BILATERAL CAROTID BODY PARAGANGLIOMAS : A CASE REPORT

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ABSTRACT

Carotid body paraganglioma is an uncommon tumor which arise from paraganglionic or chemoreceptor tissue at the carotid bifurcation. This is one of the most common primary sites for paragangliomas arising in the head and neck, mostly unilateral. Bilateral tumors is rare which occur in only 5% of sporadic and 33-38 % of familial paragangliomas. We report a quite rare sporadic case of bilateral tumors which had the characteristic CT and MRI findings.

INTRODUCTION

Paragangliomas arise in the head and neck at four primary sites ; the **carotid body**, **the jugular foramen, along the path of the vagus nerve**, and **the middle ear**. The carotid body is the most common site of these tumors. Less common sites include the sella turcica, pineal gland, cavernous sinus, larynx, orbit, thyroid gland, nasopharynx, mandible, soft palate, face, and cheek. Marchand reported the first paraganglioma (of the carotid body) in 1891. Numerous terms have been used since then to describe these tumors. The term "glomus tumor" was used to describe the rich arborization of blood vessels and nerves seen in these masses. Mulligan proposed the term "chemodectoma" to reflect the chemoreceptor tissue of origin.[5] Other names have included endothelioma, perithelioma, sympathoblastoma, fibroangioma, and sympathetic nevi. Based on the work of Glenner and Grimley, the term paraganglioma is currently accepted and widely used.[5] The typical patient is middle-aged and present late in the course of the disease, with a painless slow-growing mass. The carotid body paragangliomas is uncommon tumor but fascinating lesion. They arise within the carotid body, may be within or outside the adventitial layer of each common carotid arteries (CCA) at the bifurcation and characteristically splays the bifurcation of the CCA which result in the typical features on physical examination. These masses produce characteristic findings on radiologic images as well, particularly on computed tomographic (CT), magnetic resonance (MR) imaging. Nevertheless they also have the characteristic pathologically microscopic pattern. Surgery is the important role for treatment and very challenging. Bilateral involvement are rare which were previously reported in literature. We correlate the imaging features with the underlying pathologic findings and focus the distinctive features that is helpful in diagnosis.

A CASE REPORT

A 46 year-old woman was admitted with left neck mass for 12 years. About 12 years before admission, she developed left painless neck

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mass and was biopsied at the local community hospital. The pathological study was lymphadenitis. So she had no further treatment, but the mass was still growing slowly and she had got nasal voice.

Physical examination revealed a left upper lateral neck mass, about 7 cm. in the greatest diameter, pulsatile, compressible rubbery consistency with free horizontal mobility. Bulging of the left lateral oropharyngeal wall is seen and also, a right upper lateral neck mass was found, about 3 cm. in diameter with the same characteristic findings. No neurological deficit was detected.

Routine laboratory investigations were normal. Twenty four hours urine vinyl mandelic acid (VMA) was also normal.

Helical CT scan revealed hypo to isodensity to the muscle of bilateral carotid space masses with inward bulging into oropharyngeal airway by the bigger left sided mass on the precontrast axial image (Fig.1a) with rather homogeneous intense enhancement of the masses on the postcontrast scan (Fig. 1b). Splaying of internal carotid artery (ICA) from external carotid artery (ECA) at the carotid bifurcation is nicely shown on 3-D image reconstruction, the shaded surface display (SSD) and the maximum intensity projection (MIP) (fig. 3 a,b).

MRI revealed isosignal intensity to the muscle of the well defined bilateral tumors on T1W image and hyperintensity on T2W images (Fig. 2, 4). Multiple signal void due to tumor vessels within the masses on coronal T1W (Fig. 4a) and more conspicuous among hyperintense tumor stroma which was a characteristic "salt and pepper" appearance on T2W image (Fig. 4b) with homogeneous intense enhancement in post Gd-DTPA study (Fig. 5) were shown.

