Effect of Piecemeal vs En Bloc Approaches to the Lateral Temporal Bone on Survival Outcomes

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Abstract

Objectives. Lateral temporal bone resection (LTBR) has traditionally been performed en bloc in accordance with oncologic principles. Occasionally, this is not possible due to a low tegmen or lateralized vasculature. We sought to determine if outcomes of piecemeal and en bloc LTBR are comparable.

Study Design. Retrospective review.

Setting. Two academic medical centers.

Subjects and Methods. Multi-institutional retrospective cohort study. Current Procedural Terminology codes were used to identify patients with T1 to T3 squamous cell carcinoma of the external auditory canal (EAC) who underwent LTBR from 2005 to 2015. Kaplan-Meier curves were constructed to compare total survival between the 2 treatment approaches. Pairwise comparisons were performed using x² and Fisher exact tests (significance at P = .05), as appropriate.

Results. Twenty-five patients were identified. Ten patients underwent en bloc LTBR; 15 underwent piecemeal LTBR. Median follow-up time was 11 months (range, 1-60 months). There was not a significant difference in overall survival between en bloc (38.9 months; 95% confidence interval [CI], 22.7-55.2) compared to piecemeal (37.5 months; 95% CI, 21.1-53.9) procedures (P = .519). Estimates of disease-free survival also did not reveal statistically significant differences: estimated mean disease-free survival was 48.1 months (95% CI, 33.7-62.6) in en bloc patients and 32.5 months (95% CI, 17.1-47.8) in piecemeal patients (P = .246).

Conclusion. These data suggest that piecemeal resection can be considered for cases of squamous cell carcinoma involving the external auditory canal where anatomic constraints preclude a safe en bloc resection. Larger studies or studies with a longer follow-up time may provide improved insight into survival comparisons.

Keywords

lateral temporal bone resection, squamous cell carcinoma, ear canal, external auditory canal, piecemeal, en bloc

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Squamous cell carcinoma (SCCa) of the external auditory canal is a rare malignancy with an estimated incidence of 1 to 6 cases per 1,000,000.1 This disease process is aggressive, and the degree of tumor extension is inversely proportionate to survival.2-10 The Pittsburgh staging system is widely used to categorize the local extent of the tumor.11 This staging system has been evaluated and was shown to be reproducible and objective5 and to correlate with survival data.5

Locally aggressive tumors are typically treated with multimodality therapy, including temporal bone resection and adjuvant radiotherapy. Lateral temporal bone resection (LTBR) is the widely accepted approach for tumors lateral to the annulus.1,12,13 In addition to excision of primary tumors of the external auditory canal (EAC), LTBR can be used to excise tumors that invade the EAC from adjacent anatomic sites. More extensive tumors require subtotal temporal bone resection or total temporal bone resection.

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Adjuvant radiation has been shown to improve survival and reduce the incidence of local recurrence.3,14

Previous studies have shown trends toward improved outcomes with more extensive primary resections; the lack of statistically significant findings may be attributable in part to the small sample sizes inherent to the study of rare diseases.14 En bloc resection may be preferable when feasible, but sometimes en bloc resection may not be possible due to anatomic factors, including low tegmen, lateralized carotid artery, or lateralized jugular bulb. Previous studies have advocated or described piecemeal resections for extensive tumors.5,6,15 Even in less extensive tumors, en bloc resection may not be possible or ideal. In this study, we sought to compare oncologic outcomes for en bloc vs piecemeal resection for T1 to T3 squamous cell carcinoma of the external auditory canal.

Materials and Methods

The University of Kansas Medical Center Institutional Review Board (00000314) and the University of Texas Southwestern Institutional Review Board (032015-050) each separately approved this project. Current Procedural Terminology (CPT) codes were used to identify patients who underwent lateral temporal bone resection from 2005 to 2015. Inclusion criteria included patients age 18 years or older, stage T1 to T3, pathology-proven diagnosis of squamous cell carcinoma, and involvement of the EAC. T4 tumors were excluded from this study because of the inherent difficulty of gross total resection for these extensive tumors.

Operative reports were reviewed in detail for each case, and patients were divided into 2 categories: en bloc lateral temporal bone resection or piecemeal temporal bone resection. Piecemeal resections involved gross total removal of tumor and surrounding structures with or without frozen-section margins. En bloc procedures were performed in the traditional fashion wherein the surgeon removed the canal skin, tympanic membrane, and bony walls of the external canal together in 1 piece with a lateral cuff of conchal bowl or auriculectomy after performing a mastoidectomy and dissection through the zygomatic root and anteriorly toward the temporomandibular joint.

