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Disease-specific quality of life and psychological distress after endoscopic tympanoplasty

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Abstract

Purpose To assess the postoperative quality of life (QoL) of patients operated on for chronic otitis media (COM) and cholesteatoma by endoscopic approach, with respect to disease-specific complaints and psychological distress, using two validated questionnaires: Chronic Ear Survey (CES) and Depression Anxiety Stress Scale-21 (DASS-21).

Methods Eighty-five consecutive patients operated on for cholesteatoma and COM by endoscopic tympanoplasty from March 2018 to February 2020 filled in CES and DASS-21, within one month prior to surgery. A second administration of each questionnaire was performed at the yearly postoperative evaluation. A multivariate analysis using a linear regression model was performed to evaluate the role of the different variables associated with the questionnaires' subscales and overall scores.

Results A significant improvement was achieved in all CES and DASS-21 subscales after endoscopic tympanoplasty. No patient showed a DASS-21 score compatible with a psychological distress both at the pre- and postoperative assessments. At multivariate analysis, the only significant factors associated with postoperative improvement in CES scores were preoperative DASS-21 "depression" score and months of follow-up.

Conclusion Endoscopic tympanoplasty shows significantly improved QoL as assessed by disease-specific and psychoemotional questionnaires. A subjective favourable effect of fully endoscopic ear surgery was demonstrated.

Keywords Quality of life · Chronic ear survey · Depression anxiety stress scale · Tympanoplasty · Cholesteatoma · Endoscopic ear surgery

Introduction

The topic of the quality of life (QoL) after chronic otitis media (COM) surgery has been largely debated during the past years. Cholesteatoma surgery and especially the comparison between canal wall up (CWU) and canal wall down (CWD) tympanoplasty, and the impact of reconstructive techniques and obliteration are among the most critical aspect [1–3]. The available reports describe results obtained by traditional microscopic techniques and to date only one study described the impact of endoscopic ear surgery (EES) on the QoL [4].

In the recent years, the endoscopic approach has been successfully introduced in ear surgery (EES) with a progressive extension of surgical indications [5, 6]. Some advantages have been demonstrated in comparison to the traditional microscopic surgery, such as a minimally invasive approach, better cosmetic results and a favourable intraoperative vision, especially in "difficult" recesses of the middle ear [7, 8]. On the other hand, the main disadvantages are the one-handed procedure, the two-dimensional view and the need for training [9]. When implementing a relatively new procedure, the measurement of the main outcomes, especially the patient-reported outcomes, is essential. The QoL is in fact an established indicator in health care, to assess the impact and cost-effectiveness of treatments. Whether the less invasive procedure corresponds to an improved patient satisfaction is yet to be verified.

In the clinical practice, the most common complaints among COM patients are social interaction impediments, due to discharge from the ear, pain, need to avoid water,

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medical examinations and fear of complications. Moreover, COM patients may be subjected to multiple surgeries and this is one of the aspects which can affect the quality of life and the emotional sphere. The psychological status, including the anxiety and stress domains, related to the impact of multiple surgeries should not be neglected, to offer the best possible counseling and operative strategy [10].

The aim of the present study was to assess the postoperative QoL of patients operated on for chronic otitis media and cholesteatoma by endoscopic approach, with respect to disease-specific complaints and psychological distress, by using two validated questionnaires: Chronic Ear Survey (CES) and Depression Anxiety Stress Scale-21 (DASS-21). Moreover, an evaluation of which operative factors mostly affects the QoL outcomes was performed.

Materials and methods

The study was performed on 125 consecutive patients admitted for cholesteatomatous and non-cholesteatomatous otitis media and operated on by endoscopic tympanoplasty at the Department of Otolaryngology of the University Hospital of Modena, Italy, from March 2018 to February 2020. The exclusion criteria were: age < 18 years, surgical approach different from exclusive endoscopic tympanoplasty (i.e. combined or exclusive microscopic approach), patients unwilling to fulfill the questionnaires, patients whose pre- and/or postoperative clinical documentation was not available. All surgeries were performed under general anesthesia, as an inpatient service, by one out of two experienced surgeons (namely L.P. or I.J.F.). Discharge from the hospital was indicated 1–2 days after surgery in all cases. Patients underwent endoscopic transcanal tympanoplasty with preservation or reconstruction of the lateral attic wall in order to manage the disease located in the middle ear cavity or the attic and restore the ventilation routes coming from the Eustachian tube towards the mastoid compartment [11, 12]. Moreover, endoscopic open "centrifugal" technique was used to treat middle ear cholesteatoma with antral and periantral extension, in selected cases with small and sclerotic mastoid [13].

