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Epidermoid cysts of the pineal region

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Abstract Localization of epidermoid cysts to the pineal region is rare. The 7-year-old boy now reported presented with an 18-month history of progressive ataxia. CT and MRI scans demonstrated a 2.5×2.5 cm cyst at the pineal region with obstructive hydrocephalus. At surgery via an occipital transtentorial approach, a characteristic "pearly tumour" was encountered, and complete resection was achieved. We present the management of this child with pineal region epidermoid cyst and review 11 cases reported in the literature since 1968. In all, 8 of the 12 patients were males. The age at the time of diagnosis ranged from 7 years to 69 years. Parinaud's syndrome and hydrocephalus are the most common presenting findings. All but 1 patient underwent direct surgical resection; 1 had stereotactic decompression. Surgical treatment brought about complete resolution of the presenting symptoms and signs in 10 of the 12 cases. One patient had persistent upgaze palsy. One patient died from progression of the pineal region mass. This patient presented with hemiparesis, which is a marker of clinical aggressiveness. The authors advocate direct surgical attack as opposed to stereotactic diagnosis and aspiration to: (1) obtain maximal resection and thereby limit the potential for recurrence and delayed complications of the cyst; (2) possibly avoid shunt placement in patients who present with hydrocephalus; and (3) decrease the likelihood of sampling error.

Key words Epidermoid cyst · Pineal region · Management · Stereotaxis

Introduction

Intracranial epidermoid cysts comprise 0.2–1% of all intracranial tumours [30]. They are most commonly located in the cerebellopontine and parasellar cisterns, but have been reported throughout the neuraxis [6]. Localization to the pineal region is rare. We present one case and review an additional 11 cases reported since 1968.

Case report

This 7-year-old right-handed boy presented with an 18-month history of progressive ataxia. At the time of presentation, he was complaining of frequent falls caused by tripping over his own feet, and marked difficulty in negotiating stairs. He had lost the ability to ice-skate, a skill he had mastered 2 years previously, and had had to revert to using training wheels on his bicycle because of difficulty balancing while cycling. His past medical and surgical history was negative, with the exception of a head injury suffered as an infant, with no clinically apparent sequelae.

Neurological examination demonstrated an alert child whose cognitive development was appropriate to his age. Head circumference was 56 cm, which was above the 98th percentile for his age. The pupils were equally reactive to light, and extraocular movements were full. Papilloedema was not present. The remainder of the cranial nerve examination was unremarkable, as was the examination of strength and sensory function of the extremities. Deep tendon reflexes were within normal limits, and the plantar responses were downgoing bilaterally. He was able to walk on his heels and toes with difficulty, but was unable to perform tandem gait. He was unable to hop in single leg stance.