Pairwise comparisons were performed using χ² and Fisher exact tests (significance a priori at P = .05), as appropriate. All statistical analyses were performed using SPSS software (version 24; SPSS, Inc, an IBM Company, Chicago, Illinois). The Kaplan-Meier method was used to estimate overall and disease-free survival between the 2 treatment approaches. To follow the standard presentation of 5-year survival information, cases with follow-up greater than 60 months were classified according to their vital and disease status at 60 months for these analyses.

Results

Demographics

In our study population of 25 consecutive patients, the mean patient age was 68 (range, 49-90) years. Further demographic information can be found in Table 1.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Piecemeal, No. (%)</th>
<th>En Bloc, No. (%)</th>
<th>Total, No. (%)</th>
<th>P Value</th>
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<td>10 (40)</td>
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<td>5 (50)</td>
<td>12 (55)</td>
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<td>1 (10)</td>
<td>5 (23)</td>
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<td>6 (26)</td>
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<td>7 (70)</td>
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<td>5 (20)</td>
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</tr>
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<td>5 (50)</td>
<td>9 (36)</td>
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<td>11 (44)</td>
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<tr>
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<td>3 (30)</td>
<td>3 (12)</td>
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</table>

Abbreviation: XRT, radiation therapy.

*Represents a statistically significant difference in distribution.

Tumor Characteristics

Presenting symptoms included otalgia (72%), tumor involvement of auricle (72%), hearing loss (52%), otorhea (28%), tinnitus (24%), neck pain (20%), lymphadenopathy (20%), facial weakness (12%), and odynophagia (4%). Left ears were involved in 16 (64%) subjects. T stage distribution can be found in Table 1. At presentation, 9 (36%) tumors were primary while 16 (64%) were recurrent or persistent tumors, which had undergone previous resection or radiation therapy.

Treatment Modalities

Ten (40%) patients underwent en bloc LTBR and 15 (60%) underwent piecemeal LTBR. Nine patients (36%) underwent primary surgical resection without adjuvant therapy. Another 11 (44%) patients underwent primary resection with adjuvant radiotherapy. Three patients (12%) underwent primary resection with adjuvant chemoradiation. The final 2 patients (8%) underwent primary resection followed by adjuvant chemotherapy. Table 1 displays adjuvant treatment for each approach type.

For the surgical defects, various reconstruction methods were employed: 9 (36%) temporalis flaps, 6 (24%) radial...
forearm free flaps, 6 (24%) pectoralis flaps, 4 (16%) cervicofacial advancement flaps, 3 (12%) anterolateral thigh flaps, 1 (4%) supraclavicular flap, and 1 (4%) primary closure.

Survival Results
Tumor recurrence data were similar for both piecemeal and en bloc approaches with 60% (95% confidence interval [CI], 32.3%-83.7%) vs 78% (95% CI, 40.0%-97.2%) maintaining disease-free status (Fisher $P = .657$) at the last follow-up visit. The proportion of local recurrences among piecemeal patients was 20% (95% CI, 4.3%-48.1%) vs 11% (95% CI, 0.03%-48.3%) among en bloc patients, a difference that fails to reach significance (Fisher $P = .706$). Distant recurrences occurred at the same proportions (20% vs 11%) between the 2 groups, resulting in identical confidence intervals and significance values to those for local recurrences.

Median follow-up time was 11 months (range, 1-60 months). The Kaplan-Meier method was used to estimate overall and disease-free survival. These analyses did not reveal significant differences in overall survival between en bloc and piecemeal procedures ($P = .519$, Figure 1). En bloc patients had an estimated mean survival of 38.9 months (95% CI, 22.7-55.2) compared to 37.5 months (95% CI, 21.1-53.9) for piecemeal patients. Estimates of disease-free survival also did not reveal any statistically significant differences, with an estimated mean disease-free survival of 48.1 months (95% CI, 33.7-62.6) in en bloc patients and 32.5 months (95% CI, 17.1-47.8) in piecemeal patients ($P = .246$, Figure 2).

Discussion
In certain cases of SCCa of the external auditory canal, piecemeal resection may be preferable to an en bloc resection. Our data suggest that in T1 to T3 tumors, the choice to perform piecemeal resection does not appear to sacrifice oncologic outcomes. In this cohort of patients, there was no observable statistically significant difference in overall survival, disease-free survival, local recurrences, or distant recurrences when comparing these 2 methods. The T staging is evenly distributed when comparing the en bloc and the piecemeal resection cohorts.

In anterior skull base surgery, piecemeal resection has been shown to have equivalent outcomes to the en bloc approach in select cases. Piecemeal resection leading to gross total resection and negative margins is now a widely accepted approach for resection of anterior skull base malignancies—both the en bloc approach and piecemeal resection with negative margins adhere to oncologic surgical principles of total removal of disease.

