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Quality of life following endoscopic endonasal resection of anterior skull base cancers

Clinical article

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Object. For several decades, the exclusive purpose in the management of anterior skull base malignancies has been to increase survival rates. Recently, given the improved prognosis achieved, more attention has been focused on quality of life (QOL) as well. Producing data on QOL in anterior skull base cancers is hampered by the rarity of the neoplasm and the lack of specific questionnaires. The purpose of this study was to assess health-related QOL in a large and homogeneous cohort of patients affected by anterior skull base cancers who had undergone endoscopic endonasal resection.

Methods. The authors conducted a retrospective review of patients treated for sinonasal and skull base cancers via an endoscopic endonasal approach at two Italian tertiary care referral centers. All patients were asked to complete the Anterior Skull Base Surgery Questionnaire to evaluate their QOL before and 1 month and 1 year after surgical treatment. To assess which parameters affect QOL, the study population was divided into subgroups according to age, sex, stage of disease, surgical approach, and adjuvant therapy.

Results. One hundred fifty-three patients were enrolled in this study according to the adopted inclusion criteria. Overall QOL started at a score of 4.68 for the preoperative period, sharply decreased as far as a score of 4.03 during the 1st postoperative month, and rose again to a score of 4.59 over the course of 1 year after treatment, with a significant difference among the 3 values ($p < 0.05$). The specific symptoms and physical status domains registered poorer results at the 1-year assessment (4.00 and 4.71, respectively) than at the preoperative assessment (both domains 4.86), with a statistically significant reduction in scores ($p < 0.05$). Worse outcomes were associated with several variables: age > 60 years (difference of 0.21 points between the preoperative and 1-year period, $p < 0.05$), expanded surgical approaches with transnasal craniectomy (decrease of 0.20 points between the preoperative and 1-year period, $p < 0.05$), and postoperative radiotherapy (score of 4.53 at the 1-year period vs 4.70 in patients without any adjuvant treatment, $p < 0.05$). No statistically significant differences were found when analyzing the study population according to sex ($p > 0.1$) and T classification of disease at presentation ($p > 0.05$).

Conclusions. Radical endoscopic endonasal resection led to either complete or at least partial recovery of patient QOL within the 1st postoperative year.
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Key Words • **skull base** • **quality of life** • **endoscopic endonasal** • **sinonasal** • **malignancy** • **oncology**

Malignant anterior skull base neoplasms are rare and heterogeneous tumors that can spread to various adjacent sites such as the orbit, cavernous sinus, and brain. Nowadays, treatment modalities include surgery, radiotherapy, chemotherapy, or a combination of these. Craniofacial resection,[13] introduced in the 1960s, dramatically improved local control of the disease and is still considered the gold standard treatment for anterior skull base malignancies. Nonetheless, the procedure has been associated with nonnegligible postoperative complication (36.3%) and perioperative mortality (4.7%) rates.[7] Significant advances in endoscopic and minimally invasive surgical approaches have revolutionized the treatment

Abbreviations used in this paper: ASBS-Q = Anterior Skull Base Surgery Questionnaire; CHT = chemotherapy or radiochemotherapy; ER = endoscopic resection; ERTC = ER with transnasal craniectomy; QOL = quality of life; RT = radiotherapy; T0 = no postoperative therapy.

This article contains some figures that are displayed in color online but in black-and-white in the print edition.

of anterior skull base cancers. Selected lesions can be removed without facial incision or external craniotomy by using a purely endonasal endoscopic approach. Data from several centers worldwide have clearly demonstrated that endoscopic endonasal surgery, when properly planned and in expert hands, can be considered a sound alternative to traditional open approaches, with comparable oncological control rates but shorter hospital stays, reduced morbidity, and fewer complications.[10,16] From a clinical viewpoint, in the case of similar efficacy among the available options, the type of treatment should be chosen according to the lowest possible impact on the patient's quality of life (QOL). Unfortunately, there is a paucity of published data concerning QOL in skull base surgery, with few papers focusing especially on external surgical approaches. Moreover, the few reports analyzing QOL in endoscopic endonasal approaches present several flaws: a small number of patients studied, heterogeneity of disease in terms of histology and localization, and heterogeneity of treatment. Our purpose in the present study was to assess health-related QOL in a homogeneous cohort of patients affected by anterior skull base cancers treated with curative intent via an endoscopic endonasal approach.

Methods

Patient Selection

We retrospectively reviewed patients who had undergone endoscopic endonasal resection of sinonasal and anterior skull base malignancies between June 1997 and December 2010 at the Departments of Otorhinolaryngology of the Universities of Insubria and Brescia. Epidemiological and clinical data, surgical reports, data on adjuvant therapy and complications, and follow-up information were retrieved from a database dedicated to neoplasms of the sinonasal tract. Two teams sharing the same philosophy concerning clinical and surgical strategies had performed the surgical procedures. The surgical technique, complications, and outcomes have been described in detail elsewhere.[16,21] Patients in this study were selected according to the following criteria: affected by malignant neoplasm of the anterior skull base and sinonasal tract; treated via an endoscopic endonasal resection with curative intent; alive with or without evidence of disease at the end of the 1st postoperative year; able to read and write, without severe psychopathological or cognitive impairment, and able to give informed consent to participate in this survey; and an age between 18 and 90 years at the moment of the interview. The local ethics board approved this study.