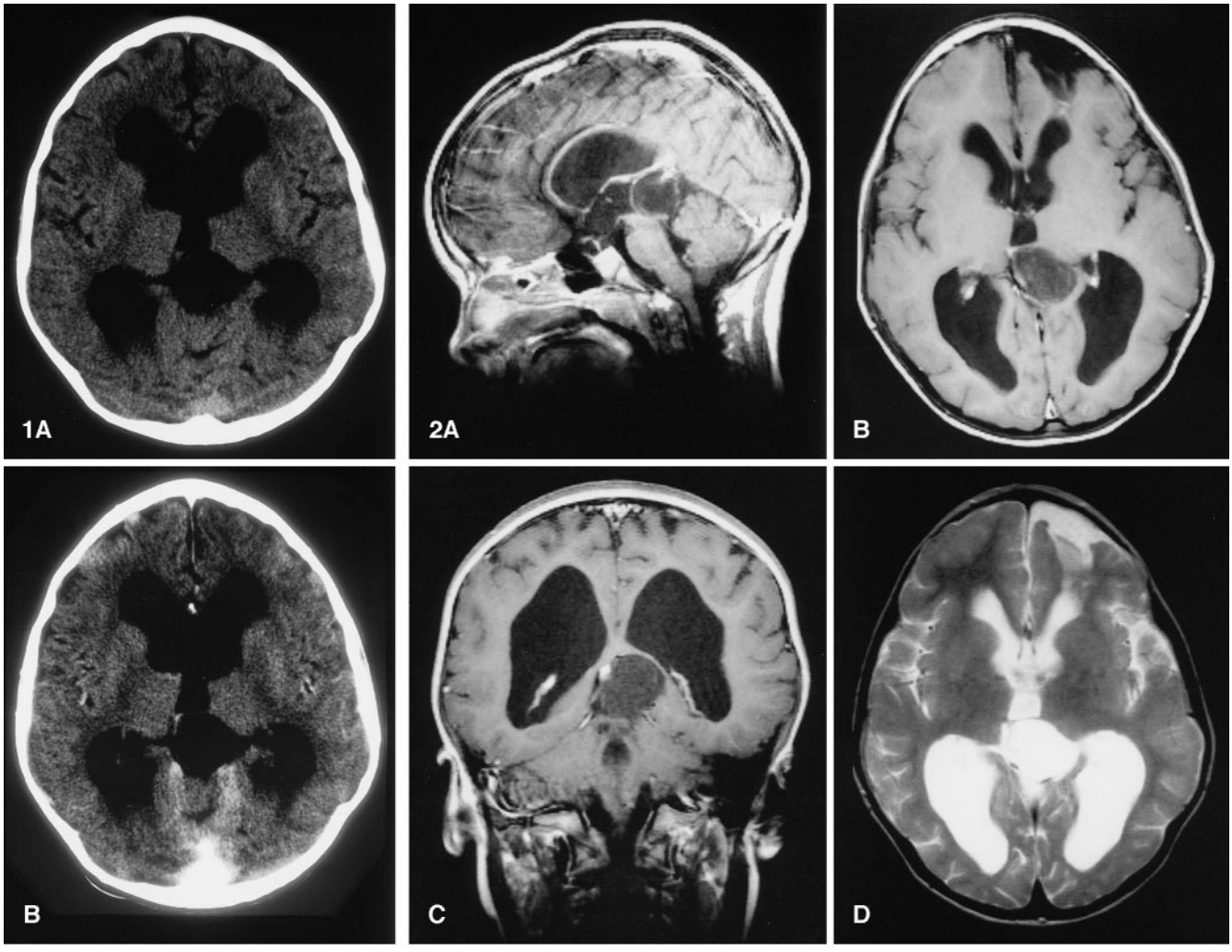


Fig. 1 CT scans **A** without and **B** with contrast, demonstrating a pineal region cyst with obstructive hydrocephalus

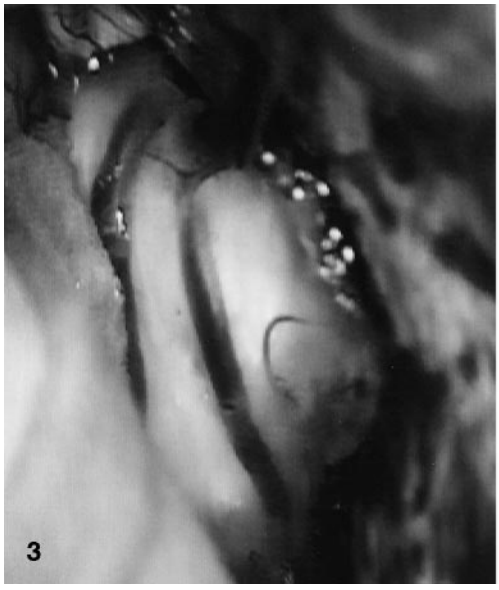
Fig. 2 **A** Sagittal, **B** axial and **C** coronal T1-weighted MRI scan demonstrating a 2.5×2.5×2.7 cm nonenhancing cystic lesion displacing the deep venous structures to the right side. **D** T2-weighted MRI scan demonstrates severe triventriculomegaly with transependymal absorption of CSF

Computed tomographic (CT) scan demonstrated a nonenhancing 2.5×2.5 cm cystic lesion of the pineal region with a density comparable to that of cerebrospinal fluid (CSF) with severe triventriculomegaly (Fig. 1). A magnetic resonance imaging (MRI) scan demonstrated that the nonenhancing cystic lesion was of signal intensity comparable to that of CSF in all sequences, and demonstrated displacement of the internal cerebral veins and vein of Galen toward the right side (Fig. 2). An old left frontal pole contusion was noted which probably related to the history of prior head injury. The imaging studies were consistent with the diagnosis of arachnoid or epidermoid cysts.

