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Spontaneous regression of a symptomatic pineal cyst after endoscopic third-ventriculostomy

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Abstract With the advent of modern diagnostic tools for neuroimaging, the incidental detection of pineal cysts in asymptomatic subjects has increased. Only rarely do pineal cysts present with the clinical signs and symptoms of increased intracranial pressure or with neurological deficits in relation to compression and distortion of the adjacent nervous structures and cerebrospinal fluid pathways. While asymptomatic cysts are considered to be normal variants for which no further investigations are usually required, surgical treatment is suggested for symptomatic cysts, with the goal of eliminating the block in the cerebrospinal fluid circulation and/or the mass effect exerted by the lesion. In this report we describe a pediatric case of symptomatic pineal cyst, revealed by repeated episodes of headache caused by secondary obstructive hydrocephalus. Following an endoscopic third-ventriculostomy, serial magnetic resonance imaging studies demonstrated that not only had the ventriculomegaly resolved but also that the pineal cyst had regressed over time. A to-and-fro movement of fluid through the cyst wall, the direction of which depends on the equilibrium existing between the inner pressure of the cyst and the outer cerebrospinal fluid pressure, is suggested as a possible mechanism accounting for this unexpected result – to our knowledge, the first reported in literature.

Keywords Pineal gland cyst · Pathogenesis · Headache · Obstructive hydrocephalus · Endoscopic third-ventriculostomy

Introduction

Pineal cysts of variable size constitute a common finding of autoptic observations, as they are described in 25% to 40% of the cases [2, 11, 25]. After the introduction of magnetic resonance imaging (MRI) techniques, their incidental detection in asymptomatic subjects is reported in 1.4% to 4.3% of the examinations [6, 9, 15, 16, 17], as probably most of the smallest cysts are below the resolution power of the current routine imaging techniques.

However, in spite of their relatively frequent occurrence, pineal cysts remain a relatively obscure clinicopathological entity with regard to their origin, as well as their natural history. Indeed, though these cysts tend to remain stable in size in the great majority of cases [6, 15, 20, 24], in some instance they may expand, interfering with cerebrospinal fluid (CSF) circulation or compressing the surrounding structures, generally after having reached a diameter of at least 1.5 cm [7, 8, 12, 18, 19].

The physiopathogenetic mechanisms accounting for cyst enlargement are unclear; different hypotheses have been propounded such as coalescence of small cysts into a unique cyst [4], proliferation of embryonic inclusion of ependymal cells [4], intracystic bleeding [14, 20, 21, 23], hormonal changes [14, 22], and a communication with the third ventricle [12].

Excision of the cyst through a direct surgical approach and marsupialization of its walls by means of stereotactic or endoscopic procedures (or by the association of the

