별첨 1 비뚤림 위험 평가 및 자료추출

1. 비뚤림 위험 평가 결과

- RoB (1)

Jin (2022)		
영역	**비뚤림위험**	**사유**
무작위 배정순서 생성	■ 낮음 □ 높음 □ 불확실	인용: Eligible patients were randomly assigned to undergo either RAL or VAL at a ratio of 1:1. Randomization was conducted with a computer-generated random numbers table. 검토의견: 컴퓨터를 이용한 난수 생성
배정순서 은폐	■ 낮음 □ 높음 □ 불확실	인용: Assignments were sealed in opaque envolopes, which were opened by the surgeons at the time of the operation. 검토의견: 적절한 방법에 의해 배정순서가 은폐됨
연구 참여자, 연구자에 대한 눈가림	□ 낮음 ■ 높음 □ 불확실	인용: This study was a single-center, open-labeled, parallel-arm, noninferiority RCT 검토의견: 눈가림이 시행되지 않았음
결과평가에 대한 눈가림 - 객관적 지표	■ 낮음 □ 높음 □ 불확실	인용: This study was a single-center, open-labeled, parallel-arm, noninferiority RCT 검토의견: 눈가림이 시행되지 않았으나, 눈가림이 중재결과에 영향을 미치지 않을 것으로 판단함
결과평가에 대한 눈가림 - 주관적 지표(예, 통증)	□ 낮음 ■ 높음 □ 불확실	인용: - 검토의견: 눈가림이 시행되지 않았으며, 주관적 지표에 대해서는 눈가림이 중재결과에 영향을 미칠 것으로 판단함
불충분한 결과자료	■ 낮음 □ 높음 □ 불확실	인용: - 탈락률: 중재군 0%, 비교군 0% - ITT 분석 수행 검토의견: 중재군 간 결측치와 결측 사유가 유사하며, 적절한 통계분석 방법을 사용함
선택적 보고	■ 낮음 □ 높음 □ 불확실	인용: ClinicalTrials.gov identifier: NCT03134534 검토의견: 사전에 정해 놓은 프로토콜에 따라 중재결과를 보고하였음을 확인함
그 외 비뚤림 - **민간 연구비 지원**	□ 낮음 ■ 높음 □ 불확실	인용: This study was supported by the National Natural Science Foundation of China (81871882, 82072557), Robotic Research Grant from Intuitive Surgical, Inc, Shanghai Municipal Education Commission-Gaofeng Clinical Medicine Grant Support (20172005), and Outstanding Academic Leader of Shanghai (20XD1402300). 검토의견: 민간 연구비 지원이 포함됨

– RoB (2)

Terra (2022)		
영역	**비뚤림위험**	**사유**
무작위 배정순서 생성	■ 낮음 □ 높음 □ 불확실	인용: the research center defined the allocation of the patients using a website software (www.randomization.org, Arlington, VA, USA). We used block randomization to allow an adequate distribution of patients between the two groups. 검토의견: 컴퓨터를 이용한 난수 생성
배정순서 은폐	□ 낮음 □ 높음 ■ 불확실	인용: Patients were randomized only after having their surgery scheduled, ensuring allocation concealment. 검토의견: 배정순서 은폐 방법에 대한 구체적 언급 없음
연구 참여자, 연구자에 대한 눈가림	□ 낮음 ■ 높음 □ 불확실	인용: the randomization status was not blinded, so both patient and medical staff were aware of the randomization assignment. 검토의견: 눈가림이 시행되지 않았음
결과평가에 대한 눈가림 **– 객관적 지표**	■ 낮음 □ 높음 □ 불확실	인용: the randomization status was not blinded, so both patient and medical staff were aware of the randomization assignment. 검토의견: 눈가림이 시행되지 않았으나, 눈가림이 중재결과에 영향을 미치지 않을 것으로 판단함
결과평가에 대한 눈가림 **– 주관적 지표**(예, 통증)	□ 낮음 ■ 높음 □ 불확실	인용: the randomization status was not blinded, so both patient and medical staff were aware of the randomization assignment. 검토의견: 눈가림이 시행되지 않았으며, 주관적 지표에 대해서는 눈가림이 중재결과에 영향을 미칠 것으로 판단함
불충분한 결과자료	■ 낮음 □ 높음 □ 불확실	인용: - 탈락률: 중재군 10.0% (4/40명), 비교군 5.0% (2/40명) - ITT 분석 수행 검토의견: 중재군 간 결측치와 결측 사유가 유사하며, 적절한 통계분석 방법을 사용함
선택적 보고	■ 낮음 □ 높음 □ 불확실	인용: ClinicalTrials.gov identifier: NCT02292914 검토의견: 사전에 정해 놓은 프로토콜에 따라 중재결과를 보고하였음을 확인함
그 외 비뚤림 **– 민간 연구비 지원**	■ 낮음 □ 높음 □ 불확실	인용: The Brazilian Ministry of Health funded the acquisition of the DaVinci Si robotic system, surgical instruments, and disposable materials specific to robotic surgery (2012NE800206). 검토의견: Public funding에 해당함

- RoB (3)

Veronesi (2021)		
영역	**비뚤림위험**	**사유**
무작위 배정순서 생성	■ 낮음 □ 높음 □ 불확실	인용: Randomization was performed through a dedicated Internetbased system with a balance software for center stratification (validated by FDA, Title 21 of the Code of Federal Regulations, Part 11) within 4 weeks prior to the planned operation date once the eligibility of the patient had been confirmed and consent was given. This interval allowed a sufficient time to schedule the date of surgery. 검토의견: 컴퓨터를 이용한 난수 생성
배정순서 은폐	□ 낮음 □ 높음 ■ 불확실	인용: - 검토의견: 배정순서 은폐 방법에 대한 구체적 언급 없음
연구 참여자, 연구자에 대한 눈가림	□ 낮음 ■ 높음 □ 불확실	인용: Masking: None (Open Label) 검토의견: 눈가림이 시행되지 않았음
결과평가에 대한 눈가림 **- 객관적 지표**	■ 낮음 □ 높음 □ 불확실	인용: Masking: None (Open Label) 검토의견: 눈가림이 시행되지 않았으나, 눈가림이 중재결과에 영향을 미치지 않을 것으로 판단함
결과평가에 대한 눈가림 **- 주관적 지표**(예, 통증)	□ 낮음 ■ 높음 □ 불확실	인용: - 검토의견: 주관적 지표를 다루지 않음
불충분한 결과자료	■ 낮음 □ 높음 □ 불확실	인용: - 탈락률: 중재군 7.9% (3/38명), 비교군 5.1% (2/39명) - ITT 분석 수행 검토의견: 중재군 간 결측치와 결측 사유가 유사하며, 적절한 통계분석 방법을 사용함
선택적 보고	■ 낮음 □ 높음 □ 불확실	인용: Clinical Trial Registration: clinicaltrials.gov, identifier NCT02804893. 검토의견: 사전에 정해 놓은 프로토콜에 따라 중재결과를 보고하였음을 확인함
그 외 비뚤림 **- 민간 연구비 지원**	□ 낮음 ■ 높음 □ 불확실	인용: This work was supported by specific grants from the Umberto Veronesi Foundation (Milan, Italy) and Intuitive Surgical Inc. (Sunnyvale, CA, USA). 검토의견: 민간 연구비 지원이 포함됨

