PREOPERATIVE AND POSTOPERATIVE VOICE IN TIS-T1 GLOTTIC CANCER TREATED BY ENDOSCOPIC CORDECTOMY: AN ADDITIONAL ISSUE FOR PATIENT COUNSELING

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Radiotherapy contends with endoscopic surgery for the role of treatment of choice for Tis-T1 glottic cancer. The amount of vocal cord to be surgically removed logically depends on the surface and deep extension of the neoplasm. Thus, a prerequisite for proper management includes an analysis of the voice changes after each of the progressive types of cordectomy described in the European Laryngological Society Classification. Between January 1998 and December 2000, 89 patients with glottic cancer (8 Tis, 63 T1a, 18 T1b) underwent different types of endoscopic cordectomy. Perceptual analysis (GRBAS scale); objective analyses of jitter, shimmer, and noise-to-harmonics ratio; and subjective (Voice Handicap Index) evaluation of voice were performed in 51 patients. Statistical evaluation of preoperative and postoperative objective results by analysis of covariance, as well as perceptual and subjective data, showed significant voice improvement after type I and II cordectomies, with the voice attaining nearly normal parameters. By contrast, after type III, IV, and V cordectomies, the vocal outcome was not significantly different from the preoperative pattern. It can therefore be concluded that type I and II resections, whenever indicated, are adequate procedures even for professional voice users. By contrast, accurate counseling is mandatory before type III, IV, and V cordectomies.

KEY WORDS — endoscopic cordectomy, glottic cancer, GRBAS scale, objective voice analysis, vocal outcome, Voice Handicap Index.

INTRODUCTION

Endoscopic surgery by CO_2 laser is nowadays considered a valid alternative to radiotherapy for treatment of Tis-T1 glottic cancer, as testified to by a continually increasing number of publications.[1-13] Radiotherapy traditionally contends with endoscopic surgery for the role of treatment of choice in these lesions. Although the oncological results are universally considered equivalent, debates about vocal outcome and patient compliance are still addressed in a number of recent articles.[10,14-21]

In patients undergoing surgical treatment for Tis-T1 glottic cancer, one of the most striking concerns relates to postoperative voice and to the possibility of improvement with respect to the tumor-bearing dysphonia. In fact, the latter is the only current reference parameter with which to compare postoperative vocal outcomes. Accordingly, personal expectations about voice must be taken into account in patient counseling.[20]

For early glottic cancer, the choice of treatment must consider such factors as oncological effectiveness, functional outcome, and patient compliance. Because of the inherent problems in planning a randomized prospective study, a comprehensive, comparative analysis of voice in a homogeneous patient population treated by radiotherapy or endoscopic cordectomy is still lacking. However, it is generally accepted that with respect to voice preservation, radiotherapy has a better outcome than surgery. Until these issues are adequately resolved, it is nonetheless worthwhile to assess vocal outcome in relation to the types of endoscopic cordectomy performed.

MATERIALS AND METHODS

Between January 1998 and December 2000, 89 consecutive cases of glottic carcinoma (8 Tis, 63 T1a, and 18 T1b) were treated by endoscopic CO_2 laser cordectomy at the Department of Otolaryngology of the University of Brescia, Italy. All of these procedures were classified according to the European Laryngological Society Working Committee[22] (Table 1).

The patient population included 84 men and 5 women, ranging in age from 44 to 86 years (mean, 63 years). None had received previous radiotherapy or surgical treatment. Twenty-three patients had already undergone single or multiple biopsies at another institution for diagnostic purposes only, but still presented with glottic erythroleukoplakias when first seen at our department.

