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Balloon Eustachian tuboplasty for Eustachian tube dysfunction: report of long-term outcomes in a UK population

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Main Article

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Abstract

Background. Balloon Eustachian tuboplasty is a surgical management option for Eustachian tube dysfunction; it has shown promising results in studies worldwide, but has had limited uptake in the UK. This study reports long-term outcomes for patients offered balloon Eustachian tuboplasty for chronic dilatory and baro-challenge-induced Eustachian tube dysfunction, and describes practical experience gained from its implementation.

Methods. Balloon Eustachian tuboplasty was conducted in 25 patients (36 ears) with Eustachian tube dysfunction over three years. Information on presenting symptoms and signs, audiometric findings, tympanometry, and Eustachian Tube Dysfunction Questionnaire-7 scores were recorded pre- and post-operatively with a minimum follow up of one year.

Results. Sixteen (64 per cent) of the 25 patients demonstrated symptom resolution after balloon Eustachian tuboplasty according to the Eustachian Tube Dysfunction Questionnaire-7. Fourteen (64 per cent) of the 22 patients with a type B or C tympanogram pre-operatively, had a type A trace post-operatively. Fifteen (75 per cent) of 20 patients with pre-operative conductive hearing loss showed improvement post-operatively, and 11 (50 per cent) of 22 patients with pre-operative middle-ear effusion or tympanic membrane retraction showed resolution.

Conclusion. Balloon Eustachian tuboplasty can improve subjective and objective measures of Eustachian tube dysfunction, and provide longer-term resolution.

Introduction

Eustachian tube dysfunction is a complex condition in which abnormalities in Eustachian tube function result in dysregulation of middle-ear ventilation. This condition is thought to be the root cause behind chronic otitis media in most cases. The management of this condition is challenging, not least because the definition of Eustachian tube dysfunction itself has been disputed, as described in a recent consensus statement.[1]

Three subtypes of Eustachian tube dysfunction have been described: dilatory Eustachian tube dysfunction, baro-challenge-induced Eustachian tube dysfunction and patulous Eustachian tube dysfunction. Dilatory Eustachian tube dysfunction is characterised by Eustachian tube obstruction for functional or anatomical reasons. Baro-challenge-induced Eustachian tube dysfunction describes obstructive symptoms when there is a change to ambient pressure. Patulous Eustachian tube dysfunction occurs when the Eustachian tube is abnormally patent.[1] Each of these three subtypes of Eustachian tube dysfunction may be described as either transient or chronic depending on the persistence of symptoms at three months.[1]

Even with the benefit of these clear descriptions of each Eustachian tube dysfunction presentation, the diagnosis may remain uncertain when findings from the patient's history, clinical examination, questionnaires and objective testing are contradictory. A recent diagnostic accuracy study for Eustachian tube dysfunction found that even with access to the full range of clinical findings, 2 patient-reported outcome measures and 14 objective clinical tests of Eustachian tube function, a panel of experts could not agree upon the diagnosis in all cases.[2]

In cases where dilatory Eustachian tube dysfunction is diagnosed, the usual treatment is medical management with topical nasal steroids, and/or insertion of ventilation tubes (grommets or T-tubes). This approach is intended to normalise middle-ear pressure and manage the associated symptoms, rather than primarily improving Eustachian tube function. In 2009, a novel surgical technique was developed almost simultaneously in both Germany[3,4] and the USA,[5] which aimed to rectify the underlying issue of poor Eustachian tube function itself. Specifically, balloon Eustachian tuboplasty employs balloon dilatation of the cartilaginous Eustachian tube to improve its function, and has the potential to improve Eustachian tube dysfunction symptoms in the long term, without ongoing intervention.