Splaying of ICA from ECA at the carotid bifurcation could be demonstrated in Sagittal oblique T1W and 2d TOF MR angiography. (Fig. 6 a,b)

The patient underwent operation on the left side first. The operative findings revealed a hypervascular mass surrounded the common, internal and external carotid arteries completely (Fig. 7). The adjacent nerves (CN X, CN XII, sympathetic chain and superior laryngeal nerves) were identified and kept away from the plane for dissection of the tumor. The tumor was dissected from common and internal carotid arteries in the adventitial layer closed to the arteries.

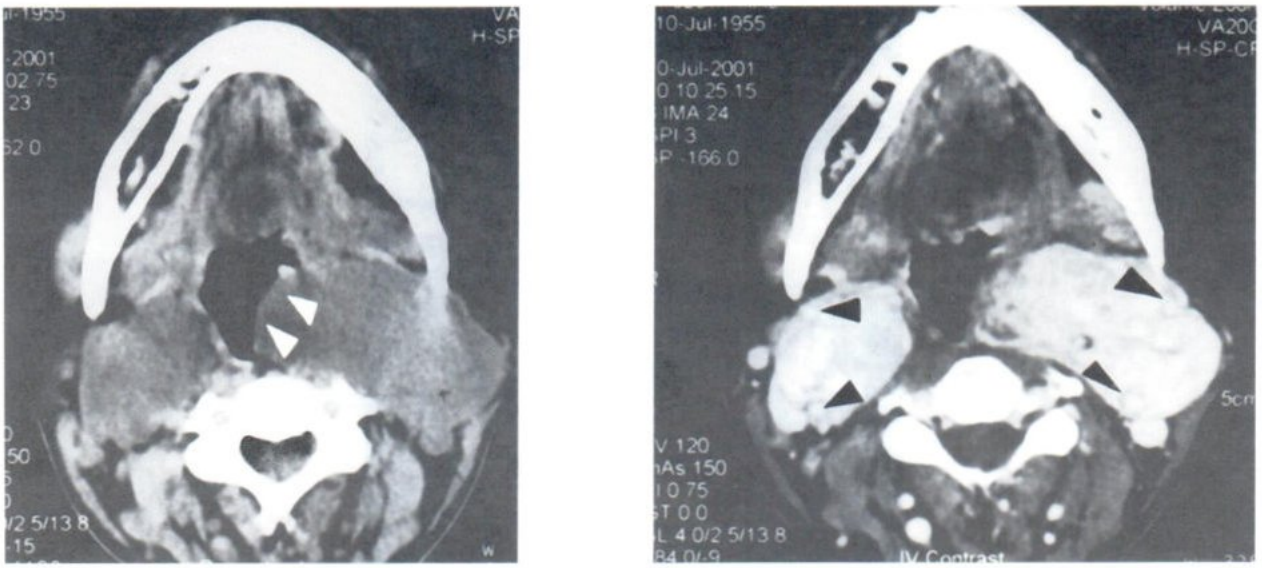
The external carotid artery was resected with the tumor. The patient had got left CN IX and superior laryngeal nerve palsies postoperatively.

The right sided mass was excised 2 months later. The tumor mass surrounded the carotid arteries partially. At this time the patient had got right CN IX and CN XII palsies postoperatively. Food and position modification were applied to the patient due to neurological deficits. Three months after the second operation, she has got full recovery of the neurological deficits.

Pathological study of both masses revealed the same findings of well defined, lobulated soft tissue mass with a fibrous pseudocapsule on gross specimen and visualized multiple tumor vessels of cut specimen (Fig. 8a). Microscopic study (Fig. 8b) reveal organoid growth pattern of cells as nests which contained of cuboidal, epitheloid cells and delicated vascularized fibrous septa which were termed Zellballen. Individual inner cells had moderately abundant granular cytoplasm. Bizzare nuclei are sometimes found, but lack of mitoses. The conclusive diagnosis was bilateral carotid body paragangliomas, without evidence of malignancy.

