	2D (n=76)	3D (n=76)	P
Operation time	180 ± 64	188 ± 57	0.439
Lobectomy	166 ± 44	182 ± 55	0.093
Lobectomy + segmentectomy	224 ± 93	193 ± 137	<0.001
Sleeve resection	173 ± 11	153 ± 31	0.640
Lobectomy + others	262 ± 96	207 ± 150	0.098
Number of lymph node excision	18.4 ± 10.5	18 ± 8.3	0.811
Conversion to open	4	3	0.698
Modified Clavien-Dindo thoracic complications after thoracic surgery			0.145
Minor grade I	15	12	
II	9	13	
Major grade IIIa	11	13	
IIIb	0	3	
IV	3	5	
Operative mortality	0	0	
Indwelling chest tube drain	5 ± 3	6 ± 4	0.006

Table. Propensity matched analysis.

Conclusion: Three-dimensional video system is a safe and feasible option for minimally invasive major lung resection for lung cancer and might be helpful in performing thoracoscopic complex procedures; segmentectomy, sleeve resection under single port thoracoscopic surgical field.

Keywords: lung cancer, Thoracoscopic surgery

PUB024
Real-Time Computed Tomography Fluoroscopy Guidance in a Rabbit Model of Solitary Lung Cancer

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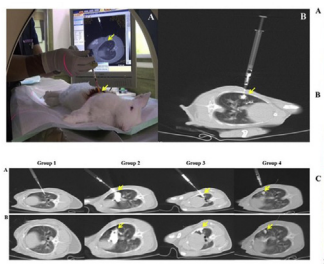
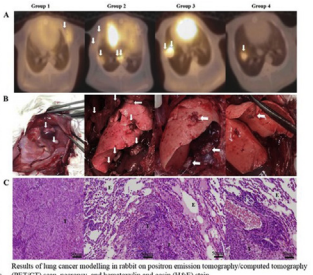
Background: We evaluate the feasibility and safety of a newly developed solitary lung cancer rabbit model that utilizes real-time computed tomography (CT) fluoroscopy-guided inoculation of VX2 single cell suspensions.

Methods: Thirty-eight rabbits were divided into four groups according to number of VX2 carcinoma cells, Lipiodol amount, Matrigel amount, and injection needle size. The different VX2 tumor cell suspensions were percutaneously injected into rabbits under real-time CT fluoroscopy guidance. Two weeks later, VX2 lung cancers were confirmed by positron emission tomography/CT, necropsy, and histology.

Results: Real-time CT fluoroscopy allowed the precise inoculation of tumor cell suspensions containing Lipiodol. Use of Matrigel and a small-sized needle reduced spreading and leakage of tumor cell suspensions in the lung parenchyma. Solitary lung cancers were successfully established in all rabbits in group 4 (22/22, 100%); these rabbits were inoculated with 150 μl VX2 tumor cells filtered through a 100 μm cell strainer, 100 μl Lipiodol, and 150 μl Matrigel, using 26-gauge needles. Pneumothorax was observed in only 2 of 38 rabbits (5.3%).



Real-time computed tomography (CT) fluoroscopy guided percutaneous inoculation of VX2 suspensions.



Results of lung cancer modelling in rabbit on positron emission tomography/computed tomography (PET/CT) scan, necropsy, and hematoxylin and eosin (H&E) stain.

Table. The correlations between suspension on computed tomography (CT) guided inoculation and tumor on necropsy

	Real-time CT fluoroscopy					Necropsy				
	Suspension location (Incidence, %)					Tumor location (Incidence, %)				
Group (n)	Lung	Lung and Pleura[a]	Pleural and Thorax[b]	Lung, Pleura and Thorax[c]	No detection	Lung	Lung and Pleura[a]	Pleural and Thorax[b]	Lung, Pleura and Thorax[c]	Thoracic wall[d]
1 (5)	0	0	0	0	5 (100)	0	2 (40)	1 (20)	1 (20)	1 (20)
2 (5)	0	0	2 (40)	3 (60)	0	0	0	0	5 (100)	0
3 (6)	4 (66.7)	2 (33.3)	0	0	0	4 (66.7)	2 (33.3)	0	0	0
4 (22)	22 (100)	0	0	0	0	22 (100)	0	0	0	0

[a]Lung and Pleural cavity
[b]Pleural cavity and Thoracic wall
[c]Lung, Pleural cavity and Thoracic wall
[d]Tumor was developed in thoracic wall of the injection site.

