

LARYNGOLOGY

L. P. Bron · D. Soldati · M.-L. Monod · C. Mégevand
E. Brossard · P. Monnier · P. Pasche**Horizontal partial laryngectomy for supraglottic squamous cell carcinoma**

Received: 6 November 2003 / Accepted: 7 June 2004 / Published online: 14 August 2004

© Springer-Verlag 2004

Abstract Between 1981–1999, 75 patients treated for supraglottic SCC with horizontal supraglottic laryngectomy (HSL) at the Otolaryngology Head and Neck Surgery Department of Lausanne University Hospital were retrospectively studied. There were 16 patients with T1, 46 with T2 and 13 with T3 tumors. Among these, 16 patients (21%) had clinical neck disease corresponding to stage I, II, III and IV in 12, 39, 18 and 6 patients, respectively. All patients had HSL. Most patients had either elective or therapeutic bilateral level II–IV selective neck dissection. Six patients (8%) with advanced neck disease had ipsilateral radical and contralateral elective II–IV selective neck dissections. Adjuvant radiotherapy was given to 25 patients (30%) for either positive surgical margins ($n=8$), pathological nodal status ($n=14$) or both ($n=3$). Median follow-up was 48 months (range, 24–199). Five-year disease-specific survival and locoregional and local control were 92, 90 and 92.5%, respectively. Among five patients who were diagnosed with local recurrence, one had a total laryngectomy (1.4%); the others were treated by endoscopic laser surgery. Two patients had both a local and regional recurrence. They were salvaged with combined surgery and radiotherapy, but eventually died of their disease. Cartilage infiltration seems to influence both local control ($P=0.03$) and disease-specific survival ($P=0.06$). There was a trend for worse survival with pathological node involvement ($P=0.15$) and extralaryngeal extension of the cancer ($P=0.1$). All patients except one recovered a close to normal function after the treatment. Aspiration was

present in 16 patients (26%) in the early postoperative period. A median of 16 days (7–9) was necessary to recover a close to normal diet. Decannulation took a median of 17 days (8–93). Seven patients kept a tracheotomy tube for up to 3 months because of persistent aspiration. There was no permanent tracheostomy or total laryngectomy for functional purposes. Horizontal supraglottic laryngectomy remains an adequate therapeutic alternative for supraglottic squamous cell carcinoma, offering an excellent oncological outcome. The postoperative functional morbidity is substantial, indicating the need for careful patient selection, but good laryngeal function recovery is the rule. The surgical alternative is endoscopic laser surgery, which may offer comparable oncological results with less functional morbidity. Nevertheless, these two different techniques need to be compared prospectively.

Keywords Supraglottic squamous cell carcinoma · Horizontal partial laryngectomy · Functional laryngeal surgery

Introduction

There is no real consensus on the best treatment option for supraglottic squamous cell carcinoma. Single modalities using either surgery or radiotherapy alone or combined sequential therapy are different therapeutic options available [1, 2]. In 1947, Alonso [3] described horizontal partial laryngectomy (HPL) as a surgical treatment for supraglottic squamous cell carcinoma. This technique took several decades to gain widespread recognition, but, in the past 20 years, it has progressively replaced total laryngectomy for selected cancers. Radiation therapy is a recognized alternative treatment allowing preservation of laryngeal function. Provided patients are carefully selected, both treatments appear to offer comparable oncological and functional outcomes [4, 5, 6, 7].

In our department, functional laryngeal surgery has been the main line of treatment for selected glottic and supraglottic SCC for 20 years [8, 9]. We have usually kept en-

This paper was presented at the 2nd World Congress of the International Federation of Head and Neck Oncologic Societies, Rio de Janeiro, Brazil, 29 November–2 December 2002.

L. P. Bron (✉) · D. Soldati · M.-L. Monod · C. Mégevand
E. Brossard · P. Monnier · P. Pasche
Department of Otorhinolaryngology and Head and Neck Surgery,
Centre Hospitalier Universitaire Vaudois, CHUV BH-12/709,
1011 Lausanne, Switzerland
Tel.: +41-21-3142682,
e-mail: luc.bron@chuv.hospvd.ch

doscopy treatment as an alternative treatment to radiotherapy for early glottic cancers [10]. HPL, as described by Alonso [3], was mostly used for healthy patients presenting with stage II and above SCCs of the supraglottis. Advanced chronic respiratory disease was considered a contraindication. Thus, radiotherapy was kept as an adjuvant treatment or as a primary treatment modality for those patients medically unfit for functional laryngeal surgery still trying to avoid the morbidity of total laryngectomy.