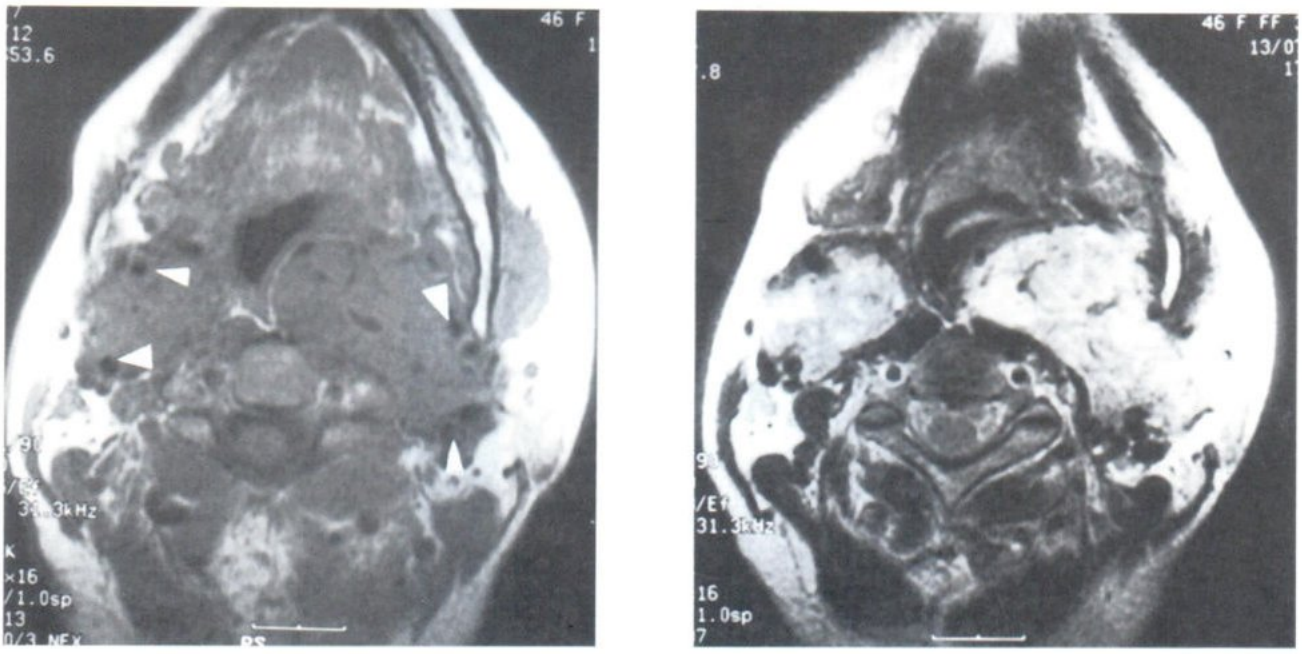
ICA = Internal Carotid Artery, **ECA** = External Carotid Artery

2d TOF MR = 2 Dimentional Time Of Flight Magnetic Resonance



1a 1b

Fig. 1 Axial CT scan (a) Homogeneous hypodensity of bilateral well defined carotid space mass with inward bulging into oropharyngeal airway (arrowhead) on precontrast image (b.) Intense enhancement of the masses after contrast injection with demonstrated splaying of ECA from OCA (arrowheads) at the carotid bifurcation by displacing ECA anteriorly ICA posteriorly