The data collected from the clinical charts included patients' sex and age, date of surgery, pre- and postoperative hearing function, type of disease (cholesteatoma vs. COM), revision surgery, surgical technique (endoscopic transcanal vs. open centrifugal tympanoplasty, type of ossicular chain reconstruction) and complications.

During the preoperative work-up, within one month prior to surgery, the Chronic Ear Survey questionnaire (CES) [14, 15] and the Depression Anxiety Stress Scales-21 (DASS-21) [16] were administered to all patients. A second administration of each questionnaire was performed at the yearly postoperative evaluation. The Chronic Ear Survey is a 13-item survey, divided in 3 subscales: activity restriction (AR), symptoms (S) and medical resources (MR). Total scores were normalized in percentiles (0–100, with 0 indicating maximum restriction of quality of life). The DASS-21 is a 21-item self-reported measure, providing maximum differentiation between depressive and anxious symptoms and consisting of 3 scales: depression (D), anxiety (A) and stress (S). Higher scores indicate greater psychological impairment.

Postoperative hearing assessment was routinely performed by the same team of audiologists. The bone-conduction (BC) and air-conduction (AC) thresholds were calculated as the average for 0.5, 1, 2 and 4 kHz frequencies. The ABG was reported as the four-tone pure-tone average (PTA) for AC minus the four-tone PTA for BC at 0.5, 1, 2 and 4 kHz frequencies.

This study was approved by our Institutional Review Board and was carried out in accordance with the Declaration of Helsinki. All patients received appropriate and comprehensible information about the surgical procedures and tests and gave their written consent.

Statistical analysis

The statistical analysis of the results was performed using SPSS for Windows (IBM SPSS Statistics, Chicago, USA). Continuous variables were expressed as mean ± standard deviation (SD). Student's *t* test was used for continuous variables with normal distribution, while Mann–Whitney *U* Test was adopted for continuous variables without a normal distribution. Comparisons between groups were performed by Pearson's chi-square or Fischer exact test for discrete variables, as appropriate. The strength of the correlation between the parameters was obtained by Pearson's correlation test.

Finally, a multivariate analysis using a linear regression model was performed to evaluate the role of the different variables associated with the questionnaires subscales and overall scores. The results were considered as significant for p values < 0.05 with a confidence interval of 95%.

Results

Following the exclusion criteria, the data analysis was performed on 85 patients, including 78 patients (92%) subjected to endoscopic transcanal tympanoplasty and 7 patients (8%) subjected to open centrifugal endoscopic tympanoplasty. Forty patients were excluded because they were < 18 years ($N = 4$), or because they underwent retroauricular approach (i.e. combined or exclusive microscopic approach; $N = 28$), or because of incorrect fulfilment of the questionnaires

($N=3$) or because their pre- or postoperative clinical documentation was not available ($N=5$).

