Original Article

Feasibility of twenty-four-hour discharge of patients with anterior mediastinal tumors after subxiphoid video-assisted thoracoscopic surgery (VATS) procedure

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Background: A wide variety of surgical procedures are administrated in day-surgery unit and are able to be discharged within 24 hours with high efficiency, safety and economy. This study sought to evaluate the safety and feasibility of 24-hour discharge of patients with anterior mediastinal tumors after subxiphoid video-assisted thoracoscopic surgery (VATS) and describe our surgery procedure experiences.

Methods: A total of 70 selected patients with anterior mediastinal tumors undergoing subxiphoid VATS were included in this prospective study. The patients' clinical features, intraoperative and postoperative complications were assessed, and postoperative pain scale and satisfaction scores were also evaluated.

Results: The subxiphoid VATS was completed with no conversion to open surgery in all included patients and were all discharged within 24 hours after surgery. The mean operative time ± standard deviation (SD) was 70.50±18.98 min, and the mean operative blood loss volume ± SD was 45.50±15.25 mL. In addition, 80% of the patients reported a postoperative pain scale score less than 3 by the day before discharge, and all patients expressed satisfaction with receiving VATS in the day-surgery unit at 2 weeks after discharge.

Conclusions: The use of subxiphoid VATS is a safe, efficient and feasible surgical approach for patients with anterior mediastinal tumors discharged within 24 hours.

Keywords: Subxiphoid video-assisted thoracoscopic surgery (subxiphoid VATS); anterior mediastinal tumors; day-surgery unit

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Introduction

Median sternotomy has been the standard surgical approach for tumors located in the anterior mediastinum for decades (1). However, in the last decade, a minimally invasive procedure, video-assisted thoracoscopic surgery (VATS), has been developed to treat anterior mediastinal tumors (2). VATS procedures are usually performed using cervical, lateral thoracic, or subxiphoid approaches. The use of the subxiphoid approach in VATS was first reported in a case of thymic cystectomy by Akamine in 1999 (3). Since then, it has gained wide acceptance by thoracic surgeons, and has a number of advantages, including less postoperative pain, less injury, and a shorter postoperative hospital stay than lateral surgery (4-6). However, no research has been conducted on the implementation of subxiphoid VATS in the day-surgery unit, where patients receive a planned surgical procedure and are discharged the same working day (7), or in less than 48 hours in certain cases (8,9). The

definition of day surgery in our hospital (Sir Run Run Shaw Hospital), like the day surgery program at West China Hospital (10), is the admission of selected patients for a planned surgery with the expectation that the patient is to be discharged within 24 hours, excluding outpatient surgery, but the patient can stay overnight.

With the development of medical technology and the need to improve the cost-effectiveness of health services, day-surgery procedures have been widely applied in clinical practice (11). Given the increased efficiency of hospitals and the lower cost of such procedures, subxiphoid VATS for anterior mediastinal tumors should be considered in a day-surgery setting. In this study, we evaluated the safety and feasibility of conducting subxiphoid VATS for anterior mediastinal tumors in a day-surgery unit where patients were discharged within 24 hours, and described our experience of performing subxiphoid VATS as a day-surgery procedure. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1277/rc).

Highlight box

Key findings

- Subxiphoid video-assisted thoracoscopic surgery (VATS) is a safe and practical approach, which can be performed in the day-surgery unit with selected patients being discharged within 24 hours after surgery.

What is known, and what is new?

- VATS is a minimally invasive procedure for treating tumors located in the anterior mediastinum.
- Subxiphoid VATS was implemented in the day-surgery unit, where patients received a planned surgical procedure and were discharged within 24 hours.

What is the implication, and what should change now?

- Selected patients with anterior mediastinal tumors can receive VATS in a day-surgery unit and be discharged within 24 hours.

