Eur Arch Otorhinolaryngol (2010) 267:107–111
DOI 10.1007/s00405-009-0968-x

HEAD AND NECK

Predicting facial nerve invasion by parotid gland carcinoma and outcome of facial reanimation

M. Preis · E. Soudry · G. Bachar · H. Shufel · R. Feinmesser · T. Shpitzer

Received: 7 January 2009 / Accepted: 18 March 2009 / Published online: 7 April 2009

Abstract We sought to define risk factors for facial nerve involvement in parotid gland carcinoma and assess the outcome of facial nerve reanimation. Medical records were reviewed of 66 patients who underwent surgery for parotid carcinoma in 2000–2007 at a tertiary hospital. Patient and tumor characteristics were compared between patients with and without facial nerve involvement and were analyzed on their influence on functional outcome following reanimation. Facial nerve involvement was verified intraoperatively in 24 patients, of whom 16 underwent reanimation during ablative surgery. Deep lobe invasion was significantly associated with intraoperative finding of facial nerve involvement. Tumors larger than 4 cm and salivary duct carcinoma had an obvious trend for facial nerve involvement. House-Brackmann score at 12 months was 3–4 in most patients. Deep lobe involvement and large tumor size may identify patients at risk of facial nerve involvement. Reanimation is associated with good functional outcome regardless of patient's age.

Keywords Malignant parotid tumors · Seventh nerve involvement · Risk factors · Functional results

M. Preis and E. Soudry have contributed equally to this study.

M. Preis · E. Soudry · G. Bachar · H. Shufel · R. Feinmesser · T. Shpitzer (✉)
Department of Otolaryngology and Head and Neck Surgery, Rabin Medical Center, Beilinson Campus, 49100 Petach Tikva, Israel
e-mail: thomas-s@zahav.net.il

M. Preis · E. Soudry · G. Bachar · H. Shufel · R. Feinmesser · T. Shpitzer
Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel

Introduction

Carcinoma of the parotid gland accounts for 14–25% of all parotid lesions and 3–6% of all head and neck cancers [1]. The malignant lesions are histologically and biologically variable. The most prevalent are mucoepidermoid, adenoid cystic, and acinic cell carcinomas [2]. Treatment traditionally consisted of radical parotidectomy [3], but recent advances in our understanding of tumor biology and the benefits of radiotherapy have led to a more conservative approach. Most head and neck surgeons today agree that the facial nerve can be spared providing the nerve is not involved. In the minority of cases (9–25%) in which the tumor is adherent to or surrounds the nerve it should be sacrificed [3–5]. Preoperative facial nerve palsy is a definite indication for its involvement by the tumor, but when the facial nerve function is intact there are no accurate preoperative known criteria for prediction of its involvement [6].

In light of the dramatic consequences of facial nerve resection in terms of both function and quality of life, preoperative knowledge of facial nerve involvement can help for better planning including microsurgical team and patient preparation.

The purpose of the present study was to define the risk factors for involvement of the facial nerve in parotid carcinoma and to examine the results of facial nerve reanimation.

Materials and methods

The study was approved by the institutional research committee. We reviewed the clinical records of all patients who underwent parotid surgery between 2000 and 2007 at a university-affiliated medical facility. The following data

were collected: patient gender and age; facial pain at presentation; facial palsy at presentation; size of the parotid lesion; deep lobe involvement; extent of surgery (superficial, subtotal/total, radical); findings of facial nerve involvement at surgery (described in the operative report as an inability to separate the tumor from the nerve); histologic findings; lymph node involvement; postoperative radiotherapy; postoperative facial palsy; and recurrence. We used the House-Brackmann scale to assess functional outcome [7].

All parotidectomies were performed by experienced head and neck surgeons via a modified Blair incision. The facial nerve stem was identified by standard landmarks (tragal pointer, posterior belly of the digastric muscle, and the tympanomastoid suture line). In some cases, the facial nerve was identified with the retrograde technique, that is, by identifying the end of the distal branch and then following the branch proximally toward the nerve stem. Facial nerve branches that were encased within the tumor were included in the resection. A cable graft was harvested for reanimation from the greater auricular or sural nerves, and microscopic epineural repair was performed with 9.0 nylon sutures.

For patients who underwent reanimation, we also collected data on length of the cable graft and facial nerve function 12 months postoperatively. In addition, reanimation outcome was evaluated by patient age and sex and administration of postoperative radiotherapy.

