Cochlear Implants Int. 10(2), 112–118, 2009
Published online 18 November 2008 in Wiley InterScience
(www.interscience.wiley.com) DOI: 10.1002/cii.360

Extradural haematoma presenting as a contralateral sixth nerve palsy after cochlear implantation

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ABSTRACT *Intracranial complications after cochlear implantation are rare. The authors present the case of a 13 month old boy with a contralateral abducens nerve palsy following cochlear implantation that led to the diagnosis of an extradural haematoma on computerised tomography scanning. The abducens palsy resolved after evacuation of the haematoma and the patient made an excellent recovery. The literature is reviewed and the mechanism of injury discussed.* Copyright © 2008 John Wiley & Sons, Ltd.

Keywords: cochlear implants; haematoma; extradural; postoperative complications

Case report

The patient was a Caucasian male aged 13 months at the time of surgery. He had non-syndromic, profound, bilateral sensorineural hearing loss diagnosed following neonatal hearing screening. Pre-operative imaging showed unusually wide internal auditory meati but otherwise normal anatomy. There was no other medical history and no family history of coagulation problems or deafness.

The right ear was selected for implantation. At the time of surgery, normal anatomy was confirmed and a cortical mastoidectomy, posterior tympanotomy and cochleostomy were performed. The thinness of the skull made it necessary to expose dura over a 2 cm diameter area to accommodate the device. The dura was undamaged during the creation of the package bed and no significant bleeding occurred. No bony island remained after the package bed had been created. Full

electrode insertion was achieved. An Advanced Bionics© (Valencia, California, USA) HiRes 90K device with a HiFocus 1-J electrode was used and neurophysiologic testing confirmed that the device was functioning normally. A light-compression head bandage was used overnight.

Postoperatively, the patient experienced multiple episodes of vomiting which settled. Within 12 h of the operation an isolated sixth nerve palsy was noticed on the left side. A computerised tomgraphy (CT) scan was performed and revealed a large right temporo-parietal acute extradural haematoma adjacent to the internal receiver of the cochlear implant. The haematoma compressed the lateral ventricle, causing a 5 mm midline shift with sulcal effacement of the right cerebral hemisphere superiorly (Figure 1). Correct placement of the cochlear implant was confirmed. He underwent an emergency mini-craniotomy and evacuation of the haematoma. At surgery the extradural clot was located mainly posterior to the implant device over the right parietal region, approximately 80 ml in volume. While no obvious source for the bleeding was identified it is likely to be due to trauma to the posterior parietal branch of the middle meningeal artery (MMA). Hitch stitches were applied to the dura. The lateral rectus palsy had resolved within

Figure 1: Axial computerised tomopgraphy scan showing a right extradural haematoma and compression of the lateral ventricle with midline shift. There is also artefact from the implant device.

DOI: 10.1002/cii

24 h. The patient made a good postoperative recovery and went home from hospital on the fifth day after implantation. Plain radiographs performed in the weeks during follow up showed that the electrodes and implant device remained in a good position.

Discussion

Cochlear implantation

Life-threatening surgical complications of cochlear implantation are extremely rare. This is the first report of an extradural haematoma following cochlear implantation in the UK and there appear to be no reports of isolated sixth nerve palsy associated with this operation (search using Medline, ProQuest and Embase databases). Gosepath et al. (2005) have reported a case of a 2.5 year old boy who underwent implantation of a Med EL Combi 40+ device (Innsbruck, Austria) which led to a extradural haematoma with no specific associated neurological deficit. The haematoma was drained, as in our case, but in addition there was a transient interruption of the arterial blood supply and cerebral ischaemia. The haematoma in our case was large enough to produce mass effect and presented with an isolated cranial nerve palsy.

Complication rates following the first 300 paediatric cochlear implants in our unit will be the subject of a separate publication in due course. In general, they are low and comparable to published series. They include eardrum perforation, haematoma, flap swelling, wound infection, vertigo, tinnitus and temporary facial weakness. Major complications include receiver migration, implant failure, meningitis, cholesteatoma, flap breakdown, persistent perforation and infection requiring explantation (Bhatia et al., 2004; Kempf et al., 1999; Proops et al., 1999).

Sixth nerve palsy

The lateral rectus muscle is innervated by this cranial nerve. Any neural compression or lesion causes esotropia greater at distance and an ipsilateral abduction deficiency resulting in horizontal diplopia. A lesion anywhere along the course of the nerve, from the pons to the orbit, can cause a lateral rectus weakness. Given the nerve's long course it is often a 'false localising sign'. Indeed, the sixth nerve palsy associated with increased intracranial pressure is possibly the best-known false localising sign, but other ocular motility disturbances (divergence paresis, convergence insufficiency and skew deviation) also elude localisation (Lepore, 2002). It is consequently no surprise that a review of the literature regarding extradural haemorrhage and a sixth nerve palsy revealed that the two pathologies are only rarely associated. Johnston and Choudhari (2003) have reported a rare case of a bilateral sixth nerve palsy following a postoperative posterior fossa extradural haematoma.

