CASE REPORT

CT-Guided Percutaneous Fine-Needle Aspiration Biopsy of Posterior Skull Base Lesions

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ABSTRACT—We describe a retroauricular approach, adjacent to the mastoid tip, in two patients that allowed successful biopsy of posterior skull base lesions. Diagnoses were central giant cell granuloma, an unusual tumor rarely reported in the skull base, and meningioma. In both patients, the needle biopsy accurately identified the pathology found at surgery. The described approach may allow biopsy of posterior lesions that are inaccessible with other methods.

Percutaneous fine-needle computed tomography (CT)-guided aspiration biopsy of head, neck, and skull base lesions has been described.¹⁻⁷ This technique allows biopsy of deep and nonpalpable lesions that are inaccessible to biopsy through a peroral transmucosal approach by the otorhinolaryngologist, and would otherwise require open surgical biopsy. These biopsies may be difficult due to intervening osseous structures and important neurovascular structures in the head and neck. The most commonly used approaches are (1) transfacial, lateral to the maxilla and lateral pterygoid plate; (2) lateral, through the mandibular notch between the coronoid process and mandibular condyle; and (3) retromandibular, through the parotid gland. However, these trajectories may not be ideally suited for certain posterior skull base lesions. We describe a retroauricular approach that has been successfully used in two patients with posterior skull base lesions that extended below the foramen magnum, and that may also allow biopsy of lesions in the posterior parapharyngeal space and digastric groove region. Lesions in the posterior skull base frequently extend below the skull base. This makes many lesions originating from the posterior skull

base amenable to percutaneous biopsy by our described technique.

PATIENTS AND METHODS

Patients

Two patients with posterior skull base masses underwent CT-guided fine-needle aspiration biopsy. Both patients had diagnostic CT and magnetic resonance (MR) images performed prior to biopsy to determine the extent of the lesions. The lesions were not visible or palpable from the skin surface or from the oropharynx or nasopharynx and were therefore not accessible to blinded percutaneous or peroral biopsy.

Case 1

A 16-year-old adolescent was initially evaluated after she sustained a mild closed head injury. Physical examination revealed "blood" behind the tympanic membrane. A head CT showed a destructive lesion of

Figure 1. (A) Axial CT shows the bone destruction with a honeycomb pattern in the posterior skull base. (B) Axial T1-weighted MR image shows a blood-fluid level (arrow). (C) Axial T2-weighted image shows the blood fluid-level. The remainder of the lesion is hypointense (arrow) likely reflecting the hemosiderin and fibrosis found pathologically.

the left posterior skull base. Skull base CT and MR imaging showed a destructive lesion of the posterior skull base that extended into the neck adjacent to the destroyed mastoid tip and foramen magnum (Fig. 1). Physical examination showed tongue deviation to the left with left-sided tongue atrophy and otoscopic evaluation at our institution revealed a reddish mass, rather than blood, behind an intact tympanic membrane. Conventional angiography revealed no significant vascularity. Therefore, we felt the lesion could be safely biopsied under CT guidance. Laboratory tests including serum calcium and parathyroid hormone were normal.

Case 2

A 40-year-old woman complained of decreased hearing in the left ear and some gait unsteadiness for 3 months. CT and MR imaging revealed a densely calcified posterior skull base mass that extended inferiorly through the jugular foramen into the parapharyngeal space (Fig. 2). More recently, she had spasms of her neck and twitching of her left eyelid. Physical examination revealed the following left-sided abnormalities: decreased hearing, absent vocal cord movement, absent sternocleidomastoid muscle function, and atrophy of the trapezius muscle. Audiometry showed moderately severe low- and high-frequency left sensorineural hearing loss. Interestingly, the

patient reported a change in her voice quality to a low-pitched and raspy voice at age 13, at which time she was found to have a paralyzed left vocal cord.

Biopsy Technique

Each patient was placed supine on the CT scan table with the head slightly extended and turned approximately 30° away from the side of the lesion. Contiguous 3-mm axial images without gantry angulation were obtained through the posterior neck and skull base at the level of the digastric groove and inferior margin of the jugular foramen. The preliminary images were reviewed and the scan table was moved to the location where the preliminary axial scans showed a clear trajectory to the lesion from the skin surface. The skin at the chosen location was marked using the gantry location light to assure the proper level. The skin was prepped and draped in a sterile fashion and the skin was locally anesthetized with 1% lidocaine. A coaxial 19- and 21-gauge noncutting needle system was utilized for the biopsy. The outer 19-gauge needle was placed at the lateral margin of the mass. Serial CT images were obtained during needle advancement to confirm accurate needle placement. The stylet was removed and several passes through the 19-gauge cannula were made with

Figure 2. (A) Axial CT scan shows a densely calcified posterior skull base mass involving the jugular foramen (straight arrow). Note the normal right jugular foramen (curved arrow) and the plaque-like extension along the foramen magnum (open arrows). (B) Axial CT scan, inferior to (A), shows extension of tumor into the parapharyngeal space (arrow) through the jugular foramen. Note the relationship of the mass to the styloid process (arrowhead). (C) Axial T1-weighted image shows the location of the internal carotid artery (arrow) at the anterior margin of the mass.

the 21-gauge needle. Samples were first taken without aspiration to minimize the amount of blood in the specimens and then with aspiration if the initial samples were not diagnostic. Cytopathology reviewed the specimens to ensure diagnostic quality and then the needle was removed.

Technique—Case 1

The needle was advanced in the retroauricular region just behind the mastoid tip into the basiocciput adjacent to the digastric groove (Fig. 3).