A complete exposure of the glottis was obtained by the Dedo or Ossoff-Holinger laser laryngoscope

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TABLE 1. TYPES OF CORDECTOMIES

Type of Cordectomy	*Extent of Cordectomy*	*No. of Patients (N = 89)*
Subepithelial cordectomy (type I)	Superficial layer of lamina propria	10
Subligamental cordectomy (type II)	Superficial portion of vocal muscle	31
Transmuscular cordectomy (type III)	Medial portion of vocal muscle	23
Total cordectomy (type IV)	Inner perichondrium of thyroid lamina	14
Extended cordectomy (type V)	Surrounding laryngeal areas (ie, contralateral vocal fold, arytenoid cartilage, ventricular fold, and subglottis)	11

Classification of endoscopic cordectomies proposed by European Laryngological Society Working Committee.[22]

coupled with the Boston University suspension system (Pilling, Philadelphia, Pennsylvania). A Sharplan 1055 S CO_2 laser with an Acuspot 712 micromanipulator (Sharplan, Tel Aviv, Israel) with superpulse emission in continuous mode (1 to 5 W, 270-μm spot size) was used.

Preoperative and intraoperative diagnostic assessment including preoperative videolaryngostroboscopy (VLS),[23] intraoperative rigid endoscopy by 0°, 30°, 70°, and 120° telescopes,[24] supravital staining with 2% toluidine blue,[25] contact endoscopy,[24] and saline infusion in Reinke's space[26] gave us the criteria to select the most appropriate type of resection.[11,12,27,28] According to the results of this test battery, we performed 10 subepithelial cordectomies (type I) in patients with a lesion assumed not to transgress the basement membrane because of a normal mucosal vibratory pattern on VLS and a complete intraoperative mucoligamentous hydrodissection on saline infusion. Subligamental cordectomy (type II) was done in 31 patients with a lesion suspected to be microinvasive or invasive carcinoma because of the absence of a mucosal wave on VLS and a lack of hydrodissection on saline infusion. Transmuscular cordectomy (type III) was performed in 23 patients in whom changes due to a previous biopsy could have interfered with the diagnostic accuracy of test battery results. Total cordectomy (type IV) was done in 14 patients with lesions involving the entire vocal fold, and extended cordectomy (type V) was performed in 11 patients with extension to the anterior commissure and contralateral vocal cord (Table 1).

All patients were subsequently examined every 2 months by a rigid or a flexible fiberoptic laryngoscope for a period ranging from 3 to 44 months (mean, 23 months). Statistical analysis of the oncological data was performed with the SPSS Statistical Package. Survival curves were calculated from the date of diagnosis by the Kaplan-Meier method. The end point for overall survival was death (regardless of the cause) or the date of the last consultation. The end point for disease-free survival was the date of the first locoregional recurrence. The end point for ultimate local control by endoscopic excision alone was the date of local recurrence requiring open-neck surgery and/or radiotherapy.

In order to obtain a more homogeneous sample, we excluded 38 of the 89 patients treated from the present functional evaluation for one or more of the following criteria: incomplete functional data (16 patients), no postoperative voice therapy (10 patients), and bilateral cordectomies for T1b lesions without anterior commissure involvement (12 patients). Therefore, only 51 men (4 patients submitted to type I resection, 22 to type II, 11 to type III, 8 to type IV, and 6 to type V) were submitted to a complete preoperative and postoperative voice evaluation at least 6 months after surgery. Such a voice analysis protocol included a perceptual, objective, and subjective evaluation of the voice.

Perceptual evaluation was performed by a panel of otolaryngologists and speech pathologists on a running speech voice sample, and the findings were graded on the GRBAS scale of Hirano.[29] It consists of 5 domains: grade (G), rough (R), breathy (B), asthenic (A), and strained (S). Each patient was rated in all 5 domains on a grading scale ranging from 0 to 3. Score 0 corresponded to a normal voice, score 1 to a slight voice problem, score 2 to a moderate voice problem, and score 3 to a severe voice problem.

The objective analysis, including percent jitter, percent shimmer, and noise-to-harmonics ratio (NHR), was performed with the Multidimensional Voice Program (MDVP) while the patient produced the sustained vowel */a/* 3 times, holding pitch and loudness as constant as possible for at least 3 seconds. Possible differences between preoperative and postoperative values of the aforementioned parameters were evaluated by an analysis of covariance (ANCOVA).

Subjective evaluation of the vocal outcome was performed by the administration of the Voice Handicap Index (VHI) questionnaire as proposed by Jacobson et al.[30] The scores were grouped into 5 different categories: a score of 0 (normal voice), scores of 1 to 30 (slight dysphonia), scores of 31 to 60 (moderate dysphonia), scores of 61 to 90 (severe dysphonia), and scores of 91 to 120 (very severe dysphonia).

