



Review Robotic versus Laparoscopic Surgery for Spleen-Preserving Distal Pancreatectomies: Systematic Review and Meta-Analysis

Gianluca Rompianesi 💿, Roberto Montalti *🗅, Luisa Ambrosio and Roberto Ivan Troisi

Division of Hepato-Bilio-Pancreatic, Minimally Invasive and Robotic Surgery, Department of Clinical Medicine and Surgery, Federico II University Hospital, Via S.Pansini 5, 80131 Naples, Italy; gianluca.rompianesi@unina.it (G.R.); luisa.ambrosio@unina.it (L.A.); roberto.troisi@unina.it (R.I.T.) * Correspondence: roberto.montalti@unina.it; Tel.: +39-081-7462732

Abstract: Background: When oncologically feasible, avoiding unnecessary splenectomies prevents patients who are undergoing distal pancreatectomy (DP) from facing significant thromboembolic and infective risks. Methods: A systematic search of MEDLINE, Embase, and Web Of Science identified 11 studies reporting outcomes of 323 patients undergoing intended spleen-preserving minimally invasive robotic DP (SP-RADP) and 362 laparoscopic DP (SP-LADP) in order to compare the spleen preservation rates of the two techniques. The risk of bias was evaluated according to the Newcastle–Ottawa Scale. Results: SP-RADP showed superior results over the laparoscopic approach, with an inferior spleen preservation failure risk difference (RD) of 0.24 (95% CI 0.15, 0.33), reduced open conversion rate (RD of −0.05 (95% CI −0.09, −0.01)), reduced blood loss (mean difference of −138 mL (95% CI −205, −71)), and mean difference in hospital length of stay of −1.5 days (95% CI −2.8, −0.2), with similar operative time, clinically relevant postoperative pancreatic fistula (ISGPS grade B/C), and Clavien–Dindo grade ≥3 postoperative complications. Conclusion: Both SP-RADP and SP-LADP proved to be safe and effective procedures, with minimal perioperative mortality and low postoperative morbidity. The robotic approach proved to be superior to the laparoscopic approach in terms of spleen preservation rate, intraoperative blood loss, and hospital length of stay.

Keywords: robotic distal pancreatectomy; laparoscopic distal pancreatectomy; spleen-preserving distal pancreatectomy; minimally-invasive distal pancreatectomy; systematic review; meta-analysis

1. Introduction

The decision on preserving the spleen when performing a distal pancreatectomy (DP) is usually based on the balance between achieving an adequate oncological clearance and avoiding complications related to asplenia. Spleen-preserving DP has therefore been mainly reserved for surgeries performed for benign indications or to excise lesions with a low malignant potential. With the advent of minimally invasive surgery, in the early 1990s, surgeons around the world started to explore the potential of the laparoscopic approach in pancreatic surgery [1,2] and, almost a decade later, of the robotic-assisted technique [3]. Minimally invasive pancreatic surgery has been progressively gaining widespread popularity, and advancements in surgical skills have removed most of the technical restrictions, allowing the safe and effective execution of complex procedures, including laparoscopic spleen-preserving distal pancreatectomy (SP-RADP) [4] and robot-assisted spleen-preserving distal pancreatectomy (SP-RADP) [5].

This systematic review and meta-analysis aims to summarize all of the available evidence regarding spleen-preserving DP and compare results and outcomes of minimally invasive SP-RADP and SP-LADP techniques.



Citation: Rompianesi, G.; Montalti, R.; Ambrosio, L.; Troisi, R.I. Robotic versus Laparoscopic Surgery for Spleen-Preserving Distal Pancreatectomies: Systematic Review and Meta-Analysis. J. Pers. Med. 2021, 11, 552. https://doi.org/10.3390/ jpm11060552

Academic Editor: Marco Milone

Received: 29 April 2021 Accepted: 9 June 2021 Published: 13 June 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https:// creativecommons.org/licenses/by/ 4.0/).

2. Materials and Methods

This systematic review and meta-analysis was conducted in accordance with the preferred reporting items for systematic reviews and meta-analyses (PRISMA 2020 Statement [6]) and was registered on PROSPERO (CRD42021239032).

2.1. Search Strategy

MEDLINE, Embase, and Web Of Science electronic databases were searched using the following terms: "pancrea*" AND "robot*" AND "laparoscop*" AND "sple*". The last search was run on 1 February 2021 with no language or publication status restrictions. Additional potentially relevant studies were identified from the reference lists of selected studies.

2.2. Study Selection

For inclusion, studies had to (1) include patients undergoing DP for any disease; (2) include procedures performed robotically and laparoscopically; and (3) report data on patients undergoing DP with the intent of preserving the spleen. Case reports, reviews, and communications, as well as non-human studies, were excluded. Two reviewers (G.R. and L.A.) independently screened the results of the electronic search at title and abstract levels. The full texts of the selected references were also retrieved for further analysis and data extraction. When duplicate reports from the same study were identified, only the most recent publication was included.

2.3. Data Extraction and Quality Assessment

Two reviewers (G.R. and L.A.) extracted data from each selected study regarding the first author; publication year; country of origin; study design; number of patients undergoing SP-RADP and SP-LADP; patients characteristics (age, sex, body mass index (BMI)); underlying disease requiring DP; American Society of Anesthesiologists (ASA) score; tumor size; conversion rate; blood loss; pancreatic stump closure technique; splenic vessel preservation and technique (Warshaw vs. Kimura); blood transfusion requirement; length of surgery; data on postoperative morbidity, including prevalence and grading of the clinical severity of postoperative pancreatic fistula (POPF) according to the ISGPS definition [7]; complications and grading according to the Clavien–Dindo classification [8]; re-operation rate; length of stay (LOS); mortality; and length of follow-up. The quality and risk of bias of each included study was evaluated independently by two reviewers (G.R. and L.A.) according to the Newcastle–Ottawa Scale for evaluating the quality of non-randomized studies in meta-analyses [9]. The level of evidence was rated according to the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) system [10]. Any disagreement was resolved through discussion in order to reach consensus across the study team.

2.4. Statistical Analysis and Data Synthesis

The primary outcome was the spleen preservation failure rate. Secondary outcomes included intraoperative blood loss, operative time, prevalence of clinically relevant POPF (grade B/C), prevalence of postoperative complications (Clavien–Dindo [8] grades \geq 3), hospital LOS, and mortality. For the analysis, values expressed as median (range) were converted to average \pm standard deviation using Wan's method [11]. To pool proportions, we used random-effects or fixed-effect modelling according to the DerSimonian and Laird method [12,13] to take into account heterogeneity. The presence of heterogeneity among the studies was assessed using Cochran's Q test and quantified with the I² inconsistency index, with 25, 50, and 75% considered as thresholds for low, moderate, and high statistical heterogeneity, respectively. Heterogeneity was evaluated by sensitivity analysis [14]. Statistical analyses were performed using Review Manager version 5.3.

3. Results

3.1. Studies Selection

Eleven studies met the inclusion criteria and were included in the systematic review and meta-analysis [15–25] (Figure 1).



Figure 1. PRISMA flow diagram. ITT: intention-to-treat.

3.2. Studies Characteristics

The characteristics of the selected studies are reported in Table 1. A total of 323 patients undergoing SP-RADP and 362 patients undergoing SP-LADP were included in this metaanalysis. Eight included series (72.7%) were retrospective cohort studies [16–18,21–25], two were matched cohort studies (18.2%) [15,19], and one was a case-control study (9.1%) [20]. The reported median follow-up was 27 months (range 6.5–47) for SP-RADP and 33.5 months (range 32–75.5) for SP-LADP. The most frequent indications for surgery were neuroendocrine tumors (NET) in 61 SP-RADP and 52 SP-LADP, mucinous cystic neoplasms in 37 SP-RADP and 28 SP-LADP, intraductal papillary mucinous neoplasms (IPMN) in 15 SP-RADP and 28 SP-LADP, and pseudopapillary tumors in 18 SP-RADP and 17 SP-LADP.

Another and Very Study Type		N Doh/Lan	Age, Years	Say (E) Bab/Lan	Lesion Size, mm	PMI Doh Lan	ASA Pob Lan	NOS Assessment		
Author and Year	Study Type	IN KOD/Lap	Rob–Lap	Sex (F) KOD/Lap	Rob–Lap	ыли коо-сар	АЗА КОО-Lap	Selection	Comparability	Outcome
Chen et al., 2015	Matched cohort	47/33	55.6 ± 14.3 -55.8 \pm 16.2	31/21	31.25 ± 3.4 -29 ± 3.4	24.4 ± 2.9 -24.8 ± 2.7	$2.5 \pm 0.7 1.91 \pm 0.3$	3 *	2 *	3 *
Eckhardt et al., 2016	Cohort	12/29	$\begin{array}{c} 50.5 \pm 14.455 \pm \\ 16.8 \end{array}$	8/17	$22\pm10.438\pm3$	$24.00 \pm 3.427.3 \pm \\ 4.3$	NA	3 *	1 *	3 *
Hong et al., 2020	Cohort	31/57	NA	NA	36.5 ± 17.4 -29.8 \pm 19.5	NA	NA	3 *	1 *	3 *
Kang et al., 2011	Cohort	20/25	$\begin{array}{c} 44.5 \pm 15.9 56.5 \pm \\ 13.9 \end{array}$	12/14	$35\pm1330\pm14$	$24.2 \pm 2.9 23.4 \pm 2.6$	NA	3 *	1 *	3 *
Liu et al., 2017	Matched cohort	76/77	NA	NA	NA	NA	NA	3 *	2 *	3 *
Morelli et al., 2016	Case-control	15/15	$58.2 \pm 13.7 49.3 \pm \\17.1$	9/13	$29.9 \pm 16.5 26.9 \pm \\13.5$	$26.4 \pm 3.126.1 \pm 1.9$	$2.40 \pm 0.52.30 \pm 0.5$	2 *	2 *	3 *
Nell et al., 2016	Cohort	5/9	NA	NA	NA	NA	NA	3 *	1*	3 *
Najafi et al., 2020	Cohort	24/32	NA	NA	NA	NA	NA	3 *	1*	3 *
Souche et al. 2018	Cohort	13/13	NA	NA	NA	NA	NA	3 *	1 *	3 *
Yang et al., 2020	Cohort	37/41	$\begin{array}{r} 42.9 \pm 1451.3 \pm \\ 14.6 \end{array}$	23/27	$27\pm1242\pm33$	$23.5 \pm 3.224.1 \pm 3.4$	$1.41 \pm 0.6 1.58 \pm 0.8$	3 *	1*	3 *
Zhang et al., 2017	Cohort	43/31	$\begin{array}{r} 47.9 \pm 10.5 48.7 \pm \\ 12.3 \end{array}$	23/19	$17.5 \pm 2.7 16.5 \pm 2.4$	$23.3 \pm 2.7 23.9 \pm 3.2$	$1.26 \pm 0.4 1.39 \pm 0.5$	3 *	1 *	3 *

Table 1. Summary of the selected studies with patients' characteristics and quality assessment according to the Newcastle–Ottawa scale (NOS). NA: not available.

3.3. Quality Assessment and Publication Bias

The results of the quality assessment of the 11 included studies according to the guidelines of the Newcastle–Ottawa Scale are reported in Table 1.

3.4. Spleen Preservation Rate

All selected studies reported the number of procedures intended to be spleen preserving and the spleen preservation failure rate for both the robotic and laparoscopic techniques. The risk difference (RD) of spleen preservation failures was 0.24 (95% CI 0.15, 0.33), favoring the robotic approach and with moderate heterogeneity ($I^2 = 63\%$) (Figure 2). Heterogeneity was evaluated by sensitivity analysis, and the results are summarized in Table 2.