At surgery, via a left-sided occipital transtentorial approach, the lesion appeared whitish in colour, a characteristic appearance of a "pearly tumour" (Fig. 3). The cyst was found anteroinferior to the confluence of the deep veins of the pineal region, which were closely applied and adherent to the cyst capsule. The capsule was opened, and the keratinaceous content was removed progressively as the capsule was dissected away from the surrounding structures and complete resection was achieved.

Pathological examination of the surgical specimen demonstrated a cyst lining consisting of stratified squamous epithelium with keratinaceous contents (Fig. 4).

The patient had an uneventful postoperative course, apart from transient neck pain and stiffness on the 3rd postoperative day. This was attributed to aseptic meningitis. His symptoms were completely resolved with a 10-day course of dexamethasone. When seen at follow-up 3 months later, the boy was able to carry out all activities without any difficulty. Neurological examination demonstrated that he was now able to walk on his heels and toes and perform tandem gait with no difficulty. He was able to hop in single leg stance with no difficulty. MRI scans at 3 and 9 months from surgery demonstrated no residual epidermoid cyst and the ventricular size was markedly decreased (Fig. 5).



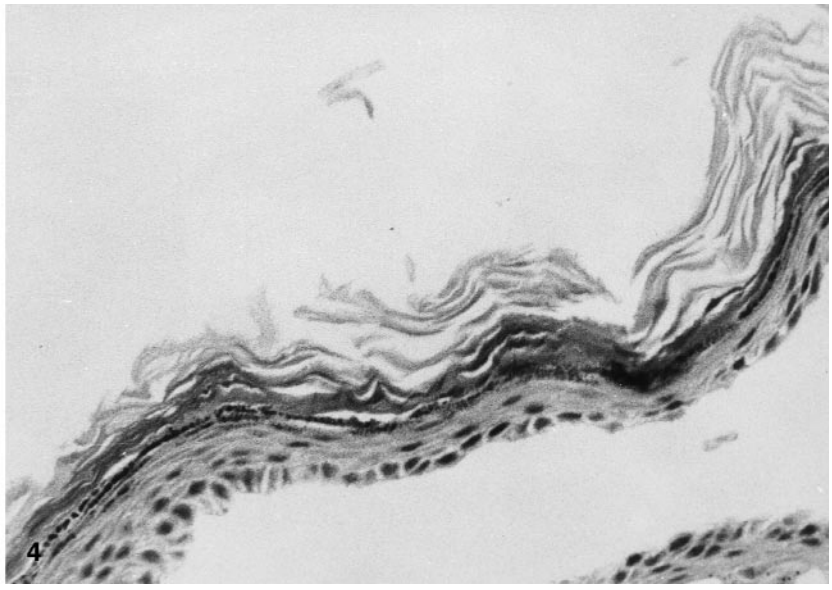


Fig. 3 Operative photograph through a left occipital transtentorial approach, demonstrating a characteristic pearly tumour

Fig. 4 Photomicrograph of the cyst wall consisting of stratified squamous epithelium with keratinaceous contents. (H&E, original magnification ×680)

Discussion

Embryology

Epidermoid cysts are inclusion tumours of the central nervous system. It is postulated that they arise from rests of ectodermal cells misplaced during the division of the neural and cutaneous ectoderm during the 3rd or 4th week of intrauterine development [42]. The predominantly lateral location of intracranial epidermoid cysts may arise from the ectodermal rest being carried laterally with the developing optic and otic vesicles, or in association with the developing embryonic vascular system [3, 11]. The occurrence of epidermoid cysts in the extradural and diploic spaces is postulated to represent inclusion, which occurs after neural tube formation and closure.

