Computed Tomography–Guided Needle Biopsy of Head and Neck Lesions

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Objective: To evaluate the diagnostic efficacy of computed tomography (CT)–guided needle biopsies of head and neck lesions.

Design: All CT-guided needle biopsies of head and neck lesions performed between September 1994 and February 1999 were included. Cytopathologic and histologic records, along with patient clinical records, were reviewed.

Setting: A tertiary care medical center.

Patients: Patients referred for evaluation of lesions inaccessible to routine methods of needle biopsy.

Results: Thirty-seven patients underwent 42 CT-guided biopsies. There were included 12 lesions in or adjacent to the skull base and 9 lesions around the pharyngoesophageal or laryngotracheal complex; the other lesions were located in the deep lobe of the parotid gland (n = 7), deep neck area (n = 12), and thyroid gland (n = 2).

Diagnostic cytologic biopsy specimens were obtained in 38 (91%) of 42 needle biopsy procedures. The results were supported histologically and/or clinically in 36 cases (95%). Eighteen patients underwent open surgical procedures. Histologic confirmation was found in 86% of cases. Nineteen patients (51%) avoided an open surgical procedure: 11 with benign disease and 8 with recurrent malignancy. There were no false-positive or false-negative results, and no complications were identified.

Conclusions: Computed tomography–guided needle biopsy is a safe and reliable minimally invasive technique for the diagnosis of poorly accessible or deep-seated lesions of the head and neck. Diagnostic needle biopsies allow improved preoperative planning and patient counseling in surgical patients and avoidance of open surgical procedures in patients with benign disease or recurrent malignant neoplasms.


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FINE-NEEDLE aspiration (FNA) biopsy of palpable lesions is a well-established technique in the diagnosis and staging of head and neck lesions. However, the assessment of poorly localized masses, such as in the previously surgically treated or irradiated neck, and masses situated deep to the vascular, neural, and bony structures in this region remains difficult. Blind needle biopsies have a low yield and are potentially dangerous. Lesions that can be visualized transorally, such as some parapharyngeal space lesions, can be approached through a transoral needle biopsy, with reported accuracy rates of 78% to 86%.1-3 Every attempt is made to avoid open biopsy in the evaluation of these lesions to prevent the disruption of surgical planes and tumor seeding. The addition of radiological imaging techniques, including ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI), to assist in obtaining needle biopsy specimens has been reported.4,5 We evaluated the diagnostic utility of CT-guided FNA in the assessment of 42 deep-seated or poorly localized lesions in 37 patients.

RESULTS

A definitive cytologic diagnosis was obtained in 91% (38/42) of needle biopsies. The various needle diagnoses are listed below:

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squamous cell carcinoma</td>
<td>13</td>
</tr>
<tr>
<td>Papillary carcinoma</td>
<td>1</td>
</tr>
<tr>
<td>Schwannoma</td>
<td>4</td>
</tr>
<tr>
<td>Neurofibroma</td>
<td>1</td>
</tr>
<tr>
<td>Meningioma</td>
<td>1</td>
</tr>
<tr>
<td>Myofibromatosis</td>
<td>1</td>
</tr>
<tr>
<td>Inflammatory pseudotumor</td>
<td>1</td>
</tr>
<tr>
<td>Warthin tumor/parotid cyst</td>
<td>4</td>
</tr>
<tr>
<td>Pleomorphic adenoma</td>
<td>1</td>
</tr>
<tr>
<td>Normal parotid gland</td>
<td>1</td>
</tr>
<tr>
<td>Colloid nodule/normal thyroid</td>
<td>2</td>
</tr>
<tr>
<td>Scar/haematoma/normal fat</td>
<td>4</td>
</tr>
<tr>
<td>Abscess</td>
<td>1</td>
</tr>
<tr>
<td>Reactive node</td>
<td>3</td>
</tr>
</tbody>
</table>

These findings were supported histologically or clinically in 95% (36/38) of cases.
PATIENTS AND METHODS

We performed a retrospective review of CT-guided needle biopsy procedures at our institution. From September 1994 to February 1999, the names of all patients undergoing CT-guided needle biopsy of head and neck lesions at Emory University Hospital, Atlanta, Ga, were recorded in a radiology database. Pathology records were reviewed for cytopathology reports and subsequent surgical pathology reports for those patients who had undergone definitive surgery or open biopsy. Clinical charts were reviewed to obtain follow-up on those patients who did not undergo surgical procedures. Forty-two CT-guided FNA biopsies were performed in 37 patients. There were 17 women and 20 men identified in this study. Their ages ranged from 13 to 83 years. The locations of the lesions from which needle biopsy specimens were obtained are listed below:

- **Location**
  - Infra-temporal fossa: 5
  - Pterygomaxillary space: 1
  - Parapharyngeal space: 3
  - Skull base: 3
  - Paralaryngotracheal: 5
  - Retropharyngeal: 4
  - Parotid gland (deep lobe): 7
  - Neck (parapsinuous muscles, nodes): 12
  - Thyroid gland: 2

All patients who had undergone CT-guided needle biopsies were included in the analysis.