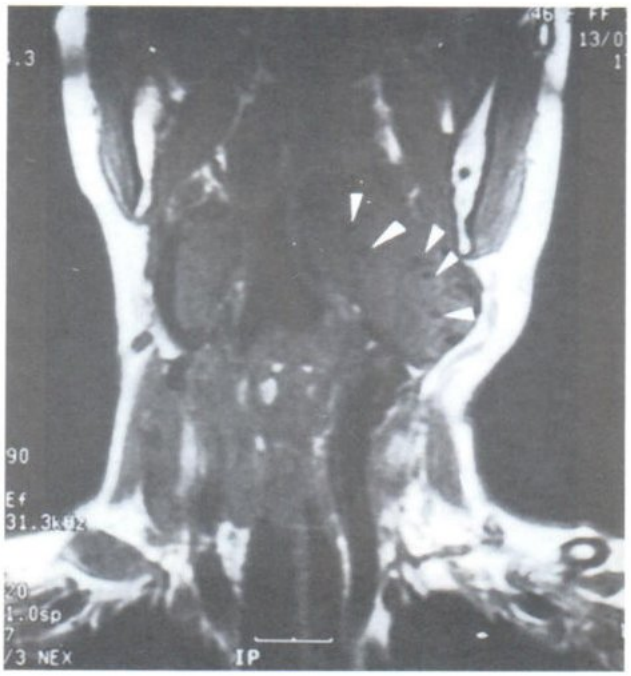
2a 2b

Fig. 2 Axial MR imagings (a.) The masses had isointensity to the muscles on T1W image with splaying of ECA from ICA (arrowheads) Internal serpentine and punctate flow void of tumor vessels within the masses is seen. (b.) More delineation of flow void tumor vessels among scattered hyperintense areas of slow flow and hyperintense of tumor stroma, giving "salt and pepper" appearance on T2W image.

3a

3b

Fig. 3 Three dimensional image reconstructions of helical CT ; SSD (Fig. 3a), MIP (Fig. 3b) Nicely shown bilateral carotid bifurcation masses, LT.mass (a.) and Rt. Mass (b.) with splaying of ECA from ICA at the carotid bifurcation



4a

4b

Fig. 4 Coronal MR imagings (a.) Multiple flow void structures within the isointense mass due to tumor vessels were shown (arrowhead) without area of hyperintensity of bleeding foci on T1W (b.) More conspicuous flow void structures in both masses among small scattered hyperintense foci of slow flow and hyperintense tumor stroma which was the characteristic "salt and pepper" appearance on T2W image

