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Journal of the American Society of Cytopathology (2022) 11, 234–240

Available online at www.sciencedirect.com

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Effects of COVID-19 pandemic on cytology: specimen adequacy in fine-needle aspiration of palpable head and neck masses

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Received 13 January 2022; received in revised form 7 April 2022; accepted 11 April 2022

KEYWORDS
Fine-needle aspiration;
Head and neck masses;
COVID-19;
Clinicians;
Cytopathologists;
Sample adequacy

Introduction At our institution, palpation-guided fine-needle aspiration (FNA) is performed by the cytopathology service on an outpatient basis at the request of otolaryngologist surgeons. The aim of this study is to assess the effect of COVID lockdown measures on our FNA service with specific focus on adequacy rates.
Materials and methods All palpation-guided FNA performed in 2019 to 2020 were identified in our pathology database. Adequacy rates were compared for 3 time periods in 2020: pre-COVID, lockdown, and post-lockdown.
Results In 2019, 121 FNAs were performed with 98% (119 of 121) obtained by pathology and only 2% (2 of 121) obtained by surgeons. In 2020, 89 FNAs were performed with 45% (40 of 89) collected by pathologists and 55% (49 of 89) by surgeons. During the pre-COVID period of 2020, 27 FNAs were collected, 85% (23 of 27) by pathologists, 8.7% of these (2 of 23) were nondiagnostic. Of the 4 FNAs performed by surgeons, all were positive for malignancy. During COVID lockdown all 24 FNAs were performed by surgeons with a 50% (12 of 24) nondiagnostic rate. Post-lockdown, with FNA referrals still below pre-COVID levels, surgeons performed 55.3% (21 of 38) of FNAs with 28.6% (6 of 21) non-diagnostic, while pathology performed 44.7% (17 of 38) with an 11.8% (2 of 17) nondiagnostic rate.
Conclusions Our FNA service noted significant changes in 2020 as a result of the COVID pandemic. Nondiagnostic rates were significantly increased in 2020 compared with 2019, primarily due to a shift to majority surgeon-performed palpation-guided FNA in the absence of cytopathology service during the lockdown period.

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2213-2945/$36
https://doi.org/10.1016/j.jasc.2022.04.002

Introduction

Fine-needle aspiration (FNA) is a rapid, safe, and cost-effective procedure that can be performed on an outpatient basis with palpation or ultrasound guidance. At our institution, palpation-guided FNA is performed by the cytopathology (CYP) service at the request of clinicians. Most often these procedures are performed in an outpatient setting at the request of an otolaryngologist (ie, ear, nose and throat [ENT] surgeon).

The global effects of the COVID-19 pandemic on the processes of health care have been tremendous. The impact on laboratory systems worldwide cannot be overestimated. While our institution's clinical laboratory showed growth in testing, the CYP laboratory suffered decreased volume of procedures and alteration of types of samples received. Long-practiced workflow routines were altered not only by global shutdowns but by decisions made at the local level. Minnesota Governor Timothy J. Walz declared a state of emergency on March 13, 2020[1] and our hospital system postponed all elective surgeries at its hospitals and clinics, effective March 18, 2020,[2] due to the novel coronavirus. Our hospital system anticipated shortages in personal protective equipment (PPE) and due to the need to conserve PPE at the clinic site, the cytopathology department had halted the performance of FNA as early as March 4, 2020. This continued through July 14, 2020.

The aim of this study was to examine the adequacy rates of FNAs performed on palpable head and neck masses at our institution in 2020. We also hoped to assess the effect of COVID lockdown measures on our CYP service.

Methods

This is a retrospective study approved by the institutional review board of the University of Minnesota, Minneapolis. The CYP department maintains statistics for all palpable FNAs as part of the routine quality assurance process. These data include the case accession number and primary diagnostic category. This list of cases was used for further query of the department's electronic pathology database. The pathology reports of all palpation-guided FNA performed in 2019 to 2020 were reviewed without any evaluation of slides. Data collected from the pathology reports included: (1) date of service; (2) location of service (outpatient or hospital inpatient) (collected for 2020 only); (3) method of collection (palpation-guided only); (4) operator (cytopathologist or surgeon); (4) use of rapid onsite evaluation (yes or no); (5) body site of aspiration (cervical lymph node, salivary gland, or oral cavity); (6) primary diagnostic category, and (7) secondary diagnosis, if any.

