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Temporal bone dissection: a possible route for prion transmission?

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Abstract

The aim of this study was to determine whether neural tissue is present in the bone 'dust' given off during temporal bone drilling. Bone 'dust' from three temporal bone dissections was collected and examined. Evidence of neural tissue was present in two out of the three specimens. Neural tissue is present in the bone dust given off during temporal bone drilling. This poses the question as to the risk of prion transmission during such dissection.

Key words: Surgical Procedures, Operative; Temporal Bone; Prions

Introduction

Bony dissection of the temporal bone is carried out during much routine ear surgery. Dissection of cadaveric temporal bones is also considered an essential part of training in otolaryngology. Some of the problems surrounding cadaveric temporal bone dissection have been high-lighted in the press recently.[1] Health and safety issues, microbiological hazards, poor maintenance of facilities and compliance with the anatomy acts have all been discussed.

Prions are an area of largely unknown hazard and concern to surgeons at present and particularly in ENT practice with reference to tonsillectomy and the current debate over disposable instruments.[2]

Mastoid dissection with a hand drill creates a significant cloud of tissue dust.[3] Among the possible microbiological hazards are aerosol inoculation of the conjunctiva of the operator with infected material. The risks of bacteria and live viruses are apparent but is there a risk of prion transmission if neural tissue is present in the tissue dust?

The aim of this short study was therefore firstly to investigate whether neural tissue is present in the tissue dust given off during bony dissection of the temporal bone.

Method

Three cadaveric temporal bones were dissected on separate occasions. Each time the bone had been harvested within the previous week and then preserved and stored by freezing. The bone was de-frosted and the soft tissue dissected off to expose the bare bone of the mastoid process, squamous temporal bone and zygomatic arch in the usual way. The specimen and the hand-piece of the drill were then placed inside a sterile, transparent theatre bag and a standard cortical mastoidectomy was performed. The bone dust given off was thus collected in the bag. The bone dust was transferred to a formalin pot and submitted for histological examination on each of the three occasions. Further dissection of the bones confirmed that neither the facial nerve nor the dura had been exposed during the initial procedures.

Histological examination consisted of staining with haematoxylin and eosin for tissue morphology and then immunocytochemistry to probe for neural tissue elements. The pS100 antibody was used (DAKO) which cross reacts strongly with human S100 protein. The antibody is strictly S100 specific when tested on formalin-fixed, paraffin-embedded human tissues. In the nervous system it stains Schwann cells, ependymal cells and glial cells. Other cell types stained are melanocytes and Langerhans cells in the skin, and interdigitating reticulum cells in lymph nodes. Staining is cytoplasmic as well as nuclear. (DAKO specification sheep rabbit anti-cow S100).

Results

Histological examination of the three specimens showed framgments of bone as well as varying amounts of fragments of cartilage, epithelium, striated muscle, connective tissue and spindle cells of uncertain nature, all against a dirty background.

Staining with S100 for neural differentiation showed focal background positivity. In addition, two out of the three specimens staining with S100 disclosed small numbers of positive-staining spindle

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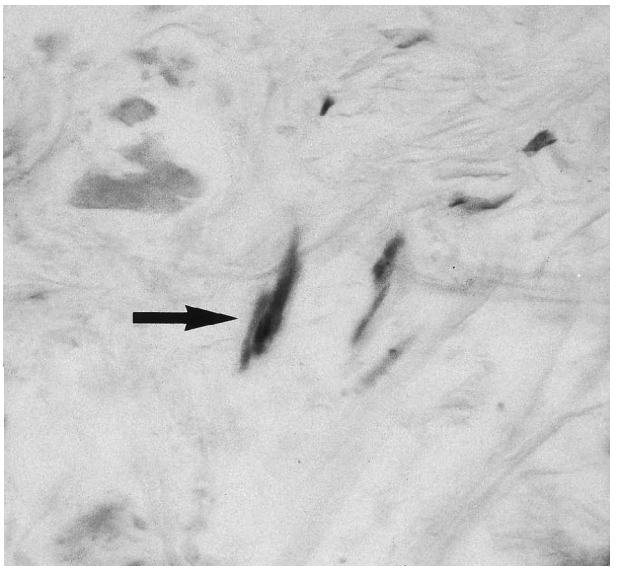

FIG. 1

Tissue dust stained with haematoxylin and eosin and then S100, photographed at low magnification, spindle cell (arrowed) staining positively for S100.

cells. The pattern of immunostaining was both nuclear and cytoplasmic. The morphological and immunohistochemical patterns seen were consistent with the presence of nerve fibres (Figure 1). It was therefore concluded that the presence of small numbers of cells with features consistent with nerve fibres gives support to the conjecture that neural tissue is present in the tissue dust given off in temporal bone drilling.

Discussion

Prions are proteins that are resistant to most forms of sterilization and disinfection,[4] but are infectious, leading to fatal conditions such as Creutzfeld-Jakob disease (CJD) and bovine spongiform encephalopathy (BSE). CJD has been shown to be transmitted via cadaveric brains, contaminated electrodes, and through donor tissues such as dura mater and cornea.[5]

The use of the drill in mastoid surgery leads to a wide scattering of bone and soft tissue. Lannigan *et al.*[3] showed that the tissue dust given off in mastoid surgery travels a distance in the trajectory of a parabola such that it could easily pass into the operator's eyes. They therefore recommended that surgeons should wear eye protection during mastoid drilling. A questionnaire survey in 1995 to all full members of the British Association of Otolaryngologists found that only 58 per cent of surgeons and 19 per cent of theatre nurses wore any form of eye protection during mastoid surgery.[6] Although spectacles provide a degree of protection, they are not infallible. A study by Prior *et al.* of 260 consecutive ENT operations, in which safety spectacles were worn, found contamination of the glasses in 15 per cent.[7] In 92 per cent of these the contamination was only of the exterior of the glasses but in eight per cent contamination was also found inside. They concluded that goggles provided the only absolute protection. The problem of conjunctival inoculation of tissue particles during the use of power tools has also been examined in orthopaedics. In one study there were 37 possible cases of eye contamination out of 60 procedures performed despite the use of eye protection.[8] In another study 511 surgeons reported they had sustained possible eye contamination, with seven definitely and four possibly contracting hepatitis B from their patients.[9] One case of HIV seroconversion after conjunctival contamination has been reported in a nurse, although not from using power tools.[10]

Our conjecture is that as well as the risk of live virus transmission (including human immunodeficiency virus (HIV) as well as hepatitis B) if neural tissue elements are present in the tissue dust given off during mastoid surgery and temporal bone dissection, then there is at least a theoretical risk of prion transmission. Moreover in the temporal bone laboratory, where standards of microbiological protection and ventilation are less strict than the operating theatre, this risk of prion tranmission is not removed by preserving the specimens by freezing.

Conclusion

This finding supports our concern that neural tissue is present in the tissue dust given off during mastoid surgery and temporal bone dissection even when macroscopic neural structures such as the facial nerve have been carefully avoided. The risk of prion transmission therefore has to be considered. Further research would obviously be required to determine the level of significance of this risk for this type of surgery. There may also be implications for other specialties such as orthopaedics and neurosurgery where power tools are also used.

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