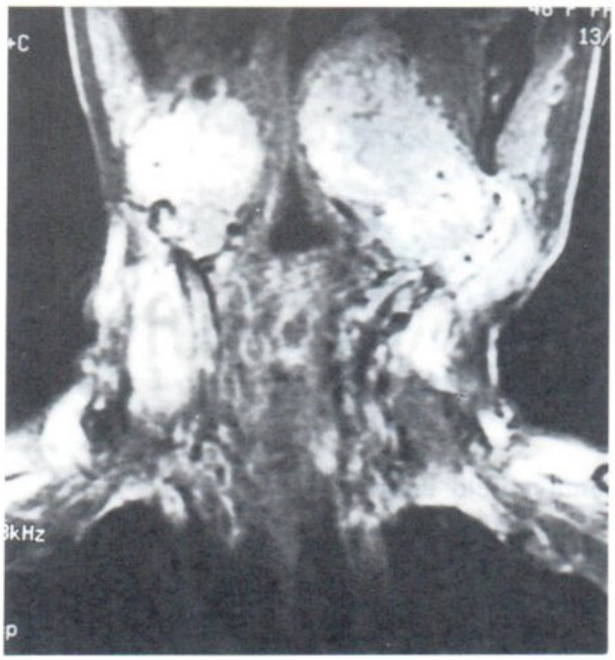
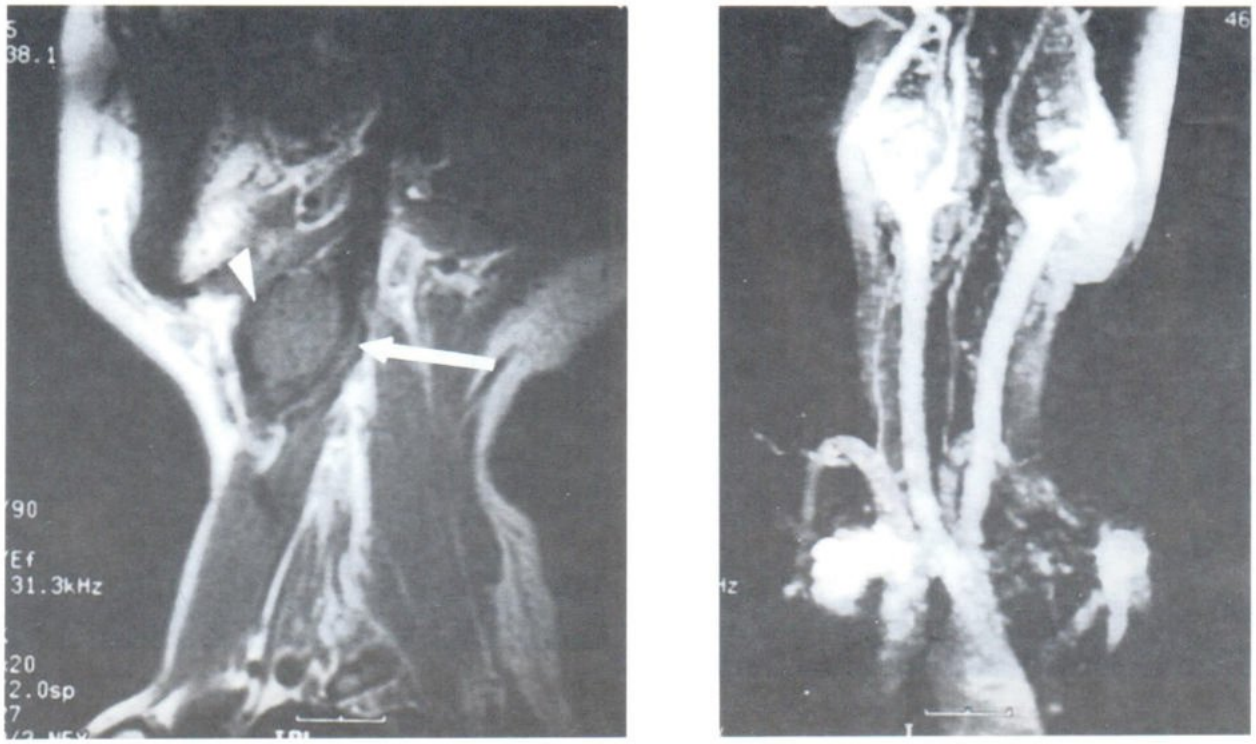


Fig. 5 Coronal MR imaging after post Gd-DTPA injection reveal homogeneous intense enhancement of the bilateral tumors causing more conspicuous internal flow void



6a 6b

Fig. 6 Sagittal Oblique T1W MR imaging (a.) and 2d TOF MR angiography (b.) : Nicely shown splaying of the carotid bifurcation, ECA (arrowhead) and ICA (arrow) in (a.)

