The Journal of Laryngology & Otology (2017), ***131***, *817–822*.
© JLO (1984) Limited, 2017
doi:10.1017/S0022215117001554

MAIN ARTICLE

Eustachian tube dysfunction leading to middle-ear pathology in patients on chronic mechanical ventilation

O ILAN[1,3], E-L MARCUS[3], Y COHEN[1], T FARKASH[4], R LEVY[4], A SASSON[3], C ADELMAN[2,4]

[1]*Department of Otolaryngology – Head and Neck Surgery, and* [2]*Speech and Hearing Center, Hadassah-Hebrew University Medical Center,* [3]*Chronic Ventilator-Dependent Unit, Herzog Hospital, and* [4]*Department of Communication Disorders, Hadassah Academic College, Jerusalem, Israel*

Abstract

Objective: This study aimed to investigate the prevalence of and risk factors for Eustachian tube dysfunction leading to middle-ear pathology in patients on chronic mechanical ventilation via tracheostomy tube.

Methods: A total of 40 patients on chronic ventilation were included in a prospective cohort study. Middle-ear status was determined by tympanometry. Tympanograms were categorised as types A, B or C; types B and C were defined as middle-ear pathology.

Results: In all, 57 ears of 40 patients were examined. Disease was found in at least 1 ear in 26 out of 40 patients. Middle-ear pathology was found in 25 out of 34 patients who were tube fed (via nasogastric tube or percutaneous endoscopic gastrostomy) *vs* 1 patient out of the 6 fed orally ($p = 0.014$), and in 23 out of 31 with conscious or cognitive impairment *vs* 3 out of 9 cognitively intact patients ($p = 0.044$).

Conclusion: Middle-ear pathology is common in patients on chronic mechanical ventilation via tracheostomy tube. The highest prevalence was in those with impaired consciousness or cognition, and oral feeding appeared protective.

Key words: Intubation, gastrointestinal; Otitis media with effusion; Respiration; Artificial; Tracheostomy; Eustachian Tube

Introduction

Both the frequency of tracheostomy and the number of patients requiring prolonged mechanical ventilation are increasing.[1] These patients have a high rate of co-morbidities.[2] Prolonged mechanical ventilation alters the normal physiology; thus, chronically ventilated patients develop a variety of pathologies that are uncommon in non-ventilated adult patients.

Middle-ear disease is prevalent in children but uncommon in adults. The most common middle-ear pathology is otitis media with effusion, with characteristic chronic middle-ear effusion. Although the actual prevalence of middle-ear effusion in adults is unknown, it was reported in 2.6 per cent of adults attending an otolaryngology clinic.[3] In a recent publication, the principal author identified 168 cases of adult middle-ear effusion in a 22-year period, suggesting this is a rare condition in adults.[4] The most common cause of adult-onset otitis media with effusion is acute or chronic upper respiratory infection, although it has been reported in association with nasal intubation or the presence of a nasogastric tube.[5] Local malignancy and acid reflux have also been implicated as causes of middle-ear effusion.[4]

Only a few studies have assessed the frequency of middle-ear effusion in mechanically ventilated patients. This condition can affect hearing, thereby depriving mechanically ventilated patients of one of the already limited channels of communication available to them. Middle-ear effusion may cause or contribute to hearing impairment in critically ill patients; other causes in this population include cerumen impaction, drug ototoxicity, acoustic trauma, hypoxia and brain dysfunction.[6–8] Hamill-Ruth *et al*. reported that the finding of a type B tympanogram for ears of patients hospitalised in the intensive care unit predicts hearing impairment,[7] as measured by distortion product otoacoustic emissions.[6–8] Middle-ear effusion was reported in 29–84 per cent of intubated and mechanically ventilated adults.[9–14] Middle-ear pressure may change during and after prolonged nasotracheal and/or nasogastric intubation in some patients.[13] Pathological

Accepted for publication 13 April 2017 First published online 31 July 2017

https://doi.org/10.1017/S0022215117001554 Published online by Cambridge University Press

tympanograms are more common in intubated than in tracheostomised patients.[9] The incidence of middle-ear effusion was reduced from 46 per cent to 22 per cent after tracheostomy in a group of patients who had been on mechanical ventilation for more than 14 days.[15] Several mechanisms have been proposed to explain the high frequency of middle-ear effusion in ventilated patients, including the supine position and mucociliary hypofunction, obstruction of the Eustachian tube orifice (endotracheal or nasogastric tube), hypocapnea and impaired swallowing.[9] Performing tracheostomy removes anatomical obstruction, decreases the need for sedation and expedites mobilisation, which may contribute this reduction in the prevalence of middle-ear effusion.[15]