	Robotic		Laparoscopic		Risk Difference		Risk Difference
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI	M-H, Random, 95% CI
Chen, 2015	45	47	13	33	9.7%	0.56 [0.39, 0.74]	
Eckhardt, 2016	11	12	23	29	8.3%	0.12 [-0.09, 0.34]	
Hong, 2020	30	31	47	57	12.2%	0.14 [0.03, 0.26]	
Kang, 2011	19	20	16	25	8.4%	0.31 [0.10, 0.52]	
Liu, 2017	62	76	50	77	11.3%	0.17 [0.03, 0.30]	
Morelli, 2016	15	15	11	15	7.5%	0.27 [0.03, 0.50]	
Najafi, 2020	23	24	27	32	10.8%	0.11 [-0.03, 0.26]	+
Nell, 2016	5	5	4	9	4.2%	0.56 [0.18, 0.94]	
Souche, 2018	13	13	12	13	9.2%	0.08 [-0.11, 0.27]	
Yang, 2020	34	37	28	41	10.1%	0.24 [0.07, 0.40]	_ _
Zhang, 2017	34	43	15	31	8.3%	0.31 [0.09, 0.52]	
Total (95% CI)		323		362	100.0%	0.24 [0.15, 0.33]	•
Total events	291		246				
Heterogeneity: Tau ² =	0.01; Chi ²	= 27.2	2, df = 10 (l	P = 0.00	02); l ² = 63	3%	
Test for overall effect:	Z = 5.14 (P < 0.0	0001)				-1 -0.5 0 0.5 1
	,		,				Favours [Laparoscopic] Favours [Robotic]

Figure 2. Spleen preservation rate forest plot.

Table 2. Sensitivity analysis by sequential omission of each individual study. Meta-analysis estimates, given the named study is omitted. CI: confidence interval.

Shu da Omitta d	Risk Difference [95% CI]	Test of Hete	Quantification of	
Study Omitted	(<1 Favors Robotic)	Chi ²	р	Heterogeneity
Chen et al., 2015	0.19 [0.13, 0.25]	10.51	0.31	df = 9; $I^2 = 14\%$
Eckhardt et al., 2016	0.25 [0.15, 0.35]	26.40	0.002	$df = 9; I^2 = 66\%$
Hong et al., 2020	0.25 [0.15, 0.36]	24.73	0.003	$df = 9; I^2 = 64\%$
Kang et al., 2011	0.23 [0.14, 0.33]	26.49	0.002	$df = 9; I^2 = 66\%$
Liu et al., 2017	0.25 [0.15, 0.36]	27.61	0.001	$df = 9; I^2 = 67\%$
Morelli et al., 2016	0.24 [0.14, 0.34]	27.11	0.001	$df = 9; I^2 = 67\%$
Najafi et al., 2020	0.25 [0.16, 0.35]	24.78	0.003	$df = 9; I^2 = 64\%$
Nell et al., 2016	0.23 [0.13, 0.32]	24.15	0.004	$df = 9; I^2 = 63\%$
Souche et al., 2018	0.26 [0.16, 0.25]	24.49	0.004	$df = 9; I^2 = 63\%$
Yang et al., 2020	0.24 [0.14, 0.34]	27.30	0.001	$df = 9; I^2 = 67\%$
Zhang et al., 2017	0.23 [0.14, 0.33]	26.34	0.002	$df = 9; I^2 = 66\%$

3.5. Patient Characteristics and Operative Details

Only four series [16,21,25,26] reported the average ASA score (median value of 1.9, range 1.3–2.5 for SP-RADP; 1.7, range 1.4–2.3 for SP-LADP), while preoperative BMI was described in six series [16,17,19,21,25,26] (median value of 24.1, range 23.3–26.4 for SP-RADP; 24.4, range 23.4–27.3 for SP-LADP). Of the groups reporting the incidence of previous abdominal surgery [16,17,21], 5 out of 15 patients in both groups had had previous surgery in one study [20], with no patients undergoing previous surgery in the other two reports. All other patients' characteristics are summarized in Table 1.

Eight of the included studies [15,16,18,20,21,23-25] reported the conversion rate, with an RD of -0.05 (95% CI -0.09, -0.01) and moderate heterogeneity (I² = 26%) of being converted to "open" technique favoring the robotic approach. Unfortunately, no study described the reason for conversion. The intraoperative blood loss (Figure 3), as reported in seven series [16,17,19,21,22,25,26], was significantly lower for the robotic group, with a mean difference of -138 mL (95% CI -205, -71) and high heterogeneity (I² = 97%). There was no statistical difference in the operative time between the two groups (Figure 3), reported by nine series [15-18,20,21,23-25], with a mean difference of 6.1 min (95% CI -40, 52) and high heterogeneity (I² = 97%). Four studies [17,23–25] reported the distal pancreatic stump closure technique, which was with an endo-GIA stapler in all cases in both groups. Eight studies [15,16,18,20,21,23-25] reported data on spleen preservation techniques, including a total of 211 robotic and 219 laparoscopic procedures. The Kimura technique [26] was adopted in 159 out of the 196 patients (81.1%) undergoing SP-RADP (the remaining 18.9% of patients had the pancreatic resection performed according to the technique described by Warshaw [27]) and in 84 out of the 154 SP-LADP (54.5%), with the Warshaw technique being adopted for the remaining 45.5%.

