Diagnostic Accuracy of Fine-Needle Biopsy for Salivary Gland Neoplasms in a Community Otolaryngology Practice

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Abstract

Objective. To assess the diagnostic accuracy of fine-needle biopsy (FNB) of salivary gland neoplasms via ultrasound (US) or palpation guidance by an otolaryngologist in a community practice.

Study Design. Retrospective chart review.

Setting. Community otolaryngology practice.

Methods. Retrospective analysis was conducted for all office-based salivary gland FNBs from a community practice from 2005 through 2018. There were 433 FNBs performed among 370 patients. The likelihood of achieving a diagnostic result based on method (US vs palpation guidance) was calculated. Of this cohort, 196 cases had surgical follow-up (parotid gland, n = 168; submandibular gland, n = 28). Correlation of preoperative FNB results to final surgical pathology was performed and measures of diagnostic accuracy computed.

Results. US-guided FNBs were more likely to achieve a diagnostic result than FNBs obtained via palpation guidance (*P* = .00002). Parotid gland FNBs demonstrated a sensitivity and specificity of 78.57% and 92.44%, respectively. Submandibular FNBs demonstrated a sensitivity and specificity of 57.14% and 93.74%.

Conclusion. FNBs performed under US guidance are more likely to achieve a diagnostic specimen than those performed under palpation guidance. FNBs of parotid gland tumors may be assessed with diagnostic accuracy in the community setting that is similar to that achieved at tertiary care centers. Further research is needed to ascertain whether this finding extends to FNBs of submandibular gland tumors. Offering this procedure at point of care in the community may improve compliance and reduce wait time.

Keywords

fine-needle biopsy, fine-needle aspiration, salivary gland, salivary gland tumors, parotid, submandibular

Salivary gland tumors make up about 3% of all head and neck neoplasms, with approximately 85% originating in the parotid gland.[1] Roughly 7% to 11% of salivary gland tumors arise in the submandibular gland and <1% in the sublingual gland.[2] Major salivary gland malignancies represent about 5% of head and neck cancers and 0.25% of all malignancies in developed countries.[3] Generally, the likelihood of malignancy increases with decreasing size of the involved salivary gland: malignancies are reported in 15% to 32% of parotid tumors, 41% to 45% of submandibular gland tumors, and 70% to 90% of sublingual gland tumors.[2]

Fine-needle biopsy (FNB) of salivary gland tumors is a useful diagnostic tool in the workup of salivary gland tumors. FNB is accurate, sensitive, and specific.[4,5] A recent systematic review and meta-analysis of 63 studies comprising 5647 FNB procedures demonstrated an overall sensitivity and specificity of 78% and 87.7%, respectively.[1] Moreover, the preoperative FNB result may influence the timing and extent of surgical intervention, as well as preoperative counseling, and is therefore a helpful adjunct in management.[6] However, some authors question its utility, arguing that salivary gland masses require excision regardless of biopsy results.[6]

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The majority of investigations into the usefulness of FNB for salivary gland lesions have emanated from tertiary care centers.[3,6-8] Ultrasound-guided FNB is commonly performed by radiologists or pathologists rather than otolaryngologists.[3,6-8] Cytopathologists may be on-site to determine specimen adequacy at the time of biopsy, and the resulting specimens are generally examined at a single tertiary care institution.[3,6-8] Indeed, some studies examining the utility of FNB for salivary gland lesions note that variations in technique, operator, and pathologists (community vs academic practice) may be confounding factors in establishing its usefulness.[5]

The majority of patients with salivary gland lesions first present to community otolaryngology practices. Same-day point-of-care office-based ultrasound-guided FNB by the treating otolaryngologist has the potential to expedite management, consolidate resources, and reduce overall health care cost.

The present study evaluates the results of salivary gland FNB as performed by an otolaryngologist in an office setting in a large community practice and as evaluated by cytopathologists at different community hospitals.