- RoB (4-5)

Huang (2021), Huang (2019)		
영역	**비뚤림위험**	**사유**
무작위 배정순서 생성	■ 낮음 □ 높음 □ 불확실	인용: Randomization was conducted with a computer-generated random numbers table. 검토의견: 컴퓨터를 이용한 난수 생성
배정순서 은폐	■ 낮음 □ 높음 □ 불확실	인용: A central randomization system was used to conduct randomization 검토의견: 독립적인 중앙 무작위배정 및 관리
연구 참여자, 연구자에 대한 눈가림	□ 낮음 ■ 높음 □ 불확실	인용: open-label, parallel-arm, noninferiority RCT 검토의견: 눈가림이 시행되지 않았음
결과평가에 대한 눈가림 **- 객관적 지표**	■ 낮음 □ 높음 □ 불확실	인용: open-label, parallel-arm, noninferiority RCT 검토의견: 눈가림이 시행되지 않았으며, 객관적 지표에 대해서는 눈가림이 중재결과에 영향을 미치지 않을 것으로 판단함
결과평가에 대한 눈가림 **- 주관적 지표**(예, 통증)	□ 낮음 ■ 높음 □ 불확실	인용: - 검토의견: 눈가림이 시행되지 않았으며, 주관적 지표에 대해서는 눈가림이 중재결과에 영향을 미칠 것으로 판단함
불충분한 결과자료	■ 낮음 □ 높음 □ 불확실	인용: - 탈락률: · Huang (2021) : 중재군 3.8% (3/79명), 비교군 7.7% (6/78명) · Huang (2019) : 중재군 0% (0/58명), 비교군 0% (0/55명) - ITT 분석 수행 검토의견: 중재군 간 결측치와 결측 사유가 유사하며, 적절한 통계분석 방법을 사용함
선택적 보고	■ 낮음 □ 높음 □ 불확실	인용: Chinese Clinical Trial Registry (ChiCTR-INR-17012777) 검토의견: 사전에 정해 놓은 프로토콜에 따라 중재결과를 보고하였음을 확인함
그 외 비뚤림 - **민간 연구비 지원**	■ 낮음 □ 높음 □ 불확실	인용: This work was supported by Shanghai Hospital Development Center (Grant Number: SHDC12016113), National Natural Science Foundation of China (No. 81702251). 검토의견: Public funding에 해당함

2. 자료추출

자료추출 내용

1.

<table>
<tr><th colspan="2">Jin (2022)</th></tr>
<tr><td>연구특성</td><td>■ 연구설계 : RCT (연구명: RVlob Trial)
■ 연구국가 : 중국
■ 연구기관 : 단일기관
■ 대상자 모집기간 : 2017.05.~2020.05.</td></tr>
<tr><td>연구대상</td><td>■ 연구대상 : NSCLC (non-small cell lung cancer)
■ 연구대상자 수 : 총 320명 (중재군 157명/대조군 163명)
■ 대상자 특성
<table><tr><th>변수</th><th>중재군 (n=157)</th><th>비교군 (n=163)</th><th>p값</th></tr><tr><td>연령, mean±SD</td><td>61 (54-66)</td><td>62 (53-68)</td><td>0.29</td></tr><tr><td>남/녀, 명(%)</td><td>81/76 (51.6%/48.4%)</td><td>76/87 (46.6%/53.4%)</td><td>0.44</td></tr><tr><td>BMI (kg/m^2), median (IQR)</td><td>23.4 (21.7-25.6)</td><td>22.9 (21.4-24.4)</td><td>0.05</td></tr><tr><td>%FEV1, mean±SD</td><td>93.42 ± 17.54</td><td>91.98 ± 17.20</td><td>0.47</td></tr><tr><td>Clinical T stage, No. (%)</td><td></td><td></td><td>0.87</td></tr><tr><td>cT1</td><td>137 (87.3)</td><td>141 (86.5)</td><td></td></tr><tr><td>cT2</td><td>17 (10.8)</td><td>20 (12.3)</td><td></td></tr><tr><td>cT3</td><td>1 (0.6)</td><td>1 (6.1)</td><td></td></tr><tr><td>cT4</td><td>2 (1.3)</td><td>1 (6.1)</td><td></td></tr><tr><td>Clinical N stage, No. (%)</td><td></td><td></td><td>0.82</td></tr><tr><td>cN0</td><td>138 (87.9)</td><td>146 (89.6)</td><td></td></tr><tr><td>cN1</td><td>8 (5.1)</td><td>6 (3.7)</td><td></td></tr><tr><td>cN2</td><td>11 (7.0)</td><td>11 (6.7)</td><td></td></tr><tr><td>Clinical TNM stage, No. (%)</td><td></td><td></td><td>0.61</td></tr><tr><td>IA</td><td>123 (78.3)</td><td>127 (77.9)</td><td></td></tr><tr><td>IB</td><td>11 (7.0)</td><td>12 (7.4)</td><td></td></tr><tr><td>IIA</td><td>1 (0.6)</td><td>5 (3.1)</td><td></td></tr><tr><td>IIB</td><td>9 (5.7)</td><td>7 (4.3)</td><td></td></tr><tr><td>IIIA</td><td>13 (8.3)</td><td>12 (7.4)</td><td></td></tr></table>※ Baseline characteristics were balanced between the groups (see Table, Supplemental Digital Content 1, which shows the patient characteristics in each group, http://links.lww.com/SLA/D129), including body mass index, Eastern Cooperative Oncology Group performance score, percent forced expiratory volume in 1 second, percent diffusing capacity of the lung for carbon monoxide, smoking history, tumor location, clinical tumor node metastasis stage, and history of comorbidities.