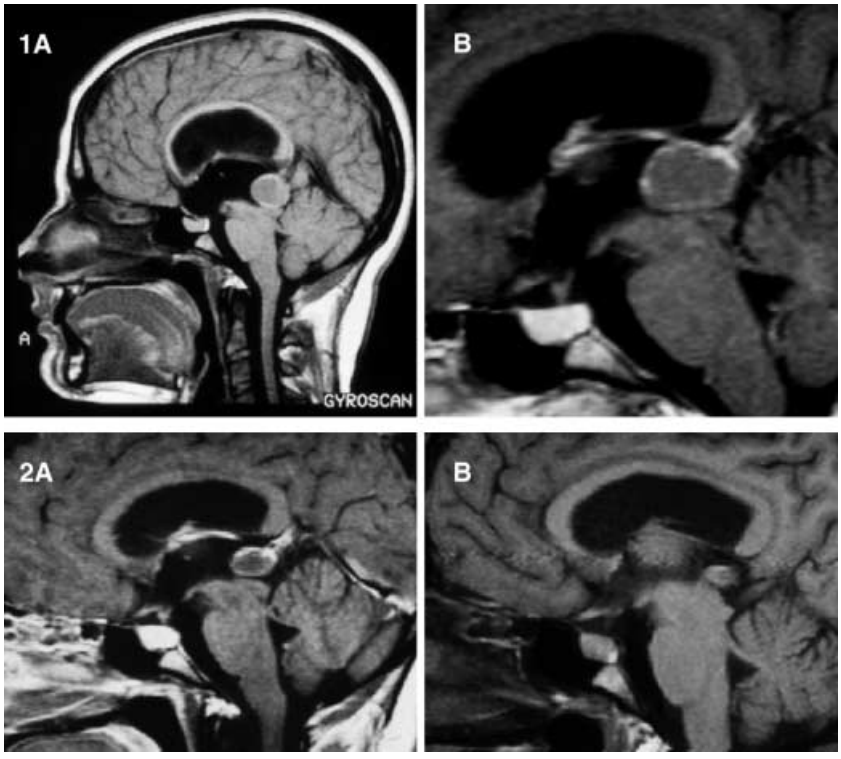

Fig. 1A, B Magnetic resonance imaging (MRI). **A** Preoperative and **B** immediate postoperative studies. **A** The pineal cyst, 2.5 cm in diameter, induces an obstructive hydrocephalus by compressing the aqueduct of Sylvius. **B** Some days later, a control MRI, carried out immediately after endoscopic third-ventriculostomy demonstrates the opening of the floor of the third ventricle and changes in shape (oval from round) and size (mild increase) of the cyst

Fig. 2A, B Same case as in Fig. 1. **A** A postoperative control magnetic resonance imaging (MRI) scan, obtained 6 months after the third-ventriculostomy procedure shows the reduction in size of the ventricular system and of the pineal cyst. **B** A further MRI control, 24 months after the surgical correction of hydrocephalus, reveals the normalization of the third ventricle and the further regression of the pineal cyst

last two techniques) represent the most utilized surgical options in symptomatic cases [14, 18, 20, 23, 27].

Cerebrospinal fluid shunting has also been utilized in several instances, generally to treat the associated hydrocephalus before the surgical excision of the cyst [20, 21, 26], more rarely as the only therapeutic measure [8].

The observation of a case of symptomatic pineal cyst, showing a spontaneous progressive regression after a third-ventriculostomy carried out to treat the associated obstructive hydrocephalus, prompted us to write the present report.

This case, the only one described in the literature to our knowledge, may provide further insight into the pathogenetic mechanisms possibly accounting for pineal cyst enlargement.

Case report

This 16-year-old girl was admitted to our section of Pediatric Neurosurgery, Catholic University Medical School, Rome, with a 2-week history of episodic headache that did not respond to medical treatment. Her family ophthalmologist had noticed a bilateral mild papillar edema a week before the admission, during a routine examination for her familial myopia. On the grounds of the headache and the ophthalmological finding, neurological advice was requested and an MRI examination performed, which showed a cystic pineal mass associated with a secondary obstructive hydrocephalus (Fig. 1A). The pineal mass lesion (2.5 cm in diameter) was characterized by a hypointense signal in T1-weighted images similar to that of the CSF and a hyperintense signal in T2-weighted images. The cyst wall enhanced moderately after contrast administration, whereas the signal intensity of the cyst content did not increase. The features were regarded as suggestive of a benign pineal cyst.

At admission, the patient's neurological examination results were negative except for the already mentioned decrease in visual acuity and fundus oculi abnormalities. During the admission the search for tumor markers (alpha fetoprotein, beta human chorionic gonadotrophin) was negative both in serum and CSF.

A two-step surgical management was planned, aimed at counteracting the secondary hydrocephalus first, and treating the mass lesion subsequently. An endoscopic third-ventriculostomy was thus performed that induced the nearly immediate disappearance of the headache. An immediate control postoperative MRI examination showed the patency of the artificially induced communication between the floor of the third ventricle and the premesencephalic cistern and the persistence of the pineal cyst, the size of which had increased compared with the preoperative examination (Fig. 1B).

The patient was discharged in good neurological condition on the fourth postoperative day to undergo a further MRI control 6 months after the admission and eventually the surgical excision of the pineal lesion. When the planned MRI control examination was carried out, the third-ventriculostomy was found to be still patent and the ventricular system reduced in size as well as the pineal cyst (Fig. 2A). On this basis and on the basis of the persistently satisfactory clinical condition, the planned surgical attack on the lesion was postponed at the request of the patient's family, and a further six-month interval MRI control was planned. This third MRI examination also confirmed the normalization of the cerebral ventricles and demonstrated a further reduction in size of the cyst.

The patient continued to do well, and an MRI study performed a year later showed complete normalization in volume and shape of the ventricular system and a further significant reduction in size of the pineal cystic lesion (Fig. 2B). At that time, it was felt that the indication for surgery was debatable, and it was decided to

adopt a wait-and-see policy. After a further year of follow-up, the patient's clinical condition remains good, and the pineal cyst is barely recognizable in the MRI examination, 3 years after the operation.