The mean age of the respondents at the time of surgery was 44 years (SD: ± 14; range:19–77). The mean age of the respondents at the time of survey was 45.3 years (SD: ± 14; range: 20–78). The male to female ratio was 1.1 (45 male patients and 40 female patients). The mean time from the surgery to the postoperative administration of the questionnaires, hereafter referred to as months of follow-up, was 14.9 months (SD: ± 6; range: 3–22). The operated ear was the left one in 51 patients (60%) and the right one in 34 patients (40%). Fifty patients (59%) were operated on for cholesteatoma, whereas 35 patients (39%) for non-cholesteatomatous chronic otitis media. Sixty-four patients (75%) underwent primary surgery whereas 21 patients (25%) underwent revision surgery. In 32 patients (38%) an ossiculoplasty was performed; in 25 of which, the ossicular chain was reconstructed with a partial ossicular replacement prosthesis (PORP), whereas in the remaining 7 cases a total ossicular replacement prosthesis (TORP) was used. In two cases a lateral semicircular canal dehiscence was observed during surgery; in 2 patients a complication was recorded, namely a postoperative perforation of the tympanic membrane in both cases. A postoperative paralysis of the facial nerve was never reported. Hearing results, stratified according to the type of surgery, are summarized in Table 1. Table 2 depicts the comparison between overall pre- and postoperative results obtained by CES and DASS-21. Statistical analysis reveals a significant improvement in all CES subscales and overall score ($p<0.001$ for all comparisons) in the postoperative versus preoperative administration. The CES items with a poorer postoperative mean score were #AR1 ('Because of your ear problem you don't swim or shower without protecting your ear') and #S1 ('hearing loss').

No patient showed a DASS-21 score compatible with a psychological distress, both at the pre- and postoperative assessments. However, a significant improvement in all DASS-21 subscales was demonstrated in the postoperative versus preoperative administration ($p<0.05$ for all comparisons). The DASS-21 subscale with a poorer postoperative mean score was the Anxiety subscale. Table 3 shows comparisons between pre- and postoperative CES and DASS-21 scores between the following subgroups: cholesteatoma vs. chronic otitis media, primary vs. revision surgery and endoscopic transcanal vs. open centrifugal tympanoplasty. Statistically significant correlations among the different variables are depicted in Table 4. At multivariate analysis, the only significant factors associated with Delta CES scores were preoperative DASS-21 "D" score and months of follow up. Table 5 describes the statistically significant results of the multivariate analysis.

Table 1 Hearing results

	Overall (SD; range)	ETT (SD; range)	OCT (SD; range)	*p*	Primary (SD; range)	Revisions (SD; range)	*p*
BC-PTA (dB)	18.7 (± 7; 10–46)	17.8 (± 8; 10–29)	18.8 (± 8; 10–46)	0.604	18.9 (± 8; 10–46)	17.9 (± 8; 10–29)	0.154
AC-PTA (dB)	36.5 (± 11; 15–72)	35.8 (± 13; 25–71)	43.8 (± 12; 15–72)	0.469	36.4 (± 12; 15–72)	36.8 (± 10; 17–71)	0.150
ABG (dB)	17.8 (± 7; 5–42)	17 (± 7; 12–36)	26 (± 7; 5–40)	0.003*	17.4 (± 7; 5–40)	18.8 (± 6; 6–42)	0.145

ETT endoscopic transcanal tympanoplasty; *OCT* open centrifugal technique; *BC-PTA* bone conduction pure tone audiometry; *AC-PTA* air conduction pure tone audiometry; *ABG* air bone gap; *SD* standard deviation

*Statistically significant *p* value

Table 2 Overall preoperative and postoperative CES and DASS-21 results

	Preoperative (SD; range)	Postoperative (SD; range)	*p*	Delta (SD; range)
CES				
Activity restriction	42.4 (± 20; 0–100)	55.6 (± 23; 0–100)	0.000*	13.2 (± 27.8; − 55 to 93.3)
Symptoms	55.8 (± 22; 5–100)	72.8 (± 16; 25–100)	0.000*	17.1 (± 20.4; − 15.7 to 65)
Medical resources	75.2 (± 22; 8–100)	85.5 (± 17; 33–100)	0.000*	10.2 (± 24.4; − 58.3 to 83.3)
Overall	57.8 (± 18; 7–94)	71.3 (± 13; 34–97)	0.000*	13.5 (± 18.4; − 28.5 to 79.6)
DASS-21				
Depression	1.4 (± 0.8;1–5)	1.2 (± 0.6; 1–4)	0.047*	− 0.2 (± 0.8; − 4 to 1)
Anxiety	1.6 (± 1; 1–5)	1.3 (± 0.8; 1–4)	0.046*	− 0.2 (± 0.8; − 4 to 2)
Stress	1.4 (± 0.9; 1–4)	1.1 (± 0.5; 1–4)	0.002*	− 0.3 (± 0.8; − 3 to 1)