Progressively introduced in the last 10 years, transoral CO₂ laser excision combined with surgery and/or radiotherapy to the neck seems to offer a valuable surgical alternative for the treatment of supraglottic primaries, with a more rapid recovery of laryngeal function [11, 12, 13]. We have recently introduced this technique in our department and are currently studying our results prospectively. During the past 18 years, our standard approach has been an open horizontal partial laryngectomy. This retrospective study of 75 patients analyzes the postoperative course, mortality and morbidity of this surgical approach to supraglottic cancer.

Subjects and methods

During the period of 1981 to 1999, 75 supraglottic partial laryngectomies were performed in the department of Otolaryngology and Head and Neck Surgery of Lausanne University Hospital. All clinical and pathological data were reviewed retrospectively. Among the 75 patients, there were 70 male and 5 female patients with a median age of 58 years (range, 32–75). The staging according to the 1983 American Joint Committee on Cancer Staging (AJCCS) is listed in Table 1.

Follow-up data were collected through bimonthly visits in our department for the first 2 years, extended to twice a year for the following years. Median follow-up was 48 months (range, 24–199). All patients presented with supraglottic squamous cell carcinoma. The tumor was confined to the laryngeal surface of the epiglottis extending into the larynx and the valleculae or tongue base in 68 (91%) and 7 (9%) patients, respectively. Patients with lateral extension to the pharynx were excluded. One patient had been treated previously with radiotherapy for a SCC of the epiglottis.

All patients had a pretherapeutic panendoscopy, including rigid broncho-esophagoscopy and direct laryngoscopy, to determine the extent of the tumor accurately and define the indication for surgery. Surgical treatment included HPL, along with bilateral neck dissection. The pharynx was systematically open at the tongue base to locate the anterior commissure and resect the thyroid cartilage precisely above the glottis, along with the entire epiglottis and the preepiglottic space. A pexy was then performed between the tongue base and the lower third of the thyroid cartilage. Our indication for this surgery was cancer of the supraglottis without ex-

ension into the vocal cords and minimal extension into the tongue base. The extent of neck surgery was dependent on the clinical status of the neck nodes, but all patients had at least a bilateral selective neck dissection, preserving the submandibular triangle, internal jugular vein, sternocleidomastoid muscle and spinal accessory nerve. Indication for adjuvant radiotherapy was as follows: positive or insufficient surgical margins and multiple neck nodes or extracapsular spread. If needed, radiotherapy courses were scheduled within 6 weeks postoperatively and delivered weekly over a period of 6 to 10 weeks to reach a total dose of 45–60 Gy. No patient had clinically positive neck disease treated with radiotherapy alone.

Statistical analysis was performed with JMP Statistics Made Visual software (SAS Institute Inc., Trunbull, Conn.). Means were compared by Student's *t*-test. Proportions were compared using a chi-square test for values greater than five and the Fisher's exact test for those less than or equal to five. Kaplan-Meier product-limit estimates were used to evaluate overall survival, cause-specific survival and local control in both groups. Univariate analysis of correlation of the following independent factors – age, tumor extension and pre- versus postoperative nodal disease – to local control and cause-specific survival was performed using the log-rank test. Multivariate analyses were done using the Cox stepwise regression analysis to determine the independent contribution of each prognostic factor.

Results

There were 16 (21%) therapeutic and 59 (79%) elective neck dissections. There were 69 bilateral selective level II–IV neck dissections, preserving the internal jugular vein, the spinal accessory nerve, the sternocleidomastoid muscle and the submandibular triangle. Six patients (8%) with clinically advanced disease (N3) had an ipsilateral radical neck dissection and a contralateral, selective, level II–IV dissection. The submandibular triangle was dissected on the ipsilateral side in two patients who initially presented with an oral second primary, which was treated surgically, at the same time.