· · · · · · · · · · · · · · · · · · ·	Rob	otic	Lapan	oscopic		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD Total	Mean	SD To	tal Weight	IV, Random, 95% C	I IV, Random, 95% Cl
Eckhantt 2016	82.5 21	141 12	261.20	194.9	29 15.2%	-101.20 [+180.00, +142.47] -170.00 [-241.96 -98.04]	
Kang, 2011	372 34	1.5 20	420.2	445.5	25 5.8%	-48.20 [-278.19, 181.79]	i — — A
Morelli, 2016	189	17 15	200	28	15 18.2%	-11.00 [-27.58, 5.58]	
Najafi, 2020	118.7 5	57.8 24	262.5	181.5	32 15.6%	-143.80 [-210.80, -76.80]	
Yang, 2020	350.5 23	35.3 37	672	484.7	41 8.6%	-321.50 [-488.11, -154.89]	
Zhang, 2017	62.0 1	1.4 43	215	34.1	31 18.3%	-152.50 [-164.98, -140.02]	
Total (95% CI)		198		2	06 100.0%	-138.11 [-205.25, -70.96]	•
Heterogeneity: Tau ^z =	6364.12; C	hi# = 218.3	0, df = 6 (P	< 0.0000	1); 1* = 97%		
Test for overall effect:	Z = 4.03 (P	< 0.0001)					Favours [Robotic] Favours [Laparoscopic]
	Rol	botic	Lan	rosconic		Mean Difference	Mean Difference
Study or Subgroup	Mean	SD Tot	al Mean	SD 1	fotal Weigh	IV. Random, 95% C	I IV. Random, 95% CI
Chen, 2015	127.5	15.8 4	7 210	19.2	33 12.05	% -82.50 [-90.46, -74.54]	-
Eckhardt, 2016	223.5	51.4 1	2 222.5	76.5	29 11.05	% 1.00 [-39.26, 41.26]	
Hong, 2020	160.5	46.1 3	1 122.2	42.4	57 11.85	56 38.30 [18.69, 57.91]	— D
Kang, 2011	348.7	121.8 2	258.2	118.6	25 9.45	% 90.50 [19.71, 161.29]	
Morelli, 2016	220	73 1	15 279	48	15 10.85	% -59.00 [-103.21, -14.79]	
Najah, 2020 Soucho, 2018	219.25	46.7 2	4 220.25	75	32 11.43	% -1.00 [-33.01, 31.01] % 49.60 (13.09, 93.02)	
Yang, 2020	333.25	87.8 3	7 303	110.8	41 10.85	% 48.50 [13.96, 63.02] % 30.25 [-13.92, 74.42]	
Zhang, 2017	139.3	56.9 4	3 133.4	41.8	31 11.75	5.90 [-16.59, 28.39]	+-
Total (95% CI)		24	2		276 100.0	% 6.13 [-39.96, 52.23]	· · · · · · · · ·
Heterogeneity: Tau ² =	4605.96; C	chi ² = 239.6	(8, df = 8 (8	< 0.0000)1); I ² = 97%		-200 -100 0 100 200
Test for overall effect:	Z = 0.26 (P	= 0.79)					Favours [Robotic] Favours [Laparoscopic]
	Rol	botic	Laparos	copic		Risk Difference	Risk Difference
Study or Subgrou	p Even	ts Total	Events	Total	Weight	M-H, Fixed, 95% CI	M-H, Fixed, 95% CI
Chen, 2015		1 47	6	33	23.1%	-0.16 [-0.30, -0.02]	
Zhang, 2017		4 43	4	31	21.5%	-0.04 [-0.18, 0.11]	
Morelli, 2016		1 15	1	15	8.9%	0.00 [-0.18, 0.18]	U
Yang, 2020		4 37	3	41	23.2%	0.03 [-0.09, 0.16]	
Kang, 2011		4 20	4	25	13.2%	0.04 [-0.19, 0.27]	
Eckhardt, 2016		2 12	3	29	10.1%	0.06 [-0.17, 0.30]	
Total (95% CI)		174		174	100.0%	-0.03 [-0.09, 0.04]	+
Total events	1	16	21				
Heterogeneity: Chi ²	= 5.49, df	= 5 (P = (0.36); * =	9%		_	
Test for overall effe	ct: Z = 0.7.	2(P = 0.4)	7)				Favours [Robotic] Favours [Laparosconic]
						D1 1 D14	
	RO	Dotic	Laparos	copic		Risk Difference	RISK Difference
Obusha an Oush second	- Errer	to Waterl	E.c.s.	Watel	Mar India	HILL Flored OFM. OL	M H Final ARK OF
Study or Subgrou	p Even	ts Total	Events	Total	Weight	M-H, Fixed, 95% CI	M-H, Fixed, 95% Cl
Study or Subgrou Chen, 2015	p Even	ts Total 4 47	Events 3	Total 33	Weight 19.8%	M-H, Fixed, 95% CI -0.01 [-0.13, 0.12]	M-H, Fixed, 95% Cl
Study or Subgrou Chen, 2015 Hong, 2020 Maralli, 2016	p Even	ts Total 4 47 0 31 0 15	Events 3 0	Total 33 57	Weight 19.8% 20.5%	M-H, Fixed, 95% Cl -0.01 [-0.13, 0.12] 0.00 [-0.05, 0.05]	M-H, Fixed, 95% CI
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016	p Even	ts Total 4 47 0 31 0 15 10 24	Events 3 0 1	Total 33 57 15	Weight 19.8% 20.5% 7.6%	M-H, Fixed, 95% CI -0.01 [-0.13, 0.12] 0.00 [-0.05, 0.05] -0.07 [-0.23, 0.10] 0.07 [-0.18, 0.33]	M-H, Fixed, 95% Cl
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020	p Even	ts Total 4 47 0 31 0 15 10 24 4 37	Events 3 0 1 11 7	Total 33 57 15 32	Weight 19.8% 20.5% 7.6% 14.0%	M-H, Fixed, 95% CI -0.01 [-0.13, 0.12] 0.00 [-0.05, 0.05] -0.07 [-0.23, 0.10] 0.07 [-0.18, 0.33] -0.06 [0.23, 0.00]	M-H, Fixed, 95% CI
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Yang, 2020 Zhang, 2017	p Even	ts Total 4 47 0 31 0 15 10 24 4 37 11 49	Events 3 0 1 11 7	Total 33 57 15 32 41 34	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4%	M-H, Fixed, 95% Cl -0.01 [-0.13, 0.12] 0.00 [-0.05, 0.05] -0.07 [-0.23, 0.10] 0.07 [-0.18, 0.33] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05]	MHH, Fixed, 95% CI
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Yang, 2020 Zhang, 2017	p Even 1 1	ts Total 4 47 0 31 0 15 10 24 4 37 11 43	Events 3 0 1 11 7 13	Total 33 57 15 32 41 31	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4%	M-H, Fixed, 95% Cl -0.01 [-0.13, 0.12] 0.00 [-0.05, 0.05] -0.07 [-0.23, 0.10] 0.07 [-0.18, 0.33] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05]	MHH, Fixed, 95%, CI
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Yang, 2020 Zhang, 2017 Total (95% Cl)	p Even 1	ts Total 4 47 0 31 0 15 10 24 4 37 11 43 197	Events 3 0 1 11 7 13	Total 33 57 15 32 41 31 209	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0%	M-H, Fixed, 95% CI -0.01 [-0.13, 0.12] 0.00 [-0.05, 0.05] -0.07 [-0.23, 0.10] 0.07 [-0.18, 0.33] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03]	MHH, Fixed, 95% CI
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Yang, 2020 Zhang, 2017 Total (95% CI) Total events	p Even 1 1	ts Total 4 47 0 31 0 15 10 24 4 37 11 43 197 29	Events 3 0 1 11 7 13 35	Total 33 57 15 32 41 31 209	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0%	M-H, Fixed, 95% Cl -0.01 [-0.13, 0.12] 0.00 [-0.05, 0.05] -0.07 [-0.23, 0.10] 0.07 [-0.18, 0.33] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03]	MHH, Fixed, 95% CI
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Yang, 2020 Zhang, 2017 Total (95% Cl) Total events Hoterogeneity: Chi ²	p Even 1 1 2 2 2 2 2	ts Total 4 47 0 31 0 15 10 24 4 37 11 43 197 29 2 5 (P = 1)	Events 3 0 1 11 7 13 35 0.44; j≠ =	Total 33 57 15 32 41 31 209 0%	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0%	M-H, Fixed, 95% Cl -0.01 [-0.13, 0.12] 0.00 [-0.05, 0.05] -0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03]	MHH, Fixed, 95%, CI
Study or Subgrout Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Zhang, 2017 Total (95% CI) Total (95% CI) Total events Heterogeneity: Chi ^a Test for overall effe	p Even 1 1 2 = 4.82, df ct Z = 1.1	ts Total 4 47 0 31 0 15 10 24 4 37 11 43 197 29 1 5 (P = 0 0 (P = 0.2	Events 3 0 1 11 7 13 35 0.44); I [≠] = 7)	Total 33 57 15 32 41 31 209 0%	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.00 [-0.05, 0.05] -0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03]	MHH, Fixed, 95% CI
Study or Subgroup Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Zhang, 2020 Zhang, 2017 Total (95% Cl) Total events Hoterogeneity: Chi ² Test for overall effe	p Even 1 2 = 4.82, df ct Z = 1.10	ts Total 4 47 0 31 0 15 10 24 4 37 11 43 197 29 25 (P = 0.2 0 (P = 0.2)	Events 3 0 1 11 7 13 35 0.44}; ⊭ = 7)	Total 33 57 15 32 41 31 209 0%	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.00 [-0.05, 0.05] -0.07 [-0.23, 0.10] -0.07 [-0.18, 0.33] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03]	M-H, Fixed, 95%, CI D d,5 d,5 d,5 d,5 d,5 d,5 d,5 d,5 d,5 d,5
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najati, 2020 Yang, 2020 Zhang, 2017 Total (95% CI) Total events Hoterogeneity: Chi ² Test for overall effe	p Even 1 1 2 2 4 = 4.82, df ct: Z = 1.11 Ro	ts Total 4 47 0 31 0 15 10 24 4 37 11 43 197 29 5 (P = 0.2) botic 5	Events 3 0 1 11 7 13 35 0.44); I [≠] = 7) Laparoo	Total 33 57 15 32 41 31 209 0% copic	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] -0.02 [-0.05, 0.05] -0.07 [-0.23, 0.10] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03]	MHH, Fixed, 95%, CI D 0.5 0.25 0.25 0.5 Favours [Robotic] Favours [Roparoscopic] Risk Difference
Study or Subgrou Chen, 2016 Morall, 2016 Morall, 2016 Majali, 2020 Yang, 2020 Zhang, 2020 Zhang, 2020 Total (95% CI) Total (95% CI) Total (95% CI) Total (95% CI) Total events Hoterogeneity: Chil Test for overall effe Study or Subgrou Char 2020	p Even 1 1 1 = 4.82, df ct: Z = 1.10 Roi p Even	ts Total 4 47 0 31 0 15 10 24 4 37 11 43 197 19 25 (P = 0.2) botic 0 tts Total	Events 3 0 1 11 7 13 35 0.44); ² = 7) Laparo Events	Total 33 57 15 32 41 31 209 0% copic Total	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0% Weight 19.2%	M-H, Fixed, 95% C1 -0.01 (-0.13, 0.12) 0.00 (-0.05, 0.05) -0.07 (-0.18, 0.33) -0.06 (-0.22, 0.09) -0.16 (-0.38, 0.05) -0.04 (-0.11, 0.03) -0.04 (-0.11, 0.03) -0.05 (-0.11, 0.05) -0.05 (-0.1	M-H, Fixed, 95%, CI D 0,5 0,25 Favours [Rebatic] Favours [Leparoscopic] Risk Difference M-H, Fixed, 95%, CI
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Yang, 2020 Zhang, 2020 Zhang, 2027 Total (95% CI) Total (95% CI) Total (95% CI) Total events Hoterogeneity: CH ² Hoterogeneity: CH ² Test for overall effe	p Even 1 1 2 2 3 4 = 4.82, df ct: Z = 1.10 Rol p Even	ts Total 4 47 0 31 0 15 10 24 4 37 11 43 197 29 29 5 (P = 0) botic ts ts Total 8 47 2 2	Events 3 3 0 11 17 7 13 35 0.44); ⊭ = 7) Laparo Events 5 5 5	Total 33 57 15 32 41 31 209 0% copic Total 33 33 33	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0% Weight 18.2%	M-H, Fixed, 95% CI 0.01 [-013, 0.12] 0.02 [-023, 0.10] 0.07 [-0.18, 0.33] -0.66 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] Risk Difference M-H, Fixed, 95% CI 0.02 [-0.14, 0.18]	M-H, Fixed, 95%, CI D 0.5 0.25 0.25 0.5 Favours [Robotic] Risk Difference M-H, Fixed, 95%, CI
