

# Reverse resection in lung cancer surgical treatment

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**Abstract Object** To develop a method to increase the resection rate of lung cancer. **Methods** Reverse resection is a modification method of the routine pulmonary lobectomy by cutting bronchus first in order to further expose hilum, then dissect and ligate the pulmonary vessels. It is applied in case of hilum was involved by cancer focus, lymph node, chest wall and mediastinum. Because of cutting-off hard bronchus, pulmonary vessels get easy to dissect. This method greatly improved resection rate. **Results** The trial cases were divided into two groups randomly, clinic group (reverse resection group) 516 cases and control group (routine resection group) 498 cases. There was no difference between two groups in age, sex, pathology type and TNM staging. In clinic group and control group, resection rate were 98.8% (510/516) and 90.45% (450/498), operation exploration rate were 1.2% (28/516) and 9.6% (48/498), rate of via pericardium pneumonectomy were 6.4% (33/516) and 12.4% (62/498), palliative resection rate were 2.7% (14/516) and 2.6% (13/498), debulking resection rate were 1.7 (9/516) and 2.4% (12/498), operation complication rate was 22.1% (114/516) and 33.7% (6/498), operation morbidity rate were 0.8% (4/516) and 1.2% (6/498) respectively. 1-year survival rate was 81.6% (412/516) and 75.5% (376/498). 3-year survival rate was 54.4% (281/516) and 45.8% (228/498), 5-year survival rate was 36.0% (186/516) and 31.3% (156/498) respectively. **Conclusion** Reverse resection is a feasible method to increase the resection rate and survival rate of lung cancer patient. **Key Words:** lung cancer, operative treatment, reverse resection

In surgical management of lung cancer patients, it is main task of thoracic surgeon to improve resection rate, decrease explorative rate. This methodology can improve survival rate and life quality. From 1992 to 2002, we adopt reverse resection and increased the resection rate of lung cancer significantly.

## MATERIAL AND METHOD

### General data

Total 1014 lung cancer cases were treated including clinic group 516 cases (321 cases of male and 204 cases of female) and control group 498 cases (282 cases of male and 216 cases of female), aged from 24~81, averagely 54.

### Grouping method

All the patients were divided into tow groups randomly: reverse resection (clinic group) and routine resection (control group).

### Lesion site and general types

In clinic group, right upper lobe lung cancer 154 cases (29.8%), right middle lobe lung cancer 26 cases (5.0%), right lower lobe lung cancer (20.9%), right lung cancer 16 cases (3.1%), total 304 cases was right lung cancer; left upper lobe lung cancer 132 cases (25.6%), left lower lobe lung cancer 72 cases (14.0%), left lung

cancer 8 cases (1.6%), total 212 cases (41.1%) were left lung cancer. Central lung cancer 324 cases (62.8%), peripheral lung cancer 192 cases (37.2%). In control group: right upper lobe lung cancer 161cases (32.3%), right middle lobe 21 cases (4.2%), right lower lobe 117 cases (23.5%), right lung cancer 13 cases (2.6%), total 312 cases were right lung cancer; left upper lobe lung cancer 112 cases (22.5%), left lower lobe lung cancer 70 cases (14.1%), left lung cancer 4 cases (0.8%), total 186 cases (37.4%) were left lung cancer. Central lung cancer 316 cases (63.5%), peripheral lung cancer 192 cases (36.5%).

### Pathology types

In clinic group Small cell lung cancer (SCLC) 82 cases (16.0%), adenocarcinoma (ACA) 170 cases (32.9%), squamous cell carcinoma (SCC) 216 cases (41.9%), adenosquamous carcinoma 21 cases (4.1%), large cell carcinoma 11 cases (2.1%), bronchoalveolar carcinoma 16 cases (3.0%); control group: SCLC 63 cases (12.7%), ACA 177 cases (35.5%), SCC 214 cases (43.0%), adenosquamous carcinoma 28 cases (5.6%), large cell carcinoma 7 cases (1.4%), bronchoalveolar carcinoma 9 cases (1.8%).

Clinic pathology (TNM staging) In clinic group: stage were 28 cases (5.4%) including stage A 12 cases and stage B 16 cases; stage II were 103 cases (20%) including stage A 29 cases and stage B 74 cases; stage III

were 375 cases (72.7%) including stage A 260 cases (50.4%) and stage B 115 cases (22.3%); stage IV were 10 cases (1.9%). In control group: stage I were 21 cases (4.2%) including stage A 9 cases and stage B 12 cases; stage II were 108 cases (21.7%) including stage A 24 cases and stage B 84 cases; stage III were 348 cases (69.9%) including stage A 240 cases (50.4%) and stage B 108 cases (48.2%); stage IV were 21 cases (4.2%).