Anterior Skull Base Surgery Questionnaire

Quality of life outcomes were assessed using the Anterior Skull Base Surgery Questionnaire (ASBS-Q), whose development, reliability, and validity have already been described.[9] Answers to the 35 questions in the ASBS-Q were expressed on an ordinal scale, with scores ranging from 1 (worst QOL) to 5 (best QOL). Items in the ASBS-Q were divided into 6 relevant domains—role of performance, impact on emotions, pain, physical function, specific symptoms, and vitality—to determine which of them mainly affected QOL during the different periods tested. The Cronbach α values for each domain were greater than 0.8.[9] The questionnaire was administered to patients either in person or through a telephone interview. An independent physician performed all interviews to avoid any bias that might stem from surgeon-patient interaction.

Assessment Periods and Overall QOL

Patients were asked to answer the questionnaire referring to 3 different periods: preoperatively, 1 month after surgery, and 1 year after surgery. The preoperative period was assessed to obtain a reference value for QOL, the 1-month period was helpful to investigate how much the resection and its extension had affected the patient's QOL, and the 1-year period was assessed to evaluate the long-term evolution of QOL, including the effects of different protocols of adjuvant therapy. All the patients enrolled in this study filled in the questionnaires referring to all 3 time points. We evaluated the median score for each period analyzed.

Variables Affecting QOL

The study population was further divided into subgroups according to demographic and clinical features to predict which of these factors might have affected QOL. It was stratified into 2 subgroups for each of the following categories: sex (male and female), age at surgery ($\leq$ 60 and > 60 years), and extent of resection (sinonasal compartment only, or endoscopic resection [ER]; or extension toward the anterior cranial fossa, or endoscopic resection with transnasal craniectomy [ERTC]), with the resulting need for skull base reconstruction.[21] The study population was also stratified into 5 subgroups according to the T classification of disease at diagnosis (T1–T4b). For this purpose, all tumors were staged according to the 2010 *American Joint Committee on Cancer Staging Manual* (7th edition), arbitrarily including all histotypes. The population was also divided into 3 subgroups according to the postoperative therapeutic protocol. The T0 subgroup included the patients who had not undergone any postoperative therapy, the RT subgroup was composed of patients subjected to postoperative radiotherapy, and the CHT subgroup included patients who submitted to postoperative chemotherapy or radiochemotherapy.

Statistical Analysis

A commercially available computer software package (IBM SPSS for Windows, version 19.0) was applied. To compare median values of the different periods analyzed, we used the Friedman test, obtaining a nonparametric 1-way repeated measurement ANOVA by ranks. To compare median values of the different subgroups, we used the Kruskal-Wallis test, which is a nonparametric test for independent samples. A p value $\leq$ 0.05 was considered statistically significant.

Results

Of the 320 patients surgically treated for skull base

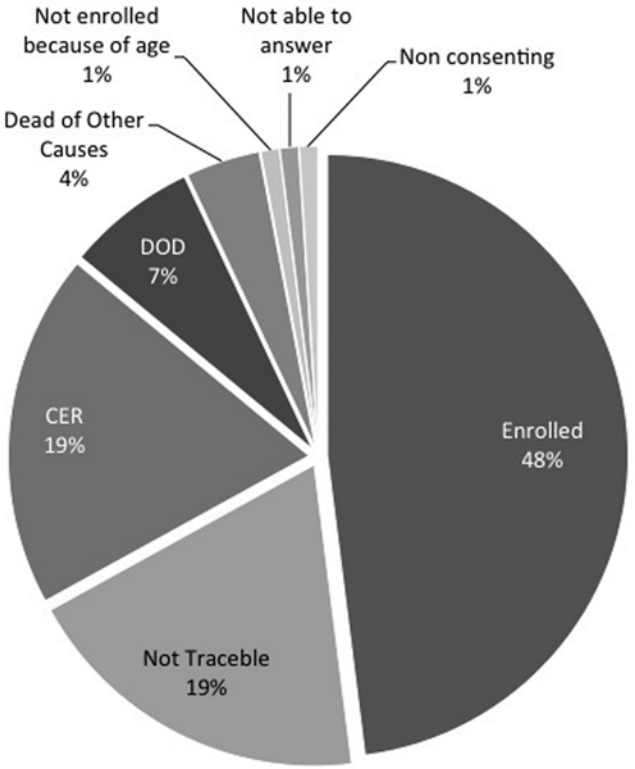

Fig. 1. Selection criteria for the population enrolled in the study. CER = cranioendoscopic resection; DOD = died of disease.

malignancies at our centers, 167 were excluded from our study for several reasons: combined transcranial approach performed, patient death, patient untraceable, and so forth (Fig. 1). Therefore, 153 patients were included in the study, and their clinical and pathological features are summarized in Table 1.