Study or Subgrou Ohen, 2015 Hong, 2020 Morell, 2016 Najali, 2020 Yang, 2020 Zhang, 2027 Total (95% CI) Total events Heterogenahy: Ch ² Test for overall effe Study or Subgrou Chen, 2015 Eckhardt, 2016	p Even 1 2 = 4.82, df ct: Z = 1.10 Ro p Even	ts Total 4 47 0 31 0 15 10 24 4 37 11 43 197 29 25 (P = 0.2) 0 (P = 0.2) botic ts 8 47 3 12 4 4	Events 3 3 0 11 7 13 35 0.44); I ² = 7 7 Laparo Events 5 6	Total 33 57 15 32 41 31 209 0% copic Total 33 29 67	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0% Weight 18.2% 8.0% 19.8%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.02 [-0.35, 0.05] -0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] -0.04 [-0.11, 0.03] -0.04 [-0.14, 0.18] 0.04 [-0.24, 0.33]	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najaf, 2020 Yang, 2020 Zhang, 2017 Total (95% CI) Total events Hoterogenally: Ch ² Test for overall effe <u>Study or Subgrou</u> Chen, 2015 Eckhardt, 2016 Hong, 2020	p Even 1 2 = 4.82, df ct: Z = 1.10 Roi p Even	ts Total 4 47 0 31 0 15 10 24 4 37 11 43 197 29 25 (P = 0.2 botic ts 18 47 3 12 4 31 4 31	Events 3 3 0 11 11 7 13 35 0.44); I [≠] = 7) Laparo Events 5 6 8 8	Total 33 57 15 32 41 31 209 0% copic Total 33 29 57 17	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 14.0% 19.8% 100.0% Weight 18.2% 8.0% 18.8% 2.0%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.00 [-0.15, 0.05] -0.07 [-0.23, 0.10] 0.07 [-0.18, 0.33] -0.66 [-0.22, 0.09] -0.64 [-0.11, 0.03] -0.64 [-0.11, 0.03] -0.64 [-0.14, 0.05] -0.04 [-0.14, 0.16] -0.04 [-0.14, 0.16] -0.04 [-0.14, 0.14] -0.04 [-0.14] -0.04	M-H, Fixed, 95%, CI D 0.5 0.25 0.25 0.5 Favours [Laparotocopic] Risk Difference M-H, Fixed, 95%, CI E
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2020 Zhang, 2017 Total (95% CI) Total events Hoterogeneity: Ch ² Total events Hoterogeneity: Ch ² Test for overall effic Study or Subgrou Chen, 2015 Eckhardt, 2016 Morelli, 2016	p Even 1 = 4.82, df ct: Z = 1.10 Roi p Even	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Events 3 0 1 11 7 13 35 0.44); r = 5 6 6 8 3 3	Total 33 57 15 32 41 31 209 0% Copic Total 33 29 57 15 32 41 31 209	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0% Weight 18.2% 18.8% 7.0% 12.0%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] -0.04 [-0.11, 0.03] -0.04 [-0.14, 0.03] 0.04 [-0.24, 0.33] 0.04 [-0.24, 0.33] -0.04 [-0.24, 0.33] -0.04 [-0.24, 0.33] -0.04 [-0.24, 0.33] -0.04 [-0.24, 0.33] -0.04 [-0.24, 0.33] -0.04 [-0.24, 0.33]	M-H, Fixed, 95%, CI D 0.5 Favours [Robotic] Favours [Laparoscopic] Risk Difference M-H, Fixed, 95%, CI E
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najsti, 2020 Yang, 2020 Yang, 2020 Zhang, 2017 Total (95% CI) Total events Heterogeneity: Ch ² Test for overall effe Study or Subgrou Chen, 2015 Eckhardt, 2016 Hong, 2020 Morelli, 2016 Najsti, 2020	p Even 1 1 2 2 2 3 2 4 8 2 4 8 2 2 1 1 1 2 2 1 1 1 1 1 1 1 1 1 1 1 1	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Events 3 0 1 11 7 13 35 0.44); I [≠] = 7 7 Laparo 5 6 8 37 7	Total 33 57 15 32 41 31 209 0% copic Total 33 29 57 15 32 41 31 209	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0% Weight 18.2% 8.0% 18.8% 7.0% 19.7% 19	M-H, Fixed, 95% CI 0.01 [-013, 0.12] 0.00 [-0.05, 0.05] -0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] -0.66 [-0.38, 0.05] -0.04 [-0.11, 0.03] -0.64 [-0.11, 0.03] -0.64 [-0.14, 0.05] -0.04 [-0.14, 0.15] -0.04 [-0.14,	M-H, Fixed, 95%, CI D
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2017 Total (95% CI) Total events Hoterogeneity: Ch ² Total events Hoterogeneity: Ch ² Test for overall effe Study or Subgrou Chen, 2015 Eckhardt, 2016 Najaf, 2020 Morelli, 2016 Najaf, 2020 Morelli, 2016	p Even 1 1 = 4.82, df ct Z = 1.1 Ro p Even	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Events 3 3 0 1 11 7 13 35 0.44); F = 7 Laparoo Events 5 6 8 3 7 2	Total 33 57 15 32 41 31 209 0% Copic Total 33 29 57 15 32 41 33 29 57 15 32 41 33 209 0%	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0% Weight 18.2% 8.0% 18.8% 7.0% 12.9% 12.9% 12.9%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] -0.04 [-0.11, 0.03] -0.04 [-0.14, 0.03] 0.02 [-0.14, 0.18] 0.04 [-0.24, 0.33] 0.04 [-0.24, 0.34] 0.04 [-0.24, 0.34] 0	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Yang, 2020 Yang, 2020 Zhang, 2017 Total (95% CI) Total events Hoterogenally: Ch ² / Test for overall effe <u>Study or Subgrou</u> Chen, 2015 Eckhardt, 2016 Hong, 2020 Morelli, 2016 Najafi, 2020 Zhang, 2017	p Even 1 2 2 = 4.82, df ct Z = 1.1 Roi p Even	$\begin{array}{c} \underline{ts} \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$	Events 3 0 1 11 7 13 35 0.44); I ^µ = 7 7 Laparo Events 6 8 37 2 5 5	Total 33 57 15 32 41 31 209 0% copic Total 29 57 15 32 41 33 29 57 15 32 41 33 29 57 15 32 41 31 209 0% 29 29 29 20 20 20 20 20 20 20 20 20 20	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0% Weight 18.2% 8.0% 18.8% 7.0% 12.9% 18.2% 18	M-H, Fixed, 95% CI 0.01 [-013, 0.12] 0.02 [-035, 0.05] 0.07 [-023, 0.10] 0.07 [-023, 0.10] 0.07 [-023, 0.09] -0.16 [-038, 0.05] -0.04 [-0.11, 0.03] -0.04 [-0.11, 0.03] -0.04 [-0.14, 0.18] 0.02 [-0.14, 0.18] 0.04 [-0.24, 0.33] -0.13 [-0.37, 0.11] 0.11 [-0.12, 0.35] 0.03 [-0.08, 0.14] -0.07 [-0.22, 0.09]	M-H, Fixed, 95% CI D 0,5 0,25 0,25 0,5 Favours [Laparoscopic] Risk Difference M-H, Fixed, 95% CI E
Study or Subgroup Chen, 2015 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2017 Total (95% CI) Total events Hoterogenety: Ch ² Test for overall effe Study or Subgrou Chen, 2015 Eckhardt, 2016 Eckhardt, 2016 Morelli, 2016 Morelli, 2016 Morelli, 2010 Morelli, 2020 Morelli, 2010 Total (95% CI)	p Even 1 1 = 4.82, df ct: Z = 1.10 Roi p Even	$\begin{array}{c} \underline{ts} \ \ \ \ \ \ \ \ \ \ \ \ \ $	Events 3 3 0 1 11 7 13 35 0.44); I [≠] = 7) Laparo Events 5 6 8 3 7 2 5	Total 33 57 15 32 41 31 209 0% copic Total 33 29 57 15 32 41 31 29 57 15 32 41 31 29 57 15 32 29 57 15 32 29 57 15 32 29 57 15 32 29 57 15 32 29 57 15 32 29 57 15 32 29 57 15 57 15 57 15 57 15 57 15 57 15 57 15 57 15 57 15 57 15 57 15 57 15 57 15 57 15 57 15 57 15 57 15 57 15 15 15 15 15 15 15 15 15 15	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0% Weight 18.2% 8.0% 18.2% 8.0% 18.8% 18.8% 18.9% 18.9% 10.9% 10.9%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] -0.04 [-0.11, 0.03] -0.04 [-0.14, 0.03] 0.02 [-0.14, 0.18] 0.04 [-0.24, 0.33] 0.03 [-0.08, 0.14] -0.07 [-0.22, 0.09] 0.06 [-0.02, 0.09]	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2017 Total (95% CI) Total events Heterogeneity: CH ² Test for overall effe <u>Study or Subgrou</u> Chen, 2015 Eckhardt, 2016 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2020 Zhang, 2020 Zhang, 2020 Zhang, 2020 Zhang, 2017 Total (95% CI)	p Even 1 1 2 2 3 5 = 4.82, df ct Z = 1.11 Roi p Even	$\begin{array}{c} \underline{ts} \underline{Total} \\ 4 & 47 \\ 0 & 31 \\ 10 & 15 \\ 10 & 24 \\ 4 & 37 \\ 11 & 43 \\ 197 \\ \underline{ts} 107 \\ \underline{ts} 107$	Events 3 0 1 11 1 13 35 0.44); I ^a = 5 6 8 3 7 2 5 5	Total 33 57 15 32 41 31 209 0% copic Total 33 29 57 15 32 41 31 209 21 33 29 57 32 41 31 238	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 19.8% 18.4% 100.0% Weight 18.2% 18.8% 7.0% 18.8% 7.0% 18.9% 12.9% 12.9% 12.9% 12.9% 10.0%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.00 [-0.05, 0.05] -0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.05] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] -0.04 [-0.14, 0.03] -0.04 [-0.44, 0.04] 0.02 [-0.14, 0.18] 0.04 [-0.24, 0.33] -0.13 [-0.37, 0.11] 0.11 [-0.12, 0.35] 0.03 [-0.08, 0.44] -0.07 [-0.22, 0.09] 0.00 [-0.06, 0.07]	M-H, Fixed, 95% CI D G G G G G G G G G G G G G G G G G G
Study or Subgroup Chen, 2015 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2020 Zhang, 2017 Total events Heterogeneity: Ch ² Total events Heterogeneity: Ch ² Test for overall effe Study or Subgrou Chen, 2015 Eckhardt, 2016 Eckhardt, 2016 Morelli, 2018 Morelli, 2019 Morelli, 2019 Zhang, 2020 Zhang, 2017 Total events Heteropeneithe Ch ²	p Even 1 1 1 2 1 = 4.82, df ct: Z = 1.1 Ro p Even	ts Total 4 47 0 31 0 15 10 24 4 37 11 43 197 29 25 (P = -0.2) botic ts ts Total 8 47 3 122 4 31 1 15 8 244 3 37 4 43 209 31 26 (P = -2.2)	Events 3 3 0 11 11 7 13 35 0.44); F = 7 Laparo 2 6 8 37 2 5 6 8 3 7 2 5 6 0 77 k P	Total 33 57 15 32 41 31 209 0% copic Total 33 29 57 15 32 41 31 209 0%	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 18.4% 100.0% Weight 18.2% 8.0% 18.2% 10.0% 10.9% 10.9%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] Risk Difference M-H, Fixed, 95% C1 0.02 [-0.14, 0.18] 0.04 [-0.14, 0.18] 0.04 [-0.24, 0.33] 0.03 [-0.08, 0.14] -0.07 [-0.22, 0.09] 0.00 [-0.06, 0.07]	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2020 Zhang, 2017 Total events Hoterogeneity: Ch ² Total events Hoterogeneity: Ch ² Test for overall effe Hong, 2020 Morelli, 2016 Hong, 2020 Zhang, 2017 Total (9% Cf) Total (9% Cf) Total (9% Cf) Total events Hoterogeneity: Ch ² Total (9% Cf) Total events	p Even 1 2 2 2 4 4.82, df ct: Z = 1.10 Rol p Even 3 4 3 4 4 4 4 4 4 4 4 4 4 4 4 4	$\begin{array}{c} \underline{ts} \underline{Total} \\ 4 47 \\ 0 31 \\ 10 15 \\ 10 24 \\ 4 37 \\ 11 43 \\ 197 \\ 29 \\ = 5 (P = 0.2 \\ 0 (P = 0.2 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 1$	Events 3 0 0 11 11 13 35 0.44); F = 7 5 6 8 3 7 2 5 0 0.77; F = 100	Total 33 57 15 32 41 31 209 0% copic Total 33 39 57 15 32 95 15 32 41 33 29 57 15 32 41 31 238 0%	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 