

Persistent Craniopharyngeal Canal: A Rare Cause for Recurrent Meningitis in Pediatric Population

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Abstract

We present the case of a 5-year-old girl who had six episodes of meningitis. She also had panhypopituitarism and was found to have a persistent craniopharyngeal canal (CPC) as the cause of her recurrent meningitis. Role of neuroradiology and a high index of suspicion by the clinical team are highlighted here. Persistent CPC is a rare cause of recurrent meningitis. We discuss the approach to the child with recurrent meningitis.

Keywords: Craniopharyngeal canal, hypopituitarism, recurrent meningitis

SECTION 1: CASE REPORT

A 5-year-old girl was diagnosed as panhypopituitarism at 4 months of age during an episode of hypoglycemic seizures. Developmental delay and short stature were noted. She was put on thyroid hormone and hydrocortisone supplements and received growth hormone injections.

She had meningitis at 2 years, confirmed by cerebrospinal fluid (CSF) analysis: showed high WBC count 1920/ μ L, low sugar of 28mg/dL, suggestive of bacterial meningitis. CSF culture was sterile. She had seizures on day 5 of admission; low sugar (38 mg/dL), and no cells were noted on repeat CSF analysis. There was no other neurological sign. She received ceftriaxone and vancomycin for 14 days. After 2 months, she had another episode of meningitis. CSF analysis showed 1090 cells with 70% lymphocytes, sugar – 20 mg/dL and protein – 155 mg/dL. CSF polymerase chain reaction (PCR) and culture were negative. She recovered within 3 days and received ceftriaxone for 14 days.

She continued to have repeated episodes of meningitis as detailed in Table 1. Maximum interval between the two episodes was 11 months (2nd and 3rd episodes).

SECTION 2

- How to approach a child with 2nd episode of meningitis
- Medical causes of recurrent meningitis
- Structural cause of recurrent meningitis
- Role of conventional versus protocolized magnetic resonance imaging (MRI) in investigating recurrent meningitis
- Identify craniopharyngeal canal (CPC) in images given [Figure 1].

How to approach a child with 2nd episode of meningitis?

Recurrent meningitis is a rare encounter in pediatrics, and establishing the diagnosis is a challenge. Of various

causes, anatomical defect either congenital or acquired is an important factor, followed by infectious diseases, immunodeficiency states, and aseptic meningitis due to inflammation [Table 2].^[1]

Bacterial meningitis is recognized as an important cause of morbidity and mortality in developing countries where infections are most frequent. It may have an array of differential diagnosis ranging from tuberculous meningitis in developing countries to central nervous system (CNS) fungal infections in temperate countries, chemical meningitis, and parameningeal collections such as subdural empyema.

In the absence of obvious leading symptoms and signs (CSF otorrhea and CSF rhinorrhea), focused clinical examination to find out visible dural connections is essential. Occygeal sinuses and nuchal areas should be actively screened as they are generally missed out in clinical examination. Laboratory investigations helping in the diagnosis are isolation of causative organism that differentiates bacterial from chemical meningitis. Culture may not be sufficient; hence, other methods (i.e., latex agglutination and PCR analysis) may have to be adopted. Anatomical defects are to be considered if the same organism is isolated, whereas various sites of infections and different organisms suggest possible immunodeficiency.

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Table 1: Patient details with CSF values

Episode	Age	CSF analysis						Treatment
		Cells	N/L	Sugar (mg/dL)	Protein (mg/dL)	Culture	PCR	Drug (number of days)
1	2 years	1920	55/45	28	65	Sterile	Not done	C+V (14)
2	2 years 2 months	1090	30/70	20	155	Sterile	Negative	C (14)
3	3 years 1 month	270	0/100	42	58	Sterile	Not done	C (14)
4	3 years 3 months	1800	80/20	27	135	Sterile	Negative	C (14)
5	3 years 7 months	1150	60/40	34	62	Sterile	Negative	C (03)
6	4 years 3 months	720	40/60	38	64	Sterile	Negative	C (04)

N=Neutrophils, L=Lymphocytes, C=Ceftriaxone, V=Vancomycin, CSF=Cerebrospinal fluid, PCR=Polymerase chain reaction

Table 2: Causes of recurrent meningitis (except dural connections and immunodeficiency syndromes)^[1]

