Journal of Interventional Medicine 6 (2023) 194–198

Contents lists available at ScienceDirect

Journal of Interventional Medicine

journal homepage: www.keaipublishing.com/cn/journals/journal-of-interventional-medicine/

Argon-helium cryoablation treatment of undifferentiated pleomorphic sarcoma of the thyroid: A case report and literature review

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ARTICLE INFO

Keywords:
Malignant thyroid tumors
Undifferentiated pleomorphic sarcoma
Cryoablation
Imageology

ABSTRACT

Undifferentiated pleomorphic sarcoma is an extremely rare malignant thyroid tumor. Thyroid sarcoma differs from common malignant thyroid tumors, such as thyroid follicular cell carcinoma. It is usually highly malignant, progresses rapidly, and is prone to remote metastasis. Currently, there is no standard protocol for the treatment of thyroid sarcomas, and most treatment effects are unsatisfactory. Argon-helium cryoablation is an important method of local treatment that is widely used in patients with unresectable advanced tumors. However, owing to the low incidence of thyroid sarcomas, there are no relevant literature reports on the treatment of thyroid sarcomas using cryoablation in China. This study reports the case of a patient with undifferentiated pleomorphic sarcoma of the thyroid gland who was treated with argon-helium cryoablation, and the immediate outcome was good. Based on a review of relevant literature, we discussed the effectiveness and safety of argon-helium cryoablation treatment to provide clinical guidance and references for the treatment of patients with thyroid sarcoma.

1. Clinical data

1.1. General information

The patient is a 66-year-old male who was admitted to our hospital on account of "a thyroid mass with progressive enlargement found during routine physical examination four months ago. There was associated neck pain and hoarseness for >20 days." In August 2022, asymptomatic "thyroid nodules" were found during a local physical examination. Due to progressive swelling of the neck mass, accompanied by acupuncture-like pain, a thyroid ultrasound examination was performed at the Yulong County Hospital on September 27, 2022. This examination showed an increased volume in the right lobe of the thyroid gland, with reduced and uneven internal echoes. A solid mass with calcification in the right lobe and isthmus of the thyroid gland corresponded to Thyroid Imaging Reporting and Data System (TI-RADS) classification: category 4a. Cystic nodules in the isthmus of the thyroid corresponded to TI-RADS classification: category 2. The nature of the multiple abnormal lymph nodes on the right side of the neck and supraclavicular region remains unclear. Computed tomography (CT) indicated a possibility of right thyroid cancer and bilateral lung metastases. A needle biopsy of the right thyroid mass was performed and combined with the results of immunohistochemistry. An anaplastic sarcoma was considered; however, no relevant treatment was administered. The patient was referred to the First People's Hospital of Yunnan Province for medical treatment. On October 18, 2022, the patient underwent another thyroid biopsy. On October 27, 2022, immunohistochemical and related examination results showed the following: (1) VIM (+), KI-67 (90% +), CK (−), CK19 (−), TTF-1 (−), CDX- 2 (+), Galectin-3 (±), Syn (−), CgA (−), CD56 (−), Napsin-A (−), PTH (−), CT (−), CK7 (−), CK20 (−), and Villin (−). Pathological diagnosis results of the tumor in the right lobe of the thyroid gland, combined with hematoxylin and eosin morphology and immunohistochemical results, indicated that the lesion was an undifferentiated pleomorphic sarcoma (UPS) (Fig. 1). Owing to the stage and characteristics of the lesion, it was inoperable; however, radiotherapy and chemotherapy were recommended. The patient and his family members did not consent to receive such treatment; thus, he was discharged from the hospital. The patient self-medicated with an oral "Chinese medicine" (details are unknown). Subsequently, the neck mass progressively increased in size, and approximately 20 days prior to presentation, the patient gradually developed occasional headaches and acupuncture-like pain in the neck mass, and his voice was hoarse. On November 23, the patient visited our outpatient clinic and was admitted with a diagnosis of an unknown "pleomorphic sarcoma of the thyroid." The patient had a history of diabetes for >10 years, which was not well managed.