Technique—Case 2

The needle was advanced in the retroauricular region, just below the mastoid tip and posterior to the styloid process, into the poststyloid parapharyngeal space just below the jugular foramen (Fig. 4).

RESULTS

Both patients tolerated the procedure well without complications. The procedures were performed on an outpatient basis and each patient was discharged home 2–3 hr postbiopsy. The biopsy was performed with local anesthesia only in one patient and with local anesthesia and minimal intravenous sedation for mild anxiety in the other patient. The obtained specimens allowed a preoperative diagnosis of central giant cell granuloma versus giant cell tumor versus brown tumor of hyperparathyroidism in the first patient and meningioma in the second patient. Normal serum calcium and parathyroid levels excluded a brown tumor. The meningioma was diagnosed by one pass without aspiration, whereas the giant cell reparative granuloma versus giant cell tumor required multiple passes with and without aspiration. Surgical pathology confirmed the diagnosis of a

Figure 3. Axial CT shows the needle entering the mass from a retroauricular approach (arrow).

Figure 4. Axial CT shows a slightly modified retroauricular approach to the posterior parapharyngeal space. This approach allows the biopsy trajectory to remain away from the internal carotid artery (compare with the location of the internal carotid artery seen in Fig. 2C).

central giant cell granuloma in the first patient and meningioma in the second patient.

DISCUSSION

CT guidance allows biopsy of deep and nonpalpable lesions that are inaccessible to peroral or blinded percutaneous biopsy and would otherwise require open surgical biopsy.¹⁻⁷ The most commonly used approaches are anterior, lateral to the maxilla and lateral pterygoid plate, and lateral, through the mandibular notch.^{1-6,8} We describe a posterior approach that may allow percutaneous biopsy of lesions of the posterior skull base, posterior parapharyngeal space, and digastric groove region.

Lesions arising within the jugular foramen or originating from contiguous regions of the posterior skull base frequently extend below the skull base into the neck either directly or through skull foramina such as the jugular foramen. This makes many lesions originally arising within the posterior skull base amenable to percutaneous biopsy.

Upper neck lesions may be intrinsic, arising from the normal contents of the neck, or extrinsic, originating from contiguous regions of the skull base. Therefore, lesions can involve the neck from various planes and have a variety of geometrical relationships to critical neurovascular structures. Lesions originating primarily in

the prestyloid parapharyngeal or masticator spaces will be located anterior to the internal carotid artery, whereas lesions arising from the posterior skull base often extend into the upper neck directly or through the jugular foramen and are more likely to be posterior to the internal carotid artery (Fig. 2C).

Barakos et al,² Esposito et al,³ and Tu et al⁴ used an anterior approach to the parapharyngeal space. Caution must be used to avoid injuring the carotid artery. The pathologies in the 15 patients with parapharyngeal lesions described by Esposito et al³ appear to be mostly primary parapharyngeal lesions and the four patients described by Barakos et al² had perineural extension of tumor along the mandibular division of the trigeminal nerve. These lesions would therefore likely be located anterior to the internal carotid artery and more easily biopsied by their described anterior transfacial approach. Our two patients had primary skull base lesions that secondarily extended into the neck. The internal carotid artery was anterior to the bulk of the lesion in both cases. Therefore, an anterior approach would likely require traversing the internal carotid artery. Accordingly, our retroauricular approach provides a safer approach to these types of lesions. Head extension makes the line of approach to this area perpendicular to the scan table so that the biopsy can be performed without the need for gantry angulation. This simplifies the pro-

cedure allowing the biopsy to be performed more rapidly and with a greater degree of target accuracy.

The unusual pathology of in our first patient merits brief discussion. Central giant cell granuloma, also called giant cell reparative granuloma, is an unusual nonneoplastic lesion, most commonly seen in the jawbones.^{9–12} The origin of the lesion is controversial. Jaffe¹³ suggested that the lesion is the result of a reparative reaction to traumatic intraosseous hemorrhage or periosteal reaction. Some pathologists believe that central giant cell granuloma and giant cell tumor represent a spectrum of the same pathology.¹⁴ Although not neoplastic, giant cell granuloma grows rapidly and recurs with incomplete resection.^{10,11} Histologically, central giant cell granuloma consists of vascular stroma, areas of hemorrhage, marked fibrosis, and fibroblasts and giant cells. Trabeculae of newly formed bone are frequently seen.^{9–12} Brown tumor of hyperparathyroidism may be indistinguishable pathologically from giant cell granuloma and must be excluded on clinical grounds.¹¹ Central giant cell granuloma of the skull base is extremely rare with only a few reported cases.^{9,10} The imaging appearance in the skull base has been described and mirrors the pathology. CT shows bone expansion with a honeycomb appearance reflecting the prominent new bone formation pathologically. MR imaging has been described in one case and showed low T1- and T2-signal thought to reflect the abundant hemosiderin pigment and fibrosis seen pathologically.⁹ Our case showed these same features, but also showed blood-fluid levels (Fig. 1), which are most commonly described in aneurysmal bone cyst. However, this finding is not unexpected because multiple areas of hemorrhage are often found pathologically.

In summary, a variety of percutaneous approaches can be used to biopsy head and neck and skull base lesions. The choice of approach requires careful review of the preliminary imaging studies to determine the relationship of the lesion to critical neurovascular structures. Our retroauricular approach is well tolerated by the patient and particularly well suited for posterior lesions such as those that have extended from the adjacent posterior skull base. With the introduction of CT fluo-

roscopy, our technique should be even more easily performed because real-time CT images can be viewed during needle advancement.

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