

# Thoracoscopy-assisted treatment for mediastinal metastasis of thyroid cancer: a case report

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## Abstract

Advanced thyroid cancer with upper mediastinal lymph node metastasis is not rare in the clinical setting. For patients with severe metastasis, a thoracocervical incision is usually performed for dissection of lymph nodes. However, the difficult operation of three-port thoracoscopy to support performance of a cervical incision in the treatment of upper mediastinal lymph node metastasis has rarely been reported to date. We herein describe a case involving the treatment of thyroid cancer with upper mediastinal lymph node metastasis. The lymph node metastasis was severe, closely adhered to the innominate vein, and fused into a mass. Thoracoscopy with a cervical incision was performed and proved to be a highly difficult surgical maneuver. The patient recovered quickly after the operation. Repeat computed tomography showed no swollen metastatic lymph nodes, indicating that the dissection was thorough. Thoracoscopy with a neck incision is more difficult than conventional longitudinal split sternotomy in the treatment of upper mediastinal lymph node metastasis, but its advantages are less severe trauma and faster recovery. This procedure may be performed by surgeons with proficient skill in cervical surgery and thoracoscopy techniques.

## Keywords

Thoracoscopy, neck incision, advanced thyroid cancer, mediastinal lymph node metastasis, treatment, case report

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## Introduction

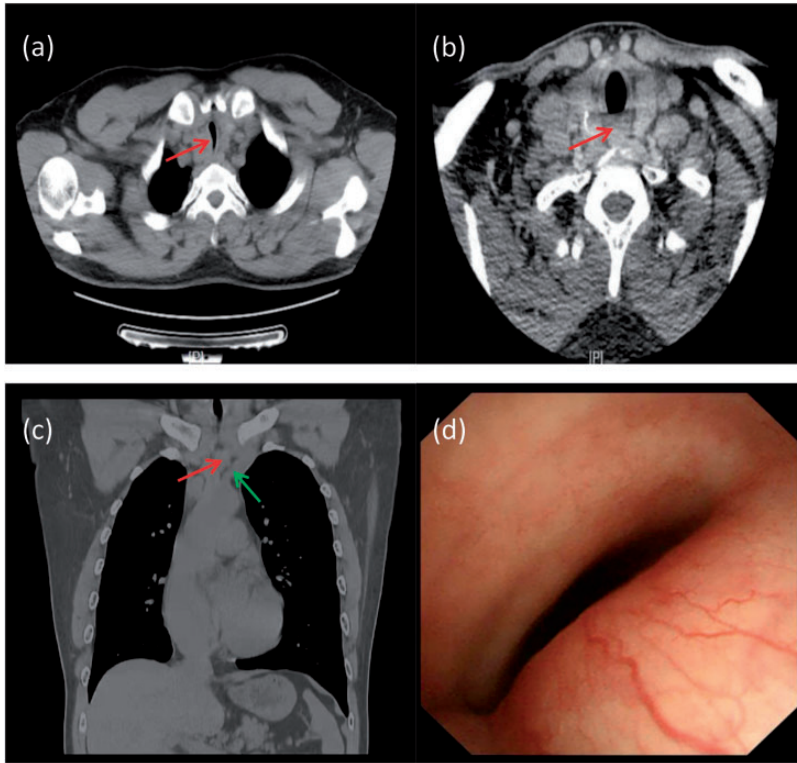
The incidence of papillary thyroid cancer has rapidly increased in recent years, and this cancer has gradually become one of the fastest growing malignant tumors. Most tumors can be detected and treated early, and the prognosis is good in such cases.<sup>1</sup> Although papillary thyroid cancer is less malignant than many other types of cancer, it is prone to the development of cervical regional lymph node metastasis.<sup>2</sup> Research has indicated that upper mediastinal lymph node metastasis is also a form of regional metastasis.<sup>3</sup> Such metastasis is not rare in the clinical setting, occurring in about 10% of cases and indicating the presence of advanced thyroid cancer.<sup>4</sup> Standardized surgery is still the preferred treatment for upper mediastinal lymph node metastasis and can significantly improve the patients' prognosis.<sup>5</sup> We herein describe the treatment of a patient with advanced thyroid cancer and upper mediastinal lymph node metastasis.