Histology

Epidermoid cysts consist of a capsule of stratified squamous epithelium containing desquamated epithelial cells, keratin, and cholesterol. Unlike true neoplasms, which exhibit exponential growth kinetics, that of epidermoid

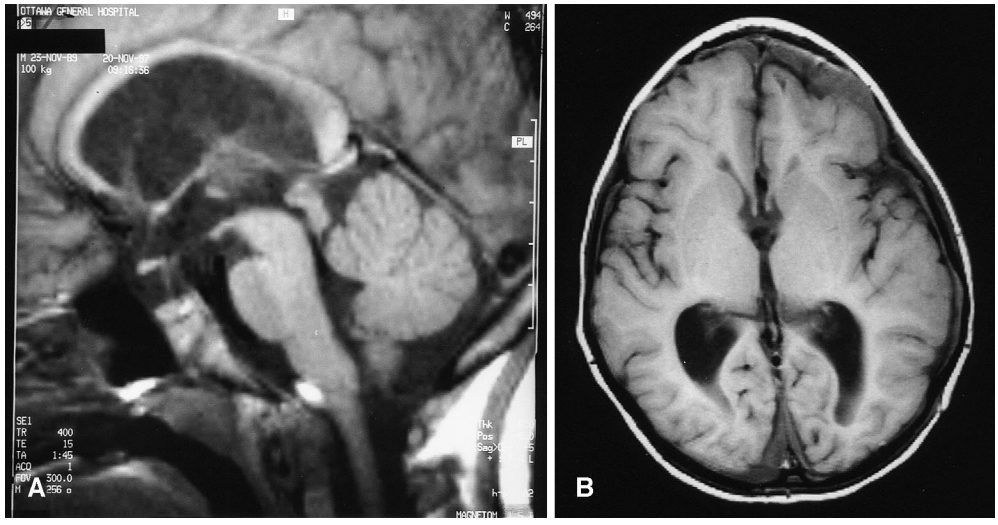


Fig. 5 Postoperative **A** sagittal and **B** axial MRI scans demonstrating resolution of the hydrocephalus and complete resection of lesion

Table 1 Case reports of epidermoid cysts since 1968 (*Ventr* ventriculogram, *HCP* hydrocephalus)

Reference	Age, sex	Presentation	Duration of symptoms	Investigations	Intervention	Outcome	Complications	Follow-up	Pathology
[33]	27, F	Parinaud's	2 years	Ventr	Transventricular	Full resolution	Aseptic meningitis	2 months	Epidermoid cyst
[17]	28, F	Parinaud's, HCP, hemiparesis	4 years	Ventr Angio	Shunted and irradiated without tissue dx age 24–. Emergent crani for acute deterioration age 28	Full resolution	Postop shunt blockage, hemianopsia	16 months	Epidermoid cyst
[31]	51, M	Parinaud's	6 weeks	Ventr Angio	Transventricular	Full resolution	Nil	1 month	Epidermoid cyst
[21]	27, M	Headache	6 months	Ventr Angio CT	Occipital transtentorial	Full resolution	Transient postop. hemianopsia	6 months	Epidermoid cyst
[40]	16, M	Hemiparesis, cerebellar signs	2 months	CT	Interhemispheric transcallosal	VP shunt 3 months postop. Died 15 months postop. from progression of mass	No postop. complications	15 months	Epidermoid cyst, autopsy declined
[45]	69, M	Parinaud's, cerebellar signs	4 years	CT	Infratentorial supracerebellar	Persistent upgaze limitation, resolution of cerebellar signs	Nil	Not reported	Epidermoid cyst with hemosiderin deposition
[3]	30, M	HCP causing acute blindness	3 weeks	Ventr CT	VA shunt, followed by infratentorial supracerebellar	Persistent visual loss	Nil	1 year	Epidermoid cyst
[42]	18, M	Parinaud's, HCP, hemiparesis	7 years	CT	Occipital transtentorial with partial occipital lobe resection	Persistent hemiparesis, Parinaud's and HCP resolved	Hemianopsia	1 month	Epidermoid cyst, thalamic germinoma
[20]	40, F	HCP	1 month	CT	Infratentorial supracerebellar	Full resolution	Nil	3 weeks	Epidermoid cyst content, no capsule
[18]	29, M	HCP, Parinaud's	2 years	CT	VP shunt at age 27 Stereotactic aspiration at age 29	Full resolution of Parinaud's	Postop. shunt blockage	2 months	Epidermoid cyst content, no capsule
[47]	21, F	Parinaud's, HCP	Not reported	MRI Angio	VP shunt followed by combined supra/infratentorial transsinus approach	Karnofsky Performance score 100	Nil	3 years	Epidermoid cyst
Present case (1998)	7, M	HCP, cerebellar signs	18 months	MRI	Occipital transtentorial	Full resolution	Aseptic meningitis	1 year	Epidermoid cyst

