Biopsy of Parapharyngeal Space Lesions

PARAPHARYNGEAL space (PPS) masses may be divided into those that occur posterior to the vessels of the carotid sheath (in the poststyloid or so-called carotid space) and those that occur anterior to them (in the prestyloid PPS)(1,2). Carotid space lesions are usually confined to paragangliomas (identifiable by their vascularity and arterial flow curves on dynamic computed tomographic [CT] or magnetic resonance [MR] images), neurogenic tumors (eg, vagus schwannomas), or aneurysms (1–6). Diseases affecting the carotid space are usually benign processes; however, occasionally a mucosal malignancy will grow into the carotid sheath.

Prestyloid PPS lesions are more vexing. Since the intrinsic contents of this space are limited to vessels, fat, nodes, and inconstant minor salivary gland tissue, primary lesions in this region are rare. However, the prestyloid PPS may be invaded by parapharyngeal mucosal squamous cell carcinomas or, much more rarely, parotid malignancies (ie, high-grade mucoepidermoid carcinoma, carcinoma ex pleomorphic adenoma)(1). Alternatively, parapharyngeal, retropharyngeal, and skull base infections may infiltrate the prestyloid PPS (1). If the fat of the prestyloid PPS is obliterated by a mass or infection, its origin may be inapparent and biopsy may be required for diagnosis.

Sampling a mass in the PPS is not trivial. These masses are often difficult to access owing to their deep location. Biopsy of most palpable PPS lesions that bulge the pharyngeal mucosa may be performed by means of a peroral transmucosal approach. This “blind” approach poses some risk to jugular and carotid vessels and the facial nerve, which may be adjacent to the area of interest. In addition, because of the inherently “contaminated” nature of peroral biopsies, antibiotics are often required after the procedure (7). The accuracy of peroral aspiration biopsy ranges from 78% (8) to 86% (7), and false-negative rates may be as high as 19% (9). Suboptimal or unsatisfactory specimens are obtained in 7%–14% of biopsies (8,9).

The accuracy of peroral fine-needle aspiration (FNA) is less favorable than that for percutaneous FNA of head and neck neoplasms, which is reported to be in the 90%–95% range (10,11). Inadequate stabilization of the lesion at the time of peroral aspiration, limits on the intraoral angles available to puncture the mass, and inability to perform deep thrusts with the biopsy needle for fear of injuring vessels have been cited as reasons for the diminished accuracy (9). Nonetheless, in the experience of the largest reported group, FNA biopsies were more accurate than biopsies with Trucut needles (Baxter Healthcare, Valencia, Calif)(9).

Because of the limitations of peroral biopsy, Shoss et al (12) recommend a percutaneous approach to biopsy of all PPS masses when possible. Imaging guidance is almost always required. Use of ultrasound, while effective elsewhere in the head and neck, is hindered by the overlying mandible, maxilla, mastoid, and styloid process. Therefore, CT-guided biopsy is the preferred approach, especially when the lesion is not palpable within the mouth or is not adjacent to the mucosa.

Because of the availability of skilled on-site cytologic assessment, our radiology department has relied on FNA as opposed to core biopsy for sampling PPS masses. The procedure we outline below is simple and inexpensive and has been employed in 17 cases since January 1992 and has yielded a definitive diagnosis in 16. Eight of the 17 patients had undergone prior treatment: surgery alone in three and surgery plus radiation therapy in five; in the one case in which biopsy results were nondiagnostic, the patient had undergone surgery and radiation therapy. In seven of the 17 PPS lesions, peroral biopsy had been attempted and the results were either nondiagnostic or not compatible with the clinical suspicion of disease. In four of the seven, CT-guided FNA led to a different diagnosis than peroral aspiration; in all cases the final clinical-surgical diagnosis agreed with the results of FNA.

The technique used to perform biopsy of lesions of the PPS has also been used to perform biopsy of parapharyngeal, deep thyroid, parotid, and precervical masses in an additional 16 patients, with an overall success rate of 91%.

All patients undergo complete CT or MR studies before referral for CT-guided biopsy. Upon review of the scans, a decision as to whether to approach the lesion via a transparotid or oblique retromaxillary approach is made. When possible, a retromaxillary approach is preferred, since transparotid biopsy may injure the facial nerve or major vessels or may yield salivary gland tissue, which might falsely implicate a minor salivary gland neoplasm of the PPS.

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Abbreviations: FNA = fine-needle aspiration, PPS = parapharyngeal space.
There are important anatomic structures to avoid when approaching the PPS. The main branches of the maxillary nerve and accompanying vessels extend anteriorly from the trigeminal ganglion to the foramen rotundum and then descend in the pterygopalatine fossa before exiting to the palate, sinuses, and nasal cavity. They are usually shielded from inadvertent puncture by the pterygoid plates posteriorly and usually do not pose a risk. The mandibular nerve descends from the foramen ovale, and its anterior motor division innervates the four muscles of mastication. A branch continues along the mandible to enter the inferior alveolar foramen and other branches, which include the lingual and buccal nerves, run with arteries from the external carotid artery system. These vessels and nerves are rarely visualized, and damage from puncture is rare. The same applies to the facial nerve in the parotid gland or along its ramifications to the muscles of facial expression further anteriorly, where retromandibular puncture is performed. Conversely, when one is performing transparotid aspiration, it is important to avoid the large retromandibular vein that courses centrally through the gland. Finally, one should avoid puncture of the internal carotid artery and internal jugular vein, which are located posterior to prestyloid PPS masses and are identifiable just lateral to the longus colli and capitis muscles. An appropriately placed needle stop should prevent unintentional injury to the carotid sheath structures.