■ 포함기준 : Patients with pulmonary masses or nodules who were identified as suitable for minimally invasive lobectomy were included in this study. Eligible patients were 18 to 80 years old, with satisfactory preoperative laboratory testing, adequate pulmonary function, and an American Society of Anesthesiologists score of Ⅰ to Ⅲ.
■ 배제기준 : Patients with pathologically confirmed pulmonary tumors other than NSCLC, current or former comorbidity with other malignant tumors, or pleural dissemination detected during surgery, along with those who had received chemotherapy, ratiotherapy, or targeted therapy for any malignancies, were excluded.</td></tr>
</table>

Jin (2022)

중재

■ 중재 : robotic-assisted lobectomy
- 사용기기: da Vinci S/Si surgical robot (Intuitive Surgical, Inc, Santa Clara, CA)

■ 병용 중재 :
- 보조치료(adjuvant therapy) 는 NCCN 가이드라인을 따라 제공했다고 밝힘

비교중재

■ 비교중재 : video-assisted lobectomy
- VAL was performed through a 4-cm incision, which was placed in the fifth ICS at the anterior axillary line and covered with a protective sleeve (Fig. 2B). When necessary, an additional auxiliary port was placed in the sixth or eighth ICS at the mid-axillary line. All surgical instruments were inserted through the incision without spreading the ribs.

■ 병용 중재 :
- 보조치료(adjuvant therapy) 는 NCCNG 가이드라인을 따라 제공했다고 밝힘

추적관찰 및 결과측정

■ 추적관찰기간 : 3년 f/u 예정이나, 해당 문헌은 수술 직후 결과만 제시함

■ 탈락률 및 탈락사유
- 중재군 : 0%
- 비교군 : 0%

■ 결과변수
- Primary endpoints : the 3-year overall survival (OS) rate and the extent of LN dissection
- Main secondary endpoints : 3-year disease-free survival, the R0 resection rate, duration of surgery, intraoperative blood loss, the conversion rate, postoperative hospital stay, the incidence of postoperative adverse events, and medical costs.

결과변수/측정도구	내용
3-year OS rates	the percentage of patients who were still alive 3 years after randomization.
LN dissection outcomes	overall LN count, the number of stations dissected, and the number of LNs in each station.
Prolonged air leak	a persistent air leak requiring chest tube drainage for greater than 5 days after surgery.
Postoperative pain scores	VAS로 측정

안전성 결과

■ 시술 관련 부작용 및 합병증

결과변수	측정시기	중재군		비교군		p값	S/NS
		N	no. (%)	N	no. (%)		
개흉술로의 전환율	수술	157	7 (4.5%)	163	9 (5.5%)	0.86	NS
수술 후 합병증	수술후	157	23 (14.6%)	163	30 (18.4%)	0.45	NS
Clavien Dindo Ⅰ-Ⅱ	수술후	157	18 (11.5%)	163	24 (14.7%)	0.49	NS
- Pleural effusion	수술후	157	8 (5.1%)	163	12 (7.4%)	0.54	NS
- Pneumonia	수술후	157	4 (2.5%)	163	1 (0.6%)	0.21	NS
- Prolonged air leak	수술후	157	9 (5.7%)	163	7 (4.3%)	0.74	NS
- Recurrent air leak	수술후	157	0	163	1 (0.6%)	〉0.99	NS
- Hemorrhage	수술후	157	1 (0.6%)	163	1 (0.6%)	〉0.99	NS
- Atrial Fibrillation	수술후	157	0	163	1 (0.6%)	〉0.99	NS
- Ischemic stroke	수술후	157	0	163	1 (0.6%)	〉0.99	NS
- Hypoxemia	수술후	157	0	163	1 (0.6%)	〉0.99	NS
Clavien Dindo Ⅲ-Ⅳ	수술후	157	5 (3.2%)	163	6 (3.7%)	〉0.99	NS
- Pleural effusion	수술후	157	2 (1.3%)	163	2 (1.2%)	〉0.99	NS
- Pneumonia	수술후	157	0	163	1 (0.6%)	〉0.99	NS

Jin (2022)

결과변수	측정시기	중재군		비교군		p값	S/NS
		N	no. (%)	N	no. (%)		
- Prolonged air leak	수술후	157	0	163	3 (1.8%)	0.25	NS
- Recurrent air leak	수술후	157	1 (0.6%)	163	1 (0.6%)	〉0.99	NS
- Hemorrhage	수술후	157	1 (0.6%)	163	1 (0.6%)	〉0.99	NS
- Ischemic stroke	수술후	157	2 (1.3%)	163	0	0.24	NS

효과성 결과

■ 효과성 결과

결과변수	측정시기	중재군		비교군		p값	S/NS
		N	mean±SD	N	mean±SD		
수술시간(min) median (IQR)	수술	157	110 (95-140)	163	120 (97.5-150)	0.25	NS
출혈량(mL) median (IQR)	수술	157	100 (50-100)	163	100 (50-150)	0.04	S
수술중 수혈률 no. (%)	수술	157	3 (1.9%)	163	2 (1.2%)	0.68	NS
수술후 재원기간(일) median (IQR)	수술후	157	4 (4-5)	163	5 (4-5)	0.76	NS
흉관 삽입기간(일) median (IQR)	수술후	157	3 (2-4)	163	3 (2-4)	0.97	NS
흉관 배액량(mL) median (IQR)	수술후	157	830 (550-1,130)	163	685 (367.5-1,160)	0.007	S
통증(VAS) median (IQR)	수술후 1일	157	2 (2-3)	163	3 (2-3)	0.08	NS
	수술후 2일	157	2 (2-3)	163	2 (2-3)	0.13	NS
	수술후 3일	157	2 (2-2)	163	2 (2-3)	0.60	NS
추가 진통제 사용 기간(일) median (IQR)	수술후	157	0 (0-1)	163	0 (0-1)	0.11	NS
재입원율 no. (%)	수술후	157	3 (1.9%)	163	3 (1.8%)	〉0.99	NS
절제 림프절 수(개) median (IQR)	수술	157	11 (8-15)	163	10 (8-13)	0.02	S
절제 림프절 구역 수(개) median (IQR)	수술	157	6 (5-7)	163	5 (4-6)	〈0.001	S
N1 림프절 수(개) median (IQR)	수술	157	6 (4-8)	163	5 (3-7)	0.005	S
N2 림프절 수(개) median (IQR)	수술	157	5 (4-8)	163	5 (3-7)	0.19	NS
병기 상승 no. (%)	수술	157	12 (7.6%)	163	20 (12.3%)	0.23	NS