The data were analyzed using SPSS version 15.0.1. Chi-square test was used to compare categorical variables between groups, and *t* test or nonparametric Kruskal–Wallis and Mann–Whitney tests, as necessary, were used for continuous variables. The data were entered into a logistic regression model to identify variables that were independently associated with facial nerve involvement in the tumor. A *P* value of less than 0.05 was considered statistically significant.

Results

Study sample

During the study period, 267 parotidectomies were performed at our institute. The most common histologic diagnosis was pleomorphic adenoma. Surgery for malignancy (primary and metastatic) was performed in 66 patients: 41 men (62.1%) and 25 women (37.9%) aged 29–93 years (mean 66.92, SD 15.06).

Facial nerve integrity was confirmed at surgery in 42 patients (24 men, 58.5% and 18 women, 72%; mean age 66.17 years) and facial nerve involvement, partial or complete, was found in 24 patients (17 men, 41.5%, and 7 women, 28%; mean age 68.25 years). There were no statistically significant differences in gender distribution or mean age between patients with or without facial involvement.

Preoperative findings

Facial palsy at presentation was found in eight patients. In all of them (100%) the facial nerve was discovered during surgery to be involved in the tumor. In 16 additional patients without facial palsy, preoperatively (27.6%), the facial nerve was found to be encased in the tumor during surgery.

Pain was a presenting symptom in seven patients, of whom four had facial nerve involvement (57%). Of the 59 patients without pain, 20 (33.8%) had facial nerve involvement. This finding was not statistically significant ($P = 0.207$).

Lesion size on preoperative imaging studies (ultrasound, computed tomography, or magnetic resonance imaging) ranged from 5 mm to 9 cm (mean 35 mm, SD 16). There was no difference in mean lesion size between the patients with (40.3 mm, SD 15) or without (32.5 mm, SD 16) facial involvement ($P = 0.072$). However, tumors larger than 4 cm were associated with facial nerve involvement in 50% of cases.

All patients underwent preoperative imaging, either computed tomography (CT) or magnetic resonance imaging (MRI). Some patients in whom malignant tumors were not suspected preoperatively underwent ultrasonography only. Invasion of the deep lobe, as evidenced by invasion into the parapharyngeal space, was revealed in 19 patients preoperatively, 16 (84.2%) of whom were found to have facial nerve involvement during surgery. Of the 47 patients without preoperative evidence of deep lobe invasion, 8 (17%) were found to have facial nerve involvement during surgery. This difference was statistically significant ($P = 0.0001$).

Operative results

The 42 patients without facial nerve involvement underwent superficial ($n = 32$) or subtotal/total ($n = 10$) parotidectomy with preservation of the facial nerve. The remainder underwent radical parotidectomy with resection of the facial nerve ($n = 8$) or with immediate reconstruction ($n = 16$). In eight patients with facial nerve involvement, reanimation was not performed due to extensive tumor infiltration of the distal nerve endings ($n = 2$), advanced age (more than 88 years; $n = 2$), or long-standing preoperative facial palsy ($n = 4$). Cable graft repair was used in 15 patients; the greater auricular nerve served as the source in 13 and the cervical plexus in 2. In the remaining patient, in whom the gap was small, end-to-end anastomosis was performed.

Neck dissection was performed in 37 patients. The results are shown in Table 1. The presence of positive lymph nodes was not a statistically significant risk factor for facial nerve involvement.

Histologic findings

The histologic diagnoses are summarized in Table 2. Five of seven patients (71.4%) with salivary duct carcinoma had involvement of the facial nerve. We did not find any difference in histology of tumors with deep lobe invasion with and without facial nerve involvement.

Postoperative radiotherapy

Fifty-one patients (77.3%) received postoperative radiotherapy, including all of the patients who underwent reanimation of the facial nerve.

Table 1 Neck dissection status and facial nerve involvement in 66 patients with parotid carcinoma

Neck status	Facial nerve involved	Facial nerve not involved	Total
No dissection	9 (31%)	20 (69%)	29
Dissection	15 (40.5%)	22 (59.4%)	37
Negative dissection	7 (41.2%)	10 (58.8%)	17
One positive node	5 (38.5%)	8 (61.5%)	13
Two or more positive nodes	3 (42.9%)	4 (57.1%)	7

Table 2 Histological diagnoses and facial nerve involvement in 66 patients with parotid carcinoma

Histology	Facial nerve involved	Facial nerve not involved	Total
SCC	6 (33.3%)	12 (66.7%)	18
Mucoepidermoid	2 (50%)	2 (50%)	4
Acinic cell ca.	2 (25%)	6 (75%)	8
Salivary duct ca.	5 (71.4%)	2 (28.6%)	7
Expleomorphic ca.	4 (36.4%)	7 (63.6%)	11
Melanoma	1 (33.3%)	2 (66.7%)	3
Adenoid cystic	1 (33.3%)	2 (66.7%)	3
Other[a]	3 (25%)	9 (75%)	12
Total	24	42	66