Consent for the procedure is obtained from the patient, with explanation of the risks of pain, bleeding, infection, anaphylactic reactions to medications, and injury to adjacent blood vessels, nerves, and lymphatic vessels. No neurovascular complications have occurred thus far, and we state that we will control bleeding at the puncture site with pressure applied locally. We state that seeding of tumor along the needle track is possible but highly unlikely and improbable. According to Cohen et al (13), Ramzy (14), and Ellis et al (15), tumor implantation along the needle track has not been reported with the use of needles that are less than 20 gauge and is "virtually nonexistent" (14) in the head and neck. We do not require administration of contrast agents unless the location of blood vessels cannot be determined by consulting the image obtained before biopsy.

During the explanation of the procedure, the patient is told that a maximum of five passes with the aspiration needle will be made. We believe that after five unsuccessful passes, the likelihood of successful aspiration of the mass with additional attempts is low. The patient is also told that the success rate for this technique is approximately 90%, although the diagnosis may not be available until all of the sampled material is processed and evaluated (which can take 24–48 hours). The patient is told that after the procedure there may be minor discomfort that may last up to 3 days and should be treated with nonaspirin analgesics.

Anteroposterior and lateral scout CT tomograms are obtained. One may be able to obtain just an anteroposterior or lateral scout view if the location of the lesion on the prior study is clear cut, but more often than not, localization for needle placement requires extrapolation from both scout views in order to select the minimum number of sections required to encompass the mass. A limited series of 5-mm-thick axial sections through the lesion is obtained. A low-kVp (120 kVp), low-mA (140 mA) technique is employed to reduce radiation dosages. From the sections through the

Figure 1. Steps in the aspiration procedure. (a) Axial CT scan obtained with the patient's head slightly oblique (to the left side) shows a parapharyngeal mass (M). (b) With the use of a laser light at the same location, three radiopaque markers are placed on the patient's skin. The middle marker (arrow) is in the best position for puncture of the mass (M). (c) An 18-gauge needle (arrow) is inserted into the anterior soft tissue in front of the ascending ramus of the mandible. The scan suggests ready passage between the mandible (m) and maxillary antrum (a). (d) A 22-gauge spinal needle with stylet is inserted through the 18-gauge open needle with its tip (arrow) at the edge of the mass. Once the cytology team is present, sharp thrusts into the mass, with suction applied and the stylet removed, are performed. The diagnosis was pleomorphic adenoma.
lesion, the optimal axial section location is selected, and the patient is withdrawn from the CT scanner to that section location. The head may be immobilized if a straight anteroposterior approach is contemplated. Otherwise, the head may be turned into the optimal biopsy plane. The laser light of the CT scanner is used to define the line on which to place three to four radiopaque markers. These will be used to select the best angle and puncture site for biopsy of the mass.

Axial scans are then obtained from 6 mm above to 6 mm below the marked section location with 3-mm scan thicknesses. From this series, the scan with the markers in place is reviewed and the puncture site marker that is true perpendicular (retromaxillary) or parallel (transparotid) to the lesion (but avoiding any major blood vessels) is selected. Adjusting the markers or head position for optimal siting is accomplished by means of repeat scanning as needed.

The patient is then withdrawn, and a mark is made on the skin below the "optimized" marker. The puncture site is prepared with sterile technique, and a local anesthetic is administered liberally, as deep as the anesthetizing (25-gauge) needle will allow. An 18-gauge injection needle is then inserted into the face at the angle that is most appropriate for avoiding major vessels but that is along the line of the lesion (Fig 1). By measuring the distance from the skin surface to the lesion, one can determine how far the 18-gauge needle should be inserted.

We have found that most parapharyngeal masses remain deep to a 1.5-inch 18-gauge needle inserted to its hub. Occasionally a lesion will require an oblique puncture of the skin; in this case, the 18-gauge needle is inserted halfway to the hub while the desired angle of insertion is estimated. The same series of 3-mm-thick axial CT sections is then obtained with adjustments to the depth or angle of the 18-gauge needle. Ideally, the tip of the 18-gauge needle should be adjacent to but not within the lesion of interest.

After verification of the location of the tip of the 18-gauge needle adjacent to and along the line of site of the lesion, the distance from the hub of the needle to the edge of the lesion is measured. A stopcock is placed at that distance on a 2.5-5-inch-long 22-gauge lumbar puncture spinal needle, which is then inserted through the 18-gauge needle so that its tip is at the border of the lesion (Fig 2). The placement of the tip of the aspiration needle can be localized by scanning the same 3-mm-thick sections.

