



Anesthesia Management of a Patient with Papillary Thyroid Carcinoma Recurrence and Metastasis to the Right Atrium and Superior Vena Cava: A Case Report

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Abstract

Postoperative recurrence and metastasis of papillary thyroid carcinoma (PTC) to the superior vena cava (SVC) and right atrium (RA) are rare. The application of Extracorporeal Jugular-femoral Vein Bypass and anesthesia management for SVC reconstruction in this rare situation holds instructive significance. In this case, we describe the successful anesthesia management of a patient with multiple tumor thrombi due to postoperative recurrence of PTC. The diagnosis was based on computed tomography of the chest and blood vessels, revealing three-dimensional SVC, postoperative recurrence of PTC, and multiple tumor thrombi in the internal jugular vein (IJV), subclavian vein, brachiocephalic vein, SVC, and RA. An experienced multidisciplinary team was established, and a detailed plan was made for respiration and circulation support, with cardiopulmonary bypass on standby.

Keywords

Papillary Thyroid Carcinoma, Superior Vena Cava Syndrome, Extracorporeal Jugular-Femoral Vein Bypass, Tumor Thrombus, Anesthesia

Abbreviations

PTC: Papillary Thyroid Carcinoma; SVC: Superior Vena Cava; RA: Right Atrium; EJVB: Extracorporeal Jugular-Femoral Vein Bypass; CT: Computed Tomography; CPB: Cardiopulmonary Bypass; IJV: Internal Jugular Vein; PET-CT: Positron Emission Tomography-Computed Tomography; MRI: Magnetic Resonance Imaging; ECG: Electrocardiogram; UCG: Ultrasonic Cardiogram; ABG: Arterial Blood Gas; NIRS: Near-Infrared Spectroscopy; rScO₂: Regional Cerebral Oxygen Saturation; ACT: Activated Clotting Time; ABP: Arterial Blood Pressure

Introduction

PTC, the most common malignant tumor of the thyroid, typically spreads through lymph node expansion. Regional metastasis in the neck is relatively common, but metastases outside the deep cervical

chain are rare [1]. The lung and bone are common sites of distant metastasis in PTC, while metastasis to the jugular veins is uncommon [2,3]. Although PTC occasionally exhibits microscopic vascular invasion, it rarely causes tumor thrombus in the internal jugular

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vein (IJV) or other major jugular veins in the neck [3,4]. In this report, we present the case of a 24-year-old patient with multiple tumor thrombi in the IJV, subclavian vein, brachiocephalic vein, SVC, and RA resulting from postoperative recurrence of PTC. Additionally, we discuss our experience in perioperative management of SVC circulation reconstruction.

Case Presentation

A 24-year-old, 70 kg, 163 cm man presented at the thyroid surgery clinic with progressive neck swelling after undergoing total thyroidectomy, bilateral central lymph node dissection, and left cervical lymph node dissection one year ago for a left cervical mass. After the operation, the patient was treated with Levothyroxine sodium and ^{131}I therapy regularly. He had no history of hypertension, myocardial infarction, or angina pectoris. The patient's neck gradually became thicker about ten months ago, but his weight did not significantly increase. Upon admission, the physical examination revealed a slightly thick neck with a visible scar from the thyroidectomy on the anterior area. The wound had healed well, and there were no signs of local vascular varicosity or skin rupture. The trachea was centered, and the patient's pronunciation was normal. Whole-body bone imaging

