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CT-Guided Aspirations in the Head and Neck: Assessment of the First 216 Cases

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BACKGROUND AND PURPOSE: **The growth of cross-sectional imaging has increased the detection of nonpalpable head and neck masses. We sought to determine the reliability of CT-guided fine-needle aspiration (FNA) over 216 consecutive cases.**

METHODS: **We retrospectively reviewed histopathologic findings and notes from 216 consecutive head and neck CT-guided FNA procedures performed between 1993 and 2003. Types of needles used, passes required, lesion location, initial cytologic diagnosis, and final histopathologic or clinical diagnosis were reviewed.**

RESULTS: **Diagnostic samples were obtained in 195 (90.3%) of the lesions, with 21 (9.7%) inadequate samples. A correct diagnosis was made in 191 cases (88.4%). Final FNA diagnosis was discordant in four (1.9%) specimens, with the parapharyngeal space and parotid gland having the highest rate of inaccuracy. The range in number of passes required for final diagnosis was one to six (mode, 2.0 passes per specimen; median, 2.0; mean, 2.6; standard deviation, 1.13). In 135 (63%) of 216 cases, definitive surgical pathologic results, including findings for the four discordant specimens, were obtained. Of the nondiagnostic specimens, six (29%) of 21 went to surgery, five (83%) of six were neoplastic, and one (17%) of six was fibrous tissue. The remainder underwent clinical and imaging follow-up.**

CONCLUSION: **CT-guided FNA is a safe, well tolerated, and accurate for the diagnosis of head and neck lesions. In our series, the percentage of diagnostic samples obtained improved compared with prior reports. The low diagnostic error rate overall was possibly related to onsite evaluation by the cytopathologist and to improved FNA technique.**

The growing quantity of cross-sectional imaging studies has led to the detection of an increasing number of nonpalpable head and neck masses. Many of these masses are not clinically suspected and asymptomatic. They may be found serendipitously during a search for degenerative disease of the cervical spine or other primary head and neck lesions.

Although palpable masses are usually aspirated by otorhinolaryngologists, endocrinologists, or cytopathologists, nonpalpable lesions or lesions in regions adjacent to critical structures (e.g., carotid arteries, vertebral arteries, or cranial nerves) are often referred to the radiologist for diagnostic intervention. Postoperative or previously irradiated sites are another area where physical examination may be uninformative, even when recurrence is suspected.

Sonographic guidance has been generally advocated for biopsy of most head and neck lesions because of its real-time capability. However, CT guidance has benefit in that it has less image degradation by the air-containing aerodigestive system structures and the bony content of the head and neck. Although bony structures may cause some beam-hardening artifact, this has been substantially reduced by thin-section collimation. Accordingly, CT can be used for accurate assessment of adjacent anatomy. With the advent of multidetector-row CT scanning, more cases of CT-guided aspirations are being requested. In our experience, the time it takes to perform these interventions is decreasing. We sought to determine the reliability of head and neck CT-guided aspiration over an experience of 216 consecutive cases.

Methods

We retrospectively reviewed the histopathologic findings, clinical records, and notes from 216 consecutive head and neck CT-guided fine-needle aspiration (FNA) procedures in 212 patients (110 women and 102 men). One neuroradiologist (D.M.Y.) and his trainees performed the procedure at two institutions between 1993 and 2003. All patients had previously

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TABLE 1: Steps in performing aspiration

Step	Description
1	Review prebiopsy images to determine the approach
2	Obtain informed consent
3	Obtain scout view
4	Obtain limited nonenhanced axial views through the lesion
5	Place skin markers on the line of the image that has best line of sight to the lesion
6	Repeat scanning to determine the puncture site
7	Perform sterile preparation of the puncture site
8	Insert the introducer needle
9	Repeat scan to verify the position of the introducer needle
10	Insert the aspiration needle
11	Verify the position of the needle tips
12	Place the needle to the edge of the mass
13	Call cytology department
14	Perform multiple multidirectional plunges into the mass
15	Withdraw only the aspiration needle
16	Submit specimen for analysis
17	Repeat steps as required on the basis of the cytologic results

undergone a contrast-enhanced CT or MR imaging. Limited axial nonenhanced CT images were obtained through the lesion at the start of the procedure; these allowed adequate delineation between the lesion and the surrounding tissues. In cases in which the lesion (e.g., tumor recurrence within scar tissue) was difficult to visualize on nonenhanced CT scans, the prior imaging study was used to determine appropriate landmarks for tissue sampling. Intravenous contrast material was not used at the time of FNA. Local anesthesia with bupivacaine was administered generously. Intravenous sedation was not used in any case.