The statistics for 2020 were separated into 3 time periods that were relevant to the parties involved (not mandated by institution or state) based on the scarcity of PPE: period 1 (pre-COVID, or January 1 through March 4), period 2 (during lockdown, or March 5 through July 14), and period 3 (post COVID lockdown, or July 15 through December 31).

At our institution more than 95% of palpation-directed FNA are performed on an outpatient basis at the request of an ENT surgeon. FNA is performed on head and neck masses including salivary glands (parotid and submandibular), cervical lymph nodes, soft tissue, and oral cavity. Thyroid fine-needle aspirates were excluded from this study because they are performed by interventional radiologists under ultrasound guidance.

FNAs are typically performed by a CYP fellow under the supervision of a board-certified faculty cytopathologist. The number of needle passes made for a given mass are typically 2 to 3 using a 1- or 1.5-inch, 23- or 25-gauge needle attached to a syringe placed in a FNA gun (syringe holder). Material from the needle is expressed on to slides to prepare 1 air-dried smear and 1 alcohol-fixed smear and the needle and syringe are rinsed into a formalin-filled container. The air-dried smears are rapidly stained on site and used for immediate evaluation of adequacy (rapid onsite evaluation [ROSE]). This is done until adequacy is obtained. Usually after 1 or 2 passes the material from additional passes can be triaged into a cell culture media (Roswell Park Memorial Institute [RPMI]) for flow cytometry, a sterile container for microbiologic cultures, or directly into formalin for a cell block, without preparation of additional slides. The same technique is used for the clinician operator with cytopathology ROSE assistance. However, if ROSE assistance is not available to the clinician, no direct smears are prepared. The clinician simply rinses the needle and syringe into a formalin-filled container for cell block preparation.

All samples are then handled in the same manner. Material collected in RPMI or sterile containers is subsequently sent for flow cytometric analysis or microbiologic cultures, respectively. In the CYP laboratory, alcohol-fixed smears are Papanicolaou-stained and any unstained air-dried smears are Diff-Quik−stained. Cell block preparations are processed and stained with hematoxylin and eosin. All cases are first screened by cytotechnologists, reviewed by a trainee (resident on the CYP rotation or CYP fellow), and ultimately signed out by a faculty cytopathologist.

Reporting of salivary gland lesions by cytopathologists follows The Milan System for Reporting Salivary Gland Cytology; the primary diagnostic categories being non-diagnostic, non-neoplastic, atypia of undetermined significance, neoplasm (benign or salivary gland neoplasm of uncertain malignant potential [SUMP]), suspicious for malignancy, and positive for malignancy.[3] For lymph nodes and all other lesions, a simple 5-tier system is used for reporting the primary diagnostic category: nondiagnostic, negative for malignancy, atypical, suspicious for malignancy, and positive for malignancy. The use of a secondary diagnosis and/or comments for clarification is an optional reporting element. For the purposes of the study, salivary gland lesions were recategorized into the 5-tier system by

placing non-neoplastic and benign neoplasms into the "negative for malignancy" category and SUMP into the "suspicious for malignancy" category.

Statistical analysis for the study was performed via VassarStats.net using a χ^2 or Fisher exact test, as appropriate. A value of $P < 0.05$ was considered statistically significant.

Results

Overall, our laboratory experienced a 13.25% decrease in total caseload for all gynecologic and nongynecologic specimens in 2020 (n = 8762) compared with 2019 (n = 10,100). To a greater degree, this volume reduction was also noted in palpable FNA specimens. A total of 121 palpation-guided FNA were performed in 2019 with 98% (119 of 121) performed by CYP and 2% (2 of 121) by surgeons (Fig. 1). Eighty-nine (89) FNA were performed in 2020, 45% (40 of 89) by pathologists and 55% (49 of 89) by surgeons. This represents a 26% decrease in the total number of FNA in 2020 compared with 2019, as well as a 66% decrease in the number performed by CYP.