Overall QOL

The median values of overall QOL referring to the analyzed checkpoints started at 4.68 for the preoperative period, decreased as far as 4.03 for the 1-month post-treatment period, and rose again to a score of 4.59 for the 1-year postoperative period, with a significant difference among the 3 values ($p < 0.05$; Fig. 2A).

Domains of QOL

Globally, we reported lower scores at the 1-month period for every domain than at the other 2 periods, with statistically significant differences ($p < 0.05$; Fig. 2B and Table 2). In analyzing the QOL domains individually, we noted that the emotion and performance fields had better scores in the 1-year period (4.80 for both) than in the preoperative period (4.60 and 4.67, respectively), indicating a significant increment ($p < 0.05$). No statistically significant differences were recorded between the preoperative and 1-year vitality and pain domains. The specific symptoms and physical status domains had poorer results in the 1-year period (4.00 and 4.71, respectively) than in the preoperative assessment (both 4.86), showing a statistically significant reduction ($p < 0.05$). When analyzing in detail the specific symptoms domain, the areas with the worst results 1 year after surgery were those concerning the sense of smell, nasal secretions, and the sense of taste, with scores of 1.78, 3.64, and 3.69, respectively, scores inferior to those reported in the preoperative period, with statistically significant differences (2.76, 1.09, and 1.07 points, respectively; $p < 0.05$). The tears and eyesight domains registered lower scores at the 1-year period than at the preoperative period, but without statistically significant differences. Appetite and appearance domains had

TABLE 1: Clinical and demographic features of 153 patients who underwent an endoscopic endonasal approach for skull base cancer*

Parameter	No. (%)
histology	
adenocarcinoma	65
carcinoma group (squamous cell, adenoid-cystic, undifferentiated)	34
olfactory neuroblastoma	24
mucosal melanoma	6
other histotypes	24
age at surgery in yrs†	
≤60	70 (45.7)
>60	83 (54.2)
sex	
M	105 (68.6)
F	48 (31.4)
classification of disease	
T1	43 (28.1)
T2	42 (27.4)
T3	26 (17.0)
T4a	19 (12.4)
T4b	23 (15.0)
surgical approach	
ER	49 (32.0)
ERTC	104 (68)
postop complication	
CSF leak	4
pneumocephalus	2
brain abscess	1
meningitis	1
adjuvant therapy	
none	66 (43.14)
RT	77 (50.33)
CHT	6 (3.92)
RT + CHT	4 (2.61)
follow-up status‡	
NED	151 (98.7)
AWD	2 (1.3)

* AWD = alive with disease; NED = no evidence of disease.
† Mean age was 58.8 years.
‡ Mean follow-up was 53.1 months.