All aspirations were performed by using a coaxial technique. In most cases, a 19-gauge introducer needle was passed to the margin of the lesion, and subsequent aspirations were accomplished with coaxially placed 22-gauge lumbar puncture spinal needles (Becton Dickinson, Franklin Lakes, NJ). The cytopathologist determined the required number of passes. Table 1 provides the step-by-step approach to obtaining an FNA sample.

Radiologists acquired all FNA samples, and a cytopathologist was present for all aspirations. The aspirated material was processed as air-dried direct smears for Giemsa-type staining (Diff-Quick; EM Diagnostic Systems, Gibbstown, NJ) for immediate evaluation and as wet-fixed smears for Papanicolaou staining. The aspiration procedure was repeated until diagnostic material was obtained. At the time of immediate cytologic evaluation, a preliminary diagnosis was rendered. Special ancillary studies such as flow cytometry or cell block preparation for immunohistochemical staining were performed at the request of the cytopathologist as needed to facilitate diagnosis. In cases in which core biopsy was required, a 20-gauge device (Biopty gun; Bard Radiologic, Covington, GA) was used. Complications were assessed at the time of the procedure. In addition, patients were provided with the phone numbers for the neuroradiology department and the neuroradiologist performing the FNA procedure in the event of any adverse outcomes, which were discussed with the patients at the time of informed consent and before their leaving the CT suite.

The types and sizes of needles used, number of passes required, locations of the lesion, initial cytologic diagnoses, and final histopathologic diagnoses or final clinical diagnoses were retrospectively obtained. Base-of-the-skull lesions and cervical paraspinal lesions were included as part of the head and neck sample. The lesions were categorized as in the thyroid or parotid glands; in the parapharyngeal space; in paraspinal areas, which included cervical spinal lesions and lesions in the anterior and posterior paraspinous soft tissues; and in other locations, such as the oral cavity, supraglottic larynx, carotid space, paraesophageal and paratracheal regions, masticator space, supraclavicular space, brachial plexus, and sternocleidomastoid muscle.

TABLE 2: Accuracy of CT-guided FNA

Diagnosis	Parapharyngeal Space	Thyroid	Parotid	Paraspinal	Other	Total
Correct	23 (85)	49 (92)	29 (81)	25 (100)	65 (87)	191
None	3 (11)	4 (8)	6 (17)	0	8 (11)	21
Wrong	1 (4)	0	1 (2)	0	2 (2)	4
Total	27	53	36	25	75	216

Note.—Data in parentheses are percentages.

Results

Of the 216 head and neck FNA procedures, 27 were involved the parapharyngeal space; 53, the thyroid gland; 25, the skull base or a paraspinal location; 36, the parotid glands; and 75, other locations.

A diagnostic sample was obtained in 195 (90.3%) of the 216 lesions, with a comparable percentage of diagnostic specimens in all of the locations stratified except for the parotid gland, where the rate was 83% (Table 2). Inaccurate samples in which the final diagnosis was discordant with the FNA results occurred in four (1.9%) of 216 specimens, with the parapharyngeal space and the parotid gland having the highest rate. A correct diagnosis was made in 191 cases (88.4%). The sample was nondiagnostic in 21(9.7%) cases. The range in number of passes required to make a final diagnosis was one to six, with a mode of two passes per specimen, a median of 2.0, and a mean of 2.6. (standard deviation = 1.13).

In 135 (63%) of 216 cases, definitive surgical pathology results were obtained, including those for the four specimens with wrong diagnoses. Among the nondiagnostic specimens, six (29%) of 21 went to surgery, five (83%) of six were neoplastic, and one (17%) of six was fibrous tissue. In the remainder, clinical or imaging follow-up was used to arrive at a final diagnosis (e.g., no recurrent tumor, inflammation, scar material, multinodular goiter). Table 3 shows the cytologic results with FNA.

In 14 instances, the cytopathologist requested core biopsy for histologic evaluation at the time of FNA. Core biopsy was deemed necessary when nonspecific neoplastic cells, such as spindle cells, were found on cytology or when supplemental material was required for more definitive diagnosis. Of the 14 histologic specimens, five were paraspinal, two were parapharyngeal, two were in a postsurgical site, and five were in other locations. A correct diagnosis was made in 11 (78.6%) of cases. The core sample was nondiagnostic in two (14.3%), and the wrong diagnosis was made in one (7.1%). The range in number of passes was one to two.