tissues is linear. Because of this linear growth, and the tendency for expansion within the subarachnoid spaces, epidermoid cysts are felt to cause gradual onset of symptoms and prolonged duration of "soft" signs, which are specific to the location of the cyst [6].

Incidence

Intracranial epidermoid cysts comprise 0.2–1% of all intracranial tumours [30]. The cerebellopontine cistern is the most common location, followed by the parasellar cistern [24], but the occurrence of epidermoid cysts has been reported throughout the entire neuraxis, including the cerebrum, cerebellum, brain stem, and ventricular system [6]. Epidermoid cysts comprise 1.6% of pineal region masses in series including both adults and children [4, 5, 8, 12, 14, 15, 23, 28, 47], and comprise 1.6% of pineal region masses in pediatric series [10, 16, 26, 32, 40, 41]. Pineal region epidermoid cysts account for 6% of intracranial epidermoids in series of both adults and children [2, 13, 29, 43, 46], and comprise 8% of intracranial epidermoids in pedi-

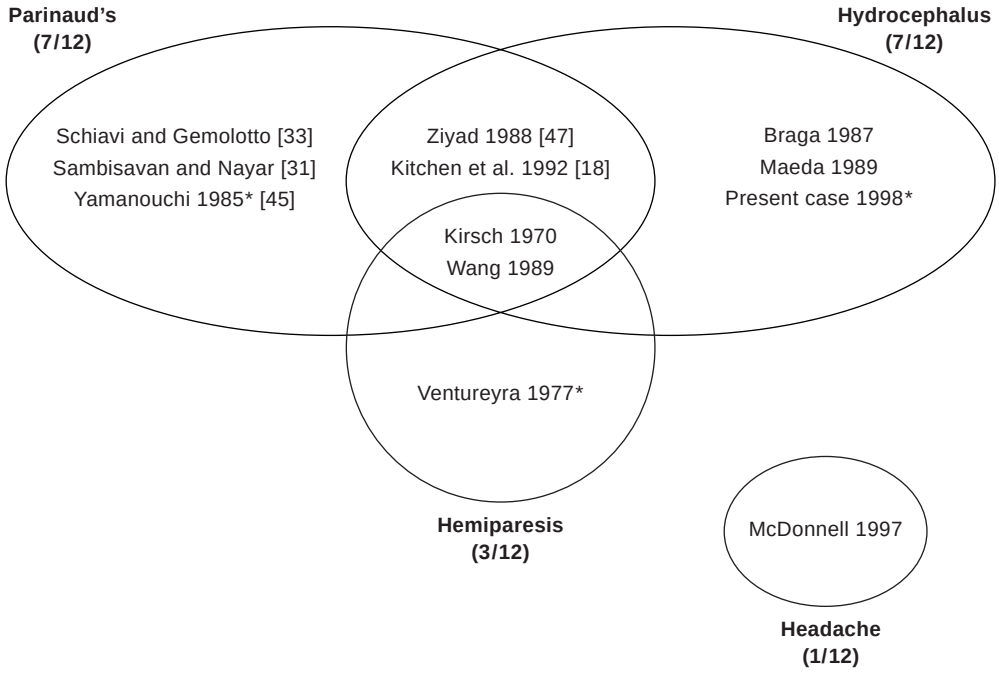


Fig. 6 Presenting symptoms and signs of the reported cases. Note that the cases marked with an *asterisk* presented with cerebellar signs (3/12). Note that the most severely affected patients presented with hemiparesis

atric series [5]. Table 1 presents the 12 cases reported in the literature since 1968 [3, 17, 18, 20, 21, 31, 33, 40, 42, 45], including our case report. The first case of a pineal region epidermoid cyst is reported to have been described by Cushing in 1928 [35]. In 1970, Kirsch found only seven previous case reports of epidermoid cysts of the pineal region upon review of the literature, and none of these patients survived the surgical intervention performed upon them [17].