Methods

Patient selection

From December 2021 to August 2023, a total of 70 patients with anterior mediastinal tumors who underwent VATS in the day-surgery unit of Sir Run Run Shaw Hospital were included in this study. Patients' inclusion criteria were as follows: (I) imaging data showed anterior mediastinal tumor with a tendency of enlargement during follow-up, or have discomfort complaint such as chest tightness, shortness of breath. (II) All the patients had anterior mediastinal tumors with clear boundaries with the peripheral nerves and large vessels and organs, and without metastasis to the bilateral lung, mediastinal lymph nodes, or distant organs. (III) If the tumors were complicated with myasthenia gravis (MG), they had to be classified as Myasthenia Gravis Foundation of America (MGFA) class I–II with the well-controlled MG symptoms. (IV) All the patients had an American Society of Anesthesiologists (ASA) grade of I–II and had no contraindications to surgery or general anesthesia. Exclusion criteria include: (I) the anterior mediastinal tumors have adhesion with surrounding tissues, nerves, organs and large vessels, or with unclear boundary, or multiple metastasis in bilateral lungs and other sites. (II) Patients with MG who were receiving medical treatment, and who had been determined to be unsuitable for surgery at day-surgery unit after evaluation. (III) Patients with a previous history of thymic tumor resection and consideration of recurrence and metastasis. (IV) Patients with a history of other malignant tumors, and the possibility of anterior mediastinal metastasis was considered. (V) Patients who are refused to receive surgery at day-surgery unit. This study was conducted in accordance with the principles outlined in the Declaration of Helsinki (as revised in 2013). The design of the present study was reviewed and approved by the Ethics Committee of Sir Run Run Shaw Hospital (No. 2024-2212-01), and informed consent was taken from all the patients.

Day-surgery unit admission procedures

All the patients included in this study received standardized management processes as shown in *Figure 1*. In the outpatient department, the patients with anterior mediastinal tumors underwent preoperative evaluations, including a complete blood count test, biochemistry and tumor marker tests, an electromyography examination, enhanced chest computed tomography (CT), cardiac ultrasound, electrocardiogram, and a lung function test. The patients who had no surgical contraindications after the preoperative examination then underwent VATS in the day-surgery unit. On the day of the surgery, the patients consumed energy drinks orally 4 hours before the surgery. After the surgery, the patients entered the post-anesthesia care unit for resuscitation, and were then sent to the day-surgery ward for postoperative management. All the patients received intravenous pain analgesia after surgery, and began a normal diet 6 hours after anesthesia resuscitation. On the

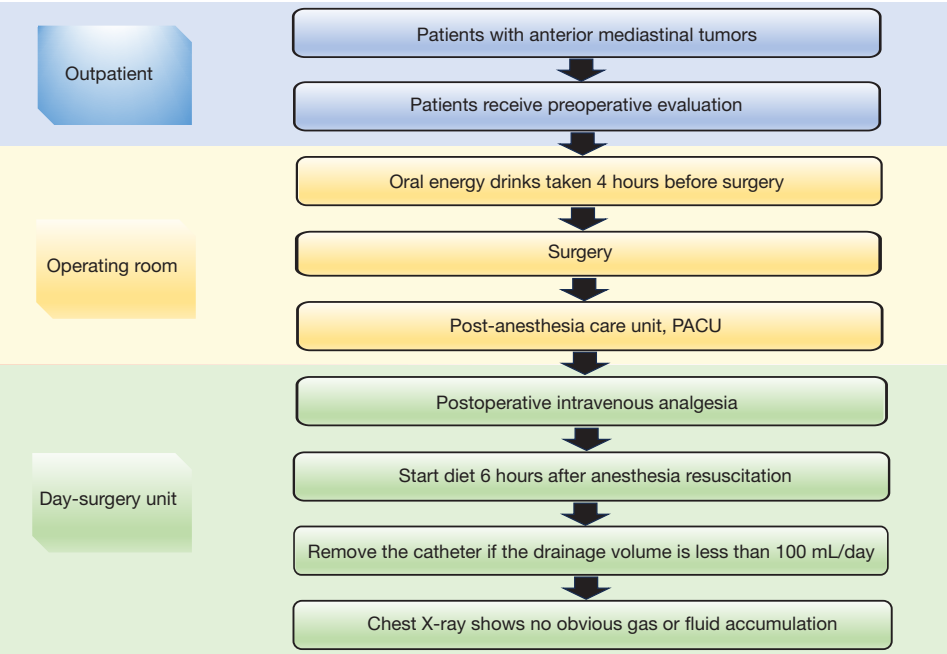

Figure 1 The standardized management processes for patients receiving subxiphoid VATS in the day-surgery unit. VATS, video-assisted thoracoscopic surgery.

second day after surgery, the patients were discharged if they met the discharge criteria after evaluation.