TABLE 2. MEAN PREOPERATIVE AND POSTOPERATIVE SCORES OF PERCEPTUAL EVALUATION BY GRBAS SCALE[29] (N = 51)

	G		R		B		A		S	
Cordectomy	*Preop*	*Postop*	*Preop*	*Postop*	*Preop*	*Postop*	*Preop*	*Postop*	*Preop*	*Postop*
Type I	3	1.5	1.5	1	0.5	1.5	0.5	0	2	1
Type II	1.89	1.05	1.52	0.47	0.94	0.52	0.42	0.15	1.15	1
Type III	2.4	1.4	1.7	0.8	1.2	0.9	0.3	0.1	1.7	1.2
Type IV	2.25	2.5	1.12	1.12	1.62	1.75	0.25	0.62	1.87	2
Type V	2.33	1.66	1.83	0.66	1	1.16	0.83	0	1.5	1.83

RESULTS

Of a total of 89 patients, 11 developed a local recurrence: 1 Tis case, 5 T1a cases, and 5 T1b cases. The rescue treatment consisted of a second endoscopic procedure in 10 patients (complementary radiotherapy was performed in 1 case). Total laryngectomy was performed in the remaining case. The overall rate of laryngeal preservation was 97%. There were 3 deaths due to unrelated causes, occurring from 3 to 21 months after primary surgery: 1 patient died of a second lung cancer, 1 of a myocardial infarction, and 1 of a stroke. No patient died of the laryngeal primary tumor. The 3-year overall survival, disease-free survival, and ultimate local control with laser alone were 96%, 83%, and 97%, respectively.

There were no intraoperative or postoperative complications in any of the 89 patients. None required tracheotomy at the end of the procedure, and all were discharged the day after surgery. No swallowing difficulties were encountered by any of the patients who underwent total or extended cordectomy.

The preoperative and postoperative GRBAS scores are reported in Table 2.[29] In particular, we observed a significant decrease of dysphonia (G) and an improvement of each qualitative vocal aspect (R, B, A, and S) between preoperative and postoperative voice after type I and II cordectomies. By contrast, after type III, IV, and V excisions, the values were comparable to the tumor-bearing dysphonia.

The results of objective voice evaluation by MDVP are summarized in Table 3, in which the values of the median and 25th and 75th percentiles of jitter, shimmer, and NHR for controls (normal population) and for both preoperative and postoperative examinations of the patients treated are reported. We subdivided the 51 patients studied with complete voice analysis into 2 groups: 26 treated by type I and II cordectomies and 25 who underwent type III, IV, and V excisions. It is noteworthy that a statistically significant difference ($p < .05$) was found by ANCOVA between preoperative and postoperative values in patients submitted to type I and II cordectomies. On the other hand, no statistically significant difference was seen between the preoperative and postoperative values of such objective parameters in patients treated by type III, IV, and V excisions.

The results of the VHI questionnaire are detailed in Table 4.[30] In the first group (type I and II excisions), the VHI scores show a trend toward a postoperative decrease of the voice-related handicap in social activities. In fact, the 3 patients with the highest reported preoperative VHI scores (31 to 60, corresponding to moderate dysphonia) were classified after operation into a lower VHI category (scores of 0 and of 1 to 30, corresponding, respectively, to normal voice and slight dysphonia). By contrast, in the

TABLE 3. ACOUSTIC PARAMETERS

	Jitter (%)			*Shimmer (%)*			*Noise-to-Harmonics Ratio*		
	Preop	*Postop*	*p*	*Preop*	*Postop*	*p*	*Preop*	*Postop*	*p*
Controls									
Median	0.56			3.54			0.13		
25th percentile	0.41			3.14			0.11		
75th percentile	0.84			4.80			0.14		
Type I or II cordectomy (N = 26)									
Median	2.25	1.43	.008	6.75	6.52	.0008	0.16	0.15	.0009
25th percentile	0.85	0.92		5.76	4.73		0.14	0.13	
75th percentile	5.09	2.20		12.43	7.86		0.22	0.18	
Type III, IV, or V cordectomy (N = 25)									
Median	2.91	2.96	>.05	6.95	8.05	>.05	0.20	0.18	>.05
25th percentile	1.09	1.25		5.01	5.39		0.15	0.14	
75th percentile	4.11	5.02		13.75	11.76		0.30	0.22	

