Revista Argentina de Clínica Psicológica
2021, Vol. XXX, N°2, 553-558
DOI: 10.24205/03276716.2020.4056

Uniportal video-assisted thoracoscopic complex and simple segmentectomy for treating early-stage non-small cell lung cancer

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Abstract

Our study intends to investigate the feasibility and safety of uniportal video-assisted thoracoscopic complex and simple segmentectomy in treating early non-small cell lung cancer (NSCLC). We retrospectively selected 136 early NSCLC patients from January 2018 to July 2019. There were 61 patients receiving uniportal video-assisted thoracoscopic surgery (U-VATS) who were then assigned into simple segmentectomy group (SS) (n=15) and complex segmentectomy group (CS) (n=46) according to the number and shape of intersegmental plane. 75 patients undergoing U-VATS lobectomy (LT) during the same time were selected as control group. The operative and postoperative outcomes were evaluated. No differences were found regarding age, sex, smoking history among the three groups. Tumor size in segmentectomy group was significantly reduced compared to lobectomy (P<0.01). The operative time of SS group was significantly decreased compared with S group and LT group (P<0.01). Both SS and CS groups could acquire appropriate surgical margins. While lymph nodes number dissected in LT group was significantly increased compared to segmentectomy group (P<0.01). No differences of postoperative complications, tube duration, drainage volume and postoperative stay were observed among three groups. However, FEV1 (L), FVC (L) and MVV (L/min) in segmentectomy group and lobectomy group were significantly decreased at one month after surgery with more improvement in segmentectomy than lobectomy (P<0.05). In conclusion, U-VATS and simple segmentectomy is safe and feasible to treat early NSCLC in short term.

Keywords: Segmentectomy; Lobectomy; NSCLC; Uniportal video-assisted thoracoscopic surgery (U-VATS).

1. Background:

Lung cancer has a high morbidity and mortality around the world [1]. Surgery is the best approach for treating early lung cancer [2]. Compared to traditional thoracotomy, video-assisted thoracoscopic surgery has the advantages of faster recovery and less trauma [3], while uniportal video-assisted thoracoscopic surgery (U-VATS) can reduce postoperative pain compared with multiple ports video-assisted thoracoscopic surgery. More and more people are willing to adopt U-VATS segmentectomy for treating early-stage NSCLC [4, 5].

Segmentectomy was initially used in treating patients with pulmonary tuberculosis, benign lung disease or NSCLC with poor cardiopulmonary function [6]. Recently, it has been used in the treatment for early NSCLC. According to the difficulty, segmentectomy can be divided into complex segmentectomy and simple segmentectomy, which is, segmentectomy with one single linear intersegmental plane is considered as simple segmentectomy, while segmentectomy with two and more intersegmental planes is regarded as a complex segmentectomy [7]. So complex segmentectomy may involve more postoperative complications with uncertain therapeutic effects. This study has shown that simple segmentectomy and complex segmentectomy are also acceptable in treating early NSCLC. However, the safety and feasibility of segmentectomy compared with lobectomy remain unknown. This study compares the therapeutic effects of the simple segmentectomy, complex segmentectomy and lobectomy in shorter time, so as to further explore the feasibility of U-VATS complex and simple segmentectomy for treating early-stage NSCLC.

2. Patients and methods

2.1 Patients

We retrospectively selected 136 patients with cT1N0M0 who had underwent U-VATS surgery in

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thoracic surgery department of The Third Hospital of Jilin University from January 2018 to July 2019. All patients underwent high-resolution CT before surgery. A total of 61 patients underwent segmentectomy had a peripheral lesion with a ground-glass opacity (GGO) rate of greater than 50% and lesion diameter ≤ 2 cm, and 75 patients underwent lobectomy had lesions with diameter ≤ 3cm, or solid component-dominated (GGO rate > 50%), or close to lung hilum. Patients with right middle lobectomy and extensive pleural adhesion and multiple lesions were excluded. A previous study [7] suggests that segmentectomy which has one, linear intersegmental plane, together with a relatively easier surgical procedure, could be considered as simple segmentectomy (Just includes Left S1+2+3, Left S4+5, Left S6, Right S6), while segmentectomy with several, or intricate intersegmental planes, with a more complex surgical procedure is considered as complex segmentectomy (Right S1, Left S1+2, etc). According to above definition, we further divided patients with segmentectomy into the complex segmentectomy group (CS) (n=46) and the simple segmentectomy group (SS) (n=15). Comparison was made with 75 patients with cT1N0M0 who had undergone U-VATS lobectomy (LT) during the same period.