Over the decade that followed the introduction of balloon Eustachian tuboplasty to clinical practice, there have been numerous studies demonstrating the safety and

effectiveness of the technique.[6–9] Two systematic reviews[10,11] have shown promising results in a wide range of patients worldwide. In the most recent review of long-term outcomes, an improvement in subjective symptoms of Eustachian tube dysfunction was seen in 73–98 per cent of patients over three studies.[11] Despite increasing evidence for its efficacy, adoption of this technique in the UK remains limited. Two centres in the UK have published generally favourable short-term results in small groups of patients.[12,13] However, despite the potential for long-term Eustachian tube dysfunction management, many remain sceptical about balloon Eustachian tuboplasty.

This paper presents findings from the introduction of balloon Eustachian tuboplasty for management of Eustachian tube dysfunction in our institution in 2015. We have prospectively assessed the safety of the procedure, long-term outcomes and learning points from our practical experience of its use.

Materials and methods

This prospective study assessed outcomes for patients in a UK population undergoing balloon Eustachian tuboplasty to manage chronic dilatory and baro-challenge-induced Eustachian tube dysfunction.

A number of factors were considered in the diagnosis of Eustachian tube dysfunction for these patients, including symptoms such as ear discomfort on pressure changes, worsening symptoms with upper respiratory tract infection, frequent ear crackling or popping, and examination findings of middle-ear effusion or tympanic membrane retraction. Objective testing demonstrated conductive hearing loss on audiometry, and flat (type B) or negative (type C) traces on tympanometry. Patients with a diagnosis of Eustachian tube dysfunction were offered balloon Eustachian tuboplasty as an alternative to other management options including ventilation tube insertion.

The balloon Eustachian tuboplasty procedure was carried out under general anaesthesia, with topical decongestant used to prepare the nose and nasal cavity. A 30-degree rigid nasendoscope was used to place the combined insertion instrument adjacent to the Eustachian orifice and advance the TubaVent balloon catheter (Spiggle & Theis Medizintechnik, Overath, Germany) into the tube. Once the catheter was advanced into the cartilaginous portion of the tube under direct vision, the balloon was inflated with saline to a pressure of 10 bar for a period of 2 minutes. The balloon has a maximum diameter of 3.28 mm along its 20 mm length on dilatation.[14] After this 2-minute period, the balloon is deflated, and the catheter and endoscope are removed to complete the procedure. This procedure may be repeated on the contralateral side using the same balloon catheter in patients with bilateral Eustachian tube dysfunction.

In the immediate post-operative period, patients were advised to perform the Valsalva manoeuvre regularly to maintain patency in the Eustachian tube. Patients were reviewed at six weeks post-operation, where they were examined, and audiometry and tympanometry repeated, with further follow up planned based on their outcome.

In order to assess the effects of this procedure, information was collected on each patient's presentation and the previous treatments they had received for Eustachian tube dysfunction. Information was also collated from their pre- and post-operative audiometry and tympanometry assessments, and the records were examined for evidence of intra-operative or post-operative complications. Each patient was asked to complete a survey at a minimum of one year post-operatively. This included a review of their pre-operative symptoms, their experience of the procedure, and the severity of any ongoing Eustachian tube dysfunction symptoms according to the Eustachian Tube Dysfunction Questionnaire-7 (a validated measure of symptoms of Eustachian tube dysfunction in adults[15]).

Results

Balloon Eustachian tuboplasty was carried out on 36 Eustachian tubes in 25 patients at our institution over a period of three years. Of the balloon Eustachian tuboplasty procedures performed, 9 were bilateral (including 1 repeat procedure), 7 were conducted on the right side, and 11 were carried out on the left (including 1 repeat procedure).

The 25 patients consisted of 17 women (68 per cent) and 8 men (32 per cent), who had a mean age of 44 years (range, 18–72 years). These patients were followed up post-operatively for a mean of 2 years and 4 months (range, 13 months to 3 years and 8 months). Fourteen patients completed the balloon Eustachian tuboplasty survey – a response rate of 56 per cent.

Symptoms of chronic dilatory Eustachian tube dysfunction were the indication for balloon Eustachian tuboplasty in 88 per cent of cases – 22 patients or 28 ears. This diagnosis was confirmed on otoscopy, with middle-ear effusion seen in 23 ears (82 per cent) and tympanic membrane retraction in 6 ears (21 per cent). All 22 patients had evidence of conductive hearing loss on pure tone audiometry. Of the 26 ears for which tympanometry results were available, 25 showed a flat type B trace on the tympanogram and 1 showed a negative type C trace.