## Case report

This manuscript was prepared and revised according to the CARE Checklist, and the reporting of this study conforms to the CARE guidelines.<sup>6</sup> A 37-year-old man was admitted to our clinic because of a 1-year history of a right neck mass and 2-month history of hoarseness. He had no fever, fatigue, sweating, palpitation, fear of heat, polyphagia, weight loss, or other symptoms. The patient was physically healthy and had no history of chronic diseases such as hypertension, diabetes, or cardiovascular or cerebrovascular diseases. His right thyroid contained a hard mass with a size of about  $3.5 \times 3.0$  cm. The boundary of the mass was unclear, the surface was not smooth, and the mass moved up and down with swallowing. No obvious mass was palpated on the left thyroid. The right neck

contained multiple enlarged lymph nodes; the largest was about  $2.5 \times 2.0$  cm, hard in texture, mildly tender, and poorly mobile. No obvious enlarged lymph nodes were palpated in the left neck. The patient's thyroid function, electrolyte concentrations, and parathyroid hormone concentration were all within the reference ranges, whereas his thyroglobulin concentration was  $>500$  ng/mL. Color Doppler ultrasound of the thyroid showed hypoechoic nodules with calcification in the right thyroid lobe, which measured about  $33.6 \times 20.5 \times 38.2$  mm (TI-RADS 5), indicating thyroid cancer. Multiple hypoechoic masses were detected in the left tracheoesophageal sulcus and suprasternal fossa, and multiple enlarged lymph nodes were present on both sides of the neck; these were considered to be metastases. Laryngoscopy indicated that the movement of the bilateral vocal cords was significantly weakened. Computed tomography (CT) revealed bilateral cervical lymph node metastasis with possible invasion of the trachea and esophagus (Figure 1 (a), (b)). Therefore, the patient's initial diagnoses were thyroid cancer, bilateral cervical lymph node metastasis, upper mediastinal lymph node metastasis, bilateral recurrent laryngeal nerve invasion, and tracheal and esophageal invasion. Plain chest CT showed that the lymph nodes in stations VI and VII of the left neck were fused into a mass, which was deep and closely adhered to the left innominate vein (see three-dimensional reconstruction in Figure 1(c)). Tracheoscopy showed that the trachea was compressed by the tumor, but there was no obvious invasion (Figure 1(d)).

Because of the patient's severe condition and high risk of surgical trauma, we decided to perform staged surgery. The patient underwent total thyroidectomy, right neck lymph node dissection, tracheostomy, and esophageal repair. During the operation, the bilateral recurrent laryngeal nerves were found to be invaded by the tumor



**Figure 1.** Preoperative plain computed tomography of the neck and chest and tracheoscopy. (a) The red arrow indicates tracheal invasion. (b) The red arrow indicates esophageal invasion. (c) The red arrow indicates station VII lymph nodes, and the green arrow indicates the innominate vein. (d) Tracheoscopy shows tracheal compression.

and could not be separated, and the nerve monitor showed no signal. The lymph nodes in stations III and IV of the right neck were fused into a mass that surrounded the internal jugular vein and could not be separated; therefore, the right internal jugular vein was disconnected. The lymph nodes at the tracheoesophageal sulcus had invaded the lateral wall of the esophagus, which was repaired after resection. The cervical esophagus was invaded to a diameter of about 1 cm; after separation and resection by an electrotome, the esophagus was sutured with an intermittent double-layer inversion pattern using absorbable thread. The postoperative pathology results supported papillary

thyroid cancer of the left thyroid lobe with three lesions ranging in diameter from about 0.2 to 0.6 cm and papillary thyroid cancer of the right thyroid lobe and central region with a size of about  $3.0 \times 2.8 \times 1.5$  cm. Cancer metastasis was seen in 8 of 23 lymph nodes (1/1 anterior laryngeal lymph node, 2/4 right station II lymph nodes, 4/16 right station III and IV lymph nodes, and 1/2 right station V lymph nodes). The soft tissues in the region of the left station VI lymph nodes were positive for metastasis, and the soft tissues in the anterior cervical region were negative for metastasis. The patient recovered well after the operation. To delay the progression of thyroid cancer, reduce the

cancer focus, and prepare for the second operation,  $I^{131}$  therapy was performed in the nuclear medicine department on 19 April 2021 (Figure 2). The patient was rehospitalized on 24 May 2021. Color Doppler ultrasound of the thyroid after total thyroidectomy revealed multiple enlarged lymph nodes in stations III and IV of the left neck, indicating the possibility of metastatic carcinoma.

