

INTRODUCTION

With few RCTs available per procedure and hospitals commonly offering multispecialty robotic surgery, we aimed to pool published RCTs across multiple cancer specialties.

AIM

To compare a set of common clinical outcomes for robotic (da Vinci systems), laparoscopic/video-assisted thoracoscopic (VATS), and open surgery by performing a systematic literature review and meta-analysis.

METHOD

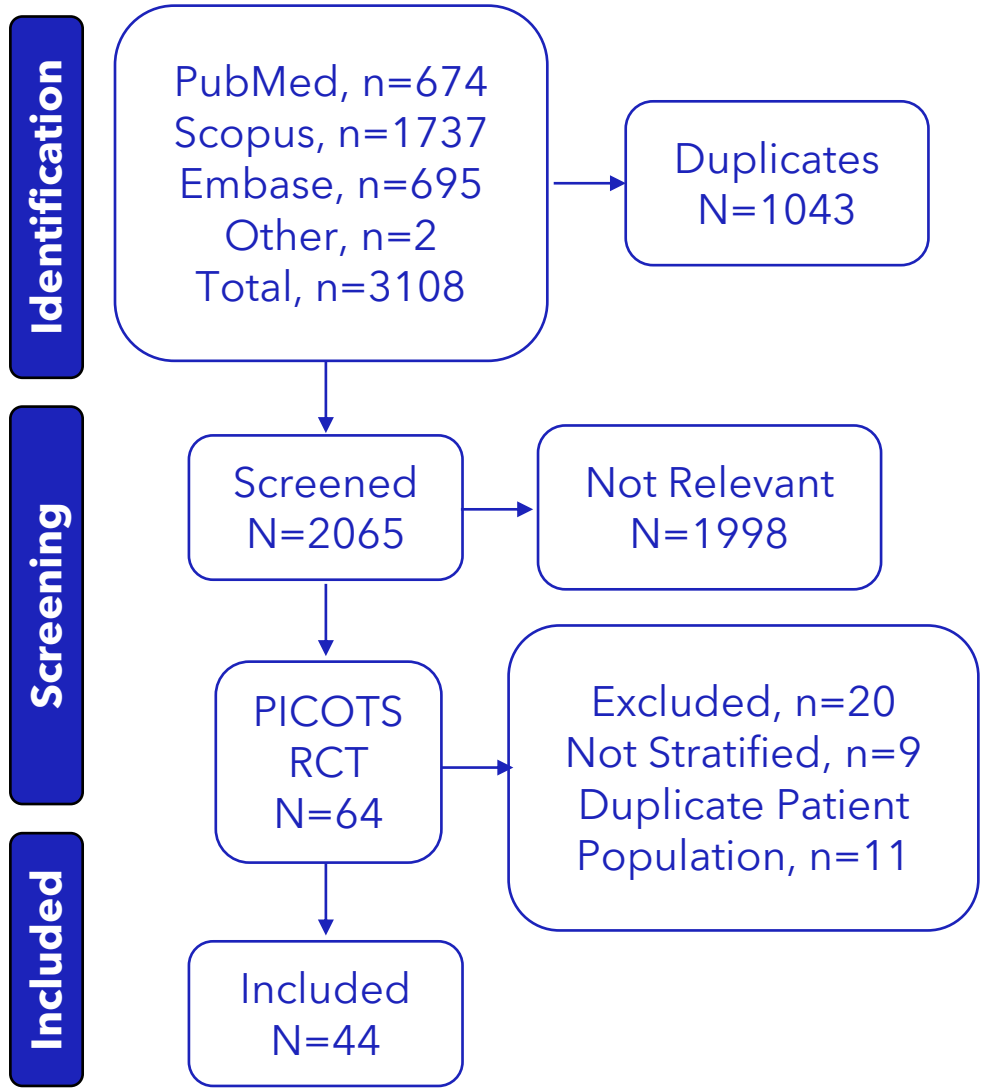
Searched PubMed, Scopus, and Embase combining free text terms with field limiters:
Robotic: robot*, da vinci, endowrist, Intuitive Surgical
Cancer: cancer, carcinoma, neoplasm, tumor, carcinoid, malignant, oncology
Study type: randomized controlled trial, RCT, random*
Filters: English, publication dates, source and document types

