ORIGINAL ARTICLE

Accuracy of FNAC and CT in the Differentiation of Benign and Malignant Parotid Tumours in a Case Series

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KEYWORDS
Parotid;
Fine needle aspiration cytology;
Computerised tomography;
Accuracy;
Sensitivity;
Specificity

Abstract
Introduction: Parotid tumours, in addition to the wide variety of types, are histologically complex. Differentiating between benign and malignant tumours in preoperative diagnosis is important in deciding the type of surgery required. Fine needle aspiration cytology (FNAC) is a simple, quick, low-cost, low-invasive and well-tolerated tool used in the preoperative diagnosis of these tumours.

Material and methods: we calculated the sensitivity, specificity, predictive positive value (PPV) and negative predictive positive value (NPV) of FNAC and computed tomography (CT) in the differentiation of benign and malignant parotid tumours operated between 2010 and 2014 in the oral and maxillofacial surgery department of the University Hospital Miguel Servet.

Results: The sensitivity of FNAC is 50%, while the specificity is high, at 98.7%. FNAC offers high reliability in the diagnosis of malignant tumours, despite its low sensitivity. However, when the diagnosis is indeterminate or benign, other than pleomorphic adenoma or Whartin tumour, the reliability to exclude malignancy decreases.

Conclusion: The low sensitivity of FNAC to differentiate malignant from benign parotid tumours, means that we cannot rule out other diagnostic tests, clinical symptoms and especially the intra-operative vision of each surgeon. Especially when the diagnosis is indeterminate. Nevertheless, it is a technique used in a systematised way and helps in pre-surgical decision-making.

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Introduction

Parotid tumours are rare, with an annual incidence of 0.4–13.5 cases per 100 000 inhabitants. They comprise only 2%–6.5% of all neoplasms of the head and neck.\(^1\) Although there is debate as to the use of fine needle aspiration cytology (FNAC) to screen for or detect parotid tumours. Both FNAC and ultrasound-guided FNAC (UG-FNAC) are basic procedures in the preoperative diagnosis of parotid gland tumours. FNAC is simple, fast, low cost, non-invasive and well tolerated. There are many studies on the accuracy of FNAC in distinguishing neoplastic from inflammatory processes, malignant from benign tumours, and these separately. In all of them, specificity is greater than sensitivity, especially in the case of malignant tumours. This is due to the great diversity of parotid tumours (42 according to the latest classification of the World Health Organisation), that are histologically complex, anatopathologically detectable, and of all the tumours of the parotid gland only between 20% and 30% are malignant. Moreover, in the literature FNAC has the lowest rate of accuracy in the diagnosis of head and neck tumours.\(^2\)

Material and Methods

The results obtained from FNAC, UG-FNAC and computerised axial tomography (CAT) in 323 benign carotid tumours operated by the department of oral and maxillofacial surgery during 2010 and 2014. Our inclusion criteria were all operated parotid tumours, with previous FNAC and definitive biopsy, over said 4 years. Parotid tumours operated without previous FNAC, unoperated previous FNAC tumours and recurrences of previously operated tumours were excluded from the study. We collected as variables in our database for all the tumours that met the inclusion criteria: age, sex, preoperative FNAC and CAT results and definitive anatopathological diagnosis of the surgical specimen. We used SPSS version 20.0 for the statistical analysis, studying sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of FNAC, UG-FNAC in differentiating between malignant and benign tumours, with and without taking into account non-conclusive and non-diagnostic results of same. We also calculated the sensitivity and specificity of CAT and if it contributed anything to the result of FNAC, classifying the results into 4 categories: true positives: correct FNAC for malignant tumour; false negatives: negative FNAC for malignancy and diagnosis of a malignant tumour as benign, false positives: positive FNAC for malignancy in a benign tumour and true negatives: FNAC accurate for a benign tumour or non-neoplastic process. The exclusion criteria were tumours operated without previous FNAC, with a previous diagnosis of malignancy or recurrences.