Piecemeal resection may be preferable to reduce morbidity in patients with small, lateral tumors with limited bony involvement, patients with a low-lying tegmen that would prevent the superior cuts of an en bloc resection, or patients with an relatively lateral internal carotid artery or jugular bulb that would preclude drilling medially on the bony annulus. Many patients undergoing LTBR are elderly and prone to atherosclerotic disease. En bloc removal theoretically risks damage to the carotid artery from manipulation of the skull base periosteum near the carotid artery and/or dislodgement of atherosclerotic plaques.

In considering treatment options, it is important to appropriately match disease and treatment morbidity. A modified lateral temporal bone resection provides effective disease control and spares patient morbidity. A recent study described a modified lateral temporal bone resection that spares the tympanic membrane and the ossicular chain, thereby limiting the conductive hearing loss to an average of 9 dB. This limited approach resulted in 100% control of disease with an average follow-up of 29 months. Total resection of disease should still be considered paramount. A
Chinese group reviewed 43 cases of T1 or T2 SCCa of the EAC and found recurrence rates of 46% for limited canal resections and 0% for lateral temporal bone resections. The recurrence rates for the 2 groups are closely tied to, and likely direct results of, rates of positive surgical margins in these 2 groups.18

A limitation of this study is the short follow-up time, as 40% of the patients had a follow-up of 4 months or less. The preponderance of short follow-up times caused the median follow-up time (11 months) to be almost a year less than the mean follow-up time (20 months), limiting the clinical applicability of the recurrence data to long-term survival outcomes. One patient who underwent en bloc resection had date of death information but lacked disease status information. This patient was included in the demographic descriptions and Kaplan-Meier overall survival analysis but was excluded from disease-free survival Kaplan-Meier, local recurrence, and distant recurrence analyses. In addition, our sample size (n = 25) was too small to analyze subgroups accounting for confounding factors or presenting characteristics using multivariable regression analyses.

Univariate analyses in this cohort of patients do not reveal significant differences in the 4 outcome measures: total survival, disease-free survival at last follow-up, local recurrences, and distant recurrences. It is possible that the sample size and the length of follow-up prevent us from observing true differences in outcomes; our confidence intervals extend to or are greater than 50% on most of these proportions and thus overlap extensively between the groups. How these differences would be affected by longer follow-up or larger sample sizes is unclear from our study.

Rare diseases such as SCCa of the external auditory canal present challenges to standard clinical trial design and make it difficult to assess the efficacy of various treatment modalities.19 Our study presents early data from 2 centers working collaboratively to evaluate surgical approaches for managing this disease. While we were able to establish inclusion criteria of T stage, patient age, pathologic diagnosis, tumor location, and surgical treatment modality, our groups were still characterized by a degree of heterogeneity. Attempts to perform multivariate analysis on these subgroup variables were unsuccessful. We collected data on microscopic positive margins (2 after en bloc resection and 3 after piecemeal resection), perineural invasion, extracapsular spread, multiple positive lymph nodes, lymphovascular invasion, facial nerve sacrifice, postoperative adjuvant treatment (both what was recommended and what the patient chose to undergo), N stage, and M stage (1 patient did have metastatic disease) but were unable to evaluate the effects of these variables on our outcome measures due to sample size. Collecting sample sizes large enough to more powerfully evaluate the differences in groups of patients would take a large multicenter approach requiring the standardization of surgical approaches and the investment of significant resources for the monitoring and management of patients and their data. An alternative approach could be to use administrative databases (ie, National Inpatient Sample) or population surveillance (ie, Surveillance, Epidemiology, and End Results) approaches, but the specifics of treatment in this surgically managed disease would be very difficult to sort out in this approach due to the lack of specificity from CPT or International Classification of Diseases, Ninth Revision codes for this procedure.

These data suggest that piecemeal resection can be considered for cases of squamous cell carcinoma involving the external auditory canal where anatomic constraints preclude a safe en bloc resection. Larger studies or studies with a longer follow-up time may provide improved insight into survival comparisons between these 2 approaches.

Author Contributions

Thomas Muelleman, hypothesis formation, literature review, data collection, data analysis, manuscript preparation, editing, approval; Naweed I. Chowdhury, hypothesis formation, literature review, data collection, editing, approval; Daniel Killeen, literature review, data collection, manuscript preparation, editing, approval; Kevin Sykes, hypothesis formation, data analysis, manuscript preparation, editing, approval; J. Walter Kutz Jr., literature review, data analysis, manuscript preparation, editing, approval; Brandon Isaacson, literature review, data analysis, manuscript preparation, editing, approval; Hinrich Staecker, hypothesis formation, literature review, data analysis, manuscript preparation, editing, approval; James Lin, hypothesis formation, literature review, data analysis, manuscript preparation, editing, approval.

Disclosures

Competing interests: J. Walter Kutz Jr., Achaogen (consultant); Brandon Isaacson, Med-El, Advanced Bionics, Stryker, Medtronic, and Olympus (consultant).

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References


