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CASE REPORT

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Thoracoscopic minimally invasive surgical treatment with the same incisions in a patient with uremia complicated with large thymoma and right upper lobe lung cancer: a case report

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Abstract

A 41 year old female with stage 5 chronic kidney disease undergoing hemodialysis was admitted to the hospital. Chest CT scan revealed a large mass lesion of approximately 6.0 × 3.5x4.9 cm in size in the anterior superior mediastinum and a ground glass nodule in the upper lobe of the right lung, which increased in size from 9 × 7 mm 1 year and 9 months ago to 11mmx9mm before surgery. We designed a localization method to accurately locate the pulmonary nodule and successfully performed thoracoscopic minimally invasive resection of both thymoma and lung cancer through a subxiphoid approach with the same incision for this patient. With the support of perioperative hemodialysis, the patient's outcome is good. The pathological diagnosis of the anterior mediastinal mass is thymoma (b1 type), and the pathological diagnosis of the right upper lobe nodule is invasive lung adenocarcinoma (acinar type). This report describes the diagnosis and treatment process of the case.

Keywords Uremia, Hemodialysis, Thymoma, lung adenocarcinoma, Thoracoscopic minimally invasive surgery

Introduction

Uremia patients are often accompanied by impaired immune function due to long-term hemodialysis, and are prone to infectious diseases and tumor diseases. Several studies have shown that compared with the general population, uremic patients receiving hemodialysis have a higher incidence rate of cancer [1–3]. Lung cancer and thymoma are common malignant tumors in chest tumors, but it is relatively rare for both to occur simultaneously. We encountered a patient with uremia undergoing hemodialysis combined with thymoma and early lung cancer. We designed a localization method to accurately locate the pulmonary nodule and successfully performed thoracoscopic minimally invasive resection of both thymoma and lung cancer through a subxiphoid approach with the same incision for this patient. With the support of perioperative hemodialysis, the patient's outcome is good. This report describes the diagnosis and treatment process of the case and conducts a literature review.

Case presentation

A 41 year old female was admitted to the hospital with the chief complaint of having been diagnosed with stage 5 chronic kidney disease on hemodialysis for nearly 2 years, and having discovered a space occupying lesion in the anterior mediastinum and a nodule in the upper lobe of the right lung for more than 1 year. The patient has been undergoing regular hemodialysis treatment in our hospital for stage 5 of chronic kidney disease in the past 2 years. A year and 9 months ago, Chest CT scan

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shows a space occupying lesion in the anterior superior mediastinum, measuring 6.0×3.5x4.9 cm in size, with a mixed cystic solid pattern and smooth edges (Fig. 1A a, b, c), At the same time, a ground glass nodule was found in the upper lobe of the right lung. We suggested that the patient should undergo surgical treatment, but the patient refused the surgery due to concerns about her poor physical condition. During follow-up, this pulmonary nodule increased in size from 9×7 mm 1 year and 9 months ago to 11mmx9mm before surgery (Fig. 1B a, b). The patient did not have symptoms of myasthenia gravis, but had a history of hypertension. After admission, physical examination, blood test, biochemical test, and tumor marker test were conducted, and the results are shown in Table 1. The results of lung function and heart function tests were both normal. The admission diagnosis of this patient is (1) Chronic kidney disease (stage 5); (2) Anterior mediastinal mass; (3) Right upper lobe nodule; (4) Hypertension (grade 3).

Preoperative evaluation showed that the patient's anterior mediastinal lesions and pulmonary nodules could be surgically removed, and this patient also required surgical treatment. Considering that the patient has uremia and poor tolerance to mediastinal and pulmonary surgery, multiple surgeries are not recommended, and the surgical time should not be too long. Therefore, we decided to perform CO_2 inflation thoracoscopy via the subxiphoid process approach for thymectomy and right upper lobe wedge resection simultaneously at the same incision. We have made the following preoperative preparations: (1) The patient underwent routine hemodialysis treatment one day before surgery; (2) Localization of nodules in the upper lobe of the right lung before the start of surgery on the day of surgery. We adopted a localization method

Table 1 The results of physical examination, blood testing and biochemical examination and tumor marker detection