Conclusion: Real-time CT fluoroscopy-guided inoculation of the appropriate composition of a VX2 tumor cell suspension using a small sized needle is an easy and safe method to model solitary lung cancer in rabbits.

Keywords: Lung cancer animal model, CT guided fluoroscopy

PUB025
Comparison of Surgical Outcomes between Multiport and Single Port Thoracoscopic Lobectomy for Lung Cancer: Propensity Score Matched Analysis

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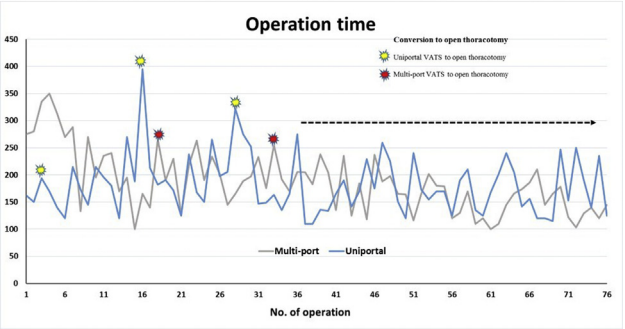
Background: We evaluated operative outcomes of single port thoracoscopic lobectomy comparted to conventional multiport thoracoscopic lobectomy to determine its safety and oncologic efficacy by propensity score matched analysis.

Methods: Between November 2006 and June 2015, retrospective data of 386 patients who underwent thoracoscopic lobectomy for single lobe in non-small cell lung cancer by one surgeon. The cases of sublobar resection and multiple or complex procedures were excluded in this analysis (n=145). Patients were divided into single port group (n=159) and multiport group (n=82). Seventy-six patients of each group were matched using propensity score analysis.

Results: The mean operative time in learning period (<50 cases) (185± 63 min in single port vs. 184 ±59 in multiport, p=0.879) and the conversion to open thoracotomy (3 cases in single port and 2 case in multiport, p=0.649) were not different significantly between the two groups.After experiencing of 28 single port lobectomy, there was no conversion to open thoracotomy. The number of excised lymph node was not impaired by single port thoracoscopic lobectomy (17±10 in single port vs. 19±11 in multiport, p=0.512). The survival curve in pathologic stage I population was not different between groups (p=0.969).

Figure 1. Operation times of single vs multiport thoracoscopic lobectomy



Conclusion: Single port approach to thoracoscopic lobectomy shows learning course similar to that of multiport thoracoscopic lobectomy in non-small cell lung cancer. It is safe and a feasible option for treatment of early-stage non-small cell lung cancer. And its oncologic outcome is acceptable compared to conventional multiport lobectomy in non-small cell lung cancer.

Keywords: lung cancer, Thoracoscopic surgery

PUB026
Comparability of the Relative Survival Metrics among Lung Cancer Patients and General Population

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Background: Cancer-related mortality measured by relative survival rate (RSR, observed survival of cancer patients versus expected survival of a matched population), and cause-specific survival (CSS, based on lung-cancer-specific mortality among cancer patients) are vulnerable to biases. RSR, commonly used in population-based studies depends on a comparable reference population, while CSS relies on accurate cause-of-death coding. In theory, RSR closely estimates CSS. We perform sensitivity analyses to investigate the RSR under various violation of comparability.