Previous studies have not investigated the frequency of middle-ear effusion in patients who are chronically ventilated via tracheostomy for over two months or the long-term effects of chronic mechanical ventilation. This study is the first to investigate the prevalence of and risk factors for Eustachian tube dysfunction leading to middle-ear pathology in the growing population of patients managed with long-term mechanical ventilation via tracheostomy, many of whom are mechanically ventilated for more than 80 days.

Materials and methods

The study was performed in the 90-bed chronic ventilator-dependent division of the Sarah Herzog Hospital, Jerusalem, Israel, a university-affiliated long-term care facility. The three units in the adult division specialise in caring for chronically ventilated patients. All procedures contributing to this work complied with the ethical standards of the Israeli Ministry of Health, the Herzog Hospital Ethics Committee institutional guidelines on human experimentation and the Helsinki Declaration of 1975, as revised in 2008.

Inclusion criteria for participation in this study were mechanical ventilation via tracheostomy tube for over 30 days and an age of 18 years and older. Patients were excluded if they were carriers of antimicrobial-resistant bacteria or had underlying pathology predisposing to middle-ear effusion or pathology. All patients were medically stable without febrile illness necessitating antimicrobial therapy.

Sociodemographic and clinical data were recorded, including age, sex, level of consciousness and cognition, feeding mode, duration of mechanical ventilation, and duration of mechanical ventilation since tracheostomy. Patients were divided into groups by either level of consciousness and cognitive state or mode of feeding, depending on the issue being evaluated. The three main categories for level of consciousness and cognitive state were intact cognition, cognitive impairment and persistent vegetative state. The three main modes of feeding were oral feeding alone or in combination with enteral feeding via nasogastric tube or percutaneous endoscopic gastrostomy (PEG); enteral feeding via nasogastric tube alone; and enteral feeding via PEG alone. Either 14 or 16 French gauge nasogastric tubes were used to feed patients. The nasogastric tube was inserted into alternate nostrils every three to four weeks.

As part of a routine evaluation, all patients fulfilling the inclusion criteria underwent otoscopy. Ears in which the tympanic membrane could not be fully visualised and those with acute middle or external ear infection were excluded. After otoscopy, tympanometry was performed by an audiologist with an AT235 diagnostic and clinical tympanometer (Interacoustics, Middlelfart, Denmark). The probe tone was 226 Hz ± 1 per cent at 85 dB SPL ± 1.5 dB. Tympanograms were classified as Jerger types A, B or C as follows: type A, peak admittance between +100 and −100 daPa; type B, no peak, little admittance (common in cases of middle-ear effusion); and type C, negative peak at a pressure more negative than −100 daPa (common with poor middle-ear aeration).[16] For the purposes of this analysis, type A tympanograms were considered normal and types B and C were considered to represent middle-ear pathology and pooled.

Statistical analysis was performed using SAS version 9.4 software (SAS Institute, Cary, North Carolina, USA). Descriptive statistics were calculated, including the mean, standard deviation, median and range for continuous variables and frequencies for categorical variables. Tympanometry findings were assessed on a per-ear and per-patient basis. Variables potentially associated with middle-ear effusion or middle-ear pathology were analysed using Fisher's exact test. Odds ratios were calculated when applicable. A p value of less than 0.05 was considered statistically significant.

Results

A total of 57 ears were examined in 40 patients. The characteristics of the study population are summarised in Table I. Patients had been mechanically ventilated through a tracheostomy tube for a median of 618 days (range 35–3564 days). Of the nine cognitively intact patients, four were fed orally (one simultaneously with PEG), four via PEG only and one via nasogastric tube only. Of the 12 patients who had cognitive impairment, 2 were fed orally in combination with nasogastric tube, 5 were fed via PEG and 5 were fed via a nasogastric tube. Of the 19 patients in a persistent vegetative state, 4 were fed via PEG and 15 were fed via a nasogastric tube.