CES chronic ear survey; *DASS-21* Depression Anxiety Stress Scale-21; *SD* tandard deviation

*Statistically significant *p* value

Table 3 Comparisons between pre- and postoperative CES and DASS-21 scores between subgroups

	Preoperative(SD; range)			Postoperative (SD; range)		
	COM	Chole	*p*	COM	Chole	*p*
CES						
Activity restriction	33.2 (24; 0–100)	49.1 (26; 0–100)	0.566	53.6 (24; 0–100)	57.1 (24; 0–100)	0.992
Symptoms	50.5 (21; 17.1–91.4)	59 (24; 5.7–100)	0.073	69 (17; 25–91.4)	75.5 (15; 27.1–100)	0.102
Medical resources	79.9 (18; 25–100)	71.9 (26; 8.3–100)	0.124	84.7 (18; 33.3–100)	86.1 (16; 47.1–100)	0.711
Overall	54.5 (16; 21.3–94.4)	60.3 (20; 7.5–91.5)	0.165	69.2 (13; 34.7–93.4)	72.9 (13; 42.4–97.1)	0.228
DASS-21						
Depression	1.3 (0.6; 1 –3)	1.5 (0.9; 1–5)	0.259	1.1 (0.4; 1–3)	1.4 (0.7; 1–4)	0.059
Anxiety	1.5 (1; 1–5)	1.7 (1.1; 1–5)	0.392	1.3 (0.7; 1–5)	1.5 (0.9; 1–4)	0.302
Stress	1.3 (0.7)	1.4 (1; 1–4)	0.418	1.1 (0.2; 1–4)	1.2 (0.6; 1–4)	0.170
	Preoperative (SD; range)			Postoperative (SD; range)		
	Primary	Revision	*p*	Primary	Revision	*p*
CES						
Activity restriction	42 (27; 0–100)	40 (25; 0–91.7)	0.727	56.5 (26; 0–100)	52.7 (24; 15–91.7)	0.560
Symptoms	53 (23; 5.7–94.3)	64.3 (22; 14.3–100)	0.055	72.8 (17; 25–100)	73 (13; 42.1–100)	0.952
Medical resources	74.2 (2; 8–100)	78.5 (21; 16.7–100)	0.463	84.1 (18; 33.3–100)	89.6 (10; 66.7–100)	0.210
Overall	56.7 (19; 7.5–94.4)	61.1 (17; 10.3–88.5)	0.350	71.2 (14; 34.7–97.1)	71.8 (11; 45.2–86.1)	0.853
DASS-21						
Depression	1.4 (0.8; 1–5)	1.3 (0.7; 1–3)	0.565	1.2 (0.6; 1–4)	1.2 (0.5; 1–3)	0.861
Anxiety	1.6 (1; 1–5)	1.6 (1; 1–4)	0.842	1.4 (0.8; 1–4)	1.4 (0.8; 1–3)	0.860
Stress	1.3 (0.8; 1–4)	1.4 (0.9; 1–4)	0.663	1.1 (0.4; 1–4)	1.2 (0.5; 1–3)	0.301
	Preoperative (SD; range)			Postoperative (SD; range)		
	OCT	ETT	*p*	OCT	ETT	*p*
CES						
Activity restriction	43 (27; 0–76.7)	42 (27; 0–100)	0.946	55.7 (24; 15–78.3)	55.6 (25; 0–100)	0.992
Symptoms	49.5 (26; 14.3–82.9)	56 (23; 5.7–100)	0.470	63.9 (22; 30.7–91.4)	73.7 (16; 25–100)	0.114
Medical resources	69 (33; 16.7–100)	75.8 (22; 8.3–100)	0.464	85 (16; 58.3–100)	85 (17; 33.3–100)	0.978
Overall	53.9 (26; 10.3–78.7)	58.2 (18; 7.5–94.4)	0.566	68.5 (15; 45.2–86.1)	71.6 (13; 34.7–97.1)	0.566
DASS-21						
Depression	1.4 (0.8; 1–3)	1.4 (0.8; 1–5)	0.892	1.4 (0.5; 1–2)	1.2 (0.6; 1–4)	0.453
Anxiety	2.1 (1.5; 1–4)	1.6 (1.1; 1–5)	0.208	2.1 (1.1; 1–3)	1.4 (0.8; 1–4)	0.081
Stress	1.9 (1.2; 1–4)	1.4 (0.9; 1–4)	0.169	1.6 (0.8; 1–3)	1.1 (0.4; 1–4)	0.121

