

Middle lobe preservation and fixation after right upper and lower lobectomy for synchronous lung cancer

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Abstract

The incidence of multiple lung cancer has been steadily increasing worldwide. Although cases of patients with lung cancers in the right upper and lower lobe have also become more frequently reported in clinical work, simultaneous right upper and lower lobectomy reports with the middle lobe preservation are still quite rare. A total of three patients with lung cancers in the right upper and lower lobe were included in the study. The patients underwent simultaneous right upper and lower lobectomy, whereas the remaining middle lobe was sutured and fixed to the intercostal muscle of the incision to prevent postoperative lobe torsion. There was no procedure to reduce residual space, such as phrenic nerve crush or thoracoplasty. All patients were discharged from the hospital 7 days after the operation. The chest tube was removed 5 days after the operation in two patients. One patient was discharged with the tube because of slight pulmonary leakage, and the tube was removed 2 weeks after the operation. Six months after the operation, the chest computer tomography showed that the middle lobe expanded well and no obvious cavity or pleural effusion was found. The suture of the remaining middle lobe and intercostal muscle of the incision is a simple and effective method that can be used to successfully avoid middle lobe torsion. This strategy is safe and can be used as the first choice for eligible patients.

KEYWORDS

Lung cancer; middle lobe preservation; pulmonary bilobectomy; pulmonary function.

INTRODUCTION

Currently, lung cancer incidence rates rank first among all malignant tumors worldwide.^{1,2} The number of patients with multiple primary lung cancer has also been steadily increasing year by year.³ In the management of these patients, thoracic surgeons are still searching for the best way to remove the tumor and preserve the normal lung tissue to the maximum extent.

There are few reports on the synchronous right upper and lower lobectomy with the middle lobe preservation.^{4–6} Since November 2016, our team has treated three patients with right upper and lower lobe lung cancers, all of whom underwent synchronous right upper and lower lobectomy.

This report presents our clinical experience with these patients.

METHODS

All patients undergoing the synchronous right upper and lower lobectomy with the middle lobe preservation from 2016 to 2020 were identified and reviewed. Preoperative examinations included enhanced chest and brain computed tomography (CT), lung function, electrocardiogram, echocardiography, abdominal ultrasound, radionuclide bone imaging, bronchoscopy, and hematological examination, excluding distant metastasis and other surgical contraindications. The three patients had no other comorbidities like hypertension or diabetes.

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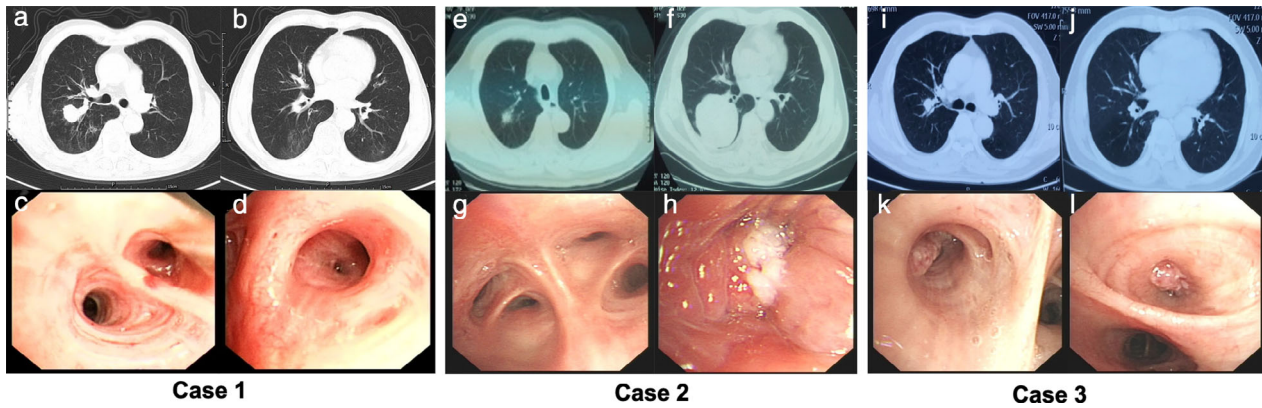