DOI: 10.1002/cii

Anatomy of the MMA and relationship to skull bones

The anterior branch not to be confused with the anterior meningial artery, which is a branch of the ascending pharyngeal artery, is the larger and lies in a groove in the greater wing of the sphenoid. It divides into branches at the sphenoidal angle of the parietal bone supplying the dura and the inner skull plate of the temporal bone. The posterior branch goes up onto the squamous temporal and near the parietal mastoid angle, then divides into branches which supply the posterior part of the dura and parietal bone. Indeed, the branches chiefly supply the bones and only partly the dura. They anastomose across the midline and with the anterior and posterior meningeal arteries. The very smallest distal branches anastomose through the skull with small arterioles from the scalp (Figures 2 and 3). In addition to the MMA branches, the possibility of involvement of the posterior meningial artery (a branch of the ascending pharyngeal artery) should also be considered. This vessel passes through the posterior compartment of the jugular foramen and rises to anastomose

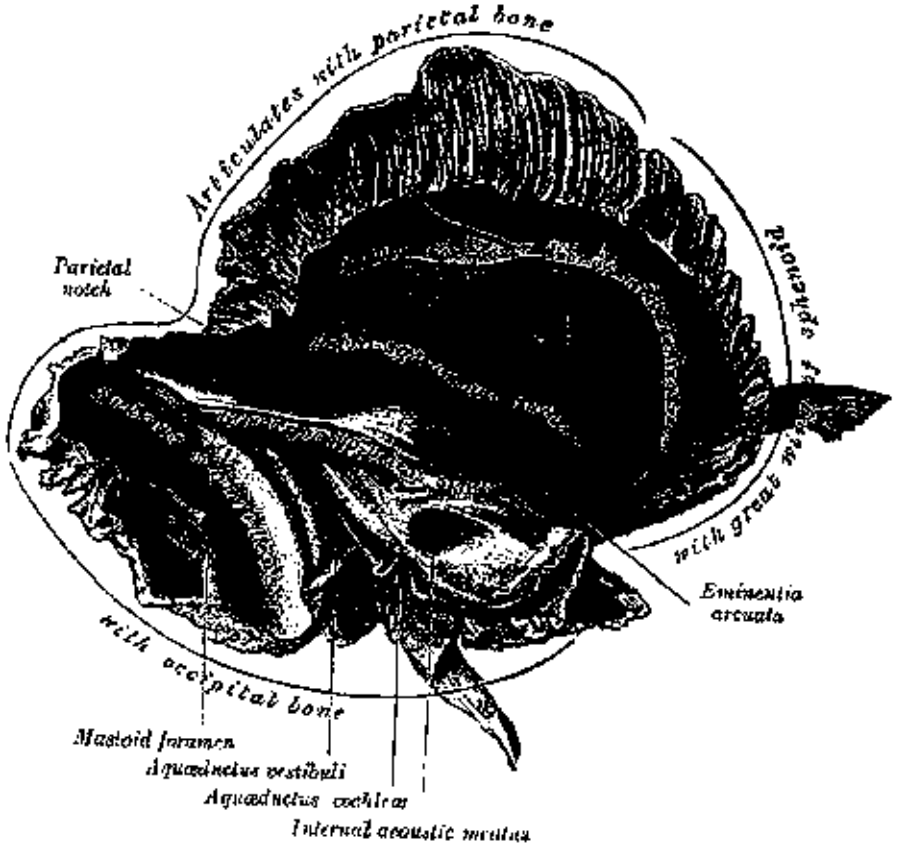

Figure 2: Inner aspect of the temporal bone showing the groove for the posterior branch of the middle meningeal artery heading towards the parietal notch just above the arcuate eminence. (Reproduced by permission of Bartleby.com)