CES chronic ear survey; *DASS-21* Depression Anxiety Stress Scale-21; *COM* chronic otitis media; *Chole* cholesteatoma; *OCT* open centrifugal technique; *ETT* endoscopic transcanal tympanoplasty; *SD* standard deviation

Discussion

Over the years, numerous studies have testified on the use of the possible applications of EES, from the external ear canal to the petrous apex and lateral skull base [5–7]. Many authors have advocated the advantages of EES: the absence of an external excision, the magnified visualization of the noble anatomic structures, the possibility to spare the unneeded mastoid drilling to gain a keyhole access to the attic and the "targeted" demolition. However, no study has analyzed whether this approach allows an advancement in terms of quality of life and if a lower surgical invasiveness corresponds to a better psychological status, except for the study by Taneja et al. [4]. The authors used a general QoL tool such as Glasgow Benefit Inventory (GBI) to compare a cohort of mixed endoscopic ear surgeries (including stapedoplasty) and demonstrated better GBI scores in all domains for endoscopic cases compared to retroauricular and combined cases. However, as specifically regards the cholesteatoma and COM surgery, the statistical tests analyzing endoscopic vs. retroauricular/combined cases did not reveal any significant difference.

The present study represents the first assessment of QoL in a cohort of patients operated on by endoscopic

Table 4 Statistically significant univariate correlations ($p < 0.05$ for all the correlations)

Variable 1	Variable 2	p	R^2
Post-op CES Symptoms Score	AC-PTA	0.046	− 0.220
Post-op CES Symptoms Score	ABG	0.017	− 0.257
Post-op CES Medical Resources Score	Months of follow-up	0.003	0.307
CES Delta Symptoms Score	Pre-op DASS-21 Depression Score	0.001	0.368
CES Delta Symptoms Score	Pre-op DASS-21 Stress Score	0.034	0.230
CES Delta Activity Restrictions Score	Pre-op DASS-21 Depression Score	0.002	0.335
CES Delta Activity Restrictions Score	Pre-op DASS-21 Anxiety Score	0.044	0.219
CES Delta Overall Score	Pre-op DASS-21 Depression Score	0.000	0.395
CES Delta Overall Score	Pre-op DASS-21 Anxiety Score	0.016	0.262
CES Delta Overall Score	Pre-op DASS-21 Stress Score	0.022	0.248
Post-op DASS-21 Stress Score	AC-PTA	0.048	0.212
Post-op DASS-21 Stress Score	ABG	0.001	0.369

CES chronic ear survey; *DASS-21* Depression Anxiety Stress Scale-21; *AC-PTA* air conduction pure tone audiometry; *ABG* air bone gap

Table 5 Evaluation of the role of the variables significantly associated with the questionnaires subscales by multivariate analysis ($p < 005$ for all the correlations)

	Variable	Non-standardized coefficients		Standardized coefficient	t	p	B-coefficient 95% CI	
		Coefficient B	Standard error	Beta			Inferior	Superior
CES delta overall score	Pre-op DASS-21 depression score	9.961	3.815	0.436	2.611	0.11	2.360	17.562
CES delta activity restrictions score	Pre-op DASS-21 depression score	18.478	5.622	0.534	3.287	0.002	7.280	28.677
CES delta symptoms score	Pre-op DASS-21 depression score	12.584	4.492	0.551	2.801	0.007	3.620	21.547
CES delta medical resources score	Months of follow-up	1.394	0.445	0.398	3.134	0.003	.507	2.281

CES chronic ear survey; *DASS-21* Depression Anxiety Stress Scale-21; *CI* confidence interval

tympanoplasty using a disease-specific questionnaire and including a psycho-emotional discomfort assessment. The main result is a statistically significant improvement recorded both in CES and in DASS-21 subscales after EES for chronic otitis media and cholesteatoma.

