CT Evaluation Of Parapharyngeal Masses: Pictorial Essay
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Citation

Abstract
A lesion in the parapharyngeal space can arise within the space or extend secondarily from the surrounding spaces. The origin of a lesion can be assessed by observing the relationship of the lesion to the fat within the prestyloid compartment of the parapharyngeal space [5].

INTRODUCTION
The parapharyngeal space is a hatchet shaped space that extends on either side of the neck from the skull base to the styloglossus muscle at the level of the angle of the mandible. It is bounded posteriorly by the vertebrae and prevertebral muscles, superiorly by the temporal bone, laterally by the mandible and the parotid space and medially by the pharyngeal space. The fascia from the styloid process to the tensor veli palatini divides the parapharyngeal space into an anterior (prestyloid) compartment and a posterior (poststyloid) compartment. Its ventral (prestyloid) compartment lies just lateral to the pharynx and deep to the masticator space and the ramus of the mandible. It contains fat, connective tissue, the pterygoid venous plexus, a small branch of fifth cranial nerve and the deep portion of the parotid gland protrudes into it. The dorsal (retrostyloid) compartment of the parapharyngeal space houses the internal carotid artery, internal jugular vein and the lower cranial nerves (ninth, tenth, eleventh and twelfth) [1].

One of the main reasons for interest in the parapharyngeal space is its critical location and anatomic relationships that allow it to act as a highway for the spread of infections and tumors from any of the areas that surround it to any of the other bordering spaces. With the advent of computed tomography (CT), the radiologic evaluation of parapharyngeal space lesions has advanced markedly providing an improved understanding of the anatomy of the parapharyngeal space and allowing improved differential diagnosis based on characteristic displacement of fascial planes [2-4].

LOCALISATION OF THE MASS
A lesion in the parapharyngeal space can arise within the space or extend secondarily from the surrounding spaces. The origin of a lesion can be assessed by observing the relationship of the lesion to the fat within the prestyloid compartment of the parapharyngeal space [5].

Compartmental localization of the lesions into prestyloid or post-styloid is done based on the displacement of the fat of the pre-styloid compartment and the involvement and displacement of the carotid vessels and the internal jugular vein. The features considered to suggest a prestyloid lesion include: displacement of the lateral wall of the pharyngeal space medially, displacement of the parotid gland laterally while maintaining an intact fat plane with the deep lobe of parotid gland and the displacement of the carotid vessels posteriorly (Fig 1). The CT features considered to suggest a poststyloid lesion include: anterolateral displacement of the prestyloid parapharyngeal fat, anterior or medial displacement of the internal carotid artery with obliteration of fat planes around the great vessels and extension posterior to the styloid process with its anterolateral displacement (Fig 2a).
Figure 1
Figure 1. Axial post contrast image showing a prestyloid extra-parotid lesion with intact fat plane with the parotid (arrowhead) and posterior displacement of styloid process (arrow).

Figure 2
Figure 2a. Vagal schwannoma in a 34-old-man. Contrast enhanced axial CT scan shows a heterogeneously enhancing Schwannoma with areas of necrosis displacing the internal carotid artery anteromedially.

Figure 3
Figure 2b. Photomicrograph (100X) demonstrating the biphasic pattern of Antoni A and Antoni B areas. The Antoni A areas contain compact cells arranged in short bundles of interlacing fascicles, while Antoni B areas contain spindle cells which are more loosely arranged.

The most difficult distinction in the pre-styloid compartment is between a lesions arising within the deep portion of the parotid gland from that arising primarily within the pre-
CT Evaluation Of Parapharyngeal Masses: Pictorial Essay

styloid compartment of the parapharyngeal space. The best method for making this distinction would be to identify fat plane between the deep lobe and the posterolateral aspect of the mass. A deep lobe of parotid mass extending into the prestyloid compartment causes widening of the stylomandibular tunnel with posteromedial displacement of the styloid process (Fig 3) [6].

Figure 4
Figure 3. Pleomorphic adenoma in a 35 yr-old-woman. Contrast enhanced axial CT scan shows a minimally enhancing water attenuation well-defined mass (star) extending into the prestyloid parapharyngeal space with widening of the stylomandibular tunnel (arrows).

Almost all of the tumors that occur in the Parapharyngeal space arise either from the deep portion of the parotid gland in the prestyloid compartment or from the neural related elements in the retrostyloid compartment [2]. Tumors of salivary gland origin (38.6%) are the commonest lesion affecting parapharyngeal space followed by neural tumors (14.4%), paragangliomas (8%), metastatic nodes (8%) and lymphoma (7.6 %) [6].

SALIVARY GLAND TUMORS

Tumors of the salivary gland origin in the parapharyngeal space arise either from the parotid gland, or salivary rests within the prestyloid compartment fat of the parapharyngeal space, or in the minor salivary glands of the pharyngeal mucosa. The commonest benign neoplasm is pleomorphic adenoma which on CT appears as a ovoid masses of soft tissue attenuation, typically homogenous when small but when larger one show areas of low attenuation representing sites of cystic degeneration or seromucinous collection (Fig 3) [6].