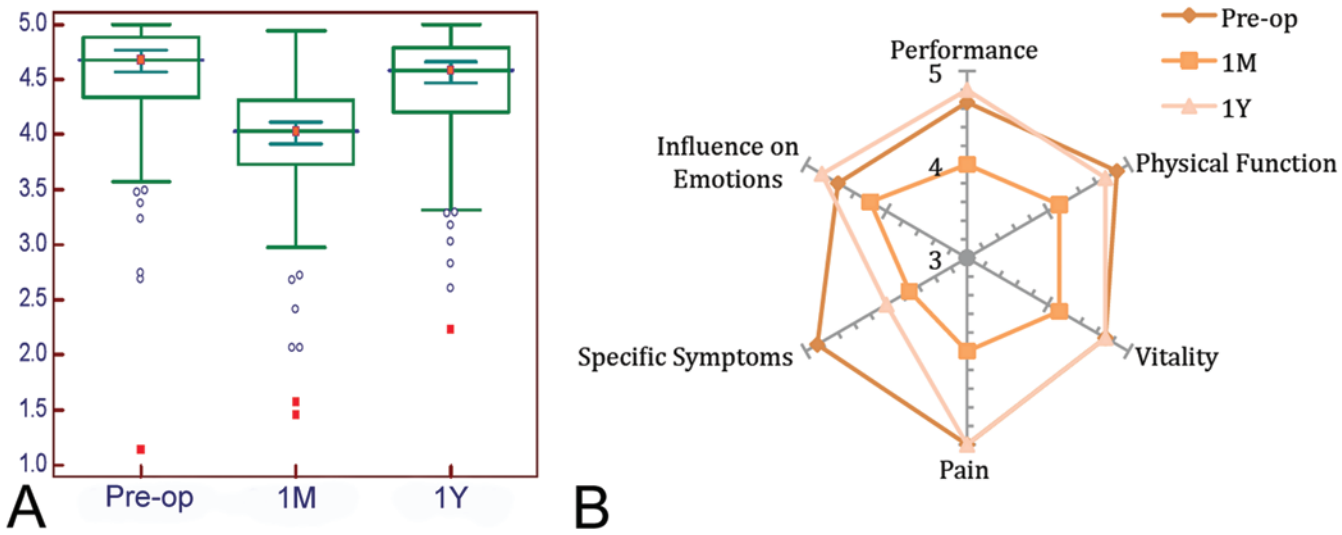

Fig. 2. **A:** Median values of overall QOL for all enrolled patients for each period tested. The 3 values were statistically different ($p < 0.05$). **B:** Radar chart depicting the median values of the QOL domains in the different periods tested. Pre-op = preoperative period; 1M = 1-month postoperative period; 1Y = 1-year postoperative period.

similar scores for the 1-year and preoperative periods, indicating that the treatments had no impact on these fields.

Variables Affecting QOL

Patient Sex. In the male subgroup we recorded a complete recovery of overall QOL, without any statistically significant difference between the preoperative (4.68) and 1-year (4.63) periods ($p > 0.05$). Detailed analysis of the QOL domains revealed that no significant differences were recorded in performance, vitality, physical function, and pain. On the other hand, the emotions domain had a 1-year score of 4.80, higher than the preoperative score of 4.60; this difference reached statistical significance ($p < 0.05$). The specific symptoms domain had a 1-year score of 4.00, lower than the preoperative score of 4.86, indicating a statistically significant difference ($p < 0.05$). In the female subgroup we recorded a statistically significant difference between the preoperative and 1-year scores ($p < 0.05$), but no significant differences were recorded in the performance, physical function, emotions, and pain domains. On the other hand, the vitality and specific symptoms domains had lower scores at the 1-year period than at the preoperative period, showing a statistically significant difference ($p < 0.05$). However, when comparing the scores of overall QOL in the male and female subgroups, we found no statistically significant difference in the 3 periods analyzed ($p > 0.05$; Fig. 3B). Moreover, scores in the female group were lower than those in the

TABLE 2: Median values of the QOL domains and differences between the different periods tested*

QOL Domain	Score			Points		
	Preop	1M	1Y	1M − Preop	1Y − 1M	1Y − Preop
performance	4.67	4.00	4.80	−0.67†	0.80†	0.13†
physical function	4.86	4.14	4.71	−0.71†	0.57†	−0.14†
vitality	4.71	4.14	4.71	−0.57†	0.57†	0.00
pain	5.00	4.00	5.00	−1.00†	1.00†	0.00†
specific symptoms	4.86	3.71	4.00	−1.14†	0.29†	−0.86†
appetite	4.78	4.13	4.59	−0.65†	0.46†	−0.19†
taste	4.75	3.35	3.69	−1.41†	0.34†	−1.07†
smell	4.54	1.67	1.78	−2.87†	0.11†	−2.76†
appearance	4.91	4.71	4.73	−0.20†	0.03	−0.18†
nasal secretions	4.73	4.20	3.64	−0.53†	−0.56†	−1.09†
tears	4.79	4.12	4.32	−0.67†	0.20†	−0.47†
eyesight	4.86	4.51	4.41	−0.35†	−0.10	−0.46†
influence on emotions	4.60	4.20	4.80	−0.40†	0.60†	0.20†

* 1M = 1 month after surgery; 1Y = 1 year after surgery.
† Statistically significant at $p < 0.05$, Friedman test.