The CES is a statistically validated survey which has been shown to correlate both with hearing thresholds and general QoL questionnaires, such as the Hearing Handicap Inventory for Adults and 36-Item Short-Form Health Survey [17]. All the scores of the CES domains were significantly higher in the postoperative vs. preoperative assessment ($p < 0.001$ for all comparisons), indicating a favourable effect of fully endoscopic ear surgery in the spheres of activity restrictions, symptoms and medical resources. The questionnaires were administered at the annual postoperative evaluation (mean follow-up time: 14.9 months), in consideration of the previously testified increasing trend of the QoL indicators over time [2, 14]. CES scores in fact continue to change beyond 6 months after treatment with the 12-month total scores and subscores at the highest levels [14]. The beneficial effect of increasing postoperative follow-up time is further underlined by the significant positive correlation found with improving scores in the Medical Resources subsection. This is also confirmed by the multivariate analysis, net of the other confounding variables. The increasing amount of medical examinations does not in fact constitute a burden, on the contrary it seems to contribute to a QoL improvement, probably linked to the subjective reassurance and to the progress obtained starting from the early postoperative period.

COM patients undergoing surgery suffer from ear discharge, pain and hearing impairment. In addition, COM may lead to restrictions in daily activities, social interactions and increased use of the healthcare system. Studies on microscopic retroauricular surgery have historically focused on the comparison between CWD and CWU [1, 2, 18]. Historically, CWD has been associated with lower quality of life, due to

the limitations of the wide neo-mastoid cavity and to the poorer hearing outcome [18]. In our study, no significant difference in any domain has been detected when endoscopic transcanal tympanoplasty and open centrifugal endoscopic tympanoplasty were compared. However, this might be explained by the difference between the conventional CWD tympanoplasty with meatoplasty and the open centrifugal endoscopic tympanoplasty, as described by Marchioni et al. [13]. In fact, a limited removal of the posterior external auditory canal wall and no meatoplasty were performed in the latter subgroup of patients, since a small and sclerotic mastoid was present in every case. Although a discrepancy in the postoperative auditory function was demonstrated in favour of the endoscopic transcanal tympanoplasty, it seems that a certain degree of demolition of the posterior auditory canal wall does not significantly influence the QoL in the open technique. This may be due to a more targeted demolition and the absence of a large neo-cavity. In other words, the preservation of the physiological volume and function of the middle ear, achieved through the endoscopic open technique, may contribute to a lower discomfort.

The most reported subjective complaint in studies on microscopic tympanoplasty was the limitation to water contact. For this reason, an important role has been attributed to the obliterative techniques, performed by different materials (bone patè, muscle flaps, cartilage, hydroxyapatite, or bioactive glass) [19, 20] for improvement of the quality of life. Our results however prove that the fear of water contact is not exclusive of patients operated on by microscopic technique, since this limitation was considered as the most annoying also by our study group. It is reasonable to suppose that, even if patients operated on by EES were not obliged, after a period of healing, to avoid contact with water, the fear of a possible discomfort or complications deriving from it, constituted a severe limitation. The other most reported complaint concerned the hearing impairment. According to Nadol et al. [14] and Jung et al. [21], the CES survey has strong correlation with PTA. This is consistent with our results: hearing loss alone constitutes a severe subjective issue and has a strong correlation with the decline in CES "S" scores and DASS-21 "D" and "S" scores. Therefore, the hearing problem represents a disease-specific handicap which can affect the psychological sphere, especially the aspects of depression and stress. Other studies described the hearing loss as a poorly tolerated symptom in COM patients, compared to other ear manifestations, such as otorrhea or tinnitus [22]. A recent paper by Lailach et al. [10] described the effects of depressive symptoms on the postoperative course after COM surgery. The study demonstrated that patients without elevated depressive symptoms had significantly better QoL scores as measured by both disease specific and general questionnaires. Given that depressiveness affects the perception of chronical illness, depressive disorders may modulate the relationship between COM symptom burden and the decrease in QoL. Moreover, it has been demonstrated that patients with depressive disorders may have a higher risk of adverse outcomes, increased analgesic consumption and increased use of the healthcare system [23]. In our study, no patient had a DASS-21 score compatible with a psychological distress, both at the preoperative and postoperative assessment. However, a significant improvement in all the DASS-21 subscales was demonstrated in the postoperative and hearing level is the only factor significantly correlated with increasing levels of depression and stress patterns. Interestingly, patients with the highest preoperative depressive burden were those who benefited the most from surgical improvement as assessed by all CES subscales. This contrasts with what was stated by Lailach et al. [10]. It is possible that a part of the preoperative depressive symptoms was associated to the fear of an extensive intervention or of possible complications, and that the favourable operative course relieved those patients of the psycho-emotional burden. The coexistence of mood disorders in patients with COM was analyzed only in a few studies [22]. The CES is not provided with items specifically aimed at identifying psycho-emotional aspects, therefore DASS-21 was used. This questionnaire investigates the presence of depression, assessing a lack of incentive, low self-esteem and dysphoria, anxiety, referring to somatic and subjective symptoms of anxiety, and stress, evaluating irritability, impatience, tension and persistent arousal after the surgery [24].