결론

■ 결론 : Both RAL and VAL are safe and feasible for the treatment of NSCLC. RAL achieved similar perioperative outcomes, together with higher LN yield. Further follow-up investigations are required to evaluate the long-term efficacy of RAL.

기타

■ 연구비 지원 : This study was supported by the National Natural Science Foundation of China (81871882, 82072557), Robotic Research Grant from Intuitive Surgical, Inc, Shanghai Municipal Education Commission-Gaofeng Clinical Medicine Grant Support (20172005), and Outstanding Academic Leader of Shanghai (20XD1402300).

■ 연구프로토콜 : ClinicalTrials.gov identifier: NCT03134534

NCCN, National Comprehensive Cancer Network

2.

<table>
<tr><th colspan="2">Terra (2022)</th></tr>
<tr><td>연구특성</td><td>■ 연구설계 : RCT (연구명: BRAVO trial)
■ 연구국가 : 브라질
■ 연구기관 : 단일기관
■ 대상자 모집기간 : 2015.04.~2017.06.</td></tr>
<tr><td>연구대상</td><td>■ 연구대상 : primary lung cancer or lung metastasis
■ 연구대상자 수 : 총 76명 (중재군 37명/대조군 39명)
■ 대상자 특성
<table>
<tr><th>변수</th><th>중재군 (n= 37)</th><th>비교군 (n= 39)</th><th>p값</th></tr>
<tr><td>연령, mean±SD</td><td>68.4 (65.2–71.5)</td><td>65.7 (61.8–69.5)</td><td>0.31</td></tr>
<tr><td>남/녀, 명(%)</td><td>17/20 (46.0%/54.0%)</td><td>17/22 (43.6%/56.4%)</td><td>1.00</td></tr>
<tr><td>BMI (kg/m^2), median (95% CI)</td><td>27.5 (26.2–28.8)</td><td>26.5 (24.9–28.1)</td><td>0.24</td></tr>
<tr><td>FEV1 (L), median (95% CI)</td><td>2.2 (2.0–2.4)</td><td>2.1 (1.9–2.3)</td><td>0.33</td></tr>
<tr><td>%FEV1, median (95% CI)</td><td>87.3 (80.8–92.8)</td><td>81.5 (77.5–85.5)</td><td>0.19</td></tr>
<tr><td>NSCLC</td><td>34 (91.9%) [a]</td><td>35 (89.7%) [b]</td><td>1.00</td></tr>
<tr><td colspan="4">a: Metastatic breast cancer, in 1; inflammatory myofibroblastic tumor, in 1; and atypical adenomatous hyperplasia, in 1
b: Metastatic melanoma, in 1; metastatic renal cell carcinoma, in 2; and small cell lung cancer, in 1</td></tr>
</table>
■ 포함기준 : eligibility for the treatment of lung cancer or lung metastasis by pulmonary lobectomy; presence of tumor of less than 5 cm in diameter; absence of tumor invasion into the chest wall, diaphragm, mediastinum, or another lung lobe; and clinical and anesthetic evaluation results showing that the patient was able to undergo the proposed procedure.
■ 배제기준 : having previously undergone a thoracic surgical procedure in the hemithorax to be operated on; and being unable to remain on single-lung ventilation during the procedure.</td></tr>
<tr><td>중재</td><td>■ 중재 : robotic-assisted thoracic surgery (RATS)
- 사용기기: Da Vinci Si (Intuitive Surgical Inc., Sunnyvale, CA, USA)
■ 병용 중재 : -</td></tr>
<tr><td>비교중재</td><td>■ 비교중재 : video-assisted thoracic surgery (VATS)
- triportal technique
■ 병용 중재 : -</td></tr>
<tr><td>추적관찰 및 결과측정</td><td>■ 추적관찰기간 : 수술 후 90일
■ 탈락률 및 탈락사유
- 중재군 : 10.0% (4/40명)
- 비교군 : 5.0% (2/40명)
■ 결과변수
- Primary outcomes: complication rate within 90 days
- Secondary outcomes: intraoperative complications, drainage time, length of hospital stay, postoperative pain, ~~postoperative quality of life~~, and readmissions within 90 days</td></tr>
</table>

Terra (2022)

결과변수/측정도구	내용
Drainage time	the interval between surgery and the removal of the chest tube and was measured in days.
Length of hospital stay	days after surgery
Postoperative pain	– a visual analog pain scale on the first, second, and third postoperative days and at the 30-day outpatient visit – the need for opioid use at the 30-day outpatient visit
Readmission	Any hospitalization within the 90-day postoperative period