Before aspiration, the stopcock is raised 1–3 cm on the needle and the stylet is withdrawn. A 10- or 20-mL syringe is connected to the 22-gauge spinal needle. If the 18-gauge guidance needle is not inserted to its hub, we recommend that an assistant hold it in place to avoid inadvertent puncture of the mass with the 18-gauge needle and distortion of the distance to the mass. Suction is applied to the 22-gauge spinal needle, and the lesion is punctured with several vigorous 1–3-cm thrusts. While the spinal needle is still within the lesion, suction is slowly released and the syringe and needle are withdrawn through the guide needle, leaving the latter in place. The aspirated material is then processed on site by the cytopathologist, who prepares air-dried slides for DiffQuik stain (EM Diagnostics Systems [Harleco], Gibbstown, NJ), along with wet-fixed slides for Papanicolaou stain. The needle and syringe are rinsed with normal saline, which is later concentrated onto a Millipore filter (Bedford, Mass) and into a cell block preparation. The air-dried slides are examined microscopically on site, and the aspiration procedure is repeated until diagnostic material is obtained.

By leaving the 18-gauge guidance needle in place, only one skin puncture is required and patient anxiety is reduced. One can easily angle the 18-gauge needle to different areas of the mass if results of the initial aspiration are nondiagnostic, since it is short.
and less deeply set than the 22-gauge needle. This ready ability to maneuver the introducer needle is a definite advantage to the coaxial system for deep biopsies. While a maximum of five passes with the 22-gauge needle may be made, patient discomfort may necessitate stopping the procedure earlier. In our experience, the mean number of passes required to arrive at a final diagnosis has been 3.1, with a range of one to six aspirations. In four of seven cases of malignancy, the results obtained at the first pass were diagnostic.

If after five passes the cytologic team believes that the specimens are still inadequate, a judgment is made as to whether the 18-gauge injection needle itself is in a position for aspiration. Only if the 18-gauge needle is at the border of the lesion and has some leeway with regard to penetration into the lesion will a final 10–20-mL syringe be connected to the 18-gauge needle for a larger-bore aspiration. Among the 17 PPS masses sampled for biopsy at our institution, 18-gauge needle biopsy was performed in only two and was successful in one.

After successful biopsy of the PPS mass, the 18-gauge injection needle is withdrawn from the face and pressure is applied for 1 minute. In general, patients have little discomfort, and in experienced hands, the procedure takes less than 1 hour. The patients are observed in the radiologic suite for 1 hour, at which time their blood pressure, heart rate, and respiratory rate in seated and standing positions are checked and compared with the preprocedural levels. Patients are given the phone number of the radiologist on call in the event of any late complications. We explain that the results of the aspiration may require up to 2 days to finalize.

Among the 16 successful aspirations of PPS masses performed, a definitive diagnosis was obtained at the initial on-site review of the slides in 12. In the remaining cases, the initial reading was equivocal, and after further processing and evaluation, a definitive report was obtained the next day. The results of the aspirations are noted in Table 1.

There have been no complications associated with this procedure, and no patients have complained of pain beyond 24 hours. As a result of this procedure, surgery was avoided in five patients with reactive/inflammatory processes who were clinically suspected of having malignancies.

In addition to being minimally invasive, highly accurate, and of high yield, this procedure is recommended for its relatively low cost. Only a limited CT scan (typically 10–20 axial sections) is required along with standard inexpensive needles and syringes. We estimate that the aspiration equipment used costs less than $14.74 (Table 2). We photograph only the images documenting the final location of the needle, and the cost of CT is the lowest in our university cost code. The cost of on-site cytologic examination is based on immediate and delayed review of the slides. While the on-site cost is $438.50, the cost for aspirations performed without immediate review is $164.00. The cost and inconvenience of repeat aspiration under CT guidance at a later date for inadequate sampling (which would have occurred more than 50% of the time in our series) appears to outweigh the added expense of immediate on-site analysis.

Before performing biopsy of PPS lesions, one should always exclude a vascular mass because of the risk of subsequent undetected bleeding in this remote site. In most cases, a hemangioma, paraganglioma, arteriovenous malformation, or aneurysm can be diagnosed with standard contrast-enhanced MR imaging or CT. In a limited number of cases, a dynamic CT or MR imaging study will be needed with or without CT or MR angiography. Conventional angiography is rarely required, owing to sophisticated transaxial techniques. While we have not encountered such entities, the prohibitive nature of complications from aspirating such vascular lesions should lead to caution before contemplating a CT-guided deep biopsy. Such is not the case with regard to the trivial risk of tumor seeding along the needle track. Aspirating masses before surgical removal is the standard of care in the head and neck, and the negligible risk of seeding is outweighed by the information obtained with regard to the operative approach.

CT-guided aspirations of the PPS are usually performed in the setting of nonpalpable lesions or after unsuccessful peroral or endoscopic biopsy. Our low-cost technique is well tolerated and effective. Attention to accurate localization of the introducer and coaxial aspiration needles augments success.

References