Accuracy of CT Scans in Predicting Cholesteatoma in Revision Tympanomastoidectomy

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Introduction

High resolution computed tomography has long been used in the evaluation of middle ear disease, especially in the evaluation of cholesteatoma. Radiologic findings of a well-defined mass with localized bone erosion are findings typical of cholesteatoma. Radiologic criteria for diagnosing recurrent cholesteatoma in patients who have undergone mastoidectomy are not well defined. The goal of this study is to compare pre-operative CT scans in patients undergoing revision tympanomastoidectomy for cholesteatoma to intraoperative findings. From this, we hope to determine if there are any radiologic characteristics that would indicate recurrent or residual cholesteatoma.

Materials and Methods

Forty-one patients underwent revision tympanomastoidectomy between August 1999 and March 2008, and had high resolution CT scans performed at our institution prior to their revision surgery. Twenty-five patients were male, and 16 were female with an average age of 27. All patients originally had undergone a canal-wall-up tympanomastoidectomy prior to their revision procedure. Pre-operative high resolution computed tomography scans of the temporal bones without contrast were obtained prior to the revision procedure. Average time from CT scan to revision surgery was 25 days.

Radiologic characteristics that were thought to be suspicious for recurrent disease were based on findings from previous CT scans that seemed to correlate with positive intra-operative findings of cholesteatoma. Specifically, we looked for: 1) well defined mass with localized bone erosion, 2) air-sac from the tympanic membrane, extending into the middle ear or attic (thought to be the radiologic equivalent of a retraction pocket), 3) soft tissue bands, 4) amount of soft tissue in the middle ear/attic/mastoid spaces, and 5) the overall impression from the CT scan (positive or negative for cholesteatoma). The amount of soft tissue was quantified in each of the three spaces (mastoid, middle ear, attic) as having no soft tissue (0 pts), partial (1 pt.) or complete opacification (2 pts.) to generate a CT score. A trained neuroradiologist interpreted the CT scans.

The operative reports were reviewed in a retrospective manner. If cholesteatoma was present, this was recorded as a positive surgical finding. Also, surgical pathology was reviewed, and if there was histologic evidence of cholesteatoma, this was also recorded as a positive surgical finding.

Results

Of the 41 patients studied, 34 (83%) of those had recurrent or persistent cholesteatoma. The majority of those cases were recurrent cholesteatoma (30) while the rest were persistent, or recurrent and persistent (4). Correlating individual radiologic criteria with the surgical findings, a well-defined mass with localized bone erosion had a PPV of 81%, with a NPV of 15% (p = 0.73). Extension of an air sac into the middle ear or attic had a PPV of 89% and NPV of 19% (p = 0.59). When looking at soft tissue bands, there was a PPV of 83% and NPV of 17% (p = 0.96). Based on the overall amount of soft tissue, graded on a scale of 0-6 points as described earlier, the overall correlation was poor, with the average score for positive findings was 3.35, while the average for negative findings was slightly higher at 3.86. The overall impression of the CT scan correlated to a PPV of 84% and NPV of 22% (p = 0.64). The presence of any of the three radiologic criteria (well defined mass, air sac, soft tissue bands) in any one CT scan was not significant for the presence of cholesteatoma (PPV 81%, NPV 19%, p = 0.26).

Of those patients with a negative impression on pre-operative CT scan who had intra-operative evidence of cholesteatoma (11 patients total), recurrence of disease was found in the attic in 7 patients, the mastoid in 4 patients, middle ear in 3 patients, the facial recess in one patient, and the sinus tympani in one patient. Conversely, those patients with a positive impression on pre-operative CT scan (23 patients) had recurrences located in the attic (17 patients), mastoid (10 patients), middle ear (5 patients), facial recess (3 patients), and sinus tympani (2 patients).

<table>
<thead>
<tr>
<th>Radiologic Finding</th>
<th>PPV</th>
<th>NPV</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well defined mass</td>
<td>81%</td>
<td>13%</td>
<td>50%</td>
<td>43%</td>
<td>0.73</td>
</tr>
<tr>
<td>Air sac</td>
<td>89%</td>
<td>19%</td>
<td>24%</td>
<td>86%</td>
<td>0.59</td>
</tr>
<tr>
<td>Soft tissue bands</td>
<td>83%</td>
<td>17%</td>
<td>56%</td>
<td>43%</td>
<td>0.95</td>
</tr>
<tr>
<td>Positive CT scan</td>
<td>84%</td>
<td>22%</td>
<td>79%</td>
<td>29%</td>
<td>0.64</td>
</tr>
</tbody>
</table>

Discussion

The aim of this study was to determine if there were any radiologic characteristics on high resolution CT scans that would predict the presence of cholesteatoma. Overall, 4 radiologic characteristics were investigated, based on previous CT studies and surgical findings. None of the specific radiologic criteria we investigated reached statistical significance for predicting recurrent cholesteatoma. This is similar to results from previous studies performed on this subject having shown that CT scan is not a reliable predictor in diagnosing recurrent disease. Results from this study confirm that high resolution computed tomography scanning poorly predicts the recurrence of cholesteatoma. To date, no specific radiologic findings are established for the diagnosis of cholesteatoma in the previously operated mastoid cavity.

The positive predictive values for a well-defined mass, soft tissue bands, and air sac (retraction pocket) from CT scan were 81%, 83%, and 89% respectively. A high positive predictive value in this study indicates that the presence of a certain finding correlates well with positive surgical findings of cholesteatoma.

The negative predictive values for a well-defined mass, soft tissue bands, and air sac (retraction pocket), were much lower at 15%, 17%, and 19% respectively. A low negative predictive value implies that the lack of a certain finding does not rule out recurrent disease. Hence, these radiologic findings are useful in ruling in, but not ruling out cholesteatoma. Overall, a positive impression from CT scan correlated poorly with intra-operative findings of cholesteatoma (p = 0.64).

Some factors that may have contributed to the results of this study were that soft tissues densities (possibly representing granulation tissue or mucosal thickening) might have obscured other findings (well defined mass, soft tissue bands, etc.), which may have impacted our results. We can also conclude that generalized soft tissue filling the middle ear and mastoid has no correlation with findings of cholesteatoma.

Overall, CT scans may remain a useful adjunct to the history, physical exam, and other tests, but cannot reliably be used to diagnose recurrent cholesteatoma. Therefore, second look tympanomastoidectomy remains the gold standard for the diagnosis of recurrent cholesteatoma.