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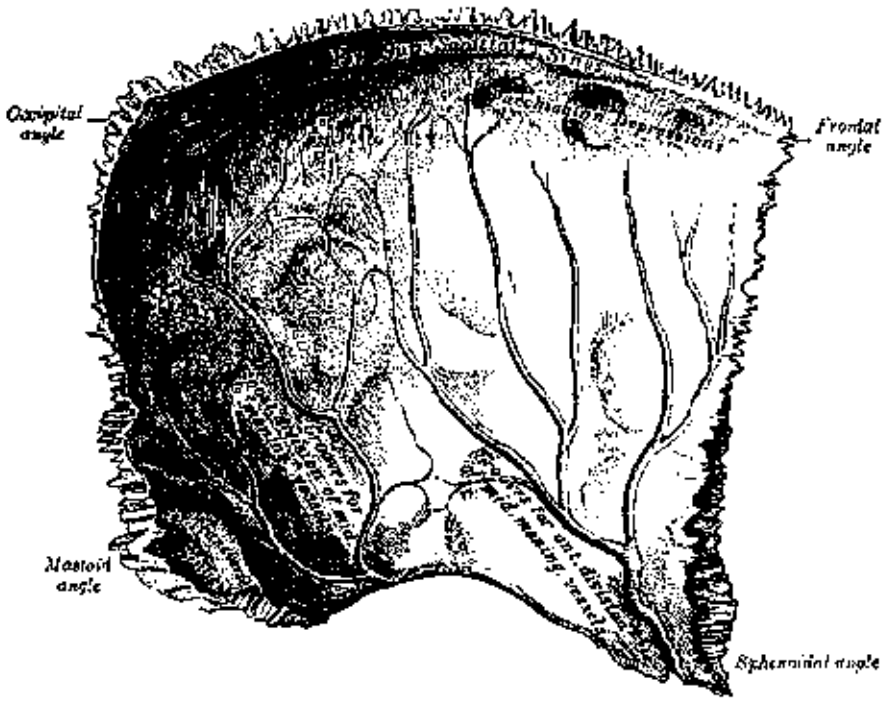

Figure 3: Inner aspect of the parietal bone showing the grooves for posterior division of the middle meningeal artery and its close relationship to the mastoid angle and transverse sinus. (Reproduced by permission of Bartleby.com)

with the posterior branches of the MMA grooving the occipito-parietal bones in its course. Finally, injury to the mastoid emissary vein during the surgical approach can result in delayed venous haematoma. However, there was no operative evidence of this during the evacuation. Sunkaraneni et al. (2004) have reported a case of an adult suffering a post operative subdural haematoma with associated motor weakness thought to have been caused by bleeding from veins opened by the drill passages used to anchor the sutures for an implant receiver. They have now abandoned the use of tie down sutures in cochlear implants.

The inner part of cochlear implant is inserted into the inner ear during surgery through the mastoid and middle ear in a trans-mastoid approach. The relationship of the grooves into the squamous and parietal bones for the posterior branch of the middle meningial artery and the arcuate eminence, cochlear turns and the mastoid make it likely that injury within the one of the bone grooves of this branch caused the extradural bleeding. This is particularly so, as no obvious bleeding was noted over the dural vessels and that most of the blood supply is to the calvarium.

Extradural haematomas in infants are difficult to diagnose. The mechanism of injury and the clinical presentation are different from those in older children (Beni-Adani et al., 1999). Normally, the presence of an expanding brain and its dural cover tightly adherent to the inner skull vault prevents any significant

DOI: 10.1002/cii

collection. Normally, haematomas from skull fractures are more likely to result either in cephalhaematomas or subgaleal collections in this age group.

However, creating a skull opening for insertion of a device with some necessary retraction of the dura may create a potential space that can fill up with the haematoma. Such extradural accumulation can follow surgical tear of one of the branches of the MMA or vein, brisk bone bleeding, or extradural bleeding from venous sinuses, during the procedure.

In the case of an infant who underwent a cochlear implant such a diagnosis will not be immediately considered. There was no subgaleal haematoma or cephalohaematoma. The presence of a sixth nerve palsy on the opposite side only served to confound the problem.

Van den Brink et al. (1999) revisited the prognostic importance of the volume of the haematoma and did not find a good correlation to presentation or six-month outcome.

However it seems logical to consider that a larger extradural haematoma may have had more serious consequences. Thus knowledge and awareness of the warning signs of an extradural haematoma is warranted. In our case a CT scan was invaluable in coming to a diagnosis and prompt referral and treatment. It also highlights the need for close neurological observations in the postoperative period, particularly if a larger craniotomy or craniectomy is carried out. While a conservative approach is possible in some particular cases of extradural haematoma, the importance of serial neurological examinations and a repeat CT scan cannot be overemphasised if such an approach is considered (Mandavia and Villagomez, 2001).

Conclusion

Rarely, a trans-mastoid cochlear implant may be associated with an extradural haematoma. The most likely cause of the haematoma is injury to the posterior branch of the MMA as it traverses within grooves in the posterior temporal and parietal bones. The haematoma can be associated with false-localising signs such as a contralateral sixth nerve palsy. Prompt evacuation of the haematoma is associated with an excellent recovery and preservation of the cochlear implant.

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