

Original Article

Imaging findings and misdiagnosis analysis of solitary fibrous tumor at head and neck

Yin-Ping Leng¹, Xing-Ju Chang¹, Meng-Qing Hu², Wan-Ling Qi¹, Min Wang¹

¹Department of Radiology, The First Affiliated Hospital of Nanchang University, Nanchang 330006, Jiangxi Province, China; ²Department of Radiology, Jiangxi Tumor Hospital, Nanchang 330029, Jiangxi Province, China

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Abstract: Objective: This study aims to investigate the imaging findings of solitary fibrous tumor (SFT) at the head and neck, in order to improve the level of imaging diagnosis. Methods: The preoperative imaging data of 12 patients with pathologically confirmed SFT at the head and neck were collected, and the computed tomography (CT) and magnetic resonance imaging (MRI) findings were retrospectively analyzed. The observation indexes included the density of the tumor, calcification, cystic degeneration, hemorrhage, MRI signal features, multi-phase enhanced CT features and enhanced MRI features. Results: All 12 patients had a single lesion, the non-enhanced CT of most of the masses revealed a moderately low density, and the internal density was heterogenous. One patient showed slightly higher mixed density, with slightly lower density. One patient had multiple punctate calcifications. In four patients, bone resorption damage occurred in bones around the masses. One patient had cystic degeneration and hemorrhage. In seven patients, multi-phase enhanced scan was performed on the masses, and most of the masses presented with multiple thick and tortuous vessels, with various enhancement and mild-to-moderate or severe enhancement. In three patients, the masses presented with mild-to-moderate heterogenous enhancement in the arterial phase, while gradual filling could be observed in the delayed phase. In three patients, the masses presented with an obvious uneven enhancement, in which there were multiple patchy and strip obscure enhancement zones; while gradual filling could be observed in the venous phase and delayed phase. In one patient, the mass presented with an obvious homogenous enhancement. Two patients underwent non-enhanced and enhanced MRI scans. In one patient, the non-enhanced MRI scan revealed a moderately long T1 signal and iso-T2 signal, in which there were multiple patchy short T1 and long T2 bleeding signals, and small patchy long T1 and long T2 cystic signals and a patchy short T2 signal. The enhanced scan revealed mild-to-moderate enhancement. In another patient, the non-enhanced MRI scan revealed a iso-T1 signal and moderately short T2 signal, in which there were multiple patchy long T1 and long T2 cystic signals. The enhanced scan revealed obvious uneven enhancement. Conclusion: Some of the characteristics of enhanced multiple-phase CT is of great value in the clinical diagnosis of SFT at the head and neck when combined with the characteristics on T2W hypointense signals.

Keywords: Solitary fibrous tumor, head and neck, CT, MRI, multi-phase enhancement, misdiagnosis

Introduction

Solitary fibrous tumor (SFT) is a rare spindle-cell tumor derived from dendritic mesenchymal cells [1], which was first reported by Klempere and Rabin in 1931 [2]. SFT can occur in the whole body, but mainly occurs in the pleura [3-5, 11]; and it can also occur in the lungs, meninges, peritoneal cavity, limbs and pelvis. SFT rarely occurs in the head and neck. According to recent literatures [1, 3-6, 10, 12, 13, 16, 17], SFTs in the head and neck have been reported to occur in the external auditory

canal, lacrimal sac, epiglottis, larynx, cheek, thyroid gland, parotid gland, sublingual gland, tongue, gums, orbits, parapharyngeal space, nasopharynx, hypoglossal nerve, scalp, infra-temporal fossa and the nasal cavity and sinus nasalis. Furthermore, most of these were reported as a single case. It is difficult to identify the clinical features of SFT and other tumors in the head and neck (such as neurilemmoma, capillary hemangioma, cavernous hemangioma and hemangiopericytoma). Furthermore, the imaging findings of SFT are similar to those of other blood-rich tumors, and the specificity of

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diagnosis is low. Hence, preoperative misdiagnosis rate is very high. The author collected the data of 12 cases of SFT, which were confirmed by postoperative pathology. In this study, the characteristics of the CT and MRI images of this disease were retrospectively analyzed, in order to improve the level of imaging diagnosis and reduce the misdiagnosis rate.

