

# Sudden Sensorineural Deafness after Unilateral Total Knee Replacement

G Crossland, F Tanweer, P Prinsley

## Citation

G Crossland, F Tanweer, P Prinsley. *Sudden Sensorineural Deafness after Unilateral Total Knee Replacement*. The Internet Journal of Otorhinolaryngology. 2009 Volume 11 Number 2.

## Abstract

We present a report of an individual who sustained a sudden onset of sensorineural hearing loss following a unilateral total knee replacement. Phillips et al reported a case in 2003 from the same hospital, following bilateral simultaneous knee replacements.<sup>(1)</sup> It was previously concluded that the most probable cause of the hearing loss was fat embolism. This is the first recorded case of a sudden bilateral hearing loss following a unilateral knee replacement. We conclude that a prospective investigation of the incidence of hearing loss after joint replacement is may be warranted.

## INTRODUCTION

Few studies exist of hearing loss after joint replacement. We present a case of a unilateral sensorineural loss after total knee replacement, review the literature and discuss the likely aetiology.

## CASE REPORT

An 80 year old farmer presented with a severe left sided hearing loss 4 weeks after undergoing a left total knee replacement for osteoarthritis. He was otherwise well, with the exception of essential hypertension. This was well controlled by amlodipine and bendroflumethazide. He took 7.5mg of meloxicam bd as required for his osteoarthritic pain. He had no prior history of otological surgical procedures. He had noted no problem with the hearing in either ear pre-operatively.

He received routine peri-operative thromboprophylaxis with subcutaneous enoxiparin. Combined spinal-epidural anaesthesia was planned, but the epidural catheter could not be sited. He therefore had a spinal anaesthetic using 20mcg of fentanyl and 2.2mls of 0.5% Marcain (R) heavy (Bupivacaine hydrochloride 0.5% and Glucose monohydrate 80mg/ml). A 16 gauge Tuohy needle and 27 gauge spinal needle were used.

Surgery to site a 'Genesis II' total knee replacement (Smith and Nephew) went smoothly.

His blood pressure remained stable throughout the procedure. Approximately one litre of blood was collected in

the first 6 hours post operatively, using a Bellocvac® ABT drain (AstraTech AB, Mölndal, Sweden). 300mls was replaced as an autologous transfusion. He received 2 litres of Hartman's solution and 500mls of Gelofusine®, intra and immediately post-operatively, followed by a further litre of Hartman's solution overnight. A morphine patient controlled analgesia system was used.

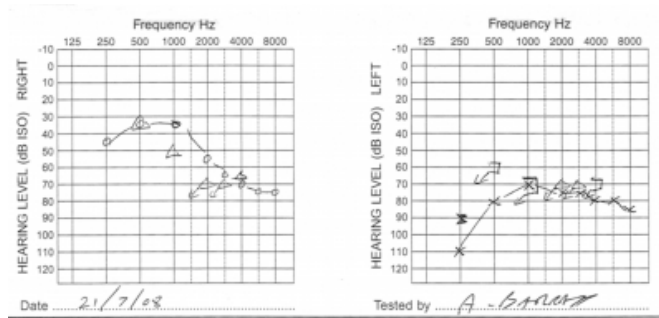
On the first post operative night he was noted to have a slightly irregular pulse. No cardiovascular compromise was noted; his pulse, blood pressure and oxygen saturations remained stable. An electrocardiogram showed occasional ventricular ectopics. He was a little disorientated at night, but otherwise made a good postoperative recovery. He first noted that his hearing had deteriorated on the second post operative day, but this was not investigated during his inpatient stay.

He was reviewed in the ENT outpatient clinic three weeks after hospital discharge. Otoscopy revealed normal tympanic membranes. Audiometry revealed a bilateral sensorineural hearing loss, more marked on the left (Figure 1). Repeat audiometry five months later showed no improvement in hearing thresholds.

He was fitted with bilateral digital hearing aids, and was very happy with the benefit these provided.

**Figure 1**

Figure 1: Post operative audiogram.



## DISCUSSION

The patient reported no previous hearing problems; post operatively he was sure that the hearing in his left ear had become markedly worse. At 80 years old a degree of pre-existing hearing loss might be expected due to presbycusis.(2) We feel his right audiogram probably is representative of his pre operative hearing. There was no pre-operative audiogram for comparison. The post operative loss appears to be most marked in the lower frequencies.