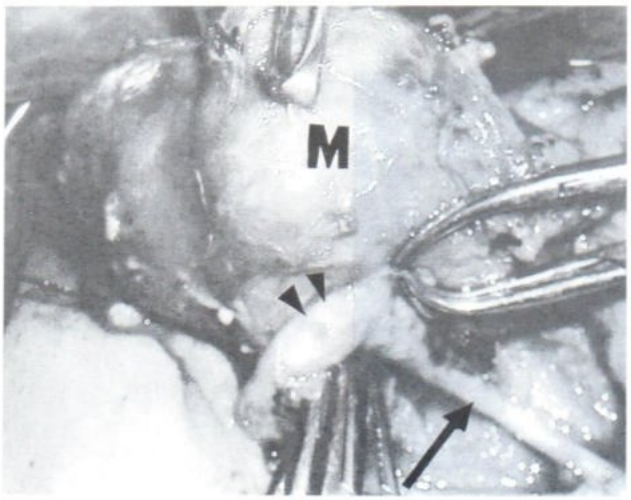
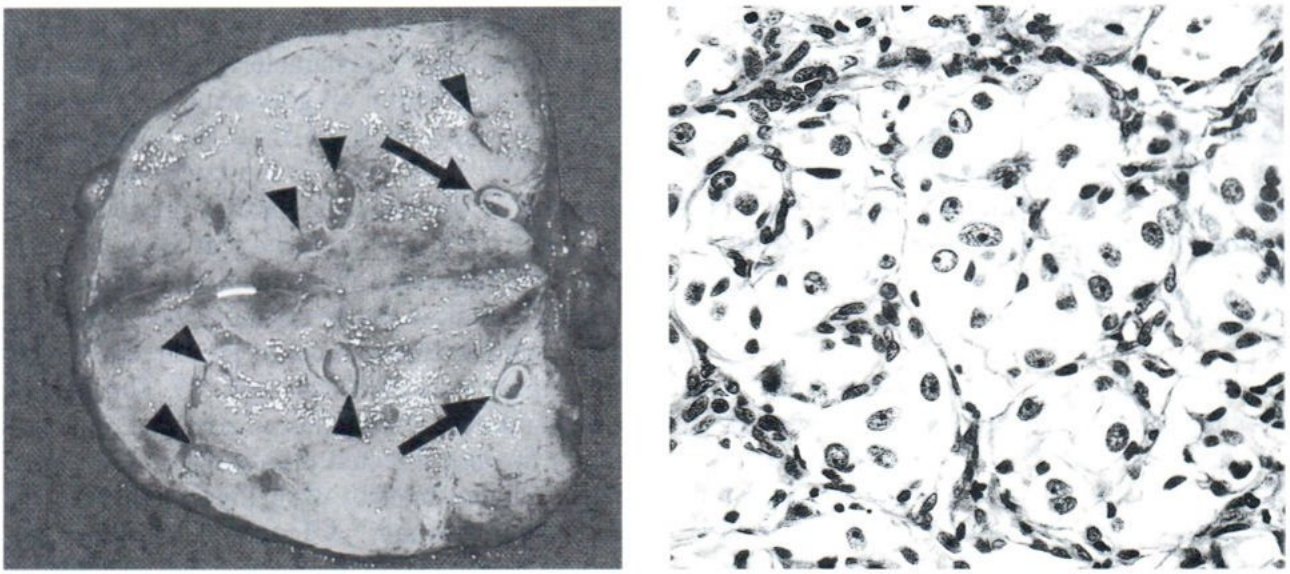


Fig. 7 Image from Intra-operative field ; during dissection the bigger Lt.sided mass from the adventitial layer at the carotid bifurcation, with demonstrated CCA (arrowhead) and ICA (arrow) ECA was incorpulated within the mass



8a 8b

Fig. 8 Pathologically images (a.) Cut surface of gross specimen revealed multiple tumor vessels (arrowheads) as in radiological images. ECA (arrow) was also demonstrated at the anterior part of the mass. (b.) Microscopic picture (40x) revealed the characteristic organoid growth pattern which termed Zellballen pattern with nests of cuboidal or epitheloid cells seperated by delicated vascularized fibrous septa. Individual inner cells have moderated abundant granular cytoplasm, bizarre nuclei are sometimes found, but lack of mitoses.