All patients received routine preoperative work-up, including high-resolution CT, brain MRI, radionuclide bone imaging, abdominal ultrasonography, echocardiography, electrocardiogram (ECG), or sometime PET-CT. All patients received the pulmonary function test to assess lung function. There were no significant surgical contraindications in all patients. All surgeries were performed by two surgeons with years of experience in thoracoscopic surgery. This study was approved by ethics committee of The Third Hospital of Jilin University and all patients signed informed consent.

2.2 Surgery process

All patients received intravenous inhalation combined anesthesia. One-lung ventilation was performed through the healthy side lung and the diseased lung was collapsed. Then they were placed in the lateral position, a 3-4 cm incision was made between anterior and posterior axillary line, silica gel incision protective casing was inserted to open the incision, a 30° video-assisted thoracoscope was inserted through it. Generally, wedge resection would be performed firstly if the lesion's location permits (not too close to lung hilum), in case of the malignant lung lesions, further lobectomy or anatomic segmentectomy was performed.

For lobectomy, Mediastinal and interlobular fissure need to be separated carefully to find the bronchus and blood vessels of the target lobe, which were then cut off by linear staples. Patients with pulmonary segmentectomy need to be found target segment tracheas and vessels based on preoperative imaging and the observation on the stretched trend of the trachea and blood vessels during the operation. The inter-segmental plan was confirmed by the dilatation and collapse method, linear staples were used to excise pulmonary parenchyma along the inter-segmental plan's border. The excised tissue was removed outside the thorax. A drainage tube was placed through the surgical incision.

2.3 Postoperative care

Chest X-ray was usually performed intermittently after the operation to judge the expansion of the lungs. The chest drainage tube was not removed until no air leak and the effusion less than 100 ml/day.

2.4 Follow-up

Chest CT and lung function were reexamined one month after surgery. All patients regularly (3-6 months, mean 13.5 months) received chest CT, abdominal ultrasound, blood test, tumor markers, etc. So far, no local recurrence and distant metastasis has occurred in all patients.

2.5 Statistical analysis

SPSS 23.0 software analyzed data which were shown as mean ± standard deviation (SD) and assessed by one-Way ANOVA or t test for measurement data. The count data were expressed by the number of cases (%) [n (%)] and assessed by chi-square test or Fisher's exact test. $P < 0.05$ were considered statistically significant.

3. Results

3.1 General information

Simple segmentectomy group (SS) included 15 patients consisting of 6 men and 9 women (average age: 57.7±10.5) years, and tumor diameter of (10.8±3.2) mm, 2 (13.3) cases had the history of smoking, all cases were adenocarcinoma. The clinical TNM stages were Tis (2 cases), IA1 (8 cases), IA2, (5 cases). Complex segmentectomy group (CS) included 46 patients, consisting of 17 men and 29 women (average age: 57.3±9.9) years, and tumor diameter of (10.2±4.6) mm, 6 (13.0) cases have history of smoking, all cases were adenocarcinoma. The clinical TNM stages were Tis (4 cases), IA1 (24 cases), IA2, (18 cases). Lobectomy group (LC) includes 75 patients, consisting of 28 men and 47

women (average age: 58.4±8.1) years, and tumor diameter of (15.4±6.6) mm, 18 (24.0) cases have history of smoking, 67 cases adenocarcinoma, 7 squamous carcinoma, 1 adenosquamous carcinoma, The clinical TNM stages were Tis (1 case), IA1 (20 cases), IA2, (42 cases), IA3 (12 cases). The average diameter of tumors in simple segmentectomy and complex segmentectomy groups were significantly smaller than that in patients with lobectomy (P <0.05). No differences were found in terms of the age, sex, smoking history among three groups (P ＞ 0.05). Meanwhile, there were also no difference of lesion distribution in different groups (Table 1).

