Distribution and Frequency of Parotid Gland Tumors in the Anhui Province: A Retrospective Multicenter Study of 758 Cases

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Article

Keywords:

Posted Date: April 10th, 2023

DOI: https://doi.org/10.21203/rs.3.rs-2686813/v1

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Abstract

Background: Parotid gland tumors are rare with complex histopathology and no early clinical symptoms. There are no reports of epidemiological and pathological features of parotid gland tumors in the Anhui province of China. We aimed to retrospectively analyze the distribution and histopathological characteristics of parotid gland tumors in the Anhui province.

Methods: We analyzed clinical data of 758 patients with parotid gland tumors who were admitted to three hospital centers between January 2018 and January 2022.

Results: The most frequent neoplasms were pleomorphic adenoma and mucoepidermoid carcinoma. There were 641 patients with benign tumors and 117 with malignant tumors. The most common benign tumors were pleomorphic adenoma, and the most frequent malignant tumor was mucoepidermoid carcinoma. Warthin tumor was the second most common benign tumor. In Hefei, squamous cell carcinoma was the second most common malignant tumor, which is inconsistent with other literature.

Conclusions: The distribution and frequency of most parotid gland neoplasms in the Anhui province were similar to those described worldwide. The historically significant male predilection of the Warthin tumor was confirmed. Future multicenter studies can serve as an epidemiological baseline to better characterize these tumors.

Introduction

Salivary gland tumors (SGT) have complex anatomical structures and diverse histopathological types, making them harder to be diagnosed and treat. Fortunately, the incidence of SGT is relatively low, about one in a million, accounting for 2–3% of head and neck tumors. The existence of only a few cases in a single center results in difficulty in analyzing and summarizing the clinical characteristics. There are discrepancies in the incidence of SGT between different geographic areas and ethnic groups. As the largest of the three pairs of salivary glands (parotid gland, submandibular and sublingual gland), the parotid gland is the most common site of SGT, accounting for 80% of SGT. Numerous studies have reported epidemiological and histopathological data for parotid gland tumors worldwide. There are few findings in English literature on parotid gland tumors in the Anhui population. This study aimed to analyze and compare the distribution, composition, and clinical data of SGT retrospectively in the Anhui province to provide a basis for diagnosing and treating patients with parotid gland tumors and to help evaluate and understand the current status of parotid neoplasms as compared to other areas.

Methods

Ethical considerations: The institutional research committees (The First Affiliated Hospital of Anhui Medical University, Fuyang People's Hospital and the Second People's Hospital of Wuhu) approved this study, and all participants signed an informed consent agreement. All methods were performed in
accordance with the relevant guidelines and regulations. All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Patient Selection, Inclusion, and Exclusion Criteria

Patients with parotid gland tumors who were hospitalized in the three centers in Anhui between January 2018 and January 2022 were included: Department of Otolaryngology-Head and Neck of the First Affiliated Hospital of Anhui Medical University (central region), Fuyang People's Hospital (northern region), and the Second People's Hospital of Wuhu (southern region) (Figure 1). Inclusion criteria for the study were as follows: patients admitted for the diagnosis and treatment of parotid gland tumors confirmed by histopathological examination. Exclusion Criteria were as follows: mesenchymal neoplasms and lymphomas, duplicates and recurrences, and tumors involving the sinonasal region, nose, and trachea.

A total of 758 patients with parotid gland tumors were included, and their data regarding gender, age, and histopathological type were obtained. Cases with incomplete information as well as duplicates and recurrences were excluded after an initial review. Tumors were classified according to the 2017 World Health Organization classification of salivary gland tumors. There were twelve different types of benign SGT tumors found in the province: common pleomorphic adenoma (PA), Warthin tumor (WT), basal cell adenoma (BCA), and myoepithelial adenoma (MA), as well as common malignant tumors, like mucoepidermoid carcinoma (MEC), adenoid cystic carcinoma (AdCC), acinar cell carcinoma (ACC), squamous cell carcinoma (SCC), myoepithelial carcinoma, pleomorphic adenoma-carcinoma.