### **Surgery procedure**

The blood vessels of hilum pulmonis or lobar vessels be dissected, ligate and cut off firstly then cut off bronchus, in routine pulmonary resection whereas reverse pulmonary resection was that bronchus was dissected and cut off firstly, and then pulmonary vessels was dissected, ligated and cutting off. Because of hard bronchus was cut off, connective tissue of hilum got easy to dissect, the difficulty of pulmonary vessels dissection was decreased. If necessary, connective tissue related to the hilum containing vessels can be divided into different bundle and clipped, severed and ligated respectively or be severed and closed by cutting-sewing machine both make it easier to treat the pulmonary vessels.

Reverse resection is demonstrated by right lung upper lobe (Fig.1- 8).

### **Right upper lobe reverse resection by dissection hilum downward**

This technique is applied to cases of those with risk of pulmonary artery trunk rupture and trauma at the course of exposure under condition of right upper lobe cancerous node adjacent to pulmonary fissure or enlarged hilar lymph node, interlobar lymph node overlay and compressed pulmonary artery stem in fissures which make it difficult to be dissected and be exposed, or under developed major, minor fissure. The technique is as follows: pull the pulmonary tissue downward to expose top hilum, and free, ligate and sever anteroapical segmental artery of right upper lobe; second, free the connective tissue around the bottom of right upper lobe and insert a clipper deep to it from anterior backwards to postolateral direction; cut right upper lobar bronchus and suture the proximal stamp of it; third, Free, ligate and cut right upper lobar vein and pull the distal stump of right upper lobe bronchial downward and outward, and free, expose, ligate and sever right posterior ascending segmental artery just around bronchus. The right upper lobar vessels and bronchus are all severed by this way. If the pulmonary fissure under developed, it can be clipped and severed respectively through pulmonary fissure remaining pulmonary stump sutured, therefore

complete operation after removing excised sample.

### **Right lung upper lobe reverse resection by dissection hilum upward**

This technique is applied to cases of cancerous node of right upper lobe adhered or infiltrated to right upper chest wall, pleural apex or mediastinal pleural at the risk of trauma or rupture if free them, or lymph node at upper hilum overlay the anteroapical artery which makes it difficult to free. The technique is to dissect, ligate and sever right upper lobar vein firstly, then dissect and expose descending pulmonary artery trunk between pulmonary fissure and ligate every branch of ascending segmental pulmonary artery of right upper lobe respectively; next, free and expose right lung upper lobar bronchus and clamp its upper wall from front to back by a clipper to sever and suture its proximal stump; finally, pull its distal stump laterally and upward to expose, ligate and sever ascending segmental pulmonary artery of right upper lobe. The right upper lobectomy is completed accordingly. Operation molds

## **RESULTS**

Operation complication rate: Of 114 cases (22.1%) in clinic group, bleeding 3 cases (0.6%), arrhythmia 64 cases (12.4%), heart failure and pulmonary edema 14 cases (2.7%), pulmonary infection 26 cases (5.0%), pleural infection 4 cases (0.8%). Of 168 cases (33.7%) in control group, bleeding 7 cases (1.4%), Arrhythmia 96 cases (14.3%), heart failure and lung edema 29 cases (5.8%), heart arrest 2 cases (0.4%), pulmonary infection 24 cases (4.8%), pleural infection 6 cases (1.2%). Pulmonary atelectasis is 4 cases (0.8%). Operation mortality: clinic group 4 cases (0.8%), control group 6 cases (3.6%). 1-year survival rate was 81.6% (412/516) and 75.5% (376/498), 3-year survival rate was 54.4% (281/516) and 45.8% (228/498), 5-year survival rate was 36.0% (186/516) and 31.3% (156/498) in clinic and control group respectively. Operation statistic is listed in table 1.

## **DISCUSSION**

Lung cancer resection rate can be improved by reverse resection.

There was no statistic difference ( $p>0.05$ ) between two groups in age, sex, pathological type and TNM staging. Most of cases were III stage, 72.7% (375/516) in clinic group and 69.9% (348/498) in control group, there was no statistic difference ( $p>0.05$ ). Resection rate in clinic group is in high level<sup>[6]</sup>. This method have advantage in

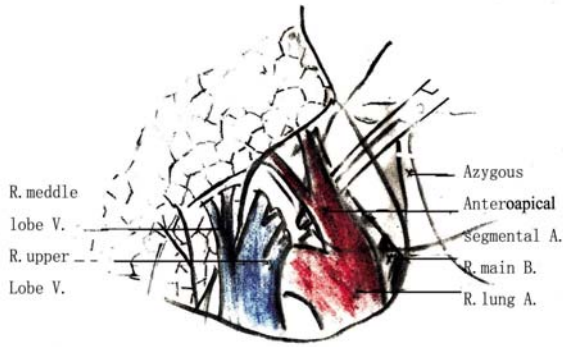


Fig.1 Dissection of right anteroapical segment A.



