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Lesson of the week

Recurrent bacterial meningitis: the need for sensitive imaging

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Sensitive imaging is needed in children with recurrent bacterial meningitis to detect cranial anatomical defects

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Recurrent bacterial meningitis in childhood is unusual and should prompt a search for immune deficiency. A variety of immunological defects may predispose to recurrent meningitis, including antibody or complement deficiency and hyposplenism. It is equally important to consider cranial anatomical defects such as skull fractures, particularly those affecting the base of the brain and extending to the sinuses and petrous pyramids.[1] Craniospinal dermal sinuses, neurenteric or dermoid cysts, occult intranasal encephaloceles, or transethmoidmeningoceles are also potential portals of entry for pathogens into the subarachnoid space.[2 3]

Encephaloceles may occur anywhere in the midline and arise from failure of closure of the embryonic neuraxis, creating a defect in the dura and cranium with or without protrusion of brain and meningeal tissue. Basal ethmoidal encephaloceles may extend into the nose and be mistaken for nasal polyps[2] or into ethmoid sinuses or orbits.

Sometimes there may be a delay in establishing a diagnosis owing to a failure to consider anatomical defects or the use of insufficiently sensitive imaging procedures. We describe two children with recurrent bacterial meningitis due to cranial anatomical defects in whom diagnosis was delayed.

Case reports

Case 1

A 9 year old boy presented with pneumococcal meningitis. Although he required ventilation, he responded rapidly to intravenous cefotaxime and penicillin. A year later he presented with a second attack, but no organism was identified in either cerebrospinal fluid or blood. A detailed immunological investigation was unremarkable (table) except for a moderately low concentration of pneumococcal antibodies (12 U/l; median 34, interquartile range 20-49). Because this was a second episode of meningitis and because he responded modestly to test immunisation with pneumovax (post-immunisation antibody level 34 U/ml), antibiotic prophylaxis was started. Abdominal ultrasonography showed a normal sized spleen, and there was no evidence of Howell-Jolly bodies in his peripheral blood.

Fifteen months before his first episode of meningitis, the patient had injured his head in a road traffic incident. A cranial anatomical defect was considered at this stage, but his original skull radiographs and cranial tomograms showed no abnormality. In the absence of a history of cerebrospinal fluid rhinorrhoea, more detailed imaging was not considered useful. He continued to remain well at follow up. Penicillin prophylaxis was stopped 18 months after his second episode of meningitis.

A third episode of meningitis occurred when he was 12, six weeks after stopping penicillin prophylaxis. Unencapsulated *Haemophilus influenzae* was cultured from his cerebrospinal fluid. A coronal thin section tomogram of the skull showed a small linear bony defect at the right ethmoid plate (fig 1). This was

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Immunological investigations in two children with recurrent bacterial meningitis

	Case 1		Case 2	
	Value	Reference range	Value	Reference range
Concentration of immunoglobulin (g/l):				
IgG	10.4	5.3-16.5	2.4	4.2-8.4
IgA	2.04	0.8-4		
IgM	0.98	0.5-2		
IgG_1	9.23	3.6-7.3	1.4	1.9-3.88
IgG_2	1.2	1.4-4.5	0.12	0.37-0.60
IgG_3	0.28	0.3-1.1	0.13	0.12-0.62
IgG_4	0.53	0.01-1.3	<0.06	<0.01
Specific antibodies to:				
Tetanus (IU)	0.41	>0.1	2.24	
Diptheria (IU)	1.0	>0.01		
Pneumococcal polysaccharide	12 U/ml before immunisation, 34 U/ml after immunisation	14-43*	Titre 10	640-10 240
Haemophilus influenzae type b (μg/ml)	1.06	>1	3.87	>1
C3 (g/l)	0.99	0.75-1.65	Normal	
C4 (g/l)	0.34	0.2-0.65	Normal	
Haemolytic complement pathway:				
Classic (U)	>1067	488-1150	Normal	
Alternative (%)	79	66-129		
Abdominal ultrasonography	Normal sized spleen		Normal sized spleen	
Coronal section cranial computed tomography	Linear bony defect at right ethmoid plate		Bony defect in crista galli	

*Interquartile range.

repaired through a right frontal craniotomy. He has since remained well without antibiotic prophylaxis.