Of the 216 FNA procedures, 196 were performed

TABLE 3: Cytohistologic findings with CT-guided FNA

Cytologic Diagnosis	No. of Lesions
Malignant neoplasm	
Squamous cell carcinoma	24
Adenocarcinoma	4
Papillary carcinoma	6
Follicular neoplasm	4
Acinic cell carcinoma	3
Adenoid cystic carcinoma	1
Mucoepidermoid carcinoma*	3
Lymphoma	1
Melanoma	2
Chordoma	2
Metastatic disease†	4
Myeloma	1
Neuroendocrine tumor	1
Spindle cell malignancy	3
Synovial sarcoma	1
Low-grade sarcoma	1
Posttransplant lymphoproliferative disorder	1
Undifferentiated carcinoma	4
Vasoformative neoplasm	1
Benign neoplasm	
Multinodular goiter	21
Cyst‡	10
Follicular adenoma	2
Pleomorphic adenoma§	14
Monomorphic adenoma	1
Warthin tumor	3
Lipoma	2
Hurthle cell tumor	3
Paraganglioma	3
Giant cell tumor	1
Granulation tissue	2
Reactive lymph node	7
No evidence of neoplasm‖	44
Infection	8
Inflammation	7
Nondiagnostic study	21

* One wrong diagnosis (abscess).

† Renal cell, breast, or prostate carcinoma.

‡ Colloid, hemorrhagic, or branchial cleft cyst.

§ One wrong diagnosis (mucoepidermoid carcinoma).

‖ Radiation change or fibrous, glandular, adipose, or muscular tissue with no tumor cells. Two wrong diagnoses (squamous cell carcinoma, schwannoma).

with 22-gauge spinal needles, 10 were performed with 25-gauge needles, and 10 were performed with 20-gauge or larger needles. Although few patients underwent biopsy with 25- or 20-gauge needles, no dramatic differences were noted in the success rate for diagnostic samples. (The sample size was inadequate for statistical comparison.) Most the aspirations done with large-gauge needles involved paraspinal samples. No postprocedural complications occurred except for one facial hematoma, which required observation in the emergency department for 6 hours. Table 2 summarizes the overall results in the 216 samples.

Discussion

FNA is an effective means for determining the histology of most head and neck lesions. The value of FNA includes its low invasiveness, the use of small needles in an area where several vascular structures are present, and the lack of a tell-tale scar from the procedure. The pain associated with the procedure is usually minimal when adequate local anesthesia is used. Neither sedation nor general anesthesia is required. We inform our patients that the aspiration needle is smaller than the needle used for drawing blood samples and that whatever discomfort may occur resolves after the needle is removed. We also inform our patients that the risk of an adverse reaction to anesthesia is greater than the risk of the procedure itself. We use a coaxial technique, as it requires only one pass through the skin, and it allows the radiologist to achieve different angles for aspiration in a specific lesion. In general, this approach is less traumatic to the patient, though it does require an introducer needle of a slightly larger gauge. In our experience, CT-guided FNA in the head and neck is a well-tolerated procedure devoid of notable complications, and it is an effective alternative to a more invasive and risky open surgical biopsy.

Non–image-guided FNA of palpable lesions is well established as an accurate diagnostic tool in the head and neck, particularly in the salivary glands (1–4). FNA via a transoral approach for visible parapharyngeal space lesions is an option with an accuracy of 78–86% (5, 6), but a false-negative rate as high as 19% secondary to inadequate stabilization of the lesion (lesions moves away from the needle, possibly due to a shallow depth from the needle entry site or loose surrounding connective tissue) at the time of aspiration, limits of the intraoral angles available to puncture the mass, and an inability to make deep blind passes secondary to the underlying vessels (7). Percutaneous image-guided FNA is not constrained by these limitations. Image-guided FNA can accurately evaluate nonpalpable lesions, particularly those in a poorly accessible or deep location in the head and neck. sonography-guided FNA is an established technique for lesion localization, particularly in the evaluation of the thyroid gland and superficial cervical lymph nodes (8–14). However, lesions deep to the bony structures of the face and air-containing spaces are not well visualized during sonography (10, 15, 16). These can accurately and readily be localized and aspirated under CT guidance (15–23).

MR-guided FNA has been performed with good results and minimal morbidity (24–31). MR imaging provides excellent soft-tissue resolution, but it does not provide detail of bony structures. Although MR imaging has the advantage of the lack of ionizing radiation, it has the disadvantages of limited availability (particularly with open MR imaging systems), longer acquisition times, and the need for instruments compatible with a magnetic field. While MR imaging guidance will likely have an expanded role in the future, especially with open higher-field-strength magnets, CT is currently the imaging technique of choice for biopsy of deep-seated or poorly localized head and neck lesions when sonography is inadequate.