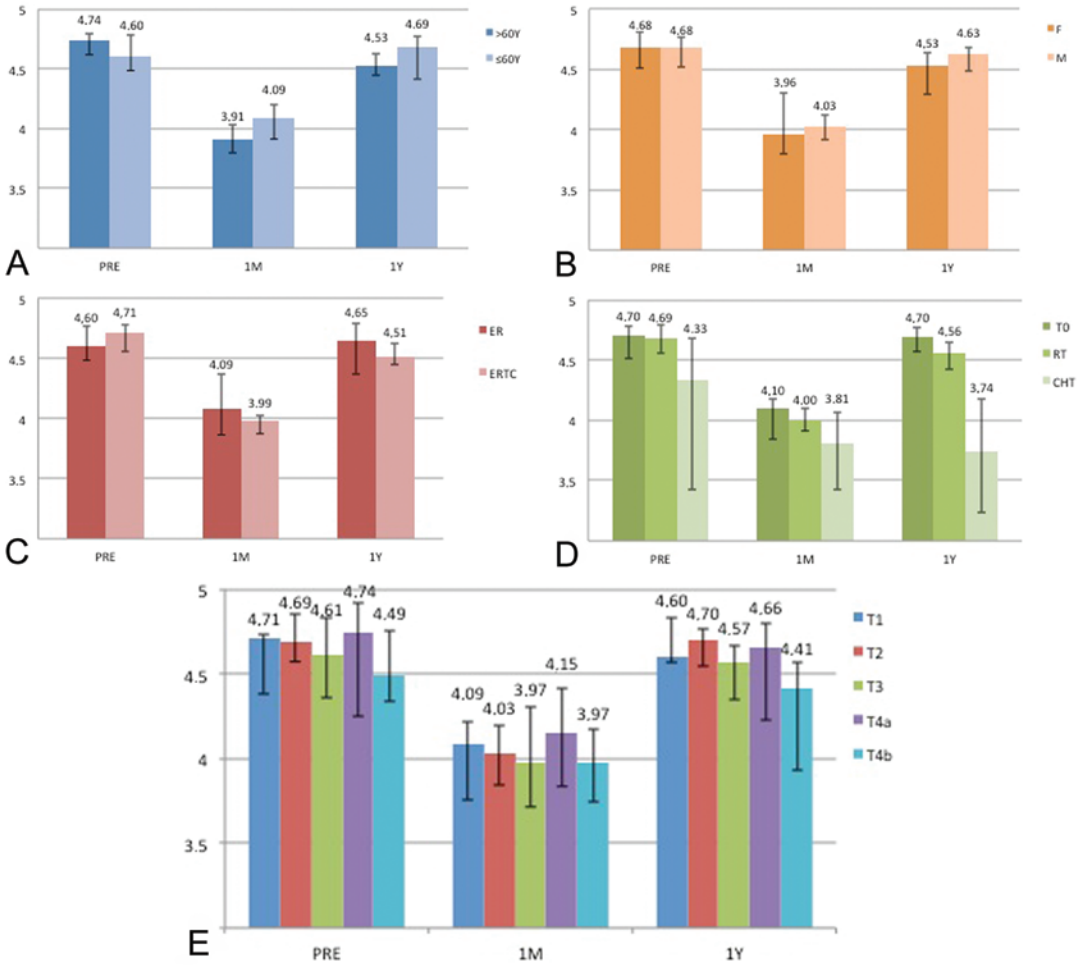

Fig. 3. The trend of overall QOL during the different periods tested, analyzed by stratifying the population according to age **(A)**, sex **(B)**, surgical approach **(C)**, adjuvant therapy **(D)**, and T classification of disease **(E)**. PRE = preoperative period.

male group in all QOL domains, but we found no statistically significant difference between the 2 groups in any of the periods analyzed ($p > 0.1$).

Patient Age. In the younger population (age ≤ 60 years), we recorded no statistically significant difference in overall QOL between the preoperative and 1-year scores. In contrast, in the over-60 group we found a statistically significant difference of 0.21 points ($p < 0.05$) between the preoperative and 1-year periods (Figs. 3A and 4A–B). Remarkably, at the 1-month period, the older group had lower scores in the physical status and specific symptoms domains than the younger group, with a significant difference of 0.43 and 0.14 points, respectively ($p < 0.05$; Fig. 4C).

Resection. In the ER group, we did not find any statistically significant differences in overall QOL ($p > 0.05$) between preoperative and 1-year values, revealing complete recovery of the parameter measured. Conversely, in the ERTC group a statistically significant decrease of 0.20 points ($p < 0.05$) was seen between the preoperative and 1-year scores (Fig. 3C). Interestingly, we recorded a statistically significant difference between the 2 surgical subgroups at the 1-month period ($p < 0.05$), confirming that the extent of surgery had an impact on overall QOL especially in the early postoperative period. However, the impact of surgical approach on the overall QOL seemed to decrease throughout the postoperative time, to the point that no statistically significant difference between the 2 subgroups was found 1 year after surgery ($p > 0.05$). More specifically, we observed better 1-month scores in the vitality, pain, and specific symptoms domains in the ER group than in the ERTC group, with statistically significant differences of 0.21, 0.20, and 0.33 points, respectively ($p < 0.05$; Fig. 4D–F). On the other hand, these differences were less at the 1-year period, with statistically significant better scores for ER only in the specific symptoms domain ($p < 0.05$).

Stage of Disease. Regarding the T classification of disease, we found no statistically significant difference in overall QOL between the preoperative and 1-year scores ($p > 0.05$). In contrast to what we observed in the T1–T4a subgroups, we did not record any differences in overall QOL between the 1-month and 1-year periods ($p > 0.05$) in patients with T4b cancers, highlighting the limited recovery gained by this subset of patients during the postoperative period (Fig. 3E). However, when comparing the