Histopathology showed close or involved surgical margins in 16 patients (21%). Overall, 26 patients had pathologically positive lymph nodes (35%); of these, ten cases (15%) were occult nodal disease. Pathological staging is listed in Table 2. Adjuvant radiotherapy was indicated in 25 patients, by nodal status in 14 cases, positive surgical margins in 8 and both in 3.

Minor postoperative complications such as hematomas and neck infections affected four and two patients, respectively. Two patients presented a dehiscence pexy in the immediate postoperative period, which was diagnosed and immediately treated surgically without long-term consequences for the patients. Other medical complications included one pulmonary embolism, one deep venous throm-

Table 1 Distribution by clinical T and N stage

	T1	T2	T3	
N0	12	36	11	59
N1	0	3	1	4
N2	1	5	0	6
N3	3	2	1	6
Total	16	46	13	75

Table 2 Distribution by pathological T and N stage

	pT1	pT2	pT3	pT4	
pN0	12	28	7	2	49
pN1	1	6	4	0	11
pN2	0	8	2	0	10
pN3	3	1	0	1	5
Total	16	43	13	3	75

Table 3 Univariate analysis in 75 patients for local control and disease-free survival

	<i>n</i>	Five years local control		Five years disease-free survival	
		%	<i>P</i> value	%	<i>P</i> value
All patients	75	92.5		92.0	
Age					
<60 years	43	92.5	NS	92.5	NS
>60 years	32	92.4		91.2	
Primary site					
Extralaryngeal	7	83.3	NS	85.7	0.10
Endolaryngeal	68	93.3		92.6	
Cartilage infiltration					
Yes	3	66.6	0.03	66.6	0.06
No	72	93.6		93.1	
Surgical resection margin					
Positive	16	93.7	NS	91.6	NS
Negative	59	92.5		92.1	
Pathological N-status					
pN +	26	–	–	86.6	0.15
pN 0	49	–	–	95.0	
Postoperative radiation					
Yes	25	95.8	NS	94.8	0.15
No	50	90.6		86.6	

bosis and two pneumonias. They could all be managed during hospitalization. No patient died during the postoperative period.

The overall 5-year local and locoregional control rate was 92.5 and 90%, respectively. Local recurrence only was the cause of failure in three patients. Two of them were salvaged surgically, retaining their larynx. One had a total laryngectomy for a deep recurrence in the tongue base. Another two patients had both a local and regional failure. They were treated with combined surgery and radiation therapy. One patient was salvaged, but the second died of his disease. Neck recurrence alone occurred in three patients. Salvage treatment was surgical and successful in one of them. Globally, five of eight locoregional recurrences were salvaged successfully. The ultimate 5-year locoregional control was then 95% with a 98.5% laryngeal preservation rate. With 100% 5-year local control for pT1, 91% for pT2, 92 and 66% for pT3 and pT4, respectively, pathological T-stage did not appear to influence significantly local control for pT1–pT3 tumors. Probably due to the small number of recurrences encountered, infiltration of the larynx skeleton (pT4 vs. pT1–3) was the only variable showing an impact on local control ($P < 0.03$) (Table 3).

Distant spread of disease was the cause of failure in six patients. Distant metastasis involved the liver, lung and bone. The overall 5-year incidence of distant metastasis was 6.9%.

On initial panendoscopy, four patients (5%) were diagnosed with early stage synchronous second primary cancers in the oral cavity, the larynx and the lung. During regular follow-up, 17 (23%) metachronous cancers were diagnosed. They involved the upper aerodigestive tract, lung and esophagus in nine, seven and one patients, respectively. The median time of detection of these second

Table 4 Causes of death

Cause of death	No. of patients	%
TNM related death		
Local recurrence	1	1
Neck recurrence	2	2
Metastasis	4	5
Second primary tumor	9	12
Other cancer	2	3
Intercurrent disease	18	24

primaries was 71 months (range 4–200). Treatment was surgical in all cases, except for the esophageal second primary, which was diagnosed at a very early stage and was successfully treated with endoscopic photodynamic therapy. Of those 17 patients, 9 died from their second cancer.

The 5-year overall and cause-specific actuarial survival rates were 75 and 92%, respectively. Causes of death are summarized in Table 4. Survival appeared not to be influenced by the size of the primary. Disease-specific survival by pathological T-stage was 93, 91, 100 and 66% for pT1, pT2, pT3 and pT4, respectively. Extension of the cancer into the cartilaginous framework of the larynx, however, seems to have an influence, but did not reach statistical significance. There was also a trend for worse survival when the primary cancer extends into the oropharynx and when neck nodes are involved. Because of the relatively small number of cases, none of these variables reached statistical significance (Table 3).

