Lateral Temporal Bone Resection in Advanced Cutaneous Squamous Cell Carcinoma: Report of 35 Patients

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Abstract

Objective To evaluate lateral temporal bone resection (LTBR) in the management of advanced cutaneous squamous cell carcinoma (SCC) with temporal bone invasion and patterns of failure.

Methods This is a retrospective study of 35 patients undergoing lateral temporal bone resection for advanced cutaneous SCC at a tertiary care center between 1995 and 2006.

Results The Pittsburgh tumor stage was T4 in 18 patients (51%), T3 in 5 (14%), T2 in 9 (26%), and T1 in 3 (9%). Clear margins were reported in 22 (63%) patients. Resection of the mandible and/or temporomandibular joint (TMJ) was required in 11 (31%) patients. Facial nerve involvement was seen in 10 (29%) patients. Survival outcomes at 2 and 5 years for overall survival were 72% and 49%; disease-free survival, 68% and 59%; and disease-specific survival, 79% and 62%, respectively. Pittsburgh T stage correlated significantly with disease-specific survival ($p = 0.015$) and margin status was significant for both disease-free survival ($p = 0.0015$) and disease-specific survival ($p < 0.001$).

Conclusions Surgery with curative intent is justified for cutaneous SCC invading the temporal bone with extended LTBR. Margin status was a significant predictor of outcome. Surgeons should plan preoperatively to achieve clear margins by extending the LTBR with possible nerve resection.

Keywords

- temporal bone
- cutaneous malignancy
- squamous cell carcinoma
- temporal bone resection

Introduction

Nonmelanoma skin cancer is the most common malignancy worldwide,¹ with 75% of these lesions arising in the head and neck.^{2–4} In males, periauricular lesions are the second most

common site for cutaneous squamous cell carcinoma (SCC).⁵ Head and neck skin cancers have reached epidemic proportions in areas of high sun exposure (such as Australia), where the annual incidence of nonmelanoma skin cancer is nearly

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1,200/100,000 people and the incidence of SCC is 387/100,000 people.⁴

Periauricular lesions have been shown to be a high-risk subsite for development of SCC metastases,⁶ and patients with advanced periauricular cutaneous malignancies represent a considerable proportion of patients with disease invading the temporal bone.⁷ This study specifically evaluates patients with advanced cutaneous SCC invading the temporal bone that were treated with lateral temporal bone resection (LTBR). Prognostic variables including preoperative facial nerve dysfunction and margin status were evaluated for their survival impact. Technical aspects of surgical resection were evaluated to assess for potential impact on disease-free outcomes.

Materials and Methods

A retrospective analysis was performed to identify all patients who underwent lateral temporal bone resection between 1995 and 2006 at the Queensland Skull Base Unit at the Princess Alexandra Hospital. All patients underwent formal staging at the head and neck tumor board using the Pittsburgh tumor staging system (modified)⁸ (►Table 1). The extent of disease was determined by clinical examination and imaging with computed tomography (CT) and/or magnetic resonance imaging (MRI). Final pathology specimens were used to corroborate initial clinical stage.

Lateral temporal bone resection was defined as removal of the structures lateral to the facial nerve and otic capsule, and this was performed in an en bloc fashion. As previously described, a mastoidectomy is performed and the specimen is removed lateral to the facial nerve, jugular vein, and internal carotid artery.⁹ Every attempt was made to spare the facial nerve. Extended LTBR consisted of the previously mentioned procedure with additional en bloc peripheral margins including temporomandibular joint (TMJ), zygoma, and infratemporal fossa. Neck dissections were performed in all patients with nodal disease. In patients with high probability for nodal spread, a functional neck dissection and/or

parotidectomy was performed to address first and second echelon nodes that could harbor occult metastases. The type of parotidectomy (total versus superficial) was at the discretion of the operating surgeon, and this decision was made intraoperatively based on extent of disease. Those with preoperative facial dysfunction underwent radical parotidectomy with removal of the lateral temporal bone. All patients who had not already failed radiotherapy received postoperative treatment.

Lateral temporal bone resection was specifically evaluated for this patient subset; therefore, more extensive procedures such as total and subtotal temporal bone resections were excluded from analysis. Primary lesions of the temporal bone, salivary gland, basal cell carcinoma, melanoma, and distant metastasis—and patients with insufficient data—were excluded from analysis.