### Surgical difficulties

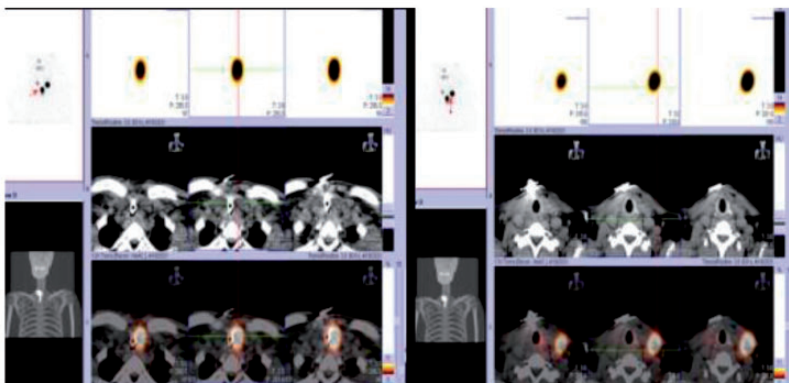
The lymph nodes in stations VI and VII of the left neck were fused into a mass, which was deep in position and closely adhered to the left innominate vein. Traditional neck incisions could not be used to completely remove the mass. Additionally, a longitudinal sternal split would have been even more traumatic and not conducive to the patient's physical and psychological recovery. Therefore, we decided to perform three-port thoracoscopy under the xiphoid process to support performance of the neck incision, which has rarely been reported (Figure 3(a), (b)). The left cervical lymph nodes in station IV had invaded the posterior wall of the internal jugular vein, and the right internal jugular vein had been severed during the initial operation; therefore, the left internal jugular vein had to be

preserved, and preparations for intraoperative repair were required (Figure 3(c)). In addition, the enlarged lymph nodes on the medial side of the anterior scalene muscle of the left neck were located deep in the deep fascia and adjacent to the vertebral artery and vein (Figure 3(d)).

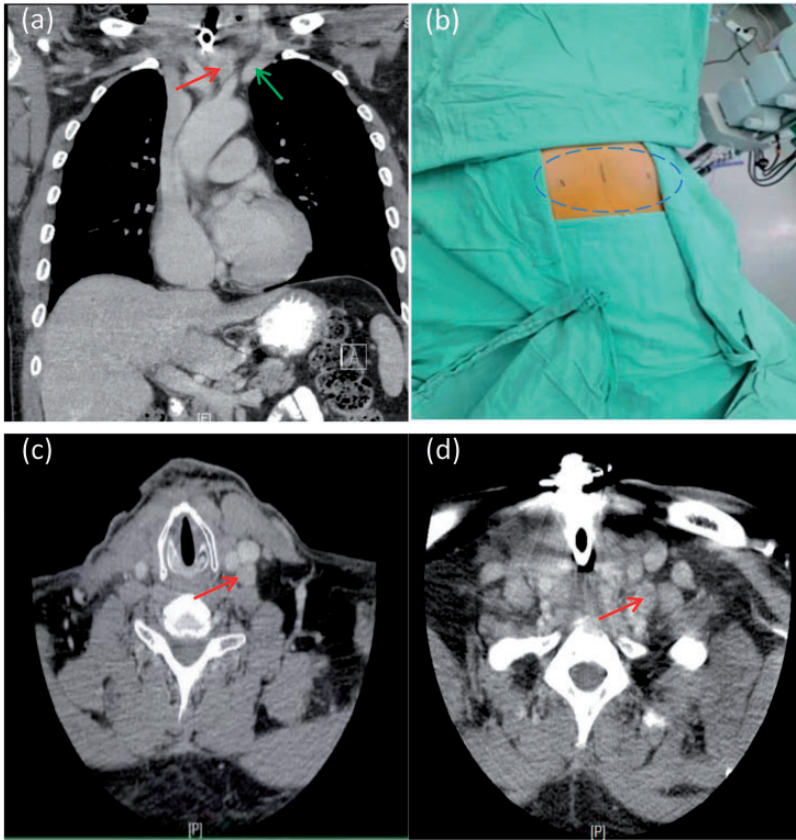
### Surgical procedure

Initially, the space between the upper mediastinal lymph node and the left innominate vein was dissociated by three-port thoracoscopy under the xiphoid process (Figure 4 (a)). The free mass then converged with the lower part through the neck incision (Figure 4(b)). Finally, hemostatic forceps were used to pull the mass from the neck, the tissue continued to be separated upward under thoracoscopy, and the upper mediastinal lymph nodes were completely removed (Figure 4(c)).