Chronic baro-challenge-induced Eustachian tube dysfunction symptoms were the dominant feature in the remaining three cases (12 per cent), which were all bilateral. These patients all had normal otoscopy, audiometry and tympanometry findings. Information on each patient's diagnosis, and the pre- and post-operative otoscopy and tympanometry results, are shown in Table 1.

The 14 patients who completed the balloon Eustachian tuboplasty survey had an average of 4.5 out of the 7 Eustachian tube dysfunction symptoms listed by the Eustachian Tube Dysfunction Questionnaire-7 pre-operatively. The seven listed symptoms are: pressure in the ear, pain in the ear, a feeling that the ear is clogged or underwater, ear symptoms during a cold or sinusitis, crackling or popping sounds in the ear, ringing in the ear, and a feeling that the hearing is muffled. These patients reported that their Eustachian tube dysfunction symptoms had been present for a mean of 12 years (range, 7 months to 60 years).

Twenty of the 25 patients had undergone previous grommet insertion to manage the Eustachian tube dysfunction symptoms (with an average of 1.6 grommets inserted in each ear). In addition, nine patients had T-tubes (an average of 1.4 T-tubes per ear), and six patients had both grommets and T-tubes. Therefore, this group had been seen regularly in the otology clinic, with an average of 13.4 appointments per patient since 2011 (since an online record was kept of clinic bookings), although 1 patient had been reviewed in clinic on 49 occasions in the five years prior to his balloon Eustachian tuboplasty procedure.

The majority of balloon Eustachian tuboplasty procedures were uneventful. There was difficulty in passing the balloon catheter in only one case because of a narrow nose that prevented access. A further unsuccessful attempt was made to pass the scope and balloon catheter via the pharynx in this

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Table 1. Overview of patient details and outcome of balloon Eustachian tuboplasty

			Pre-operative findings		Post-operative findings		
Patient number	Diagnosis	Laterality	Otoscopy	Tympanometry trace(s)	Otoscopy	Tympanometry trace(s)	Outcome
1	Chronic dilatory ETD	Right	Effusion	B	Effusion	B	T-tube insertion
2	Chronic dilatory ETD	Right	Effusion	B	Effusion	B	Discharged
3	Chronic dilatory ETD	Right	Effusion, retraction	B	Resolved	A	Discharged
4	Chronic dilatory ETD	Right	Effusion	B	Resolved	A	Discharged
5	Chronic dilatory ETD	Right	Effusion, retraction	B	Effusion resolved	A	Ongoing review
6	Chronic dilatory ETD	Right	Effusion, retraction	B	Resolved	A	Discharged
7	Chronic dilatory ETD	Right	Effusion	B	Lost to f/u	Lost to f/u	Lost to f/u
8	Chronic dilatory ETD	Left	Effusion	B	Resolved	A	Discharged
9	Chronic dilatory ETD	Left	Grommet in situ	B	Perforation post-grommet extrusion	B	Hearing aid
10	Chronic dilatory ETD	Left	Effusion, retraction	B	Resolved	A	Discharged
11	Chronic dilatory ETD	Left	Effusion	B	Resolved	A	Ongoing review
12	Chronic dilatory ETD	Left	Effusion	B	Resolved	A	Discharged
13	Chronic dilatory ETD	Left	Effusion	B	Resolved	A	Discharged
14	Chronic dilatory ETD	Left	Effusion	B	Resolved	A	Discharged
15	Chronic dilatory ETD	Left	Effusion	C	Effusion	C	Grommet insertion
16	Chronic dilatory ETD	Left	Effusion	B	Lost to f/u	Lost to f/u	Lost to f/u
17	Chronic dilatory ETD	Left	Effusion, retraction	B	Effusion, retraction	B	Revision balloon Eustachian tuboplasty
17 (revision)	Chronic dilatory ETD	Left	Effusion, retraction	B	Effusion, retraction	B	T-tube insertion
18	Chronic dilatory ETD	Bilateral	Right = effusion; left = effusion, retraction	Right = B; left = B	Resolved	Right = A; left = A	Discharged
19	Chronic dilatory ETD	Bilateral	Bilateral effusion	Right = B; left = B	Bilateral effusion	Right = C; left = B	T-tube insertion
20	Chronic dilatory ETD	Bilateral	Bilateral effusion	Right = B; left = B	Bilateral effusion	Right = B; left = B	Hearing aid
21	Chronic dilatory ETD	Bilateral	Bilateral effusion	Declined test	Bilateral effusion	Declined test	T-tube insertion
22	Chronic dilatory ETD	Bilateral	Bilateral effusion	Right = B; left = B	Resolved	Right = A; Left = A	Discharged
23	Baro-challenge-induced ETD	Bilateral	Normal	Right = A; left = A	Normal	Right = A; left = A	Discharged
24	Baro-challenge-induced ETD	Bilateral	Normal	Right = A; left = A	Normal	Right = A; left = A	Discharged
25	Baro-challenge-induced ETD	Bilateral	Right = normal; left = T-tube	Right = A; left = B	Right = normal; left = T-tube	Right = A; left = B	Revision balloon Eustachian tuboplasty
25 (revision)	Baro-challenge-induced ETD	Bilateral	Right = normal; left = T-tube	Right = A; left = B	Right = normal; left = T-tube	Right = A; left = B	Ongoing review