안전성 결과

■ 시술 관련 부작용 및 합병증

결과변수	측정시기	중재군		비교군		p값	S/NS
		N	no. (%)	N	no. (%)		
개흉술로의 전환율	수술	37	0	39	2 (5.1%)	0.49	NS
수술 중 합병증	수술	37	0	39	3 (7.7%) 2명: arterial lacerations 1명: venous injury	0.24	NS
수술 후 합병증(90일 이내)	수술 후 90일 이내	37	7 (18.9%)	39	14 (35.9%)	0.12	NS
– Prolonged air leak		37	4 (10.8%)	39	5 (12.8%)	1.00	NS
– Empyema		37	0	39	2 (5.1%)	0.49	NS
– Pleural effusion		37	0	39	1 (2.5%)	1.00	NS
– Surgical site infection		37	0	39	1 (2.5%)	1.00	NS
– Subcutaneous emphysema		37	0	39	1 (2.5%)	1.00	NS
– Acute kidney failure		37	1 (2.7%)	39	2 (5.1%)	1.00	NS
– Pyrexia		37	0	39	1 (2.5%)	1.00	NS
– Pneumonia		37	1 (2.7%)	39	1 (2.5%)	1.00	NS
– Sepsis		37	2 (5.4%)	39	1 (2.5%)	0.61	NS
– Severe pain		37	0	39	1 (2.5%)	1.00	NS
– Pulmonary embolism		37	1 (2.7%)	39	0	0.48	NS
– Arrhythmia		37	1 (2.7%)	39	0	1.00	NS
– Bronchospasm		37	1 (2.7%)	39	2 (5.1%)	1.00	NS
– Atelectasis		37	0	39	1 (2.5%)	1.00	NS
Grade ≥ 3 수술 후 합병증(90일 이내)	수술 후 90일 이내	37	7 (18.9%)	39	10 (25.6%)	0.58	NS
– Death		37	1 (2.7%)	39	1 (2.5%)	1.00	NS
– Prolonged air leak		37	4 (10.8%)	39	5 (12.8%)	1.00	NS
– Empyema		37	0	39	2 (5.1%)	0.49	NS
– Pleural effusion		37	0	39	1 (2.5%)	1.00	NS
– Surgical site infection		37	0	39	1 (2.5%)	1.00	NS
– Subcutaneous emphysema		37	0	39	0	1.00	NS
– Acute kidney failure		37	1 (2.7%)	39	2 (5.1%)	1.00	NS
– Pyrexia		37	0	39	0	1.00	NS
– Pneumonia		37	1 (2.7%)	39	1 (2.5%)	1.00	NS
– Sepsis		37	2 (5.4%)	39	1 (2.5%)	0.61	NS
– Severe pain		37	–	39	1 (2.5%)	1.00	NS
– Pulmonary embolism		37	1 (2.7%)	39	0	0.48	NS
– Arrhythmia		37	1 (2.7%)	39	0	1.00	NS
– Bronchospasm		37	1 (2.7%)	39	0	1.00	NS
– Atelectasis		37	0	39	0	1.00	NS

효과성 결과

■ 연속형 자료

Terra (2022)

결과변수	측정시기	중재군		비교군		p값	S/NS
		N	mean±SD	N	mean±SD		
수술시간(min) median (95% CI)	수술	37	241.7 (218.3-265.1)	39	214.4 (200.3-228.5)	0.06	NS
재원기간(일) median (95% CI)	수술 후	37	3 (2-4)	39	4 (2-5)	0.55	NS
흉관 삽입기간(일) median (95% CI)	수술 후	37	2 (1-2)	39	2 (1-4)	0.27	NS
재수술률 no. (%)	수술 후	37	1 (2.7%) a	39	2 (5.1%) b	0.59	NS
재입원률(90일 이내)(일), no. (%)	수술 후	37	1 (2.7%)	39	8 (20.5%)	0.029	S
통증(VAS 〉 2) no. (%)	수술후 1일	37	5	39	2	0.26	NS
	수술후 2일	37	3	39	1	0.35	NS
	수술후 3일	37	1	39	0	0.49	NS
	수술후 30일	37	1	39	2	1.00	NS
추가 진통제 사용 no. (%)	수술후 30일	37	9	39	12	0.61	NS
병기 상승 no. (%)			3		5	0.71	NS

a : Prolonged air leak
b : Prolonged air lean 1명; empyema 1명

결론	■ 결론 : RATS and VATS lobectomy had similar 90-day outcomes. However, RATS lobectomy was associated with a significant reduction in the 90-day hospital readmission rate. Larger studies are necessary to confirm such a finding.
기타	■ 연구비 지원 : The Brazilian Ministry of Health funded the acquisition of the DaVinci Si robotic system, surgical instruments, and disposable materials specific to robotic surgery (2012NE800206). ■ 연구프로토콜 : ClinicalTrials.gov identifier: NCT02292914

3.

<table>
<tr><th colspan="2">Veronesi (2021)</th></tr>
<tr><td>연구특성</td><td>■ 연구설계 : RCT (연구명: ROMAN Study)
■ 연구국가 : 이탈리아
■ 연구기관 : 다기관(4개 기관)
■ 대상자 모집기간 : 2017.04.~2018.11.</td></tr>
<tr><td>연구대상</td><td>■ 연구대상 : early stage NSCLC
■ 연구대상자 수 : 총 77명 (중재군 38명/대조군 39명)
■ 대상자 특성
<table>
<tr><th>변수</th><th>중재군 (n=38)</th><th>비교군 (n=39)</th><th>p값</th></tr>
<tr><td>연령, mean±SD</td><td>69±8.3</td><td>69±7.3</td><td>0.87</td></tr>
<tr><td>남/녀, 명(%)</td><td>21/17 (55.3%/44.7%)</td><td>23/16 (59.0%/41.0%)</td><td>0.82</td></tr>
<tr><td>BMI (kg/m^2), mean±SD</td><td>27±4.0</td><td>26±4.1</td><td>0.44</td></tr>
<tr><td>FEV1 (L), mean±SD</td><td>86±25.0</td><td>91±24.8</td><td>0.37</td></tr>
<tr><td>Clinical stage (%)*</td><td></td><td></td><td>0.48</td></tr>
<tr><td>- ⅠA</td><td>28 (76%)</td><td>25 (71%)</td><td></td></tr>
<tr><td>- ⅠB</td><td>7 (19%)</td><td>7 (20%)</td><td></td></tr>
<tr><td>- ⅡA</td><td>2 (5%)</td><td>1 (3%)</td><td></td></tr>
<tr><td>- ⅡB</td><td>0</td><td>2 (6%)</td><td></td></tr>
<tr><td>수술 유형</td><td></td><td></td><td>0.99</td></tr>
<tr><td>- Lobectomy</td><td>36 (94.7%)</td><td>37 (94.9%)</td><td></td></tr>
<tr><td>- Segmentectomy</td><td>2 (5.3%)</td><td>2 (5.1%)</td><td></td></tr>
</table>
* 이용 가능한 데이터 총 72명
■ 포함기준 : age older than 18 years old and known or suspected NSCLC. In case of suspected lung cancer with no preoperative diagnosis, frozen section was indicated during surgery in order to confirm the disease. If a benign lesion was diagnosed, the patient was considered a dropout of the study.
patients in clinical stage T1–T2–T3, N0–N1, candidate for lobectomy, anatomical segmentectomy, or bilobectomy; patients with multiple lung tumors could be included if they could be resected with a lobectomy, lobectomy plus segmentectomy, or bilobectomy and each tumor should be staged separately; and American Society of Anesthesiologists score 1–3. Written informed consent was signed prior to performing any study procedures.
■ 배제기준 : metastatic cancer, extrapulmonary primary cancers in the past 2 years, severe heart disease, alcohol abuse, renal impairment (creatinine 〉2.5 mg/dl), and other serious comorbidities that contraindicate surgery.</td></tr>
<tr><td>중재</td><td>■ 중재 : robotic-assisted throacoscopic surgery (RATS). lobectomy 또는 segmentectomy
- 사용기기: Da Vinci Robotic System (Intuitive, Summyvale, USA)
■ 병용 중재 :
- 수술 후 진행된 보조치료, 항암치료, 방사선 치료 시행률에 두 군 간 차이 없음</td></tr>
<tr><td>비교중재</td><td>■ 비교중재 : video-assisted thoracoscopic surgery (VATS), lobectomy 또는 segmentectomy
■ 병용 중재 :
- 수술 후 진행된 보조치료, 항암치료, 방사선 치료 시행률에 두 군 간 차이 없음</td></tr>
<tr><td>추적관찰 및 결과측정</td><td>■ 추적관찰기간 : 수술 직후
■ 탈락률 및 탈락사유
- 중재군 : 7.9% (3/38명)
- 비교군 : 5.1% (2/39명)</td></tr>
</table>