Statistics

Kaplan-Meier plots were used to summarize time to event measured from date of surgery. Statistical comparisons of survival were made for stage, margin status, and preoperative facial nerve function. For overall survival (OS), death from any cause was the event of interest. For disease-free survival (DFS), the earliest recurrence, whether primary, nodal, or distant, was the relevant event. Observations were censored for patients with no evidence of recurrence at time of death or last contact. Disease-specific survival (DSS) was defined as death from the disease. Differences between survival curves were tested using the log-rank test.

Results

Demographic and Diagnostic Data

Sixty-two patients underwent LTBR for a malignancy involving the temporal bone. The distribution of pathology included SCC, basal cell carcinoma, melanoma, adenocarcinoma, adenoid cystic carcinoma, and mucoepidermoid carcinoma, respectively (►Fig. 1). Ninety percent of the patients who required LTBR in this cohort had a cutaneous primary (56/62), and 77% of the cutaneous malignancies (43/56) were SCC.

Thirty-five patients who underwent lateral temporal bone resection for cutaneous SCC were available for analysis. In this patient subset, all patients were male. The age range was 46 to 92 years with a mean age of 69 years. Mean follow-up was 36 months (24 to 160 months). Over half (21/35) of the patients had some form of previous excisional surgery to address cutaneous SCC immediately adjacent to the temporal bone that ultimately failed locally and/or regionally. In patients who had failed preoperative radiotherapy at an outside institution, surgery was considered as salvage therapy. Eight patients previously received radiotherapy with or without chemotherapy prior to undergoing salvage LTBR. No patients underwent planned preoperative radiotherapy. Patients who had not received prior radiation therapy ($n = 27$, 77%) were treated with postoperative radiotherapy.

The most common site of involvement was the preauricular area in 46% (16/35) of patients. Auricular lesions were identified in 37% (13/35) patients; the postauricular area was

Table 1 University of Pittsburgh tumor staging system (modified)⁸

T1	Limited to EAC No bone erosion No soft tissue involvement
T2	Limited to EAC Limited bone erosion Limited soft tissue (<0.5 cm)
T3	Full thickness EAC erosion Limited soft tissue (<0.5 cm) ME/mastoid involvement
T4	Adjacent structures involved Dura, petrous apex, TMJ, cochlea, carotid canal, jugular foramen Extensive soft tissue Facial nerve palsy

Abbreviations: EAC, external auditory canal; ME, middle ear; TMJ, temporomandibular joint.

TOTAL: 62 patients LTBR
43 patients with SCC
n = 35 patients eligible

Fig. 1 Tumor pathology. BCC, basal cell carcinoma; LTBR, lateral temporal bone resection; SCC, squamous cell carcinoma.

involved in 11% (4/35) and the infra-auricular area comprised 6% (2/35) of patients (►Fig. 2). Of note, carcinoma primary to the middle ear was identified in only 1 patient, which was excluded from analysis.

The Pittsburgh staging system was used to classify the extent of disease. The distribution of the tumors was T1, 3 patients; T2, 9 patients; T3, 5 patients; and T4, 18 patients. Patients staged as T4 were most commonly done so for invasion of the TMJ, or facial nerve, or because they had significant (>0.5 cm) soft tissue involvement. The majority of T4 lesions (56%) were located in the preauricular subsite (►Fig. 3).

Recurrence at the primary site and/or regional nodal involvement was encountered in 34% (12/35) and 6% (2/35) respectively. Patients who recurred locally had extensive disease that was difficult to clear, as 83% (10/12) had Pittsburgh stage T4 tumors and 75% (9/12) had positive margins.

Management Data

In addition to LTBR, selective neck dissections were performed in 22 (63%) patients and parotidectomy in 33 (94%) patients, and 11 (31%) patients required resection of the TMJ or mandible to obtain clear margins. Three patients required resection of their infratemporal fossa. Final pathology showed direct involvement of the facial nerve in 10 patients, requiring sacrifice. Clear margins were reported in 22 (63%) patients. Patients with positive margins most commonly had T4 lesions (12/18) with significant invasion. Nineteen patients (54%) had microscopic

Fig. 2 Tumor subsites.

Fig. 3 Tumor distribution by Pittsburgh T stage.

evidence of perineural invasion. In patients who underwent neck dissection, 7 patients (32%) had positive nodal disease on final pathology.