did not show any definite signs of tumor bone metastasis. Neck ultrasound revealed branch embolism in the left subclavian vein and left internal jugular vein. Positron emission tomography-computed tomography (PET-CT) showed that the recurrent goiter in the thyroid area had invaded the left brachiocephalic vein, forming a tumor thrombus. Bilateral lung and anterior space lymph node metastasis were also observed. The left neck showed longitudinally striped areas with increased glucose metabolism, indicating potential tumor metastasis. Chest CT and blood vessel imaging suggested scattered nodules in both lungs, which could be metastases. The soft tissue shadow in the left internal jugular vein, subclavian vein, left brachiocephalic vein, and superior vena cava may represent tumor thrombus (**Fig-1**). A shadow in the anterior mediastinum raised suspicion of tumor metastasis. Magnetic resonance imaging (MRI) of the soft neck tissue revealed the absence of the thyroid, multiple lymph nodes in the neck, and multiple nodules and mass shadows in the neck and upper part. Electrocardiogram (ECG) and Ultrasonic cardiogram (UCG) results were normal. Laboratory examination revealed myoglobin levels of 571.2 ng/ml, troponin levels of 532.6 ng/ml, and thyroglobulin levels of 709.9 $\mu\text{g/L}$, with no other significant findings.

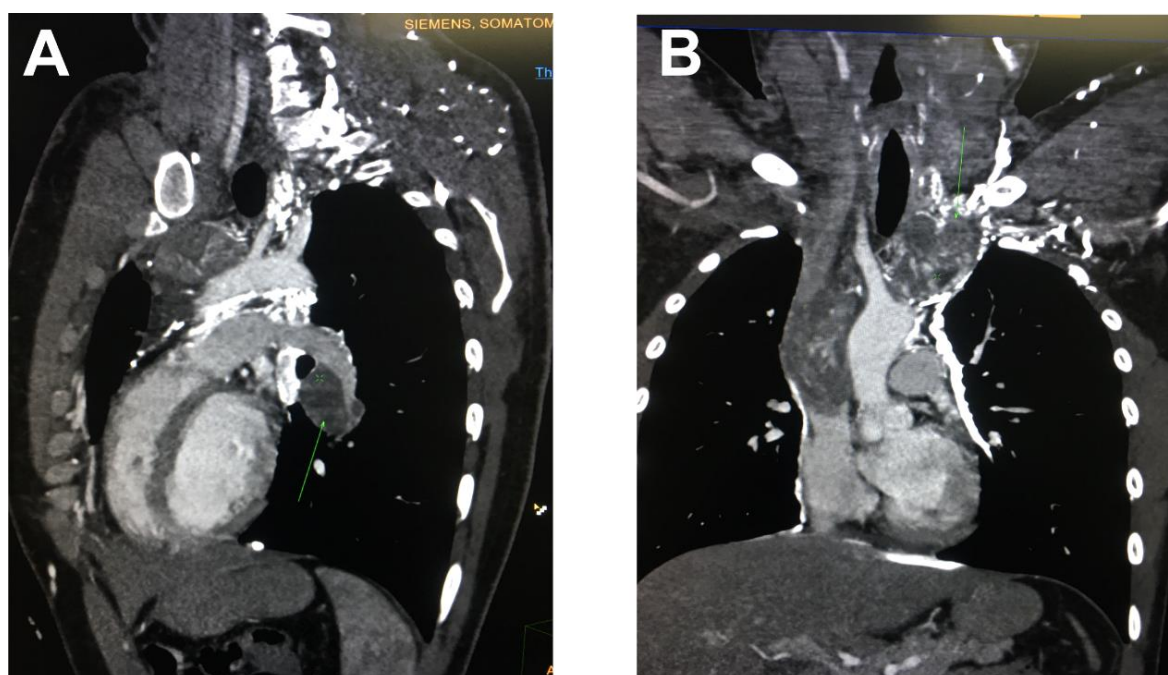


Fig-1: Representative Sagittal (A) And Coronal (B) Images from the CT Scan

The green arrow of preoperative enhanced CT scan points towards the tumor thrombus in superior vena cava.