ETD = Eustachian tube dysfunction; f/u = follow up

case, but it was possible to complete the contralateral balloon Eustachian tuboplasty successfully via the nose. Only one patient reported a complication immediately post-operatively, describing a headache that settled with analgesia.

Six patients reported issues with performing the Valsalva manoeuvre in the initial post-operative period as directed, specifically because of discomfort and a subsequent inability to auto-inflate the middle ear. One patient described post-operative unilateral facial swelling that worsened with the Valsalva manoeuvre; this settled without intervention once the manoeuvre had been discontinued for 48 hours. Another patient performed such a forceful Valsalva manoeuvre post-operatively that the tympanic membrane perforated.

The balloon Eustachian tuboplasty procedure resolved the Eustachian tube dysfunction symptoms in 16 (64 per cent) of the 25 patients. Specifically, 12 (54 per cent) of the 22 patients with chronic dilatory Eustachian tube dysfunction, and 2 (67 per cent) of the 3 patients with baro-challenge-induced Eustachian tube dysfunction, achieved symptom resolution. This outcome was determined based on: the post-operative records, the need for further Eustachian tube dysfunction management and the patients' own experience of their outcome as reported in the survey.

At the time of writing, 16 (64 per cent) of the patients have been discharged from follow up, although it must be noted that a small number of patients required ongoing follow up because of other ear conditions (e.g. ongoing symptomatic retraction pocket) or were discharged because they wanted no further intervention despite ongoing symptoms. In 11 of the 22 patients with chronic dilatory Eustachian tube dysfunction, post-operative otoscopy indicated that middle-ear effusion or retraction had resolved following balloon Eustachian tuboplasty. Fourteen patients (64 per cent) had a type B or C tympanogram pre-operatively that progressed to a type A trace post-operatively.

Patients were asked to respond regarding their current Eustachian tube dysfunction symptoms via the patient survey and the Eustachian Tube Dysfunction Questionnaire-7. This questionnaire gives a score of 1–7 for each of the seven Eustachian tube dysfunction symptoms (as noted above). It defines Eustachian tube dysfunction in those with individual symptom scores of over 2.1 and with total scores of over 14.5. Of the 14 patients who completed this questionnaire, 9 (64 per cent) reported symptom scores below these thresholds post-operatively, indicating resolution of their Eustachian tube dysfunction symptoms.