There was no perioperative mortality in this series. One patient returned to the operating room with positive deep margins for clearance of the infratemporal fossa. Expected complications of radiotherapy were encountered; however, one patient undergoing concurrent chemotherapy developed pancytopenia and died of overwhelming sepsis.

Survival and Recurrence Data

The 2-year and 5-year OS for the entire cohort was 72% and 49% (►Fig. 4). For all patients, DFS at 2 and 5 years was 68% and 59% with locoregional recurrence tending to occur within the first 3 years. Cumulative DSS for the cohort was 79% and 62% at 2 and 5 years (►Fig. 5). ►Fig. 5 shows that patients who were 5 years from time of treatment were likely cured of their disease.

When patients were staged by the Pittsburgh staging system and stratified into early-stage (T1–2) and late-stage (T3–4) disease, early-stage patients had 2 and 5 year DSS of 100%, which was significantly better than patients with late-stage lesions (T3–4), who had a 2- and 5-year DSS of 70% and 45% ($p = 0.015$) (►Fig. 6).

Ten patients (29%) had preoperative facial nerve palsy as defined by the House Brackmann grading system¹⁰ (II–VI) on physical examination. There was no statistically significant difference in DFS at 2 and 5 years ($p = 0.564$) in patients with normal functioning facial nerves (68% versus 63%) versus patients with facial nerve palsy on preoperative examination

Fig. 4 Kaplan-Meier estimates of overall survival for all patients.

Fig. 5 Kaplan-Meier estimates of disease-specific survival for all patients.

(61% versus 47%). Similarly, there was no significant difference in 2-year (82% versus 67%) and 5-year (67% versus 50%) DSS in patients who had normal preoperative facial nerve function versus facial nerve paralysis ($p = 0.44$).

Thirty-seven percent of patients had involved margins. Margin status was statistically significant in terms of recurrence and DSS. A clear margin was associated with DFS of 81% at 2 years, whereas a positive margin had a DFS of 45% at 2 years (► **Fig. 7**). DSS was significantly worse in patients with positive margins, as only 50% of patients with an involved margin were alive versus 95% of patients who had been cleared of their disease at 2 years ($p < 0.001$) (► **Fig. 8**).

Discussion

Although primary malignant tumors of the temporal bone are rare, cutaneous cancers spreading to the temporal bone are a problem that deserves more attention. Nearly 90% of patients who underwent temporal bone resection in this series had primary cutaneous malignancies that invaded the temporal bone. Periauricular and auricular cutaneous malignancies are notoriously difficult to control, as demonstrated by higher rates of recurrence when compared with skin malignancies involving other subsites of the head and neck,^{11–14} and they may even carry a worse prognosis.¹⁵ When inadequately excised, disease extension progresses medially, involving nerves, the parotid gland, and bony and cartilaginous struc-

Fig. 7 Kaplan-Meier estimates of disease-free survival by margin status.

tures before moving laterally through the skin, where it becomes clinically apparent.

Patients with advanced cutaneous SCC requiring temporal bone resection in our cohort of 35 patients had an overall DFS of 59%. Our 2- and 5-year DSS rates of 79% and 62%, respectively, compare favorably with those cited in the literature for both cutaneous lesions and primary temporal bone lesions^{1,6,9,16–24}; however, there are few reports exclusively addressing cutaneous SCC involving the temporal bone, and most combine pathologic subtypes, which may skew survival data. The group of patients in this study, by the nature of their disease presentation and subsite location, had multiple “high-risk” factors including large size, bone invasion, recurrent disease/incomplete excision, periauricular location, and perineural invasion.^{6,11} Byers et al reviewed 486 patients with SCCs of the external ear, of which 20 were found with advanced disease that required temporal bone resection with facial nerve sacrifice and no adjuvant radiotherapy.¹³ The 2- and 5-year survival rates were 80% and 45%, respectively, with recurrent disease in 65% (13/20) of patients.

Our series also shows a trend toward improved survival and lower rates of recurrence when early-stage (T1–2) and advanced-stage (T3–4) groups are compared. The majority of the T4 lesions can be attributed to TMJ and facial nerve invasion from a preauricular subsite, as opposed to the other adjacent structures set forth in the Pittsburgh staging system (dura, petrous apex, cochlea, carotid canal).⁸

Fig. 6 Kaplan-Meier estimates of disease-specific survival by modified Pittsburgh T stage.

Fig. 8 Kaplan-Meier estimates of disease-specific survival by margin status.