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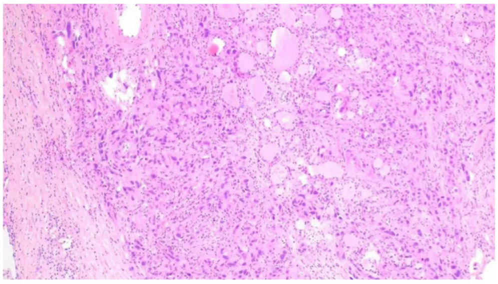
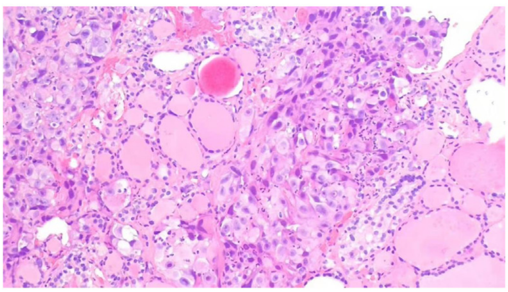
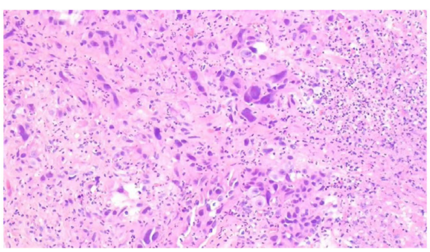
https://doi.org/10.1016/j.jimed.2023.10.002
Received 13 June 2023; Received in revised form 9 October 2023; Accepted 9 October 2023
Available online 20 October 2023



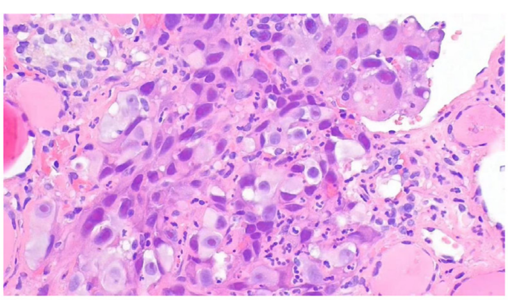
a) Tumor cells grow infiltratively between the thyroid follicles (×5)



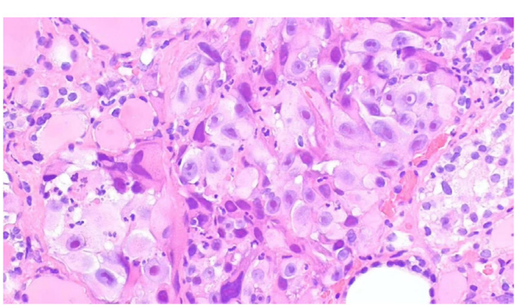
b) Tumor cells grow infiltratively (×10)



c) The boundary between the tumor cells and surrounding thyroid tissue is not clear (×10)



d) Tumor cells are fat spindle-shaped, and nucleus spindle-shaped, with atypia (×20)



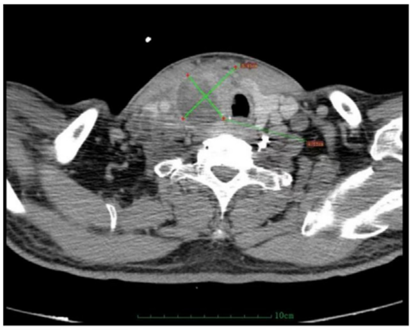
e) Some cells are epithelial-like, and the cytoplasm are rich; the nucleus is oval, with atypia (×20)

Fig. 1. Pathological findings (HE Staining).

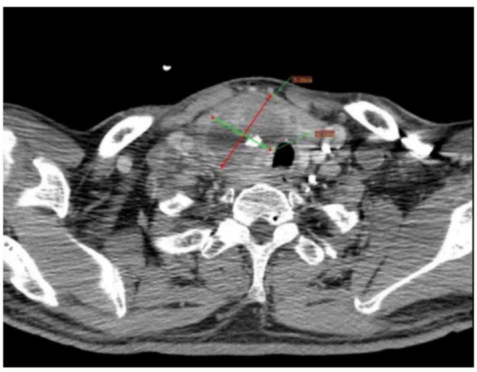
1.2. Main diagnosis and treatment process