SCC squamous cell carcinoma

[a] Other histologies include: Merkle cell (2), adenosquamous (2), mucinous (2), epithelial-myoepithelial, malignant myoepithelial, poorly differentiated, undifferentiated, malignant mixed tumor, malignant Schwannoma

Functional outcome

At 12 months postoperation, nine patients had a House-Brackmann score of 3, three patients had a score of 4, and two patients had a score of 6. The other two patients died within 2 months of surgery. The functional outcome as assessed by the House-Brackmann score was unaffected by patient age or gender, cable graft length, or lesion size.

Discussion

The present study describes one center's 7-year experience with treating parotid cancer. We retrospectively analyzed preoperative clinical and imaging factors and the postoperative histology data to determine their association with an intraoperative finding of facial nerve involvement. Significant results were noted for a preoperative clinical finding of facial nerve palsy and preoperative imaging evidence of deep lobe invasion. Large tumors had an obvious trend for facial nerve involvement, though the results were not statistically significant. We did not find any difference in age, gender, pain at presentation and presence of positive lymph nodes between patients with and without facial nerve involvement. The predominance of acinic cell, expleomorphic, and salivary duct carcinoma in our patients is surprising in light of earlier reports wherein the most common type of malignant tumor was mucoepidermoid carcinoma [2]. Salivary duct carcinoma appeared to be closely, albeit not significantly, associated with facial nerve involvement (71.4% of patients). The rates for the other histologic diagnoses ranged from 25 to 50%.

Early prediction of a high risk of facial nerve involvement by malignant parotid tumors is important for treatment planning and patient counseling.

At present, facial palsy at presentation is the only predictor of invasion of the facial nerve by tumor cells, and it is the only indication of the possible need for radical parotidectomy and facial reanimation.

Most studies published so far assessed the risk of postparotidectomy facial nerve palsy. They identified several risk factors for nerve damage and dysfunction: older age [8–10], possibly owing to the reduced regenerative ability of the facial nerve with time; deep lobe involvement [10], and large tumor size [11]. Only very few studies, however, investigated the preoperative prediction of facial nerve involvement by parotid neoplasms. Bendet et al. [12] found that even when facial function is clinically intact, a low response to preoperative electroneuronography could indicate facial nerve involvement: the lower the preoperative response, the poorer the expected postoperative facial nerve

function. Divi et al. [13] reported that cross-sectional imaging with computed tomography and magnetic resonance imaging had a high negative predictive value for facial nerve involvement.

Sacrifice of the facial nerve results in both functional and aesthetic deficits that can be emotionally traumatizing to the patient. Cable nerve grafting has been successfully utilized to rehabilitate patients following radical parotidectomy [14, 15]. The functional results of the reanimation procedure in our department are in accordance with those reported in the literature.

The effect of radiation on functional outcome after cable grafting is still controversial. Several authors argued that it has a detrimental effect on the return of facial function and advocated the use of muscle transfers and static slings in patients in whom postoperative radiotherapy was planned [16, 17]. Others, however, noted an adequate return of function with interposition nerve grafts despite the administration of postoperative radiotherapy [18, 19]. In the present study, all patients who underwent a reanimation procedure received postoperative radiation. Without a control group, it is impossible to discuss a potential detrimental effect, although by 12 months after surgery, most of our patients had achieved good to moderate function.

Although in some studies, functional outcome after facial nerve reanimation was lower in older than in younger patients [20, 21], we found no such difference. The two patients with the worst functional scores (House-Brackmann 6) were 69 and 74 years old, whereas patients who were 76, 80 and 84 years old achieved good function (House-Brackmann 3).

This study was limited by the small study group, owing to the rarity of parotid carcinoma, and the even rarer cases requiring facial nerve resection. Further studies including a larger number of patients are needed.

Conclusions

Preoperative imaging evidence of invasion of the deep lobe and large tumor size are risk factors for facial nerve involvement in parotid carcinoma. Patient age and gender, pain at presentation and presence of positive lymph nodes were not significantly associated with facial nerve involvement. Salivary duct carcinoma appeared to be closely associated with facial nerve involvement. These findings have important implications for the preoperative identification of patients at risk of radical parotidectomy. Such knowledge would help counselors emotionally prepare patients for the outcome and would allow surgeons to prepare preoperatively for a possible reanimation procedure during ablative surgery.

