Chronic post-traumatic erosion of the skull base

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Summary. Delayed post-traumatic erosion of the skull base is reported in three patients who presented as adults with cerebrospinal fluid fistulae and a history of recurrent meningitis. These skull defects were associated with herniation of the subarachnoid space into the diploe of the skull base, the paranasal sinuses and the orbit. This rare complication of head injury is assumed to have occurred as the result of a dural tear at the time of trauma. Its site probably determines whether a resulting meningocele widens the intradiploic space or broaches the cranial floor.

Key words: Intradiploic leptomeningeal cyst – Leptomeningeal cyst – Growing fracture – Post-traumatic bone erosion

Bone erosion and widening of fracture margins due to transosseous arachnoid herniation are rare, but well-recognised complications of calvarial fractures in infancy or early childhood [1, 2]. Tearing of the dura mater at the time of injury is a prerequisite [3]. There have been only six previous reports of such lesions developing after fractures in the posterior fossa [4–9] and few of defects developing in adults [10–12].

We report three adults who presented with bone defects of the skull base at sites of previous fractures associated with transosseous extension of the subarachnoid space and dural defects. We suggest that such lesions may have been underdiagnosed in the past because they are less likely than calvarial defects to be symptomatic and because of previous difficulties in imaging the skull base.

Case reports

Case 1

A 33-year-old woman was referred for investigation of recurrent meningitis. Seventeen years previously she sustained a frontal skull fracture, which caused transient acute cerebrospinal fluid (CSF) rhinorrhoea and persistent anosmia. She had two episodes of pneumococcal meningitis 3 years and 3 months prior to referral. CT demonstrated a large defect in the planum sphenoidale, extending forwards to involve the floor of the anterior cranial fossa. Areas of encephalomalacia were present in both frontal lobes. CT cisternography demonstrated widening of the subfrontal subarachnoid space, which herniated into the skull base defects. The herniation via the sphenoid extended laterally into an enlarged intradiploic space in the greater wing and the adjacent middle cranial fossa floor (Fig. 1), while that in

Fig. 1a, b. Case 1. a Direct coronal CT cisternogram showing contrast medium filling the central portion of the defect in the jugum sphenoidale with widening of the intradiploic space of the sphenoid wing (arrow) on the right. b More posterior section showing contrast medium within the widened diploe of the skull base (arrow)

Fig. 2. Case 1. Direct coronal CT cisternogram through the anterior cranial fossa. The subfrontal subarachnoid space is wide and herniates through the bony defect into the right frontal sinus
Fig. 3. Case 2. Lateral skull radiograph showing lucent area in the occipital bone extending anteriorly into the squamous and petrous portions of the temporal bone.

Fig. 4. Case 2. Axial CT cisternogram showing a left occipito-temporal defect in the inner table with intradiploic extension of contrast medium. The underlying subarachnoid space is widened and the overlying outer table is thinned.

Fig. 5. Case 3. Direct coronal CT cisternogram showing contrast medium in a large frontal porencephalic cyst and subarachnoid herniation through the anterior cranial fossa floor. The bone of the orbital roof is abnormally thick but there is no intradiploic extension of the subarachnoid space.

the floor of the anterior fossa traversed the cribiform plate into the anterior ethmoid sinuses and the frontal bone into the right frontal sinus (Fig. 2). At bifrontal craniotomy a meningocele was found extending through the anterior defect into the right anterior ethmoid and frontal sinuses with a meningoencephalocele in a larger midline defect in the planum sphenoidale. The defects were repaired using autologous bone and fascia lata grafts. The patient made a satisfactory recovery and has experienced no further episodes of meningitis on follow-up for 2 years.

Case 2

A 44-year-old man was referred after treatment elsewhere had failed to cure recurrent meningitis and CSF rhinorrhoea. He had been dropped on his head at the age of 3 years, sustaining an occipital skull fracture. He experienced the first of five episodes of meningitis when aged 21 years and had intermittent CSF rhinorrhoea ever since. Unsuccessful surgery had been performed in 1975, 1978 and 1981. There was no active CSF leak at the time of his referral.

Skull radiographs demonstrated a lucent area with well-defined margins in the left occipital bone (Fig. 3). Cranial CT showed focal cerebral atrophy in the left temporoparietal region and a wide defect in the inner table of the occipital and temporal bones. CT cisternography demonstrated that the subarachnoid space herniated into this defect in several places (Fig. 4). Cerebrospinal fluid rhinorrhoea was assumed to have occurred via the left middle ear. An occipital craniectomy was performed. The outer table was thin and the diploe was honeycombed with CSF-filled spaces. The inner table was eroded and dura mater was absent over a wide area, with an underlying porencephalic cyst. The dural defect was repaired with artificial dura mater and the patient has remained free from rhinorrhoea and meningitis for four years. He was previously reported in a series of patients investigated for CSF rhinorrhoea [13].

Case 3

A 33-year-old man was referred for treatment of CSF rhinorrhoea. Seventeen years previously he sustained a compound depressed fracture of the left frontal bone with fractures of the left zygoma and right parietal bone. He was treated in hospital for 3 months; acute CSF rhinorrhoea ceased spontaneously after 6 weeks, but recurred 6 months prior to referral, after an episode of meningitis. Cranial CT, performed for the first time, demonstrated a left frontal porencephalic cyst and bifrontal encephalomalacia. There was a wide defect in the left orbital roof and adjacent cribiform plate. CT cisternography showed a CSF fistula to the left nostril and subarachnoid herniation via the bony defects into the orbit, anterior ethmoid and frontal sinuses (Fig. 5). The bone of the orbital roof was thickened but the diploic space was not widened. At operation two defects in the anterior cranial fossa floor were found, the larger lying anteriorly, with an associated meningocele, and a smaller posterior one containing a meningoencephalocele. Both were reduced and the dural defects were repaired with pericranial patch grafts, successfully closing the fistula. The patient has remained free of symptoms for 12 months.

Discussion

The term leptomeningeal cyst was coined by Dyke [14] and defined by Taveras and Ransohoff [1] as a fluid-filled space confined by pia-arachnoid adhesions through which cerebral pulsation is transmitted to cause erosion of the overlying bone. Such arachnoid adhesions may occur after trauma or meningeal inflammation. They are not true cysts since they remain, at least partially, in communication with the rest of the subarachnoid space [1]. Although Dyke originally included adult cranial trauma [14], the term has become associated with expanding skull defects after fracture in children. These lesions are commonly known as growing fractures [2] but other terms have been used: meningocele spuria [15], traumatic malacia [16], fibrosing osteitis [17], cerebrocranial erosion [18], and post-traumatic bone absorption [19]. Despite such a variety of terminology most authors agree that the essential features are injury in infancy or early childhood, a dural tear at the time of fracture, damage to the under-