Postoperatively, the median time for decannulation was 17 days (range 8–93). For 16 patients (21%), aspiration delayed closure of the tracheotomy. Of those, seven

patients (9%) were discharged with a tracheotomy and a nasogastric feeding tube. All of them were eventually decannulated and able to swallow in a maximum period of 3 months, providing intensive swallowing rehabilitation. One patient became aphagic after radiotherapy because of cricopharyngeal muscle stenosis. He then needed insertion of a percutaneous gastrostomy and has not been able to eat since, even after multiple endoscopic dilatations. There was no total laryngectomy for failure to recover function.

Discussion

Optimal management of supraglottic cancers aiming at the best possible cure and functional conservation has been a matter of debate between surgeons and radiation oncologists for many years. We have reviewed a series of 75 patients with supraglottic SCC treated primarily with HPL.

Cancers of the supraglottis are efficiently treated with functional surgery, which achieves a very good local control of the disease in early lesions. But, more advanced primaries are less likely to be treated by surgery alone, notably when the tumor extends into the base of the tongue, laryngeal cartilages or paralaryngeal spaces [4, 5, 14]. For stage I and II diseases, both Bocca et al. [4] and DeSanto [5] report between 85–100% local control at 3 years after treatment with HPL in series of 537 and 70 patients, respectively. Advanced stage of disease is usually accompanied with a drop in local control, in particular for T4 cancers [4, 15]. Most of the recurrences present in the tongue base, but salvage treatment is efficient, even if it often requires a total laryngectomy. Adjuvant radiotherapy improves both local control and survival in cases with advanced neck disease or positive surgical margin and is therefore considered standard in these settings [14, 16].

With primary radiotherapy more so than surgery, recurrence rates are dependent on the primary tumor volume and the degree of pre-epiglottic space infiltration, as seen on CT examination [17]. Local control varies greatly with stage between 100 to 27% from T1 to T4 cancers, respectively [7, 18]. In case of recurrence, surgical salvage is efficient, but requires a total laryngectomy in up to 30% of cases, even for patients initially eligible for a functional procedure [7, 18, 19]. Failure in the neck is a significant problem in supraglottic cancer and impacts on patient survival [2, 6, 15, 16]. Whereas positive neck nodes require combined surgery and radiotherapy [7, 16], the management of the clinically negative neck at present is still controversial.

The percentage of occult nodal disease is around 30% [5, 6, 20]. Unilateral treatment, based on the initial localization of the primary, is insufficient and carries a high risk of failure in the contralateral neck [5, 6, 15]. Bilateral irradiation appears effective in eradicating occult metastasis in both sides of the neck, but carries significantly more long-term morbidity than elective surgical treatment [5, 6]. It therefore has been our attitude to perform systemat-

ically bilateral anterior (level II–IV) neck dissection as both a therapeutic and diagnostic measure and to use combined therapy, with adjuvant radiotherapy, when necessary. Our findings of 35% pathological neck disease and our extremely low rate of regional recurrence (8%) support our practice. Despite the relatively low percentage of occult nodal disease (15%) in our series, we preferred bilateral selective neck dissection, preserving the submandibular triangle, internal jugular vein, sternocleidomastoid muscle and spinal accessory as it carries hardly no morbidity compared to a bilateral prophylactic irradiation.

Using primary surgery and adjuvant radiotherapy, our global 5-year local control rate was 92.5%. With 100, 91, 92 and 66% for T1, T2, T3 and T4, respectively, our results compare favorably with previously published data [4, 5, 14, 15]. Among eight patients who recurred, three failed at the primary site only. They could all be salvaged, with one patient losing his larynx. The other five patients failed in the neck. Combined surgery and radiotherapy salvaged two patients, but three could not be controlled and eventually died of their disease. Our 5-year overall loco-regional control was then 95% with a 98.5 laryngeal conservation rate.