Veronesi (2021)

■ 결과변수

- primary outcome : conversion rate, early complications
- secondary outcome : extent of lymph node (LN) dissection

안전성 결과

■ 시술 관련 부작용 및 합병증

결과변수	측정시기	중재군		비교군		p값	S/NS
		N	no. (%)	N	no. (%)		
개흉술로의 전환율	수술	38	3 (7.9%)	39	2 (5.1%)	0.64	NS
초기 수술 후 합병증	수술후	38	13 (34.2%)	39	9 (23.1%)	0.28	NS
합병증 정도							
- Ⅰ-Ⅱ	수술후	38	11 (32%)	39	4 (12%)	0.04	S
- Ⅲ	수술후	38	2 (8%)	39	3 (9%)	0.85	NS
가장 빈번한 초기 수술 후 합병증							
- Air leak	수술후	38	6 (16%)	39	4 (10%)	0.47	NS
- Atrial fibrillation	수술후	38	4 (11%)	39	3 (7.7%)	0.71	NS
- Serious drainage	수술후	38	1 (3%)	39	1 (3%)	0.99	NS
- Pneumonia	수술후	38	4 (11%)	39	1 (3%)	0.16	NS
- Pneumothorax	수술후	38	0	39	1 (3%)	0.32	NS
- Atelectasis	수술후	38	3 (8%)	39	1 (3%)	0.29	NS
- Urinary tract infection	수술후	38	1 (3%)	39	0	0.31	NS
- Other complications	수술후	38	3 (8%)	39	2 (5%)	0.62	NS
후기 합병증	수술후	38	5 (23%)	39	2 (11%)	0.33	NS

효과성 결과

■ 연속형 자료

결과변수	측정시기	중재군		비교군		p값	S/NS
		N	mean±SD	N	mean±SD		
수술시간(min) mean±SD	수술	38	179±54.2	39	183±40.9	0.71	NS
흉관 삽입기간(일) median (IQR)	수술후	38	4 (3-6)	39	4 (3-6)	0.48	NS
재원기간(일) median (IQR)	수술후	38	5 (4-8)	39	4 (3-6)	0.27	NS
절제 림프절 수(개) hilar lylmph nodes	수술	38		39			
mean±SD			7.8±4.3		4.5±3.6	0.0006	S
median (IQR)			7 (5-10)		4 (2-7)	0.0003	S
절제 림프절 수(개) mediastinal lymph nodes	수술	38		39			
mean±SD			8.1±5.4		5.7±3.7	0.0001	S
median (IQR)			7 (5-10)		5 (3-7)	0.0001	S
절제 림프절 구역 수(개)	수술	38		39			
mean±SD			5.2±1.4		3.9±1.2	0.0001	S
median (IQR)			6 (4-6)		4 (3-5)	0.0002	S

결론

■ 결론 : The results of this trial demonstrated that RATS was not superior to VATS considering the perioperative outcome for early-stage NSCLC, but the robotic approach allowed an improvement of LN dissection. Further studies are suggested to validate the results of this trial.

기타

■ 연구비 지원 : This work was supported by specific grants from the Umberto Veronesi Foundation (Milan, Italy) and Intuitive Surgical Inc. (Sunnyvale, CA, USA).

■ 연구프로토콜 : Clinical Trial Registration: clinicaltrials.gov, identifier NCT02804893.

4.

Huang (2021), Huang (2019)

연구특성

- 연구설계 : RCT
- 연구국가 : 중국
- 연구기관 : 다기관(3개 기관)
- 대상자 모집기간 :
  - (Huang, 2021) 2016.01.~2020.07.
  - (Huang, 2019) 2016.01.~2018.12.