19.8% 19.8% 19.8% 100.0% Weight 18.2% 8.0% 12.9% 12.9% 12.9% 16.9% 100.0%	M-H, Fixed, 95% CI 0.01 [-013, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.06 [-0.22, 0.09] -0.06 [-0.23, 0.05] -0.04 [-0.11, 0.03] Misk Difference M-H, Fixed, 95% CI 0.02 [-0.14, 0.18] 0.04 [-0.24, 0.33] -0.13 [-0.37, 0.11] 0.11 [-0.12, 0.35] 0.03 [-0.08, 0.14] -0.07 [-0.22, 0.09] 0.00 [-0.06, 0.07]	M+H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgroup Chen, 2015 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2020 Zhang, 2020 Zhang, 2020 Zhang, 2020 Zhang, 2020 Study or Subgrou Chen, 2015 Eckhardt, 2016 Eckhardt, 2016 Morelli, 2018 Morelli, 2020 Yang, 2020 Zhang, 2017 Total events Hoterogeneity: Chi ¹ Test for overall effe	p Even 1 2 2 = 4.82, df ct: Z = 1.11 Roi p Even 2 = 3.34, df ct: Z = 0.1	ts Total 4 47 0 31 0 15 10 24 4 37 11 43 197 14 197 15 195 5 196 5 197 12 5 0 10 14 30 197 5 0 10 15 8 24 3 37 4 337 4 43 209 31 15 6 3 10 16 6 31 16 31 17	Events 3 0 0 11 7 13 35 0.44); IP = 77 7 Laparo 5 6 8 37 2 5 5 0.0.77); IP = 100 9	Total 33 57 15 32 41 31 209 0% Total 0% 57 32 41 31 29 57 32 41 31 238 0%	Weight 19.8% 20.5% 20.5% 14.0% 19.8% 18.4% 100.0% Weight 18.2% 8.0% 18.8% 7.0% 12.9% 18.2% 18.2% 18.2% 18.2%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] -0.02 [-0.13, 0.12] -0.07 [-0.23, 0.10] -0.07 [-0.23, 0.10] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] -0.04 [-0.11, 0.03] -0.04 [-0.14, 0.03] -0.02 [-0.14, 0.18] -0.02 [-0.14, 0.18] -0.03 [-0.08, 0.14] -0.03 [-0.08, 0.14] -0.07 [-0.22, 0.09] -0.00 [-0.06, 0.07]	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2020 Zhang, 2017 Total events Heterogeneity: Ch ²⁷ Test for overall effe Study or Subgrou Chen, 2015 Eckhard, 2016 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2017 Total (95% Cf) Total events Heterogeneity: Ch ²⁷ Test for overall effe	p Even 1 = 4.82, df ct: Z = 1.1 Roi p Even - 3.34, d.1 Roi p Even	$\begin{array}{c} \underline{ts} \overline{Total} \\ 4 47 \\ 0 31 \\ 10 15 \\ 10 24 \\ 4 37 \\ 11 43 \\ 197 \\ 25 5 (P = 0.2 \\ 0 (P = 0.2 \\ (P = 0.2 \\ 0 (P = 0.2 \\ $	Events 3 3 0 11 11 17 13 355 5 6 8 3 3 5 6 8 3 7 7 2 5 36 8 3 35 36 8 3 35 36 8 3 35 36 8 30 7 7 7 36 8 3 35 36 8 30 7 31 7 32 5 36 10 36 10 37 10 36 10 37 10 36 10 37 10 36 10 37 10 <t< td=""><td>Total 333 57 15 32 41 31 209 0% copic Total 33 29 0% 57 15 32 41 31 238 0% oscopic</td><td>Weight 19.8% 20.5% 20.5% 7.6% 14.0% 19.8% 14.0% 100.0% Weight 18.2% 18.2% 12.9% 18.2% 16.9% 100.0%</td><td>M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] Risk Difference M-H, Fixed, 95% C1 0.02 [-0.14, 0.18] 0.04 [-0.24, 0.33] -0.01 [-0.16, 0.14] -0.03 [-0.08, 0.14] -0.03 [-0.08, 0.14] -0.07 [-0.22, 0.09] 0.00 [-0.06, 0.07] Mean Difference</td><td>M-H, Fixed, 95%, CI D D D D D D D D D D D D D</td></t<>	Total 333 57 15 32 41 31 209 0% copic Total 33 29 0% 57 15 32 41 31 238 0% oscopic	Weight 19.8% 20.5% 20.5% 7.6% 14.0% 19.8% 14.0% 100.0% Weight 18.2% 18.2% 12.9% 18.2% 16.9% 100.0%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] Risk Difference M-H, Fixed, 95% C1 0.02 [-0.14, 0.18] 0.04 [-0.24, 0.33] -0.01 [-0.16, 0.14] -0.03 [-0.08, 0.14] -0.03 [-0.08, 0.14] -0.07 [-0.22, 0.09] 0.00 [-0.06, 0.07] Mean Difference	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgroup Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Zhang, 2020 Zhang, 2020 Zhang, 2020 Zhang, 2020 Zhang, 2020 Total events Heterogeneity: Chi ² Test for overall effe Study or Subgroup Angafi, 2020 Yang, 2020 Zhang, 2020 Zhang, 2021 Total events Heterogeneity: Chi ² Test for overall effe Butudy or Subgroup	p Even 1 2 = 4.82, df ct: Z = 1.1 Rol p Even 	ts. Total 4 47 7 0 0 31 10 10 15 14 37 11 43 197 19 12 55 (P = 0.2) 200 00 (P = 0.2) botic 50 11 43 11 15 8 244 31 15 8 244 33 37 209 31 = 6 13 209 33 12 203 31 = 6 50 Total 50 50	Events 3 3 11 11 7 355 0.44); I*= 5 6 8 3 7 2 36 37 2 36 37 36 37 36 37 2 36 37 36 37 36 37 36 37 36 37 37 36 37 36 36 37 36 37 36 37 38 39 30 31 32 336 336 37	Total 33 37 15 32 34 37 15 32 31 209 0% copic Total 33 29 97 15 32 21 31 238 0% oscopic SD To	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 19.8% 19.8% 100.0% Weight 18.2% 8.0% 18.2% 8.0% 18.2% 10.0% 10	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] -0.02 [-0.13, 0.12] -0.07 [-0.23, 0.10] -0.07 [-0.23, 0.10] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] -0.04 [-0.11, 0.03] -0.04 [-0.11, 0.03] -0.02 [-0.14, 0.18] -0.02 [-0.14, 0.18] -0.01 [-0.16, 0.14] -0.01 [-0.16, 0.14] -0.01 [-0.16, 0.14] -0.01 [-0.16, 0.14] -0.07 [-0.22, 0.09] -0.00 [-0.06, 0.07] 	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgroup Chen, 2015 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2020 Zhang, 2017 Total events Hoterogeneity: Ch ² Total events Hoterogeneity: Ch ² Total events Hoterogeneity: Ch ² Total 2016 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2017 Total (95% CI) Total events Hoterogeneity: Ch ² Test for overall effe Study or Subgroup Chen, 2015 Total events	p Even 1 2 = 4.82, df ct: Z = 1.1 Rol p Even 2 = 3.34, df ct: Z = 0.1 Rol Mean 10.2	$\begin{array}{c} ts. \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$	Events 3 3 0 1 11 11 11 17 13 35 5 7 7 1 Laparo Events 5 6 6 8 3 3 7 7 5 6 6 8 3 3 7 7 2 5 5 6 6 8 3 3 7 7 2 5 5 5 5 5 5 0.0.77 1 8 3 1	Total 33 37 15 32 41 31 209 0% Total 33 32 9 57 15 32 238 0% 00% 50 50 To 50 50 50 5.1	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 19.8% 19.8% 100.0% Weight 18.2% 8.0% 18.8% 7.0% 18.2% 18.9% 100.0% 18.9% 100.0%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] Risk Difference M-H, Fixed, 95% C1 0.02 [-0.14, 0.18] 0.04 [-0.24, 0.33] -0.13 [-0.37, 0.11] 0.11 [-0.12, 0.35] 0.03 [-0.08, 0.14] -0.03 [-0.08, 0.14] -0.04 [-0.08, 0.14] -0.04 [-0.08, 0.14] -0.05 [-0.08, 0.14] -0.05 [-0.08, 0.14] -0.05 [-0.08, 0.14] -0.03 [-0.08, 0.14] -0.04 [-0.08, 0.14] -	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgroup Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Zhang, 2020 Zhang, 2017 Total events Heterogeneity: Chi ¹ Test for overall effe Study or Subgroup Chen, 2015 Eckhardt, 2016 Morelli, 2018 Morelli, 2018 Total events Heterogeneity: Chi ¹ Test for overall effe Study or Subgroup Chen, 2015 Eckhardt, 2016	p Even 1 2 2 4.82, df 4.82, df 7 7 8, 2 8, 2 1 1 2 2 3.44, df 8, 2 1 8, 2 1 1 1 2 2 1 1 2 2 1 1 1 2 2 1 1 1 2 2 1 1 1 1 2 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Events 3 3 0 11 11 7 13 35 5 6 8 3 7 7 7 1 10 Laparo Events 5 6 8 3 7 7 10 10 10 10 10 10 10 10	Total 333 57 15 32 41 31 209 0% Copic Total 33 29 97 75 32 23 29 57 32 41 31 31 238 0% 00% 50 55.1 6.7	Weight 19.8% 20.5% 7.6% 14.0% 19.8% 19.8% 19.8% 100.0% Weight 18.2% 8.0% 18.2% 18.2% 18.2% 18.9% 10.0% 12.9% 18.2% 18.2% 10.0% 12.9% 18.2% 19.2% 19.2% 19.2% 1	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.06 [-0.22, 0.09] -0.66 [-0.22, 0.09] -0.66 [-0.22, 0.09] -0.66 [-0.22, 0.09] -0.64 [-0.11, 0.03] -0.04 [-0.11, 0.03] -0.04 [-0.14, 0.03] 0.04 [-0.14, 0.18] 0.04 [-0.24, 0.33] -0.01 [-0.16, 0.14] -0.37 [-0.22, 0.09] 0.00 [-0.06, 0.07] 	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgroup Chen, 2015 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2020 Zhang, 2017 Total events Hoterogeneity: Ch ² Test for overall effe Study or Subgrou Chen, 2015 Eckhardt, 2016 Hong, 2020 Zhang, 2017 Total (95% CI) Total events Heterogeneity: Ch ² Total events	1 2 2 4 5 2 4 5 2 4 5 2 4 5 2 4 5 2 4 5 2 4 5 2 4 5 2 4 5 2 4 5 2 4 5 2 4 5 2 5 5 5 5 5 5 5 5 5 5 5 5 5	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Events 3 3 0 1 1 1 1 1 3 3 3 0 4 2 5 5 6 6 8 3 3 7 1 Laparo Events 5 6 6 8 3 7 2 5 5 5 5 5 5 5 5 5 5 5 5 5	Total 333 57 15 322 411 31 209 0% copic Total 33 29 57 15 322 41 323 0% <	Weight 19.8% 19.8% 14.0% 14.0% 14.0% 14.0% 19.8% 18.8% 100.0% Weight 18.2% 18.2% 18.8% 7.0% 18.8% 100.0% 18.9% 100.0% 10.0%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] -0.04 [-0.11, 0.03] -0.04 [-0.14, 0.18] 0.04 [-0.24, 0.33] -0.14 [-0.18] 0.04 [-0.24, 0.33] -0.13 [-0.37, 0.11] 0.13 [-0.13, 0.14] -0.03 [-0.08, 0.14] -0.04 [-0.21, 2.78] Mean Difference	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgroup Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Zhang, 2020 Zhang, 2020 Zhang, 2020 Zhang, 2020 Zhang, 2020 Total events Hoterogeneity: Chi ² Test for overall effe Study or Subgroup Chen, 2015 Eckhardt, 2016 Morelli, 2016 Morelli, 2016 Total events Hoterogeneity: Chi ² Test for overall effe Study or Subgroup Chen, 2015 Eckhardt, 2016 Hong, 3020 Chen, 2015 Eckhardt, 2016 Hong, 2020	1 1 2 2 2 4 4 4 4 4 4 4 4 4 4 4 4 4	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Events 3 0 1 11 7 13 35 5 6 8 77 12 Laparo 5 6 8 3 7 2 5 00 177; P = 7 Laparo 1 100 1	Total 333 57 15 32 41 31 209 0% 0% 33 29 57 532 29 57 15 322 41 31 238 0% 55 55 5.1 6.7 2 3 3 28 3	Weight 18,8% 20,5% 7,6% 18,8% 18,0% 19,8% 18,2% 100,0% 18,2% 8,0% 18,2% 18,8% 7,0% 18,8% 7,0% 18,8% 7,0% 18,8% 7,0% 18,8% 7,0% 18,8% 7,0% 10,0%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.06 [-0.22, 0.09] -0.66 [-0.22, 0.09] -0.66 [-0.22, 0.09] -0.66 [-0.22, 0.09] -0.66 [-0.23, 0.05] -0.04 [-0.11, 0.03] -0.04 [-0.14, 0.03] 0.02 [-0.14, 0.18] 0.04 [-0.24, 0.33] -0.01 [-0.16, 0.14] -0.31 [-0.37, 0.11] 0.04 [-0.24, 0.33] 0.03 [-0.08, 0.14] -0.07 [-0.22, 0.09] 0.00 [-0.06, 0.07] 	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgrou Chen, 2015 