Infections	HSV
	EBV
	HIV
	Lyme's disease
	Brucellosis
Structural lesions: Periodic release of contents in the dural space causing chemical meningitis	Toxoplasmosis
	Dermoid cysts
	Craniopharyngioma
Inflammatory disorders	Glioma
	Sarcoidosis
	SLE
	Vasculitis
	Behcet's disease
	Recurrent hereditary polyserositis
	Vogt-Koyanagi-Harada syndrome (aseptic meningitis, sensorineural deafness, uveitis, retinal hemorrhages, and skin-and-hair depigmentation)

HSV=Herpes simplex virus, EBV=Epstein-Barr virus, SLV=Systemic lupus erythematosus

Immunodeficiency workup includes immunoglobulin panel, immunoglobulin G subclass, lymphocyte subsets, and complement panel. If these measures fail to offer any clue to diagnosis, MRI brain and spine should be considered as precise localization of anatomic defect is important for surgical repair.

In addition, isolation of causative organism indicates and provides specific clues toward localization: *Hemophilus* and *Pneumococcus* species suggest possible cranial defect; *Escherichia coli* and Gram-negative coli indicate spinal defect; isolation of *Meningococcus* species suggests likely complement deficiencies or agammaglobulinemia; and extra CNS infections suggest the possibility of immunodeficiency.^[2]

Structural causes of recurrent meningitis

Several structural abnormalities may be associated with recurrent meningitis. Mass lesions such as epidermoid and craniopharyngioma are associated with aseptic meningitis.

Abnormal tracts leading to the cranial and spinal subarachnoid space may be seen in the anterior skull base (traumatic or nontraumatic CSF fistulas into the paranasal

sinuses, middle ear, or mastoids), midline along the dorsal aspect of the entire spine (dorsal dermal sinuses), or along the ventral aspect of the spine (neurenteric fistulae). Conventional imaging studies can provide important clues (such as fluid collections in the paranasal sinuses or mastoid air cells and presence of spina bifida or vertebral segmentation anomalies) that can point to the presence of such abnormalities.

Concomitant occurrence of two congenital lesions is described in various combinations:^[2]

- Meningocele of the anterior skull base and a defect in the stapedial footplate
- Meningoencephalocele of the cribriform plate and a fistula at the oval foramen
- Meningocele through a cleft crista galli and a fistula at the oval foramen
- Cribriform plate and an inner-ear malformation with a fistula through the stapedial footplate
- It is important to know these associations as medial skull defects are often missed because of their rarity and difficulty in diagnosing them on routine imaging, which leads to recurrence of meningitis even after surgical correction.

We obtained a detailed history of trauma, travel and excluded any possible external dural connection by thorough clinical examination. Immunodeficiency workup (lymphocyte subset and immunoglobulin panel) was negative. Initial MRI of the brain and spine performed with routine imaging protocols failed to demonstrate any pathology. With sterile cultures and rapid resolution of symptoms within 2–3 days of onset, a possibility of chemical meningitis was considered. Her treatment history of dexamethasone- (increased doses as part of stress dosing) for panhypopituitarism further strengthened our suspicion. Moreover, complete resolution of symptoms was seen with only 3 days of antibiotic therapy in two of the six episodes. Careful review of the initial MRI and subsequent high-resolution MRI and computed tomography (CT) scan of the skull base demonstrated the presence of CPC. CSF leak through the canal could not be demonstrated.

Role of conventional versus protocolized magnetic resonance imaging in investigating recurrent meningitis

Conventional MRI techniques employ thick sections (4–5 mm thick), which are clearly suboptimal in the

evaluation of dermal sinuses and CSF fistulae. High-resolution imaging with custom-built protocols employing thin section (1–2 mm thick) is required in evaluation for the skull base and spine in cases of recurrent meningitis. Often, imaging is the sole mode of diagnosis when CSF leak is not visible externally (e.g., CSF leak into the nasopharynx). Correlation with CT findings is often essential to delineate the extent of the pathology.

SECTION 3

Relevance of craniopharyngeal canal to hypopituitarism and recurrent meningitis

Size and site of occurrence of CPC determine the clinical presentation. CPC has been classified into three subgroups based on radiological characteristics [Table 3]. As expected, due to its developmental origin, pituitary dysfunction is a frequent manifestation and generally associated with Type 2 (size 3.5–4.4 mm) and Type 3 (size 5.9–31 mm) CPCs and was noted in 21% ($n = 6/29$) by Abele *et al.* in their series. This study also indicated the association between CPC and recurrent meningitis.^[3] Our case belongs to Type 1 canal as per the above classification system, which does not describe to have associated hypothyroidism.