Type A tympanograms were obtained for 25 out of 57 ears (44 per cent), type B tympanograms in 22 out of 57 (39 per cent) and type C tympanograms in 10 out of 57 (18 per cent). Middle-ear pathology (type B or C tympanogram) was found in 32 out of 57 ears (56 per cent). Middle-ear effusion (type B tympanogram) was found in at least 1 ear in 18 out of 40 patients (45 per cent). Middle-ear pathology was found in at least 1 ear in 26 out of 40 patients (65 per cent). Of the 17 patients who underwent tympanometry in both ears, 7 had type A tympanograms in both ears, 1 had a type A tympanogram in 1 ear and a type B tympanogram in the other,

https://doi.org/10.1017/S0022215117001554 Published online by Cambridge University Press

TABLE I
PATIENT CHARACTERISTICS

Characteristic	Value
Sex, *n* (%)	
– Male	19 (48)
– Female	21 (52)
Age, years	
– Mean (± SD)	65.6 ± 20
– Median	69.8
– Range	22–93
Cognition, *n* (%)	
– Intact	9 (22)
– Impaired	12 (30)
– Persistent vegetative state	19 (48)
Feeding mode, *n* (%)	
– Oral	6 (15)
– Oral only	3 (8)
– Oral & NGT	2 (5)
– Oral & PEG	1 (2)
– NGT only	21 (52)
– PEG only	13 (32)
Duration of mechanical ventilation, days	
– Mean ± SD	862.4 ± 846
– Median	618
– Range	35–3564
Duration of mechanical ventilation since tracheostomy, days	
– Mean ± SD	840.2 ± 847
– Median	598
– Range	33–3543

Data are *n* (%) unless otherwise stated. SD = standard deviation; NGT = nasogastric tube; PEG = percutaneous endoscopic gastrostomy

3 patients had a type A tympanogram in 1 ear and a type C tympanogram in the other, 4 patients had type B tympanograms in both ears, and 2 patients had type C tympanograms in both ears.

Table II shows the prevalence of middle-ear effusion according to patient characteristics. Middle-ear effusion was not found in any of the 6 patients who were fed orally but was diagnosed in 11 out of the 21 patients (52 per cent) fed via nasogastric tube only and in 7 out of the 13 patients (54 per cent) fed via PEG only. The difference reached only borderline significance ($p = 0.0552$); however, when patients fed via nasogastric tube only or via PEG only were pooled into the single category of patients not fed orally, the prevalence of middle-ear effusion was significantly higher than in those fed orally ($p = 0.0243$). To assess the possible role of nasogastric intubation in developing middle-ear effusion, the prevalence of middle-ear effusion in patients with a nasogastric tube who were fed by nasogastric tube alone or by nasogastric tube combined with oral feeding was compared with the prevalence in patients without a nasogastric tube who were fed either orally or via PEG. There was no significant difference in middle-ear effusion rate between the two groups.

Middle-ear effusion was found in 11 per cent of patients with intact cognition, 67 per cent of those with impaired cognition and 47 per cent of those in a vegetative state ($p = 0.0379$). When patients in a vegetative state and those with impaired cognition were pooled into the single category of patients without intact cognition, the prevalence of middle-ear effusion was significantly higher in the combined group (55 per cent) than in patients with intact cognition (11 per cent, $p = 0.0266$). The odds ratio for having middle-ear effusion in the combined group compared with cognitively intact patients was 9.7 (95 per cent CI, 1.08 to 87.31). Neither the duration of mechanical ventilation nor time since

TABLE II
PREVALENCE OF MIDDLE-EAR PATHOLOGY BY PATIENT CHARACTERISTICS

Patient characteristic	MEE, *n* (%)	*p* value	Middle-ear pathology, *n* (%)	*p* value
Mode of feeding				
– Oral feeding ($n = 6$)	0 (0)	0.0552	1 (17)	0.0275
– NGT only ($n = 21$)	11 (52)		16 (76)	
– PEG only ($n = 13$)	7 (54)		9 (69)	
Presence of oral feeding				
– Yes ($n = 6$)	0 (0)	0.0243	1 (17)	0.0143
– No ($n = 34$)	18 (53)		25 (74)	
Presence of an NGT				
– Yes ($n = 23$)	11 (48)	0.7547	17 (74)	0.1978
– No ($n = 17$)	7 (41)		9 (53)	
Cognition				
– Intact ($n = 9$)	1 (11)	0.0379	3 (33)	0.0215
– Impaired ($n = 12$)	8 (67)		11 (92)	
– Vegetative state ($n = 19$)	9 (47)		12 (63)	
Intact cognition				
– Yes ($n = 9$)	1 (11)	0.0266	3 (33)	0.0444
– No ($n = 31$)	17 (55)		23 (74)	
Duration of mechanical ventilation, days				
– < 618 ($n = 20$)	8 (40)	0.7512	11 (55)	0.3203
– ≥ 618 ($n = 20$)	10 (50)		15 (75)	
Duration of mechanical ventilation after tracheostomy, days				
– < 598 ($n = 20$)	8 (40)	0.7512	11 (55)	0.3203
– ≥ 598 ($n = 20$)	10 (50)		15 (75)	