Indexes	Numerical value
Height	162 cm
Weight	43 kg
BP	170/110 mmHg
HR	75/min
Respiratory rate	21/min
RBC	4.1×10^12/L
Hb	123 g/L
UA	227 umol/L
UREA	10.73 mmol/L
CREA	612 umol/L
K+	5.17 mmol/L
CEA	4.1 ug/L
NSE	9.7 ug/L

that the localization point of the lung can be observed both in imaging and thoracoscopy, and the operation steps are as follows: Firstly, cut a soluble medical absorbable haemostatic material into pieces and dissolve it in 10 ml of 50% glucose solution (Fig. 2a, b), Add 1 ml of 1% methylene blue solution and mix well to prepare a liquid with a certain concentration and blue color, and 5 ml of this liquid will be injected into the lung for localization of pulmonary nodule (Fig. 2c); Then, based on the location of the nodule in the right upper lobe of the lung on CT, we selected the puncture point at the third intercostal space of the right clavicle midline (Fig. 2e), because the level here is located about 3 cm below the level of the nodule in the right upper lobe of the lung. The depth of puncture is determined by measuring the thickness of the

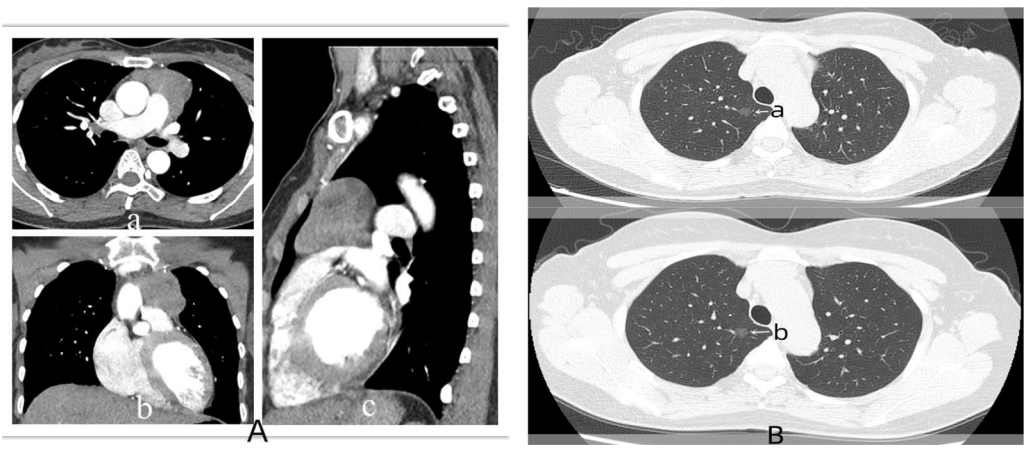

Fig. 1 **A** Space occupying lesion in the anterior superior mediastinum, mixed cystic solid type (arrow), a horizontal plane, b coronal plane, c sagittal plane. **B** A nodule in the upper lobe of the right lung (indicated by the arrow), (a) shows 1 year and 9 months ago, and (b) shows 1 year and 9 months later

