Update on Surgical Outcomes of Lateral Temporal Bone Resection for Ear and Temporal Bone Malignancies

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Abstract

Objectives Review outcomes of lateral temporal bone resections for ear and temporal bone malignancy.

Design, Setting, and Participants Retrospective review of all lateral temporal bone resections performed from 2008 to 2015 at a single tertiary care center.

Main Outcome Measures Patient demographics, perioperative variables, overall survival, disease-free survival (DFS), and comparison of Kaplan–Meier curves.

Results Overall, 56 patients were identified with a mean follow-up period of 2.3 ± 1.8 years. The predominant histopathologic diagnosis was squamous cell carcinoma (SCC, 54%), followed by salivary gland tumors (18%), and basal cell carcinoma (9%). Tumor stages were T1–T2 in 23%, T3–T4 in 73%, and two unknown primary lesions. Mean overall survival was 4.6 ± 0.4 years. Comparison of tumors with and without lymph node involvement or perineural invasion approached statistical significance for overall survival ($p = 0.07$ and 0.06 , respectively). DFS was 2.5 ± 0.3 years. Stratification by lymph node status had a statistically significant difference in DFS ($p = 0.03$). Subgroup analysis of SCC patients did not reveal significant differences.

Conclusions Based on our cohort, most patients with temporal bone malignancies present with advanced disease, making it difficult to achieve negative margins. Overall, lymph node status was the strongest predictor of survival in this group.

Keywords

- lateral temporal bone resection
- cancer
- malignancy
- outcomes

Introduction

Malignancies of the temporal bone are rare, accounting for less than 1% of head and neck tumors with an annual yearly incidence of six in one million people.^{1,2} Presenting symptoms of temporal bone malignancies are often nonspecific, including hearing loss, otalgia, external otitis, otorrhea or bleeding, necrosis, or ulceration in the area, and rarely facial nerve palsy.^{3,4} Because the presentation is both rare and often nonspecific, diagnosis may be delayed and neoplasms may already be advanced at the time of eventual diagnosis.³ Due to the aggres-

sive nature of many of these tumors, multimodality therapy with surgery and radiation remains the standard of care.

Surgical intervention for advanced temporal bone malignancies can be exceedingly challenging due to the complex anatomy of this region, and surgical approaches have been refined over time. Previously, temporal bone malignancies were treated with radical mastoidectomy alone.⁴ In 1954, Parsons and Lewis detailed a method for en bloc subtotal temporal bone resection which then became the standard of care for temporal bone malignancies.⁵ Lateral temporal bone resection (LTBR) was later introduced in 1960 by Conley and

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Novack, and remains the workhorse approach for many temporal bone lesions.⁶

Despite advances in the management of temporal bone malignancies, staging and prognostic predictors for tumors remain elusive. The Pittsburgh Staging Criteria proposed by Arriaga et al⁷ in 1990 is widely utilized, and has been shown to correlate with prognosis in several retrospective studies,^{8–11} although no significant correlation was observed in others.¹¹ In previous studies, obtaining negative margins as well as lymph node status have been shown to be important predictors of survival.

We previously retrospectively evaluated the outcomes of LTBR for malignancy at the Massachusetts Eye & Ear Infirmary (MEEI) from 1990 to 2007, and demonstrated that upfront surgical resection followed by postoperative radiation was an effective management strategy, and the presence of positive margins was a poor prognostic sign. Here, we provide an update to this work by reviewing the outcomes of LTBR at MEEI from 2008 to 2015.

Methods

Data Acquisition

Approval was obtained from the MEEI Institutional Review Board. Retrospective review of all patients undergoing LTBR from January 1, 2008 to September 30, 2015 at a single institution (MEEI, Boston, Massachusetts, United States) was conducted. Patients undergoing surgery for malignancy of the external auditory canal (EAC), auricle, parotid gland, and/or skull base were included, identifying 56 patients. Preoperative data collected included patient demographics, imaging, previous radiation and chemotherapy treatment, and preoperative facial nerve function. Primary tumors of the EAC or auricle were staged according to the University of Pittsburgh TNM staging system and all others were staged according to American Joint Committee on Cancer (AJCC) guidelines.⁷ Preoperative imaging and postoperative pathology data were gathered for staging. Additional pathology data recorded, included histopathologic diagnosis, presence of residual disease, perineural spread, and lymphovascular involvement. Patient outcome variables included postoperative facial nerve function, presence of recurrence (include timing and type), and death information (including time and cause where available).

Statistical Analysis

Comparisons of mean values between patient populations (such as overall survival [OS] or disease-free survival [DFS]) were performed using Student *t*-tests. Comparisons of percentiles (such as 2-year OS for two groups) were performed using chi-square analysis. Kaplan–Meier survival curves were created from the data using SPSS software (version 23.0.0.0, IBM Corp., Armonk, New York). The *p* values less than or equal to 0.05 were considered statistically significant.

Results

A total of 56 patients met the inclusion criteria during the study period with a mean follow-up period of 2.3 ± 1.8 years.

Fig. 1 Histogram depiction of cases per year demonstrating the frequency of LTBR surgeries during the study period. LTBR, lateral temporal bone resection.