Surgery procedures

The detailed surgical procedures of VATS are shown in *Figures 2,3*. Briefly, each patient was placed in the supine position, and the surgeon stood on the right of the patient. Under general anesthesia, a 2-cm horizontal incision was made below the xiphoid process, and a 1.5-cm incision and 5-mm incision were made at 0.5 cm below the intersection of the midclavicular line and costal arch, respectively, with the left side incision serving as an endoscopic observation incision and the right side incision serving as an auxiliary operation incision. After the left port placement, carbon dioxide insufflation began, and an intrapleural pressure of 8 mmHg was maintained. Next, a total anterior mediastinal tumor resection was routinely performed with safe surgical margins, employing the no-touch technique. An 8-F chest drain was placed in each mediastinal cavity at the end of the surgery.

Discharge standard

All the patients had to meet the discharge criteria based on a symptom assessment and imaging examination before discharge. Specifically, the patients had to be able to get out of bed and exercise autonomously on the second day after surgery, and the radiograph examination taken on the second day after surgery had to show no hemothorax, pneumothorax, or atelectasis on the chest.

Follow-up management

The follow-up management of the discharged patients relied on outpatient review and telephone calls. All the patients returned to the outpatient department for a follow-up review 2 weeks after surgery. The patients also underwent outpatient or telephone follow up every 3 months.

Results

Patient characteristics

A total of 70 patients who received VATS in the day-surgery unit were included in this study. The patients had an average age of 51±10.9 years. Of the patients, 32 were male and 38 were female, and 32 (45.71%) had a body mass index (BMI) >24 kg/m^2, and 20 (28.57%) had a history of smoking.