Regarding the audiometry outcomes for the patients with chronic dilatory Eustachian tube dysfunction and conductive hearing loss, post-operative pure tone audiometry data were available for 20 of the 22 patients, or 26 of the 28 ears. Of these, resolution or improvement of the conductive hearing loss was seen in 16 ears (62 per cent), as demonstrated in Table 2. In order to assess the extent of the conductive hearing deficit in each case, the mean air–bone gap was calculated across the air and bone conduction results for 0.5, 1, 2 and 3/4 kHz, for each ear. From this group of 26 ears, there was a mean pre-operative air–bone gap of 22.1 dB (range, 2.5–37.5 dB), and a mean post-operative air–bone gap of 14.5 dB (range, 0–37.5 dB). The mean reduction in air–bone gap in this group was 7.6 dB.

Limitations

The results of this study are limited by the relatively small sample size, which precludes the ability to analyse subgroups of patients according to their outcomes. Furthermore, the incomplete information available on post-operative audiometry and tympanometry because of patients not attending follow up, and the limited response to the balloon Eustachian tuboplasty survey, mean that symptom resolution could not be confirmed in some cases.

Discussion

This study demonstrates the long-term outcomes of one of the largest cohorts reported in the UK literature to receive balloon Eustachian tuboplasty for the management of chronic dilatory and baro-challenge-induced Eustachian tube dysfunction. These data provide further confirmation of the procedure's safety, with the only direct complication reported being a single case of headache in the immediate post-operative period, which settled with simple analgesia. Several patients did experience difficulties related to the Valsalva manoeuvre in the days following the procedure, though in general there were no long-term ill-effects.

This study also highlights how Eustachian tube dysfunction affects patients. Patients reported an array of symptoms, often connected to ongoing middle-ear effusion, tympanic membrane retraction and conductive hearing loss. This examination of patient symptoms confirms the findings of the recent consensus statement on Eustachian tube dysfunction,[1] in that there were clear differences in the symptoms and signs found in patients with chronic dilatory Eustachian tube dysfunction versus baro-challenge-induced Eustachian tube dysfunction. Balloon Eustachian tuboplasty appears to benefit both of these patient groups, despite their differences.

Whether diagnosed with chronic dilatory or baro-challenge-induced Eustachian tube dysfunction, the magnitude of these patients' symptomatology is compounded by their longevity, in a group where the average reported symptom duration was 12 years. These patients had been seen repeatedly by numerous ENT professionals, with an average of 13.4 clinic appointments over an eight-year period. The majority of patients had tried multiple interventions, such as grommet or T-tube insertion, to no avail, with the associated risk-to-benefit ratio of myringotomy declining as the condition persisted. This highlights the effect that this condition has on patients, and draws attention to the burden placed on the ENT departments that manage these cases and the overall financial expense to the National Health Service (NHS). Therefore, if balloon Eustachian tuboplasty could offer any prospect of long-term resolution of Eustachian tube dysfunction symptoms in this challenging group, it would be beneficial both to patients and to the NHS overall.

This examination of the outcomes for 25 patients (36 ears) receiving balloon Eustachian tuboplasty at our institution does establish the procedure's effectiveness in the majority of cases. Based on a variety of assessments for those patients with chronic dilatory Eustachian tube dysfunction at a minimum of 13 months post-operatively, including patients' own reports of their symptoms (64 per cent resolution), the Eustachian Tube Dysfunction Questionnaire-7 (64 per cent resolution), comparison of pre- and post-operative audiometry (62 per cent resolution), and tympanometry (i.e. change to a normal type A trace, in 64 per cent), this intervention produced an improvement in Eustachian tube dysfunction for roughly 63 per cent of our patients. Most importantly, 64 per cent of the overall patient group have subsequently been discharged

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Table 2. Audiometric findings for patients with chronic dilatory Eustachian tube dysfunction