TABLE 4. DISTRIBUTION OF PATIENTS ACCORDING TO SCORE ON VOICE HANDICAP INDEX[30]

	Score 0		Score 1-30		Score 31-60		Score 61-90		Score 91-120	
Cordectomy	Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop
Type I or II (N = 26)	3	4	20	22	3	0	0	0	0	0
Type III, IV, or V (N = 25)	0	0	12	12	12	10	1	3	0	0

second group (types III, IV, and V), the VHI scores showed that most of the patients had an unvaried postoperative voice-related handicap.

DISCUSSION

Introduction of endoscopic cordectomy and, particularly in the past decade, of partial resection as described by several authors[5,7,8,10-15,22,31-33] prompts a detailed comparison among different types of cordectomy in relation to tumor extension and volume, expectations of the patient, and vocal results.

As described in previous reports, in our institution type I and II cordectomies are limited to patients with untreated Tis and T1 lesions of the mid-cord. Type III, IV, and V resections are, respectively, performed in patients with persistent erythroleukoplakias after random biopsies for diagnostic purposes alone, T1a lesions involving the entire vocal cord, and T1b lesions extending to the anterior commissure or to the contralateral cord.[11,12,27,28] The oncological results obtained with such a treatment policy are comparable to those described in the literature[7-9,13,32,34] and further confirm the validity of these indications.

A complete voice assessment including perceptual, objective, and subjective evaluation is mandatory whenever a meaningful analysis of the pathological voice and its treatment is to be accomplished.[35] The present study also confirms the substantial homogeneity of information coming from such a comprehensive vocal workup, even though statistical validation is limited to objective acoustic parameters.

Comparison of preoperative and postoperative vocal characteristics shows that patients treated by type I and II excisions can reasonably expect to improve their voice. According to previous studies, in fact, a normal vocal outcome is usually obtained after type I and II cordectomies.[27] Both perceptual and subjective evaluations show a clear trend toward postoperative reduction of the grade of dysphonia and of the severity of handicap in daily social and/or professional life. Moreover, statistically significant differences between preoperative and postoperative voices after type I and II excisions were evident when an ANCOVA was applied to the objective acoustic parameters.

In contrast, resection of most of the vocal muscle and of the anterior commissure has been demonstrated to worsen postoperative voice in comparison with normal controls.[5,7,27,36] In the present study, patients with type III, IV, and V cordectomies often had a tendency toward a permanent dysphonia and an important subjective voice-related disability. Statistical analysis of the objective data also shows that the postoperative voice is not significantly different from the preoperative condition in terms of jitter, shimmer, and NHR. Nevertheless, a slight degree of improvement is sometimes possible even after type V cordectomy. However, as a precautionary measure, during patient counseling, it is wise to predict that the voice will remain similar to the preoperative one after surgical treatment.

Recent publications have pointed out the possibility of performing a second phonosurgical procedure after transmuscular, total, or extended cordectomy in order to reduce the dysphonia resulting from such endoscopic treatments.[37,38] Even though these data are extremely encouraging, a span of disease-free time between endoscopic cordectomy and phonosurgery is always mandatory. Moreover, further treatments (both endoscopic and external approaches) are often necessary in order to obtain adequate vocal results; these treatments reduce patient compliance and the cost-effectiveness ratio.

Type I and II excisions can therefore be regarded as functionally adequate treatment, even for professional voice users. By contrast, in patients with tumors requiring more extended cordectomies, the disadvantages inherent to radiotherapy (duration of treatment, loss of time for work and social activities, higher rate of other possible complications, and partial preclusion of further conservative salvage surgery) could become acceptable.

In conclusion, on the basis of our results, endoscopic surgeons can adequately answer questions posed by the patient regarding postoperative voice, depending on the site and extent of tumor removal.

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