We could find no studies of the incidence of hearing loss after joint replacement. The only previous case report of sudden hearing loss after knee replacement was at the senior author's institution in 2003.(1) Those individuals who suffer a lesser degree of hearing loss may not present immediately to otolaryngology or audiology, and the association of hearing loss with previous joint surgery may not be as apparent. It may hence be under diagnosed and under reported.

In the previously reported case of deafness after knee replacement, it was concluded fat microemboli occluding the delicate cochlea circulation was the most likely aetiology.(1) Since this report, a histological examination of right atrial and arterial blood samples taken during knee replacement surgery intra-operatively has shown microscopic fat emboli in 50% of cases.(3) Animal studies of fat emboli suggest that small (15-20µm) emboli may traverse the lung vasculature.(4)

The internal auditory artery (labyrinthine) artery supplies both the cochlea and labyrinth and has a diameter of 200 to 300µm.(5) The cochlea is supplied by the common cochlea artery, an end artery, with poor co-lateral circulation.(6, 7) The modiolar branch supplies the apex of the cochlea and a vestibulocochlear branch supplies the base of the cochlea, posterior semicircular canal and saccule. The modiolar artery has a diameter of approximately 60 µm.(8) It has smaller

branches that supply the stria vascularis.(9) Obstruction of these vessels by fat micro-emboli could lead to low frequency hearing loss without vertigo. An analogous situation occurs in the retinal vasculature, where the end effects are more open to clinical examination via fundoscopy. Intra-arterial fat globules and retinal haemorrhages can be seen. They are found in approximately 50% of individuals with fat embolism syndrome (FES).(10) The patient in our case did not undergo fundoscopy, which can often help clinch a clinical diagnosis of fat embolism.

FES is caused by more extensive fat emboli. It is classically characterised by a petechial rash, cardiorespiratory compromise and neurological dysfunction. It is a diagnosis of exclusion with a differential diagnosis including myocardial infarction, pulmonary embolism, cardiogenic shock, sepsis, transient ischaemic attack, cerebrovascular accident and metabolic disturbance.(11-13) The incidence after major orthopaedic procedures or long bone fractures varies from 11% to 29%.(12-15)

Autologous transfusion is now common practice after joint replacement surgery.(16) The collected blood carries particulate debris and high levels of pro-inflammatory cytokines. A 40µm filter was used in our case to remove debris from the blood, but this would still leave microemboli of a size that could compromise the cochlea microcirculation.

Interleukin-1- Beta (IL-1β) is present in autologous blood, at levels 26 times higher than normal blood.(17) Interestingly, high levels of IL-1β causes sensorineural deafness in Muckle-Wells syndrome, with reports of reversal of the loss using anakinra (an IL-1β antagonist) therapy.(18, 19)

Spinal anaesthesia was used in this case, following an abandoned attempt to site an epidural catheter for a combined spinal-epidural.

Communication exists between the CSF and the perilymph via the cochlear aqueduct. A decrease in cerebrospinal fluid (CSF) pressure can, in theory, result in decreased perilymphatic pressure, relative endolymphatic hydrops, and hearing loss that is usually low frequency and temporary.(20) A study of hearing thresholds after neurologic surgery and non-neurologic procedures involving spinal anaesthesia showed the degree of hearing loss correlated with the amount of CSF lost.(20) Epidural anaesthesia carries a small (less than 1%) risk of dural puncture, hearing loss is very rare, but there are case reports

of its occurrence.(21, 22)

### CONCLUSIONS

This is the first case report of sudden, permanent, unilateral deafness following a unilateral total knee replacement. We believe this condition may be more common than reports suggest, as we have seen a similar presentation relatively recently at the same institution.

We feel the most likely aetiology was again fat embolism. Other factors that may have played a role include spinal anaesthesia and autologous transfusion.

Fundoscopy may help in the diagnosis of otherwise subclinical fat emboli.

A future study might compare pre and post operative hearing thresholds, in those that have joint replacements with and without spinal anaesthesia. The histological examination of arterial blood samples for emboli, fundoscopic examination, and IL-1 $\beta$  levels may be areas for further investigation.