The lymph nodes in stations III and IV of the left neck were thoroughly removed under the neck incision. The posterior wall of the internal jugular vein and the thoracic duct had been invaded, and a line of 4-0 Prolene suture was used to repair the tissue near the vein angle and behind the internal jugular vein (Figure 4(d)). The postoperative pathology results indicated lymph node metastasis of papillary thyroid



**Figure 2.**  $I^{131}$  therapy in the nuclear medicine department.



**Figure 3.** Preoperative marking and enhanced computed tomography scan of the neck and chest for the secondary operation. (a) The red arrow indicates station VII lymph nodes, and the green arrow indicates the innominate vein. (b) The blue circle represents the preoperative marking of three holes under the xiphoid process. (c) The red arrow indicates that the internal jugular vein has been invaded by station IV lymph nodes. (d) The red arrow indicates enlarged lymph nodes on the medial side of the anterior scalene muscle of the left neck.

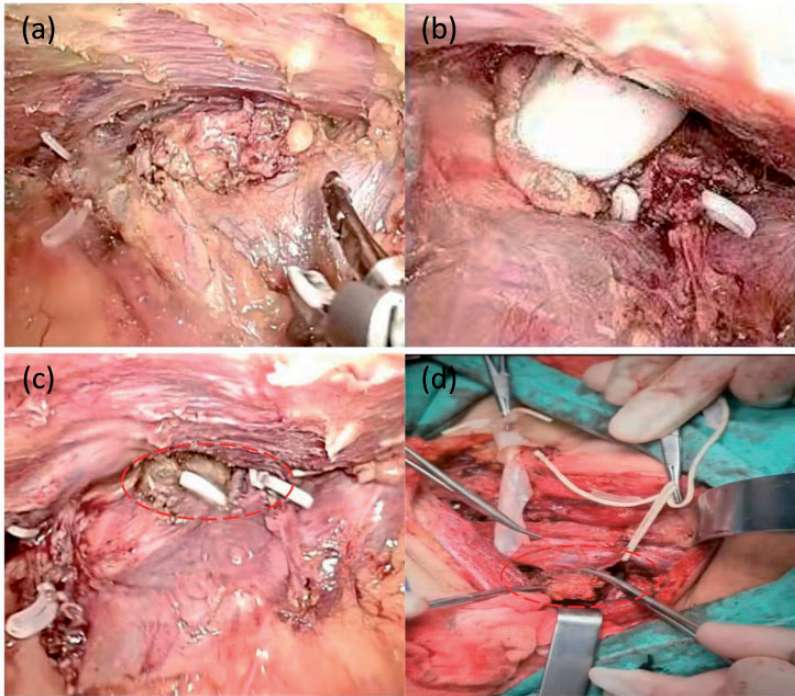
cancer in 7 of 23 lymph nodes, including those in the regions of peripheral scar tissue (1/1), upper mediastinum (0/7), paravertebral veins (1/1), station II of the left neck (1/5), station III of the left neck (2/5), station IV of the left neck (1/3), and stations VI and VII of the left neck (1/1).

The patient recovered well after the operation and was discharged. One month later, his thyroglobulin concentration was 15.7 ng/mL, which was within the reference range. CT showed postoperative changes in

the thyroid and no obviously enlarged lymph nodes around the trachea and esophagus (Figure 5).