Data and methods

General information

The data of 12 cases of SFT confirmed by postoperative pathology from September 2011 to March 2017 in our hospital were collected. Among these patients, three were male and nine were female; and the age of these patients ranged within 3-75 years old (one patient was three years old), with an average age of 52 years old. Tumor occurring sites: tumor masses occurred in the pterygoid fossa in two patients, symptoms of frontal and anterior ear and throat pains presented in one patient, and a mass in the cheeks and pain in the maxillary premolars of the upper jaw were the symptoms that presented in one patient. Furthermore, tumor masses in the neck occurred in two patients, and all manifested as a painless mass in the neck. In one patient, the tumor mass occurred in the thyroid gland, and the clinical manifestation was painless mass in the neck. In two patients, tumor masses occurred in the submandibular space, and all manifested as a painless mass under the jaw. In one patient, the tumor mass occurred in the orbit, and the clinical manifestation was protrusion of the eyeball. In one patient, the tumormass occurred in the nasal cavity, and the clinical manifestation was nasal bleeding with nasal obstruction. In one patient, tumor masses occurred in the submandibular gland, and the clinical manifestation was painless mass under the jaw. In one patient, the tumor mass occurred in the frontal sinuses, and the clinical manifestation was painless mass under the forehead. In one patient, the tumor mass occurred in the foramen magnum region, and the clinical manifestation was headache.

Inspection methods

Among these 12 patients, ten patients underwent non-enhanced CT scans, seven patients underwent multi-phase enhanced CT scans,

and five patients underwent both non-enhanced and enhanced CT scans. The equipment used for the CT scan was a 16-slice multidetector CT scanner (Siemens Somatom Sensation 16, Erlangen, Germany). Scanning was first performed at a scanning slice thickness of 2 mm, and subsequently performed at a scanning slice thickness of 1.0 mm. Then, a coronal and sagittal multi-planar reconstruction (MPR) was performed. The enhanced scan was conducted with a 300 mg/mL angiografin or Ultravist intravenous injection, the injection dose was set between 80-100 mL, and the multi-phase enhanced scan was performed on the masses. Merely two patient underwent a non-enhanced + enhanced MRI scan. The equipment used for the MRI inspection was a Magnrtom 3.0 T TrioTim scanner (Siemens, Erlangen, Germany). The scan sequences included T1WI, T2WI and diffusion weighted imaging (DWI) sequences. The slice thickness was set at 8 mm, and the slice gap was set at 10 mm. For the enhanced scanning, a bolus injection of gadolinium diethylenetriaminepentaacetic acid (Gd-DTPA) was performed at the elbow vein, and the dose was set at 0.2 mL/kg of body weight.

Image analysis

The films were read by two associate chief physicians in diagnostic radiology of the head and neck. Observation content: the density of the tumor, calcification, cystic degeneration, hemorrhage, MRI signal features, changes in multi-phase enhanced CT and enhanced MRI images.

Results

Location, size and morphology of lesions

Among these 12 patients, two patients had tumor masses in the pterygoid fossa, two patients had tumor masses in the neck, one patient had a tumor mass in the thyroid gland, two patients had tumor masses in the submandibular space, one patient had a tumor mass in the orbit, one patient had a tumor mass in the nasal cavity, one patient had a tumor mass in the submandibular gland, one patient had a tumor mass in the frontal sinuses, and one patient had a tumor mass in the foramen magnum region. All cases had single lesions, and the lesion size ranged between 2.0 × 2.2 cm and 5.7 × 4.5 cm. In nine patients, the tumor