All procedures were performed by a neuroradiologist with a cytopathologist present. Previous diagnostic studies were reviewed by the radiologist to define the area of interest. Recent creatinine levels were obtained, but coagulation studies were not routinely ordered. All patients had an intravenous access line placed after written informed consent was obtained.

Before the procedure is begun, a marker is placed on the skin over the area of the lesion. The patient is then scanned in the supine position at 3-mm intervals. The images are reviewed, and the slice location for the biopsy is chosen. The CT gantry is pulled out. At this point, intravenous sedation is administered if necessary, usually to those patients undergoing skull base and retropharyngeal biopsies. Vital signs are monitored every 5 minutes by a radiology nurse. Local anesthesia is used in all patients. After injection, the needle may be left in place, perpendicular to the skin, and a second scan can be obtained to confirm the correct trajectory. The needle is then exchanged for the biopsy needle, and subsequent scans are performed when necessary to confirm the course of the needle. In general, deeper lesions are rescanned every 1 to 2 cm as the needle is advanced.

When the needle is at the periphery of the lesion, the gantry is pulled out and a 10-mL syringe is attached to the needle. Multiple 1- to 2-cm passes are made with a cutting, turning motion while pulling back on the plunger of the syringe. When blood appears in the needle hub, the needle is withdrawn and passed off to the cytologist.

If the lesion is deep, a coaxial technique may be used with an 18-gauge Chiba needle to localize the periphery of the lesion, and a 22-gauge Chiba needle is put through the larger needle. Alternatively, parallel needles may be placed. For superficial lesions, a 22-gauge phlebotomy needle is used. If inadequate material is obtained, the 18-gauge needle is used to perform a core biopsy.

Approaches used included transcervical, retromandibular, and transcondylar notch techniques (Figure 1). When an adequate specimen is confirmed by pathology, the patient is transferred to the radiology holding area, where the length of stay is determined by the amount of sedation used.

The specimens were expressed onto a glass slide, and a gross examination of the aspirated material was performed. Often, small tissue fragments were identified. Direct smears were made, air-dried, and stained with a Giemsa-type stain. Slides were also prepared for subsequent staining by the Papanicolaou method. The air-dried slides were then immediately evaluated microscopically, and the adequacy of the specimen was determined. If the specimen was scant, composed of blood only, or otherwise nondiagnostic, additional sampling was requested.

At the time of immediate cytologic evaluation, a preliminary diagnosis was rendered. Portions of the specimen were triaged for special ancillary studies to facilitate diagnosis or to provide additional prognostic information. Examples include flow cytometric evaluation for suspected lymphoid malignancy or cell block preparations for immunohistochemical staining.

Histologic confirmation of needle biopsy results was obtained in 86% (12/14) of cases. There were discrepancies in 2 cases. In one case, findings of a deep-lobe parotid FNA were consistent with normal parotid tissue; however, histologic examination showed oncocytoma. In the other case, the patient had a foramen rotundum mass, which was consistent with normal nerve; however, histologic examination showed oncocytoma. In 2 cases, the patient had a foramen rotundum mass, which was consistent with normal nerve; however, histologic examination showed oncocytoma. In general, deeper lesions are rescanned every 1 to 2 cm as the needle is advanced.

The results of 20% of the first 10 biopsies were nondiagnostic, whereas those of only 6% (2/32) of the remaining biopsies were nondiagnostic.

An open procedure was avoided in 19 (51%) of 37 patients: 11 with benign disease and 8 with recurrent car-

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cinoma. In 9 (50%) of 18 patients with disease requiring surgery, preoperative planning was enhanced by positive identification of the lesion. Only 2 patients underwent surgery that could possibly have been avoided; the aspirates in both cases were nondiagnostic. One patient had a pterygomaxillary space chloroma, and 1 patient was immunosuppressed, with reactive lymphadenopathy. There were no complications except self-limited pain. Four patients underwent core needle biopsy (all in the last 32 biopsies).

**COMMENT**

The diagnosis of poorly accessible or deep-seated lesions in the head and neck is challenging. Identification of benign disease processes or recurrent cancer can result in avoidance of surgical procedures that risk vital neural and vascular structures in the head and neck. In surgical candidates, preoperative identification of the tumor permits operative planning and patient counseling. Radiologic studies, including MRI and CT, can yield details of deep or distorted anatomy, but differentiating between tumor, scar tissue, radiation edema, or infection using these techniques alone can still be difficult.

