Open vs Laparoscopic vs Robotic Pancreaticoduodenectomy: Systematic Review of the Literature and Network Meta-Analysis of Randomized Controlled Trials

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Introduction

Various publications have compared outcomes between open, laparoscopic and robotic pancreaticoduodenectomies (OPD, LPD, RPD), although the number of randomized controlled trials (RCTs) is limited. Our aim was to perform a network meta-analysis of RCTs comparing the outcomes of OPD, LPD and RPD.

Methods

We performed a systematic literature search of PubMed/MedLine, Cochrane Library, ClinicalTrials.gov and Google Scholar, to identify RCTs. The systematic review was conducted PRISMA-NMA guidelines, R software and NIH QAT.

Results

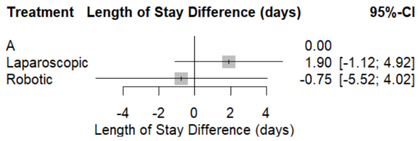
Seven RCTs including a total of 1247 patients with mean age 62.6 years were included for analysis.
Age, BMI, and disease stage were similar for all groups.
OPD was associated with a small but statistically significant higher 90-day mortality than LPD, with a 0.32% increase (p<0.05).

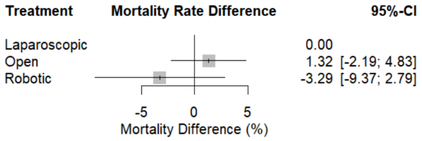
Post-pancreatectomy hemorrhage was less frequent after ODP and RDP compared to LDP (ODP vs LDP -0.66%; RDP vs LDP -1.42%; p<0.05).
Operating time was significantly longer for LPD and RPD compared to OPD (LPD vs OPD +72.6 min; p=0.0018, RPD vs OPD +67.1 min; p=0.1238).

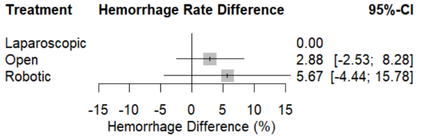
No significant differences in length of hospital stay (MD=1.94 days in favor of LPD) and in the incidence of complications of Clavien–Dindo grade 3 or higher were found (OPD vs LPD; OD=0.7982 (95% CI: 0.5667–1.1243, p = 0.1972), RPD vs LPD; OD= 0.5473 (95% CI: 0.2512–1.1926, p = 0.1293), OPD vs RPD; OR of 1.1653 (95% CI: 0.8392–1.6181, p = 0.3609).

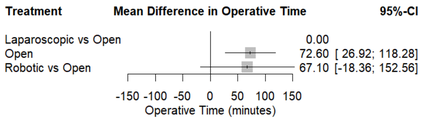
Conclusion

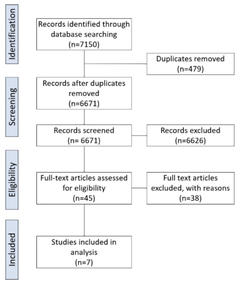
Our network meta-analysis of RCTs suggests that OPD was associated with higher mortality compared to LPD and RPD. LPD and RPD were associated with longer operative times, no significant difference in complications and failed to exhibit statistically significant reduction in hospital stay, while LPD demonstrated higher rates of PPH. The substantial heterogeneity across studies highlights the need for further well-designed, multicenter RCTs, especially the ones comparing LPD to RPD, to better elucidate the relative benefits and risks of these surgical approaches in pancreaticoduodenectomy.











Conversion Rates OPD vs LPD

Study	RD	SE(RD)	RD	95%-CI	Weight (common)	Weight (random)
Palanivelu 2017	3.1000	0.1250	3.10	[2.86; 3.34]	5.7%	20.0%
Poves 2018	23.5000	0.1622	23.50	[23.18; 23.82]	3.4%	20.0%
Qin 2024	3.4000	0.0390	3.40	[3.32; 3.48]	58.6%	20.0%
Van Hilst 2019	16.6000	0.0707	16.60	[16.46; 16.74]	17.9%	20.0%
Wang 2023	2.0000	0.0788	2.00	[1.85; 2.15]	14.4%	20.0%
Common effect model			**6.22**	**[6.16; 6.28]**	**100.0%**	.
Random effects model			**9.72**	**[1.17; 18.27]**	.	**100.0%**