The malignant salivary gland lesions have irregular, ill-defined margins with heterogenous contrast enhancement and bone destruction (Fig 4).

Figure 5
Figure 4. Adenoid cystic carcinoma of the parotid in a 56yr-old-man. Contrast enhanced axial CT scan shows a heterogenous enhancing lesion with irregular margins, muscle infiltration, vascular encasement with loss of fat planes and bone destruction.

On certain occasions rare lesions of salivary gland origin are in the parapharyngeal space. One among them is cystic choristoma of salivary gland which demonstrated cystic density on plain scans (10-20HU) with no enhancement on post contrast studies (Fig 5). Choristoma of salivary gland are very rare lesions with imaging features which parallel epidermoid cysts [7, 8].
NEUROGENIC TUMORS

Among the neurogenic lesions which form the next most common group schwannoma (76-80%) is more common than the neurofibroma [4]. Schwannomas are usually ovoid or fusiform masses with well-delineated margins and are higher in attenuation than adjacent muscle or isodense, less commonly of lower attenuation than the adjacent muscle (Fig 2a &b). These schwannomas show typical anteromedial displacement of the internal carotid artery and lateral displacement with compression of the internal jugular vein. The neural sheath tumors with extension into the jugular foramen show smooth scalloped jugular foraminal widening (Fig 6).

Neurogenic tumors show a density less than that of muscle with cystic areas and minimal post contrast enhancement (Fig 7). The hypodensity of these neurogenic tumors has been related to regions of both low cellularity and high lipid content [9]. They have also been attributed to entrapment of perineural adipose tissue by plexiform neurofibroma or cystic degeneration secondary to infarction or necrosis.
Figure 8
Figure 7. Neurofibroma in a 22yr-old-man. Contrast enhanced axial CT scan shows the minimally enhancing tumor in the post-styloid space (star) causing anterior displacement of ICA (arrow).

Figure 9
Figure 8a. Carotid body tumor in a 26 yr-old-man. Post contrast axial CT shows intensely enhancing tumor in the post-styloid space (star) causing splaying of internal and external carotid artery (arrows).

GLOMUS TUMORS
The glomus tumors are ovoid lesions with welldefined margins showing a density more than or equal to that of muscles and intense homogenous contrast enhancement (Fig 8a) [6]. The high cellularity and vascularity of these tumors may account for their isodensity on CT (Fig 8b). Their marked vascularity accounts for their homogenous hyperdensity after contrast enhancement [9]. The carotid body tumors caused splaying of ICA and ECA (Fig 8) while glomus vagale tumors caused anteromedial displacement of ICA (Fig 9) [10]. These typical features of intense contrast enhancement and vascular displacement patterns are helpful in arriving at a precise preoperative diagnosis.

Figure 10
Figure 8b. Photomicrograph (100x) shows solid aggregates of glomus cells around small capillary sized vessels in a myxoid stroma. The glomus cells are round, regularly shaped with sharply punched out rounded nucleus.
LYMPHOMA

Primary malignant lymphomas of the parapharyngeal space are rare and involvement is secondary to the involvement of the head and neck. On imaging studies, they are homogeneous, enhancement is mild to moderate, may display necrosis and display calcification post-treatment. They are isodense to muscle on CT and circumscribed with distinct margins that occasionally display extra nodal extension with less well-defined margins and areas of necrosis within the tumor matrix (Fig 10). CT is also useful for detection of bone destruction involving the base of the skull, paranasal sinuses, and the mandible or maxilla [11]. As a general rule, lymphomas tend to be less infiltrative and cause relatively little bone erosion compared to carcinomas and most sarcomas [6]. The involvement of Waldeyer’s ring is an important feature as it gives vital clue to the diagnosis as the imaging features of lymphomas are quite nonspecific.

INFECTIONS

Most infections that result in a parapharyngeal space abscess arise either in the palatine tonsil or pharynx or are odontogenic in origin. The CT findings of cellulitis are those of “dirty” fat and some swelling of the fat in the prestyloid compartment. The abscesses in our study had a low-attenuation necrotic, pus-filled center with a thick, irregular, enhancing rim on CT (Fig 11). Other features include evidence of air pocket with myositis, loss of fat plane with the great vessels and trans-spatial configuration. The presence of the abscess rim separates cellulitis from an abscess and this differentiation is important as it has significant implications on management [12].
Figure 13
Figure 11. Parapharyngeal Abscess in 69 yr-old-man. Post contrast Axial CT shows a peripherally enhancing right parapharyngeal abscess with air pockets (arrows).

Figure 14
Figure 12. Tubercular lymphadenitis in a 12 yr-old-boy. Axial post contrast images showing multiple peripherally and densely enhancing lesions (arrows).