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A comprehensive contingency team was assembled before the operation, which included thyroid surgeons, cardiothoracic surgeons, ICU staff, and anesthesiologists. Preparations were made for dehydration, diuresis (using Mannitol and furosemide), and potassium supplementation prior to the operation. It was recommended to establish all venous pathways in both lower limbs to reduce local edema, create optimal surgical conditions, and keep the option of using cardiopulmonary bypass during the operation open. As an emergency measure, the cardiopulmonary bypass (CPB) team was on standby. The patient's vital signs upon entering the operating room were stable. General anesthesia was induced intravenously using Midazolam 4mg, Sufentanil 20ug, Cisatracurium 16mg, and Propofol 150mg to facilitate intubation with a left double-lumen bronchial catheter while invasive arterial pressure monitoring was in place. Anesthesia was maintained with 2% sevoflurane, a propofol infusion at $25\text{mg}\cdot\text{kg}^{-1}\cdot\text{h}^{-1}$, and a remifentanyl infusion at $0.15\text{ug}\cdot\text{kg}^{-1}\cdot\text{h}^{-1}$. Under ultrasound guidance, a large-bore central venous access was obtained through the left femoral vein to provide a route for administering vasopressors, fluids,

and blood products. Subsequently, 8.5F blood vessel sheath tubes were inserted into the right internal jugular vein and right femoral vein, respectively. These two tubes were connected using a three-way connector and a one-way blood vessel passage, establishing the external jugular vein bypass (EJVB) (**Fig-2**). After measuring the pressure of the internal jugular vein, the channel was opened, and physiological saline with heparin sodium (100ug/ml) was continuously infused into the operative site.

In addition, a lower body heating blanket was utilized to prevent hypothermia, intravenous transfusions were warmed using heating equipment, and arterial blood gas (ABG) analysis was repeatedly performed during the operation. Near-infrared spectroscopy (NIRS) technology was employed to monitor regional cerebral oxygen saturation (rScO_2), with a baseline rScO_2 value of 64.4%. Ulinastatin and methylprednisolone were intravenously administered post-operation to inhibit excessive inflammatory response, alleviate ischemia-reperfusion injury, and protect vital organs. rScO_2 and Activated Clotting Time (ACT) were measured and recorded when the left and right internal jugular veins (IJVs) were blocked and unblocked. Prior to blocking the superior vena cava (SVC) for heparin infusion, ACT was ensured to be above 200-250 seconds. Following the reconstruction of the artificial blood vessel, protamine was administered to correct ACT back to baseline levels. During anesthesia, timely drug treatments were administered based on changes in patients' vital signs and ABG results to maintain acid-base and electrolyte balance.

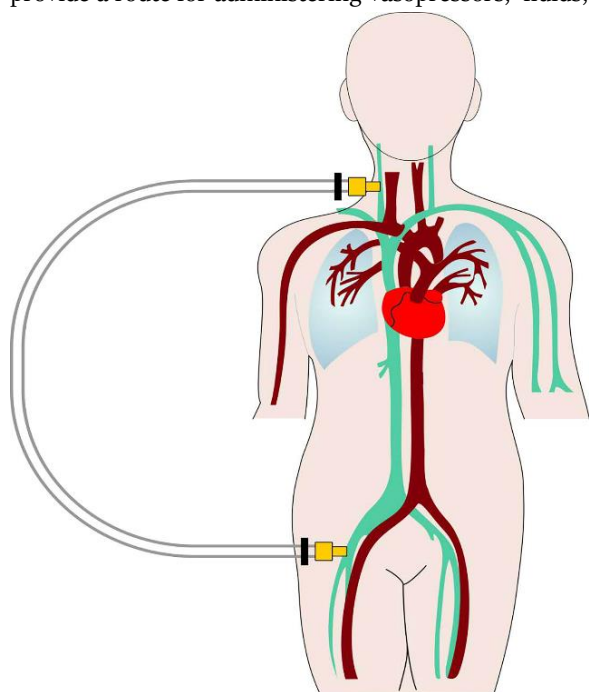


Fig-2: Establishment of Temporary Extracorporeal Jugular-Femoral Vein Bypass

Scheme of Jugular-femoral Vein Bypass technique including the two 8.5F blood vessel sheath tubes inserted in the internal jugular vein and femoral veins connected with a three-way connector and one-way blood vessel passage.