MEE = middle-ear effusion; NGT = nasogastric tube; PEG = percutaneous endoscopic gastrostomy

https://doi.org/10.1017/S0022215117001554 Published online by Cambridge University Press

tracheostomy was associated with a difference in prevalence of middle-ear effusion ($p = 0.7512$).

In a similar analysis, middle-ear pathology (type B or C tympanogram) was found in 1 of the 6 patients (17 per cent) fed orally, 16 of the 21 patients (76 per cent) fed via nasogastric tube only and in 9 of the 13 patients (69 per cent) fed via PEG only; the difference among groups was statistically significant ($p = 0.0275$). The prevalence of middle-ear pathology was significantly higher in patients fed via tube only (nasogastric tube or PEG) than in those fed orally (74 per cent *vs* 17 per cent, $p = 0.0143$). No association was found between the prevalence of middle-ear pathology in patients with or without nasogastric intubation (74 per cent *vs* 53 per cent, $p = 0.1978$).

Middle-ear pathology was found in 33 per cent of patients with intact cognition, 92 per cent of those with impaired cognition and 63 per cent of those in a persistent vegetative state. The difference among groups was significant ($p = 0.0215$). In addition, middle-ear pathology was significantly higher in patients with impaired consciousness or cognition than in those with intact cognition (74 per cent *vs* 33 per cent, $p = 0.0444$). The odds ratio for middle-ear pathology in patients with impaired consciousness or cognition *vs* those with intact cognition was 5.74 (95 per cent CI, 1.16 to 28.57). Neither the overall duration of mechanical ventilation nor duration of mechanical ventilation since tracheostomy were associated with a significant difference in the prevalence of middle-ear pathology ($p = 0.3203$).

Discussion

Middle-ear effusion is common in children but rare in adults; however, it is prevalent in intubated and mechanically ventilated adults. The few studies evaluating the condition of the middle-ear in mechanically ventilated and intubated patients found that a large percentage of ears examined by tympanometry exhibited pathology, mainly middle-ear effusion.[10,11,14,17] In a series of 27 patients on mechanical ventilation, tracheostomy improved the condition of the middle ear.[15] The improvement was associated with a higher level of consciousness but, since intubation usually necessitates sedation, the effect of intubation cannot be separated from the level of consciousness in that study. However, short-term follow-up showed that after this improvement, the prevalence of middle-ear effusion in patients with tracheostomy was 22 per cent, which is still an order of magnitude higher than the level reported in an adult out-patient otolaryngology clinic.[3]

The present study had a unique opportunity to examine a cohort of patients with tracheostomy and mechanical ventilation lasting for months or years. These patients represent a growing population of adults with chronic critical illness and requiring prolonged mechanical ventilation. The results suggest that in the long-term mechanically ventilated patient, the prevalence of middle-ear effusion is high even after tracheostomy.

This study found that oral feeding confers some protection against middle-ear pathology. The prevalence of middle-ear effusion and middle-ear pathology was significantly lower in patients fed orally, either as the only mode of feeding or when combined with feeding via nasogastric tube or PEG. The feeding method was implicated as an important factor contributing to the middle-ear condition.[18,19] The nasogastric tube is considered to be an independent cause of middle-ear effusion because tube placement near to the Eustachian tube nasopharyngeal opening is thought to cause blockage and prevent ventilation of the middle ear. Although this explanation is widely accepted, it is supported by very little clinical evidence. A critical literature review identified only two studies involving small cohorts of patients fed by nasogastric tube. Wake *et al*. reported middle-ear effusion in 9 out of 10 patients after laryngectomy, with no control group[19]; and in a comparison of 10 patients fed via nasogastric tube because of neurological impairment that precluded oral feeding with 12 neurologically impaired patients who were capable of eating, Vento *et al*. found prevalences of middle-ear effusion of 90.0 per cent and 8.3 per cent, respectively.[18] Since all patients included in these studies had nasogastric intubation and were not fed orally, it was impossible to distinguish between the effects of these two factors.

