Analysis of healthcare resource use of the robotic surgery system for lung cancer in Japan

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Objectives

The robot-assisted surgery system has the potential to overcome the limitations of existing low-invasive surgical systems with regard to operatability and precision of maneuvers.

Da Vinci system (dV), the robot-assisted surgery system produced by Intuitive Surgical Inc., was reimbursed for lobectomy for lung cancer in Japan since Apr 2018, without any premiums. Additional evidence of relative benefits for patients is necessary for premiums.

Our objective is to assess the healthcare resource use of the dV against open surgery and Video-Assisted Thoracoscopic surgery (VATS) lobectomy for lung cancer patients in Japan.

Design and method

For this study, hospital-based claims data with DPC (DRG-like flat payment system) were obtained from Medical Data Vision Co., Ltd. Patients with lung cancer who received either open surgery, VATS, or dV were included for the analysis.

Propensity score matching (PSM) was performed to adjust for patient background biases. PSM incorporated six factors age, gender, BMI, smoking history, stage of disease based on TNM classification, and Charlson Comorbidity Index (CCI).

The following components of healthcare resource use were measured: the length of hospitalization (entire length and length after surgery), medical costs (index hospitalization, total cost after 30/90/365 days of discharge). The following health-related outcomes were also compared: surgical site infection, transfusion, readmission.

Results: open surgery vs dV surgery

	Before PSM			After PSM		
	Open (n=3513)	dV (n=1054)	P value	Open (n=1022)	dV (n=1022)	P value
Age, mean (SD)	70.7 (8.52)	69.4 (9.22)	**<0.001**	69.3 (9.07)	69.7 (8.91)	0.27
Female, n (%)	1048 (29.8)	440 (41.7)	**<0.001**	419 (41.0)	413 (40.4)	0.82
BMI, mean (SD)	23.2 (3.62)	23.1 (3.35)	0.66	23.1 (3.58)	23.1 (3.36)	0.43
Smoking history, n (%)	2531 (72.0)	601 (57.0)	**<0.001**	579 (56.7)	600 (58.7)	0.37
Stage, n (%)						
1	1195 (34.0)	761 (72.2)	**<0.001**	725 (70.9)	730 (71.4)	0.85
2	1458 (41.5)	234 (22.2)	**<0.001**	237 (23.2)	234 (22.9)	0.91
3	758 (21.6)	31 (2.94)	**<0.001**	33 (3.23)	31 (3.03)	0.90
4	65 (1.85)	6 (0.569)	**0.01**	9 (0.881)	6 (0.587)	0.60
CCI, mean (SD)	4.15 (2.40)	3.52 (2.11)	**<0.001**	3.61 (1.98)	3.56 (2.13)	**0.02**

Table 1

	Open (n=1022)	dV (n=1022)	P value
Total length of hospitalization, mean (SD)	13.2 (11.1)	9.56 (6.08)	**<0.001**
Length after surgery, mean (SD)	11.0 (10.4)	7.77 (5.67)	**<0.001**
Total cost of index hospitalization, mean (SD)	1904508 (617581)	2032796 (408249)	**<0.001**
Total cost by 30 days after discharge, mean (SD)	1982870 (667437)	2087173 (434099)	**<0.001**
Total cost by 90 days after discharge, mean (SD)	2205446 (880847)	2238162 (592089)	**<0.001**
Total cost by 365 days after discharge, mean (SD)	2792791 (1868136)	2525993 (1215529)	0.14
SSI	20 (1.96)	9 (0.881)	0.06
Transfusion, n (%)	72 (7.05)	24 (2.35)	**<0.001**
Readmission, n (%)	47 (4.60)	25 (2.45)	**0.01**

Table 2

A total of 4,567 patients met inclusion and exclusion criteria. Using PSM, 1,022 pairs of patients were matched. **Table 1** shows the baseline characteristics of the enrolled patients.

dV arm had less healthcare resource usage with regard to the length of hospitalization, and better post-operative outcomes. Even though the initial medical cost was higher for dV arm, the difference between two arms decreases over time, dV arm was less costly than open arm after 365 days of discharge (**Table 2**).

Results: VATS surgery vs dV surgery

	Before PSM			After PSM		
	VATS (n=20670)	dV (n=1054)	P value	VATS (n=1054)	dV (n=1054)	P value
Age, mean (SD)	70.2 (9.04)	69.4 (9.22)	**0.003**	69.3 (9.52)	69.4 (9.22)	0.94
Female, n (%)	8443 (40.8)	440 (41.7)	0.58	446 (42.3)	440 (41.7)	0.83
BMI, mean (SD)	23.0 (3.42)	23.1 (3.35)	0.66	23.1 (3.45)	23.1 (3.35)	0.41
Smoking history, n (%)	12701 (61.4)	601 (57.0)	**0.004**	567 (53.8)	601 (57.0)	0.15
Stage, n (%)						
1	12615 (61.0)	761 (72.2)	**<0.001**	739 (70.1)	761 (72.2)	0.31
2	5984 (29.0)	234 (22.2)	**<0.001**	252 (23.9)	234 (22.2)	0.38
3	1387 (6.71)	31 (2.94)	**<0.001**	33 (3.13)	31 (2.94)	0.90
4	240 (1.16)	6 (0.569)	0.10	4 (0.380)	6 (0.569)	0.75
CCI, mean (SD)	3.80 (2.16)	3.52 (2.11)	**<0.001**	3.49 (1.88)	3.52 (2.11)	0.13

Table 3

	VATS (n=1054)	dV (n=1054)	P value
Total length of hospitalization, mean (SD)	11.5 (8.27)	9.52 (6.00)	**<0.001**
Length after surgery, mean (SD)	9.43 (7.78)	7.74 (5.60)	**<0.001**
Total cost of index hospitalization, mean (SD)	2015954 (603863)	2029799 (403282)	**<0.001**
Total cost by 30 days after discharge, mean (SD)	2091040 (642003)	2083100 (428963)	**0.01**
Total cost by 90 days after discharge, mean (SD)	2280322 (816715)	2230678 (585617)	0.65
Total cost by 365 days after discharge, mean (SD)	2760989 (1583516)	2512846 (1200721)	**<0.001**
SSI	16 (1.52)	9 (0.854)	0.22736
Transfusion, n (%)	19 (1.80)	24 (2.28)	0.53769
Readmission, n (%)	32 (3.04)	25 (2.37)	0.42042

Table 4

A total of 21,724 patients met inclusion and exclusion criteria. Using PSM, 1,054 pairs of patients were matched. **Table 3** shows the baseline characteristics of the enrolled patients.

dV arm had less healthcare resource usage with regard to the length of hospitalization compared to VATS arm. Even though the initial medical cost was higher for dV arm, the difference between two arms decreases over time, dV arm was less costly than VATS arm after 30 days of discharge (**Table 4**).

Conclusion:

Introduction of robotic surgery system may reduce overall healthcare costs and improve post-operative outcomes in lung cancer field.

[COI Disclosure]

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