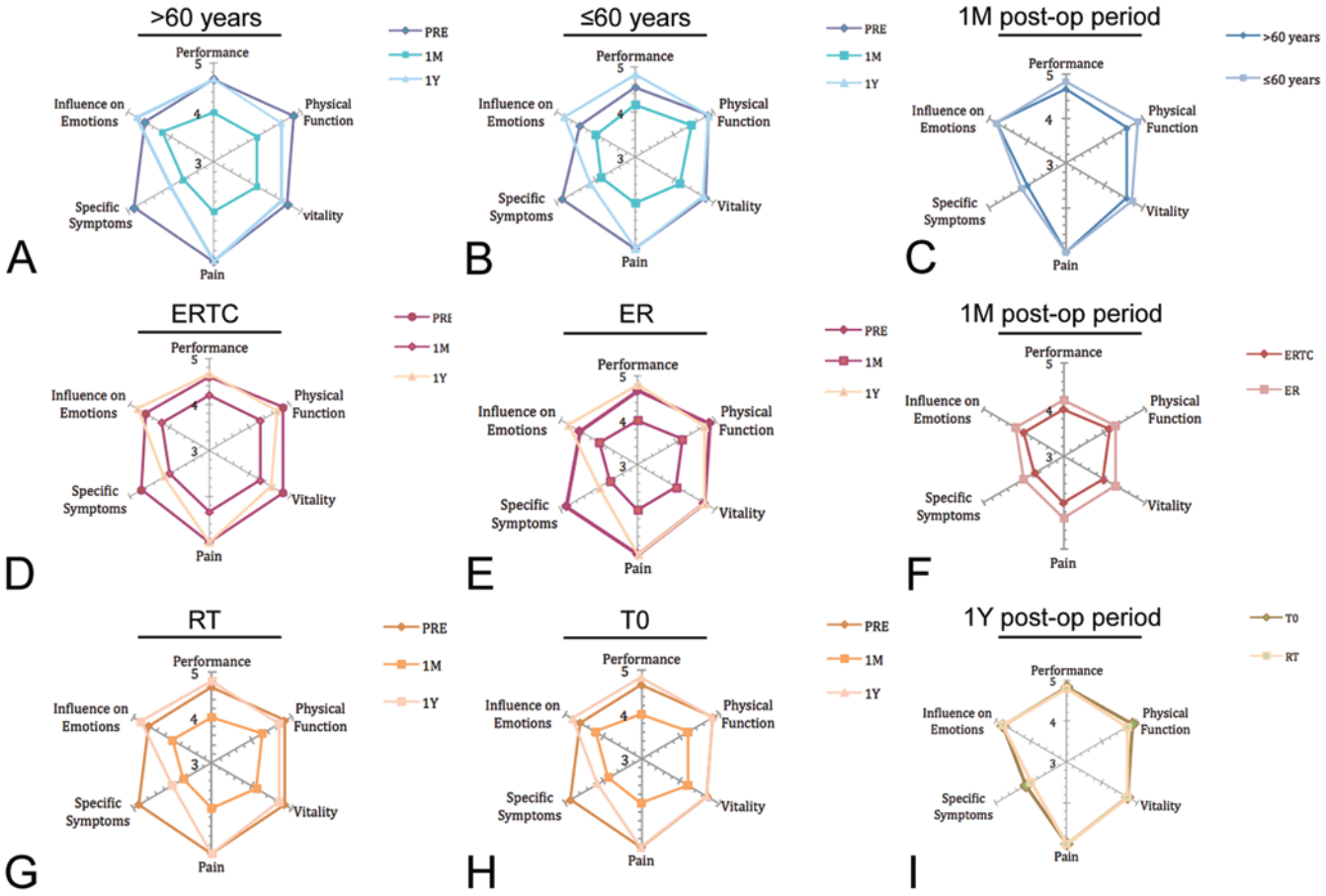

Fig. 4. Radar charts of QOL domains during the different periods tested, stratifying the population according to age **(A–C)**, surgical approach **(D–F)**, and adjuvant therapy **(G–I)**. Comparisons between these subgroups are reported only for the most significant periods (C, F, and I).

5 subgroups, we found no statistically significant difference in overall QOL for the periods tested ($p > 0.05$).

Adjuvant Therapy. We did not find any significant difference in overall QOL ($p > 0.05$) between the preoperative and 1-year period in the T0 subgroup, pointing out complete recovery of the parameter measured. In the RT subgroup, the 1-year value of overall QOL was statistically significantly lower than the preoperative value ($p < 0.05$; Fig. 3D). These results highlight how the RT patients required more time to recover their preoperative lifestyle than those given no postoperative treatment. On the other hand, in the CHT subgroup there was no significant difference among the 3 periods analyzed ($p > 0.05$) in terms of overall QOL. However, the lack of statistical power in this subgroup was probably due to the small sample size (Fig. 4G–H). When comparing the 3 subgroups, we found no statistically significant difference ($p > 0.05$) among the values at the 1-month period (4.10, 4.00, and 3.81 for the T0, RT, and CHT groups, respectively). These data are explained by the fact that the adjuvant therapies had not yet begun in this early postoperative period. In contrast, when comparing the 3 subgroups at the 1-year period, the T0 subgroup showed higher overall QOL scores than the RT subgroup, which in turn recorded higher scores than the CHT subgroup (T0 = 4.70 > RT = 4.53 > CHT = 3.74), with statistically significant differences ($p < 0.05$). Similarly, when analyzing in detail the specific symptoms domain at the 1-year period, we found the scores progressively decreasing from the T0 (4.14) to the RT (4.00) and CHT (3.00) subgroups, with statistically significant differences ($p < 0.05$; Fig. 4I).