## Discussion

Although papillary thyroid cancer is less malignant than many other types of cancer, it is prone to the development of cervical regional lymph node metastasis.<sup>2</sup> Upper mediastinal lymph node metastasis is also reportedly a form of regional



**Figure 4.** Intraoperative condition of the secondary operation. (a) The space between the upper mediastinal lymph node and left innominate vein was dissociated by three-port thoracoscopy under the xiphoid process. (b) The free mass converged with the lower part through the neck incision. (c) The red circle shows the post-dissection status of the station VII lymph nodes. (d) The red circle shows that the internal jugular vein has been invaded by station IV lymph nodes.

metastasis. Some researchers have indicated that locally advanced thyroid cancer mainly indicates that the tumor has obviously invaded surrounding important structures such as the recurrent laryngeal nerve, trachea, esophagus, larynx, cervical great vessels, upper mediastinum, or extensive skin and muscles. Locally advanced thyroid cancer has a poor prognosis and is one of the main causes of death in patients with thyroid cancer.<sup>7</sup> The anterior superior mediastinal lymph nodes (also known as the station VII lymph nodes) include the lymph nodes of the anterior superior mediastinum and the tracheoesophageal sulcus,



**Figure 5.** Postoperative computed tomography scan of the neck. No obvious tumor residue is shown.

ranging from the sternal notch to near the innominate artery.<sup>8</sup> Standard upper mediastinal lymph node dissection can significantly improve patients' survival and quality of life.<sup>2</sup> The traditional treatment for mild upper mediastinal lymph node metastasis is removal of the lymph nodes directly downward through the neck incision. For severe metastasis, such as that affecting the lymph nodes below the innominate vein, resulting in very enlarged lymph nodes, or resulting in fusion and close adherence to the surrounding blood vessels, it is often necessary to split the breastbone longitudinally to remove the lymph nodes.<sup>9</sup>

Zhang et al.<sup>10</sup> described the treatment of upper mediastinal lymph node metastasis in a patient with thyroid cancer with the assistance of cervical endoscopy. However, the thoracic entrance space is narrow. If the lymph node metastasis along the horizontal line is severe, the operation is difficult to perform. In addition, the sternum, clavicle, and large blood vessels cannot be clearly exposed; only dissection of metastatic lymph nodes can be performed, and it is difficult to achieve the standard dissection range. Through the thoracic approach, the surgical field of view is wider and separation of the innominate vein and upper mediastinal lymph nodes is safer; thus, the dissection is more thorough.<sup>11</sup> Other researchers have reported that when thyroid cancer invades the upper mediastinal vessels or leads to obvious upper mediastinal lymph node metastasis, endoscopic-assisted mediastinal lymph node dissection can be attempted.<sup>5</sup>

Many studies to date have indicated that three-port thoracoscopy under the xiphoid process has outstanding advantages in the treatment of thymic tumors and other upper mediastinal tumors and even in the

performance of upper mediastinal lymph node dissection. With the favorable magnification and lighting functions of the endoscope, the tumors can be removed more thoroughly and with less trauma, more rapid recovery, and a more reliable effect.<sup>12-16</sup> However, the application of three-port thoracoscopy under the xiphoid process to assist the performance of a cervical incision in the treatment of upper mediastinal lymph node metastasis of thyroid cancer has rarely been reported. In this case, preoperative enhanced CT of the neck showed that the lymph nodes in stations VI and VII of the left neck were fused into a mass, deeply positioned, and closely adhered to the left innominate vein. They would not have been able to be removed via a traditional neck incision, and longitudinal splitting of the sternum would have been a very high-trauma procedure not conducive to the patient's physical and psychological recovery. Therefore, we performed three-port thoracoscopy combined with a neck incision and successfully removed all upper mediastinal lymph nodes. After the operation, the patient developed no complications and recovered well.

Notably, I<sup>131</sup> therapy is controversial. Some clinicians believe that the effect of I<sup>131</sup> therapy is not excellent and that the cancer focus cannot be markedly reduced. Moreover, the follow-up time in the present case was relatively short, and the postoperative thyroglobulin concentration was only one of the reference indicators. Further follow-up is necessary. In the future, we will determine the thoroughness of tumor treatment in combination with biomarkers and imaging examinations.

In conclusion, after sufficient preoperative evaluation and with the availability of a skilled head and neck surgeon and

thoroscopic technology, it is safe and feasible to apply thoroscopic-assisted neck incision to remove the upper mediastinal lymph nodes in patients with advanced thyroid cancer combined with upper mediastinal lymph node metastasis. This procedure can greatly improve such patients' quality of life and prognosis.

### Declaration of conflicting interest

The authors declare that there is no conflict of interest.

### Ethics statement

Study protocol approval was not required because this is a case report. Written informed consent was obtained from the patient for publication of the case report and accompanying images, and all details have been deidentified to protect the patient's identity.

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