Table 1. **Lesion distribution among three different groups.**

Group	Right upper lobe	Right lower lobe	Left upper lobe	Left lower lobe
SS (n=15)	-	5 S6	4 S1+2+3, 2 S4+5	4 S6
CS (n=46)	7 S1,4 S1+2,3 S1+3,2 S2,2 S2+3,3 S3	1 S6+10,3 S7+8,1 S9+10,2 S10	2 S1, 8 S1+2, 2 S1+3	1 S7+8, 1 S9, 1 S10, 3 S9+10
LT (n=75)	28	13	18	16

3.2 Comparison of operative indexes among three groups

In the operation time, SS group was significantly shorter than CS and LT groups (P<0.01) (Table 2). Lymph node dissection number in both CS and LT groups were significantly less than lobectomy group (P <0.01). One case in CS group changed to thoracotomy due to bleeding which was caused by vascular variation, 1 case in LT group changed to thoracotomy due to bleeding when excised a lymph node which tightly stick to the blood vessel.

Table 2. **Comparison of operative indexes among three groups.**

Group	Operation time(min)	Intraoperative blood loss（ml）	Margins distance（cm）	Number of lymph nodes	Perioperative nodule location（%）	Conversion to thoracotomy (%)
SS (n=15)	131±27	50±22	1.9±0.9	9.5±3.6	2(13.3)	0
CS (n=46)	175±49	67±46	2.0±1.0	10.7±4.4	8(17.3)	1(2.2)
LT (n=75)	176±41	70±61	2.7±1.2	13.2±4.6	-	1(1.3)

3.3 Comparison of postoperative complications among three groups

There were 2 cases (13.3%) in SS group, 8 cases (17.4%) in CS group, and 14 cases (18.7%) in LT group (Table 3). Regarding the postoperative complications (including Arrhythmia, Pulmonary infection, Air leakage (> 7 days), Subcutaneous emphysema, Incision infection), no differences were found (P> 0.05) without death of patients.

Table 3. **Comparison of postoperative complications among three groups [n (%)]**

Group	Arrhythmia	Pulmonary infection	Air leakage（＞7 days）	Subcutaneous emphysema	Incision infection	Total
SS(n=15)	1 (6.7)	0	1 (6.7)	0	0	3 (13.3)
CS(n=46)	2 (4.3)	1 (2.2)	3 (6.5)	1 (2.2)	1 (2.2)	8 (17.4)
LT(n=75)	2 (2.7)	3 (4.0)	3 (4.0)	2 (2.7)	4 (5.3)	14 (18.7)

3.4 Comparison of postoperative recovery among three groups

As seen in Table 4, there were no differences among three groups in postoperative recovery indexes (P>0.05).

Table 4. **Comparison of postoperative recovery among three groups.**

Group	Tube duration (days)	Drainage volume (ml)	Postoperative stay (days)
SS (n=15)	5.2±1.6	1050±309	7.3±1.6
CS (n=46)	5.7±1.8	1083±347	7.8±2.0
LT (n=75)	5.8±1.8	1194±336	8.4±2.4

3.5 Pulmonary function changes at one month after segmentectomy or lobectomy.

There were no differences in preoperative pulmonary function in segmentectomy and lobectomy groups (P ＞ 0.05) and both groups showed significantly reduced level of FEV1(L), FVC(L) and MVV(L/min) 1 month after surgery (P＜0.05) (Table 5), while segmentectomy group seemed better than lobectomy group (P＜0.05).

Table 5. **Pulmonary function changes at one month after segmentectomy or lobectomy.**

Group	Time	FEV1(L)	FVC(L)	MVV(L/min)
SS (n=15)	Preoperative	2.59±0.58	3.12±0.63	87.41±7.58
	1 month after surgery	2.23±0.62	2.56±0.68	78.25±9.47
CS(n=46)	Preoperative	2.49±0.63	3.02±0.56	86.21±8.51
	1 month after surgery	2.07±0.68	2.54±0.59	76.45±10.08
LT(n=75)	Preoperative	2.52±0.56	3.23±0.69	87.32±7.68
	1 month after surgery	1.74±0.58	2.16±0.72	71.15±9.35