FIGURE 1 Preoperative CT and bronchoscopy images of three patients. Case 1 (a)–(d): chest CT showed a round nodule in the right upper lobe (a), and no obvious lesion was found in the lower lobe (b). Bronchoscopy showed a neoplasm in the bronchus of the posterior segment of the right upper lobe (c) and mucosal swelling to block the lumen in the bronchus of the lateral basal segment of the lower lobe (d). Case 2 (e)–(h): chest CT showed an irregular nodule in the right upper lobe (e) and a space-occupying lesion in the lower lobe (f). Bronchoscopy did not find neoplasms in the bronchus of the right upper lobe (g), but a neoplasm could be seen blocking the bronchial lumen of the dorsal segment of the lower lobe (h). Case 3 (i)–(l): chest CT showed a nodule in the right upper lobe (i), and no obvious lesion was found in the lower lobe (j). Bronchoscopy showed a neoplasm in the bronchus of the posterior segment of the right upper lobe (k) and a neoplasm in the bronchus of the dorsal segment of the lower lobe (l)

RESULTS

Clinical characteristics

Preoperative chest CT and bronchoscopy results are shown in Figure 1. Lung function and surgical data of the three patients are shown in Table 1. Preoperative and postoperative pathological results are shown in Table 2.

Surgical procedure

Case 1 underwent synchronous thoracoscopic upper and lower lobectomy with systemic lymph node dissection, case 2 underwent synchronous open upper and lower lobectomy with systemic lymph node dissection, and case 3 underwent synchronous open upper lobectomy and lower lobectomy and bronchoplasty with systemic lymph node dissection. Before the end of the three operations, the middle lobe was fully expanded to check for air leakage in lung tissue. If air leakage was observed, it was solved by suture to improve the expansion of the middle lobe. Next, the lung tissue near the incision was intermittently sutured with the incision's intercostal muscle for three stitches by silk threads to prevent

postoperative lung torsion before the incision was finally sutured (Figure 2). There was no procedure to reduce residual space (e.g., phrenic nerve crush or thoracoplasty). The chest tube was placed through the seventh intercostal space to the top of the chest cavity. The operative time and blood loss of the patients are shown in Table 1.

Clinical course

After the surgery, all patients were encouraged to cough to facilitate sputum discharge and lung expansion without respiratory physiotherapy routinely. No patients developed middle lobe atelectasis. All three patients were discharged from the hospital on the seventh day after the operation. When the drainage fluid in the chest tube was pale yellow and there was no air leakage, we removed the chest tube. Two patients successfully recovered without surgical complications, and the chest tube was removed on the fifth day after the operation. One patient was discharged with the chest tube because of slight air leakage, and the tube was removed 2 weeks after the operation.

The chest radiograph examination results on the second day after the operation showed that the remaining middle

TABLE 1 The surgery and lung functional data of patients

Cases	Age(y)	Sex	MVV (% Pred)	FEV1(L)	FEV1 (% Pred)	DLCO (% Pred)	Operation time(h)	Estimated bleed volume(mL)	Post-operative hospital stay(days)	Chest tube removal time(days)
1	68	M	90.5	2.35	90.5	67.7	3.5	100	7	5
2	64	M	85.3	2.45	82.6	82.9	3	100	7	5
3	63	M	64.4	2.15	70.0	72.9	3.5	100	7	14

Abbreviations: DLCO, diffusion capacity for carbon monoxide of lung; FEV1, forced expiratory volume in first 1 s; MVV, maximal voluntary ventilation.

TABLE 2 Preoperative and postoperative pathological data of patients

Cases	Lobe	Preoperative pathological type	Preoperative T stage	Preoperative N stage	Postoperative pathological type	Postoperative T stage	Postoperative N stage
1	UL	Poorly differentiated SCC	T1b	N0	Small cell carcinoma and large cell neuroendocrine carcinoma	T1c	N2
	LL	SCC	T1a	N0	SCC	T1a	N2
2	UL	-	T1b	N0	Adenocarcinoma	T1b	N0
	LL	SCC	T4	N0	SCC	T4	N0
3	UL	SCC	T1b	N0	SCC	T1c	N0
	LL	SCC	T1a	N0	SCC	T1a	N0

Abbreviations: LL, lower lobe; SCC, squamous cell carcinoma; UL, upper lobe.