			Mean air–bone gap (dB HL)			
Patient number	Laterality	Pre-op audiogram findings	Pre-op	Post-op	Difference	Clinical summary of hearing loss
1	Right	CHL	36.25	37.5	−1.25	Stable
2	Right	CHL	16.25	31.25	−15	Deteriorated
3	Right	CHL	26.25	0	26.25	Improved
4	Right	CHL	8.75	3.75	5	Resolved
5	Right	Mixed HL	37.5	6.25	31.25	Improved
6	Right	CHL	16.25	8.75	7.5	Improved
7	Right	CHL	12.5	–	–	Lost to f/u
8	Left	CHL	35	7.5	27.5	Improved
10	Left	Mixed HL	22.5	0	22.5	Resolved
11	Left	CHL	31.25	7.5	23.75	Improved
12	Left	CHL	21.25	1.25	20	Resolved
13	Left	CHL	28.75	20	8.75	Improved
14	Left	CHL	11.25	6.25	5	Improved
15	Left	CHL	10	13.75	−3.75	Stable
16	Left	CHL	18.75	–	–	Lost to f/u
17	Left	CHL	28.75	3.75	25	Resolved
17 (revision)	Left	CHL	21.25	8.75	12.5	Improved
18	Right	CHL	22.5	13.75	8.75	Improved
18	Left	CHL	21.25	20	1.25	Stable
19	Right	CHL	22.5	0	22.5	Resolved
19	Left	CHL	27.5	25	2.5	Stable
20	Right	CHL	8.75	25	−16.25	Deteriorated
20	Left	CHL	20	28.75	−8.75	Deteriorated
21	Right	Mixed HL	31.25	22.5	8.75	Improved
21	Left	Mixed HL	6.25	26.25	−20	Deteriorated
21 (revision)	Right	CHL	27.5	18.75	8.75	Improved
21 (revision)	Left	CHL	2.5	3.75	−1.25	Stable

Mean air–bone gap was calculated from findings at 0.5, 1, 2 and 3/4 kHz. Only changes in mean air–bone gap of 5 dB HL or more were considered significant because of inter-test variability. Pre-op = pre-operative; post-op = post-operative; CHL = conductive hearing loss; HL = hearing loss; f/u = follow up

from further follow up at clinic, demonstrating the benefit both to patients and the NHS alike.

Coupled with our experience of this procedure as straightforward for both patient and surgeon in the majority of cases, these findings suggest that, overall, balloon Eustachian tuboplasty offers an important opportunity to improve chronic dilatory Eustachian tube dysfunction outcomes.

This evaluation also sought to define why some patients benefit more from balloon Eustachian tuboplasty than others, and why some patients showed evidence of deterioration in their middle-ear ventilation post-operatively. Unfortunately, because of the relatively small sample size studied, and the inclusion of patients with both chronic dilatory and baro-challenge-induced Eustachian tube dysfunction, it is difficult to draw firm conclusions. However, we have noted a number of learning points from our experience of this intervention.

It is our experience that patients who either cannot or do not perform the Valsalva manoeuvre regularly after the balloon Eustachian tuboplasty procedure do not have a favourable outcome, in keeping with the findings of a recent systematic review on the topic.[11] One patient underwent balloon Eustachian tuboplasty and contralateral myringoplasty simultaneously. As such, they were unable to regularly equalise their middle-ear pressure without disturbing the tympanic membrane graft, and subsequently continued to experience symptoms. Similarly, a patient in whom balloon Eustachian tuboplasty was performed along with grommet removal found that the tympanic membrane did not heal as quickly as expected, likely due to continued Valsalva manoeuvres through a patent myringotomy. Therefore, we would advise against performing balloon Eustachian tuboplasty along with any other procedure that will result in a tympanic membrane perforation.

As noted previously, the use of the Valsalva manoeuvre post-operatively also created issues for a further subset of patients. They found the Valsalva manoeuvre to be uncomfortable post-procedure and did not perform this as regularly as advised. They too experienced little symptom resolution. However, patients who performed the Valsalva manoeuvre too forcefully also experienced issues; one patient suffered a new tympanic membrane perforation, and one developed transient cervicofacial emphysema.