Presentation

Eight of the 12 cases were male. The age at the time of diagnosis ranged from 7 to 69 years, with 9 of the 12 cases being less than 30 years of age at the time of diagnosis. Three of the 12 cases were 18 years of age or younger. The duration of symptoms prior to diagnosis ranged from 1 month to 7 years. Parinaud's syndrome and hydrocephalus were the most common findings, each being present in 7 of the 12 cases (Fig. 6). Hemiparesis and cerebellar signs were each present in 3 of the 12 cases. One patient presented with headache and nausea only. The distribution of symptoms and signs is presented in Fig. 6. The most severely affected patients were those who presented with hemiparesis, in that 2 of the 3 patients who presented with hemiparesis also demonstrated Parinaud's syndrome and hydrocephalus, and the remaining patient demonstrated hemiparesis and cerebellar signs.

Episodic aseptic meningitis resulting from spontaneous leakage or rupture of the cyst is a well-recognized presentation of intracranial epidermoid cysts. This occurred in 2 cases. One case presented 2 years prior to definitive diagnosis with a transient episode of diplopia and gait ataxia, which was attributed to aseptic meningitis after a negative CT scan and lumbar puncture [45]. Globules of "fat" were found within the lateral ventricles of another case at the time of operation [42]; this finding was attributed to the preoperative spontaneous intraventricular rupture of the epidermoid cyst.

Investigations

In the past, imaging studies consisting of pneumoventriculography and contrast-medium ventriculography were capable of localizing a lesion of adequate size to the pineal region, but were nonspecific with respect to the nature of the lesion. The exception to this rule with respect to intracranial epidermoid tumours in general was when air or contrast medium was able to enter the cyst and outline its characteristic lamellated, "cauliflower-like" interior. However, this characteristic feature was found in only 4 of 18 central nervous system epidermoids verified surgically in the pre-CT era [13].

Angiography demonstrates an avascular region corresponding to the epidermoid cyst, and shift of the arterial and venous structures of the pineal region, and may be helpful in determining the location of the lesion within the pineal region on the basis of the vascular shifts. Raimondi recommended planning the surgical approach to pineal region masses on the angiographic localization of the lesion within the pineal region [26]. CT scanning typically demonstrates a cystic lesion of density comparable to or

slightly higher than that of cerebrospinal fluid. T1- and T2-weighted magnetic resonance imaging studies typically demonstrate the epidermoid cyst to have a signal intensity comparable to or slightly greater than that of cerebrospinal fluid on both sequences [24]. However, pathologically verified intracranial epidermoid cysts of the pineal region [45] and other intracranial locales demonstrating hyperdensity on CT, increased signal intensity on T1- and decreased signal intensity on T2-weighted images have been reported [37]. Differences in cholesterol and protein content and the presence or absence of hemorrhage of varying age have been postulated to account for the variable imaging appearances [24, 37].

The principal differential diagnosis on magnetic resonance studies of the pineal epidermoid cyst with typical findings of decreased signal on T1-weighted images and increased signal on T2-weighted images is that of an arachnoid cyst. Fluid-attenuated inversion recovery (FLAIR) and steady-state free precession (SSFP) magnetic resonance imaging protocols have been reported to aid in the differentiation of epidermoid cysts from arachnoid cysts [19], as has the use of diffusion-weighted magnetic resonance imaging [24]. Other possible differential diagnoses include a pineal cyst or a dilated suprapineal recess of the III ventricle, but both should be distinguishable on sagittal MRI views.