During the 7-year period, 56 lateral LTBR surgeries were performed at MEEI, with a mean of 7 surgeries per year (**Fig. 1**). In the previous report,¹² 35 LTBR surgeries were performed by a single surgeon from 1990 to 2007. The current cohort included 43 males and 13 females (M:F = 3.3) with a mean age of 67.3 ± 16.1 years at the time of surgery (**Table 1**). Primary tumor sites included the EAC (32.1%), auricle (28.6%), parotid (19.6%), skull base (16.1%), and unknown (3.6%). The predominant histopathologic diagnosis was squamous cell carcinoma (SCC, 53.5%), followed by salivary gland tumors (17.9%), basal cell carcinoma (BCC, 8.9%), adenocarcinoma (7.1%), and melanoma (3.6%). Other rare tumors included eccrine porocarcinoma (3.6%), endolymphatic sac tumor (1.8%), adnexal carcinoma (1.8%), and carcinoid tumor (1.8%). The majority of tumors were staged T4 (62.5%), with the remaining tumors of stage T3 (10.7%), T2 (12.5%), T1 (10.7%), and unknown (3.6%). Notably, 45% of patients underwent surgery for recurrent disease while the remaining 55% were treated for primary lesions.

Comparison of perioperative variables between the previous and current cohort revealed a statistically significant difference only in the gender ratio ($p < 0.05$) (**Table 1**). There was a trend toward greater use of neck dissection in the 2008–2015 group compared with the 1990–2007 group (63 vs. 49%, respectively, $p = 0.28$). Additionally, use of adjuvant chemotherapy increased from 9% in 1990–2007 group to 21% in 2008–2015 group, though this difference was not statistically significant ($p = 0.19$).

Survival Analysis

Mean OS for all patients was 4.6 ± 0.4 years after surgery. Compared with the 1990–2007 group for whom OS was 3.7 ± 4.0 years, the difference in OS was not statistically significant ($p = 0.9$). Comparison of OS among early T-stage diagnosis (T1–T2) and advanced stage (T3–T4) showed no statistically significant differences ($p = 0.28$) (the two tumors of unknown primary were excluded from analysis). Comparison of tumors resected with negative versus positive margins

Table 1 Patient demographics

	1990–2007 <i>n</i> = 35	2008–2015 <i>n</i> = 56	<i>p</i> Value
Preoperative variables			
Male to female ratio	1.2	3.3	0.0445
Mean age (y)	62.7 ± 14.8	67.3 ± 16.1	0.1750
Distribution of T-stage	Tx (1); T1 (7); T2 (3); T3 (7); T4 (17)	Tx (2); T1(6); T2 (7); T3 (6); T4 (35)	0.4529
Preoperative RT treatment	20% (<i>n</i> = 7)	25% (<i>n</i> = 14)	0.7680
Operative variables			
Patients undergoing parotidectomy	77% (<i>n</i> = 27)	75% (<i>n</i> = 42)	0.8637
Patients undergoing neck dissection	49% (<i>n</i> = 17)	63% (<i>n</i> = 35)	0.2764
Patients undergoing facial nerve sacrifice	31% (<i>n</i> = 11)	23% (<i>n</i> = 13)	0.5348
Postoperative variables			
Postoperative RT treatment	68% (<i>n</i> = 24)	66% (<i>n</i> = 37)	0.9859
Adjuvant chemotherapy	9% (<i>n</i> = 3)	21% (<i>n</i> = 12)	0.1876
Patients with residual disease	46% (<i>n</i> = 16)	61% (<i>n</i> = 34)	0.2370
Patients with positive lymph node involvement	20% (<i>n</i> = 7)	27% (<i>n</i> = 15)	0.6284

Abbreviation: RT, radiation therapy.

was similarly not statistically significant ($p = 0.42$). Comparison by positive lymph node involvement on histopathology ($p = 0.07$) and positive perineural invasion ($p = 0.06$) were found to approach statistical significance (► **Fig. 2**).

Recurrence Analysis

During the follow-up period, 34% of patients developed local recurrence, which was consistent with 34% of patients having local recurrence in the 1990–2007 group.¹² Notably, 45% of patients of the current cohort underwent LTBR for recurrence of a prior carcinoma. DFS for the entire cohort was 2.5 ± 0.3 years after surgery. Compared with the 1990–2007 group for which DFS was 2.8 ± 3.4 years, the difference was not statistically significant ($p = 0.5$). DFS stratification approached statistical significance for T-stage diagnosis ($p = 0.06$) (► **Fig. 3**) and positive perineural invasion ($p = 0.09$) (► **Fig. 3**). Comparison of lymph node status was a statistically significant predictor of DFS ($p = 0.03$) (► **Fig. 3**), however, the presence of positive margins was not found to be significant ($p = 0.6$) (► **Fig. 3**). Local recurrence occurred more often in patients undergoing secondary surgery for carcinoma (48%) than in patients undergoing primary surgery (23%), although this result was not statistically significant ($p = 0.22$). Among the three major histopathological subtypes, recurrence rates were 30% in SCC, 20% in salivary tumors, and 20% in BCC though comparison could not be made due to low number of salivary tumors and BCC.