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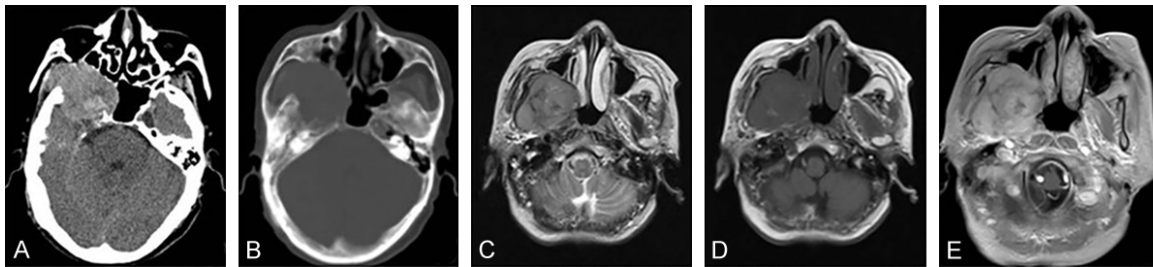


Figure 1. A 65-year-old female patient developed SFT in the right pterygoid fossa, which was preoperatively misdiagnosed as schwannoma. (A, B) Lumpy-mixed moderately lower density shadows were seen in the right pterygopalatine fossa, non-enhanced CT (A) revealed that the mass had clear boundaries, the density was heterogenous, the central density was lower, and the surrounding density presented with iso-density, in which a patchy moderately higher dense hemorrhage (shown by the black arrow) was observed in the mass. The bone around the mass was significantly absorbed and damaged. (C-E) In the right pterygopalatine fossa, lumpy mixed signals of moderately long T1 and iso T2 are shown. T2 (C) revealed a patchy low signal (shown by the black arrow) in the mass, T1 (D) revealed a patchy high signal of hemorrhage in the mass, enhanced scan (E) revealed that the lesions presented with significant heterogenous enhancement, and patchy non-enhanced areas were seen within the mass.

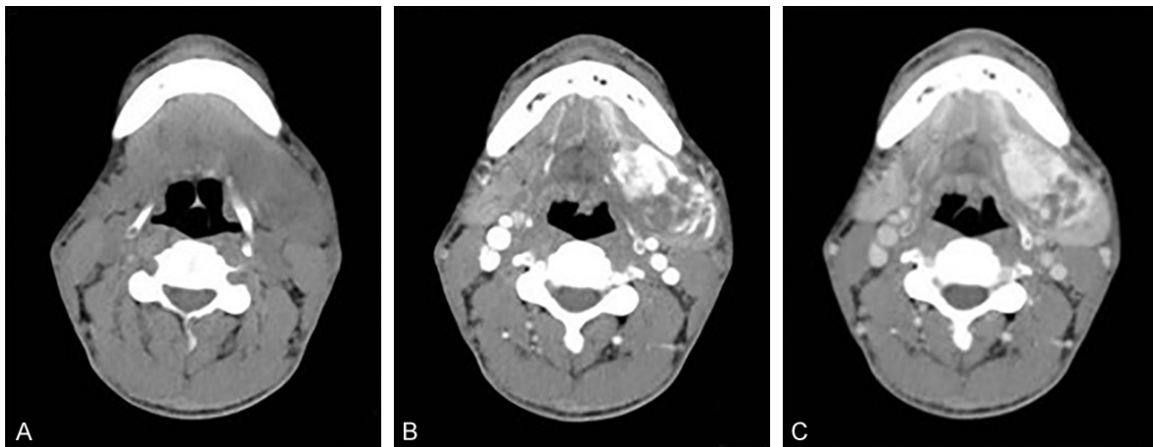


Figure 2. A 40-year-old male patient developed SFT in the left submandibular space, which was preoperatively misdiagnosed as hemangioma. (A-C) Quasi-elliptic moderately lower iso density shadows were seen in the left submandibular space, non-enhanced CT (A) revealed that the mass had clear boundaries, the density was heterogenous, and patchy lower density was seen in the central area. The arterial phase of the enhanced CT (B) revealed that the lesion presented with multiple thick and tortuous vascular shadows, showing obvious heterogenous enhancement; and the central area was not enhanced. In the delayed phase (C), the central non-enhanced area of the lesions was further filled.

masses were quasi-circular or oval; and in three patients, the tumor masses were slightly lobulated or irregular in shape. All tumor masses had distinct boundaries with pseudocapsule, and the capsules were intact. The adjacent structures of these tumor masses presented with displacement caused by pushing and pressing.