Conflict of interest statement The authors have no financial conflict of interest.

References

1. Zbären P, Schüpbach J, Nuyens M, Stauffer E, Greiner R, Häusler R (2003) Carcinoma of the parotid gland. Am J Surg 186:57–62. doi:10.1016/S0002-9610(03)00105-3
2. Huang CC, Tseng FY, Chen ZC, Hsu CJ, Ko JY, Lou PJ et al (2007) Malignant parotid tumor and facial palsy. Otolaryngol Head Neck Surg 136:778–782. doi:10.1016/j.otohns.2006.10.043
3. Spiro JD, Spiro RH (2003) Cancer of the parotid gland: role of 7th nerve preservation. World J Surg 27:863–867. doi:10.1007/s00268-003-7112-7
4. Spiro RH, Huvos AG, Strong EW (1975) Cancer of the parotid gland: a clinicopathologic study of 288 primary cases. Am J Surg 130:452–459. doi:10.1016/0002-9610(75)90483-3
5. Spiro RH (1986) Salivary neoplasms: overview of a 35 year experience with 2,807 patients. Head Neck Surg 8:77–84. doi:10.1002/hed.2890080309
6. Dailiana T, Chakeres D, Schmalbrock P, Williams P, Aletras A (1997) High resolution MR of the intraparotid facial nerve and parotid duct. AJNR Am J Neuroradiol 18:165–172
7. House JW, Brackmann DE (1985) Facial nerve grading system. Otolaryngol Head Neck Surg 93:146–147
8. Gaillard C, Perie S, Susini B, St Guily JL (2005) Facial nerve dysfunction after parotidectomy: the role of local factors. Laryngoscope 115:287–291. doi:10.1097/01.mlg.0000154735.61775.cd
9. Laccourreye H, Laccourreye O, Cauchois R, Jouffre V, Ménard M, Brasnu D (1994) Total conservative parotidectomy for primary benign pleomorphic adenoma of the parotid gland: a 25-year experience with 229 patients. Laryngoscope 104:1487–1494
10. Marchesi M, Biffoni M, Trinchi S, Turriziani V, Campana FP (2006) Facial nerve function after parotidectomy for neoplasms with deep lobe localization. Surg Today 36:308–311. doi:10.1007/s00595-005-3146-9
11. Dulguerov P, Marchal F, Lehmann W (1999) Postparotidectomy facial nerve paralysis: possible etiologic factors and results with routine facial nerve monitoring. Laryngoscope 109:754–762. doi:10.1097/00005537-199905000-00014
12. Bendet E, Talmi YP, Kronenberg J (1998) Preoperative electroneurography (ENoG) in parotid surgery: assessment of facial nerve outcome and involvement by tumor—a preliminary study. Head Neck 20:124–131. doi:10.1002/(SICI)1097-0347(199803)20:2<124::AID-HED5>3.0.CO;2-4
13. Divi V, Fatt MA, Mukherji SK, Bradford CR, Chepeha DB, Wolf GT et al (2004) Use of cross-sectional imaging in predicting facial nerve sacrifice during surgery for parotid neoplasms. ORL J Otorhinolaryngol Relat Spec 66:262–266. doi:10.1159/000081123
14. Conley JJ (1957) Facial rehabilitation following radical parotid gland surgery. Arch Otolaryngol 66:58–66
15. Fisch U, Lanser MJ (1991) Facial nerve grafting. Otolaryngol Clin North Am 24:691–708
16. Lathrop F (1963) Management of the facial nerve during operations on the parotid gland. Ann Otol Rhinol Laryngol 72:780–801
17. Pillsbury HC, Fisch U (1979) Extratemporal facial nerve grafting and radiotherapy. Arch Otolaryngol 105:441–446
18. Conley JJ (1961) Facial nerve grafting. Arch Otolaryngol 73:322–327
19. McGuirt WF, Welling B, McCabe BF (1989) Facial nerve function following irradiated cable grafts. Laryngoscope 99:27–34. doi:10.1288/00005537-198901000-00007

20. Guntinas-Lichius O, Streppel M, Stennert E (2005) Postoperative functional evaluation of different reanimation techniques for facial nerve repair. Am J Surg 191:61–67. doi:10.1016/j.amjsurg.2005.05.054

21. Reddy PG, Arden RL, Mathog RH (1999) Facial nerve rehabilitation after radical parotidectomy. Laryngoscope 109:894–899. doi:10.1097/00005537-199906000-00010