Statistical Analysis

We compared the three central data in terms of demographic parameters, medical history, and histopathological types of parotid gland neoplasms. Descriptive statistical analysis of the data was performed using frequencies and percentages of the variables via Excel. Fisher's exact test and Pearson's chi-square test evaluated the differences between the biological behavior of the tumors and their clinical and demographic characteristics, using a cut-off value of a p-value of \( \leq 0.05 \) and a 95% confidence interval.

Ethics Statements

This study was conducted in full accordance with the World Medical Association Declaration of Helsinki (version 2002). This study was approved by the Research Ethics Committee of the three Hospitals. All study participants provided informed consent.

Results
The overall results can be found in Table 1. A total of 758 parotid gland tumors were included (641 benign and 117 malignant cases). A slight female predilection (51.8%) can be observed in cases of both benign and malignant tumors. Cases were observed to occur more frequently between the ages of 40 and 70 with an average age of 50.77 years old (Figure 2). The ratio of the prevalence of benign to malignant tumors was 5.48:1. The gender and age distribution of benign and malignant tumors are shown in Table 1. The age group with the highest incidence of benign and malignant parotid tumors was that of patients who were 51-60 years old and accounted for 25.99% of the cases (Figure 3). The distribution of tumors and patients of different ages and genders is shown in Figure 4.

**The composition and distribution of the pathological types of parotid benign tumors in the three central hospitals in Anhui:**

The most common benign parotid tumors of the three centers were PA, WT, BCA, and MA, accounting for 45.87%, 18.41%, 7.02% and 5.93% of cases, respectively (Table2).

Comparing the incidence between the three hospitals, PAs were the most common benign tumors varying from 40.82% in Wuhu to 51.85% in Hefei. The second most common benign tumors were WTs, with a range of incidence between 16.30% (Hefei) to 21.43% (Fuyang), followed by BCA ranging from 5.56% (Hefei) to 8.93% (Fuyang). The fourth most common benign tumor was MA, accounting for 5.19% in Hefei, 1.79% in Fuyang, and 13.61% in Wuhu.

**Gender distribution**

For benign tumors, there was a slight female predilection in Hefei (54.13%) and in Wuhu (55.75%). A slight male predilection (53.19%) was observed at Fuyang People's Hospital. In cases with WT, there were significantly more male patients than female patients, with an average male-to-female sex ratio of 15.86:1, as shown in Table 2.

**Geographic distribution**

The first and second most common benign tumors of were PA and Wt, respectively, at the three centers. The incidence of PA in Hefei was higher than in Fuyang and Wuhu (p<0.05). There was no significant difference in the incidence of PA between Fuyang and Wuhu (p>0.05) or the incidence of WT and BCA among the three regions (p>0.05). The third most common benign tumor in Wuhu was MA; the incidence of which was much higher in Wuhu than in Fuyang and Hefei (p<0.05), but there was no statistical difference in incidence between Fuyang and Hefei (p>0.05), as shown in Figure 5. Pathological pictures of the most common benign tumors are shown in Figure 6.

**The composition and distribution of the pathological types of parotid gland malignant tumors in the three hospitals in Anhui:**
The common malignant parotid tumors at the three centers were MEC, AdCC, ACC, and SCC, accounting for 28.21%, 17.95%, 11.97%, and 8.55% of cases, respectively (Table 3 and Figure 7). Comparing the incidence between the three hospitals, MEC was the most common malignant tumor varying from 18.75% in Hefei to 35.00% in Fuyang. The second most common malignant tumors were AdCC with an incidence of 14.58% (Hefei) to 20.69% (Wuhu), followed by ACC ranging from 10% (Hefei) to 17.24% (Wuhu). SCC accounted for 16.67% of malignant tumors in Hefei, 5% in Fuyang, and 0% in Wuhu.

**Gender distribution**

There was a slight female predilection for malignant tumors in Fuyang (65.03%) and in Wuhu (55.16%). A slight male predilection (54.05%) was observed at the First Affiliated Hospital of Anhui Medical University. SCC was the second most common malignant tumor in Hefei, as shown in Table 3.

