

Mortality after local allergic response to titanium cranioplasty

Samantha Hettige · John S. Norris

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Dear Editor,

The significant morbidity rate of cranioplasty has been well reported in the literature [1], but never before have the immediate decline and death due to titanium allergy been described. Here we describe what we believe is the first reported case of a fatal allergic reaction of the brain to a titanium cranioplasty. Titanium is thought to be a bio-inert material, and for this reason, along with its radiolucent and rigid properties, it has been popular for use in cranial implants. There are an increasing number of reports of incompatibility reactions to titanium implants where symptoms improve when the implant is removed. Cranioplasty insertion is quoted in the literature to have a moderate morbidity rate [1], but mortality is unusual.

A 64-year-old female presented with a single episode of transient global amnesia. A CT and MRI scan revealed a 3.7-cm olfactory groove meningioma, and she was offered excision. She had no headache, no focal neurological deficit, except a diminished sense of smell, and no relevant past medical history except allergy to multiple food products and also to metals such as nickel. She underwent total excision of the lesion with steroid cover, but due to swelling of the right frontal lobe, the bifrontal bone flap was not replaced. During recovery she was found to require permanent cerebrospinal fluid (CSF) diversion for hydrocephalus.

After neurorehabilitation, a titanium cranioplasty was fashioned for her sunken cranial defect. Prior to elective cranioplasty insertion she was alert, mobilising independently, and able to hold the occasional simple conversation.

Immediately after insertion, she was slow to wake from the anaesthetic, only extending to pain. A postoperative scan showed no focal acute intracranial lesion, but edematous

brain with bilateral sulcal effacement and effacement of the basal cisterns (see Fig. 1). The pupils then became dilated and non-reactive. She underwent immediate cranioplasty removal, but despite measures to reduce her intracranial pressure, she became cardiovascularly unstable in intensive care and died the same day.

Post-mortem examination showed that diffuse brain swelling was the cause of death. Early changes of necrosis were seen in the midbrain and basal ganglia. The cerebellum, pons, and medulla were swollen. There were no obvious large thromboses in the venous system. Blood testing revealed elevated levels of mast cell tryptase, which confirmed the examiner's suspicion, in view of the patient's previous allergic history, that an immunological response to titanium had occurred.

The previous histology of the meningioma was reviewed, which confirmed atypical meningioma (WHO grade II) with no excessive numbers of mast cells, ruling out residual tumour being a possible cause of potential histamine release causing diffuse brain swelling.

All other potential causes for this phenomenon, such as whether the patient had received any new medications, were ruled out.

There are two case reports detailing an allergic response to acrylic (polymethyl methacrylate) cranioplasty causing mortality [4, 7], but allergic reaction in the brain tissue to titanium has not been described previously.

Titanium is thought to be a bio-compatible substance and thus is favoured amongst clinicians as an inert material to use for bodily implants. Its other advantages make it useful for cranioplasty: it has a low density (light weight) and is easily shaped for good cosmesis, but stays rigid and strong [5]. It also does not interfere with any postoperative imaging modes [2], unlike ceramic plates. However, there is controversy over whether titanium allergy exists. There are reports of contact dermatitis and granulation caused by titanium [8], and other reports of local allergic reactions to titanium

S. Hettige (✉) · J. S. Norris
Department of Neurosurgery, Hurstwood Park Neurological
Centre, Haywards Heath,
Sussex RH16 4EX, UK
e-mail: samanthahettige@hotmail.com

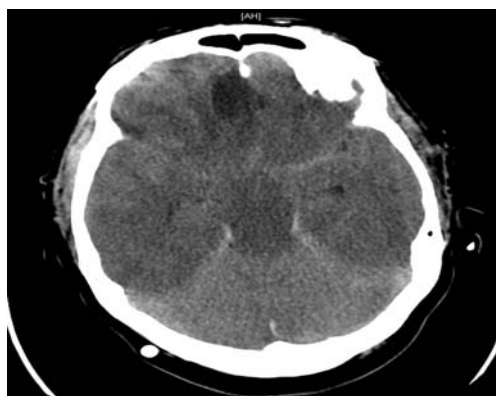


Fig. 1 Immediate postoperative CT scan showing effacement of sulci and basal cisterns secondary to brain swelling

implants in athroplasty [6] and to dental implants [3], causing poor bony healing and necessitating their removal.

One group found titanium dioxide hypersensitivity in a significant proportion of the subjects tested with the lymphocyte transformation test (LTT) [9], where patch testing gave negative results.

Titanium allergy is still contentious, and very few reports exist, signifying its rarity, but reactions of the brain parenchyma to titanium can lead to immediate death, as illustrated by this case. We feel that the field of neurosurgery must be made aware of this important phenomenon, which currently is a diagnosis of exclusion. Perhaps patients who are known to have multiple allergies should be sent for hypersensitivity testing prior to elective insertion of titanium cranioplasty as a preoperative screen to avoid bad outcomes if titanium continues to be the implant material of choice.

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Conflict of interest None

Ethical approval Not required

References

1. Cabraja M, Klein M, Lehmann TN (2009) Long-term results following titanium cranioplasty of large skull defects. *Neurosurg Focus* 26(6):E10
2. Chandler CL, Uttley D, Archer DJ, MacVicar D (1994) Imaging after titanium cranioplasty. *Br J Neurosurg* 8(4):409–414
3. Evrard L, Waroquier D, Parent D (2010) Allergies to dental metals. Titanium: a new allergen. *Rev Med Brux* 31(1):44–49
4. Gautschi OP, Schlett CL, Fournier JY, Cadosch D (2010) Laboratory confirmed polymethyl-methacrylate (Palacos)-hypersensitivity after cranioplasty. *Clin Neurol Neurosurg* 112(10):915–916
5. Gordon DS, Blair GA (1974) Titanium Cranioplasty. *Br Med J* 2:478–481
6. Lalor PA, Revell PA, Gray AB, Wright S, Railton GT, Freeman MA (1991) Sensitivity to titanium. A cause of implant failure? *J Bone Joint Surg Br* 73(1):25–28
7. Meel BL (2004) Fatal systemic allergic reaction following acrylic cranioplasty: a case report. *J Clin Forensic Med* 11(4):205–207
8. Thomas P, Bandl WD, Maier S, Summer B, Przybilla B (2006) Hypersensitivity to titanium osteosynthesis with impaired fracture healing, eczema, and T-cell hyperresponsiveness in vitro: case report and review of the literature. *Contact Dermatitis* 55(4):199–202
9. Valentine-Thon E, Müller K, Guzzi G, Kreisel S, Ohnsorge P, Sandkamp M (2006) LTT-MELISA is clinically relevant for detecting and monitoring metal sensitivity. *Neuro Endocrinol Lett* 27(1):17–24