Despite our good 92% disease-free survival rate at 5 years, the overall 5-year survival was 75%, mainly because of second primary cancers. Mostly found in the lung, they are diagnosed on routine follow-up radiological examination and often confirmed endoscopically. The high incidence of metachronous cancers is a recognized problem of head and neck cancers, especially in survivors of laryngeal cancers [9, 21]. Despite systematic pretherapeutic broncho-esophagoscopy, regular postoperative follow-up and broncho-esophageal cytological studies with control panendoscopies at 2 years, patients appeared to present with aggressive second primaries in the lung, which are often fatal [22]. In addition, with such a high loco-regional control rate, distant metastases are beginning to have a significant impact on survival, a phenomenon that we have previously noticed in glottic cancers [9]. Some authors advocate the use of neoadjuvant chemotherapy before surgery for laryngeal cancers. Thus, they intend to control some of the early tumoral dissemination and effectively achieve better survival [23].

Our functional results were satisfactory. Normal laryngeal function, with removal of the tracheostomy tube and a close to normal diet, was reached in 80% of the patients within a month. Recovery of a good swallowing function was delayed in 16 patients. However, they were all decannulated and able to eat in the first 3 months after the surgery. No completion laryngectomy for intractable aspiration was needed. With 98.5%, our overall laryngeal preservation rate compares favorably with previously published data reporting 98 to 93% laryngeal preservation rates after surgery [14, 24] and 84% after radiotherapy [18]. Recovering a close to normal swallowing function after HPL is often a major problem, and an increased incidence of life-long gastrostomy has been reported [25, 26]. In our series, only one patient, who presented with cricopharyngeal muscle stenosis after adjuvant radiother-

apy, required a percutaneous gastrostomy and never recovered normal swallowing, despite multiple attempts at endoscopic dilatation. However, open surgery of the larynx remains a serious undertaking for some patients whose general health condition, notably respiratory, may not allow the transient postoperative loss of laryngeal function.

Conclusion

With careful selection of the patients, HPL, along with adjuvant radiotherapy, is a suitable treatment option for supraglottic SCC. Postoperative recovery of laryngeal function is the rule, and long-term sequelae are infrequent, with 60% of the patients avoiding adjuvant treatment. For the initial early stage of the disease (stages I–II), radiotherapy seems to offer a similar outcome with less immediate functional morbidity. However, in patients initially suitable for functional surgery, salvage of local failure most often requires a total laryngectomy. Based on these results, our first line of treatment for supraglottic cancers remains surgical.

Transoral CO₂ laser resection of these cancers controls early stages of the disease with efficiency comparable to open surgery and carries less laryngeal morbidity. This fairly new approach has brought promising results and offers an excellent alternative treatment for selected patients. Following the publication of numerous convincing reports, we have recently introduced transoral CO₂ laser resections in our department and are prospectively collecting data to compare endoscopic with open transcervical horizontal partial laryngectomies