Results

Of the 323 operated parotid tumours, 282 were benign and only 42 malignant. The most frequent of the benign tumours...
were pleomorphic adenoma (131 cases) and Warthin’s tumour (82 cases). The most common of the malignant tumours were intraparotid squamous cell carcinoma metastases (11 cases) followed by adenocarcinoma and acinar cell carcinoma, and mucoepidermoid carcinoma in fourth place. The mean age of presentation of the benign tumours in females was 52.75 years (confidence interval [CI] 50.07–55.43) and in males 55.79 years (CI 53.9–58.08). For malignant tumours, the mean age was 66 years for females, with a CI 58.05–73.95, and 68.48 for males, with a CI 61.55–75.42.

For all the malignant tumours, FNAC was diagnostic of malignancy in 50% (21 of the 42 cases), was not diagnostic in 4.8% (2), inconclusive in 16.7% (7) and benign in 28.6% (12). For the benign tumours, the diagnosis was benign in 83.3% of the cases (234 out of the 281), non-diagnostic in 9.6% (27), inconclusive in 6% (17) and malignant in 1.1% (3).

Sensitivity in differentiating between malignant and benign tumours in our case series, if we consider the inconclusive and non-diagnostic results as if they were benign FNAC, was 50% (21 cases), with a CI 0.35–0.65, and PPV of 87.5%, with a CI 0.74–1.01, more than the published studies (Table 1).

Excluding the cases of inconclusive and non-diagnostic FNAC, we are left with 270 cases. And sensitivity increases to 63.3%, with CI 0.47–0.8, specificity is 98.7%, with a CI of 0.97 and 1, and the PPV remains at 87.5% (Table 2).

The overall value of FNAC is high: 92% (proportion of valid positives among the results as a whole). True positives + true negatives/all the cases.

The great changes in the nomogram between the pretest likelihood of malignancy (prevalence), 13% in our series of cases, and the post-test positive likelihood ratio (PLR), 48.69 with a CI 15.86–159.35, and the post-test negative likelihood ratio (NLR), 0.37 with a CI 0.23–0.58, indicate that FNAC is often conclusive when the diagnosis is a malignant tumour (Fig. 1).

Sensitivity for Warthin’s tumour and pleomorphic adenoma separately, in our case review, was 61% and 85.5%, respectively. For the remaining benign tumours, sensitivity was less than 54.5%, and for mucoepidermoid carcinoma, 20%.
Table 3  Accuracy of CAT in Parotid Tumours.

<table>
<thead>
<tr>
<th></th>
<th>Malignant PA</th>
<th>Benign PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malignant CAT</td>
<td>54.5% (12)</td>
<td>8.9% (8)</td>
</tr>
<tr>
<td>Benign CAT</td>
<td>45.5% (10)</td>
<td>91.1% (82)</td>
</tr>
<tr>
<td>Total</td>
<td>19.6% (22)</td>
<td>84.4% (90)</td>
</tr>
<tr>
<td>Malignant CAT and FNAC</td>
<td>62.2% (23)</td>
<td>37.8% (14)</td>
</tr>
<tr>
<td>Benign CAT and FNAC</td>
<td>1.6% (4)</td>
<td>98.4% (243)</td>
</tr>
<tr>
<td>Total</td>
<td>90.5% (27)</td>
<td>9.5% (257)</td>
</tr>
</tbody>
</table>

and 98.4% respectively, and not higher than the sensitivity of FNAC on its own in our study (Table 3).

Discussion

FNAC is a simple, low cost and non-invasive technique that is widely used in the preoperative diagnosis of head and neck masses. It has the lowest sensitivity in the diagnosis of malignant parotid tumours out of all the head and neck tumours. It also has limited validity and accuracy; therefore it should not be used according to some authors as a single diagnostic tool, but as a complementary technique, as a first diagnostic approach to establish whether surgery is necessary, but not to establish a specific diagnosis. In our study the overall value of FNAC was 92% and in the literature it varies from 79% to 98%. The sensitivity rate in differentiating between malignant and benign tumours ranges from 39.1% in the article by Jeong et al., 53.8% in that of Herrera Hernández et al., 83% in the study by Bartels et al. In our series of cases it is low, 50%, in line with the majority of published studies. However, it increases to 63.3% if we exclude the cases of non-diagnostic and inconclusive FNAC. This is because most inconclusive FNAC results are for malignant tumours, and if we exclude these results, the sensitivity increases and the false negatives reduce by almost half in our study. In many studies the non-diagnostic and inconclusive cases are not taken into account, and therefore sensitivity is greater. In addition, as can be seen in the literature, malignant tumours give the most false negatives, from 14% to 48%, and the amount of inconclusive results in our review was greater than that reported in the literature. Therefore it is advisable to repeat the FNAC and consider other diagnostic tests in nondiagnostic and inconclusive cases.