### References

1. Phillips JS, Prinsley PR. Sudden unilateral deafness after bilateral knee replacement. *J Laryngol Otol*. 2003 Apr;117(4):310-1.
2. ISO7029. Acoustics : threshold of hearing by air conduction as a function of age. International standard ISO / International Organization for. Genève: International Organization for Standardization; 2000.
3. Kim YH, Kim JS, Hong KS, Kim YJ, Kim JH. Prevalence of fat embolism after total knee arthroplasty performed with or without computer navigation. *J Bone Joint Surg Am*. 2008 Jan;90(1):123-8.
4. Byrck RJ, Mullen JB, Mazer CD, Guest CB. Transpulmonary systemic fat embolism. Studies in mongrel dogs after cemented arthroplasty. *Am J Respir Crit Care Med*. 1994 November 1, 1994;150(5):1416-22.
5. Wende S, Nakayama N, Schwerdtfeger P. The internal auditory artery: (embryology, anatomy, angiography, pathology). *J Neurol*. 1975 Aug 4;210(1):21-31.
6. Axelsson A. The vascular anatomy of the cochlea in the guinea pig and in man. *Acta Otolaryngol*. 1968;Suppl 243:3+.
7. Axelsson A. Comparative anatomy of cochlear blood vessels. *Am J Otolaryngol*. 1988 Nov-Dec;9(6):278-90.
8. Gruber DD, Dang H, Shimozone M, Scofield MA, Wangemann P. Alpha1A-adrenergic receptors mediate vasoconstriction of the isolated spiral modiolary artery in vitro. *Hear Res*. 1998 May;119(1-2):113-24.
9. Tange RA. Vascular inner ear partition: a concept for some forms of sensorineural hearing loss and vertigo. *ORL J Otorhinolaryngol Relat Spec*. 1998 Mar-Apr;60(2):78-84.
10. Chuang EL, Miller FS, 3rd, Kalina RE. Retinal lesions following long bone fractures. *Ophthalmology*. 1985 Mar;92(3):370-4.
11. Gurd AR, Wilson RI. The fat embolism syndrome. *J Bone Joint Surg Br*. 1974 Aug;56B(3):408-16.
12. Lindeque BG, Schoeman HS, Dommissie GF, Boeyens MC, Vlok AL. Fat embolism and the fat embolism syndrome. A double-blind therapeutic study. *J Bone Joint Surg Br*. 1987 Jan;69(1):128-31.
13. Schonfeld SA, Ploysongsang Y, DiLisio R, et al. Fat embolism prophylaxis with corticosteroids. A prospective study in high-risk patients. *Ann Intern Med*. 1983 Oct;99(4):438-43.
14. Fabian TC, Hoots AV, Stanford DS, Patterson CR, Mangiante EC. Fat embolism syndrome: prospective evaluation in 92 fracture patients. *Crit Care Med*. 1990 Jan;18(1):42-6.
15. Kallenbach J, Lewis M, Zaltzman M, Feldman C, Orford A, Zwi S. 'Low-dose' corticosteroid prophylaxis against fat embolism. *J Trauma*. 1987 Oct;27(10):1173-6.
16. Moonen AF, Thomassen BJ, van Os JJ, Verburg AD, Pilot P. Retransfusion of filtered shed blood in everyday orthopaedic practice. *Transfus Med*. 2008 Dec;18(6):355-9.
17. Sinardi D, Marino A, Chillemi S, Irrera M, Labruto G, Mondello E. Composition of the blood sampled from surgical drainage after joint arthroplasty: quality of return. *Transfusion*. 2005 Feb;45(2):202-7.
18. Mirault T, Launay D, Cuisset L, et al. Recovery from deafness in a patient with Muckle-Wells syndrome treated with anakinra. *Arthritis Rheum*. 2006 May;54(5):1697-700.
19. Yamazaki T, Masumoto J, Agematsu K, et al. Anakinra improves sensory deafness in a Japanese patient with Muckle-Wells syndrome, possibly by inhibiting the cryopyrin inflammasome. *Arthritis Rheum*. 2008 Mar;58(3):864-8.
20. Walsted A. Effects of cerebrospinal fluid loss on hearing. *Acta Otolaryngol Suppl*. 2000;543:95-8.
21. Hardy PA. Transient hearing loss with labour epidural block. *Anaesthesia*. 2003 Oct;58(10):1041.
22. Johkura K, Matsushita Y, Kuroiwa Y. Transient hearing loss after accidental dural puncture in epidural block. *Eur J Neurol*. 2000 Jan;7(1):125-6.

**Author Information**

**Graeme J Crossland, MRCS. DOHNS**

SpR ENT, James Paget University Hospital

**Faiz Tanweer, MRCS. DOHNS. MS M.S (ENT)**

SpR ENT, James Paget University Hospital

**Peter R Prinsley, FRCS(ORL)**

Consultant ENT, James Paget University Hospital