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2020 Zhang, 2017 Total events Hoterogeneity: Ch ² Total events Hoterogeneity: Ch ² Total events Hoterogeneity: Ch ² Study or Subgrou Chen, 2015 Eckhard, 2016 Najaf, 2020 Zhang, 2017 Total (95% Cl) Total events Hoterogeneity: Ch ² Study or Subgroup Chen, 2015 Eckhard, 2016 Study or Subgroup Chen, 2015 Eckhard, 2016 Study or Subgroup Chen, 2015 Eckhard, 2016 Study or Subgroup Chen, 2015	p Even 1 1 2 2 4 4 4 2 4 4 2 4 4 2 4 4 4 2 4 4 4 4 4 4 4 4 4 4 4 4 4	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Events 3 3 0 1 1 1 1 7 7 Laparo Events 5 6 8 8 3 7 7 Laparo Events 5 6 6 8 8 3 7 2 5 5 6 6 8 8 3 7 1 Laparo Laparo La	Total 333 57 15 32 41 31 209 0% copic Total 33 29 0% copic Total 33 29 0% 57 32 41 31 238 0% oscopic SD To 5.1 6.7 2 3 3.8 4.6	Weight 19.8%, 20.5%, 7.6%, 19.8%, 19.8%, 19.8%, 19.8%, 19.8%, 19.8%, 18.2%, 18.2%, 18.2%, 18.2%, 18.2%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 18.5%, 19,	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] Risk Difference M-H, Fixed, 95% C1 0.02 [-0.14, 0.18] 0.04 [-0.24, 0.33] -0.01 [-0.16, 0.14] -0.03 [-0.08, 0.14] -0.03 [-0.08, 0.14] -0.03 [-0.08, 0.14] -0.03 [-0.08, 0.14] -0.03 [-0.08, 0.14] -0.03 [-0.08, 0.14] -0.03 [-0.22, 0.09] 0.00 [-0.06, 0.07] Mean Difference Man Difference 	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgroup Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Zhang, 2020 Zhang, 2017 Total events Hoterogeneity: Chi ² Test for overall effe Study or Subgrou Chen, 2015 Eckhardt, 2016 Morelli, 2018 Morelli, 2019 Total events Hoterogeneity: Chi ² Test for overall effe Study or Subgroup Chen, 2015 Eckhardt, 2016 Hoterogeneity: Chi ² Test for overall effe Study or Subgroup Chen, 2015 Eckhardt, 2016 Hong, 2020 Chen, 2015 Eckhardt, 2016 Hong, 2020 Chen, 2015 Eckhardt, 2016 Hong, 2020 Chen, 2015 Hoterogeneity: Chi ² Test for overall effe	1 1 2 2 2 2 4 4 2 4 4 2 4 4 2 4 4 2 4 4 2 4 4 2 4 4 2 4 4 2 4 4 2 4 4 2 4 4 2 4 4 2 4 4 4 4 2 4 4 4 4 4 4 4 4 4 4 4 4 4	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Events 3 3 0 1 1 1 7 1 3 3 5 5 6 6 8 8 3 7 7 1 Laparo Events 5 6 6 8 3 7 7 2 2 5 5 6 6 8 3 3 7 7 1 Laparo Events 1 1 1 1 1 7 7 1 2 1 2 1 1 1 1 1 7 7 1 2 1 2 1 1 1 1 1 7 7 1 2 2 2 5 6 6 8 3 3 7 7 1 Laparo Events 1 1 1 1 1 1 1 1 1 1 1 1 1	Total 333 57 55 52 41 31 209 0% 0% 33 29 5 7 15 32 33 29 5 32 411 31 238 0% 00% 5.1 6.7 2 3.8 4.6 3.8 3.8	Weight 19.8%, 20.5%, 7.6%, 14.0%, 19.8%, 19.8%, 19.8%, 19.8%, 19.8%, 19.8%, 19.8%, 19.8%, 19.8%, 18.4%, 19.8%, 19.	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.06 [-0.22, 0.09] -0.66 [-0.22, 0.09] -0.66 [-0.22, 0.09] -0.66 [-0.22, 0.09] -0.66 [-0.22, 0.09] -0.02 [-0.14, 0.18] 0.04 [-0.14, 0.18] 0.04 [-0.24, 0.33] -0.01 [-0.16, 0.14] -0.31 [-0.32, 0.11] 0.04 [-0.24, 0.33] -0.07 [-0.22, 0.09] 0.00 [-0.06, 0.07] Mean Difference FV, Random, 95% C1 -4.30 [-6.30, -1.80] 0.20 [-0.42, 2.79] 0.20 [-0.24, 2.79] 0.20 [-0.24, 0.15] -0.20	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgroup Chen, 2015 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2020 Zhang, 2017 Total events Hoterogeneity: Chi ² Total events Hoterogeneity: Chi ² Test for overall effe Study or Subgroup Chen, 2015 Eckhardt, 2016 Najaf, 2020 Zhang, 2017 Total events Hoterogeneity: Chi ² Total events Hoterogeneity: Chi Total events Hoterogeneity: Chi Total events Hoterogeneity: Chi Total events Chen, 2015 Eckhardt, 2016 Hoterogeneity: Chi Ang, 2020 Zhang, 2020 Zhang, 2021 Total events Hoterogeneity: Chi Rashore Subgroup Chen, 2015 Eckhardt, 2016 Hong, 2020 Zhang, 2020 Zhang, 2021 Hoterogeneity: Chi Rashore Subgroup Chen, 2015 Eckhardt, 2016 Hong, 2020 Zhang, 2021 Hoterogeneity: Chi Rashore Subgroup Chen, 2015 Eckhardt, 2016 Hong, 2020 Zhang, 2021	1 2 2 4 4 4 4 4 4 4 4 4 4 4 4 4	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Events 3 3 0 1 1 3 5 5 6 6 3 3 0 0 4 4 % P = 1 3 5 5 6 6 3 3 7 7 2 1 2 5 5 6 6 3 3 7 7 2 5 5 6 6 1 6 1 6 7 7 2 5 5 6 6 1 1 6 7 7 1 1 1 1 1 1 1 1 1 1 1 1 1	Total 333 57 532 41 31 209 0% copic Total 333 39 99 99 97 57 32 41 31 238 0% oscopic 50 51 6.7 2 3 3.8 4.6 3.8 3.8	Weight 19.8%, 20.5%, 14.0%, 14.0%, 18.8%, 18.8%, 8.0%, 8.0%, 8.0%, 8.0%, 8.0%, 18.2%, 18.2%, 19.2%,	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] -0.04 [-0.11, 0.03] -0.04 [-0.14, 0.03] 0.04 [-0.14, 0.18] 0.04 [-0.14, 0.18] 0.04 [-0.24, 0.33] 0.03 [-0.08, 0.14] -0.03 [-0.08, 0.14] -0.03 [-0.08, 0.14] -0.03 [-0.08, 0.14] -0.03 [-0.08, 0.14] -0.03 [-0.28, 0.14] -0.20 [-0.22, 0.29] 0.00 [-0.06, 0.17] -0.20 [-0.22, 1.27] 0.20 [-0.22, 1.27] 0.20 [-0.22, 1.27] -0.20 [-1.27, 1.32] -0.20 [-1.27, 1.32] -	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgroup Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Zhang, 2020 Zhang, 2017 Total (versts Hoterogeneity: Chi ² Test for overall effe Study or Subgroup Chen, 2015 Eckhardt, 2016 Morelli, 2018 Morelli, 2019 Total events Hoterogeneity: Chi ² Test for overall effe Study or Subgroup Chen, 2015 Gen, 2015 Chen, 2015 Ch	1 1 2 2 3 4 4 2 4 2 4 4 2 4 4 4 4 4 4 4 4 4 4 4 4 4	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Events 3 3 0 1 1 1 7 7 3 3 5 0 .44); *= 5 6 6 8 3 3 7 2 5 6 6 8 3 3 7 2 5 6 6 8 3 3 7 2 5 6 6 8 3 3 7 2 2 5 6 6 8 3 3 7 2 2 5 6 8 8 3 7 7 2 6 8 8 1 1 4 5 8 8 1 1 1 6 8 8 1 1 1 1 1 1 1 1 1 1 1 1	Total 333 57 51 22 41 31 209 0% copic Total 333 29 57 322 57 332 957 322 57 324 11 238 0% oscopic 5.1 6.7 2 3.8 4.6 3.8 7.2	Weight 19.8% 20.5% 20.5% 7.6% 19.8% 20.5% 14.0% 18.2% 14.0% 18.4% 100.0% 18.2% 18.2% 18.6% 18.2% 18.6% 12.9% 18.6% 12.9% 16.9% 100.0% 11.4% 29.9% 17.3% 29.15.12.8% 15.2.8% 29.15.12.8% 16.4% 20.5% 15.2.8% 21.3% 16.4% 20.5% 16.8%	M-H, Fixed, 95% C1 -0.01 [-0.13, 0.12] -0.02 [-0.13, 0.12] -0.07 [-0.23, 0.10] -0.07 [-0.23, 0.10] -0.07 [-0.23, 0.10] -0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] -0.04 [-0.11, 0.03] -0.04 [-0.14, 0.03] -0.02 [-0.14, 0.18] -0.41 [-0.12, 0.35] -0.01 [-0.16, 0.14] -0.31 [-0.32, 0.11] -0.01 [-0.16, 0.14] -0.31 [-0.32, 0.19] -0.00 [-0.06, 0.07] 	M-H, Fixed, 95%, CI D G G G G G G G G G G G G G
Study or Subgroup Chen, 2015 Hong, 2020 Morelli, 2016 Najaf, 2020 Zhang, 2017 Total events Hoterogenalty: Chi ¹ Test for overall effe Study or Subgrou Chen, 2015 Eckhardt, 2016 Den, 2015 Eckhardt, 2016 Total events Hoterogeneity: Chi ¹ Total events Hoterogeneity: Chi ² Total events Hoterogeneity: Chi ² Total events Total events Total events Total events	1 1 2 2 3 4 4 5 2 4 5 2 4 5 4 5 4 5 4 5 5 5 5 5 5 5 5 5 5 5 5 5	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Events 3 3 0 1 1 7 1 3 0 0 4 4 5 6 6 6 8 3 0 0 4 5 6 6 7 2 5 6 6 7 2 5 6 6 7 7 2 5 6 6 7 7 7 1 1 6 7 6 7 7 1 1 6 7 7 1 1 1 1	Total 33 357 15 209 0% copic Total 33 29 33 29 33 29 33 29 51 52 5.1 67 3 3.8 4.6 3.8 3.8 3.8 7.2 2 2	Weight 19.8%, 20.5%, 20.5%, 14.0%, 14.0%, 19.8%, 19.8%, 19.8%, 19.8%, 19.8%, 100.0%, 1	M-H, Fixed, 95% C1 0.01 [-0.13, 0.12] 0.02 [-0.13, 0.12] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.07 [-0.23, 0.10] 0.06 [-0.22, 0.09] -0.16 [-0.38, 0.05] -0.04 [-0.11, 0.03] Risk Difference M-H, Fixed, 95% C1 0.02 [-0.14, 0.18] 0.44 [-0.14, 0.18] 0.44 [-0.14, 0.18] 0.44 [-0.24, 0.33] 0.01 [-0.16, 0.14] -0.37 [-0.22, 0.09] 0.00 [-0.06, 0.07] Mean Difference W.Random, 95% C1 -4.30 [-6.80, -1.80] 0.20 [-0.12, 1.27] 0.20 [-0.24, 0.41] -0.20 [-0.24, 0.41] -0.20 [-0.24, 0.41] -0.20 [-0.24, 0.41] -0.20 [-0.24, 0.42] -2.30 [-4.45, 0.15] -1.50 [-4.85, 1.65] -1.52 [-2.44, -0.20]	M-H, Fixed, 95%, CI D D D D D D D D D D D D D
Study or Subgroup Chen, 2015 Hong, 2020 Morelli, 2016 Najafi, 2020 Zhang, 2020 Zhang, 2017 Total (versts Hoterogeneity: Chi ² Test for overall effe Study or Subgroup Chen, 2015 Eckhardt, 2016 Morelli, 2018 Morelli, 2019 Total (verst, 2017 Total (verst, 2017 Total (verst, 2017 Total (verst, 2017 Total (verst, 2017 Total (verst, 2015 Chen,	1 1 1 1 1 1 1 1 2 2 4 2 3 2 4 2 3 4 4 2 4 2 4 2 4 2 4 2 4 2 4 2 4 4 2 4 4 2 4 4 4 4 4 4 4 4 4 4 4 4 4	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Events 3 3 0 1 1 1 7 3 3 4 4 4 2 5 6 6 8 3 3 7 2 5 5 6 6 8 3 3 7 2 5 5 6 6 8 3 3 7 2 5 5 6 8 8 3 7 1 1 1 1 1 1 1 1 1 1 1 1 1	Total 333 357 15 32 41 31 209 0% copic Total 33 329 57 322 957 322 411 311 238 00% 0500 To 5.1 6.7 2 3.8 4.6 3.8 7.2 3.8 4.6 3.7 2 0.0007)	Weight 19.8% 19.8% 20.5% 20.5% 7.6% 19.8% 20.5% 19.8% 14.0% 19.8% 18.4% 100.0% 8.0% 18.2% 8.0% 18.2% 8.0% 18.2% 8.0% 20.5% 18.2% 18.2% 16.2% 20.5% 12.2% 18.2% 100.0% 20.5% 12.4% 21.144 16.0% 23.11.44 16.0% 24.16 8.3% 25.15.24% 15.2% 26.3% 16.0% 27.733 8.9% 28.10% 10.0%	M-H, Fixed, 95% C1 0.01 [-013, 0.12] 0.02 [-013, 0.12] 0.07 [-023, 0.10] 0.07 [-023, 0.10] 0.07 [-023, 0.10] 0.07 [-023, 0.10] 0.06 [-022, 0.09] -0.06 [-022, 0.09] -0.06 [-0.20, 0.09] -0.06 [-0.20, 0.09] -0.02 [-0.14, 0.18] 0.04 [-0.14, 0.18] 0.04 [-0.24, 0.33] -0.01 [-0.16, 0.14] -0.31 [-0.32, 0.19] 0.00 [-0.06, 0.07] Mean Difference IV, Random, 95% C1 -4.30 [-0.80, -1.80] -0.07 [-0.22, 0.09] 0.00 [-0.06, 0.07] -2.30 [-4.5, 0.15] 1.00 [-2.19, 4.50] -2.30 [-4.5, 0.15] 1.00 [-2.86, 4.60] -1.50 [-2.86, 4.60] -1.52 [-2.84, -0.29]	M-H, Fixed, 95%, CI D D C S Favours [Robotic] Favours [Laparoscopic] Risk Difference M-Fixed, 95%, CI C S Favours [Laparoscopic] Risk Difference M-Fixed, 95%, CI C S Favours [Laparoscopic] Favours [Laparoscopic] Maen Difference IV, Random, 95%, CI C S Favours [Laparoscopic] Mean Difference F F