**Geographic distribution**

The most common malignant tumor was MEC at the three centers. There were no statistical differences in the incidence of MEC, AdCC, and ACC in the three regions. The incidence of SCC varied in the three regions and was higher in Hefei and Fuyang than in Wuhu (p<0.05). There was no statistical difference in the incidence of SCC between Hefei and Fuyang (p>0.05). Pathological pictures of the most common malignant tumors are seen in Figure 8.

**Discussion**

Anhui is located in the southeastern province of China, covering 140,100 square kilometers with a population of 61.13 million. Hefei is the capital and central region of the Anhui Province, with a permanent resident population of 9.3699 million. Fuyang is the largest northern central city of Anhui Province, with a permanent resident population of 8.171 million. Wuhu is the regional center of southern Anhui Province, with a permanent resident population of 3.672 million. Many patients with parotid gland tumors are treated in the largest comprehensive hospitals in each region. This provided a population to evaluate epidemiological and pathological features of parotid gland tumors in the Anhui province of China.

This study observed a slight female predilection among the 758 patients with parotid tumors in the Anhui province, consistent with other findings. However, other studies concluded that parotid gland tumors were more common in males, which could be due to regional differences. In the current study, the ages of the patients ranged from 14 to 90 years (mean, 50.77 years). The age group of benign tumors with the highest incidence was 51–60 years old in both men and women, which was similar to previous reports. Furthermore, there were more cases of women in their 30s and 40s than men, which may be due to the gender characteristic of benign tumors.
Based on the histopathological data, 84.6% of the parotid gland tumors were benign tumors in this group, which was higher than the rates reported by authors in the UK, Brazil, Shanghai, and the Sichuan region of China\textsuperscript{15}. All reports suggested benign tumors were predominant in parotid gland tumors. Comparing the incidence between the three hospitals, PAs were the most common benign tumors varying from 40.82\% in Wuhu to 51.85\% in Hefei, consistent with previous literature\textsuperscript{5}. This study showed that the second most common benign tumor were WTs, similar to earlier demographic studies\textsuperscript{12,18,19}. BCA was found to be the third most common benign tumor in Hefei and Fuyang. However, the third most common benign tumor in Wuhu was MEC, which was much higher than BCA. This trend may be characteristic of the disease distribution in Wuhu.

In this study, a large female predilection was observed in cases of PA. Pseudopodia were also found in pathological sections of the PAs, which was recognized as the infiltration of neoplastic cells into the capsule\textsuperscript{20}. PAs are a tumor with a wide range of histopathological features that typically exhibit various cell types, including round, angular, oval, and plasmacytoid cells with a duct-like space dominated by fibrous and mucoid stroma\textsuperscript{21}. Squamous metaplasia and incomplete capsules were common, whereas other features such as vascular invasion, crystals, and psammoma bodies were less common. Zbären and Stauffer\textsuperscript{22} observed that 48\% of 218 cases of parotid PAs had features of pseudopodia and/or satellite nodules, with a higher incidence in classical subtypes. The high rate of tumor infiltration into encapsulated tissue may be a risk factor for recurrence, especially after surgical resection, as tumor tissue within the capsule may remain at the surgical site\textsuperscript{23}. This is the theoretical basis of superficial parotidectomy in cases with PA\textsuperscript{20}.

In this study, WT accounted for 18.4\% of benign tumors, which was less than the prevalence in parts of Pennsylvania per one study. WT showed a significant gender difference, with a male-to-female ratio of 15.86:1. The prevalence in males was significantly more than in females, which was higher compared to previous literature\textsuperscript{24}. Some literature showed a relationship between smoking and WT. There were a few female tobacco users in the WT group; however, we did not further explore this relationship. But the historically significant male predilection of WT was confirmed.

The present study showed that the most common malignant tumor of the parotid gland was MEC, varying from 18.75–35\%, which was consistent with previous reports of global prevalence\textsuperscript{14,17,25,26}. The second most common malignant tumor was ACC accounting for 20\% of all malignant tumors in all centers except Hefei, where the second most common malignant tumor was SCC. We found that the prevalence of SCC was higher than that of other regions, which was inconsistent with other reports\textsuperscript{19}. Lee et al reported that the most frequent malignant tumor in the parotid gland was SCC (30\%), which was considered to be the epidemiologic distribution of parotid gland tumor in the Chumnam area of Korea\textsuperscript{27}.