After admission, the patient underwent plain and enhanced neck CT on November 28, 2022, which showed a significant increase in the volume of the right thyroid gland, and nodular low-density shadows were seen, with the largest measuring approximately 34 mm × 39 mm. Additionally, nodular calcification shadows were observed, the boundary of the lesion was unclear, and the edge of the lesion was obviously enhanced on the enhanced imaging. The shape of the left lobe of the thyroid gland was normal, the size was uniform, and the density was uniform. The trachea shifted to the left, and there was no obvious damage or absorption of adjacent bone. Multiple nodular soft tissue density shadows were seen in the neck, with the largest measuring approximately 18 mm × 22 mm, and the enhanced CT showed obvious heterogeneous enhancement (Fig. 2). Combined with the clinical examination results, the definitive diagnosis was: 1) UPS of the thyroid gland (T4N1bM1, stage IV); 2) lung metastasis of malignant thyroid tumor; 3) lymph node metastasis of malignant thyroid tumor; 4) cancerous pleurisy; 5) type II diabetes; 6) cancer pain; and 7) pleural effusion. After the patient was admitted to the hospital, the hoarseness gradually worsened, and chest tightness, wheezing, and shortness of breath were aggravated and relieved repeatedly. The patient awakened due to shortness of breath during sleep at night. A follow-up CT showed the following: 1) no apparent abnormalities in brain; 2) high possibility of cancer of the right thyroid gland, and further examinations were recommended; 3) enlarged lymph nodes in the right neck and bilateral supraclavicular fossae; 4) the vocal cords on both sides were relatively thickened, and the glottic fissure was relatively narrow and required a combination with other clinical signs. Symptomatic treatments, such as edema reduction, were administered, and the dyspnea was slightly relieved; however, there was still chest tightness at night and aggravated dyspnea. Considering that the current radiotherapy, chemotherapy, and drug treatment cannot reduce the compression of the tumor on the airway in a timely manner and cannot relieve the patient's nocturnal dyspnea, and the patient did not consent to surgical treatment, minimally invasive argon-helium cryoablation was recommended for the short-term treatment of the tumor compression. His family members consented to cryoablation treatment after discussing with the patient.

On January 3, 2023, the patient underwent CT-guided argon-helium cryoablation of the thyroid sarcoma under local anesthesia. The patient was evaluated using CT to locate the cryoablation puncture point. After a successful local anesthesia with 2% lidocaine, two argon-helium ablation needles (each of 1.7 mm diameter) and one 22G puncture needle were inserted along the CT-positioning needle track. After the puncture position was determined, 6 mL of protective water layer (0.9% sodium chloride 100 mL + dexamethasone 10 mg + iohexol 10 mL) was injected using the 22G puncture needle to protect the trachea and nerves, and the argon-helium cryoablation system (Beijing Sunshine Yibang Medical System Co., Ltd, Model AH-22) was started for the first cycle of argon freezing. The temperature reached −160 °C, froze for 5 min, and the tumor ablation area was checked after CT re-scanning. When the area reached the edge of the planned tumor ablation range, the argon gas was turned off, the helium gas was turned on for thawing, and the second cycle was started when the temperature reached 20 °C. After freezing for 4 min, the scan was repeated, and the lesion showed satisfactory ablation. After the thawing, the position of the argon-helium ablation needle was adjusted, followed by another two cycles of cryoablation. The argon-helium puncture needle was pulled out after repeating the scan, and a satisfactory ablation area of the lesion was observed. The puncture point was sealed with an aseptic dressing to end the operation. The entire cryoablation procedure lasted for 1 h 40 min, and the patient did not complain of any discomfort during the operation. Intraoperative CT images are shown in Fig. 3.



a) Tumor mass in the neck, with tracheal deviation



b) Maximal diameter of the tumor is 5.49 cm × 4.15 cm

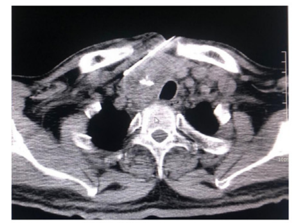
c) Boundary of the tumor mass is not clear and very close to trachea

Fig. 2. Computed tomography images obtained on November 28, 2022, after hospital admission.