Tubercular lymphadenitis usually shows a central low attenuation necrotic area with peripheral rim enhancement and minimal perilesional fat stranding (Fig 12). This is in contrast to pyogenic lymphadenitis and abscess which show more surrounding fat plane obliteration with thickening of the surrounding muscles and skin [13].

METASTATIC NODES
The metastatic lymphnode in the parapharyngeal space in our study was from a primary in the oropharynx (squamous cell carcinoma) which forms the drainage area of the level II group of lymphnodes. The lymphnode measured 3 cm in diameter showing heterogenous contrast enhancement. The lymphnodal mass demonstrated central areas of necrosis and evidence of extracapsular spread features which are considered as a specific criterion for diagnosing neck metastases (Fig 13) [14]. The CT features and presence of a primary lesion helps to confirm the diagnosis of metastases as their imaging features of overlap with that of infective lymphadenitis [6].
Figure 15
Figure 13. Metastatic lymphnodes in a 66 yr-old-woman. Axial post contrast images showing bilateral heterogenously enhancing lymphnode with areas of central necrosis (arrow), extracapsular spread and vascular invasion (arrowhead).

Figure 16
Figure 14. True internal carotid artery aneurysm in a 8 yr-old-girl. Post contrast axial CT shows intensely vascular saccular aneurysm in the post-styloid space.

Pseudoaneurysms of the carotid system are rare and usually are secondary to infection or fine needle procedures in the neck. The pseudoaneurysm shows vascular enhancing and nonenhancing areas and anatomical continuity with the ICA (Fig 15). Features indicative of inflammation may be seen in the surrounding soft tissues [16].

VASCULAR LESIONS
The vascular lesions in the parapharyngeal space include aneurysms of the internal carotid system. Extracranial aneurysms of the internal carotid artery are rare and usually secondary to atherosclerosis. On CT scan, extracranial internal carotid aneurysms, particularly the fusiform type, may have peripheral eggshell calcification and exhibit arterial enhancement after intravenous contrast (Fig 14) [15]. Of all the masses that occur in the parapharyngeal space, the aneurysm is most immediately life-threatening [15].
Figure 17
Figure 15. Internal carotid pseudoaneurysm in a 2 yr-old-girl. Post contrast axial CT image shows a large mass with central tubular area of arterial enhancement (star) surrounded by nonenhancing fluid density areas (arrow).

OTHER TUMORS
Meningiomas are the most common of the intracranial neoplasms to extend into the parapharyngeal space. They exit the intracranial compartment either by extending through the jugular fossa or other neurovascular canals or by invading the skull base bone [17]. Meningiomas are enhancing, homogeneous tumors that may have calcifications either in a localized portion of the lesion or scattered throughout the tumor (Fig 16a & 16b). These tumors may reveal a dumbbell configuration with a smaller intracranial and larger extracranial component [6]. Hyperostotic thickening of the bone is a common finding (Fig 17) [2].

Figure 18
Figure 16a. Meningioma in a 24 yr-old-woman. Axial CT shows a enhancing heterogenous density mass (arrow).

Figure 19
Figure 16b. Photomicrograph (100x) shows the characteristic meningothelial cells (star) and the psammoma bodies (arrow).
Figure 20
Figure 17. Meningioma in a 39 yr-old-woman. Skull base extension of the meningioma seen as hyperostosis of the adjacent skull base (star) with a small calcified intracranial infratentorial component (arrow).

Solitary fibrous tumors are uncommon spindle cell neoplasms in the parapharyngeal space with most of the cases documented in literature being case reports. The imaging features are fairly nonspecific.

Chordomas arising from the clivus may rarely extend caudally into the parapharyngeal space. On CT, most tumors have a nonhomogeneous enhancing appearance, with multiple scattered areas of “calcification” that presumably represent residual skull base fragments. In general, because of their bony matrix and the presence of scattered calcifications, these tumors are more easily diagnosed on CT than on MR imaging studies [18-20].

Among the lesions of the parapharyngeal space with skull base extension the pattern of involvement of the skull base gives a clue to the probable histopathological diagnosis. Meningiomas cause hyperostoses of the ipsilateral portion of skull base a feature typical of meningioma. The schwannomas which show extension into the skull base cause smooth scalloped widening of the jugular foramen, unlike in cases of paraganglioma where the involvement is said to be permissive and destructive [9]. Chordoma causes destruction of the sphenocilval synchondroses while lymphoma caused nonspecific bony destruction of the skull base.

CONCLUSION
CT is a very valuable tool in the preoperative diagnosis of parapharyngeal space lesions based on the lesion morphology and lesion extent. The advantages of CT in the diagnosis of parapharyngeal lesions included short scan time, ability to detect calcification, evaluation of skull base, detect bone destruction and patient acceptance especially in the pediatric population.

References
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