For the pre-COVID period (period 1), 27 FNA were obtained, 85% (23 of 27) by pathologists and 15% (4 of 27) by surgeons (Fig. 2). Most of the procedures (n = 23; 85%) were performed outpatient with the remainder in the hospital. Cytopathologists were responsible for 21 outpatient cases and 2 hospital procedures; surgeons for 2 outpatient cases and 2 hospital procedures. In terms of the lesion location, all were head and neck sites. This included cervical lymph nodes (17 of 27; 63%), salivary glands (8 of 27; 30%), and oral cavity (2 of 27; 7%). All procedures had ROSE by CYP. For cytopathologist-performed FNA, 8.7% (2 of 23) were non-diagnostic, 65.2% (15 of 23) negative for malignancy, 4.35% (1 of 23) atypical, 4.35% (1 of 23) suspicious for malignancy, and 17.4% (4 of 23) positive for malignancy. Of the 4 FNAs performed by surgeons, all were positive for malignancy (metastatic squamous cell carcinoma). There was no significant difference in nondiagnostic rate for CYP versus clinicians for this time period ($P = 0.721$).

During the COVID lockdown (period 2), CYP personnel were unable to visit the outpatient clinics due to scarcity of PPE. A total of 24 FNA were performed during period 2, all by the ENT surgeons (n = 24; 100%). Twenty-three cases (96%) were performed on an outpatient basis and 1 was performed in the hospital. As for the sampled body site, all were head and neck, with cervical lymph nodes 67% (16 of 24), salivary gland (parotid) 16.5% (4 of 24), and oral cavity 16.5% (4 of 24). Cytopathology assisted with 1 on-site ROSE at the beginning of period 2 (March 10, 2020) but were unable to provide ROSE services for the remainder of the lockdown. Because ROSE was not available no direct smears were made. The FNA material was placed directly in formalin by the surgeon. This material was used to prepare a cell block. During period 2, ENT surgeons performed 24 palpation-guided FNA with 50% (12 of 24) non-diagnostic, 12.5% (3 of 24) negative for malignancy, 4.2% (1 of 24) atypical, 8.3% (2 of 24) suspicious for malignancy, and 25% (6 of 24) positive for malignancy. Statistical comparison of performance between the 2 groups is not applicable in this situation, as CYP performed no FNAs during this time period.