Imaging performance

CT performance: In four patients, the non-enhanced CT revealed masses with moderately

low density, the internal density was heterogenous, and multiple patchy low density shadows could be observed (**Figures 1A** and **2A**). In three patients, images revealed moderately low density masses with homogeneous density. In one patient, images revealed slightly higher mixed density, with slightly lower density. In one patient, images revealed a mass with a mixed density, in which the density of the hemorrhage could be observed (**Figure 1A**, shown by the black arrow); while in one patient, the mass presented with multiple punctate calcifications (**Figure 3A**, shown by the black arrow). In four

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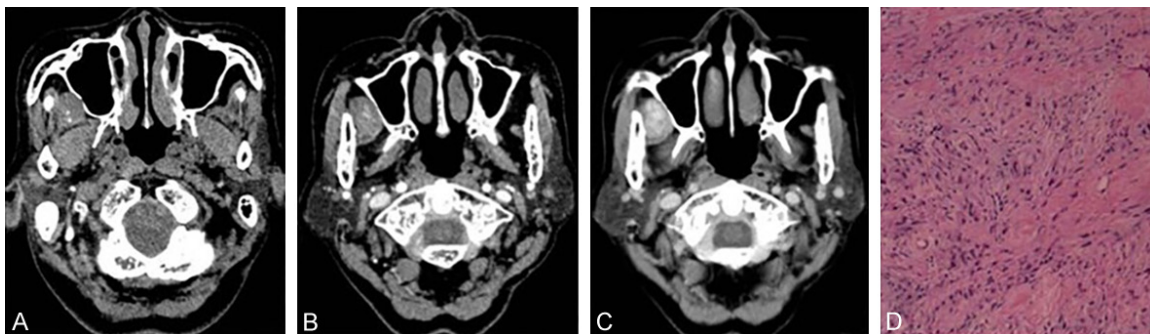


Figure 3. A 75-year old female patient developed SFT at the right pterygopalatine fossa, which was preoperatively misdiagnosed as a neurogenic tumor. (A-D) Quasi-circular moderately lower iso density shadows were seen in the right pterygopalatine fossa, non-enhanced CT (A) revealed that the mass had clear boundaries, the density was heterogenous, and multiple punctate calcifications (shown by the black arrow) were seen in the mass. The arterial phase of the enhanced CT of (B) the lesions revealed a mild heterogenous enhancement, and the delayed phase (C) revealed a gradual filling. Under a microscope (D), the tumor had clear boundaries of cells, which were composed of spindle cells; and the density of the cell distribution was different, showing sarciniform or irregular arrangement. The nuclei were fine, and interstitial collagen was rich (H&E, $\times 100$).

patients, bone resorption damage occurred in bones that surrounded the masses (**Figure 1B**). On images in the arterial phase of the enhanced scan, six patients presented with multiple thick and tortuous vessels (**Figure 2B**) with various degrees of enhancement, showing mild-to-moderate or severe enhancement. On images in the arterial phase of three patients, the masses presented with mild-to-moderate heterogenous enhancement; and on images in the delayed phase, gradual filling could be observed (**Figure 3B** and **3C**). Furthermore, in three patients, the masses presented with obvious heterogenous enhancement, in which multiple patchy and strip obscure enhancement zones were present; and on images in the venous phase and delayed phase, gradual filling could be observed (**Figure 2B** and **2C**). In one patient, the mass presented with an obvious homogenous enhancement.

MRI performance: In one patient, non-enhanced MRI scan revealed a moderately long T1 signal and iso-T2 signal, in which multiple patchy short T1 and long T2 bleeding signals, small patchy long T1 and long T2 signals, and patchy short T2 signals were found within the masses (**Figure 1C**, shown by the black arrow). The enhanced scan revealed masses that presented with mild-to-moderate enhancement. In another patient, the non-enhanced MRI scan revealed an iso-T1 signal and moderately short T2 signal, in which there were multiple patchy long T1 and long T2 cystic signals. The

enhanced scan revealed obvious uneven enhancement (**Table 1**).