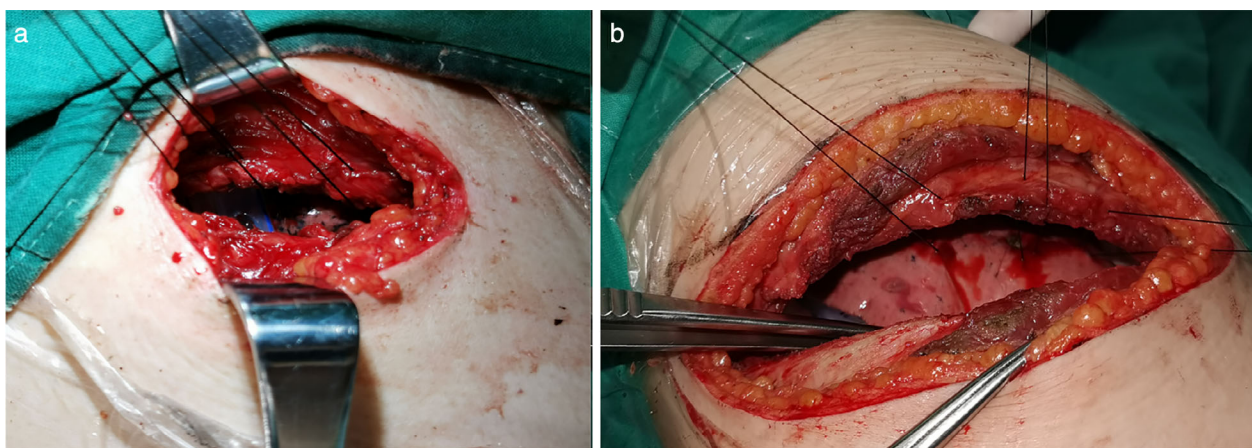


FIGURE 2 The method of preventing middle lung torsion. The suture position is the nearest place of the middle lobe close to the intercostal muscle of the incision. The lung tissue was intermittently sutured with the incision's intercostal muscle for three stitches by silk threads. (a) Image was taken during the VATS operation of case 1, through the fourth intercostal space; (b) image was taken during the open operation of case 2, through the fifth intercostal space

lobe in all three patients expanded well with clear margins, although the right thoracic cavity was not fully filled. The mediastinum slightly shifted to the right, and the upper end of the chest tube was at the top of the right chest (Figure 3 (a)–(c)). Patient 1 died of distant metastasis half a year after the operation. The chest CT results of the other two patients half a year after the operation showed that the right thoracic cavity became small, and the mediastinum markedly shifted to the right. The remaining middle lobe fully filled the cavity (Figure 3(d)–(i)).

DISCUSSION

Following the increase of lung cancer incidence, the cases of patients with lung cancers in the right upper and lower lobe have also become more frequent, whereas synchronous right upper and lower lobectomy reports with the middle lobe preservation are still quite rare. At this time, most doctors might choose the right pneumonectomy to avoid serious complications such as middle lobe torsion or atelectasis. Still, right pneumonectomy has been associated with a higher risk of mortality and complications than lobectomy.⁷ Middle lobe preservation can preserve more lung function,

reduce surgery risk, and improve postoperative quality of life.^{8,9}

In the present study, we successfully performed three cases of synchronous right upper and lower lobectomy with the middle lobe preservation. The operation was safe and feasible, with few complications. Only one patient experienced mild air leakage and healed 2 weeks after the operation. The complication most feared by surgeons is middle lobe torsion, which may lead to operation failure, sometimes even requiring another middle lobe resection and therefore additionally increasing the trauma.¹⁰ Consequently, many surgeons prefer to go straight to the right pneumonectomy. The method we applied to prevent middle lobe torsion in our three cases is pretty simple and straightforward. After the middle lobe expanded, lung tissue near the incision was fixed to the intercostal muscle by three intermittent sutures. Chest CT half a year after the operation showed that the middle lobe expanded well, and no obvious empty space and effusion was found in the right thoracic cavity. These results suggested that this fixation method is effective, and it can prevent middle lobe torsion without affect lung expansion.

After double lobectomy, patients lose more lung function than lobectomy, so there is a higher requirement for