Discussion

In 1995, a prospective randomized controlled trial of stage T1 NSCLC showed that segmentectomy and wedge resection had a higher recurrence rate than lobectomy, then lobectomy is widely used as the standard surgery [8]. However, with the promotion of low-dose CT and increased awareness of public physical examination, more and more early-stage lung cancers have been discovered. Many studies [9-11] have shown that segmentectomy is comparable to lobectomy in the treatment of early NSCLC. Therefore, the segmentectomy for early NSCLC is now more and more used. In general, the segmentectomy is more complex than lobectomy, but a previous study [7] had further divided the lung segment into simple segment and complex segment according to the difficulty of lung segment resection, which is similar to other study [12] found that thoracoscopic complex (uncommon) segmentectomy, compared with simple (common) segmentectomy, can also obtain sufficient surgical margins and no more complications were found.

In fact, considering the tumor location indifferent lung lobes and the availability of safe surgical margins, although some lesions could be treated with simple segmentectomy (Just includes Left S1+2+3, Left S4+5, Left S6, Right S6), while most patients who are suitable for segmentectomy should undergo complex segmentectomy, therefore two types of segmentectomy should be compared with lobectomy to further analyze the results. This study shows that when compared with lobectomy, simple segmentectomy and complex segmentectomy are feasible in treating early periphery NSCLC with non-inferior oncological and perioperative results and retain more lung function.

Our study showed significantly smaller tumor size in segmentectomy group than lobectomy group along with shorter operation time (SS group: 131±27min) without difference between CS group and LT group (175±49 vs 176±41min). Lmph nodes dissected number in LT group was significantly increased. In other words, for pure ground glass nodules (pGGOs) we generally selected systematic lymph node sampling, while for those with solid-component lesions, systematic lymph nodes dissection was performed. This is because pGGOs are more likely to be non-invasive, and lymph node metastasis rarely occurs in those cases[13, 14].NCCN presently recommends systemic lymph node sampling or dissection for stage IA NSCLC and our study meets this criterion[15].

Regarding the margins, some studies have shown that when the margin distance[16] greater than the diameter of the tumor may prevent margin relapse. In this study, the margins distance in the CS and SS groups are 2.0cm and 1.9cm respectively, which are larger than the tumor diameter of the two groups (about 10mm), indicating that both U-VATS simple segmentectomy and complex segmentectomy could obtain sufficient margins even though less than lobectomy's margin distance 2.7cm.

The incidence of complications was 13.3% in U-VATS SS group and 17.4% in the U-VATS CS group, which is not significantly different from 18.7% in the LT group in this study. Other studies [4, 5, 17] showed that the incidence of complications of U-VATS segmentectomy were 6.3-13.3%, our result is generally acceptable. One study has shown that segmentectomy, especially for complex segmentectomy, is more subjected to air leak, which may be related to the multiple intersegmental planes [18]. In this study, no more air leakage occurred after complex segmentectomy, which may have something to do with the use of linear stapler to divide the intersegmental plane.

Many studies have shown that patients with segmentectomy retain more lung function than patients with lobectomy [19, 20]. Our results show that the patient's FEV1 (L), FVC (L), and MVV (L/min) was reduced at 1 month compared with baseline

both in segmentectomy or lobectomy, but the reduction was smaller in pulmonary segmentectomy than in lobectomy, and SS group did not show significant difference compared with CS group. It maybe because the number of resected segments in SS and CS groups mostly less than 2 segments. This study shows that in the short term, patients after segmentectomy retain more pulmonary function, which is helpful for postoperative recovery, especially for patients with poor cardiopulmonary function who cannot tolerate lobectomy.

This study has some limitations. Firstly, this study only recruited a small sample number. Second, the follow-up time in this study is not enough long (6-18 months, mean 13.5 months) and the sample size is relatively small. So far, no recurrence and metastasis have occurred in the segmentectomy and lobectomy. Although the evidence for the long-term safety is insufficient, we have ensured sufficient margins distance and enough lymph nodes dissected. However, in the future, large cohort study is required to confirm the findings.