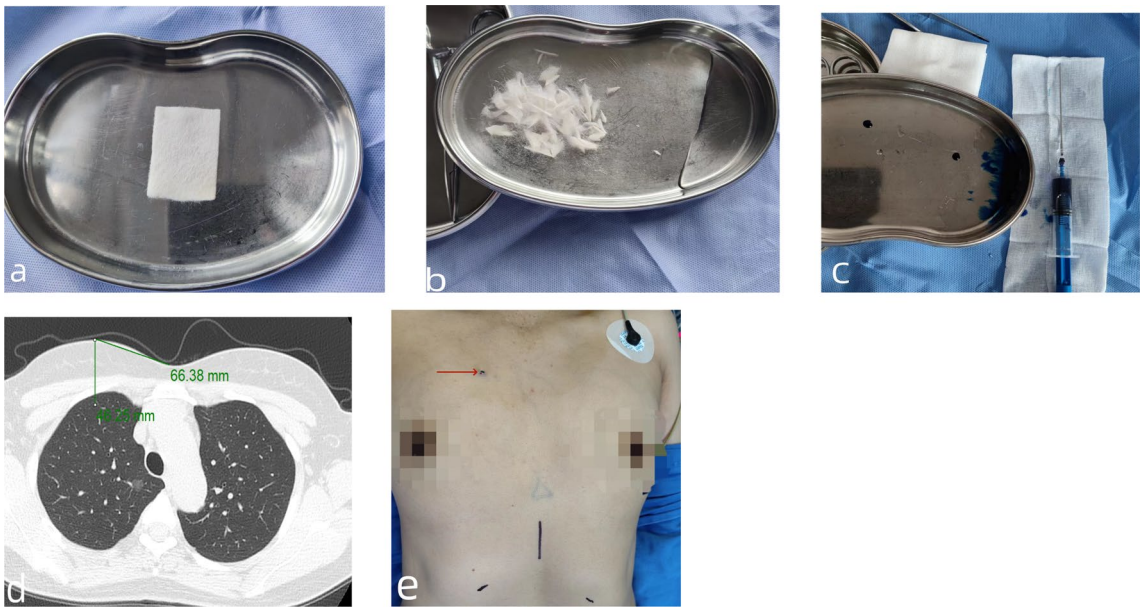

Fig. 2 **a** Absorbable hemostatic materials, **b** the absorbable hemostatic material was cut into small pieces and dissolved in glucose solution, **c** that methylene blue solution was added and mix well, **d** the measurement of puncture depth of the puncture needle from CT images, **e** the selection of puncture points

chest wall (Fig. 2d), and the depth of the puncture needle entering the lungs is approximately 0.5-1 cm. After successful puncture, the liquid we prepared was quickly injected into the lung tissue, followed by immediate chest CT examination. On chest CT, a nodular shadow similar to soft tissue density appears at the puncture site (Fig. 3a–c), which is located about 3 cm below the apical segment of the right lung nodule. This nodular shadow is the reference mark for determining the resection range of the right lung lesion during surgery, and due to its blue surface, it is easy to find under thoracoscopy during surgery (Fig. 3d).

Surgical procedure: The patient was placed in a supine split leg position under general anesthesia with dual lumen tracheal intubation. An incision of about 3 cm was made under the subxiphoid to establish a sternal tunnel. A 10 mm puncture trocar was inserted and the incision was sutured to seal, then a thoracoscope was inserted from this port (Fig. 4A a). A 0.5 cm incision was made under both rib edges, with a 5 mm puncture trocar inserted (Fig. 4A b, c). A laparoscopic forceps was placed on the left side, and an ultrasonic scalpel was placed on the right side (Fig. 4B). The CO2 pressure was 10 mmHg, and the flow rate was 12 L/min. The surgery is divided into two parts: thymectomy and right upper lobe wedge resection.

The first part is to perform thymectomy. Firstly, fully incise the bilateral mediastinal pleura, free the front of the thymus, free the adipose tissue on both sides of the thymus and its surrounding areas in front of the bilateral phrenic nerves, free the lower pole of the thymus and the isthmus from bottom to top in front of the pericardium, expose the innominate vein, and expose the upper pole of the thymus on both sides above the innominate vein and cut it off. During the operation, we observed a large tumor in the anterior mediastinum that adhered to the left upper lobe of the lung (Fig. 5a). However, the outer membrane of the tumor was intact and did not invade the surrounding tissues (Fig. 5b). We added a 1.5 cm incision in the 5th intercostal space of the left clavicle midline (Fig. 4A d), inserted a 12 mm trocar (Fig. 4C), and placed a laparoscopic forceps from this port to pull the thymus to assist in completing thymectomy (Fig. 5c). The second part is wedge resection of the right upper lobe of the lung. Firstly, the blue stained area of the right upper lobe was discovered under thoracoscopy, which is the preoperative localization point (Fig. 3d). Based on this localization point, the resection range was determined. Subsequently, an endoscopic stapler with a 60 mm blue nail compartment was inserted from the trocar in the left fifth intercostal space, and a wedge resection of the right upper lobe of the lung was performed above the positioning point, with the cutting edge oriented horizontally (Fig. 5d). Finally, the excised thymic, lymph nodes and lung tissue were placed in a specimen bag and taken out from the incision under the subxiphoid process (Fig. 6a, b, c,d). Two closed thoracic drainage tubes with a diameter of 5 mm were inserted into the chest cavity through