Discussion

The goals of treatment for sinonasal and skull base cancers are now balanced between maximizing oncological control and minimizing the functional disability of patients. Advantages and limits of endoscopic endonasal techniques with respect to traditional approaches are well known.[6,10,16] In the last few years, encouraging oncological results have emerged from large case series with long-term follow-ups, confirming the safety and efficacy of endoscopic endonasal resection in the management of sinonasal and anterior skull base malignancies. Furthermore, recent meta-analyses and review articles have sufficiently shown that endoscopic transnasal resection, in selected cases and in expert hands, can lead to disease-control and survival rates comparable with those for traditional open approaches.[11,17] Nowadays, however, when evaluating long-term outcomes, endoscopic approaches should be compared with

traditional external approaches in terms of not only safety and efficacy but also QOL. And, while sound data regarding the safety and efficacy of endoscopic techniques are now available, the same is not true for the topic of QOL. In this respect, the systematic evaluation of QOL and its clinical variables is a modern method of comparing different surgical approaches with similar efficacies. At the moment, only limited and confusing data are available regarding QOL in endoscopic endonasal skull base surgery. In this context, the overall heterogeneity of the case series are attributable to different pathologies (benign, malignant, and pituitary tumors together), tumor sites (anterior, middle, and lateral skull base), surgical corridors, and reconstructive methods, which are confounding factors. In addition, the small sample of cases often does not allow adequate stratification of the population into subgroups. To further complicate matters, different authors have assessed QOL using various questionnaires, which have not always been validated.

To overcome these limits, we analyzed the evolution of QOL in a large cohort of patients with anterior skull base malignancies treated according to a standardized technique.[16] We used a questionnaire initially designed for open anterior skull base surgery[9] but subsequently validated for endoscopic endonasal surgery as well.[19] To reduce variability, the questionnaire was administered by the same investigators. In this way we tried to produce data as homogeneous as possible. Our results seemed to suggest that overall QOL decreases sharply during the 1st postoperative month and tends to improve over the course of 1 year until it reaches at least partial recovery. This finding agrees with results in previous reports.[4] In our analysis, the most critical period appeared to be the early postoperative one. In this period, the main domains affected were pain and specific symptoms: patients principally complained of loss of taste and smell but also reported nasal discharge and crusting. These last 2 symptoms produce a significantly negative impact on patient QOL during the normal postoperative process of healing. Pant et al. found similar results when dealing with benign and malignant anterior skull base tumors.[19] In their study, QOL was assessed using the ASBS-Q and seemed to be affected mainly in the specific symptoms domain during the first 1–3 postoperative months. However, in agreement with our findings, the sinonasal morbidity gradually improved with time, reaching partial or complete recovery from 6 months to 1 year after the endoscopic endonasal procedure. Furthermore, the increased sinonasal morbidity following endoscopic skull base surgery seemed to be affected by the complexity of the surgical procedures and the use of nasoseptal flaps.[5,19] Our data also confirmed that the more extensive the surgery, the greater the impact on patient QOL. In fact, the worst score was found in patients who had undergone transnasal craniectomy with skull base reconstruction rather than in the subgroup of patients who did not require such an extended approach. Nevertheless, the differences between these 2 subgroups, which were particularly evident at the 1-month period, decreased during the 1st year after surgery. In addition, reports on traditional open approaches also confirmed that QOL is influenced by the extent of surgery.[8] In this respect, the only study to compare subcranial and endoscopic approaches showed that patients treated endoscopically had significantly better QOL scores in the physical function and emotions domains than those treated with open surgery.[1] As stated, our study presents several strong points with regard to previous publications: a validated questionnaire, the same investigators to administer the questionnaire, and a large and homogeneous cohort of patients with similar pathologies and treatments.