Persistent CPC and hypopituitarism is a well-established association as per various reports, but association with recurrent meningitis is rare. Only three reported cases of recurrent meningitis and CPC^[3-5] are available in literature, of which only one has been reported in a 4.5-year-old child.^[4]

SECTION 4

- How to treat CPC and associated symptoms
- Illustration of the surgical finding in our case
- Follow-up.

Treatment options

Surgical correction is the treatment option for recurrent meningitis with established persistent CPC.^[4] Debate still exists about operating incidentally picked up canals, associated pituitary dysfunction, and established visual defects.^[4] Traditional intracranial approach is being replaced

by newer techniques such as neuronavigation. Defects can be corrected transnasally. Literature evidence indicates that there is no difference in the success rate of endoscopic and open-skull procedures (~90%). However, the advantages of lesser incidence of intra- and post-operative complications such as meningitis, abscess, wound infection, sepsis, and perioperative mortality rate make the former the preferred surgical method.^[6,7]

In this case, the parents were informed about the available surgical options and were counseled thoroughly by a team of pediatric neurology, neurosurgery, and ENT surgery. They opted for endoscopic surgery assisted with neuronavigation over open surgery. Sphenoidotomy was performed. Under neuronavigation guidance, posterior aspect of the sphenoid bone and upper clivus was drilled. After few millimeters of drilling, the tract was delineated and was traced caudally till nasopharynx and cranially up to the posterior aspect of the pituitary fossa. Content of the canal was fibrous band, which was disconnected, and ends were coagulated. Histopathology of the dissected tissue revealed fibrous tissue. There were no postoperative complications.

Follow-up

She was operated in July 2015. There was no further episode of meningitis postsurgery till date. There was an episode of febrile illness in February 2016, where all investigations including CSF examination were normal. She is on levetiracetam and hormonal supplement.

Learning points

- Recurrent meningitis: Neuroimaging is essential with neuroradiologist's interpretation
- Chemical meningitis versus bacterial meningitis should be differentiated for prognosis and treatment duration
- Associated hypopituitarism should raise doubt toward persistent CPC as a cause of recurrent meningitis.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients

Table 3: Classification of craniopharyngeal canal as per size and other characteristics^[3]

Type of canal	Features	Size	Hypopituitarism	Recurrent meningitis	Other salient features
Type 1 ($n=9$)	Incidentally picked up	0.7-1.1 mm	Nil	Nil	Other skull defects
Type 2 ($n=7$)	With ectopic adenohypophysis	3.5-4.4 mm	2	Nil	Cortical migration defects
Type 3A ($n=4$)	Associated cephalocele	5.9-31 mm	Nil	Nil	No other congenital defects
Type 3B ($n=7$)	Associated tumor (pituitary adenoma, craniopharyngioma, dermoid, teratoma, and glioma)	5.9-31 mm	2	1	No other congenital defects
Type 3C ($n=2$)	Features of both A and B	5.9-31 mm	2	Nil	No other congenital defects

CPC=Craniopharyngeal canal

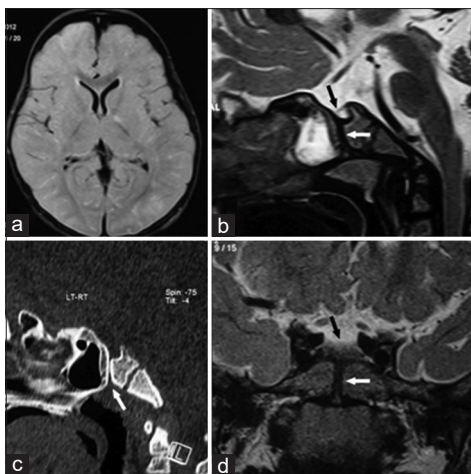


Figure 1: (a) Fluid-attenuated inversion recovery axial images showing leptomeningeal signal changes. (b) T2 sagittal showing hypoplastic pituitary (black arrow) and persistent craniopharyngeal canal. (c) Computed tomography head showing persistent bony canal below the pituitary fossa. (d) T2 coronal showing hypoplastic pituitary (black arrow) and persistent craniopharyngeal canal

understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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