Methods

The Tufts Medical Center Institutional Review Board approved this study, which is based on a large community practice with multiple satellite offices in southern Massachusetts that are affiliated with the Tufts Medical Center otolaryngology program. Office-based salivary gland FNBs performed over a 13-year period (2005-2018) were identified by *Current Procedural Terminology* code 42400 in a retrospective chart review. During the first 8-year period (2005 to 2013), FNBs were done with palpation guidance by 4 otolaryngologists, including the senior author. After October 2013, a dedicated ultrasound clinic was established, and all subsequent biopsies and slide fixation were performed by the senior author using a standard technique. The wet- and air-dried slide preparation techniques were chosen per the interpreting pathologist's preference.

Clinical information was collected, such as age, sex, and location of salivary gland neoplasm. The method—ultrasound versus palpation guidance—and cytopathology result were recorded for each FNB. If a patient subsequently underwent excision of the salivary gland in question, a final pathologic diagnosis was also recorded.

All FNBs were performed in the office after written consent was obtained from the patient. Patients were placed in the semisupine position in an office chair, and the salivary gland lesion was isolated with palpation or US guidance. Local anesthetic (1-3 mL; 1% lidocaine with 1:100,000 epinephrine) was infiltrated to achieve local anesthesia. FNB was performed with a 1.5-in 25-G needle or a 1.25-in 27-G needle attached to a 10-mL disposable plastic syringe via a capillary action technique combined with minimal negative pressure. Four passes were made for each salivary gland lesion. The specimens were placed in CytoLyt—a methanol-based buffered preservative solution (wet preparation)—or

smears were prepared, air-died, and fixed with 95% ethanol. No on-site cytopathologist was used to check on specimen adequacy.

Biopsy specimens were sent to the pathology department at 1 of the 5 affiliated community hospitals and reviewed by a cytopathologist. Results would typically be available within a 1-week period. Measures of diagnostic accuracy were then computed. The primary outcomes were diagnostic yield of US- and palpation-guided FNBs, calculated as the number of diagnostic FNB results divided by total FNBs performed. This was then evaluated for parotid and submandibular gland lesions with each method. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of diagnostic FNB results were calculated. A true positive was defined as a result where an FNB diagnosis of malignancy was confirmed on final surgical histopathology; similarly, a true negative was defined as a benign FNB result that was confirmed on final surgical histopathology. A false positive was defined as an FNB diagnosis of malignancy with subsequent benign surgical histopathology. A false negative was defined as an FNB diagnosis of benign disease with malignancy reported on final surgical histopathology.

Results

Over a 13-year period (2005-2018), 433 office-based salivary gland FNBs were performed in 370 patients in a large community otolaryngology practice. There was an equal number of male and female participants (185 each). The mean age of the patients at the time of their biopsy was 63.8 years.

Parotid gland lesions accounted for 87% (n = 377) of all FNBs, and 12.9% (n = 56) of FNBs were performed on submandibular gland lesions. There were no reported FNBs on sublingual glands.

Fifty-five patients underwent >1 FNB: 13 were performed on different salivary gland lesions whereas 50 were done on the same lesion. Of the 50 repeat FNBs, 33 were due to a previously reported nondiagnostic result and 17 for follow-up monitoring. Each was treated as a unique FNB because each FNB was performed at a separate time, on a different or changing lesion, and, at times, with a different modality (US vs palpation).

Palpation guidance was used in 47.3% (205/433) and ultrasound guidance in 52.7% (228/433) of the lesions. FNB resulted in an overall diagnostic rate of 73.4% (318/433), regardless of method. When method was considered, a diagnostic rate of 63.9% (131/205) was achieved with palpation guidance, and this improved to 82.0% (187/228) with US guidance ($P = .00002$). In parotid gland masses, the diagnostic rate was 65.0% (n = 119) with palpation guidance and 82.3% (n = 161) with US guidance ($P = .000067$). In submandibular gland masses, the diagnostic rate was 54.6% (n = 12) with palpation guidance and 76.5% (n = 26) with US guidance ($P = .086$).