Fig.2 Dissection of right upper lobe main bronchus



Fig.3 Dissection of right upper lobe V.



Fig.3 Dissection of right upper lobe V.

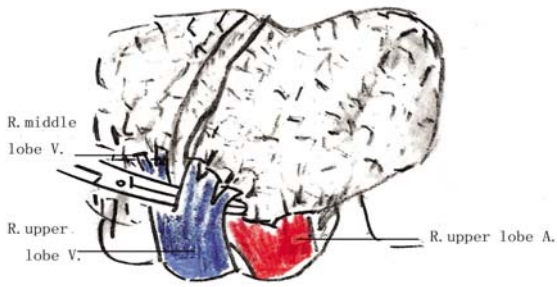


Fig.5 Dissection of right upper lobe B.

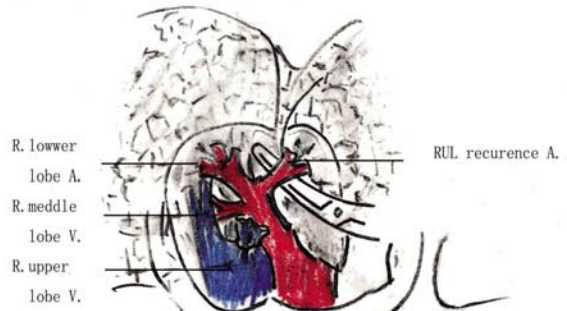


Fig.6 Dissection of upper lobe recurrence A.

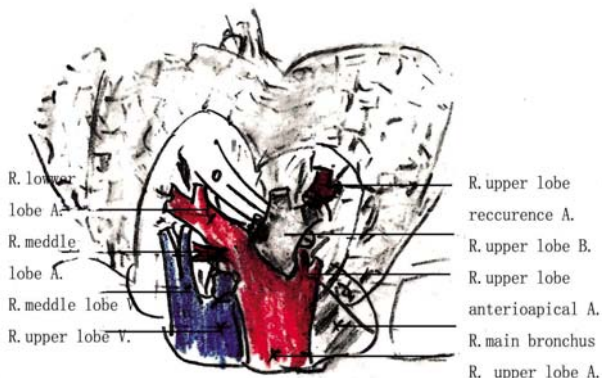


Fig.7 Dissection of right upper lobe B.

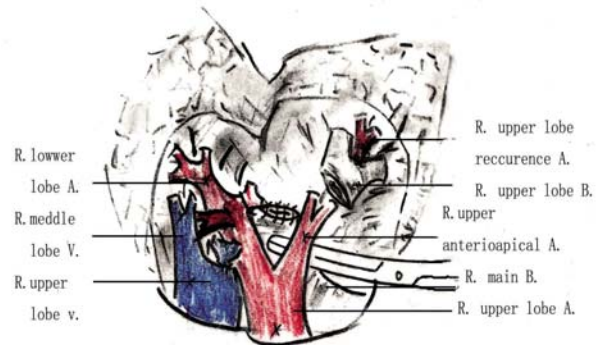


Fig.8 Dissection of right upper anteroapical segment A.

**Table 1** Operation statistics of lung cancer of reverse resection group and control group [cases(%)]

method	Clinic Group							Control Group				
	LR	RP	VPR	RVPR	ER	PR	DR	LR	VPR	ER	PR	DR
RUL	138(26.7)	34(6.6)			2(0.4)	3(0.6)	2(0.4)	122(24.5)		11(2.2)	3	3
RML	14(2.7)	11(2.1)						8(1.6)		1(0.2)		
RLL	84(2.7)	21(4.0)	9(1.7)	8(1.6)	2(0.4)	2(0.4)	1(0.2)	92(18.5)	9(1.8)	8(1.6)	2	2
RMUL	23(4.5)	8(1.6)	4(0.8)	2(0.4)				12(2.4)	8(1.6)			
RMUL	24(4.6)	9(1.7)	6(1.2)	4(0.8)				19(3.8)	5(1.0)		1	
RP	17(3.3)	8(1.6)	5(1.0)	5(1.0)	1(0.2)	1(0.2)	2(0.4)	34(6.8)	8(1.6)	5(1.0)	1	
LUL	126(24.4)	26(5.0)	6(1.2)	3(0.6)				84(16.9)	7(1.4)	10(2.0)	1	1
LLL	68(13.2)	20(3.9)	7(1.4)	4(0.8)	1(0.2)	1(0.2)	1(0.2)	51(10.3)	8(1.6)	7(1.4)	1	1
LP	16(3.1)	8(1.6)	4(0.8)	2(0.4)				28(5.6)	9(1.8)	6(1.2)	2	2
ER	6(1.2)							48(9.6)				
Total	516	145(28.1)	41(7.9)	28(5.4)	6(1.2)	14(2.7)	9(1.7)	498	54(10.8)	48(9.8)	13(2.6)	12(2.4)