1.3. Follow-up

The patient experienced reduced neck pain postoperatively, breathed more smoothly, and the symptoms of nocturnal dyspnea resolved. He was discharged from the hospital three days after the operation. Re-examination CT, which showed that the tumor volume had shrunk after the ablation (Fig. 4), was performed on January 26, 2023. The dyspnea and hoarseness resolved, and there was no further discomfort. Because of the COVID-19 epidemic in Yunnan Province, China, the patient did not return to the hospital for further follow-up visits. Afterwards, several efforts to reach the patient failed, and he was declared lost to follow-up.

a) No.1 argon-helium knife ablation needles were inserted in position

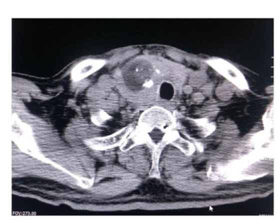


b) No.2 argon-helium knife ablation needles were inserted in position

c) Boundary and size of an "Ice ball" was clearly seen during the cryoablation procedure

d) Boundary and size of the "Ice ball" was clearly seen during the cryoablation procedure (another section)

e) Ablation area could be seen clearly just after the cryoablation

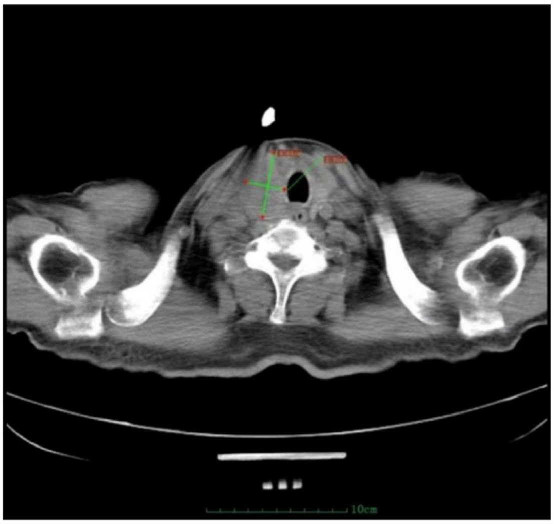


f) Ablation area could be seen clearly just after the cryoablation (another section)

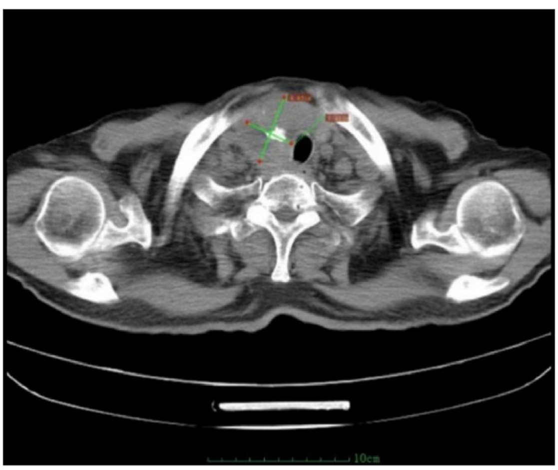
Fig. 3. Computed tomography images during cryoablation.

2. Discussion

According to the World Health Organization, the histological classification of thyroid tumors is mainly divided into primary epithelial, primary nonepithelial, and secondary tumors. Approximately 95% of thyroid tumors originate from thyroid follicular cells, and most originate



a) Tumor mass shrinks, and tracheal deviation is alleviated



b) Diameter of the tumor decreased to 4.85 cm × 3.46 cm

Fig. 4. Follow-up computed tomography images obtained on January 26, 2023, three weeks after the cryoablation procedure.

from C cells (parafollicular cells of the thyroid). Malignant thyroid lymphoma is the most common thyroid tumor of nonepithelial origin, whereas thyroid sarcoma and secondary thyroid malignant tumors are rare in clinical practice.[1,2]

UPS is a new term introduced in the 2013 WHO classification. These lesions are a heterogeneous group of tumors with no clear direction of differentiation, which cannot be classified into other specific categories using current molecular and immunohistochemical criteria. Therefore, they are considered a diagnosis of exclusion by pathologists and clinicians. Most of these tumors were previously classified as malignant fibrous histiocytoma, which was subsequently renamed UPS. These sarcomas are typically aggressive, can occur anywhere in the body, and have high rates of local recurrence and metastasis.