More and more studies demonstrated the safety of segmentectomy for treating early lung cancer [21, 22]. Segmentectomy as a treatment in some early-stage peripheral NSCLC, compared with lobectomy, is not only available on oncologic outcomes, but also can retain the patient's lung function to the maximum extent. Segmentectomy is undoubted the best treatment for lung cancer patients with poor cardiothoracic function and multiple lesions in different lung lobes.

In conclusion, our research indicates that even though simple segmentectomy doesn't show any advantages rather than operation time compared with lobectomy, at least uniport thoracoscopic complex segmentectomy and simple segmentectomy are safe and reliable for the treatment of early NSCLC in the short term.

Disclosure of conflict of interest

None.

Reference:

[1] Siegel, R.L., Miller, K.D. and Jemal, A., 2018. Cancer statistics, 2018. CA: A Cancer Journal for Clinicians, 68(1), pp.7-30.

[2] Howington, J.A., Blum, M.G., Chang, A.C., Balekian, A.A. and Murthy, S.C., 2013. Treatment of stage I and II NSCLC: Diagnosis and management of lung cancer, 3rd ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest, 143(5 Suppl), pp. e278S-e313S.

[3] Paul, S., Altorki, N.K., Sheng, S., Lee, P.C., Harpole, D.H., Onaitis, M.W., Stiles, B.M., Port, J.L. and D'Amico, T.A., 2010. Thoracoscopic lobectomy is associated with lower morbidity than open lobectomy: a propensity-matched analysis from the STS database. Journal of Thoracic and Cardiovascular Surgery, 139(2), pp.366-378.

[4] Han, K.N., Kim, H.K., Lee, H.J. and Choi, Y.H., 2016. Single-port video-assisted thoracoscopic pulmonary segmentectomy: a report on 30 casesdagger. European Journal of Cardio-Thoracic Surgery, 49 Suppl 1(pp. i42-47.

[5] Duan, L., Jiang, G. and Yang, Y., 2018. One hundred and fifty-six cases of anatomical pulmonary segmentectomy by uniportal video-assisted thoracic surgery: a 2-year learning experience. European Journal of Cardio-Thoracic Surgery, 54(4), pp.677-682.

[6] Jones, D.R., Stiles, B.M., Denlinger, C.E., Antippa, P. and Daniel, T.M., 2003. Pulmonary segmentectomy: results and complications. The Annals of Thoracic Surgery, 76(2), pp.343-349.

[7] Handa, Y., Tsutani, Y., Mimae, T., Tasaki, T., Miyata, Y. and Okada, M., 2019. Surgical Outcomes of Complex Versus Simple Segmentectomy for Stage I NSCLC. Annals of Thoracic Surgery, 107(4), pp.1032-1039.

[8] Dong, Q., Guo, Q., Luo, B. and Xu, Y., 2017. Expert consensus on management of cognitive impairment after stroke. Chinese Journal of Stroke, 12(06), pp.519-531.

[9] Hou, L., Chen, Z., Li, C., Zheng, D., Shi, H., Zou, C., Zhang, H., Lu, Z. and Ding, C., 2019. Correlation between serum adiponectin level and cognitive impairment after ischemic stroke. International Journal of Cerebrovascular Disease, 7), pp.503-508.

[10] Okada, M., Tsutani, Y., Ikeda, T., Misumi, K., Matsumoto, K., Yoshimura, M. and Miyata, Y., 2012. Radical hybrid video-assisted thoracic segmentectomy: long-term results of minimally invasive anatomical sublobar resection for treating lung cancer. Interactive Cardiovascular and Thoracic Surgery, 14(1), pp.5-11.

[11] Tsutani, Y., Miyata, Y., Nakayama, H., Okumura, S., Adachi, S., Yoshimura, M. and Okada, M., 2013. Oncologic outcomes of segmentectomy compared with lobectomy for clinical stage IA lung adenocarcinoma: propensity score-matched analysis in a multicenter study. Journal of Thoracic and Cardiovascular Surgery, 146(2), pp.358-364.

[12] Wang, Z., Gu, S., Liu, Y., Zhou, F. and Huang, S., 2020. Serum miR-191-5p and miR-20a-5p

combined as a diagnostic marker for cognitive dysfunction after stroke. Journal of Practical Medicine, 36(05), pp.593-596+601.