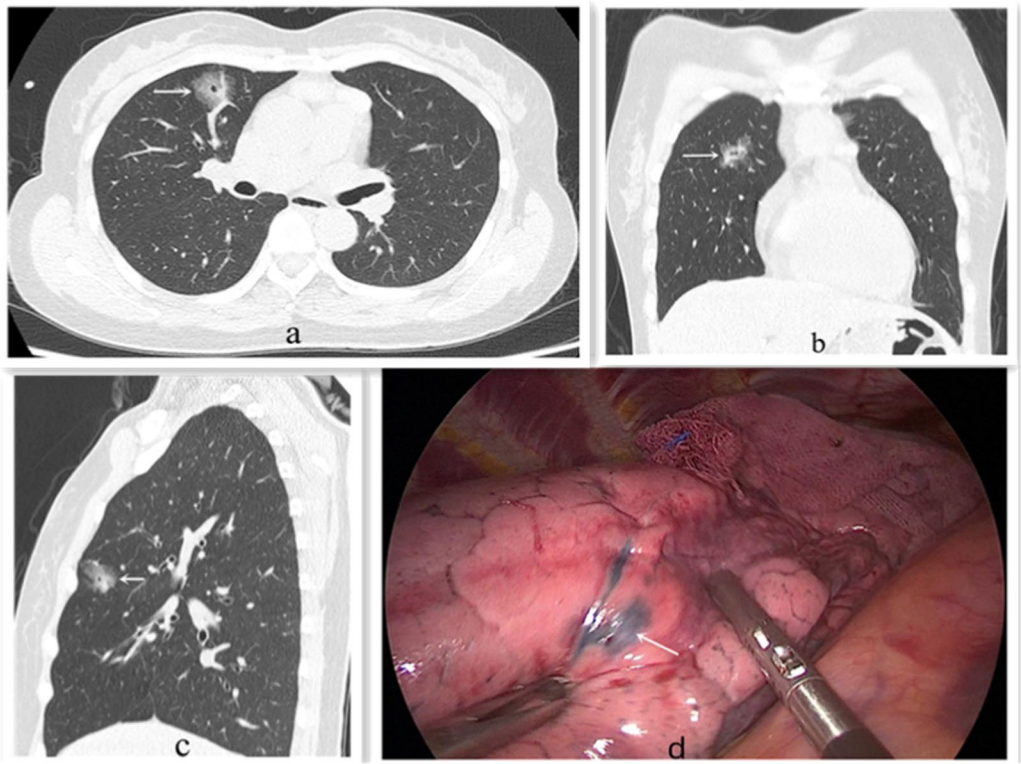

Fig. 3 **a**–**c** The localized nodule in the upper lobe of the right lung on chest CT (indicated by arrows), while **d** shows the localization marker on the upper lobe of the right lung under thoracoscopy (indicated by arrows)