Discussion

Though pineal cysts were first described as specific entities one century ago by Campbell in 1899 [3], their etiology still remains unclear. Several physiopathogenetic hypotheses have been advanced, such as dysembryogenetic or developmental abnormalities (the incomplete obliteration of the cavum pineale by neuroepithelial cells during the early fetal life [5], the persistence of the pineal diverticulum [26]), an ischemic degeneration [7], and enzymatic degenerative processes [10].

Indeed, the small cysts so commonly found incidentally in asymptomatic subjects [6, 9, 15, 16, 17] or as autopsy observations [2, 11, 25] have been considered to be variants of the normal, because of their high incidence, the absence of clinical relevance and their tendency to remain stable in size during life in the large majority of cases [9, 20, 24].

In contrast, large symptomatic pineal cysts are relatively uncommon, generally revealed by the clinical manifestation of an increased intracranial pressure and/or deficitary neuroophthalmological signs [2, 7, 13, 14, 20, 24, 27]. Although it is likely that these “large” symptomatic pineal cysts represent an evolution of preexisting small cysts [24], the mechanisms accounting for their growth are still controversial: coalescence of small cysts into a large unique cyst [4], hormonal factors [14, 23], intracystic bleeding [14, 21, 23] and a communication with the third ventricle [12] are the most accepted pathogenetic hypotheses.

The role of hormonal factors has been suggested by epidemiological data, such as the threefold female-to-male ratio and the high incidence after the onset of puberty and the gradual decrease with age [7, 8, 14, 18, 20, 27].

The theory of intracystic bleeding is supported by observations of xanthochromic or frankly hemorrhagic intracystic fluid detected during surgical excision of the lesion [20]. This mechanism, however, cannot be taken into account to explain the progression of cysts with a CSF-like content, as it may be observed in many patients undergoing MRI examination and also in a large proportion of operated-on subjects.

A to-and-fro CSF flow owing to a communication with the third ventricle resulting in the cyst growth has recently been propounded by Kang and co-workers, on the grounds of a single personal direct observation during a surgical operation [12]. Unfortunately, to our knowledge no previous or subsequent similar experiences have been reported.

With regard to the clinical presentation, most of the symptomatic pineal cysts are revealed by signs of raised intracranial pressure. Headache, chronic or with paroxysmal character, not responding to drug therapy, as in our case, and often associated with nausea and vomiting is the most frequently reported presenting symptom [7, 8, 10, 14, 23, 24]. It depends on the associated obstructive hydrocephalus or the impairment in the venous flow within the vein of Galen. The fundus examination may show pale papillae or, more rarely, papilledema [7, 10, 27].

Ophthalmological signs are represented by visual and oculomotor disturbances such as diplopia, blurred vision, unilateral oculomotor nerve palsy or Parinaud syndrome, attributed either to the chronic hydrocephalus or to brain stem dysfunction [7, 10, 27].

Neurological and neuropsychiatric signs have been described in some reports, namely motor or sensory impairment [7, 8, 27], cerebellar deficit [7, 27], epilepsy [7, 8] and emotional disturbances [8, 14, 24]. Pineal apoplexy has been also described [12, 27].

Nowadays, the diagnosis of pineal cysts is mainly based on MRI examinations, which are more sensitive than CT scans [6, 24, 27] and provide a better definition of the relationship of the cyst with the aqueduct and brainstem structures. On MRI studies the cyst appears as a spherical or ovoid mass in the pineal region, ranging from 0.5 to 1.5 cm in diameter in most of the asymptomatic cases, and up to 4.5 cm in symptomatic subjects [6, 7, 8, 10, 24]. The signal intensity of the cyst varies according to its fluid content. In most cases, the cyst is hypointense to the nervous parenchyma with a signal intensity similar to that of the CSF in T1-weighted images [6, 27]; in some instances, however, the signal may increase in relation to a high protein density [27]. The signal intensity on T2-weighted images is increased compared with that of CSF, because the fluid is relatively motionless. The cyst wall has smooth margins and it may enhance in a rim-like fashion after contrast administration [7, 8, 24, 27]. CT scans may reveal in some cases calcifications, described as a bracelet-like configuration [8, 14, 20, 24].