Thyroid UPS is rare, with only a few case reports from China and other countries.[3–6] Clinical manifestations of thyroid UPS are similar to those of thyroid cancer. The primary manifestation was a progressively enlarging thyroid mass. In severe cases, thyroid UPS can cause dyspnea, impaired swallowing, and hoarseness. With no specific signs or typical imaging findings, a diagnosis of UPS mainly relies on histological morphology and the analysis of multiple groups of immunohistochemical markers[7] to exclude different differentiation directions. The clinical manifestation of this patient was progressive goiter, and the diagnosis of UPS was confirmed by pathological and immunological examinations. For the treatment of thyroid UPS, the primary method reported in the literature is surgical resection. However, owing to the aggressive growth of tumors, complete resection is difficult, and the curative effect of surgery is unsatisfactory. Patients with extrathyroidal invasion or distant metastasis are usually unsuitable for surgery, and surgical treatment in some patients may be limited to palliative care.[6] Ablation therapies, including thermal ablation and cryoablation, are a minimally invasive procedure for treating solid tumors. The patient had obvious local symptoms of a thyroid tumor, and because he refused surgery, ablation therapy was considered. Cryoablation has advantages of less damage to connective and nerve tissues, alleviation of cancer pain, and a more robust immune regulatory effect etc.[10,11] The patient received argon-helium cryoablation therapy, which is the first reported case with such treatment for thyroid UPS in China.

Argon-helium cryoablation is a high-tech and minimally invasive tumor treatment technology that is widely used in European and American countries and has gradually become popular in China in recent years. The argon-helium knife used in the operation was not a real knife but a hollow ablation needle. Under the guidance of CT or B-ultrasound positioning, the knife head with a needle tip of only 1.7–2.4 mm was accurately punctured into or around the lesion. According to the Joule-Thomson principle, argon gas passes rapidly through the tip of the knife to produce a throttling effect, and the needle tip cools rapidly. Within 15 s, the diseased tissue can be frozen to −150 °C to −160 °C, making the tumor's inner micro vessels embolize, and ice crystals form inside tumor cells. After freezing for 10–20 min, the argon gas is turned off, and helium gas is turned on. The helium gas passes through the knife tip rapidly, which can increase the temperature of the lesion from −160 °C to 20 °C–40 °C. This makes the intracellular ice crystals inside the frozen tumor melt, resulting in rupture and death of the tumor cells. Through 2–3 freeze-thaw cycles during the operation, the tumor tissue is destroyed thoroughly, and the immune effect of the body against the tumor can also be activated.[10]

During argon-helium cryoablation therapy, the cooling and heating speed, time, and temperature were precisely set and controlled by a computer. The size and shape of the ablation and destruction area can be clearly seen under CT images, which can be monitored in real time to ensure the range of frozen "ice ball" not only completely covers the tumor but also minimizes damage to surrounding normal tissues and organs. Argon-helium cryotherapy is a purely physical therapy that has a good therapeutic effect on various solid tumors in the whole body, including soft tissue sarcomas.[8,9] The argon-helium cryoablation treatment process is minimally invasive, precise, and has high overall safety. During the operation, the patients experience almost no pain and good tolerance. In most cases, this procedure can be performed under local anesthesia. Trauma and adverse reactions to the human body are far fewer than those associated with conventional treatment approaches. For early stage tumors, a curative effect similar to that of surgery can be achieved. It can also be applied to patients with tumors who have lost the chance of surgery in the late stage, those who are elderly, those who cannot tolerate anesthesia, and those who are unwilling to undergo surgery. Focal treatment, such as cryoablation, can reduce the tumor burden and alleviate the symptoms of compression, thereby delaying tumor progression.

In this patient with UPS of the thyroid, argon-helium cryoablation was safely performed. This effectively relieved the patient's airway compressive symptoms and cancer pain, which has not been reported in China. Argon-helium cryoablation is a safe and effective minimally invasive treatment option for patients with malignant thyroid tumors and UPS. Unfortunately, the patient was lost to follow-up due to special reasons after the surgery; the medium and long-term treatment effect on the patient could not be monitored. In the future, our hospital will strive to accumulate more cases of argon-helium cryoablation treatment for malignant thyroid tumors and continuously improve the diagnosis ability and treatment of malignant thyroid tumors.

Ethical approval

The study was approved by the ethics committee of Lijiang Hankang Tumor Hospital. All clinical practices and observations were conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from each patient before the study was conducted.

Patient consent

Written informed consent was obtained from patient for publication of the case report and any accompanying images.

Declarations of competing interest

We declare that we do not have any commercial or associative interest that represents a conflict of interest in connection with the work submitted.

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