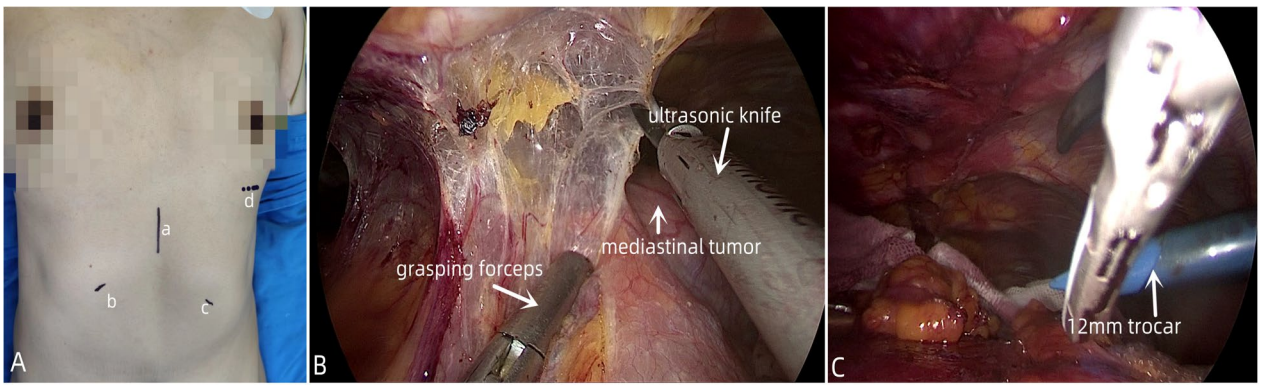

Fig. 4 Incision diagram, **a** represents the incision under the subxiphoid process, **b**, **c** represent the incisions under the rib margins on both sides, and **d** represents the incision in the 5th intercostal space of the left clavicle midline

incisions below the rib edges on both sides, and the surgery was successfully completed. The surgical time is about 150 min, and the intraoperative blood loss is about 20 ml. The patient received bedside hemodialysis treatment on the 1st, 4th, and 7th day after operation. Due to persistent pleural effusion, the thoracic drainage tubes were not removed until the seventh day, and the patient was discharged on the 8th day. The hospital stay was 11 days, and the patient had no serious complications during the perioperative period.

Pathological diagnosis and follow-up: The pathological diagnosis of the anterior mediastinal mass is thymoma (b1 type), and no lymph node metastasis. The pathological diagnosis of the right upper lobe nodule is invasive lung adenocarcinoma (acinar type). Due to the fact that mediastinal tumor was R0 resected and the pathological

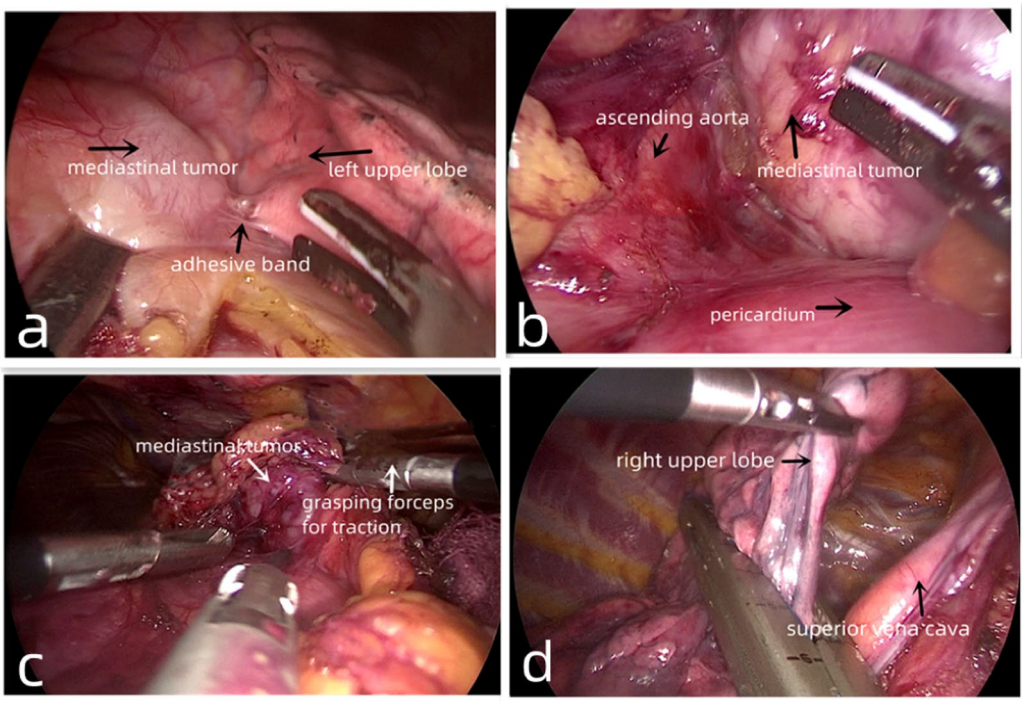

Fig. 5 **a** Adhesion between the mediastinal tumor and the left upper lobe of the lung, **b** the outer membrane of the tumor was intact and did not invade the surrounding tissues, **c** a laparoscopic forceps from 12 mm trocar to pull the thymus, **d** a wedge resection of the right upper lobe of the lung