Palpable lesions are easily addressed with FNA. However, many lesions are hidden from palpation by the structures of the midface, mandible, and trachea or are ill defined owing to previous surgery or radiation therapy. It is in these situations that the addition of imaging techniques to direct the needle biopsy is especially useful.

Ultrasound-guided FNA is a well-established technique for localizing lesions of the thyroid, salivary glands, and cervical lymph nodes, but lesions deep to the bony structures of the facial skeleton and air-containing spaces of the head and neck are not easily localized with ultrasonography. At our institution, ultrasonography is the preferred modality for imaging needle biopsies of the thyroid gland. This preference accounts for the very small number of CT-guided needle biopsies of thyroid glands in our series.

Magnetic resonance imaging provides excellent soft tissue detail, exceeding that of CT, but does not provide bony detail. Magnetic resonance imaging-assisted needle biopsy has been performed by Fried et al, with good results and minimal morbidity. Drawbacks include the need for special nonmagnetic instruments that are compatible for use with the strong magnetic field. Because of the tight confines of the MRI scanner, open MRI scanners are preferable, but they are not widely available.

A CT scan provides good soft tissue and bone detail and does not have the drawbacks of MRI in image-guided biopsy procedures. Gathey et al described successful CT-guided needle biopsies of 6 patients with laryngopharyngeal abnormalities that were identifiable on CT scan but not on physical examination or endoscopy. The findings of all biopsies were diagnostic. Robbins et al reported that the results of 5 of 5 CT-guided FNA biopsies of inaccessible head and neck lesions were diagnostic. A large series, involving 111 biopsies in 109 patients, was recently reported by Sack et al. Definitive cytologic diagnoses were obtained in 93 (84%) of 111 cases, with an 81% rate of histologic confirmation in those cases in which subsequent open procedures were performed. Nondiagnostic cytologic evaluation was obtained in 16% of cases. The results were false-positive in 3 cases and false-negative in 2 cases. Surgery was avoided in 46 (37%) of 109 patients as a result of a needle diagnosis of recurrent malignancy or benign disease.
In our series of patients, CT-guided needle biopsy was used primarily in patients with clinically nonpalpable or inaccessible lesions, with 50% of the lesions being at or near the skull base or laryngopharyngoesophageal area (Figure 2 and Figure 3). Sixteen percent of the biopsy specimens were obtained from the deep lobe of the parotid gland. While squamous cell carcinoma represented the most common diagnosis, a wide variety of pathologic lesions were correctly diagnosed by needle biopsy.

In our series, diagnostic tissue was obtained in 91% of cases, with 86% of subsequent histologic specimens confirming the cytologic diagnoses. The cytologic diagnosis was confirmed histologically and/or clinically in 95% of cases. These results are similar to those of other series.

The ability of CT-guided needle biopsy to diagnose recurrent cancer and benign lesions is a very useful tool in patient evaluation and treatment. In our study, surgery was avoided in 19 (51%) of 37 patients: 11 with benign disease and 8 with recurrent carcinoma. Two of 4 patients in whom the findings of needle biopsy were nondiagnostic underwent surgery that could have been avoided if diagnostic cytologic evaluation could have been obtained. Also, the cost of the CT-guided needle biopsy is significantly less than that of open biopsy in the operating room.

There appears to be a learning curve on the part of the radiologist in using the CT-guided needle biopsy technique. This learning curve is reflected in the 20% nondiagnostic cytology rate in the first 10 biopsies, which was reduced to 6% in the subsequent 32 biopsies. This improvement is attributable to improved technique with experience and possibly to the addition of larger needle core biopsy in lesions that are difficult to diagnose by FNA, such as nerve sheath tumors. This learning curve was also noted in ultrasound-guided needle biopsies. It is also important for the radiologist to be flexible in altering technique or approach. This is exemplified by one of our cases in which a patient who had undergone an endoscopic examination and a biopsy, with negative results, and then underwent CT-guided FNA of a paraesophageal lesion. The specimen was nondiagnostic, and the procedure was immediately converted to an ultrasound-guided needle biopsy, the findings of which successfully diagnosed squamous cell carcinoma.

In this series, there were no false-negative results. In a large series involving 1022 aspirates of tumors and tumorlike conditions of the oral and maxillofacial region, Daskalopoulou et al encountered 18 cases with false-negative cytologic results. Thus, negative FNA results should not be relied on when the clinical assessment indicates malignancy.

CONCLUSIONS

Our findings confirm the safety and efficacy of CT-guided needle biopsy of inaccessible head and neck lesions. Definitive diagnosis can result in the avoidance of unnecessary open surgical procedures in patients with benign disease or recurrent malignancy. Improved preoperative planning and patient counseling for patients requiring surgery are other benefits of this procedure. A learning curve does exist for the radiologists who perform this procedure.
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REFERENCES