Risk Difference: -20 -10 0 10 20

Heterogeneity: I^2 = 100%, τ^2 = 95.1246, p = 0

Mortality OPD vs LPD

Study	OPD Events	OPD Total	LPD Events	LPD Total	OR	95%-CI	Weight
Palanivelu 2017	1	32	1	32	1.00	[0.06; 16.71]	10.4%
Poves 2018	0	34	2	32	0.18	[0.01; 3.83]	8.7%
Qin 2024	6	328	8	328	0.75	[0.26; 2.17]	72.0%
Wang 2023	2	100	0	100	5.10	[0.24; 107.62]	8.9%
Random effects model		**494**		**492**	**0.80**	**[0.32; 1.99]**	**100.0%**

Odds Ratio: 0.01 0.1 1 10 100

Heterogeneity: I^2 = 0%, τ^2 < 0.0001, p = 0.50

Odds Ratio (OR)

Leak Rate OPD vs RPD

Study	Experimental Events	Experimental Total	Control Events	Control Total	OR	95%-CI	Weight (common)	Weight (random)
Klotz	3	33	4	23	0.47	[0.10; 2.36]	29.8%	30.8%
Liu	18	80	13	80	1.50	[0.68; 3.31]	70.2%	69.2%
Common effect model		**113**		**103**	**1.19**	**[0.59; 2.40]**	**100.0%**	.
Random effects model					**1.05**	**[0.37; 2.97]**	.	**100.0%**

Odds Ratio: 0.1 0.5 1 2 10

Heterogeneity: I^2 = 37%, τ^2 = 0.2419, p = 0.21

Odds Ratio (Log Scale)

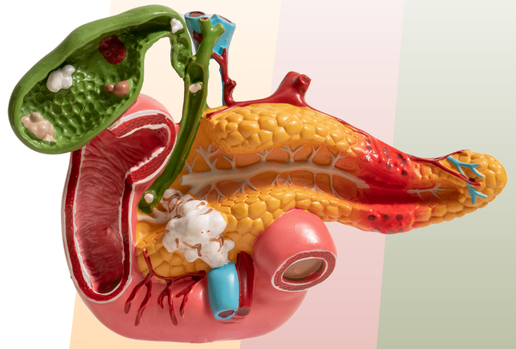
Leak Rate OPD vs LPD

Study	Experimental Events	Experimental Total	Control Events	Control Total	OR	95%-CI	Weight (common)	Weight (random)
Palanivelu	2	32	3	32	0.64	[0.10; 4.14]	10.3%	9.8%
Poves	0	32	0	34	1.06	[0.02; 55.23]	1.8%	2.2%
Qin	12	328	17	328	0.69	[0.33; 1.48]	60.1%	59.3%
Van Hilst	2	20	4	18	0.39	[0.06; 2.44]	13.9%	10.0%
Wang	5	100	4	100	1.26	[0.33; 4.85]	13.9%	18.7%
Common effect model		**512**		**512**	**0.73**	**[0.41; 1.30]**	**100.0%**	.
Random effects model					**0.73**	**[0.41; 1.31]**	.	**100.0%**

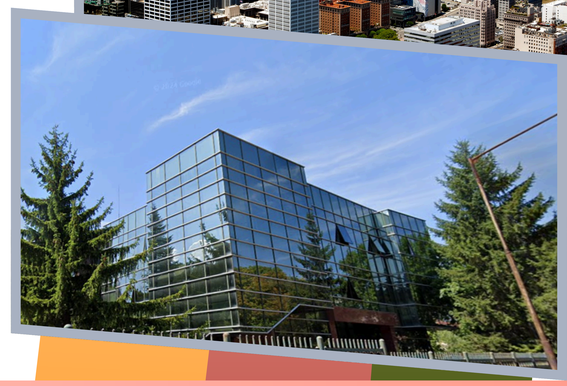
Odds Ratio: 0.1 0.5 1 2 10

Heterogeneity: I^2 = 0%, τ^2 = 0, p = 0.88

Odds Ratio (Log Scale)







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