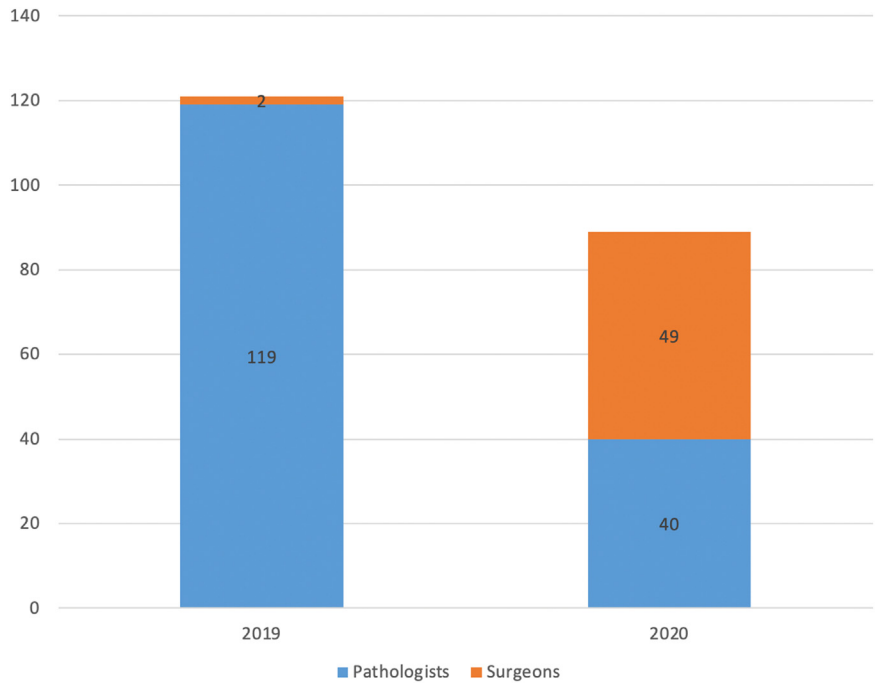
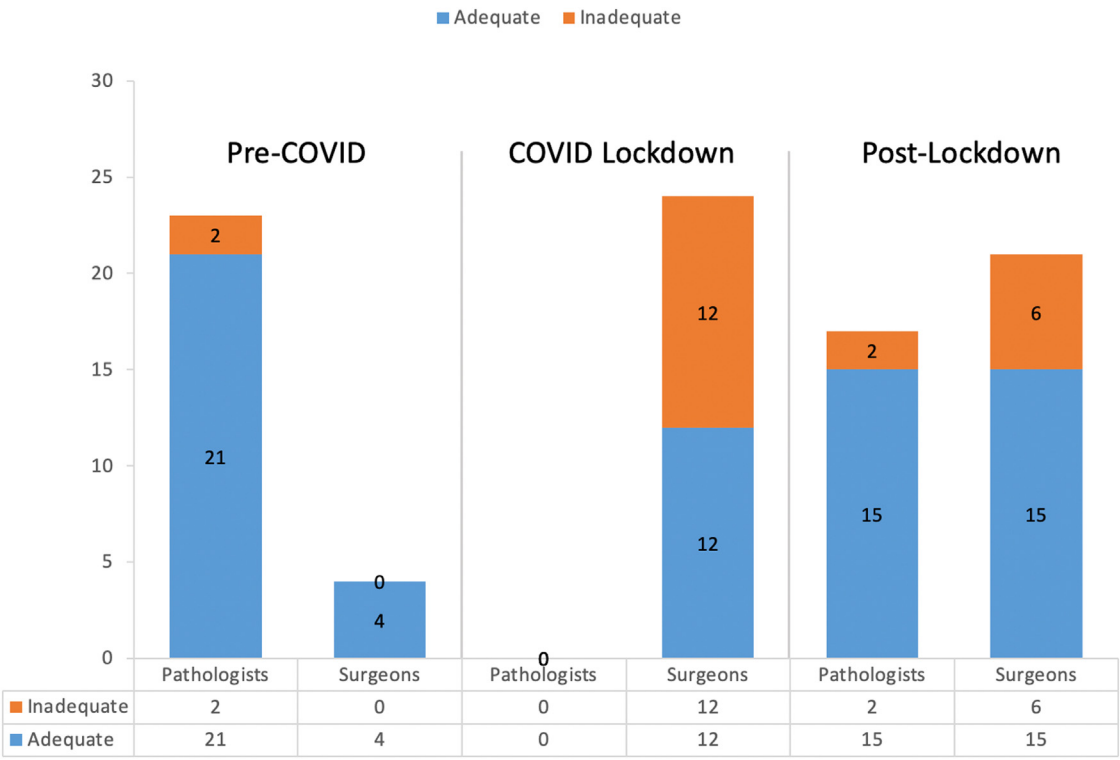


Figure 1 Comparison of FNAs performed by cytopathologists and surgeons in 2019 versus 2020. In 2020, there was a decrease in the total number of palpation-guided FNAs and an increase in the percentage performed by surgeons.



	Pathologists	Surgeons	Pathologists	Surgeons	Pathologists	Surgeons
Inadequate	2	0	0	12	2	6
Adequate	21	4	0	12	15	15

Figure 2 Palpation-guided FNA adequacy rates for 2020. This figure shows a detailed breakdown of rates of inadequacy by operator in selected periods of 2020.