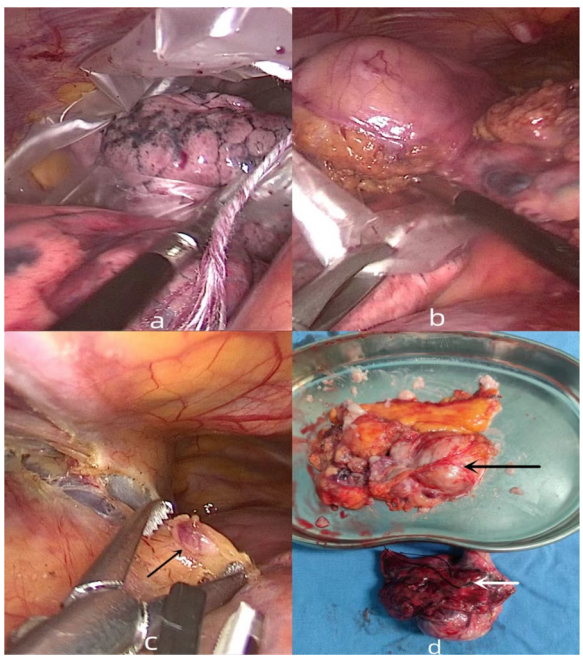

Fig. 6 **a** Lung tissue placed in a specimen bag, **b** the mediastinal tumor tissue placed in a specimen bag, **c** lymph nodes, **d** shows specimens of anterior mediastinal mass and pulmonary nodule: white arrow represents tumor tissue in the anterior mediastinum, and black arrow represents pulmonary nodule in the upper lobe of the right lung

type was B1 type thymoma which malignancy was relatively low, postoperative radiotherapy is not recommended. Because the pathological subtype of lung cancer was alveolar adenocarcinoma with low malignancy and low risk of recurrence and metastasis, patients did not receive anti-tumor treatment after surgery. Regular hemodialysis treatment was continued, and there were no signs of tumor recurrence during a follow-up period of nearly 2 years (Fig. 7).

Discussion

Because of the accumulation of toxins in the body, the immune cell activity of uremic patients is inhibited, which not only increases the risk of cancer, but also increases the susceptibility to infection. In addition, there is a high incidence rate and mortality of cardiovascular diseases [4–7]. On this condition, if these patients receive surgical treatment, their perioperative complications and mortality rate will be significantly higher than the general population [8, 9]. Therefore, uremia is a relative contraindication for many major operations, but not an absolute contraindication. Some literature has reported successful cases of uremia combined with malignant tumors undergoing major operations [8, 10].

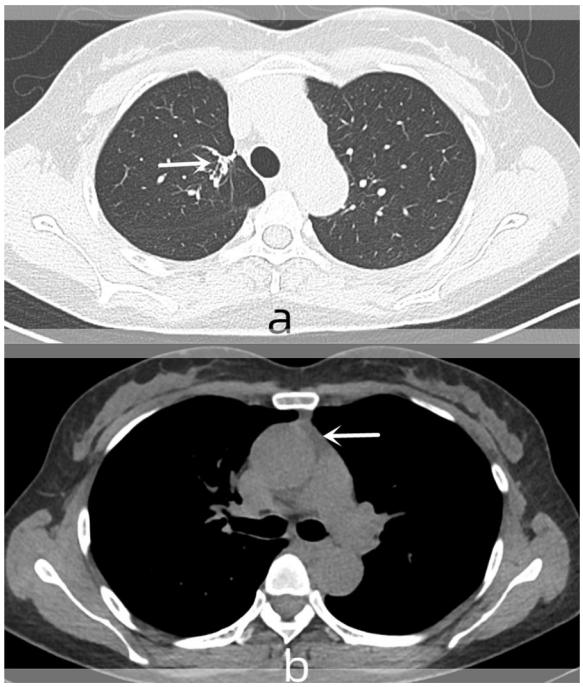

Fig. 7 Chest CT scan 2 years after surgery. The arrow in **a** indicates the original surgical site of the lung, while the arrow in **b** indicates the original surgical site of the mediastinal tumor