Squamous Cell Carcinoma Analysis

The largest subtype of the 2008–2015 group was the SCC group constituting 53.5% of patients. Subtype analysis was performed with mean OS by Kaplan–Meier estimated at 4.1 ± 0.6 years and mean DFS 2.2 ± 0.4 years. Stratification

of OS by T-stage ($p = 0.4$), positive margins ($p = 0.3$), positive lymph node involvement ($p = 0.56$), and perineural involvement ($p = 0.2$) did not achieve statistical significance. Stratification of DFS by T-stage ($p = 0.5$), positive margins ($p = 0.4$), and perineural involvement ($p = 0.4$) did not achieve statistical significance. Stratification of DFS by positive lymph node involvement approached statistical significance ($p = 0.08$).

Discussion

We have presented a retrospective review of outcomes of LTBR for malignancy at MEEI from 2008 to 2015. The mean OS of our cohort was 4.62 ± 0.42 years after surgery, which is comparable both to the previous MEEI cohort¹² and to the known literature.^{4,12} Compared with the 1990–2007 group that studied LTBR outcomes following one surgeon, our data spans five surgeons. As a result, this study contains a larger number of LTBR cases during a smaller amount of time. Though our cohort had a higher proportion of males, the groups were otherwise not statistically different in perioperative characteristics (► **Table 1**), allowing for reasonable comparison. There were, however, nonstatistically significant trends toward greater use of neck dissection (63 vs. 49%) and adjuvant chemotherapy (21 vs. 9%) from 2008 to 2015 compared with 1990 to 2007. Given the controversy in treatment paradigms for temporal bone malignancy,¹³ this finding may highlight a shift toward more aggressive treatment at our institution. Finally, the number of patients with residual disease on pathology was higher in the more recent cohort (61 vs. 46%). This may be attributed to the high number of patients who were operated on for recurrent disease (45%). The number of secondary operations performed from 1990 to 2007 was not reported for comparison.

Fig. 2 Stratification of overall survival by (A) early versus advanced tumor stage ($p = 0.28$) (B) negative versus positive pathological margins after surgery ($p = 0.42$) (C) negative versus positive lymph node status diagnosed after surgery ($p = 0.07$) and (D) negative versus positive perineural invasion ($p = 0.06$).

OS for the 2008–2015 group compared with 1990–2007 group was higher (4.6 vs. 3.7 years) though this difference was not statistically significant ($p = 0.90$). Our analysis did not reveal any statistically significant factors that predicted better OS rates, though positive lymph node involvement and perineural invasion were both found to approach statistical significance. This aligns with literature reports that positive lymph node involvement can be a predictor of poor prognosis.¹⁴ Further studies may substantiate the prognostic value of perineural invasion in predicting OS. We did not find a statistically significant difference in OS when stratifying by T-stage, similar to the previous MEEI cohort, which may be

due to small sample size as well as a heterogeneous patient population. In addition, there were only a small number of early-stage patients in this cohort, which makes the comparison difficult.

Comparison of the 2008–2015 and 1990–2007 groups showed no significant difference in DFS (2.5 vs. 2.8 years, $p = 0.5$). In the current cohort, tumor recurrence was more likely in patients operated on for a recurrent tumor rather than a primary tumor (48 vs. 23%), although this difference was not statistically significant, likely due to the relatively short follow-up period for patients operated on in 2014 and 2015 ($p = 0.22$). The high number of patients undergoing

Fig. 3 Stratification of disease-free survival by (A) early versus advanced tumor stage ($p = 0.06$) (B) margin status ($p = 0.55$) (C) negative versus positive lymph node status diagnosed after surgery ($p = 0.03$) and (D) negative versus positive perineural invasion ($p = 0.09$).

surgery for recurrent disease (45%) may also contribute to the high rate of positive margins observed in this cohort (61%). In analysis of DFS, lymph node involvement was found to be a statistically significant factor ($p = 0.03$), similar to the finding for OS. We were not able to corroborate the finding of Essig et al who found that margin status was a significant factor in predicting DFS.¹¹

Overall, management of temporal bone and ear malignancies is a challenging problem. Our findings thus far highlight the difficulty in finding adequate prognostic factors for OS and DFS. Though positive lymph node involvement may be an important factor to consider, our study was limited by the sample size. In addition, though the mean follow-up period was 2.3 years, follow-up in particular for patients operated on between 2014 and 2015 was limited and continued monitoring of LTBR

outcomes at our institution is necessary. Additionally, as a tertiary care center, the proportion of patients undergoing surgery for advanced T3-T4 tumors (73%) and recurrent disease (45%) was high, limiting our analysis of early-stage tumors.

Conclusions

Temporal bone and ear malignancies present a unique challenge for care teams. Our findings regarding patients undergoing LTBR as a part of their treatment plan highlight the aggressive nature of the disease and the difficulty in predicting outcomes. We found that positive lymph node status may portend worse OS and DFS for patients but continued study to achieve larger sample sizes may bring to light factors helpful in patient management.

Funding Sources

None.

Conflicts of Interest

None.

Financial Disclosures

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