Period 3 represents the time after lockdown ended and CYP personnel were able to return to the outpatient clinic until the end of 2020. During period 3, 38 FNAs were performed with 44.7% (17 of 38) by cytopathology and 55.3% (21 of 38) by surgeons. Only 1 procedure was performed in the hospital by ENT while the remaining 37 were performed at the outpatient site. Most specimens were obtained from cervical lymph nodes (25 of 38; 65.8%), while 18.4% (7 of 38) were salivary gland (parotid), 7.9% (3 of 38) oral cavity, and 7.9% (3 of 38) from other head and neck sites. All cytopathology-procured specimens had ROSE while only 3 clinician-directed procedures used ROSE assistance. For CYP during period 3, 11.8% (2 of 17) were nondiagnostic, 47.1% (8 of 17) negative for malignancy, 11.8% (2 of 17) atypical, 5.9% (1 of 17) suspicious for malignancy, and 23.4% (4 of 17) positive for malignancy. There were 21 clinician-performed procedures during this same time period and 28.6% (6 of 21) were nondiagnostic, 14.3% (3 of 21) negative for malignancy, 19% (4 of 21) atypical, 9.5% (2 of 21) suspicious for malignancy, and 28.6% (6 of 21) positive for malignancy. The inadequate specimen rate for clinicians versus CYP for this time period did not reach clinical significance ($P = 0.195$).

For comparison, we reviewed similar statistics for 2019, dividing the year into identical time-frames. For "period 1" of 2019 (defined as January 1 through March 4) a total of 19 FNAs were collected, all by the cytopathology service. Most specimens were from the head and neck. This consisted of cervical lymph nodes (10 of 19; 52.6%) and salivary glands (8 of 19; 42.1%). The remaining case (1 of 19; 5.3%) was from non-head and neck soft tissue. ROSE assistance was available for all procedures with 5.3% (1 of 19) nondiagnostic, 68.4% (13 of 19) negative for malignancy, 10.5% (2 of 19) atypical, 0% (0 of 19) suspicious for malignancy, and 15.8% (3 of 19) positive for malignancy. For "period 2" of 2019 (which matched the COVID lockdown time period of March 5 through July 14) there were 43 FNAs, all performed by CYP with ROSE. There were 46.5% (20 of 43) cervical lymph nodes, 46.5% (20 of 43) salivary gland, 5% (2 of 43) soft tissue (head and neck), and 2% (1 of 43) other (non-head and neck lymph node). The diagnostic breakdown for this time period was 7% (3 of 43) nondiagnostic, 51.2% (22 of 43) negative for malignancy, 16.3% (7 of 43) atypical, 7% (3 of 43) suspicious for malignancy, and 18.5% (8 of 43) positive for malignancy. For the time-matched "period 3" of 2019 (July 15 through December 31) 59 FNA samples were collected with 97% (57 of 59) by CYP and 3% (2 of 59) by surgeons. All but 1 case, performed by a surgeon, had ROSE assistance. The body sites were 66.1% (39 of 59) cervical lymph nodes, 23.7% (14 of 59) salivary gland, 1.7% (1 of 59) oral cavity, 5.1% (3 of 59) soft tissue (head and neck), and 3.4% (2 of 59) non-head and neck sites (soft tissue of trunk and groin lymph node) with 13.6% (8 of 59) nondiagnostic, 40.7% (24 of 59) negative for malignancy, 8.5% (5 of 59) atypical, 13.5% (8 of 59)

suspicious for malignancy, and 23.7% (14 of 59) positive for malignancy.

Overall, for the year 2020, the nondiagnostic rate for all palpation-guided FNA was 25% (22 of 89) compared with 9.9% (12 of 121) for 2019 (Fig. 3), a statistically significant increase ($P = 0.004$). The 2019 nondiagnostic rate was 0% (0 of 2) for clinicians versus 10.1% (12 of 119) for CYP ($P = 0.811$). The 2020 nondiagnostic rate was 36.7% (18 of 49) for clinicians versus 10% (4 of 40) for CYP ($P = 0.003$).

When we compared malignancy rates for 2020 versus 2019 in each matched time period (Table 1), we saw no statistically significant differences. The period 1 malignancy rate for 2020 was 30% (8 of 27) versus 15.8% (3 of 19) for 2019 ($P = 0.234$). For period 2, the malignancy rate was for 2020 versus 2019 was 18.6% (8 of 43) versus 24% (6 of 24) ($P = 0.375$). Finally, for period 3, the malignancy rate was 23.7% (14 of 59) for 2020 and 26.3% (10 of 38) for 2019 ($P = 0.478$).