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A comprehensive investigation into cervicofacial emphysema following balloon Eustachian tuboplasty demonstrated 10 cases in 3670 procedures – an incidence of only 0.27 per cent,[16] which settled in all cases once the Valsalva manoeuvre had been discontinued for a period of time. This rare complication is thought to arise as a result of small tears in the Eustachian tube caused by the dilatation, which allow gas to escape into the tissue around the parotid area on Valsalva manoeuvres.

Therefore, we would advise that patients undergoing this intervention are informed of the importance of performing frequent Valsalva manoeuvres in the post-operative period and warned that they should not attempt to achieve equilibrium too rapidly, but rather aim for increased frequency instead of excessive force. Patients should also be warned regarding the risk of cervicofacial emphysema as part of their informed consent for the procedure, and be advised to contact the surgical team if they develop symptoms post-operatively.

One further learning point from Skevas *et al.* is their recommendation for the use of oral or intravenous antibiotic therapy in cervicofacial emphysema patients, in addition to discontinuation of the Valsalva manoeuvre for a period of at least two weeks.[16] This recommendation is based on a recent study examining the bacterial species found on balloon Eustachian tuboplasty catheter tips post-operatively.[17] That study found several bacterial species in high concentrations, including corynebacterium, *Staphylococcus hominis, Proteus mirabilis*, *Escherichia coli*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus pyogenes* and *Klebsiella oxytoca*,[17] which have the potential to create significant deep tissue infection in the event of rupture of the Eustachian tube mucosa and subsequent surgical emphysema. The patient affected by cervicofacial emphysema in our cohort did not receive antibiotics, and stopped performing the Valsalva manoeuvre for 48 hours, and did not have any further adverse effect.

Our experience of balloon Eustachian tuboplasty also demonstrates the importance of access to the Eustachian tube orifice in the post-nasal space. In our patient group, there was one case where a procedure was abandoned because of difficult access, which may have been predicted from the appearance of the nasal cavity on rigid endoscopy pre-operatively. We would advise that clinicians are aware of the alternate methods of placing the balloon catheter in these situations, including endoscopic access via the pharynx. Similarly, a patient was referred for consideration of balloon Eustachian tuboplasty to manage unilateral Eustachian tube dysfunction symptoms and was found to have excessive scarring over the Eustachian tube orifice which would preclude intubation, likely due to previous injudicious intervention at adenoidectomy. Therefore, we recommend that the Eustachian tube orifice is endoscopically examined as part of the pre-operative assessment to ensure suitability.

Patient selection is clearly also key in the application of this procedure. As noted, the diagnosis may be challenging, with the mismatch between patient-reported symptoms and objective testing, but clinicians should remain wary of patients who describe debilitating symptoms with little evidence. In our cohort, one patient described intense pain from the presence of any form of middle-ear ventilation device, despite the demonstrable resolution of Eustachian tube dysfunction symptoms they produced. Balloon Eustachian tuboplasty was therefore offered as a less invasive alternative, and was initially effective; however, the patient soon returned to clinic with ongoing symptoms they attributed to Eustachian tube dysfunction, despite normal findings on otoscopy and tympanometry.

We would also advise that, although balloon Eustachian tuboplasty has generally been utilised in patients with long-standing symptoms, in whom multiple previous management options have been tried, its use may be advantageous in other situations too. Specifically, balloon Eustachian tuboplasty can be useful for patients where standard management options like grommets and T-tubes are not acceptable, like the patient from our cohort who wished to join the military.

- Balloon Eustachian tuboplasty is a surgical intervention for Eustachian tube dysfunction
- This intervention is well tolerated and can improve Eustachian tube dysfunction symptoms
- Despite this, balloon Eustachian tuboplasty remains under utilised in the UK
- This study details the long-term outcomes of balloon Eustachian tuboplasty in a UK population
- Practical experience of implementing the procedure is described

Conclusion

This paper offers further evidence that balloon Eustachian tuboplasty is a safe, well-tolerated procedure, which provides benefit to chronic dilatory and baro-challenge-induced Eustachian tube dysfunction symptoms in the majority of patients, and therefore has associated potential cost benefits to the health service in a UK population.

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