References were screened using **PICOTS** criteria:
Patients: adults with primary localized urologic, gynecologic, colorectal, thoracic, general, or head & neck cancer
Intervention: da Vinci multi-port robotic surgery
Comparator: laparoscopic/VATS or open surgery
Outcomes: 1. operative time, 2. estimated blood loss, 3. blood transfusions, 4. conversions to open, 5. length of hospital stay, 6. postoperative complications (postop comps), 7. reoperations, 8. readmission, and 9. mortality within 30 days (with a sensitivity analysis to follow-up)

Time frame: Jan 1, 2010 to Aug 4, 2022
Study type: Peer-reviewed full text publications in English, randomization by surgical approach

RESULTS

Figure 1: Search Flowchart



- Robot vs. laparoscopic/VATS
- Longer operative time
 - Fewer conversions to open surgery
 - Shorter hospital stay

- Robot vs. Open
- Longer operative time
 - Less blood loss
 - Fewer transfusions
 - Shorter hospital stay
 - Fewer postoperative complications to 30d and to follow-up

CONCLUSION

Our meta-analysis of available RCTs for cancer procedures has shown similar or superior surgical outcomes for robotic-assisted surgery compared to open or laparoscopic/VATS surgery across 6 specialties. These findings can help policy makers and healthcare providers evaluate robotic-assisted surgery using the da Vinci surgical systems from a multispecialty perspective.