Case 2

A 4 month old boy was admitted with irritability and poor feeding. He was febrile, poorly perfused, and had a full anterior fontanelle. After fluid resuscitation and a septic screen, he was treated with intravenous cefotaxime. Culture of his cerebrospinal fluid grew *Streptococcus pneumoniae*, and blood cultures were sterile. He had made a complete recovery at follow up six weeks later, and hearing assessment was normal.

Two months later he was readmitted with lethargy, poor feeding, fever, and rapid breathing. Intravenous cefotaxime was started. Cultures of blood and cerebrospinal fluid again grew *S pneumoniae*. Ultrasonography showed a normal spleen.

He was treated for 18 days and discharged home with penicillin prophylaxis. The table lists the immunological investigations performed before discharge. Two weeks later, lymphocyte subset analysis and lymphocyte proliferation responses gave normal results, with normal immunoglobulin and subclass levels. A cranial tomogram showed a bony defect in the crista galli, lying anteriorly between the upper nasal cavity and the base of the frontal area (fig 2). This was repaired endoscopically. At review six months later he was doing well and his neurological development was normal.

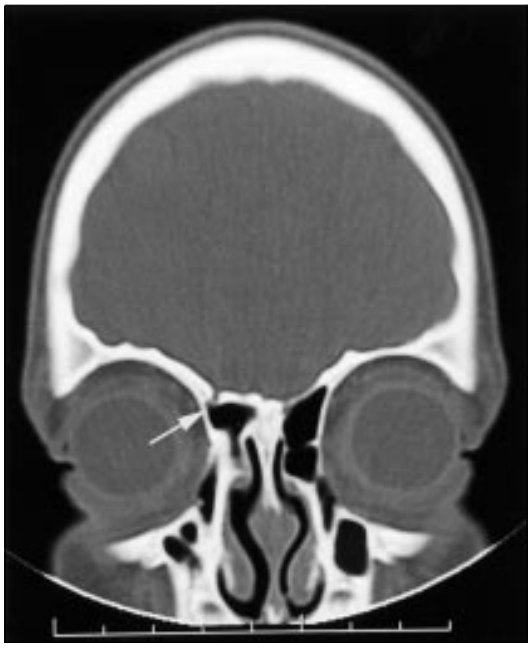

Fig 1 Cranial computed tomogram showing small linear defect at right ethmoid plate (arrow). Reproduced with parents' permission

Discussion

Cranial antomical anomalies should be investigated in patients with recurrent bacterial meningitis and a thorough immunological investigation performed to identify antibody or complement deficiencies and hyposplenism. Prophylactic penicillin and pneumococcal vaccination may fail to prevent recurrent meningitis in patients with a bony defect of the skull or spine.

Deficiency of the IgG_2 subclass is not rare in young children and often resolves spontaneously. It is not commonly associated with recurrent bacterial meningitis, although a case of recurrent pneumococcal meningitis in a 3 year old boy with low concentrations of IgG_2 specific pneumococcal antibodies has been described.[4] Furthermore, children with humoral immunodeficiencies often have infections in other sites such as ears, lung, and skin. The presence of a minor antibody deficiency should not preclude the search for a cranial defect.