Postoperative pathology

In this study, all patients were diagnosed by biopsy, and the nature of the disease was confirmed as SFT by postoperative pathology. All tumor masses had distinct boundaries with pseudocapsules, in which the capsules were intact in six patients and the capsules were not intact in the other six patients. The section of the tumor mass was grayish white, and the texture was soft, medium, or tough. In one patient, the SFT presented with cystic degeneration (neck), while the tumor mass presented with bleedings (pterygopalatine fossa) in another patients. In the benign SFT, the tumor cells were composed of spindle cells under a microscope, which were arranged in bundle, radial, or storiform shapes that formed nodular structures. The tumor cells had various densities, the nuclei were ovoid or short spindle-shaped, the chromatin was fine, and the division of the nuclei could be occasionally observed. Abundant blood vessels were seen in the intercellular space among tumor cells, and part of blood vessels had a dilated lumen. A small amount of fibrous tissue was found surrounding the tumor. Immunohistochemical results: CD34 (+) in 12 patients, vimentin (+) in nine patients, CD99 (+) in eight patients, Bcl-2 (+) in 12 patients, CK (-) in 11 patients, and S-100 (-) in eleven patients.

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Table 1. Clinical survey of 12 cases of solitary fibrous tumor of the head and neck

Ordinal	Gender	Age	Location	Clinical features	Preoperative diagnosis	Non-enhanced CT	Enhanced CT
1	Female	65	Pterygoid fossa	Pains in the forehead, the front of the ear and the throat	Schwannoma	Hybrid density	Mild-to-moderate enhancement, gradual filling
2	Female	27	Neck	Painless neck mass	Giant lymph node hyperplasia	Moderately lower density	Markedly enhancement gradual withdrawal
3	Female	64	Thyroid gland	Painless thyroid mass	Nodular goiter	Moderately lower equidensity	Mild-to-moderate enhancement, gradual filling
4	Male	40	Submandibular space	Painless submandibular mass	Hemangioma	Moderately lower equidensity	Marked persisting enhancement
5	Female	52	Orbit	Protrusion of the eyeballs	Mixed tumor	Moderately lower density	-
6	Female	65	Neck	Painless neck mass	Angiogenic tumor	-	Marked persisting enhancement
7	Female	75	Pterygoid fossa	Cheek mass and upper jaw pain	Neurogenic tumor	Moderately lower equidensity	Mild-to-moderate enhancement, gradual filling
8	Female	69	Nasal cavity	Nasal bleeding and nasal congestion	Nasal mass	Moderately lower equidensity	-
9	Female	64	Submandibular gland	Painless submandibular mass	Mixed tumor	-	Marked persisting enhancement
10	Male	3	Submandibular space	Painless submandibular mass	Eosinophilic granuloma	Moderately lower density	-
11	Female	63	Frontal sinuses	Painless forehead mass	Mucocele	Moderately lower equidensity	-
12	Male	50	Foramen magnum region	Headache	Meningioma	Hybrid moderately higher density	-

Discussion

Clinical and pathological characteristics

Clinical characteristics: SFT is a rare mesenchymal tumor characterized by positive CD34 [1]. Its clinical diagnosis depends on histopathology and immunohistochemistry. In the present study, tumor masses occurred in the neck in two patients, a tumor mass occurred in the nasal cavity in one patient, tumor masses occurred in the pterygoid fossa in two patients, a tumor mass occurred in the thyroid in one patient, tumor masses occurred under the jaw in two patients, a tumor mass occurred in the orbit in one patient, a tumor mass occurred in the submandibular gland in one patient, a tumor mass occurred in the frontal sinuses in one patient, and a tumor mass occurred in the foramen magnum region in one patient. These were basically consistent with those in related literatures. SFTs at the head and neck often occur in adults aged 20-70 years old [6], with an average age of approximately 52.3 years old [7]; and this tumor relatively rarely occurs in children [8]. The difference in its incidence between males and females was not statistically significant [6, 9, 10]. In the present study, the age of these patients ranged within 3-75 years old, with an average age of 53 years old. This disease occurred in one child who was three years old. Nine patients were female and three patients were male. This was a slightly different with that in related literatures. The reason may be related to the small number of cases in the present study. SFT at the head and neck is generally characterized by a local painless mass that grows slowly [3, 5]. In the present study, nine patients were characterized by painless mass, only two patients with lesions in the pterygoid fossa and one patient with lesion in the foramen magnum region developed local pains. Since the clinical features of SFT are similar to patients who mostly have benign tumors of the head and neck, and the characteristics of the clinical symptoms of SFT have not been identified to date. Thus, its clinical diagnosis remains difficult, and misdiagnosis can easily occur.