Table 1: Included studies

Specialty	Cancer	Study	Trial Identifier	Randomized Sample Size		FU	Outcomes in Analysis	FU >30d	Risk of Bias				
				Intervention	Control				Randomization	Deviations	Missing Data	Measurement	Overall
Urology	Prostate	Asimakopoulos 2011. J Sex Med 8:1503-12	France, Italy	R: 64	L: 64	12mo	3,4,9	6,7,9	-	+	+	+	-
		Porpiglia 2013. Eur Urol 63:606-14	San Luigi Gonzaga H, Italy	R: 60	L: 60	30d	1-7,9	6,7,9	-	+	+	+	-
		Stolzenburg 2021. Eur Urol 79:750-9	LAP-01, Germany	R: 586	L: 196	3mo	1-4	6,7,9	-	-	+	+	-
		Yaxley 2016. Lancet 388:1057-66	Australia, ACTRN 12611000661976	R: 163	O: 163	12wk	1-3,5,9	6-9	+	+	+	+	+
		Würschimmel 2020. J Endourol 34:847-55	NCT 02924922, Switzerland	R: 61	L: 54	6mo	1,3-5	6,7,9	6	x	+	+	+
	Renal	Zhou 2019. Int J Clin Exp Med 12:3591-3601	Beijing Jishuitan H, China	R: 38	L: 37	2yr	1,2	6,9	+	x	+	+	+
		Bochner 2015. Eur Urol 67:1042-50	NCT 01076387, USA	R: 60	O: 58	90d	1,2,5,9	6,9	+	x	+	+	+
		Catto 2022. JAMA 327:2092-2103	iROC, UK	R: 169	O: 169	12mo	1-3,5	6-9	+	-	+	+	-
		Khan 2016. Eur Urol 69:613-21	CORAL, UK	R: 20 vs. L: 20 vs. O: 20	12mo	1,2,4-6,9	6,9	+	+	-	+	+	-
		Maibom 2022. BJU Int 130:102-13	BORARC, UK	R: 25	O: 25	hospital	1-3,5		+	+	+	+	+
Gynecology	Bladder	Mastroianni 2022. J Urol 207:982-92	NCT 03434132, Italy	R: 58	O: 58	6mo	1-3,5,6,8	6,8,9	+	+	+	+	+
		Nix 2010. Eur Urol 57:196-201	U North Carolina, USA	R: 21	O: 20	30d	1,2,5,6,9		-	-	+	+	-
		Parekh 2013. J Urol 189:474-9	Pre-RAZOR, USA	R: 20	O: 20	30d	1-3,5,6		+	x	+	+	x
		Parekh 2018. Lancet 391:2525-36	RAZOR, USA	R: 176	O: 174	2yr	1-3,5	6,9	+	+	+	+	+
		Veilgaard 2022. World J Urol 40:1669-77	BORARC, Denmark	R: 25	O: 25	90d	6,7,9	6-9	+	-	+	+	-
	Endometrial	Lundin 2019. Int J Gynecol Cancer: 28/3/2019 doi:10.1136/ijgc-2019000285	NCT 01526655, Sweden	R: 25	O: 25	6wk	1-3,5-7	6	+	+	+	+	+
		Maenpaa 2016. AJOG 215:588 e1-7	NCT 014 66777, Finland	R: 50	L: 51	6mo	1-7,9	6	-	+	+	+	-
		Salehi 2017. Eur J Cancer 79:81-9	RASHEC, Sweden	R: 60	O: 60	30d	1-3,5-9		+	+	+	+	+
		Silva 2018 Clinics (Sao Paulo) 73:e522s	ICESP, Brazil	R: 44	L: 45	30d	1,2,4,5,9		-	-	+	+	-
		Somashekhar 2014. Indian J Surg Oncol 5:217-23	Manipal Comprehensive Cancer Center, India	R: 25	O: 25	30d	6		x	x	+	+	x
	E&C	Narducci 2020. Gynecol Oncol 158:382-9	ROBOGYN-1004, France	R: 191	L: 194	M 25mo	1,2,9		-	+	+	+	-
Colorectal	Cervical	Luo 2018. BMC Women's Health 18:61	General Hospital and Hainan Branch, China	R: 30	L: 30	2yr	4,5	6,9	-	+	+	+	-
		Obermair 2020. AJOG 222:249 e1-10	LACC	MIS: 319 (R: 41, L: 238)	O: 312	6mo	1,2,5	6	x	x	+	+	x
		Jimenez Rodriguez 2011. Cir Esp 89:432-8	ISRCTN 60866560, Spain	R: 28	L: 28	ST	1,3-7,9		-	+	+	+	-
	Rectal	Debakay 2018. Minim Invasive Surg 2018:5836562	IRB 00004025, Egypt	R: 28	L: 29	30d	1,2,4-9		-	x	+	+	x
		del Gutierrez Delgado ¹ 2022. J Robot Surg 16:179-187	Regional Hospital in Malaga, Spain	R: 178	L: 122	8yr	1,4-9		x	-	-	-	x
		Jayne 2017. JAMA 318:1569-80	ROLARR	R: 237	L: 234	6mo	1,4-6,9		x	-	+	+	x
		Kim 2018. Ann Surg 267:243-51	NCT 01591798, S Korea	R: 82	L: 81	12mo	1-7,9		x	+	+	+	x
		Somashekhar 2015. Indian J Surg 77:788-94	Manipal-Vattikuti Inst Robot Surg, India	R: 25	O: 25	M 5mo	1,2,5,9	6	x	x	+	+	x
		Wang 2017. Int J Med Robot 13(1) doi: 10.1002/rcs.1725	Jinling Hospital, China	R: 71	L: 66	12mo	1,9	6	-	-	+	+	-
	Colon	Park 2012. Br J Surg 99:1219-26	NCT 01042743, Korea	R: 35	L: 35	30d	1-6,9		+	+	+	+	+
General	Gastric	Lu 2021. Ann Surg 273:858-67	FUGES-011, China	R: 150	L: 150	30d	1-9		-	+	+	+	-
		Ojima 2021. JAMA Surgery 156:954-63	UMIN000031536, Japan	R: 119	L: 122	90d	1-5,7,9	6,9	+	+	+	+	+
		Pan 2017. Surg Laparosc Endosc Percutan Tech 27:428-33	China	R: 102	L: 61	11mo	1,2,4,5,7,9	6	-	x	+	+	-
		Wang 2016. J Surg Oncol 113:397-404	Nanjing U, China	R: 158	O: 153	30d	1-3, 5-7,9		-	-	+	+	-
		Huang 2019. Transl Lung Cancer Res 8:951-8	ChiCTR-INR-17012777	R: 58	O: 55	28d	2,6,7,9		+	+	+	+	+
	Lung	Huang 2021 Transl Lung Cancer Res 10:4281-92	ChiCTR-INR-17012777	R: 76	O: 72	3yr	1,5		+	+	+	+	+
		Jin 2022. Ann Surg 275:295-302	RVlob, China	R: 157	VATS: 163	30d	1-6,8,9		+	+	+	+	+
		Terra 2022. J Bras Pneumol 48:e20210464	BRAVO, Brazil	R: 37	VATS: 39	90d	1,3-5	6-9	-	x	+	+	x
		Veronesi 2021. Front Oncol 11:726408	ROMAN	R: 38	VATS: 39	30d	1,4-6	8	-	x	-	+	x
		Van der Sluis 2019. Ann Surg 269:621-30	ROBOT, Netherlands	R: 56	O: 56	M 40mo	1,2,5-9	9	+	+	+	+	+
Head & Neck	Esoph ageal	Yang 2022. Ann Surg 275:646-53	RAMIE, China	R: 183	MI: 179	30d	1,2,4-6,9	9	+	+	+	+	+
		He 2016. Chin Med J (Engl) 129:2160-6	Jinan Military Gen. H, China	R: 50	O: 50	NR	1,5,6,9		-	+	+	+	-
		Kim 2016. JLAST A 26:618-624	Kyungpook Nat. UH, Korea	R: 125	O: 125	m 32mo	1,5,9	7	+	+	+	+	+