In malignant tumor patients undergoing hemodialysis treatment, due to severe renal dysfunction, patients often experience reduced excretion or metabolism of anti-tumor drugs through the kidneys, leading to increased toxicity associated with drug treatment, even complications such as tumor lysis syndrome that severely impair renal function may occur, thereby limiting tumor drug treatment and ultimately promoting tumor progression [11, 12].Therefore, renal failure is an important factor limiting cancer patients from receiving anti-tumor treatment, which also leads to significantly higher cancer-related mortality rates in hemodialysis patients compared to the general population [3, 4]. However, for some malignant tumor patients, despite the significant risks associated with surgical treatment, it has almost become the only possible treatment method for achieving long-term survival when drug therapy is limited.

The patient with uremia we encountered had both early-stage lung cancer and giant thymoma. After reviewing the literature, we did not find any similar case reports, so there is no treatment method that can be used as a reference for this patient. Surgical treatment is almost the only feasible treatment for this patient to achieve long-term survival. Based on the characteristics of the patient's condition, we designed an individualized treatment plan. Firstly, perioperative blood dialysis treatment was used. Secondly, we used a simple and effective localization method for the patient's lung nodule. Then, we used thoracoscopic surgery to complete thymectomy for thymoma and wedge resection for lung nodule in the same position and the same surgical incision, The surgery was successful, and the damage was minimized. The patient did not experience any serious complications during the perioperative period.

The highlight of this treatment method lies in the following points: (1) We creatively used a lung nodule localization method by dissolving an absorbable hemostatic material in high concentration glucose, and then adding methylene blue to make a high concentration viscous liquid. After injection into the lungs, it can form a certain density of clump locally, which can be displayed on CT. The methylene blue in this liquid can be detected under thoracoscopy due to its blue color on the surface of lung tissue. (1) We creatively used a method for locating pulmonary nodules, which involves dissolving an absorbable hemostatic material in high concentrations of glucose, adding methylene blue to it, and creating a high concentration viscous liquid. After injection into the lungs, it can form a local mass shadow similar to soft tissue density that can be displayed on CT, Meanwhile, methylene blue in this liquid can be detected under thoracoscopy due to its blue color on the surface of lung tissue. The liquid we produce is harmless to the human body, quickly absorbed, and inexpensive. Compared to conventional CT guided pulmonary nodule localization methods, this localization method only requires one CT examination of the patient, which not only reduces radiation damage caused by repeated CT scans, but also reduces medical costs. (2) If a patient suffers from both lung cancer and thymoma and needs to undergo surgery on both areas simultaneously, the conventional surgical method is to first perform thoracoscopic thymectomy through the subxiphoid process in a supine position with legs divided. After this surgery, the patient needs to change his position to a healthy lateral position in order to complete thoracoscopic wedge resection of the lung through a intercostal incision, This operating mode undoubtedly increases the time for surgery and anesthesia. However, in the treatment of this case, we performed a thoracoscopic operation on both lung cancer and thymoma simultaneously in the same position and under the same incisions, which minimized the damage caused by surgery and anesthesia to the patient. (3) Due to the large volume of the thymoma in this patient, if thymectomy is to be performed, it usually requires a midline thoracotomy, which is difficult to complete with conventional thoracoscopic surgery via the subxiphoid process. However, the midline thoracotomy surgery will cause significant damage to this patient. To perform thoracoscopic thymectomy via the subxiphoid process for this patient,

we added a 1.5 cm incision in the 5th intercostal space of the left clavicle midline, through which laparoscopic forcep can be inserted to pull the huge thymoma, thus the patient avoided the midline thoracotomy surgery. In addition, an endoscopic cutting and suturing device can also be inserted into the right chest cavity through this port for wedge resection of the right upper lobe of the lung.

In conclusion, the series of treatment methods we have designed for this patient have been proven to be safe and feasible, which is in line with the patient's interests. The success of this patient's treatment is partly due to her age advantage and shorter hemodialysis time, and partly due to that we adopted a reasonable and personalized treatment strategy. This indicates that combined uremia is not an absolute contraindication for thoracic surgery. For some selective cases, if sufficient perioperative preparation is made and reasonable surgical methods are selected, they can also receive good prognosis after receiving surgical treatment.