In this respect, a recent meta-analysis[2] has shown a statistically significant difference in QOL between patients treated for benign and those treated for malignant tumors, no matter which type of approach has been utilized. These data could be expected not only because of general cancer-related influences on the different aspects of QOL, but also for the impact of early and long-term morbidity due to the adjuvant therapies. In fact, our data showed a statistically significant deterioration in the QOL of patients treated with postoperative radiotherapy, especially in the specific symptoms domain. Moreover, patients in this subset had only a partial recovery of their former QOL at the 1-year period, requiring more time to return to their normal lifestyle than the patients who did not receive postoperative treatment. These results are in accordance with those of previous studies describing a significant deterioration in QOL and an increase in depression after adjuvant radiation therapy for skull base cancer.[8,12,18] When evaluating data in terms of the T classification of disease, we found no statistically significant difference among the 5 subgroups of our study population. This result seems to suggest that the stage of disease does not have a direct impact on overall QOL. However, when analyzing each subgroup separately by using the Friedman test, we observed a full recovery of overall QOL at the 1-year period in all cases, except in the T4b patients, who only partially regained their preoperative lifestyle. This result is not easily understood given the fact that, in most cases, these patients undergo procedures similar to those used in the T4a patients. A possible explanation in some cases could be related to the extent of resection; that is, T4b lesions might involve the pterygopalatine fossa or the nasopharynx, whose removal would certainly increase functional impairment. Another explanation for this finding could be that preoperative counseling is less optimistic for the T4b patients; therefore, the subsequent impact on their QOL would be greater. Honestly speaking, a clear and sound reason has not been found. The demographic features of our patient cohort were investigated to find a significant predictor of QOL. Recent case studies on endoscopic skull base surgery evaluating QOL (using the ASBS-Q) have described the female sex as a significant predictor of a poor outcome.[3] Our data do not confirm this difference. Similarly, Palme et al. did not find sex to be a prognostic factor, although they used tools different from ours.[18] When evaluating the role of age, we observed only partial recovery of QOL in the patients over 60 years of age at the 1-year period, whereas younger patients had a complete recovery of their preoperative lifestyle. A similar conclusion, although based on a heterogeneous group of patients treated via open approaches, was reached by Gil et al.[8] So, based on our results, the age factor should

not be considered to be of minor importance in determining postoperative outcome. Altogether, the data from our study are encouraging, showing that endoscopic endonasal surgery in patients with skull base cancers leads to a complete recovery of overall QOL 1 year after surgery. Variables associated with a worse QOL were an age > 60 years, expanded ERTC, and postoperative radiotherapy.

Obviously, our study has limitations. First of all, the retrospective nature of the study design could influence the interpretation of data, but it represents the only means to collect a significant cohort of patients given the very recent introduction of endoscopic transnasal approaches. Moreover, we did not consider the recurrence of disease as a factor affecting QOL. The burden of living with disease recurrence is obviously substantial, and the disappointment of primary treatment failure can naturally influence several aspects of a patient's well-being. However, in our oncological experience, QOL was impaired even when patients with no actual evidence of disease were concerned that the cancer might recur. In addition, the impact of complications on QOL was not analyzed; however, we have had so few complications (8 [5.2%] in 153 patients, as detailed in Table 1) that their analysis would not have reached a statistically significant value and thus would not have significantly modified the global meaning of our study. Last but not least, there is presently no consensus regarding the best instrument for assessing QOL. In our study, we did not adopt the 22-Item Sino-Nasal Outcome Test (SNOT-22) questionnaire[15] because we believe that sinonasal morbidity can be equally estimated using only the specific symptoms domain of the ASBS-Q. Other authors agree with this viewpoint.[2]

Conclusions

The evolution of skull base surgery calls for a holistic evaluation of outcomes, not limited to survival rates alone. In our opinion, rigorous measurement of functional outcomes and QOL is of paramount importance. We maintain that there is a strong need for prospective multicenter studies to more accurately assess the QOL features of patients with anterior skull base cancers treated with endoscopic endonasal surgery in relation to other treatments. In this respect, Patel suggests a need for meticulous multiinstitutional data collection regarding functional outcomes in patients who have undergone skull base surgical procedures.[20] For this purpose, a large Internet-based database of cases with malignant sinonasal and skull base tumors treated via an endoscopic endonasal approach has been set up to collect the clinical history of patients, imaging data, pathological findings, surgical management, and postoperative treatments.[14] Obviously, prospective QOL evaluation should also be included in the pre- and posttreatment assessment of these patients. Incorporating a QOL questionnaire into the standard of care of patients with skull base cancers will enable the surgeon to better understand, in a more holistic fashion, the impact of treatment on the daily lifestyle of these patients and consequently to identify the best treatment option for a given patient. This is particularly true in the case of new treatment proposals.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author contributions to the study and manuscript preparation include the following. Conception and design: Turri-Zanoni, Battaglia. Acquisition of data: Lepera. Drafting the article: Turri-Zanoni, Dallan. Critically revising the article: Castelnuovo, Battaglia, Bignami, Nicolai, Dallan. Reviewed submitted version of manuscript: Castelnuovo, Lepera, Battaglia, Bolzoni Villaret, Bignami, Nicolai, Dallan. Approved the final version of the manuscript on behalf of all authors: Turri-Zanoni. Statistical analysis: Lepera. Administrative/technical/material support: Bolzoni Villaret, Nicolai. Study supervision: Castelnuovo, Bolzoni Villaret, Bignami, Nicolai, Dallan.

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