Procedures

All 12 cases were managed surgically. Eleven of the 12 cases underwent direct surgical attack. The approaches utilized included the interhemispheric transcallosal approach [40], the transventricular approach [31, 33], the occipital transtentorial approach (our case report) [21, 42], the infratentorial supracerebellar approaches [3, 20, 45] and the recently described combined supra-/infratentorialtranssinus approach [47]. One case was exposed by parieto-occipital craniotomy with resection of the occipital lobe [17]. Another case involved resection of the occipital pole as part of an occipital transtentorial approach [42]. Four [3, 17, 18, 47] of the 7 cases who presented with hydrocephalus underwent shunting prior to definitive surgical therapy. One patient required placement of a ventricular shunt 3 months after partial resection of the epidermoid cyst for the development postoperatively of symptomatic hydrocephalus with recurrence of the mass [40]. This patient represents the only known mortality of all the series, and warrants further consideration (see below). One case of a pineal region epidermoid cyst underwent tissue diagnosis and therapeutic aspiration for treatment of its mass effect by stereotactic biopsy [18].

Pathology

Pathological examination of the tissue specimens confirmed epidermoid cyst with capsule in 9 cases (present report) [3, 17, 21, 31, 40, 42, 47]; dysplastic epidermoid cyst capsule and contents in 1 case [33]; and keratinaceous material consistent with epidermoid cyst content in 2 cases [18, 20]. Of particular interest is that pathological examination of one case [42] demonstrated the presence of a thalamic germinoma in addition to the presence of a pineal region epidermoid cyst.

Outcome

Reported follow-up ranged from 3 weeks to 3 years. Perioperative morbidity consisted of 2 cases of transient aseptic meningitis (our case report) [33], 1 case of transient homonymous hemianopsia most probably secondary to retraction injury to the occipital lobe [21], and two cases of homonymous hemianopsia secondary to occipital lobe resection utilized to expose the lesion [17, 42]. There was one case of persistent upgaze limitation [45]; otherwise, all symptoms were uniformly resolved in 10 of the 12 cases. Two [17, 18] of the 4 patients [3, 17, 18, 47] who had been shunted preoperatively remained shunt dependent on the basis of postoperative shunt malfunctions requiring shunt revision. All 3 of the patients who presented with hydrocephalus but who were not shunted preoperatively (our case report) [20, 42] remained shunt free at the last reported follow-up.

There was 1 known death in the series. This 16-year-old male, previously reported by the senior author (ECGV), presented with right hemiparesis and cerebellar signs [40]. CT scan demonstrated a hypodense cystic lesion of the pineal region with a heterogeneously enhancing portion extending into the left thalamus and internal capsule regions. Partial resection of the tumor via an interhemispheric transcallosal approach yielded a specimen consistent with epidermoid cyst only, yet the mass expanded over 6 months to produce a new onset hydrocephalus which required shunting. His family declined further surgical treatment, and progression of the mass led to the eventual death of the patient 15 months after the initial surgery. The family declined postmortem examination.

This single mortality represented 1 of 3 cases presenting with hemiparesis [17, 40, 42]. These 3 cases were in the most severely affected patients in the series (Fig. 6). We postulate three possible explanations as to why some epidermoid cysts of the pineal region exhibit clinical aggressiveness leading to hemiparesis. First, a large epidermoid cyst of the pineal region may cause a sufficient mass effect to compress the internal capsule or cerebral peduncle. This appears to have been the case in the report of Kirsch and Stears [17], in which the diagnosis of a large pineal epidermoid cyst was made at the time of emergent surgery for impending cerebral herniation 4 years after ventriculographic diagnosis of a pineal region mass. The unbiopsied mass had been irradiated twice in the intervening period for progressive enlargement. Second, the epi-

dermoid cyst may undergo malignant degeneration with the acquisition of invasive characteristics. The malignant degeneration to squamous cell carcinoma of intracranial epidermoid cysts and remnants of intracranial epidermoid cysts following subtotal resection is well-documented [1, 9, 39], and pathological examination of one of the specimens reported in this paper demonstrated dysplastic changes of the epidermoid cyst [33]. Third, the epidermoid cyst tissue of the pineal region may represent one subtype of a histologically heterogeneous mass that contains tissues of a clinically more malignant nature. Wang reported the case of an epidermoid cyst of the pineal region which occurred in association with a thalamic germinoma, and in which the patient presented with hemiparesis [42]. Edwards reported the case of a pineal region tumour, which was biopsied stereotactically to demonstrate epithelial debris consistent with epidermoid cyst but which a later craniotomy demonstrated to be a teratoma [10]. Yamaki reported a case of the simultaneous presentation of a teratoma of the pineal region and an epidermoid cyst of the IV ventricle [44]. Raimondi noted the potential histological heterogeneity of epidermoid cysts of the pineal region, and stressed the importance of maximal tissue resection for accurate diagnosis [26].