[13] Ding, N., Mao, Y., Gao, S., Xue, Q., Wang, D., Zhao, J., Gao, Y., Huang, J., Shao, K., Feng, F., Zhao, Y. and Yuan, L., 2018. Predictors of lymph node metastasis and possible selective lymph node dissection in clinical stage IA NSCLC. Journal of Thoracic Disease, 10(7), pp.4061-4068.

[14] Lin, Y.H., Chen, C.K., Hsieh, C.C., Hsu, W.H., Wu, Y.C., Hung, J.J., Hsu, P.K. and Hsu, H.S., 2020. Lymphadenectomy is Unnecessary for Pure Ground-Glass Opacity Pulmonary Nodules. J Clin Med, 9(3),

[15] Ettinger, D.S., Aisner, D.L., Wood, D.E., Akerley, W., Bauman, J., Chang, J.Y., Chirieac, L.R., D'Amico, T.A., Dilling, T.J., Dobelbower, M., Govindan, R., Gubens, M.A., Hennon, M., Horn, L., Lackner, R.P., Lanuti, M., Leal, T.A., Lilenbaum, R., Lin, J., Loo, B.W., Martins, R., Otterson, G.A., Patel, S.P., Reckamp, K., Riely, G.J., Schild, S.E., Shapiro, T.A., Stevenson, J., Swanson, S.J., Tauer, K., Yang, S.C., Gregory, K. and Hughes, M., 2018. NCCN Guidelines Insights: NSCLC, Version 5.2018. Journal of the National Comprehensive Cancer Network, 16(7), pp.807-821.

[16] Sawabata, N., Ohta, M., Matsumura, A., Nakagawa, K., Hirano, H., Maeda, H. and Matsuda, H., 2004. Optimal distance of malignant negative margin in excision of nonsmall cell lung cancer: a multicenter prospective study. The Annals of Thoracic Surgery, 77(2), pp.415-420.

[17] Lin, Y., Zheng, W., Zhu, Y., Guo, Z., Zheng, B. and Chen, C., 2016. Comparison of treatment outcomes between single-port video-assisted thoracoscopic anatomic segmentectomy and lobectomy for NSCLC of early-stage: a retrospective observational study. Journal of Thoracic Disease, 8(6), pp.1290-1296.

[18] Suzuki, K., Saji, H., Aokage, K., Watanabe, S.I., Okada, M., Mizusawa, J., Nakajima, R., Tsuboi, M., Nakamura, S., Nakamura, K., Mitsudomi, T., Asamura, H., West Japan Oncology, G. and Japan Clinical Oncology, G., 2019. Comparison of pulmonary segmentectomy and lobectomy: Safety results of a randomized trial. Journal of Thoracic and Cardiovascular Surgery, 158(3), pp.895-907.

[19] Tane, S., Nishio, W., Nishioka, Y., Tanaka, H., Ogawa, H., Kitamura, Y., Takenaka, D. and Yoshimura, M., 2019. Evaluation of the Residual Lung Function After Thoracoscopic Segmentectomy Compared with Lobectomy. Annals of Thoracic Surgery, 108(5), pp.1543-1550.

[20] Nomori, H., Shiraishi, A., Cong, Y., Sugimura, H. and Mishima, S., 2018. Differences in postoperative changes in pulmonary functions following segmentectomy compared with lobectomy. European Journal of Cardio-Thoracic Surgery, 53(3), pp.640-647.

[21] Zeng, W., Zhang, W., Zhang, J., You, G., Mao, Y., Xu, J., Yu, D., Peng, J. and Wei, Y., 2020. Systematic review and meta-analysis of video-assisted thoracoscopic surgery segmentectomy versus lobectomy for stage I NSCLC. World Journal of Surgical Oncology, 18(1), pp.44.

[22] Winckelmans, T., Decaluwe, H., De Leyn, P. and Van Raemdonck, D., 2020. Segmentectomy or lobectomy for early-stage non-small-cell lung cancer: a systematic review and meta-analysis. European Journal of Cardio-Thoracic Surgery,