In contrast to other studies [24, 25], our results demonstrated no significant QoL differences in the comparison between type of pathology (cholesteatoma vs. COM) and between primary and revision surgeries. Many studies on microscopic technique interestingly found that patients who had undergone revision surgery, showed worse QoL indicators compared with the primary surgery [14, 21, 24]. The authors attributed this to the necessity of performing a more extended resection in revision surgery, often consisting of a CWD and with consequences on the hearing. Our results however demonstrated that undergoing endoscopic revision surgery does not imply a greater psychophysical discomfort compared to receiving primary surgery. This could be due to the less invasiveness of the technique, the absence of external incision and the absence of large surgical cavities even in the revision surgery and in open techniques. These considerations should however be taken with caution as our study does not include a control population of patients undergoing microscopic tympanomastoidectomy.

The present study has strength and limitations: the main strength is the novelty of the topic, since no previous study addressed the disease-specific QoL in patients undergoing endoscopic tympanoplasty. The main limitation is the absence of a control cohort of patients undergoing

microscopic tympanomastoidectomy. A future study including a larger sample size and the comparison with a microscopic patient's cohort is needed. Moreover, the results were collected at a single institution and therefore reproducibility was not demonstrated. Experience of the surgeon, social and cultural factors are in fact crucial factors affecting outcomes.

Conclusion

Endoscopic tympanoplasty shows significantly improved QoL as assessed by disease-specific and psycho-emotional questionnaires. A favourable effect of fully endoscopic ear surgery was demonstrated. The variables which were significantly associated with the outcomes were follow-up time and preoperative depressive symptoms.

Author contributions DL: conceived the presented idea, wrote the manuscript, verified the analytical methods, supervised the work, final approval of the submitted version. MR: conceived the presented idea, wrote the manuscript, patients' enrollment, verified the analytical methods, supervised the work, final approval of the submitted version. MF: conceived the presented idea, verified the analytical methods, final approval of the submitted version. EB: conceived the presented idea, patients' enrollment, verified the analytical methods, final approval of the submitted version. MB: conceived the presented idea, verified the analytical methods, final approval of the submitted version. IJ Fernandez: conceived the presented idea, statistical analysis, verified the analytical methods, supervised the work, final approval of the submitted version. LP: conceived the presented idea, verified the analytical methods, critical revision of the manuscript, final approval of the submitted version. MA-C: conceived the presented idea, wrote the manuscript, verified the analytical methods, critical revision of the manuscript, final approval of the submitted version.

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Data availability the data that support the findings of this study are available from the corresponding author upon reasonable request.

Code availability Not available.

Compliance with ethical standards

Conflict of interest All the authors declare no conflicts of interest.

Ethical approval Comitato Etico AVEN, ID 0019114/19.

Consent to participate All patients received appropriate and comprehensible information about the surgical procedures and tests and gave their written consent.

Consent for publication All the authors give their consent for publication.

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