연구대상

- 연구대상 : NSCLC (non-small cell lung cancer)
- 연구대상자 수 :
  - (Huang, 2021) : 총 148명 (중재군 76명/비교군 72명)
  - (Huang, 2019) : 총 113명 (중재군 58명/비교군 55명)
- 대상자 특성
  - (Huang, 2021)

변수	중재군 (n=76)	비교군 (n=72)	p값
연령, mean±SD	60.9±9.4	61.0±7.6	0.911
남/녀, 명(%)	51/25 (67.1%/32.9%)	51/21 (70.8%/29.2%)	0.624
%FEV1, median (95% CI)	89.0±14.1	90.0±16.2	0.716
병리학적 TNM stage, n (%)			0.342
Ⅰ	24 (31.6%)	21 (29.2%)	
Ⅱ	24 (31.6%)	17 (23.6%)	
Ⅲ	27 (35.5%)	33 (45.8%)	
Ⅳ	1 (1.3%)	1 (1.4%)	

  - (Huang, 2019)

변수	중재군 (n=58)	비교군 (n=55)	p값
연령, mean±SD	61.9±9.0	60.6±7.4	0.40
남/녀, 명(%)	41/17 (70.7%/29.3%)	39/16 (70.9%/29.1%)	0.98
%FEV1, median (95% CI)	90.3	89.54	0.80
수술명			0.57
- Lobectomy	53	50	
- Bilobectomy	4	2	
- Sleeve lobectomy	1	2	
- Pneumonectomy	0	1	

- 포함기준 : they were diagnosed with primary NSCLC with clinical N2 (c-N2) disease-stage according to the eighth edition of the American Joint Committee on Cancer Tumor-Node-Metastasis (TNM) classification, were 18 to 75 years old, had adequate pulmonary and cardiac function to tolerate pulmonary resection, volunteered to participate in this study, and were able give written informed consent. Positron emission tomography computed tomography (PET-CT) and biopsy through endobronchial ultrasound guided transbronchial needle aspiration (EBUS-TBNA) or mediastinoscopy were recommended if the patients were willing. All the tumors of included patients were evaluated as resectable by the MDT. If the above examinations were absent, patients with enlarged mediastinal lymph nodes (diameter more than 1 cm) on computed tomography could be included after they were assessed by MDT.
- 배제기준 : (I) pathological results other than NSCLC through intraoperative frozen section

<table>
<tr><th colspan="2">Huang (2021), Huang (2019)</th></tr>
<tr><td></td><td>examination; (II) pleural dissemination or other unexpected metastasis observed during operation; (III) change of resected range based on intraoperative exploration or unexpected event.</td></tr>
<tr><td>중재</td><td>■ 중재 : robotic-assisted thoracic surgery (RATS)
- 사용기기: da Vinci Surgical System (Intuitive Surgical, Sunnyvale, CA, USA)
■ 병용 중재 :
- 수술 후 회복 향상 프로그램(enhanced recovery after surgery)을 두 군에 동일하게 적용함
- 보조치료(항암치료, 방사선치료, 면역치료, 표적치료) 비율이 두 군 간 유사함</td></tr>
<tr><td>비교중재</td><td>■ 비교중재 : video-assisted thoracoscopic surgery (VATS)
- conventional lobectomy with a rib-spreading thoracotomy of about 15 cm
■ 병용 중재 :
- 수술 후 회복 향상 프로그램(enhanced recovery after surgery)을 두 군에 동일하게 적용함
- 보조치료(항암치료, 방사선치료, 면역치료, 표적치료) 비율이 두 군 간 유사함</td></tr>
<tr><td>추적관찰 및 결과측정</td><td>■ 추적관찰기간 : ~3년
■ 탈락률 및 탈락사유
- (Huang, 2021) 중재군 3.8% (3/79명), 비교군 7.7% (6/78명)
- (Huang, 2019) 중재군 0% (0/58명), 비교군 0% (0/55명)</td></tr>
<tr><td>안전성 결과</td><td>■ 시술 관련 부작용 및 합병증
- (Huang, 2021)
<table>
<tr><th rowspan="2">결과변수</th><th rowspan="2">측정시기</th><th colspan="2">중재군</th><th colspan="2">비교군</th><th rowspan="2">p값</th><th rowspan="2">S/NS</th></tr>
<tr><th>N</th><th>no. (%)</th><th>N</th><th>no. (%)</th></tr>
<tr><td>Prolonged air leak</td><td>수술 후</td><td>76</td><td>6 (7.9%)</td><td>72</td><td>6 (8.3%)</td><td>0.922</td><td></td></tr>
<tr><td>Bronchopleural fistula</td><td>수술 후</td><td>76</td><td>4 (5.3%)</td><td>72</td><td>1 (1.4%)</td><td>0.367</td><td></td></tr>
<tr><td>Pneumonia</td><td>수술 후</td><td>76</td><td>3 (3.9%)</td><td>72</td><td>6 (8.3%)</td><td>0.318</td><td></td></tr>
<tr><td>Atrial fibrillation</td><td>수술 후</td><td>76</td><td>3 (3.9%)</td><td>72</td><td>4 (5.6%)</td><td>0.714</td><td></td></tr>
<tr><td>Atrial arrhythmia</td><td>수술 후</td><td>76</td><td>3 (3.9%)</td><td>72</td><td>4 (5.6%)</td><td>0.714</td><td></td></tr>
<tr><td>Chest tube reinsertion</td><td>수술 후</td><td>76</td><td>3 (3.9%)</td><td>72</td><td>4 (5.6%)</td><td>0.714</td><td></td></tr>
<tr><td>Subcutaneous emphysema</td><td>수술 후</td><td>76</td><td>3 (3.9%)</td><td>72</td><td>2 (2.8%)</td><td>1.000</td><td></td></tr>
<tr><td>Chylothorax</td><td>수술 후</td><td>76</td><td>3 (3.9%)</td><td>72</td><td>2 (2.8%)</td><td>1.000</td><td></td></tr>
<tr><td>Hyperpyrexia</td><td>수술 후</td><td>76</td><td>2 (2.6%)</td><td>72</td><td>6 (8.3%)</td><td>0.158</td><td></td></tr>
<tr><td>Hemorrhage</td><td>수술 후</td><td>76</td><td>2 (2.6%)</td><td>72</td><td>1 (1.4%)</td><td>1.000</td><td></td></tr>
<tr><td>Recurrent laryngeal nerve injury</td><td>수술 후</td><td>76</td><td>1 (1.3%)</td><td>72</td><td>4 (5.6%)</td><td>0.200</td><td></td></tr>
<tr><td>Pyulmonary embolism</td><td>수술 후</td><td>76</td><td>1 (1.3%)</td><td>72</td><td>0</td><td>1.000</td><td></td></tr>
<tr><td>Pyothorax</td><td>수술 후</td><td>76</td><td>0</td><td>72</td><td>1 (1.4%)</td><td>0.486</td><td></td></tr>
<tr><td>ARDS</td><td>수술 후</td><td>76</td><td>0</td><td>72</td><td>1 (1.4%)</td><td>0.486</td><td></td></tr>
</table>
ARDS, acute respiratory distress syndrome