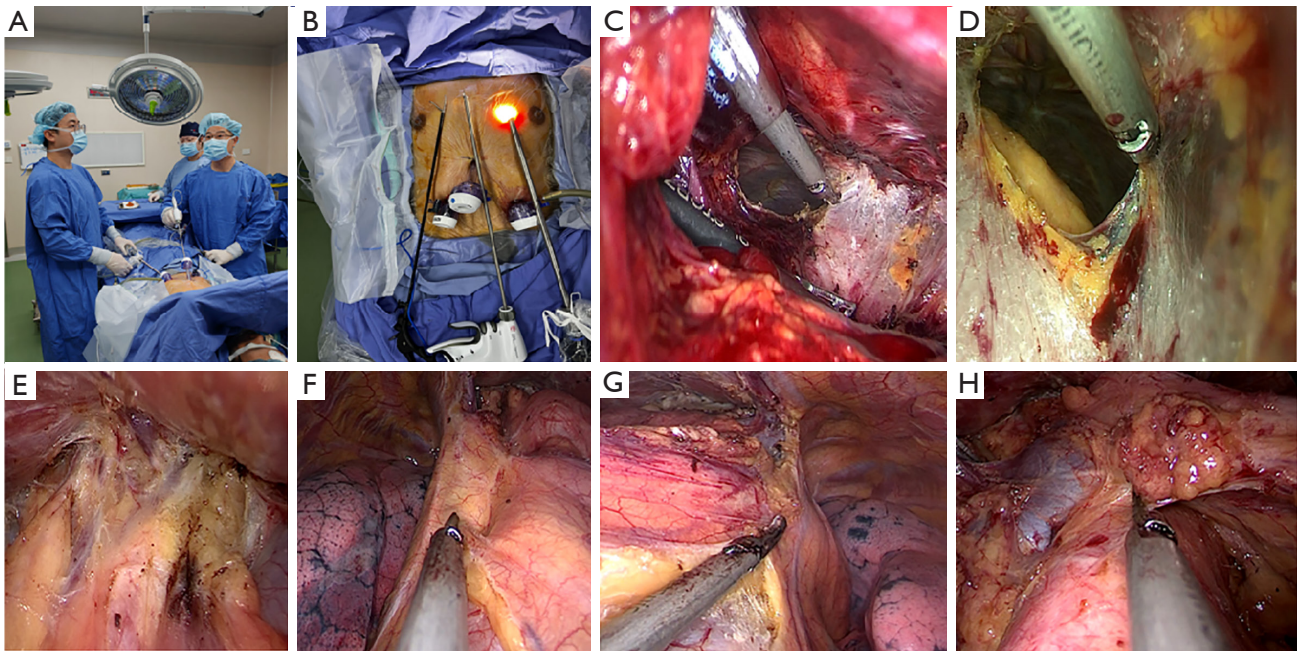

Figure 2 Images of surgeon's positioning and the well-exposed operative field. (A) Patient and operator positions. (B) Incisions. (C,D) Cutting the right mediastinal pleura and the left mediastinal pleura. (E) Separating the posterior sternum space from the bottom to the suprasternal notch. (F,G) The bilateral mediastinal pleura was opened with an ultrasound scalpel along the phrenic nerve. (H) Clearing the pericardium fat from the diaphragmatic angle to the inferior margin of the innominate vein. This image (A) is published with the participants' consent.

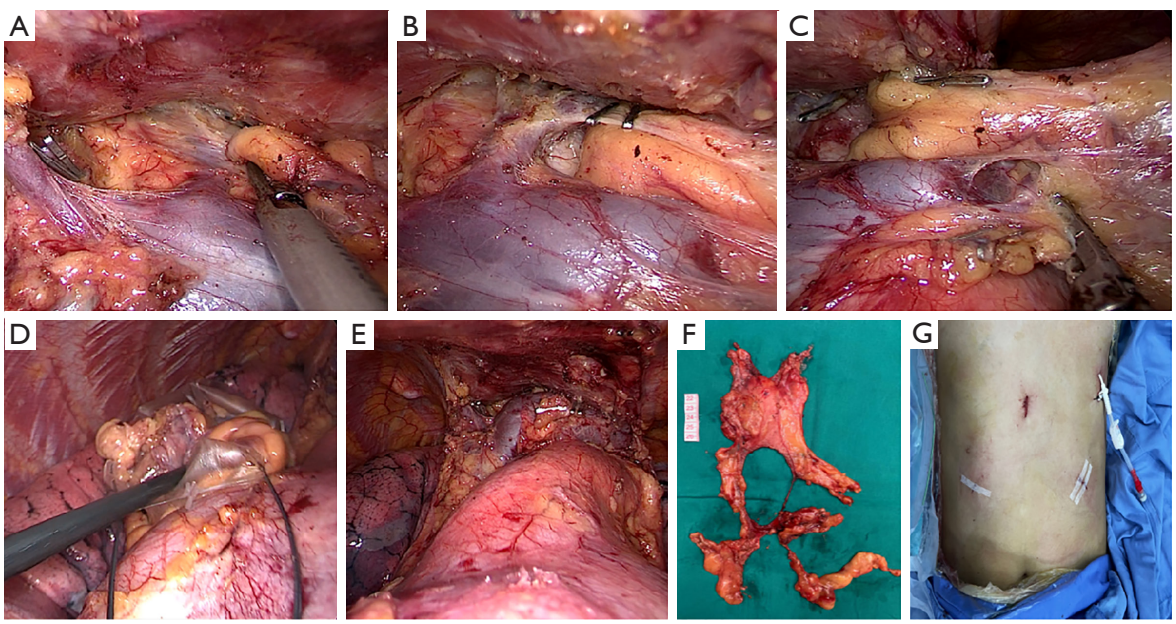

Figure 3 Images of the well-exposed operative field, surgical specimen and postoperative drainage. (A) Separating the right upper pole of the thymus and exposing the inferior thyroid vein. (B) Separating the left upper pole of the thymus and exposing the brachiocephalic artery, left innominate vein, and left common carotid artery. (C) Disconnection of the thymus vessels. (D) Removing the specimen from the main operation incision. (E,F) The scope of dissection including the bilateral anterior mediastinum, diaphragmatic angle, the peri thymus adipose tissue. (G) Incisions were sutured with absorbable thread and an 8-F-Abel tube was placed in the fifth costal axillary line instead of a chest tube.

Table 1 Demographic characteristics of the enrolled patients

Characteristics	Value (N=70)
Age (years)	51±10.9
Sex (male/female)	32/38
BMI (kg/m^2)	23.65±3.01
Smoking	20 (28.57)
Hypertension	14 (20.00)
Diabetes	2 (2.86)
COPD	6 (8.57)
Cardiopathy	8 (11.43)
Tumor size (cm)	2.7±1.9
ASA score (I–II)	70 (100.00)

Data are presented as mean ± standard deviation, number, or n (%). BMI, body mass index; COPD, chronic obstructive pulmonary disease; ASA, American Society of Anesthesiologists.