During the operation, a solid mass measuring $5 * 4 * 3$ cm was identified in the anterior mediastinum, invading the pericardium, major blood vessels in the mediastinum, the right innominate vein, the SVC, the left common frontal artery, the tunica vaginalis of the aortic arch, and the tunica vaginalis of the right innominate artery. Additionally, tumor thrombus and thrombus filled the entire course of the SVC, left innominate vein, left subclavian vein, and left IJV. The duration of the surgery was approximately 8 hours. The surgeons successfully removed the mediastinal tumor, which had invaded the superior vena cava, left innominate vein, and associated thrombus, and

reconstructed an artificial blood vessel. Following intensive care in the ICU, the patient's condition gradually stabilized, leading to their transfer back to the general ward three days' post-operation. After a period of rehabilitation, the patient was discharged half a month later and is currently in good condition under maintenance treatment.

Discussion and Conclusions

We present a case describing the successful anesthesia management of a patient with multiple tumor thrombi resulting from postoperative recurrence of PTC. The patient's diagnosis, based on computed tomography of the chest and blood vessels, including a three-dimensional SVC, indicated postoperative recurrence of PTC and the presence of multiple tumor thrombi in the internal jugular vein (IJV), subclavian vein, brachiocephalic vein, SVC, and RA. To ensure optimal care, we assembled an experienced multidisciplinary team and devised a detailed plan for respiration and circulation support, with cardiopulmonary bypass on standby.

Extensive vascular invasion or venous tumor thrombus in PTC is considered a risk factor for distant metastases, early relapse, and poor prognoses [5,6]. The patient's CT scan revealed that the lesions extending from the SVC to the RA were caused by tumor thrombus. The obstruction of the SVC could be attributed to either malignant or nonmalignant mediastinal mass enlargement. In this case, surgical resection is a crucial treatment approach to improve the patient's long-term prognosis. However, it poses significant challenges for the anesthesiologist due to the high risk of perioperative cardiovascular collapse and life-threatening complications such as airway obstruction [7-9].

During SVC reconstruction, the occlusion of the SVC can lead to a sudden decrease in the amount of blood returning to the heart and a reduction in arterial blood pressure (ABP). Additionally, a rapid increase in SVC pressure can cause an elevation in cerebral vein pressure, potentially leading to cerebral venous return obstruction and subsequent postoperative brain dysfunction. In this particular case, the surgeon successfully removed the mediastinal tumor that had

invaded the superior vena cava, left innominate vein, and associated thrombus. Furthermore, the tumor thrombus was completely excised, and an artificial blood vessel was reconstructed using a temporary extracorporeal jugular-femoral vein bypass.

Therefore, one of the critical points of anesthesia management is to ensure effective circulating blood volume and protect brain function. Maintaining stable blood circulation and ensuring blood perfusion to other important organs are also important aspects of anesthesia management. Firstly, a double-lumen tracheal catheter was inserted to ensure correct positioning under the guidance of the fiber bronchoscope. During the operation, one-lung ventilation was used to cooperate with the procedure, and respiratory parameters were adjusted to ensure adequate oxygenation. Secondly, glucocorticoids and diuretics were administered after induction, and the superior vena cava (SVC) was opened, respectively, with fluid input limited to reduce organ edema and promote postoperative recovery. Thirdly, the establishment of the external jugular vein cannula (EJVB) and the use of vasoactive drugs can ensure appropriate internal jugular vein (IJV) pressure and cerebral perfusion pressure during SVC occlusion, thus protecting the brain. EJVB can reduce bleeding without the need for whole-body heparinization and achieve complete tumor resection, which is conducive to the operation. Previous studies [10-12] have found that this method is easy to operate with excellent controllability, allowing for stable hemodynamics, lower SVC pressure during occlusion, and reduced bleeding. In terms of anesthesia monitoring, continuous monitoring of arterial blood pressure, IJV pressure, dynamic monitoring of arterial blood gas (ABG), and blood glucose levels are necessary to promptly assess cerebral oxygen metabolism.