Pathological characteristics: SFTs are mostly solid masses with pseudocapsules. These capsules are mostly intact, the sections are mostly grayish white or taupe, and the texture is hard or tough. If the tumor mass is large, it may be

lobulated. It was reported in a previous literature that lobulation may be related to tumor growth speed [11]; while hemorrhage, necrosis and calcification could be sometimes observed. Under a microscope, characteristic fibroblast-like cells at different growth stages could be observed. Tumor mass boundaries were clear, and formed alternately distributed cell-rich regions and cell-poor regions; in which the latter were rich in collagen fibers [12]. Furthermore, tumor cells were arranged in various patterns, showing a sarciniform, braided, whirlpool and storiform arrangement; and a variety of patterns can co-exist. In some patients, the vascular sheath was tumor-like, paliform, or wavy. Immunohistochemical results are the basis for the diagnosis of SFT. Vimentin and positive CD34 were very critical for the diagnosis of SFT [5]. Hasegawa *et al.* [13] reported that when CD34 was negative, positive bcl-2 was helpful for the diagnosis of SFT. In the present study, CD34 was positive in 12 patients and Vimentin was positive in nine patients, which are important bases for distinguishing SFT from other spindle cell tumors such as hemangiopericytoma, neurogenic tumor and fibrosarcoma [1].

Imaging features of SFT at the head and neck

CT performance of SFT: Benign SFTs are characterized as solitary quasi-circular or irregular soft tissue masses. Tumor size varies, in which tumors are quasi-circular or elliptic when the size is small, and are irregular when the size is large, which may be lobulated. However, the lobulated shape is not a sign of malignancy. Lesions have clear boundaries, density is often heterogenous, and hemorrhage, calcification and necrosis can be observed in these lesions. Pseudocapsules can be observed around these tumor masses, and these capsules are either intact or not intact. In this study, the tumor masses had pseudocapsules in all 12 patients, in which the capsules were intact in six patients and the capsules were not intact in other six patients. Furthermore, calcification occasionally appears within the mass [1, 6, 8]. In this study, one patient developed calcification. The author considered that the presence of calcification is not a sign for distinguishing between benign and malignant SFTs. When the lesion is adjacent to the bones, bones around the tumor can be absorbed and damaged [1, 6]. In this study, bones around the lesions were absorbed and damaged in four patients. The

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imaging findings of the tumor are closely related to its histopathological components. Most tumor masses had moderately low density, and the internal density was heterogenous. Furthermore, multiple patchy and nodular moderately lower density areas were present in the iso-density masses. The author considered that iso-density shadows represented the dense areas of tumor cells, and moderately lower density shadows represented the collagen fiber distributing areas.

SFT often histologically manifests as parallel or mesh-like arrangements of spindle cells with CD34 expression in the collagen matrix, and is mixed with multiple small thin-walled vessels [14]. Therefore, the enhancement of these masses is related to the proportion and distribution of spindle cells, collagen fibers and small vessels [14]. Furthermore, the cell-dense area and vessel-rich area were significantly enhanced, while the cell-sparse area and collagen fiber distributing area were not significantly enhanced. When the collagen fibers were rich, CT dynamic contrast-enhanced scan revealed that the enhancement was often not significant in the arterial phase, and a slow and persistent enhancement can be observed in the late stage [14]. When the tumor was rich in blood vessels or dense cells, the blood supply was often more abundant within the lesions; and large feeding arteries could be observed in the masses in the early stage, manifesting as multiple thick tortuous vascular shadows. In the late stage, masses that contained collagen fibers could develop mild marginal enhancements. In this study, tumor masses presented with multiple thickened tortuous vascular shadows in six patients and the masses presented with mild-to-moderate heterogenous enhancement in three patients in the arterial phase. Furthermore, gradual filling could be observed in the late stage, and this phenomenon may be related to the presence of abundant collagen fibers in these tumor masses. In addition, masses presented with obvious heterogenous persistent enhancement in the arterial phase in three patients. This indicated that these tumor masses were rich in blood vessels or dense cells. In the early stage, these tumor masses presented with multiple patchy and nodular moderately lower density shadows without significant enhancement. In the delayed phase, slight enhancement could be observed