High-grade solid MEC and SCC are pathologically confusing and susceptible to the subjective influence of pathologists. In our study, the prevalence of MEC in Hefei was lower than in the other two centers. We speculated that this result was related to the aspect of pathological diagnosis. The third most common
tumors were AdCC and ACC in Hefei and ACC in Fuyang and Wuhu. Some studies report that ACC is the fifth most common malignant parotid gland tumor\(^\text{13}\). In fact, the variability in different pieces of literature about the prevalence of ACC may result from small and unicentric cohorts, perhaps due to geographic characteristics.

Understanding the epidemiological and histopathological characteristics of parotid gland tumors in the Anhui Province is crucial for better diagnosing these diverse and complex tumors and serving as an epidemiological baseline for diagnosing patients in this area.

**Limitations**

Due to the multi-institutional retrospective setting, we should consider the selection bias from three hospitals. Finally, the results may be limited by documentation.

**Conclusion**

This retrospective study compared the epidemiological and histopathological characteristics of parotid gland tumors in three regions of the Anhui province. The most common benign tumors were PA and WT, while MEC was the most frequent malignant tumor. The significant male predominance of WT was also confirmed.

**Declarations**

**Acknowledgments**: We thank Bo Wang and ZhiYu Fang from the Fuyang People's Hospital, ChuanYa Jiang from the Second People's Hospital of Wuhu, Anhui province China.

**Author Contributions**: M.D. and Y.L. conceived and designed the project. X.Y.collected study samples. X.Y. and M.D. and Y.L wrote and revised the manuscript.