In case 1 lack of cerebrospinal fluid rhinorrhoea and apparently normal results on imaging led to a delay in diagnosis, although the history of head injury was a clue to the diagnosis. In case 2 there was no clini-

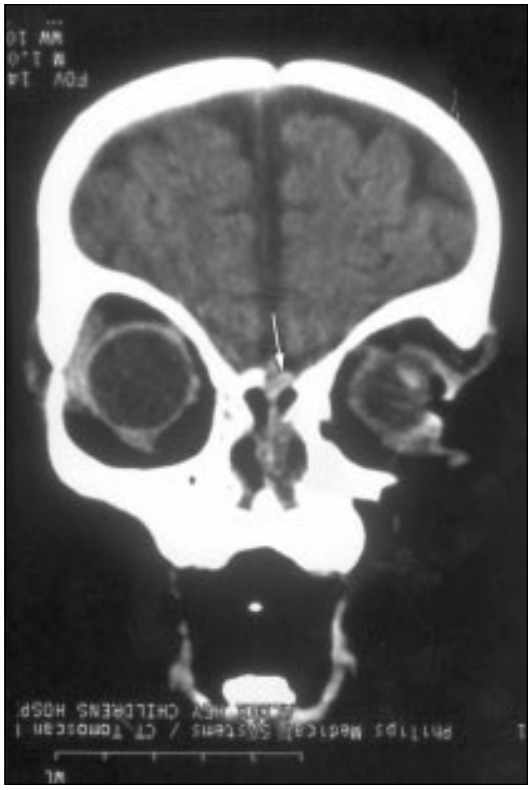

Fig 2 Cranial computed tomogram showing bony defect in crista galli (arrow). Reproduced with parents' permission

cal evidence of leaking cerebrospinal fluid. A minor antibody deficiency could have confused matters, although a defect was still searched for. Mollaret's meningitis (recurrent aseptic meningitis associated with herpes simplex virus) was not considered in these cases because of its viral aetiology and presentation as recurrent episodes of apparent aseptic meningitis.[5] We are unaware of Mollaret's meningitis in children with cranial anatomical defects.

Thin section cranial computed tomography offers a relatively easy, reliable, and non-invasive method of delineating anatomical defects in recurrent meningitis.[6] *S pneumoniae* is usually implicated, and treatment includes surgical repair of the underlying defect. Axial cranial computed tomography may fail to identify defects in the basal ethmoidal area and cribiform plate and so give false reassurances, whereas coronal thin sections show detailed anatomy of the anterior cranial fossa and identify most skull defects. Prompt recognition and repair of the defect, with dural closure, prevents further episodes of meningitis and ensures a good outcome for neurological development.

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A memorable patient

Mother and child

She had walked for over a day, down from the jungle covered hills, and now lay stoically, silent and almost unblinking, watching us over the curve of her gravid abdomen. "Deep transverse arrest" meant nothing to me until I saw the baby's arm hanging limply between her legs. "You can deliver this one," said the house officer in charge of the obstetric unit for the day.

I pulled the small, lifeless arm. It came off in my hand, neatly disarticulating at the shoulder blade like an overcooked chicken wing. There was a brief silence, and a kaleidoscope of emotion—embarrassment, horror, incredulity? I can't recall.

Predictably, inexorably, the situation became more technical, more invasive. An array of medieval instruments was tried, but served only to macerate the baby further. Under spinal anaesthesia, we removed the baby by caesarean section. I can still feel my fingers hooking through abdomen and lifting ribs out. I can still see the loose strings of green and black bowel being scooped out. I can't remember what we did with the assorted body parts, but I'm sure that the mother never saw her dead child. I have no idea what, if any, medical or psychological aftercare she received.

At the time, it was just another clinical experience garnered in the uncontrolled exotic world of Asian electives. The next week, a truckload of 50 wounded and dead was delivered to the hospital, fresh from a nearby border skirmish. For a while, I held the ace in the pack of clinical stories, a top trump of elective tales, more riveting than stories of golf in the Caribbean. With time, it faded away, tipped from the parapets of memory by the toil of house jobs and the steady accumulation of more immediate medical horror stories. But it never quite disappeared.

Now, more than a decade later, with children of my own and the experience of being an anxious parent in hospital behind me, I realise more of what this meant and reflect on how much I have changed in that time.

That woman deserved better than a newly qualified house officer and a foreign medical student to care for her. She deserved antenatal care, a decent transport system—all those things we take for granted in this part of the world. However, it wouldn't surprise me to find the situation unchanged, even in this new millennium. That saddens and troubles me still.

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