The PPV is 87.5%, with a CI 0.74–1.01, similar to published studies in which the PPV goes from 80% to 96%. The low sensitivity, despite its quite high PPV, indicated its usefulness more in confirming a diagnosis than as a screening test, since there is a high rate of false negatives.

The specificity for diagnosing benign tumours is greater and similar to the ranges found in the literature, at 98.7%, without taking into account inconclusive and nondiagnostic FNAC results. In the study by Jeong et al. it is up to 99.3% (Table 4).

The most frequent distribution frequencies of the different tumour types are: 85.5%, for pleomorphic adenoma, followed by Warthin’s tumour, 61%, similar to that found in the literature, 76.5% and 70.9%, respectively. Mucoepidermoid carcinoma is the most frequent malignant tumour in the published case series and reviews; however, in our study it is the fourth in frequency, after intraparotid metastases, adenocarcinoma and acinar cell carcinoma. This might be because not all malignant tumours are operated and in our study we took into account operated cases with an anatomicopathological result.

Conclusions

FNAC is a very useful tool for preoperative diagnosis and influences surgical decisions, and for preventing unnecessary intervention, especially when the diagnosis is pleomorphic adenoma and Warthin’s tumour, and also when the result is malignant. Specificity was high in diagnosing benign tumours and false positives were few, therefore a FNAC with a malignant result is very helpful for surgical decision-making. This means that we must take more care with nondiagnostic and inconclusive results that report the most false negatives, and perform a further biopsy and other tests if necessary. And we must also pay particular

Table 4  Review of Sensitivity, Specificity, PPV and NPV of FNAC in Different Published Studies.

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV (%)</th>
<th>NPV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jeong et al. 2</td>
<td>39.1</td>
<td>99.3</td>
<td>90</td>
<td>90.5</td>
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<tr>
<td>Herrera Hernández et al. 6</td>
<td>54</td>
<td>90</td>
<td>90</td>
<td>70</td>
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<tr>
<td>Bartels et al. 4</td>
<td>83</td>
<td>86</td>
<td>83</td>
<td>86</td>
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<tr>
<td>Lin and Bhattacharyya 7</td>
<td>63</td>
<td>97.5</td>
<td>81</td>
<td>93.9</td>
</tr>
<tr>
<td>Altuna Mariezkurrena et al. 8</td>
<td>80</td>
<td>96.6</td>
<td>80</td>
<td>96.6</td>
</tr>
<tr>
<td>Wong and Li 9</td>
<td>53</td>
<td>91</td>
<td>96</td>
<td>-</td>
</tr>
<tr>
<td>Ngansangiam et al. 1</td>
<td>81.3</td>
<td>99.1</td>
<td>92.9</td>
<td>97.5</td>
</tr>
<tr>
<td>Seethala et al. 7</td>
<td>86</td>
<td>92</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Shetty and Geethaman 10</td>
<td>94.4</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Feinstein et al. 11</td>
<td>75</td>
<td>95.1</td>
<td>84.9</td>
<td>91.2</td>
</tr>
<tr>
<td>Ghantous et al. 12</td>
<td>90</td>
<td>98</td>
<td>90</td>
<td>98</td>
</tr>
<tr>
<td>Weerasinghe et al. 13</td>
<td>75</td>
<td>97.5</td>
<td>96</td>
<td>83</td>
</tr>
</tbody>
</table>

NPV: negative predictive value; PPV: positive predictive value.
attention with cases of benign FNAC that are not pleomorphic adenoma or Warthin’s tumour, since the FNAC has lower sensitivity. Although we have explained the reason why the result for pleomorphic adenoma, Warthin’s or malignant tumours is highly sensitive, we must never overlook clinical symptoms, imaging tests and intraoperative findings. In the case of FNAC with a malignant result, it is advisable to request imaging tests to help us in surgical decision making.

**Conflict of Interests**

The authors have no conflict of interests to declare.

**Appendix A. Supplementary data**

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.otoeng.2017.12.009.

**References**