**Data Availability Statement**: All patient’s data can be provided from the corresponding author.

**Competing Interests Statement**  The authors declare no authors competing interests

**References**


### Tables

**Table 1.** Tumor category, gender, and age distribution of parotid tumors in three hospitals

<table>
<thead>
<tr>
<th>AGE</th>
<th>Benign tumors</th>
<th>Malignant tumors</th>
</tr>
</thead>
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<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>10-20</td>
<td>8</td>
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<tr>
<td>21-30</td>
<td>34</td>
<td>42</td>
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<td>31-40</td>
<td>26</td>
<td>54</td>
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<td>41-50</td>
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<td>51-60</td>
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<td>61-70</td>
<td>62</td>
<td>58</td>
</tr>
<tr>
<td>71-80</td>
<td>22</td>
<td>24</td>
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<tr>
<td>81-90</td>
<td>3</td>
<td>5</td>
</tr>
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**Table 2.** Distribution characteristics of benign tumors of the parotid gland in three regions
<table>
<thead>
<tr>
<th>Histological type</th>
<th>Hefei1 M/F</th>
<th>Fuyang2 M/F</th>
<th>Wuhu3 M/F</th>
<th>Total M/F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA</td>
<td>140(52/88)</td>
<td>94(40/54)</td>
<td>60(23/37)</td>
<td>294(115/179)</td>
<td>P=0.034</td>
</tr>
<tr>
<td></td>
<td>51.85%</td>
<td>41.96%</td>
<td>40.82%</td>
<td>45.87%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P=0.028</td>
<td>P=0.031</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P=0.826</td>
<td></td>
</tr>
<tr>
<td>WT</td>
<td>44 43/1</td>
<td>48(44/4)</td>
<td>26(24/2)</td>
<td>118(111/7)</td>
<td>P=0.331</td>
</tr>
<tr>
<td></td>
<td>16.30%</td>
<td>21.43%</td>
<td>17.69%</td>
<td>18.41%</td>
<td></td>
</tr>
<tr>
<td>BCA</td>
<td>15 3/12</td>
<td>20 8/12</td>
<td>10 3/7</td>
<td>45(14/31)</td>
<td>P=0.342</td>
</tr>
<tr>
<td></td>
<td>5.56%</td>
<td>8.93%</td>
<td>6.80%</td>
<td>7.02%</td>
<td></td>
</tr>
<tr>
<td>MA</td>
<td>14 8/6</td>
<td>4 0/4</td>
<td>20 8/12</td>
<td>38(16/22)</td>
<td>P=0.000</td>
</tr>
<tr>
<td></td>
<td>5.19%</td>
<td>1.79%</td>
<td>13.61%</td>
<td>5.93%</td>
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</tr>
<tr>
<td></td>
<td></td>
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<td>P=0.077</td>
<td>P=0.003</td>
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<td></td>
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<td></td>
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<td>P=0.000</td>
<td></td>
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</tbody>
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Table 3. Distribution characteristics of malignant tumors of the parotid gland in three regions
<table>
<thead>
<tr>
<th>Histological type</th>
<th>Hefei1</th>
<th>Fuyang2</th>
<th>Wuhu3</th>
<th>Total</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M/F</td>
<td>M/F</td>
<td>M/F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEC</td>
<td>9(6/3)</td>
<td>14(8/6)</td>
<td>10(7/3)</td>
<td>33</td>
<td>P=0.166</td>
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<tr>
<td></td>
<td>18.75%</td>
<td>35.00%</td>
<td>34.48%</td>
<td>28.21%</td>
<td></td>
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<tr>
<td>SCC</td>
<td>8 6/2</td>
<td>2 (2/0)</td>
<td>0</td>
<td>10</td>
<td>P=0.025</td>
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<tr>
<td></td>
<td>16.67%</td>
<td>5.00%</td>
<td>0</td>
<td>8.55%</td>
<td>P1-2=0.168</td>
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<tr>
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<td></td>
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<td>P1-3=0.022</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>P2-3=0.506</td>
</tr>
<tr>
<td>AdCC</td>
<td>7 4/3</td>
<td>8 2/6</td>
<td>6 2/4</td>
<td>21</td>
<td>P=0.729</td>
</tr>
<tr>
<td></td>
<td>14.58%</td>
<td>20.00%</td>
<td>20.69%</td>
<td>17.95%</td>
<td></td>
</tr>
<tr>
<td>ACC</td>
<td>7 1/6</td>
<td>4 0/4</td>
<td>5 2/3</td>
<td>14</td>
<td>P=0.669</td>
</tr>
<tr>
<td></td>
<td>14.58%</td>
<td>10.00%</td>
<td>17.24%</td>
<td>11.97%</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>17 (9/8)</td>
<td>12(2/10)</td>
<td>8(2/6)</td>
<td>39</td>
<td>–</td>
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<tr>
<td></td>
<td>35.42%</td>
<td>30%</td>
<td>27.59%</td>
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<tr>
<td>Total</td>
<td>48</td>
<td>40</td>
<td>29</td>
<td>117</td>
<td>–</td>
</tr>
</tbody>
</table>

**Figures**
Figure 1

Geographical distribution map of three regions in Anhui Province
Figure 2

Overall age distribution of parotid tumors
Figure 3

Age distribution of benign and malignant tumors in parotid gland
Figure 4

Age and sex distribution of parotid gland tumors
Figure 5

Composition chart of main benign tumors of parotid gland in three regions

PA-pleomorphic adenoma, WT-Warthin tumor, BCA-basal cell adenoma, MA-myoepithelioma
Figure 6

Most common pathological pictures of benign tumors 6A: PA-pleomorphic adenoma, 6B: WT-Warthin tumor, 6C: BCA-basal cell adenoma, 6D: MA- myoepithelioma
Figure 7

Composition chart of main malignant tumors of parotid gland in three regions; MEC-mucoepidermoid carcinoma, SCC-squamous cell carcinoma,
AdCC-adenoid cystadenocarcinoma, ACC- acinar cell carcinoma
Figure 8

Most common pathological pictures of malignant tumors 8A: MEC-mucoepidermoid carcinoma, 8B: SCC-squamous cell carcinoma, 8C: AdCC-adenoid cystadenocarcinoma, 8D: ACC- acinar cell carcinoma