The majority of patients referred for surgery for advanced cutaneous SCC had been previously treated. Incomplete excision was common in our series, possibly in an effort to preserve cosmesis and function, which places patients at increased risk for both local recurrence and nodal metastasis.²⁵ Furthermore, the auricular subsite has been reported to have the highest incidence of incomplete excision for cutaneous SCC.²⁶

In the current study, margin status was crucial in terms of recurrence and DSS. Up to 50% of lesions with positive margins will recur,²⁷ and a statistically significant negative impact on survival has been reported in patients with involved margins versus those who have been cleared of their disease.^{9,28} Positive margins were reported in 37% of the patients in this study, and ultimately 69% of these patients had recurrence of their disease compared with 18% recurrence in patients with clear margins. Margin status was statistically significant in terms of both DFS and DSS, as a positive margin almost halved the 2-year survival (95% clear margin versus 50% positive margin). Moody et al showed a similar finding with primary SCC of the temporal bone.⁸ Nineteen of 31 patients (61%) had a positive surgical margin, which translated into a statistically significant 2-year survival for patients with clear margins. This may also reflect the difficulty in orienting and determining margins on a composite specimen.

Although LTBR was sufficient for all cases in terms of controlling gross medial extension, surgeons must be prepared to extend the margin peripherally to obtain a clear margin. This includes removing the TMJ (30%), facial nerve (29%), and less frequently performing infratemporal fossa resection. Although every attempt is made to preserve the facial nerve, clinical perineural invasion (PNI) has been shown to significantly affect survival, and the treatment philosophy should be based on the extent of PNI along the facial nerve as with any skull base resection.^{29,30} In our experience, surgical resection with clear margins followed by radiation optimizes the patient's chance for cure.

It is important to differentiate between histologic PNI and large-nerve or clinical PNI, as the difference is commonly misunderstood. Clinical PNI occurs with focal neurologic deficits, and invasion may be visualized on MRI.³¹ Facial nerve involvement, which can also be due to external compression, is an ominous sign as seen in the most recent modification of the Pittsburgh staging system, which upstages such lesions to T4 status.^{8,32} Only 30 to 40% of these patients will have preoperative manifestations of neurotropism, but once patients are symptomatic, there is evidence that long-term survival will be on the order of 20 to 30%.^{29,33} In this series, nearly one third of patients were identified with preoperative facial nerve weakness and subsequent PNI on final pathology. Although not statistically significant, there was a trend toward worse DFS and DSS in patients with facial nerve involvement.

In this cohort, the majority of patients (21/35) had some form of previous excisional surgery prior to referral. It is important to distinguish those patients who may have postoperative nerve deficits, whether motor or sensory, from

their excisional surgeries, as these patients may be classified incorrectly as having clinical PNI. Therefore, it is imperative that patients undergo MRI to delineate the extent of disease and presence of clinical PNI as patients with radiologic evidence of clinical PNI have a poorer prognosis than those whose scans are negative.³⁴ Gandhi et al demonstrated that in the majority of cases, MRI demonstrated the presence and anatomic extent of PNI.³¹ High-field magnets found in 3-Tesla (3T) scanners may assist presurgical planning, as they offer improved spatial resolution and increased signal-to-noise ratio when depicting anatomic detail of cranial nerves at the skull base.³⁵ Therefore, if we can accurately predict the peripheral and medial spread of disease, we can best design an appropriate surgical resection, as it has been shown that a properly planned surgical resection of PNI may improve survival without significant added morbidity.³⁶

A technical limitation of this study in terms of preoperative planning is that not all patients received imaging based upon high-field MRI. Radiologic evaluation of the skull base at our institution is currently based on a 3T imaging platform to most accurately assess extent of disease and PNI. With newer imaging technology and the ability to isolate the disease peripherally as well as preventing central failure in patients with clinical PNI, we hope to show a continued improvement in survival for patients with cutaneous SCC extending to the temporal bone and skull base.

Conclusion

We present a dedicated series of lateral temporal bone resections for cutaneous SCC with temporal bone invasion from a single institution. Tumor-free margins are the critical goal of any treatment plan for advanced cutaneous SCC involving the temporal bone, as margin status was a significant predictor for 5-year DFS and DSS. High-field MRI (3T) may influence the extent of resection in terms more accurately delineating the primary disease and perineural spread. Surgeons should be prepared to extend the resection to include the TMJ, facial nerve, and infratemporal fossa to obtain margin clearance peripherally and centrally.

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