Only 1 of the 12 cases was not treated by direct surgical attack. Kitchen et al. reported the diagnosis and treatment of a pineal region epidermoid cyst by stereotactic aspiration of the cyst content [18]. The 28-year-old man presented with Parinaud's syndrome 2 years after being shunted for presumed aqueductal stenosis. The Parinaud's syndrome resolved with aspiration of the cyst content. The mortality and severe morbidity of stereotactic biopsies of the pineal region have been well-established at 1.3% and 0.8%, respectively [27]. It appears reasonable on the basis of these reported morbidity and mortality rates to consider stereotactic procedures for these lesions. However, in the particular case of a suspected epidermoid cyst of the pineal region there are some concerns. First, given the smaller volume of tissue removed for pathological study, the risk of sampling error intuitively appears to be higher in a stereotactic procedure than in the case of an open maximal resection. The importance of minimizing sampling error is attested to by the possible histological variability of tumours of the pineal region discussed above, and by the case report of a stereotactic biopsy result of epidermoid debris consistent with epidermoid cyst that was later proved at craniotomy to represent a teratoma [10]. Second, the capsule of the epidermoid cyst remains in situ, with the potential for reaccumulation of the epidermoid cyst over the lifetime of the patient. Such reaccumulation may expose the patient to the risk of recurrence of the presenting symptoms and signs, as well as the risk of such delayed complications as spontaneous rupture of the cyst leading to single or recurrent bouts of aseptic meningitis and malignant transformation of the epidermoid cyst, phenomena that are well documented [1, 9, 22, 39]. Direct surgical attack offers the possibility of total resection with cure and avoidance of these potential late complications, which are of particular concern given the typically youthful ages of these patients. Third, the patient reported by Kitchen remained shunt dependent after stereotactic aspiration, whereas all 3 of the patients in this series who presented with hydrocephalus and underwent direct surgical attack remained shunt free postoperatively. While it is impossible to determine from case reports whether or not the severity of hydrocephalus was comparable in the patients shunted or not shunted prior to surgical attack, direct surgical attack offers the possibility of avoiding shunt placement by re-establishing normal cerebrospinal fluid pathways. For these reasons, it is felt that direct surgical management is more appropriate than stereotactic biopsy and aspiration, and the authors continue to advocate open management of such lesions.

Conclusions

Localization of epidermoid cysts to the pineal region is rare. Epidermoid cysts comprise 1.5% of pineal region tumours in adults, and 1.6% of pineal region tumours in children. They present in young persons, with 9 of the 12 cases being 30 years of age and younger. Parinaud's syndrome and hydrocephalus are the most common presenting findings. The principal radiological differential diagnosis on magnetic resonance imaging is that of an arachnoid cyst. Epidermoid cysts of the pineal region respond well to surgical treatment, in that surgical treatment brought about complete resolution of the presenting symptoms and signs in 10 of the 12 cases. One patient had persistent upgaze palsy with resolution of the other presenting symptoms and signs. One patient died from progression of the pineal region mass. This patient presented with hemiparesis, which should be considered a marker of clinical aggressiveness. Eleven of the 12 patients underwent direct surgical attack; one patient underwent diagnostic and therapeutic stereotactic aspiration with resolution of his presenting Parinaud's syndrome, but remained shunt-dependent postoperatively. The authors advocate direct surgical attack as opposed to stereotactic diagnosis and aspiration to: 1) decrease the likelihood of sampling error; 2) obtain maximal resection and thereby limit the potential for recurrence and delayed complications of the cyst; and 3) possibly avoid shunt placement in patients who present with hydrocephalus. These issues are felt to be of particular concern given the typically youthful ages of these patients.

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