Differential diagnoses include cystic gliomas, dermoid and epidermoid tumors, teratomas, arachnoid cysts and cystecercosis of the quadrigeminal cistern [27]. Though most authors agree on the simple observation of asymptomatic pineal cysts, opinions diverge with regard to the best therapeutic options in symptomatic cases. Surgical excision of the cyst is suggested by the majority of authors with the goal of removing the mass effect exerted by the lesion and obtaining a histological verification.

The most utilized techniques are an open suboccipital craniectomy with a supracerebellar infratentorial approach [7, 27] or a stereotactic endoscopic treatment [20]. These types of procedure would eliminate the obstacle exerted by the cyst in the CSF circulation, while

offering at the same time histological verification of the lesion. Unfortunately, in some instances, examination of the specimen of the cystic wall does not result in a clear histological diagnosis [20]. In the event of severe associated hydrocephalus, such as in our case, a CSF shunting procedure, to be performed prior to or simultaneously with surgery, may be utilized to normalize the CSF pressure.

Extrathecal CSF diversion techniques allow easy control of the associated hydrocephalus and clinical manifestations. Their use as a unique surgical treatment is limited by the necessity to rely on the MRI diagnosis exclusively, in the absence of a histological diagnosis. The technique of third-ventriculostomy is devoid of the known complications related to the presence of an artificial device for CSF shunting and may offer also the possibility of obtaining a biopsy specimen of the lesion. Consequently, it has been increasingly utilized in recent years [20].

Our case differs from those reported in the literature because shunting of the associated hydrocephalus not only succeeded in eliminating the signs of chronically increased intracranial pressure, but also resulted in complete cure of the lesion. In fact, in our patient the cyst progressively reduced in size over a period of 2 years following endoscopic third-ventriculostomy (Fig. 2), a finding which excludes the occurrence of an abrupt rupture of the cyst wall.

The progressive reduction of the cyst in our patient, associated with normalization of the intracranial pressure brought about by the third-ventriculostomy, offers in our opinion the possibility to propound a further pathological mechanism accounting for enlargement of at least some pineal cysts and, conversely, for their reduction in volume.

In our case normalization of the intraventricular pressure was followed by a reduction in size of the cystic lesion. The most likely interpretation of the phenomenon is a displacement of fluid from the cystic cavity into the third ventricle. Should such a mechanism be tenable, the cyst wall should act as a semipermeable membrane that would allow a to-and-fro movement across it according to the pressure gradient existing between the cyst cavity and the surrounding fluid spaces. In this situation any condition that increases the CSF pressure inside the third ventricle would favor enlargement of the cyst. Similarly, enlargement of the cyst could ensue if an increase in its oncotic pressure occurred following an increase in protein or cell content. The last condition is probably the first step that may lead to the development and then the enlargement of a pineal cyst. In fact, in cases in which the initial development of the cyst would cause an obstacle to the CSF circulation through the aqueduct, a vicious circle could be established, as the increase in CSF pressure within the third ventricle would induce a further expansion of the lesion, which in turn would cause a further block in CSF circulation. Among the factors that theoretically could increase the oncotic pressure, those which should more likely be taken into account are the same (hormonal variations, intracystic hemorrhage and so on) that are usually propounded to explain the origin of pineal cysts or their progressive growth.

On the other hand, a decrease in ventricular pressure induced by CSF subtraction, as in our case following third-ventriculostomy, should be regarded as the main factor able to reverse the direction of the fluid movement resulting in a decrease of the cyst volume.

The just-mentioned hypothesis would not necessitate a frank communication between the cyst and the third ventricle to explain volumetric changes of pineal cysts. Should such a pathogenic mechanism be verified, the obvious clinical implications would be the necessity for a longer observation period of the patient harboring a symptomatic pineal cyst after the initial operation of CSF diversion and the initial normalization of the intracranial pressure before the surgical attack on the pineal lesion. It would be, in fact, possible that at least in some cases the reduction in pressure within the ventricular system could be the only therapeutic maneuver necessary to treat this type of benign condition.

The advantage of a wait-and-see policy after an endoscopic third-ventriculostomy is supported by the recent observation of two pediatric cases of tectal mesencephalic tumors which spontaneously disappeared within 18 and 12 months, respectively, after the surgical procedure. However, in these two cases the regression of the tumors appeared to be related to the characteristic of the tumor rather than to the induced “normalization” of CSF pressure [1].