Discussion

The COVID-19 pandemic has affected all aspects of health care delivery, including the cytopathology laboratory. During lockdown periods, cytopathology laboratories around the world saw significant decreases in specimen volume.[4-9] Our laboratory experienced a 13.25% decrease in specimen volume in 2020 compared with 2019. This included a 26% decrease in the total number of palpation-guided FNA and a 66% decrease in the number performed by CYP. The complete 4-month cessation of our FNA service led to a significant increase in the number of nondiagnostic palpation-guided FNA specimens during the shutdown and for all of 2020. We have yet to see a complete post-COVID shutdown recovery of service volume.

FNA is valuable for the initial evaluation of superficial, palpable masses of the head and neck. It is a fast, simple, minimally invasive, and cost-effective procedure. High levels of accuracy, sensitivity, and specificity are reported for salivary gland and neck masses.[10-12] Diagnostic accuracy can be influenced by the use of cytology support services. ROSE has been shown to decrease the number of nondiagnostic specimens by offering immediate feedback and appropriate triage of specimens.[13-15] Few studies have specifically evaluated the performance of CYP versus clinicians in FNA of palpable masses of the head and neck. Wu et al[16] reviewed 100 palpation-guided FNA performed by clinicians and 100 performed by pathologists over a 1-year period. Clinicians had significantly higher rates of nondiagnostic specimens than cytopathologists (33% versus 7%). Nur et al[17] analyzed the results of FNA of palpable salivary gland lesions over a 13-year period and found an 11% nondiagnostic rate for CYP and 20% for surgeons.

Onsite CYP assistance (ROSE) has numerous advantages. ROSE can improve the quality of head and neck FNA.[13-15] The first advantage is immediate microscopic evaluation and feedback. If adequate material is not obtained then additional passes can be made with possible alteration of technique. Adjustments in area of the lesion sampled, approach, needle angle, or needle gauge can be made. Second is optimal smear preparation. CYP-trained personnel have experience in slide preparation and can

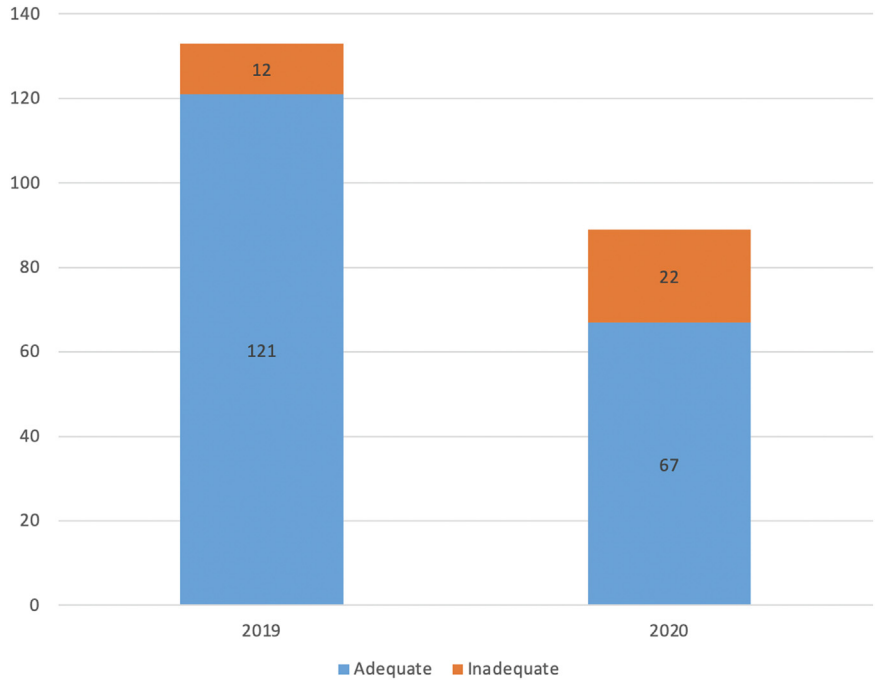


Figure 3 Comparison of FNA adequacy rates in 2019 versus 2020 by operator. There was a significant increase in the number of inadequate palpation-guided FNAs in 2020 ($P = 0.004$).