Table 2 Post-operative pathological diagnosis

Pathological diagnosis	Number of patients
Thymic cyst	29
Pericardial cyst	15
Type A thymomas	8
Type B thymomas	4
Type AB thymomas	5
Teratoma	4
Thymic carcinoma	3
Lymphoma	1
Ectopic parathyroid gland	1

Table 3 Surgical results

Parameters	Value (N=70)
Operation time, min	70.50±18.98
Blood loss, mL	45.50±15.25
Postoperative drainage, mL	85.47±11.09
Conversion	0

Data are presented as mean ± standard deviation or number.

The average tumor size was 2.7±1.9 cm. In relation to accompanying diseases, 14 (20.00%), 2 (2.86%), 6 (8.57%), and 8 (11.43%) of the patients had hypertension, diabetes, chronic obstructive pulmonary disease, and cardiopathy, respectively. Importantly, all the patients enrolled in this study had an ASA score of I–II (*Table 1*). Postoperative pathological results are shown in *Table 2*. There were 17 thymomas (8 type A, 4 type B, 5 type AB) and 3 thymic carcinomas, and only 1 patient was complicated with MG, MGFA class I.

Surgical results

All the patients received VATS using the subxiphoid approach. The total operative time was 70.50±18.98 min, and the volume of blood loss during operation was 45.50±15.25 mL. No patient required conversion to thoracotomy during surgery (*Table 3*). After the patients returned to the day-surgery care ward, the average pleural drainage volume was 85.47±11.09 mL on the first day after surgery. No patient suffered an atrial fibrillation, pulmonary infection, atelectasis, pulmonary embolism, prolonged air leak, postoperative bleeding, or wound infection after VATS. Chest X-ray revealed good pulmonary re-expansion in all patients, and only two patients suffered pleural effusion without any significant clinical symptoms, therefore all patients were extubated immediately before discharging. All patients received intravenous administration of flurbiprofen axetil injection for pain management after surgery, and patients were asked to rank their pain using the pain scale (which ranged from 0 to 10, and on which 0 represented no pain, and 10 represented the worst pain) postoperatively by the day before discharge. Most of the patients tolerated the pain well, with 56 (80%) patients rating their pain as less than 3 on the postoperative pain scale (*Table 4*).

Patient satisfaction

Patients were asked to evaluate their satisfaction by providing a postoperative satisfaction score (on a scale ranging from 0 to 5, on which 0 represented total dissatisfaction, and 5 represented the highest level of satisfaction) at 2 weeks after discharge. As *Table 5* shows,

Table 4 Postoperative complications

Parameters	Value (N=70)
Drainage in first 24 hours (mL)	85±16
Postoperative bleeding	0
Atrial fibrillation	0
Pulmonary infection	0
Pleural effusion	2
Atelectasis	0
Pulmonary embolism	0
Prolonged air leak	0
Wound infection	0
Postoperative pain scale (VAS)	
0–3	56 [80]
4–6	14 [20]
7–10	0
Readmission rate	0

Data are presented as mean ± standard deviation, number, or n [%]. VAS, visual analog scale.

Table 5 Assessment of patient satisfaction

Patients' satisfaction score	Number of patients
0	–
1	–
2	–
3	4
4	52
5	14

all the patients expressed satisfaction with the VATS procedure in the day-surgery unit, and 14 patients (20%) patients expressed the highest level of satisfaction with the procedure. All the patients were followed up at 3 months, and no postoperative complications were observed.

Discussion

A total of 70 patients with anterior mediastinal tumors who underwent subxiphoid VATS at the day-surgery unit were included in this study. During the median follow-up period of 46 days, no patient required emergency room admission or emergency surgery, and almost all patients expressed satisfaction with the procedure and surgery outcome. Our results suggest that if patients are carefully selected, subxiphoid VATS is safe and feasible, and patients can be discharged within 24 hours with acceptably low rates of major complications and readmission for any complication.