Of the biopsied salivary glands, 196 (168 parotid glands, 28 submandibular glands) were ultimately surgically removed, for which histopathology was available. Malignancy was detected

Table 1. Distribution of FNBs in Cases With Surgical Follow-up.[a]

Location	No.	Malignant histopathology	FNBs performed	Diagnostic FNBs
Parotid	168	37 (22)	187	147
Submandibular	28	7 (25)	29	23
Overall	196	44 (22.44)	216	170

Abbreviation: FNB, fine-needle biopsy.
[a]Values are presented as No. (%).

Table 2. Final Histopathologic Diagnosis of Parotid Gland Tumors.

Histopathologic diagnosis	No.	%
Benign	131	
Warthin's tumor	60	35.7
Pleomorphic adenoma	45	26.8
Benign cyst	9	5.4
Inflammation/sialadenitis	4	2.4
Oncocytoma	3	1.8
Basal cell adenoma	3	1.8
Lymph node	2	1.2
Benign salivary tissue	2	1.2
Sarcoidosis	2	1.2
Lymphangioma	1	0.6
Malignant	37	
Lymphoma	11	6.5
Squamous cell carcinoma	8	4.8
Salivary duct carcinoma	4	2.4
Myoepithelial carcinoma	2	2.4
Mucoepidermoid carcinoma	3	1.8
Adenocarcinoma	3	1.8
Mammary analogue of secretory carcinoma	1	0.6
Neuroendocrine carcinoma	1	0.6
Adenoid cystic carcinoma	1	0.6
Acinic cell carcinoma	1	0.6

Table 3. Final Histopathologic Diagnosis of Submandibular Gland Tumors.

Histopathologic diagnosis	No.	%
Benign	21	
Inflammation/sialadenitis	9	42.9
Pleomorphic adenoma	8	28.6
Warthin's tumor	3	10.7
Thrombosed vein	1	3.6
Malignant	7	
Lymphoma	4	14.3
Adenocarcinoma	1	3.6
Myoepithelial carcinoma	1	3.6
Squamous cell carcinoma	1	3.6

Table 4. Sensitivity, Specificity, PPV, and NPV for FNB Based on Location.[a]

Location	Sensitivity	Specificity	PPV	NPV
Parotid	78.57	92.44	70.97	94.83
Submandibular	57.14	93.74	80.00	83.33
Overall	74.29	92.59	72.22	93.28

Abbreviations: FNB, fine-needle biopsy; NPV, negative predictive value; PPV, positive predictive value.
[a]Values are presented as percentages.

on histopathology. Lymphoma was identified in 15 specimens overall, and these lesions underwent 20 FNBs (including 5 repeat FNBs). Only 25% (n = 5) of FNBs performed on lymphoma produced a true positive result.

Discussion

FNB has been identified as a useful adjunct to determine management for patients with salivary gland lesions. A 2017 comprehensive review demonstrated that although FNB does have inherent limitations, it can differentiate benign and malignant lesions with good to excellent sensitivity and specificity.[9] Additionally, US guidance has been shown to improve the diagnostic rate of FNBs: a 2018 retrospective study of FNBs performed by cytopathologists at an academic medical center demonstrated a statistically significant reduction in nondiagnostic samples with US guidance, from 21.2% to 6.6% ($P < .001$).[7] US guidance may help to target nonpalpable lesions, as well as solid versus cystic or necrotic regions, and avoid nearby vessels, thereby increasing the diagnostic rate and decreasing the complication risk.[7,8] This result was replicated in our study, which demonstrated that US FNB was statistically more likely to yield a diagnostic specimen ($P = .00002$).

Our review of the literature found that the majority of studies investigating salivary gland FNBs were performed by a cytopathologist or radiologist in tertiary care centers and reviewed by fellowship-trained cytopathologists.[3,6-8]

in 22.0% (37/168) of parotid gland neoplasms and 25% of submandibular gland neoplasms (7/28) on final surgical histopathology. Preoperative FNB was diagnostic in 87% (170/196) of the lesions (**Table 1**).

