. Al-Holou WN, Yew AY, Boomsaad ZE, Garton HJ, Muraszko KM, Maher CO. Prevalence and natural history of arachnoid cysts in children. J Neurosurg Pediatr 2010; 5: 578-585.
5. Weber F, Knopf H. Incidental findings in magnetic resonance imaging of the brains of healthy young men. J Neurol Sci 2006; 240: 81-84.
6. Gale Encyclopedia of Neurological Disorders. Arachnoid cyst. Updated September 2006. Available at: http://www.answers.com/topic/arachnoid-cyst.
7. Pascual-Castroviejo I, Roche MC, Martínez Bermejo A, Arcas J, García Blázquez M. Primary intracranial arachnoidal cysts. A study of 67 childhood cases. Childs Nerv Syst 1991; 7: 257-263.
8. Griffiths TD. Musical hallucinosis in acquired deafness. Phenomenology and brain substrate. Brain 2000; 123: 2065-2076.
9. Millichap JG. Temporal lobe arachnoid cyst-attention deficit disorder syndrome: role of the electroencephalogram in diagnosis. Neurology 1997; 48: 1435-1439.
10. Valenca MM, Valenca LP, Menezes TL. Computed tomography scan of the head in patients with migraine or tension-type headache. Arq Neuropsiquiatr 2002; 60: 542-547.
11. Cameron AD. Psychotic phenomena with migraine and an arachnoid cyst. Progress in Neurology and Psychiatry. Updated Mar-Apr 2002. Available at: http://www.escriber.com/Progress/Features.asp?Action=View&Archive=True&ID=67&GroupID=&Page=11.
12. Hoffman H, Hendrick E, Humphreys R, et al. Investigation and management of suprasellar arachnoid cysts. J Neurosurg 1982; 57: 597-602.
13. Pierre A, Capelle L, Brauner R, et al. Presentation and management of suprasellar arachnoid cysts. J Neurosurg 1990; 73: 355-359.
14. Neyzi O. Büyüme-gelişme bozuklukları. In: Neyzi O, Ertuğrul T (eds). Pediatri (3ncü baskı). İstanbul: Nobel Tıp Kitapevi; 2002: 79-99.
15. Tanner JM, Whitehouse RP. Clinical longitudinal standards for height, weight, height velocity, weight velocity and stages of puberty. Arch Dis Child 1976; 51: 170-179.
16. Rengachary SS, Watanabe I. Ultrastructure and pathogenesis of intracranial arachnoid cysts. J Neuropathol Exp Neurol 1981; 40: 61-88.
17. Rengachary SS. Intracranial arachnoid and ependymal cysts. In: Wilkins RH, Rengachary SS (eds). Neurosurgery. New York: McGraw-Hill; 1985: 2160-2172.
18. Rengachary SS, Watanabe I, Brackett CE. Pathogenesis of intracranial arachnoid cysts. Surg Neurol 1978; 9: 139-144.

19. Wester K. Peculiarities of intracranial arachnoid cysts: location, sidedness, and sex distribution in 126 consecutive patients. Neurosurgery 1999; 45: 775-779.

20. Galassi E, Piazza G, Gaist G, Franc F. Arachnoid cysts of the middle cranial fossa: a clinical and radiological study of 25 cases treated surgically. Surg Neurol 1980; 14: 211-219.

21. Rappaport ZH. Suprasellar arachnoid cysts: options in operative management. Acta Neurochirurgica (Wien) 1993; 122: 71-75.

22. Sugawara A, Ebina K, Ohi H, et al. Suprasellar arachnoid cyst associated with precocious puberty: report of an operated case and review of literature. No Shinkei Geka 1992; 20: 1107-1112.

23. Turgut M, Ozcan EO. Suprasellar arachnoid cyst as a cause of precocious puberty and bobble-head doll phenomenon. Eur J Pediatr 1992; 151: 176.

24. Starzyk J, Kwiatkowski S, Urbanowicz W, et al. Suprasellar arachnoidal cyst as a cause of precocious puberty-report of three patients and literature overview. J Pediatr Endocrinol Metab 2003; 16: 447-455.

25. Hochhaus F, Butenandt O, Schwarz HP, Ring-Mrozik E. Auxological and endocrinological evaluation of children with hydrocephalus and/or meningomyelocele. Eur J Pediatr 1997; 156: 597-601.

26. Adan L, Bussieres L, Dinand V, Zerah M, Pierre-Kahn A, Brauner R. Growth, puberty and hypothalamic-pituitary function in children with suprasellar arachnoid cyst. Eur J Pediatr 2000; 159: 348-355.

27. Mohn A, Schoof E, Fahlbusch R, Wenzel D, Dörr HG. The endocrine spectrum of arachnoid cysts in childhood. Pediatr Neurosurg 1999; 6: 316-321.