The risks of CT-guided FNA are usually minor and

include pain, vasovagal reaction, minor infection, and minor hemorrhage (8). Notable complications, such as seeding of the biopsy tract, pneumothorax, severe hemorrhage, and death have been estimated to occur in only 0.003–0.031% of patients; these have been directly correlated to the size of the needle (11, 17, 32). It is common opinion that, with needles smaller than 18 gauge, this risk is infinitesimal. Injury to the adjacent nerves is possible but usually transient. There is a potential for a reaction to local anesthesia or the sterile preparation agent, typically povidone iodine. Walker et al (32) described a case of pseudoaneurysm formation in an internal maxillary artery manifesting with transoral hemorrhage 3 months after CT-guided biopsy in the masticator space. They believe that the potential for vascular complications may be increased in patients who have undergone prior radical neck surgery and radiation therapy. Porcellini et al (33) describe a complication of pseudoaneurysm rupture in the internal carotid artery. Contrast-enhanced CT had failed to depict the lesion, which was not pulsatile and thought to be a neoplastic cervical lymph node. After FNA and leakage of the aneurysm, color Doppler scanning and MR-imaging showed aneurysmal changes of the carotid artery wall with an intraluminal thrombus. Successful emergency resection with a polytetrafluoroethylene interposition graft was performed. We did not have any notable complications. All patients reported resolution of procedure-related pain within 24 hours. In a recent 5-year series of CT-guided FNA procedures of head and neck lesions, DelGaudio et al (23) also reported no significant complications.

The results of this study compare favorably to those of a previously reported 5-year experience (22). We obtained a diagnostic sample in 195 (90.3%) of 216 cases, which compares positively with the rate from a series of 111 cases (83.8%). A correct diagnosis was made in 191 (88.4%) of our 216 cases compared with the prior study result of 83.4%. The improved sampling rate is likely due to a combination of improvement in FNA technique and cytopathologist technique or skill.

DelGaudio et al (23) suggested a learning curve on the part of the radiologist using the CT-guided needle-biopsy technique. They reported an improvement from 20% to 6% in the nondiagnostic rate in the first 10 biopsy procedures compared with the subsequent 32. Improved collection likely results from several factors including 1) more vigorous aspiration as experience increases, 2) more effective approaches to the lesions, 3) better feedback from the cytologists, and 4) correct choices of needle size. Improved cytopathologic techniques and cytopathologist skill are also likely contributing factors.

The critical value of onsite cytology must be highlighted. In our study, there were few instances in which a single FNA pass was considered diagnostic. This was partly because the cytologist often requests aspirations of different portions of the lesions to reduce sampling error. It may also be that initial passes through the lesions have more contamination with adjacent tissue than subsequent passes for which a track has already cleared a path in the underlining subcutaneous fat and deep muscle. Austin and Cohen (34) showed a significant increase from 80% to 100% in obtaining diagnostic specimens with a cytopathologist present. FNA is most accurate when immediate assessment for specimen adequacy is performed and a differential diagnosis constructed so that additional material can be acquired for special studies (including conversion to core biopsy) when needed (35). The cytopathologist also allows for termination of the procedure once diagnostic material is obtained; this increases the safety of the procedure.

In no instance did a sample obtained after the fourth pass yield diagnostic material. This observation suggests that some lesions are less readily sampled than others. In this case, it is our policy to attempt a true cut biopsy; however, the overall yield on performing this study is intermediate, as only 11 of 14 true cut histologic samples yielded the correct diagnosis.

We perform a higher rate of thyroid biopsy procedures under CT guidance than clinicians at many other institutions. This is because of a high rate of referrals from the otorhinolaryngologists directly to our neuroradiology department. Our neuroradiologists have more experience performing CT-guided FNA, whereas our body-imaging radiologists use sonography.

The 90% yield of diagnostic samples reported in this study is commensurate with that of other studies of FNA in the head and neck and other parts of the body. A relatively low rate of incorrect diagnoses (1.9%) was attributable to FNA in this study, possibly because of the multiple aspirations with onsite evaluations by the cytology team.

Conclusion

CT-guided FNA is a safe, well tolerated, and accurate tool in diagnosis of head and neck lesions. Our series demonstrates an overall low diagnostic error rate, which may have been secondary to improved cytopathology and neuroradiologist FNA technique. The presence of a cytopathologist during CT-guided FNA is critical to maintaining high diagnostic sampling rates, achieving low rates of incorrect diagnoses, and providing the best possible care to the patient.

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