DISCUSSION

Paragangliomas account for 0.6 % of all neoplasms in the head and neck region and 0.03% of all neoplasms.[1] About 80 % of all paragangliomas are either carotid body tumors or glomus jugulare tumors.[2,3] Paragangliomas may be multicentric and may manifest as unilateral or bilateral lesions .These multicentric lesions may occur either synchronously or metachronously. The carotid body tumor is uncommon. After reviewing of the previous literatures of the carotid body paraganglioma within the last 9 years, there were a small number of patients about 10 cases within a 10 years period which comprised of 1-5 cases of bilateral tumors. These data supported the rarity of bilateral lesions. Bilateral carotid body occur in only 5% of sporadic and 33-38% of familial paragangliomas.[4] There was the largest series of 30 patients with these tumors with bilateral lesions in 16 patients over the 7 years period. The anatomy, physiology of the system, evaluation of the patients and their families including surgical techniques, postoperative sequelae were discussed by James L et al.[18] This tumor is a discrete mass found at the CCA bifurcation. The carotid body is situated within or outside the adventitial layer of each CCA at the level of their bifurcation. It commonly arises along the posteromedial wall at the bifurcation but may also be located along either the ECA or ICA. The carotid body initiates reflex changes in cardiovascular and respiratory activity and serves as a chemosensory reflex receptor by detecting changes in arterial partial pressures of oxygen and carbon dioxide, pHand other factors.[5,6,18,21] Then there was a case report of bilateral carotid body tumor and central alveolar hypoventilation by Roncoroni AJ, et al.[19] Known combinations of head and neck paragangliomas including vagal-

carotid body paragangliomas, carotid body-glomus jugulare tumor, carotid body-glomus jugulo-tympanicum tumors and simultaneous occurence of pheochromocytoma, papillary thyroid carcinoma, thyroid adenoma,[20] thymoma,[20] functioning extraadrenal paragangliomas,[5] and other endocrine disorders along with the carotid body tumor had also been reported, suggesting the possibility of a rare form of multiple endocrine neoplasia.[6]

Malignant behavior in head and neck paragangliomas is recognized with approximately the same frequency (2-13 % of cases) as in paragangliomas elsewhere in the body.[7] Metastatic involvement of the lungs, skull, vertebral bodies, cervical lymph nodes,[1] heart, liver, pancreas, pleura, dura mater, and skin have been described. Although some authors consider local invasion as a manifestation of metastatic spread, most autho-rities regard extension to regional lymph nodes or distant metastasis as the only reliable indicators of malignancy.[2,8,21] The prevalence of local recurrence and local invasion is estimated at only 10% for carotid body tumor,[2,8] but it's about 40%-50% for glomus jugulare tumor and 17% for vagal paragangliomas.[1]

The typical patient of the carotid body paraganglioma is middle-aged and present lated in the course of the disease, with a painless slow -growing mass. Only a few patients have clinical manifestations of compression symptoms include hoarseness of voice, lower cranial nerve palsies or carotid sinus syndrome. The overall prognosis of patients with a cervical paraganglioma is favorable. If there are bilateral tumors, the familial history should be asked.

But it may be a sporadic case as in our cases without a familial history, anyhow it may be found in a quite less frequency. Because of the hypervascularized nature of the tumor mass and arising within the adventitial layer of the CCA at the carotid bifurcation which produce the typical features of pulsatile masses with freely mobile in the horizontal direction on physical examination.

ICA = Internal Carotid Artery, **ECA** = External Carotid Artery **CCA** = Common Carotid Artery

Multiple radiological imaging modalities are helpful for the diagnosis of carotid body paragangliomas. The characteristic appearance of a carotid body tumor on gray-scale US scans is a round-to-oval, well defined, heterogeneous hypoechoic solid mass in the lateral neck with splaying of the common carotid bifurcation by displacing ECA anteriorly and ICA posteriorly.[9,10,11,12] By using a high resolution transducer, small vessel flow can be demonstrated within the tumor matrix. Encasement of the carotid vessels may occur on rare occasions.[10,21] The hypervascular nature of all tumor masses and predominantly upward directed intratumoral flow signal can be demonstrated by using the duplex and color doppler ultrasound.[22] CT scan shows homogeneous density mass with intense enhancement in post contrast study.