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Author contributions
Yong-jun Deng: the acquisition, analysis, interpretation of data and have drafted the work or substantively revised it. Huan-peng Liu and Jian-bin Zou：the acquisition, analysis.

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Availability of data and materials
All data, models, and code generated or used during the study appear in the submitted article.

Declarations

Ethics approval and consent to participate
The study was approved by the Ethics Committee of the Affiliated Hospital of Yunnan University and the informed consent was signed by the patients in advance.

Consent for publication
Written and signed consent to publish the case was obtained from the patient.

Competing interests
The authors declare no competing interests.

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References

1. Maisonneuve P, Agodoa L, Gellert R, et al. Cancer in patients on dialysis for end-stage renal disease: an international collaborative study. Lancet. 1999;354(9173):93–9. https://doi.org/10.1016/s0140-6736(99)06154-1.
2. Butler AM, Olshan AF, Kshirsagar AV, et al. Cancer Incidence Among US Medicare ESRD Patients Receiving Hemodialysis, 1996–2009. Am J Kidney Dis. 2015;65(5):763–72. https://doi.org/10.1053/j.ajkd.2014.12.013.
3. Betjes MG. Uremia-associated ageing of the thymus and adaptive immune responses. Toxins (Basel). 2020;12(4):224. https://doi.org/10.3390/toxins12040224.
4. Betjes MG. Immune cell dysfunction and inflammation in end-stage renal disease. Nat Rev Nephrol. 2013;9(5):255–65. https://doi.org/10.1038/nrneph.2013.44.
5. Wakasugi M, Kazama JJ, Yamamoto S, et al. Cause-specific excess mortality among dialysis patients: comparison with the general population in Japan. Ther Apher Dial. 2013;17(3):298–304. https://doi.org/10.1111/j.1744-9987.2012.01144.x.
6. Vogelzang JL, van Stralen KJ, Noordzij M, et al. Mortality from infections and malignancies in patients treated with renal replacement therapy: data from the ERA-EDTA registry. Nephrol Dial Transplant. 2015;30(6):1028–37. https://doi.org/10.1093/ndt/gfv007.
7. Dounousi E, Duni A, Naka KK, Vartholomatos G, Zoccali C. The innate immune system and cardiovascular disease in ESKD: monocytes and natural killer cells. Curr Vasc Pharmacol. 2021;19(1):63–76. https://doi.org/10.2174/1570161118666200628024027.
8. Palamuthusingam D, Nadarajah A, Pascoe EM, et al. Postoperative mortality in patients on chronic dialysis following elective surgery: a systematic review and meta-analysis. PLoS ONE. 2020;15(6): e0234402. https://doi.org/10.1371/journal.pone.0234402.
9. Palamuthusingam D, Nadarajah A, Johnson DW, Pascoe EM, Hawley CM, Fahim M. Morbidity after elective surgery in patients on chronic dialysis: a systematic review and meta-analysis. BMC Nephrol. 2021;22(1):97. https://doi.org/10.1186/s12882-021-02279-0.
10. Ou YC, Yang CR, Yang CK, Cheng CL, Hemal AK. Simultaneous robot-assisted nephroureterectomy and cystectomy in patients with uremia and multifocal urothelial carcinoma. J Endourol. 2011;25(6):979–84. https://doi.org/10.1089/end.2010.0602.
11. Yamamoto Y, Kanzaki R, Ose N, Funakoshi Y, Ikeda N, Takami K, Iwasaki T, Iwazawa T, Yokouchi H, Shiono H, Kodama K, Shintani Y; Thoracic Surgery Study Group of Osaka University. Lung Cancer Surgery for Patients on Hemodialysis: A Decade of Experience at Multicenter Institutions. Ann Thorac Surg. 2020;109(5):1558–1565. https://doi.org/10.1016/j.athoracsur.2019.11.044.
12. Janus N, Launay-Vacher V, Thyss A, et al. Management of anticancer treatment in patients under chronic dialysis: results of the multicentric CANDY (CANcer and DialYsis) study. Ann Oncol. 2013;24(2):501–7. https://doi.org/10.1093/annonc/mds344.

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