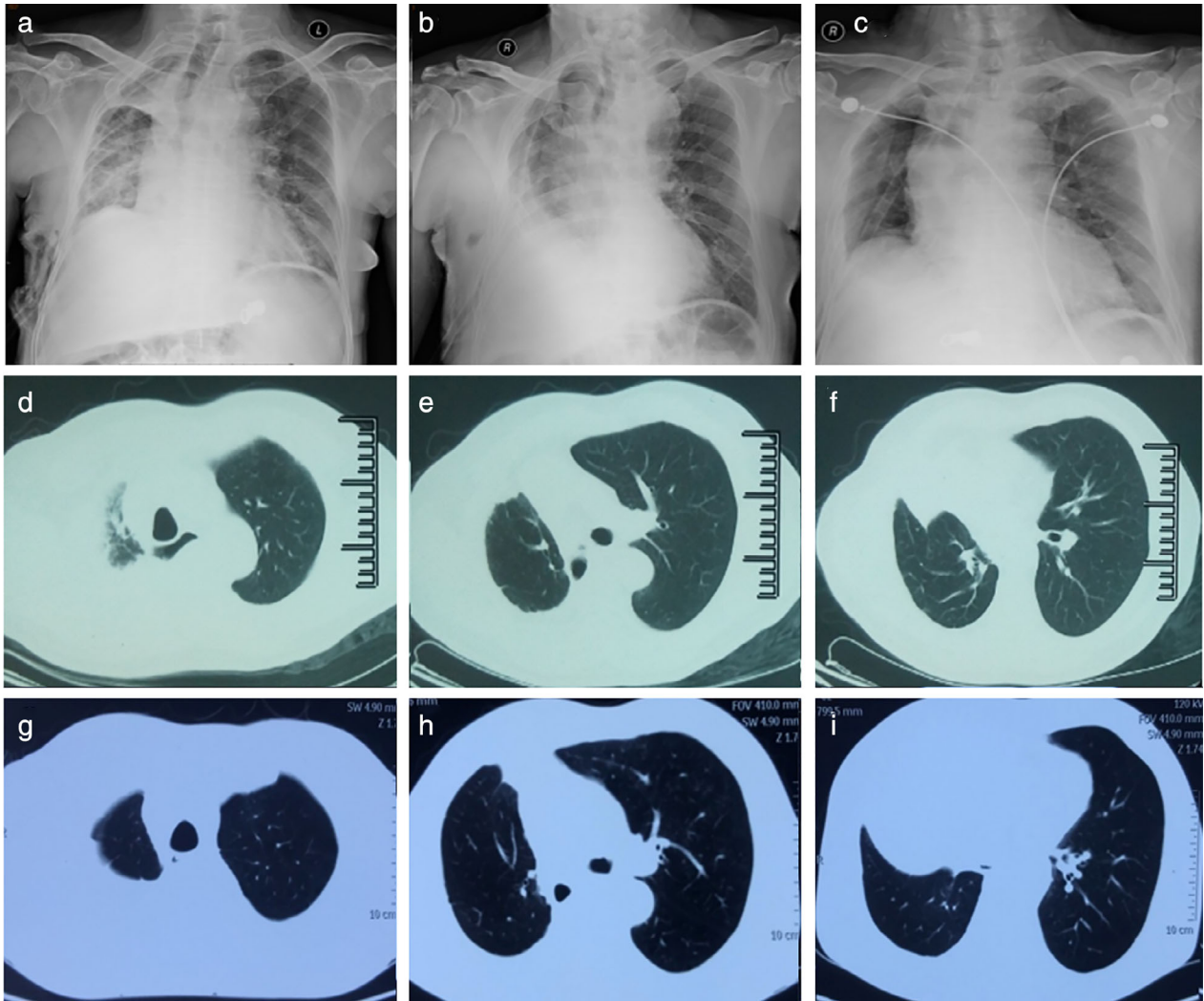


FIGURE 3 Postoperative radiograph of the patients. (a)–(c) The postoperative chest X-ray of three patients 2 days after the surgery. (d)–(f) The postoperative CT images of case 2 6 months after the surgery. (g)–(i) The postoperative CT images of case 3 6 months after the surgery

lung function reserve. According to our experience, if forced expiratory volume in the first-second (FEV1) is >2 L/min, diffusion capacity for carbon monoxide of the lung (DLCO) $>60\%$ predicted value and ventilation reserve percentage $>80\%$, the operation of synchronous right upper and lower double lobectomy is safe. López Pujol et al.¹¹ also reported that FEV1 <1.8 L/min was a risk factor for higher mortality rates in pneumonectomy. For safety considerations, preoperative pulmonary function assessment should satisfy right pneumonectomy so that the surgeons can proceed with the middle lobe resection when middle lobe torsion occurs after operation.

In our study, preoperative CT examination of only one patient clearly showed two cancers. In the other two patients, the cancers were only detected by CT in the upper lobe. Their cancers in the lower lobe were small and were only detected by bronchoscopy. Therefore, every lung cancer patient scheduled to receive surgical treatment should be routinely examined by bronchoscopy before the operation

so as to avoid missing the small tumor located in the bronchial lumen that is difficult to be found by CT.

The main limitations of the present study are the small number of cases and no long-term outcomes. These two points need to be further improved in our future work.

To sum up, although synchronous right upper and lower lobectomy with the middle lobe preservation is risky and challenging, adequate preoperative preparation and careful surgical dissections support can remarkably aid in the successful surgery. The suture of the remaining middle lobe and intercostal muscle of the incision is a simple and effective method for avoiding middle lobe torsion that does not limit the expansion of the middle lobe. Our experience indicates that this strategy is feasible for eligible patients and worthy of further application in clinical practice.

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DISCLOSURE

The authors declare no conflicts of interest.

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