Methods: Outcomes of patients diagnosed with stage I-IV NSCLC (2000-2013) were obtained from the SEER registry. Population-level mortality was extracted from the National Center for Health Statistics. The actuarial survival were summarized as RSR (Ederer II) and CSS, stratified by sex, age and year of diagnosis. We vary the odds of dying from any cause for smoker vs non-smoker (θ) incorporating the prevalence of smoking in the general population. We also consider adjusted-RSR based on 2%, 5% and 10% prevalence of lung-cancer death in the general population.

Results: Analyses included 236418 males and 199567 females, with stage I (16%), II (4%), III (28%) or IV (52%) NSCLC. Prevalence of smoking has decreased between 2000-2013 from 25.5% to 20.5% for males and 21.1% to 15.5% for females, though much lower than the prevalence among cancer patients. In 2013, 6% of all deaths were attributed to lung cancer; this trend was higher in the older age (10.9% among ages 65-74). The bias from dissimilar smoking patterns and lung-cancer deaths in the general population is negligible (Table 1). The deviation is larger with longer follow-up and older age among both genders.

Conclusion: RSR is an appropriate surrogate to measure excess mortality due to cancer. However, the bias in RSR may be of concern for older age groups and an adjustment to the expected survival is recommended when reporting RSR by age groups.

Table 1: Cohort-based cumulative relative survival ratios (RSR) for patients diagnosed in 2008 and the differences in percent units to unadjusted RSR and adjusted for (a) prevalence of smoking and (b) prevalence of lung death in the general population.

sex	Age at diagnosis	CSS	RSR-unadjusted	RSR-smoke adjusted (θ=1.6)	Difference: smoking prevalence (θ=1.6)	Difference: smoking prevalence (θ=3)	Difference: smoking prevalence (θ=5)	RSR-5% lung death adjusted	Difference: 2% lung death prevalence	Difference: 5% lung death prevalence	Difference: 10% lung death prevalence
1-year follow-up											
Male	18	46.5	42.9	42.9	0.0	0.1	0.2	42.9	0.0	0.0	0.0
	45	45.7	43.1	43.2	0.1	0.3	0.5	43.0	0.0	0.0	0.0
	60	43.2	39.6	40.0	0.3	0.9	1.4	39.6	0.0	0.0	-0.1
	75	36.8	33.0	34.0	1.0	2.8	4.4	32.9	-0.1	-0.1	-0.3
Female	18	60.8	59.7	59.8	0.0	0.1	0.2	59.7	0.0	0.0	0.0
	45	54.4	52.4	52.5	0.1	0.3	0.4	52.4	0.0	0.0	0.0
	60	50.8	47.8	48.1	0.3	0.8	1.3	47.8	0.0	0.0	-0.1
	75	41.0	37.6	38.6	1.0	2.7	4.4	37.5	0.0	-0.1	-0.2
5-year follow-up											
Male	18	20.7	18.4	18.5	0.1	0.3	0.4	18.4	0.0	0.0	0.0
	45	17.9	15.5	15.8	0.3	0.7	1.1	15.5	0.0	0.0	-0.1
	60	16.5	13.7	14.4	0.7	1.8	2.9	13.6	0.0	-0.1	-0.2
	75	13.7	11.1	13.1	2.0	6.1	10.9	10.8	-0.1	-0.2	-0.5
Female	18	25.3	23.9	24.0	0.1	0.2	0.4	23.9	0.0	0.0	0.0
	45	23.8	21.7	22.0	0.2	0.6	1.0	21.7	0.0	0.0	0.0
	60	21.8	19.1	19.8	0.7	1.9	3.1	19.0	0.0	-0.1	-0.2
	75	16.0	13.8	15.8	2.0	6.1	10.9	13.6	-0.1	-0.2	-0.5

*CSS = lung-cancer spedfic death (death due to other causes are censored)
*θ is the ratio of odds of dying from any cause for smokers compared with non-smokers.

Keywords: Relative survival, Net survival, Population study, Expected survival probability