Splaying of the carotid bifurcation could be demonstrated on 3-D image reformations (MIP, SSD) of the helical CT. On MR imaging, paragangliomas typically exhibit a low signal or iso signal to the muscles on T1W sequence and a high signal intensity on T2W sequence with homogeneous intense enhancement on postcontrast study. Multiple serpentine and punctate areas of signal void characterize the typical paraganglioma with all MR sequences, these areas are variably distributed throughout the mass and are believed to represent flow voids in the larger intratumoral vessels as shown in our case. The "salt and pepper" appearance is very popularly used. The classical salt and pepper appearance was originally described by Olsen et al[11] from the appearances on T2W images. The "pepper" component represents the multiple areas of signal void interspersed with the "salt" component seen as hyperintense foci[12,2] (due to slow flow or hemorrhage) on both T1W, T2W images which there was less frequency of salt component. Some authors described this finding in another way by define the flow void of pepper among the background of salt or hyperintense tumor stroma on T2W or T1W post contrast images.[3] Scattered sites of high signal intensity on T2W, which contribute to giving the tumor a "salt and pepper"

MIP = Maximum Intensity Projection, **SSD** = Shaded Surface Display

appearance in our case, may be due to slow flow because there is no any hemorrhage within the tumor masses as shown in the gross specimen. This feature is limited to paragangliomas that are greater than 2 cm. in diameter[13] and is not considered diagnostic, as it has also been reported in other hypervascular lesions (metastatic hypernephroma, metastatic thyroid carcinoma). However accompanying this finding with splaying of the carotid bifurcation on T1W Sagittal or Sagittal oblique views, MRA could be helpful and characteristic in the diagnosis of these tumors. MR angiography may also be useful in defining the flow -related enhancement of feeding vessels in lesions larger than 1.5 cm. In addition from providing superior definition of location, extent, and characterization of paragangliomas, MR imaging also demonstrates better tumor involvement of the ICA and IJV in comparison with that seen with CT.[21] MR imaging can depict paragangliomas that are smaller than 5 mm., while CT examination with iodine contrast study allows the detection of tumors greater than 8 mm.in diameter.[14] For angiographic appearance, the typical appearance is a hypervascular mass with enlarged feeding arteries, intense tumor blush, and early draining veins. Rarely, avascular paragangliomas may occur. Carotid body tumor typically cause splaying of the ECA and ICA. The most common feeding vessels to any head and neck paraganglioma are the ascending pharyngeal artery (via the musculo-spinal artery) and the ascending cervical artery. With progressive tumor growth, other sources of arterial supply may be recruited from the facial, lingual, thyroid, posterior auricular, occipital, and deep cervical arteries.

The pathological features are a well defined, lobulated soft tissue mass within pseudocapsule with usually tan-gray to reddish-purple external surface of gross specimen[21] and multiple blood vessels on the cut surface as shown in our case. The characteristic microscopic pictures are organoid growth pattern seperated by numerous vascularized fibrous septa which termed Zellballen by Kohn which classically exhibit a nest architecture. Less commonly, trabecular, pseudorosette, or pseudoglandular patterns of cellular arrangements may be seen. The stroma surrounding these cells lines are the admixture of nerve fibers, endothelial cells, and vascular pericytes.

Optimal management of the carotid bifurcation paraganglioma is complete surgical resection. Surgery of carotid body tumor is a challenge to the surgeon because of the large vascularization of the tumor, involvement of the carotid vessels and the close anatomical relationship with the cranial nerves. It carries inherent risks of excessive blood loss and cranial nerve injury. Then a meticulous surgical technique is necessary. For our case, two surgeries were performed at different time and neither of them presented any morbidity.

CONCLUSION

A rare case of bilateral carotid bifurcation paragangliomas is presented. The clinical presentation, physical exam, radiological and pathologcal findings are characteristic as demonstrated. The literatures on carotid body paraganglioma are reviewed.

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IJV = Internal Jugular Vein

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