Table 1 Diagnostic category assignment for time matched periods in 2019 and 2020.

	2019	2020	
Period 1			
Nondiagnostic	1	2	
Benign	13	15	
Atypical	2	1	
Suspicious	0	1	
Positive	3	8	$P = 0.234$
Period 2			
Nondiagnostic	3	12	
Benign	22	3	
Atypical	7	1	
Suspicious	3	2	
Positive	8	6	$P = 0.375$
Period 3			
Nondiagnostic	8	8	
Benign	24	11	
Atypical	5	6	
Suspicious	18	2	
Positive	14	6	$P = 0.478$

Totals are for all operators (CYP and surgeons). There are no significant differences in malignancy rate for any time period.

make appropriate air-dried and alcohol-fixed slides. Both air-dried and alcohol-fixed slides have different advantages in cytologic interpretation. Air-dried Diff-Quik stained slides are optimal for nuclear assessment of lymphoid and other hematopoietic proliferations. Characteristics of cytoplasmic granules and stromal material are also highlighted on Diff-Quik stained slides. On the other hand, alcohol-fixed Papanicolaou-stained slides are optimal for nuclear detail and detection of keratinized cells. Finally, once adequacy is obtained, additional passes can be triaged to cell block for immunohistochemistry, RPMI for flow cytometry, or sterile media for microbiologic culture. All of these serve to optimize specimen collection for diagnosis.

In the performance of fine-needle aspirates, as with any skill, "practice makes perfect". While not specific to head and neck masses, Ljung et al[18] found that physicians with formal training in FNA sample procurement, who had performed at least 100 procedures, were much more likely to obtain cellular, diagnostic material than physicians without formal training. Wang et al[19] published a study comparing ultrasound-guided thyroid FNA performance between newly trained head and neck surgeons and radiologists. In the first 100 procedures performed by unskilled surgeons, the nondiagnostic rate was high. The average nondiagnostic rate at 1-50 and 51-100 FNAs was 21.05% and 16.06%, respectively. By the time the surgeon group had performed over 250 FNAs, the average nondiagnostic rate had decreased to 9.21%.

There are numerous factors that may influence FNA adequacy rate other than onsite cytologic evaluation or operator experience. These variables include use of imaging guidance, needle gauge, number of needle passes, nodule size or depth, and lesion characteristics such as sclerosis or cystic degeneration. We did control for the use of ultrasound guidance. However, a number of these variables are not routinely documented in the patient chart or pathology report, and were not specifically examined in our study. This makes it difficult to suggest how manipulation of these procurement elements may lead to improved sample collection.

In summary, our study shows that the quality of aspiration specimens declined over the pandemic as a direct result of the absence of cytopathology support. Adequacy rates are influenced by training, experience, and onsite slide preparation and assessment. The 3 pathologists who participated in this study were formally trained during a 1-year ACGME accredited cytopathology fellowship and all had performed hundreds of FNA procedures. These pathologists provided direct, hands-on supervision for the cytopathology fellows involved in sample collection. While performing the on-site FNA procedure, cytopathologists can ensure quality slide preparation and appropriate triage of the sample. Proper handling of the specimen includes the following decision-making: (1) should additional passes should be performed; (2) would it be most beneficial to have additional air-dried versus alcohol-fixed smears; and (3) should additional passes be placed in RPMI for flow cytometry, a sterile container for microbiologic cultures, or in formalin for the preparation of a cell block for immunohistochemistry of molecular testing. Clinicians and cytopathologists should work together to improve specimen adequacy in FNA of head and neck masses. Cytopathologists have distinct advantages in the performance of FNA.

For surgeons performing FNA biopsy, appropriate training and experience in this technique is highly recommended, or at the very least they should have onsite cytopathology assistance during the procedure.

Funding sources

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest disclosures

The authors have no conflicts of interest to disclose.

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