Measures of diagnostic accuracy were then calculated for those specimens for which diagnostic FNB cytopathology and final surgical histopathology were available (n = 170; **Tables 2** and **3**). Diagnostic accuracy in the parotid gland for distinguishing benign from malignant pathology was as follows: sensitivity, 78.57%; specificity, 92.44%; PPV, 70.97%; and NPV, 94.83%. Diagnostic accuracy in the submandibular gland for distinguishing benign from malignant pathology was as follows: sensitivity, 57.14%; specificity, 93.74%; PPV, 80.00%; and NPV, 83.33% (**Table 4**).

A separate analysis of cytopathology results was undertaken for those specimens that were positive for lymphoma

Some studies questioned the ability of clinicians to obtain diagnostic samples, when compared with cytopathologists performing the procedure.[7,8] Variations in technique (palpation vs US guided), operator (clinician vs pathologist), and practice (community vs academic) have also been considered to be confounding factors in establishing the usefulness of FNB for these lesions.[5] While these studies supported FNB as a useful tool in salivary gland lesion management and preoperative counseling, there is a paucity of information elucidating whether these results may be replicated in an office-based setting in the community.

To our knowledge, ours is the first study examining the efficacy of office-based salivary gland FNBs, with and without ultrasound guidance, in an office setting in the community. In this setup, FNBs were performed by the treating otolaryngologist, often at the time of initial visit, and interpreted by community cytopathologists. This study shows that salivary gland FNB sensitivity and specificity is comparable to that achieved in a tertiary care setting.

In our study, the parotid FNB showed a high degree of sensitivity (78.57%) and specificity (92.44%) in distinguishing benign from malignant pathology. A recent systematic review and meta-analysis including 63 studies comprising 5647 parotid FNB procedures found an overall sensitivity and specificity of 78% and 87.7%, respectively.[1]

In our study, submandibular gland FNB showed high specificity (93.74%); however, the sensitivity (57.14%) was not as robust as in other studies. This is likely due to the small number of excised submandibular glands (n = 28); a larger sample size is therefore necessary to determine the efficacy of submandibular gland FNBs. Additionally, in our study, lymphoma represented 57% of malignant submandibular gland lesions on final surgical histopathology, often after nondiagnostic or false-negative preoperative FNB. This contributed to a lower sensitivity and NPV.

Therefore, in cases where there is a high degree of suspicion for lymphoma—such as history of lymphoma, multiple lymph nodes, or abundant lymphocytes on cytology from the first FNB—we now perform additional passes, and the sample is transported in RMPI-1640 medium or Hank's medium for flow cytometry studies. Some studies have shown that core biopsy achieves higher sensitivity in cases of lymphoma when compared with FNB (92%-100% vs 66.7%-74%, respectively).[10,11] Therefore, core biopsy is considered an option for repeat biopsy.

There are several strengths and limitations to this study. It encompasses a 13-year period, during which >400 FNBs were performed and analyzed. The large sample size suggests that our results would be replicable and generalizable. The limitations include those inherent to any retrospective chart review. Some community practices may not perform as many FNBs per year; therefore, additional studies are needed to elucidate if practices performing fewer FNBs would reach similar levels of statistical accuracy. The majority of FNBs in this study were of parotid gland lesions; as such, additional data are needed to establish the utility of FNB in submandibular and sublingual gland lesions applied to our setting.

Conclusion

In this series, we demonstrate high diagnostic yield and accuracy of office-based FNB of the salivary gland lesions performed in a high-volume community setting. We conclude that by using ultrasound guidance and following consistent protocols, high diagnostic yield can be achieved without the need for on-site adequacy testing. Results in the community setting are comparable to those reported from a tertiary care center. Offering the office-based procedure at the point of care in the community expedites results, reduces patient anxiety, and improves patient compliance.

Author Contributions

Jennifer L. Harb, contributed to the formulation of the research idea, data collection, statistical analysis, and manuscript writing and editing, approved the final submission; **Dara Bakar**, contributed to the formulation of the research idea, data collection, statistical analysis, and manuscript writing and editing, approved the final submission; **Jagdish K. Dhingra**, contributed to the formulation of the research idea, data collection, statistical analysis, and manuscript writing and editing, approved the final submission.

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