References

- DeSanto LW (1985) Cancer of the supraglottic larynx: a review of 260 patients. *Otolaryngol Head Neck Surg* 93:705–711
- Spaulding CA, Hahn SS, Constable WC (1987) The effectiveness of treatment of lymph nodes in cancers of the pyriform sinus and subglottis. *Int J Radiat Oncol Biol Phys* 13:963–968
- Alonso JM (1947) Conservative surgery of cancers of the larynx. *Trans Am Acad Ophthalmol Otolaryngol* 51:633–642
- Bocca E (1991) Surgical management of supraglottic cancer and its lymph nodes metastases in a conservative perspective. *Ann Otol Rhinol Laryngol* 100:261–267
- DeSanto LW (1990) Early supraglottic cancer. *Ann Otol Rhinol Laryngol* 99:593–597
- Levendag P, Vikram B (1987) The problem of neck relapse in early stage supraglottic cancer – results of different treatment modalities for the clinically negative neck. *Int J Radiat Oncol Biol Phys* 13:1621–1624
- Mendenhall WM, Parsons JT, Mancuso AA (1996) Radiotherapy for squamous cell carcinoma of the larynx: an alternative to surgery. *Head Neck* 18:24–35
- Bron L, Brossard E, Monnier P, Pasche P (2000) Supracricoid partial laryngectomy with cricothyroidoepiglottopexy and cricothyroidopexy for glottic and supraglottic carcinomas. *Laryngoscope* 110:627–634
- Bron LP, Pasche P, Monnier P, Schweizer V (2002) Functional analysis after supracricoid partial laryngectomy with CHEP or CHP. *Laryngoscope* 112:1289–1293
- Bron LP, Soldati D, Zouhair A, Ozsahin M, Brossard E, Monnier P, Pasche P (2001) Treatment of early stage squamous cell carcinoma of the glottic larynx: endoscopic surgery or cricothyroidoepiglottopexy versus radiotherapy. *Head Neck* 23:823–829
- Ambrosch P, Kron M, Steiner W (1998) Carbon dioxide laser microsurgery for early supraglottic carcinoma. *Ann Otol Rhinol Laryngol* 107:680–688
- Iro H, Waldfahrer F, Altendorf-Hofmann A, Weidenbecher M, Sauer R, Steiner W (1998) Transoral laser surgery for supraglottic cancer. *Arch Otolaryngol Head Neck Surg* 124:1245–1250
- Rudert HH, Werner JA, Höft S (1999) Transoral carbon dioxide laser resection of supraglottic carcinoma. *Ann Otol Rhinol Laryngol* 108:819–827
- Lee NK, Goepfert H, Wendt CD (1990) Supraglottic laryngectomy for intermediate-stage cancer: U.T. M.D. Anderson cancer center experience with combined therapy. *Laryngoscope* 100:831–836
- Lutz CK, Johnston JT, Wagner RL, Myers EN (1990) Supraglottic carcinoma: patterns of recurrence. *Ann Otol Rhinol Laryngol* 99:12–17
- Nicolai P, Redalli LO, Tomenzoli D, Barezzani MG, Bertoni F, Bignardi M, Antonelli AR (1997) Prognostic determinants in supraglottic carcinoma: univariate and Cox regression analysis. *Head Neck*:323–334
- Freeman DE, Mancuso AA, Parsons JT, Mendenhall WM, Million RR (1990) Irradiation alone for supraglottic larynx carcinoma: can CT findings predict treatment results. *Int J Radiat Oncol Biol Phys* 19:485–490
- Spaulding CA, Krochak RJ, Hahn SS, Constable WC (1986) Radiotherapeutic management of cancer of the supraglottis. *Cancer* 57:1292–1298
- Mendenhall WM, Parsons JT, Stringer SP, Cassisi NJ (1997) Radiotherapy for carcinoma of the supraglottis. *Otolaryngol Clinics North Am* 30:145–161
- Spaulding CA, Constable WC, Levine PA, Cantrell RW (1989) Partial laryngectomy and radiotherapy for supraglottic cancer: a conservative approach. *Ann Otol Rhinol Laryngol* 98:125–129
- Grosjean P, Pasche P, Monnier P (2000) Die Frühdiagnose von Karzinomen im Kopf- und Halsbereich. Interventionelle und diagnostische Bronchologie. Herausgegeben K. Wassermann. München-Deisenhofen. Dustri-Verlag
- Licciardello JT, Spitz MR, Hong MPH, Hong WK (1989) Multiple primary cancer in patients with cancer of the head and neck: second cancer of the head and neck, oesophagus and lung. *Int J Radiat Oncol Biol Phys* 17:467–476
- Laccourreye O, Muscatello L, Laccourreye L, Naudo P, Brasnu D, Weinstein G (1997) Supracricoid partial laryngectomy with cricothyroidoepiglottopexy for “early” glottic carcinoma classified as T1-T2N0 invading the anterior commissure. *Am J Otolaryngol* 18:385–390
- Bocca E, Pignataro O, Oldini C (1983) Supraglottic laryngectomy: 30 years of experience. *Ann Otol Rhinol Laryngol* 92:14–18
- Spriano G, Antognoni P, Sanguinetti G, Sormani M, Richetti A, Ameli F, Piantanida R, Luraghi R, Magli A, Corvo R, Tordiglione M, Vitale V (2000) Laryngeal long-term morbidity after supraglottic laryngectomy and postoperative radiation therapy. *Am J Otolaryngol* 21:14–21
- Steiniger JR, Parnes SM, Gardner GM (1997) Morbidity of combined therapy for the treatment of supraglottic carcinoma: supraglottic laryngectomy and radiotherapy. *Ann Otol Rhinol Laryngol* 106:151–158