Figure 3. Secondary outcomes forest plots: (**A**) intraoperative blood loss (mL); (**B**) operative time (min); (**C**) perioperative blood transfusions; (**D**) Clavien–Dindo grade \geq 3 complications; (**E**) postoperative pancreatic fistula grade B/C; (**F**) hospital length of stay (days).

3.6. Postoperative Morbidity and Outcomes

Eight series [15–18,20,21,24,25] reported the perioperative mortality, with no cases of 30-day deaths. Seven studies [15–17,20,21,24,27] described the prevalence of POPF. The RD of clinically relevant POPF (ISGPS grade B/C) was 0.00 (95% CI –0.06, 0.07) with no heterogeneity ($I^2 = 0\%$). The RD of Clavien–Dindo grade \geq 3 postoperative complications, as reported in six series [16,18,21,22,25,26], was –0.04 (95% CI –0.11, 0.03) with no heterogeneity ($I^2 = 0\%$). The mean hospital LOS difference was –1.5 days (95% CI –2.8, –0.2) in favor of SP-RADP and with high heterogeneity ($I^2 = 0\%$). Data on overall postoperative complications, clavien–Dindo grade 1–2 postoperative complications, biochemical leaks, and postoperative bleeding episodes are reported in Table 3.

Table 3. Risk differences between robotic and laparoscopic spleen-preserving distal pancreatectomies. CI: confidence interval; POPF: postoperative pancreatic fistula.

Outcome	Studios	Risk Difference	Test of Het	erogeneity	Quantification of	
outcome	Studies	[95% CI] (<1 Favors — Robotic)	Chi ²	p	Heterogeneity	
Spleen preserving failure	16-26	-0.25 [-0.30, -0.19]	27.22	0.002	df = 10; $I^2 = 63\%$	
Open conversions	16, 17, 19, 21, 22, 24–26	-0.05[-0.09, -0.01]	9.41	0.22	$df = 7; I^2 = 26\%$	
Overall complications	16–19, 21, 25, 26	-0.06[-0.14, 0.02]	2.15	0.91	$df = 6; I^2 = 0\%$	
Complications—Clavien-						
Dindo grade	16, 18, 21	-0.02[-0.15, 0.11]	1.00	0.61	$df = 2; I^2 = 0\%$	
1-2						
Complications—Clavien-						
Dindo grade	16, 18, 21, 22, 25, 26	-0.04 [-0.11 , 0.03]	4.82	0.44	$df = 5; I^2 = 0\%$	
≥ 3						
POPF grade B/C	16–18, 21, 22, 25, 26	0.00 [-0.06, 0.07]	3.34	0.77	$df = 6; I^2 = 0\%$	
Biochemical leaks	16–18, 21, 26	-0.04 [-0.14 , 0.05]	1.01	0.91	$df = 4; I^2 = 0\%$	
Intra-/post-operative blood	16 17 10 21 25 26	0.03[0.09.0.04]	5.49	0.36	$df = 5$, $I^2 = 0^{\circ/2}$	
transfusions	10, 17, 19, 21, 23, 20	-0.03 [-0.09, 0.04]	5.49	0.50	$u_1 = 5, 1 = 9/6$	
Reoperation rate	16, 17, 21, 22, 26	0.01 [-0.05, 0.07]	3.86	0.42	$df = 4; I^2 = 0\%$	
Hospital length of stay	16–19, 21, 22, 25, 26	-1.52 [-2.84, -0.20]	25.16	< 0.001	df = 7; $I^2 = 72\%$	

3.7. Quality of Evidence

The level of evidence was rated according to GRADE and is summarized in Table 4.

Table 4. Robotic versus laparoscopic surgery for spleen-preserving distal pancreatectomies. * The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI). CI: Confidence interval; RR: Risk ratio; MD: Mean difference.

				Anticipated Absolute Effects		
Outcomes	N of Participants (Studies) Follow up	Evidence (GRADE)	Relative Effect (95% CI)	Risk with Laparoscopic Approach	Risk Difference with Robotic Approach	
Spleen preservation rate	685 (11 observational studies)	$\oplus \oplus \bigcirc \bigcirc$ LOW	RR 1.31 (1.16 to 1.48)	680 per 1000	211 more per 1000 (109 more to 326 more)	
Blood Loss	404 (7 observational studies)	$\oplus \oplus \bigcirc \bigcirc$ LOW	-	Mean blood loss was 233.3 mL	MD 138.11 lower (205.25 lower to 70.96 lower)	
Operative time	518 (9 observational studies)	$\oplus \oplus \bigcirc \bigcirc$ LOW	-	Mean operative time was 206.1 min	MD 6.13 higher (39.96 lower to 52.23 higher)	
Pancreatic fistula grade B–C	447 (7 observational studies)	$\oplus \oplus \bigcirc \bigcirc$ LOW	RR 1.03 (0.66 to 1.60)	151 per 1000	5 more per 1000 (51 fewer to 91 more)	
Complications Clavien–Dindo 3–4	406 (6 observational studies)	$\oplus \oplus \bigcirc \bigcirc$ LOW	RR 0.79 (0.52 to 1.20)	167 per 1000	35 fewer per 1000 (80 fewer to 33 more)	
Hospital length of stay	492 (8 observational studies)	$\oplus \oplus \bigcirc \bigcirc$ LOW	-	Mean hospital stay was 9.8 days	MD 1.52 lower (2.84 lower to 0.2 lower)	
Perioperative bleeding	143 (3 observational studies)	⊕⊕⊖⊖ LOW	RR 0.93 (0.24 to 3.63)	55 per 1000	4 fewer per 1000 (42 fewer to 144 more)	

4. Discussion

To the best of our knowledge, this systematic review and meta-analysis is the first report summarizing all the available evidence on patients undergoing spleen-preserving distal pancreatectomy with robotic and laparoscopic techniques. All published studies comparing these two minimally invasive surgical approaches were screened in order to analyze the intention-to-treat population of patients undergoing DP where the spleen was intended to be preserved and to evaluate whether the surgical technique would have an impact on the spleen preservation success rate.

The spleen holds the largest lymphoid tissue mass in the body, producing early immunoglobulins M and containing macrophages that act as barriers against encapsulated pathogens. Avoiding unnecessary splenectomies prevents those patients undergoing DP from facing significant thromboembolic [28] and infective risks [29]. The most serious post-splenectomy complication is overwhelming post-splenectomy infection (OPSI), which can start with flu-like symptoms but can rapidly progress to septic shock, coma, and disseminated intravascular coagulation [30]. OPSI can represent a major medical emergency, with a mortality rate that can be up to 50–70% [31,32], a yearly incidence of 0.23%, and a lifetime risk of approximately 5%. The risk is greater within the first two years postoperatively but can vary depending on patient risk factors, such as age, immunological status, and indication for splenectomy [33,34]. In order to protect splenectomized individuals from such complications, prophylactic pneumococcal, Haemophilus influenzae type b, meningococcal, and annual influenza vaccinations are usually performed. Despite these risks, splenectomy is routinely performed alongside DP for pancreatic adenocarcinoma in order to achieve an adequate oncological clearance, given the high risk of lymph node involvement [35]. Spleen preservation should be considered in all patients undergoing DP for benign indications or pre-malignant/low-grade tumors, as it has been shown to be a safe procedure that can reduce perioperative morbidity and enable better long-term outcomes [36–39]. The spleen can be preserved despite the excision of the splenic vessels, as firstly described by Warshaw in 1988 [27], or with splenic vessel preservation, as demonstrated by Kimura et al. almost a decade later [26]. Both approaches have been shown to have comparable short- and long-term results in a recent international multicentric retrospective study [40] and carry fewer complications when performed with a minimally invasive technique. After early experiences of laparoscopic DP [1,2], the minimally invasive approach to pancreatic surgery has progressively gained popularity, with safety and efficacy profiles comparable to open surgery, together with reduced blood loss and a faster recovery time [41–45]. According to the most recent evidence-based guidelines, minimally invasive DP should be considered over open DP for all patients with benign and low-grade malignant tumors [46]. The robotic technique, with its superior accuracy, 3D vision, greater range of motion and precision [47], and excellent safety and efficacy profile in complex oncological surgery [48,49], has been utilized by several surgeons when performing pancreatic procedures [5,50,51].

This meta-analysis showed that the robotic approach is more effective than laparoscopy in allowing spleen preservation during DP, with an RD of spleen preservation failures of 0.24 (95% CI 0.15, 0.33), with reduced intraoperative blood loss (mean difference of -138 mL (95% CI -205, -71)) and similar operative time (mean difference of 6.1 min (95% CI -40, 52)). Patients undergoing SP-RADP were also less likely to experience intraoperative conversion to the "open" technique, with 3/201 open conversions (1.5%) in the robotic group and 15/219 (6.8%) in the laparoscopic group, with an RD of -0.05 (95% CI -0.09, -0.01) [15,16,18,20,21,23–25]. It was not possible to identify the proportion of patients where splenic vessel excision (Warshaw technique) was planned preoperatively, but a higher proportion of splenic vessel preservation was observed in patients undergoing SP-RADP (159/196 patients (81.1%)) versus SP-LADP (84/154 (54.5%)). With the exception of cases of tumor proximity or vascular involvement of the splenic vessels, when splenectomy or the Warshaw technique are usually the preferred choices, the Kimura technique is generally the preferred approach. The higher proportion of successful splenic vessel preservations in the robotic group, coupled with the superior spleen preservation rate, could reflect the more precise vascular dissection of the small tributaries of the splenic artery and vein that can be performed robotically. No differences in overall, clinically significant complications (Clavien–Dindo grade \geq 3) and POPF were observed between the two groups, but patients undergoing SP-RADP had a significantly shorter hospital LOS, with a mean difference of -1.5 days (95% CI -2.8, -0.2).