References

1. Alkhani AM, Boop FA, Rutka JT (1999) Involution of enhancing intrinsic tectal tumors after endoscopic third-ventriculostomy. J Neurosurg 91:863–866
2. Arieti S (1954) The pineal gland in old age. J Neuropathol Exp Neurol 13:482–491
3. Campbell AW (1899) Notes on 2 cases of dilatation of central cavity or ventricle of the pineal gland. Trans Pathol Soc (London) 50:15–18
4. Carr JL (1944) Cystic hydrops of the pineal gland with a report of six cases. J Nerv Ment Dis 99:552–572
5. Cooper ER (1932) The human pineal gland and pineal cysts. J Anat 67:28–46
6. Di Costanzo A, Tedeschi G, Di Salle F, Golia F, Morrone R, Bonavita V (1993) Pineal cysts: an incidental MRI finding? J Neurol Neurosurg Psychiatry 56:207–208

7. Fain JS, Tomlinson FH, Scheithauer BW, Parisi JE, Fletcher GP, Kelly PJ, Miller GM (1994) Symptomatic glial cysts of the pineal gland. J Neurosurg 80:454–460
8. Fetell MR, Bruce JN, Burke AM, Cross DT, Torres RAA, Powers JM, Stein BM (1991) Non-neoplastic pineal cysts. Neurology 41:1034–1040
9. Golzarian J, Balériaux D, Bank WO, Matos C, Flament-Durand J (1993) Pineal cyst: normal or pathological? Neuroradiology 35:251–253
10. Hadju SI, Porr RS, Lieberman PH, Foote FW (1972) Degeneration of the pineal gland of patients with cancer. Cancer 29:706–709
11. Hasegawa A, Ohtsubo K, Mari W (1987) Pineal gland in old age: quantitative and qualitative morphological study of 168 human autopsy cases. Brain Res 409:343–349
12. Kang HS, Kim DG, Han DH (1998) Large glial cyst of the pineal gland: a possible growth mechanism. J Neurosurg 88:138–140
13. Kiely MJ (1993) Neuroradiology case of the day. Pineal cyst with cerebral aqueduct obstruction. Am J Roentgenol 160:1338–1339
14. Klein P, Rubinstein LJ (1989) Benign symptomatic glial cysts of the pineal gland: a report of seven cases and a review of the literature. J Neurol Neurosurg Psychiatry 52:991–995
15. Lee DH, Norman D, Newton TH (1987) MR imaging of pineal cyst. J Comput Assist Tomogr 11:586–590
16. Lum GB, Williams JP, Machen BC, Akkaraju V (1987) Benign cystic pineal lesions by magnetic resonance imaging. J Comput Tomogr 11:228–235
17. Mamourian AC, Towfighi J (1986) Pineal cysts: M.R. imaging. AJNR 7:1081–1086
18. Maurer PK, Ecklund J, Parisi J, Ondra S (1990) Symptomatic pineal cyst: case report. Neurosurgery 27:451–454
19. Mena H, Armonda RA, Ribas JL, Ondra SL, Rushing EJ (1997) Nonneoplastic pineal cysts: a clinicopathological study of twenty-one cases. Ann Diagn Pathol 1:11–18
20. Musolino A, Cambria S, Rizzo G, Cambria M (1993) Symptomatic cysts of the pineal gland. Stereotactic diagnosis and treatment of two cases and review of the literature. Neurosurgery 32:315–320
21. Osborn RE, Deen HG, Kerber CW, Glass RF (1989) A case of hemorrhagic pineal cyst: MR/CT correlation Neuroradiology 31:187–189
22. Sawamura Y, Ikeda J, Ozawa M, Minoshima Y, Saito H, Abe H (1995) Magnetic resonance images reveal a high incidence of asymptomatic pineal cysts in young women. Neurosurgery 37:11–15
23. Sevitt S, Schorstein J (1947) A case of pineal cyst. Br J Med 2:490–491
24. Tamaki N, Shirtaki K, Lin T, Masumura M, Katayama S, Matsumoto S (1989) Cysts of the pineal gland. A new clinical entity to be distinguished from tumors of the pineal region. Child's Nerv Syst 5:172–176
25. Tapp E, Huxley M (1972) The histological appearance of the human pineal gland from puberty to old age. J Pathol 108:137–144
26. Vaquero J, Martinez R, Escandon J, Bravo G (1988) Symptomatic glial cysts of the pineal gland. Surg Neurol 30:468–470
27. Wisoff JH, Epstein F (1992) Surgical management of symptomatic pineal cysts. J Neurosurg 77:896–900