In our case report, we presented the successful anesthesia management of superior vena cava (SVC) artificial vascular reconstruction in patients with recurrent papillary thyroid carcinoma (PTC). The establishment of a multidisciplinary team and the use of external jugular vein cannula (EJVB) provided robust respiratory and circulatory support. However, through careful examination and evaluation, this case

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involved comprehensive planning and implementation. As a result of preoperative multidisciplinary discussions, intraoperative individualized anesthesia management, and the establishment of EJVB, the patient was successfully discharged after surgery with a favorable prognosis, as confirmed by long-term follow-up.

Conflict of Interest

The author has read and approved the final version of the manuscript. The author declares no conflicts of interest.

References

- [1] Portela RA, Choby GW, Manni A, Campbell D, Crist H, Goldenberg D. Unusual sites of metastasis of papillary thyroid cancer: Case series and review of the literature. *Ear Nose Throat J.* 2015 Aug;94(8):E43-47. [PMID: 26322457]
- [2] Sugimoto S, Doihara H, Ogasawara Y, Aoe M, Sano S, Shimizu N. Intraatrial extension of thyroid cancer: a case report. *Acta Med Okayama.* 2006 Apr;60(2):135-40. [PMID: 16680191]
- [3] Yamagami Y, Tori M, Sakaki M, Ohtake S, Nakahara M, Nakao K. Thyroid carcinoma with extensive tumor thrombus in the atrium. *Gen Thorac Cardiovasc Surg.* 2008 Nov;56(11):555-58. [PMID: 19002756]
- [4] Al-Jarrah Q, Abou-Foul A, Heis H. Intravascular extension of papillary thyroid carcinoma to the internal jugular vein: A case report. *Int J Surg Case Rep.* 2014;5(8):551-53. [PMID: 25044067]
- [5] Kawano F, Tomita M, Tanaka H, Nagahama H, Tashiro K, Nakao H, Kataoka H, Nakamura K. Thyroid carcinoma with extensive tumor thrombus in the superior vena cava: A case report. *Int J Surg Case Rep.* 2016;29:25-29. [PMID: 27810607]
- [6] Kowalski LP, Filho JG. Results of the treatment of locally invasive thyroid carcinoma. *Head Neck.* 2002 Apr;24(4):340-44. [PMID: 11933175]
- [7] Chaudhary K, Gupta A, Wadhawan S, Jain D, Bhadoria P. Anesthetic management of superior vena cava syndrome due to anterior mediastinal mass. *J Anaesthesiol Clin Pharmacol.* 2012 Apr;28(2):242-46. [PMID: 22557753]
- [8] Takeda S, Miyoshi S, Omori K, Okumura M, Matsuda H. Surgical rescue for life-threatening hypoxemia caused by a mediastinal tumor. *Ann Thorac Surg.* 1999 Dec;68(6):2324-26. [PMID: 10617025]
- [9] Narang S, Harte BH, Body SC. Anesthesia for patients with a mediastinal mass. *Anesthesiol Clin North Am.* 2001 Sep;19(3):559-79. [PMID: 11571906]
- [10] Liu B, Pan L, Wang X, Chen G. [Anesthesia management of lobectomy combined with superior vena cava graft for lung cancer with superior vena cava syndrome]. *Zhongguo Fei Ai Za Zhi.* 2003 Dec 20;6(6):492-94. [PMID: 21310139]
- [11] Ma W, Qiu Y, Cui Y, Yang G, Wang Z, Liu B. Catheter-related right internal jugular vein large thrombus formation after inadvertently malposition in the cranial direction. *J Thromb Thrombolysis.* 2019 Aug;48(2):355-57. [PMID: 31124032]
- [12] Liu B, Wang X, Yu H, Li Q, Zhang X. [The clinical investigation of extracorporeal vein bypass during lobectomy combined with superior vena cava graft for lung cancer]. *Zhongguo Fei Ai Za Zhi.* 2004 Feb 20;7(1):55-57. Chinese. [PMID: 21211194]