RUL: right upper lobectomy; RML: right middle lobectomy; RLL: right lower lobectomy; RMUL: right middle and upper lobectomy; RMLL: right middle and lower lobectomy; RP: right pneumonectomy; LUL: left upper lobectomy; LLL: left lower lobectomy; LR: lung resection; VPR: via pericardium resection; RP: retrograde resection; RVPR: retrograde via pericardium; ER: Explorative resection; PR: palliative resection; LP: Left pneumonectomy; DR: debulking resection.

lung cancer surgical management. Resection rate is correlated with reverse resection methodology. In case of hilum involved cancer focus, lymph node, chest wall and mediastinum, vessels is difficult to dissect. Bronchus can be severed at first, then dissect, ligate, sever vessels. Connective tissue related to the hilum get movable, the difficulty of pulmonary vessels dissection decrease accordingly. If necessary, connective tissue of hilum can be divided into different bundle and be clipped, severed, ligated respectively. This method can improve resection rate safely.

#### Reverse resection can decrease lung cancer operation complication.

Reverse resection greatly decreased via pericardium lung resection rate and pneumonectomy rate. Via pericardium lung resection rate is 5.4% (28/516) and 10.8 (54/498) in clinic group and control group, statistic difference is significant ( $p < 0.05$ ). Pneumonectomy is 6.4% (33/516) and 12.4% (62/498), in clinic group and control group, statistic difference is significant ( $p < 0.05$ ). Pneumonectomy rate was lower than 20-30% reported by Wu Yilong<sup>[7]</sup>. Arrhythmia is a common complication after lung resection. It is correlated with lung resection volume<sup>[3,4]</sup>, mortality rate was reported 3.8% in partial lung resection, 11.2% in lobotomy, 23.5-24% in pneumonectomy, even 46.9% was reported<sup>[5]</sup>. Lung resection volume was one of main factor, because lung volume resection condition can cause heart hemodynamic change. Knorring et al<sup>[6]</sup> reported right ventricular and pulmonary vascular spasm can cause hypoxemia and arrhythmia, because of pneumonectomy rate via pericardium

or pneumonectomy decreased by reversed resection. Lung is an organ which all the blood go through, vascular bed was reduced after lung resection, in order to pump the same volume blood at the same time, heart must contract to overcome the resistance which was caused by blood vascular reduction. In order to maintain body circulation, lung artery and blood capillary pressure rise, infiltrate will be added. If lymph system is overload, heart failure and pulmonary edema will be caused<sup>[7,8]</sup>. This pathophysiology change is relative related with lung volume resection, that is, the more lung volume was resected, and lung blood vessel bed reduced, the more lung edema and heart failure occurrence, the more early and serious complication caused. Because of pneumonectomy rate was lower in clinic group, heart failure, pulmonary edema morbidity rate (2.7%) is lower in clinic group than that of in control group (8%), statistic difference is significant ( $p < 0.05$ ). Because of deadly heart complication decreased, operation mortality in clinic group is lower with control group, statistic difference is significant ( $p < 0.05$ ).

#### Reverse resection can dissect lung cancer radically and improve survival rate.

Palliative resection and debulking resection rate was 4.5% (23 cases) in clinic group and 5.0% (25 cases) in control group, no difference was observed ( $p > 0.05$ ). Because of complication and mortality rate was decreased, 3-year survival rate was higher in clinic group than that of in control group ( $p < 0.05$ ), but 5-year survival rate was no difference ( $p > 0.05$ ) between them.

**Reverse resection made lung cancer resection easier and shortened the operation course.**

In a single-tube anesthesia case, when bronchus was cut off, the lobe get collapsed, operation field was well exposed. Especially in pulmonary under developed fissure cases, pulmonary lobe can be cut off or can be severed by a sew-cutting machine.

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