Day surgery refers to the hospitalization, surgical operation, brief postoperative observation, rehabilitation, and discharge of patients with certain indications within one working day. The China Ambulatory Surgery Alliance notes that day surgery is a planned operation for patients in addition to outpatient surgery, and for patients receiving day surgery with special conditions or those with disease progression, the longest time of the hospital stay should not exceed 48 hours (8,9). In our hospital, we defined the day surgery as the admission of selected patients for a planned surgery with the expectation that the patient is to be discharged within 24 hours after surgery. According to literature reports, patients undergoing VATS are generally required to be hospitalized for 3–5 days before discharge (6,12). In this study, by optimizing the surgical methods and procedures, and employing the enhanced recovery after surgery (ERAS) approach, the patients were able to be safely discharged within 24 hours of the surgery.

The duration of the surgical operation is a key point in considering whether the patient is suitable for day surgery and discharge within 24 hours. Previous studies have shown that duration of operation represented the only predictive factor for the next morning discharge after VATS resection of thymus (13), and higher BMI also indicated for longer hospital stay (13,14). In this study, we placed patients in the supine position rather than the lithotomy position or the supine position with legs spread apart to reduce patients' movement and shorten the operation time. Moreover, we optimized subxiphoid VATS procedures by distributing the operating incisions to be right side dominant, making it more convenient for surgeons to operate and shortening the surgical time. Further, based on our experience in performing subxiphoid VATS, the innominate vein should be considered as the boundary, the inferior area and the superior area of the innominate vein are supposed to be processed sequentially. Then, the innominate vein was exposed easily and clearly to improve the operative process. Consequently, the mean surgical operation time in this study was 70.50±18.98 min, which is much shorter than that of conventional subxiphoid uniportal VATS or that of intercostal VATS (12). Subxiphoid procedures initially take a great deal of time to perform (12,15); however, we expect

that the operative time will decrease and stabilize with the accumulation of cases.

Another important factor affecting the discharge of patients within 24 hours after surgery is the development of acute complications, such as bleeding, atrial fibrillation, pulmonary infection, and pleural effusion. In subxiphoid VATS, surgeons have a wider surgical field of view due to the greater exposure of the anterior mediastinal area, which allows surgeons to reach high into the area above the level of the left innominate vein, and provides an excellent view of various important anatomical structures (16). As a result, surgeons can perform the surgery more precisely and achieve complete hemostasis during the subxiphoid VATS, which reduces intra- or postoperative complications. In this study, the patients receiving subxiphoid VATS suffered no atrial fibrillation, pulmonary infection, atelectasis, pulmonary embolism, prolonged air leak or wound infection, and only two patients suffered pleural effusion; these two patients displayed no significant clinical symptoms on the first day after surgery and recovered within 2 weeks.

ERAS is difficult to achieve in thoracic surgery due to postoperative pain (17), which may also prolong patients' hospital stay. Post-thoracotomy pain is very common and occurs in approximately 50% of patients after thoracotomy, and the incidence of postoperative pain for traditional intercostal incisive thoracoscopic surgery is similar to that of thoracotomy due to the damage of the intercostal nerve during operation (18). Damage of the intercostal nerves can be prevented in subxiphoid VATS, which reduces postoperative pain (15,16,19). As a result, all the patients underwent subxiphoid VATS in this study and tolerated the pain well, which is important in mobilizing patients' early and reducing postoperative complications. The placement of a chest tube is also thought to increase postoperative pain, even in patients who undergo subxiphoid VATS (20). In this study, all the patients underwent subxiphoid VATS and had their drainage tubes removed one day after surgery, which might have also reduced the patients' postoperative pain and improved their satisfaction levels.

Conclusions

Our findings suggest that subxiphoid VATS is a safe, practical, reproducible approach that can be performed in selected patients being discharged within 24 hours. The outcomes of this procedure were safe and satisfactory. Nevertheless, this study is limited by its single-institution nature and a short follow-up time. Well-designed multi-center or comparative studies are required to corroborate these findings.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1277/rc

Data Sharing Statement: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1277/dss

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1277/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was conducted in accordance with the principles outlined in the Declaration of Helsinki (as revised in 2013). The design of the present study was reviewed and approved by the Ethics Committee of Sir Run Run Shaw Hospital (No. 2024-2212-01), and informed consent was taken from all the patients.

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