In a study of 100 critically ill, mechanically ventilated patients in intensive care, González Pena *et al*. reported that a higher prevalence of middle-ear effusion in those fed via an 18 French gauge nasogastric tube than in those fed via a 12 or 16 French gauge nasogastric tube (odds ratio 2.54).[14] In the present study, all patients with nasogastric intubation had either a 14 or 16 French gauge tube, which may explain why no association was found between nasogastric intubation and middle-ear effusion or middle-ear pathology.

Recently, Huyett *et al*. investigated the incidence of radiographic mastoid and middle-ear effusion (i.e. as demonstrated in head computed tomography or magnetic resonance images) in patients in a neurological intensive care unit.[20] Brain imaging was performed on admission and on at least one other occasion within 14 days of the intensive care unit stay. During hospitalisation, 10.3 per cent of patients developed middle-ear effusion. A longer duration of hospitalisation and the presence of an endotracheal or nasogastric tube were associated with middle-ear effusion. However, multivariate analysis showed that presence of an endotracheal tube and duration of stay, but not the presence of a nasogastric tube, were associated with middle-ear effusion.

In agreement with the current study, Lucks *et al*. and Kesser *et al*. found no significant difference in the prevalence of middle-ear effusion or middle-ear pathology in patients with a nasogastric tube *vs* those fed

https://doi.org/10.1017/S0022215117001554 Published online by Cambridge University Press

with PEG, or in those with a nasogastric tube *vs* those without.[11,17] This finding supports the hypothesis that the nasogastric tube in itself (at least up to 16 French gauge) does not cause the pathology; the actual cause may be the lack of swallowing movements in patients fed solely via intubation. Decreased levels of cognition and consciousness also appear to increase the risk of middle-ear pathology. The current study found that patients able to perform effective swallowing movements seemed to be protected from middle-ear pathology, as seen in the orally fed group. Therefore, swallowing movements may decrease the prevalence of middle-ear pathology.

Patients with impaired consciousness or cognition had a significantly higher prevalence of middle-ear effusion and pathology compared with those with intact cognition. Other studies also reported that sedation and impaired consciousness were associated with middle-ear effusion.[10,14,17] Patients with disturbances in consciousness and sedated patients either cannot perform swallowing movements or have a decreased capability, and are also in a supine position; such factors potentially predispose to Eustachian tube dysfunction. In the current study, none of the patients were sedated; disturbances in consciousness and cognition were due to underlying neurological impairment.

- **Middle-ear effusion is uncommon in adults but is common in patients on mechanical ventilation**
- **The incidence of middle-ear effusion is reduced after tracheostomy in patients on mechanical ventilation for more than 14 days**
- **The frequency of middle-ear effusion in patients chronically ventilated via tracheostomy for over two months has not been investigated**
- **Middle-ear effusion was found in 45 per cent of patients mechanically ventilated via tracheostomy tube for a median of 618 days**
- **Impaired consciousness or cognition seems to predispose to Eustachian tube dysfunction, while oral feeding appears protective**

This study was limited by its cross-sectional design; thus, it is unknown when middle-ear effusion developed. However, since neither the length of mechanical ventilation nor the time since tracheostomy were associated with the prevalence of middle-ear pathology, it is possible that the pathology developed at an early stage in these chronically ventilated patients. Although the number of patients in the current series is comparable to the number included in earlier studies of mechanically ventilated patients, the relatively small cohort precluded subgroup analysis (such as comparing the various modes of feeding for cognitively intact patients).

Conclusion

Middle-ear pathology is common in patients with tracheostomy and long-term mechanical ventilation. The prevalence was highest in those with impaired consciousness or cognition. Patients fed orally were protected from middle-ear pathology; thus, oral feeding should be encouraged, if clinically possible. Routine otoscopy for these patients is also recommended because this condition is very common and often under-diagnosed. Further studies including long-term tympanometry follow-up in the growing population of chronic mechanically ventilated patients are needed to confirm these findings.