Table 2: Summary of Results

Meta-Analysis of Hazard Ratios										Heterogeneity		
Outcome	#	Robot n	Control n	OR/RD/MD [95% CI]	p-value	Md	I ²	p-value				
Robotic vs. Laparoscopic/Video-assisted thoracoscopic												
Op Time	24	2379	1960	MD: 27.76 [15.92, 39.60]	<0.0001	RE	94%	<0.0001				
Blood Loss	17	1732	1380	MD: -10.68 [-25.82, 4.46]	0.17	FE	81%	<0.0001				
Transfusions	12	1330	1008	RD: -0.01 [-0.02, 0.005]	0.19	FE	33%	0.12				
Conversions	21	2237	1755	RD: -0.01 [-0.02, -0.0001]	0.049	FE	26%	0.13				
Conversions	13	2237	1755	OR: 0.70 [0.49, 0.99]	0.04	FE	0%	0.86				
Hospital Stay	19	1594	1507	MD: -0.57 [-0.92, -0.21]	0.002	RE	63%	0.0001				
Postop Comps	12	1027	982	OR: 1.14 [0.92, 1.41]	0.22	FE	28%	0.17				
Postop Comps, FU	25	2485	2052	OR: 0.97 [0.78, 1.21]	0.78	FE	47%	0.006				
Reoperations	9	759	676	OR: 0.95 [0.54, 1.69]	0.87	FE	0%	0.72				
Reoperations, FU	14	1506	1063	OR: 1.06 [0.65, 1.72]	0.82	FE	0%	0.92				
Readmissions	4	497	451	OR: 1.73 [0.82, 3.65]	0.15	FE	0%	0.75				
Readmissions, FU	7	604	562	OR: 1.21 [0.68, 2.17]	0.51	FE	37%	0.15				
Mortality	21	1802	1884	RD: -0.002 [-0.008, 0.005]	0.62	FE	0%	1.00				
Mortality, FU	22	1839	1923	RD: -0.002 [-0.008, 0.005]	0.63	FE	0%	1.00				
Robotic vs. Open												
Op Time	18	1250	1457	MD: 56.94 [36.48, 77.39]	<0.0001	RE	99%	<0.0001				
Blood Loss	16	1068	1270	MD: -255.9 [-327, -185]	<0.0001	FE	97%	<0.0001				
Transfusions	10	941	917	OR: 0.41 [0.29, 0.57]	<0.0001	FE	0%	0.95				
Hospital Stay	18	1250	1457	MD: -1.00 [-1.65, -0.35]	0.003	RE	96%	<0.0001				
Postop Comps	12	555	545	OR: 0.60 [0.44, 0.80]	0.0006	FE	0%	0.82				
Reoperations	4	259	249	OR: 0.56 [0.22, 1.43]	0.23	FE	0%	0.46				
Reoperations, FU	8	733	722	OR: 0.63 [0.38, 1.03]	0.06	FE	0%	0.78				
Readmissions	3	160	161	OR: 1.17 [0.55, 2.47]	0.69	FE	0%	0.55				
Readmissions, FU	6	498	486	OR: 0.72 [0.50, 1.04]	0.08	FE	0%	0.61				
Mortality	13	802	798	RD: 0.002 [-0.008, 0.01]	0.64	FE	0%	1.00				
Mortality, FU	16	1035	1163	RD: 0.007 [-0.005, 0.02]	0.25	FE	0%	0.75				

Figure 2: Postoperative Complication Sensitivity Analysis