- (Huang, 2019)
<table>
<tr><th rowspan="2">결과변수</th><th rowspan="2">측정시기</th><th colspan="2">중재군</th><th colspan="2">비교군</th><th rowspan="2">p값</th><th rowspan="2">S/NS</th></tr>
<tr><th>N</th><th>no. (%)</th><th>N</th><th>no. (%)</th></tr>
<tr><td>사망률</td><td>28일</td><td>58</td><td>1 (1.7%)</td><td>55</td><td>0</td><td>1.00</td><td></td></tr>
<tr><td>합병증 발생률</td><td>28일</td><td>58</td><td>16 (27.6%)</td><td>55</td><td>21 (38.2%)</td><td>0.23</td><td></td></tr>
<tr><td>Pyulmonary embolism</td><td>28일</td><td>58</td><td>1 (1.7%)</td><td>55</td><td>0</td><td>1.00</td><td></td></tr>
<tr><td>Hemorrahge required reoperation</td><td>28일</td><td>58</td><td>1 (1.7%)</td><td>55</td><td>1 (1.8%)</td><td>1.00</td><td></td></tr>
<tr><td>Bronchopleural fistula</td><td>28일</td><td>58</td><td>3 (5.2%)</td><td>55</td><td>1 (1.8%)</td><td>0.65</td><td></td></tr>
<tr><td>ARDS</td><td>28일</td><td>58</td><td>0</td><td>55</td><td>1 (1.8%)</td><td>0.49</td><td></td></tr>
<tr><td>Pneumonia</td><td>28일</td><td>58</td><td>3 (5.2%)</td><td>55</td><td>6 (10.9%)</td><td>0.44</td><td></td></tr>
</table></td></tr>
</table>

Huang (2021), Huang (2019)

결과변수	측정시기	중재군		비교군		p값	S/NS
		N	no. (%)	N	no. (%)		
Prolonged air leak	28일	58	4 (6.9%)	55	6 (10.9%)	0.68	
Atrial arrhythmia	28일	58	2 (3.4%)	55	3 (5.5%)	0.95	
Chest tube reinsertion	28일	58	2 (3.4%)	55	3 (5.5%)	0.95	
Chylothorax	28일	58	3 (5.2%)	55	0	0.24	
Recurrent nerve injury	28일	58	1 (1.7%)	55	4 (7.3%)	0.33	
Others	28일	58	1 (1.7%)	55	2 (3.6%)	0.96	

ARDS, acute respiratory distress syndrome

효과성 결과

■ 효과성 결과

- (Huang, 2021)

결과변수	측정시기	중재군		비교군		p값	S/NS
		N	mean±SD	N	mean±SD		
수술시간(min) mean±SD	수술	76	104.2±41.0	72	102.3±29.2	0.757	
출혈량, n (%)	수술	76		72		〈0.001	S
〈 100 mL			65 (85.5%)		16 (22.2%)		
≥ 100 mL			11 (14.5%)		56 (77.8%)		
흉관 삽입기간(일) median (IQR)	수술후	76	4.0 (3.3-5.0)	72	5.0 (4.0-7.0)	0.002	S
흉관 배액량(mL) median (IQR)	수술후	76	855.0 (602.5-1,167.5)	72	920.0 (592.5-1,646.3)	0.146	
재원기간(일) median (IQR)	수술후	76	10.0 (8.0-13.0)	72	11.0 (9.0-14.8)	0.054	

생존결과

- 무질병 생존율: 두 군 간 차이가 없음(p=0.925)
  - 1년: 중재군 90.4%, 비교군 86.0%
  - 2년: 중재군 76.4%, 비교군 74.2%
  - 3년: 중재군 57.5%, 비교군 49.9%
- 전체 생존율: 두 군 간 차이가 없음(p=0.853)
  - 1년: 중재군 97.2%, 비교군 97.0%
  - 2년: 중재군 94.2%, 비교군 93.2%
  - 3년: 중재군 84.6%, 비교군 74.9%

- (Huang, 2019)

결과변수	측정시기	중재군		비교군		p값	S/NS
		N	mean±SD	N	mean±SD		
수술시간(min) mean±SD	수술	58	108±39	55	103±30	0.41	
출혈량, mean±SD	수술	58	86.3±41.1	55	165.7±46.4	〈0.001	S
흉관 삽입기간(일) median (range)	수술후	58	4 (2-63)	55	5 (3-66)	〈0.01	S
흉관 배액량(mL) median (range)	수술후	58	820 (220-2,460)	55	960 (320-4,630)	0.05	
재원기간(일) median (range)	수술후	58	10 (7-31)	55	11 (6-44)	0.07	
통증(VAS), mean±SD							
1일	수술후	58	5.9±1.4	55	7.0±1.2	〈0.001	S
2일	수술후	58	5.4±1.3	55	6.9±1.1	〈0.001	S

Huang (2021), Huang (2019)

결과변수	측정시기	중재군		비교군		p값	S/NS
		N	mean±SD	N	mean±SD		
3일	수술후	58	5.0±1.4	55	6.2±1.2	〈0.001	S
4일	수술후	58	4.1±1.4	55	5.4±1.2	〈0.001	S
5일	수술후	58	3.7±1.2	55	4.8±1.4	〈0.001	S
절제 림프절 구역 수(개)	수술	58	7.0±1.1	55	6.8±1.4	0.31	
절제 림프절 수(개)	수술	58	16.9±6.2	55	16.0±6.5	0.79	
절제 N2 림프절 수(개)	수술	58	10.6±4.0	55	9.9±4.5	0.38	

결론

■ 결론 :

- (Huang, 2021) RATS reduced intraoperative bleeding, drainage duration, post-operative pain, and achieved similar long-term survival outcomes compared with po-eterolateral thoracotomy in c-N2 stage NSCLC patients.
- (Huang, 2019) Present study proves that the feasibility and safety of RATS lobectomy to treat patients with cN2 stage NSCLC, and it should be superior to thoracotomy due to lesser intraoperative blood loss.

기타

■ 연구비 지원 : This work was supported by Shanghai Hospital Development Center (Grant Number: SHDC12016113), National Natural Science Foundation of China (No. 81702251).

■ 연구프로토콜 : Chinese Clinical Trial Registry (ChiCTR-INR-17012777)