References

1 Cox CE, Carson SS, Holmes GM, Howard A, Carey TS. Increase in tracheostomy for prolonged mechanical ventilation in North Carolina, 1993–2002. *Crit Care Med* 2004;**32**:2219–26
2 Carson SS, Cox CE, Holmes GM, Howard A, Carey TS. The changing epidemiology of mechanical ventilation: a population-based study. *J Intensive Care Med* 2006;**21**:173–82
3 Somefun AO, Adefuye SA, Danfulani MA, Afolabi S, Okeowo PA. Adult onset otitis media with effusion in Lagos. *Niger Postgrad Med J* 2005;**12**:73–6
4 Mills R, Hathorn I. Aetiology and pathology of otitis media with effusion in adult life. *J Laryngol Otol* 2016;**130**:418–24
5 Finkelstein Y, Ophir D, Talmi YP, Shabtai A, Strauss M, Zohar Y. Adult-onset otitis media with effusion. *Arch Otolaryngol Head Neck Surg* 1994;**120**:517–27
6 Hamill-Ruth RJ, Ruth RA. Evaluation of audiologic impairment in critically ill patients: results of a screening protocol. *Crit Care Med* 2003;**31**:2271–7
7 Hamill-Ruth RJ, Ruth RA, Googer K, Volles D, Deivert M, Turrentine B. Use of otoacoustic emissions to screen for hearing loss in critically ill patients. *Audiology* 1998;**37**:344–52
8 Roth Y, Sokolov M, Adler M, Ezry T, Harell M. Otorhinolaryngological problems occurring within the intensive care unit. *Intensive Care Med* 2003;**29**:884–9
9 Cavaliere F, Masieri S, Liberini L, Proietti R, Magalini SI. Tympanometry for middle-ear effusion in unconscious ICU patients. *Eur J Anaesthesiol* 1992;**9**:71–5
10 Lin CC, Lin CD, Cheng YK, Tsai MH, Chang CS. Middle ear effusion in intensive care unit patients with prolonged endotracheal intubation. *Am J Otolaryngol* 2006;**27**:109–11
11 Lucks D, Consiglio A, Stankiewicz J, O'Keefe P. Incidence and microbiological etiology of middle ear effusion complicating endotracheal intubation and mechanical ventilation. *J Infect Dis* 1988;**157**:368–9
12 Skaansar K, Christensen P, Aasmundstad T. Middle ear effusion in intubated intensive care patients. *Acta Anaesthesiol Scand* 2009;**53**:417
13 Tos M, Bonding P. Middle ear pressure during and after prolonged nasotracheal and/or nasogastric intubation. *Acta Otolaryngol* 1977;**83**:353–9
14 González Pena M, Figuerola Massana E, Hernández Gutiérrez P, Rello Condomines J. Middle ear effusion in mechanically ventilated patients: effects of the nasogastric tube. *Respir Care* 2013;**58**:273–8
15 Chung HK, Lin CC, Wang CY, Lin CD, Tsai MH, Chang CS. Improvement in otitis media with effusion in patients undergoing tracheostomy after prolonged endotracheal intubation. *J Otolaryngol Head Neck Surg* 2009;**38**:532–6
16 Jerger J. Clinical experience with impedance audiometry. *Arch Otolaryngol* 1970;**92**:311–24

https://doi.org/10.1017/S0022215117001554 Published online by Cambridge University Press

17 Kesser BW, Woodard CR, Stowell NG, Becker SS. Middle ear effusion in adult ICU patients: a cohort study. *Ear Nose Throat J* 2013;**92**:340–6
18 Vento BA, Durrant JD, Palmer CV, Smith EK. Middle ear effects secondary to nasogastric intubation. *Am J Otol* 1995; **16**:820–2
19 Wake M, McCullough DE, Binnington JD. Effect of nasogastric tubes on Eustachian tube function. *J Laryngol Otol* 1990;**104**: 17–19
20 Huyett P, Raz Y, Hirsch BE, McCall AA. Radiographic mastoid and middle ear effusions in intensive care unit subjects. *Respir Care* 2017;**62**:350–6

Address for correspondence:
Dr O Ilan,
Department of Otolaryngology – Head & Neck Surgery,
Hadassah-Hebrew University Medical Center,
POB 12000,
Jerusalem 91120, Israel.

E-mail: ofir.ilan@mail.huji.ac.il

Dr O Ilan takes responsibility for the integrity of the content of the paper
Competing interests: None declared

https://doi.org/10.1017/S0022215117001554 Published online by Cambridge University Press