in the margins of moderately lower density areas. This indicates that these masses contained a small amount of collagen fibers.

MRI performance of SFT: The T1WI signal features of SFT at the head and neck are similar to those of the neck muscles, which reveal iso or moderately lower signals; while moderately higher signals were revealed on T2WI images. The signal features of the T2WI images of SFT reflect the content of collagen in fibrous tissues [14, 15]. When the collagen composition in the tumor mass is high, it reveals a low signal on T2WI images; while the area with more cells and lesser collagen revealed high signals on T2WI images. That is, T2WI signals gradually decrease with the increase in the number of collagen fibers in tumor masses [16]. This is a characteristic performance. According to Liu Y *et al.* [17], in addition to the morphology of MRI, multimodal MRI has also been applied in studies on SFT at the head and neck, including DWI and dynamic enhancement (DCE) MRI. These lesions mildly reveal high signals on DWI images, the apparent diffusion coefficient (ADC) value can be quantitatively analyzed and compared with muscles, and a higher ADC value was helpful to confirm that the tumor was benign. On DCE-MRI, the time intensity curve of the tumor mass revealed a rapid increase, followed by slow decrease, which was helpful to correct the diagnosis. In this study, only two patients were examined by MRI, the lesions had isointense or hypointense signals on T1WI and mixed slightly high signals on T2WI. This was basically consistent with related literatures. The MRI enhancement of SFT at the head and neck was the same with that of CT, and commonly manifested as an obvious enhancement. Multiple thick and tortuous vascular shadows could be observed in the masses. This was related to rich blood vessels in the tumor masses. Furthermore, it could also manifest as a mild to moderate enhancement. In the late stage, it is gradually filled. This is related to the abundance of collagen fibers in tumor masses. Sometimes, small-stripped, branching vascular flow void signals could be observed on T1WI and T2WI images [1, 11, 17]. In this study, enhanced scan revealed that masses were mild-to-moderate or severe enhanced, and no obvious flow void signals could be observed.

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Analysis of the differential diagnosis and misdiagnosis

Due to the low incidence of SFT at the head and neck, and the presence of nonspecific clinical symptoms, this is poorly understood by clinicians and imaging doctors; leading to very low correct diagnostic rate by preoperative CT and MRI for SFT at the head and neck. In this study, all 12 patients were misdiagnosed; and the preoperative diagnoses included the following: neurogenic tumors (two patients), vascular tumors (two patients), mixed tumor (two patients), nodular goiter (one patient), nasal phyma (one patient), eosinophilic granuloma (one patient), giant lymph node hyperplasia (one patient), mucocele (one patient), and meningioma (one patient). Therefore, SFTs in the neck should be distinguished from neurogenic tumors, mixed tumors of the salivary gland and hemangiopericytoma. (1) Neurogenic tumors such as neurofibroma and schwannoma: schwannoma characteristics include low or iso signals on T1WI images, variable high signals on T2WI images, obvious cystic degeneration, obvious enhancement of the solid area or cystic wall, and an enhancement that is not as high as SFT; neurofibroma characteristics include iso-intense signal on T1WI images, hyperintense signal on T2WI images, the presence of a central low signal area in the high signal area, the formation of target signs [18], low density on CT images, and mild-to-moderate enhancement on enhanced scans. This is different from that of SFT, and is helpful for distinguishing between these two. (2) Mixed tumor of the salivary gland: non-enhanced CT revealed that it generally contains adipose tissues, may contain cystic degeneration, has clear boundaries with the salivary gland; enhanced CT scan revealed non-enhancement or mild enhancement in the early stage, manifestation of a delayed enhancement, and presented with a delayed contour. Although SFTs have no internal adipose tissues and basically have no cystic degeneration, the enhancement is related to the components of pathological tissues in the tumor masses. (3) Hemangiopericytoma: tumors are quasi circular or elliptic, blood supply is rich, vascular flow void signals are common in the tumor masses, necrosis and hemorrhage are common, calcification is rare, and enhancement is significant [19]; SFT are rare in hemorrhage, and necrosis and calcification and

the degree of enhancement is lower than that of hemangiopericytoma. SFT in the nasal cavity should also be distinguished from hemangioma, lymphoma and inverted papilloma. (1) Hemangioma: it is most usually found in the nasal septum, is a soft tissue mass that grows and expands, its surrounding bones are compressed and absorbed, its lesions have clear boundaries, and dynamic enhanced scan reveals significant progressive enhancement, thereby the tumor has typical characteristics of hemangioma. (2) Lymphoma: The tumor usually primarily occurs in one side of the anterior part of the nasal cavity. However, it easily widely invades into the surrounding tissues. When backward, it invades the nasopharynx, and when upward, invades the orbits. Furthermore, when invading the sinus nasalis, orbits and skull bases, patients are accompanied with corresponding bone absorption and damage. Tumor mass density is homogenous, and the enhanced scan reveals a mild homogenous enhancement. (3) Inverted papilloma: it is a rare benign epithelial tumor, and it is related to human papillomavirus (HPV) infection [20]. It is most usually found in the pars parietalis or lateral wall of the nasal cavity, and often occurs in a single side. The mass is mammillary, the density is homogenous, enhanced scan reveals mild enhancement, and surrounding bones can undergo absorption and damage and hyperplasia. Enhanced MRI reveals heterogeneous enhancement of the lesions, which is gyrus-like; and it has its characteristics. SFTs in the basis cranii should be distinguished from meningioma, schwannoma and hemangiopericytoma. Meningioma: meningioma can be combined with adjacent cranial bone hyperplasia. The "dural tail sign" is often obvious. Tumor signal is homogenous, and the enhanced scan reveals a obvious homogenous enhancement [21]. However, SFT tends to have a non-uniform T2WI signal, which is more uneven, and sometimes obvious flow void signals can be seen in the tumor mass. SFT are rare in the "dural tail sign". The surrounding bone is mainly absorbed by oppression. In addition, the SFT at the orbit should also be distinguished from spongy hemangioma, capillary hemangioma, angiofibroma and other spindle cell tumors of orbit, such as fibrous histiocytoma. Kim *et al.* [16] considered that the enhancement of SFT at the orbit mostly shows rapid entering and rapid

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withdrawal, which is helpful in identifying these tumors.

Conclusion

In summary, SFTs at the head and neck are rare soft tissue tumors with spindle cells. It occurs widely and can occur in any systemic tissues. Since clinical knowledge of the disease is deficient, and the understanding of imaging is poor, therefore misdiagnosis usually occurs. It is necessary to consider the possibility of SFT when clinicians find the following manifestations: the image presents with a single soft tissue mass with clear boundaries, the surrounding tissues present with the performance of compression, the non-enhanced CT image of the masses presents with moderately low iso density, there are multiple patchy and nodular moderately lower density areas in the iso density area, occasionally accompanied with scattered calcifications, enhanced CT images present with various degrees of enhancement, mild-to-moderate or severe enhancement are shown, the enhancement is heterogenous, and it is closely related to the pathological components and distribution of the tumors, especially when the internal low signal of the mass and the internal signal of the lesions is heterogenous on T2WI images, presenting with small-stripped and branching vascular flow void signals. However, the final diagnosis depends on the pathological and immunohistochemical examinations.

Disclosure of conflict of interest

None.

Address correspondence to: Min Wang, Department of Radiology, The First Affiliated Hospital of Nanchang University, No. 17 of Yongwai Zheng Street, Donghu District, Nanchang 330006, Jiangxi Province, China. Tel: +86 13970059767; E-mail: wangming_df@163.com

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