Due to the lack of long-term follow-up data, the postoperative morbidity results of the present meta-analysis could underestimate the possible beneficial effects of the robotic approach in terms of expected lower incidence of complications related to the occurrence of splenic infarctions and asplenia-related infections due to the significantly higher proportion of successful splenic and splenic vessel preservation in patients undergoing SP-RADP. Prevalence of overall complications, of Clavien–Dindo grade \geq 3 complications, and of clinically relevant POPF were similar to those reported in the literature following minimally invasive DP and open DP [40], with overall complications reported in 31.5% and 45.4%, Clavien–Dindo grade \geq 3 complications in 14.7% and 16.7%, and clinically relevant POPF in 14.8% and 15.1% of patients undergoing SP-RADP and SP-LADP, respectively.

Unfortunately, there was no randomized controlled trial directly comparing SP-RADP and SP-LADP that could be included in the present analysis. We performed a sensitivity analysis in order to further investigate the moderate heterogeneity ($I^2 = 63\%$) of the main outcome.

In conclusion, both SP-RADP and SP-LADP proved to be safe and effective procedures, with minimal perioperative mortality and low postoperative morbidity. The robotic approach proved to be superior to the laparoscopic approach in terms of spleen preservation rate, intraoperative blood loss, and hospital length of stay. Future prospective and randomized studies with a longer follow-up could better evaluate the possible differences between these two techniques in terms of mid- to long-term complications and outcomes.

Author Contributions: Conceptualization, R.M. and G.R.; methodology, G.R.; software, R.M.; validation, R.I.T.; formal analysis, L.A.; resources, L.A.; writing—original draft preparation, G.R.; writing—review and editing, R.M. and R.I.T. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The data used for this manuscript are available upon request of the reviewers.

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

ASA:	American Society of Anesthesiologists
BMI:	body mass index
CI:	confidence interval
DP:	distal pancreatectomy
IPMN:	intraductal papillary mucinous neoplasm
LOS:	length of stay
NET:	neuroendocrine tumors
OPSI:	overwhelming post-splenectomy infection
POPF:	postoperative pancreatic fistula
RD:	risk difference
SP-LADP:	spleen-preserving laparoscopic-assisted distal pancreatectomy
SP-RADP:	spleen-preserving robot-assisted distal pancreatectomy

References

- 1. Gagner, M.; Pomp, A.; Herrera, M.F. Early experience with laparoscopic resections of islet cell tumors. *Surgery* **1996**, *120*, 1051–1054. [CrossRef]
- 2. Cuschieri, A. Laparoscopic surgery of the pancreas. J. R. Coll. Surg. Edinb. 1994, 39, 178–184. [PubMed]

- 3. Melvin, W.S.; Needleman, B.; Krause, K.R.; Ellison, E.C. Robotic Resection of Pancreatic Neuroendocrine Tumor. *J. Laparoendosc. Adv. Surg. Tech.* **2003**, *13*, 33–36. [CrossRef]
- Masson, B.; Fernández-Cruz, L.; Sa-Cunha, A.; Adam, J.-P.; Jacquin, A.; Laurent, C.; Collet, D. Laparoscopic Spleen-Preserving Distal Pancreatectomy: Splenic vessel preservation compared with the Warshaw technique. *JAMA Surg.* 2013, 148, 246–252. [CrossRef]
- 5. Esposito, A.; Casetti, L.; De Pastena, M.; Ramera, M.; Montagnini, G.; Landoni, L.; Bassi, C.; Salvia, R. Robotic spleen-preserving distal pancreatectomy: The Verona experience. *Updat. Surg.* **2020**, *73*, 923–928. [CrossRef]
- Page, M.J.; McKenzie, J.E.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Akl, E.A.; Brennan, S.E.; et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ* 2021, 372, n71. [CrossRef] [PubMed]
- Bassi, C.; Marchegiani, G.; Dervenis, C.; Sarr, M.; Abu Hilal, M.; Adham, M.; Allen, P.; Andersson, R.; Asbun, H.J.; Besselink, M.G.; et al. International Study Group on Pancreatic Surgery (ISGPS). The 2016 update of the International Study Group (ISGPS) definition and grading of postoperative pancreatic fistula: 11 Years After. *Surgery* 2017, *161*, 584–591. [CrossRef]
- 8. Dindo, D.; Demartines, N.; Clavien, P.-A. Classification of Surgical Complications: A new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann. Surg.* 2004, 240, 205–213. [CrossRef]
- Wells, G.; Shea, B.; O'Connell, D.; Peterson, J.; Welch, V.; Losos, M.; Tugwell, P. The Newcastle-Ottawa Scale (NOS) for Assessing the Quality of Nonrandomised Studies in Meta-Analyses. Available online: http://www.ohri.ca/programs/clinical_ epidemiology/oxford.asp (accessed on 1 June 2021).
- 10. Hultcrantz, M.; Rind, D.; Akl, E.A.; Treweek, S.; Mustafa, R.A.; Iorio, A.; Alper, B.S.; Meerpohl, J.; Murad, M.H.; Ansari, M.T.; et al. The GRADE Working Group clarifies the construct of certainty of evidence. *J. Clin. Epidemiol.* **2017**, *87*, 4–13. [CrossRef] [PubMed]
- 11. Wan, X.; Wang, W.; Liu, J.; Tong, T. Estimating the sample mean and standard deviation from the sample size, median, range and/or interquartile range. *BMC Med Res. Methodol.* **2014**, *14*, 1–13. [CrossRef]
- 12. Higgins, J.P.T.; Thompson, S.G. Quantifying heterogeneity in a meta-analysis. *Stat. Med.* **2002**, *21*, 1539–1558. [CrossRef] [PubMed]
- 13. DerSimonian, R.; Laird, N. Meta-analysis in clinical trials. Control. Clin. Trials 1986, 7, 177–188. [CrossRef]
- 14. Higgins, J.P.T.; Thompson, S.G.; Deeks, J.J.; Altman, D.G. Measuring inconsistency in meta-analyses. *BMJ* **2003**, 327, 557–560. [CrossRef]
- Chen, S.; Zhan, Q.; Chen, J.-Z.; Jin, J.-B.; Deng, X.-X.; Chen, H.; Shen, B.-Y.; Peng, C.-H.; Li, H.-W. Robotic approach improves spleen-preserving rate and shortens postoperative hospital stay of laparoscopic distal pancreatectomy: A matched cohort study. *Surg. Endosc.* 2015, 29, 3507–3518. [CrossRef] [PubMed]
- 16. Eckhardt, S.; Schicker, C.; Maurer, E.; Fendrich, V.; Bartsch, D.K. Robotic-Assisted Approach Improves Vessel Preservation in Spleen-Preserving Distal Pancreatectomy. *Dig. Surg.* **2016**, *33*, 406–413. [CrossRef] [PubMed]
- Hong, S.; Song, K.B.; Madkhali, A.A.; Hwang, K.; Yoo, D.; Lee, J.W.; Youn, W.Y.; Alshammary, S.; Park, Y.; Lee, W.; et al. Robotic versus laparoscopic distal pancreatectomy for left-sided pancreatic tumors: A single surgeon's experience of 228 consecutive cases. *Surg. Endosc.* 2020, *34*, 2465–2473. [CrossRef] [PubMed]
- 18. Kang, C.M.; Kim, D.H.; Lee, W.J.; Chi, H.S. Conventional laparoscopic and robot-assisted spleen-preserving pancreatectomy: Does da Vinci have clinical advantages? *Surg. Endosc.* **2011**, *25*, 2004–2009. [CrossRef] [PubMed]
- 19. Liu, R.; Liu, Q.; Zhao, Z.-M.; Tan, X.-L.; Gao, Y.-X.; Zhao, G.-D. Robotic versus laparoscopic distal pancreatectomy: A propensity score-matched study. *J. Surg. Oncol.* 2017, *116*, 461–469. [CrossRef]
- Morelli, L.; Guadagni, S.; Palmeri, M.; Di Franco, G.; Caprili, G.; D'Isidoro, C.; Bastiani, L.; Di Candio, G.; Pietrabissa, A.; Mosca, F. A Case-Control Comparison of Surgical and Functional Outcomes of Robotic-Assisted Spleen-Preserving Left Side Pancreatectomy versus Pure Laparoscopy. J. Pancreas 2016, 17, 30–35.
- Najafi, N.; Mintziras, I.; Wiese, D.; Albers, M.B.; Maurer, E.; Bartsch, D.K. A retrospective comparison of robotic versus laparoscopic distal resection and enucleation for potentially benign pancreatic neoplasms. *Surg. Today* 2020, *50*, 872–880. [CrossRef] [PubMed]
- Nell, S.; Brunaud, L.; Ayav, A.; Bonsing, B.A.; Koerkamp, B.G.; van Dijkum, E.J.N.; Kazemier, G.; de Kleine, R.H.; Hagendoorn, J.; Molenaar, I.Q.; et al. Robot-assisted spleen preserving pancreatic surgery in MEN1 patients. *J. Surg. Oncol.* 2016, 114, 456–461. [CrossRef] [PubMed]
- Souche, R.; Herrero, A.; Bourel, G.; Chauvat, J.; Pirlet, I.; Guillon, F.; Nocca, D.; Borie, F.; Mercier, G.; Fabre, J.-M. Robotic versus laparoscopic distal pancreatectomy: A French prospective single-center experience and cost-effectiveness analysis. *Surg. Endosc.* 2018, *32*, 3562–3569. [CrossRef] [PubMed]
- 24. Yang, S.J.; Hwang, H.K.; Kang, C.M.; Lee, W.J. Revisiting the potential advantage of robotic surgical system in spleen-preserving distal pancreatectomy over conventional laparoscopic approach. *Ann. Transl. Med.* **2020**, *8*, 188. [CrossRef]
- 25. Zhang, J.; Jin, J.; Chen, S.; Gu, J.; Zhu, Y.; Qin, K.; Zhan, Q.; Cheng, D.; Chen, H.; Deng, X.; et al. Minimally invasive distal pancreatectomy for PNETs: Laparoscopic or robotic approach? *Oncotarget* **2017**, *8*, 33872–33883. [CrossRef] [PubMed]
- 26. Kimura, W.; Inoue, T.; Futakawa, N.; Shinkai, H.; Han, I.; Muto, T. Spleen-preserving distal pancreatectomy with conservation of the splenic artery and vein. *Surgery* **1996**, *120*, 885–890. [CrossRef]
- 27. Warshaw, A.L. Conservation of the Spleen With Distal Pancreatectomy. Arch. Surg. 1988, 123, 550–553. [CrossRef]

- 28. Rottenstreich, A.; Kleinstern, G.; Spectre, G.; Da'As, N.; Ziv, E.; Kalish, Y. Thromboembolic Events Following Splenectomy: Risk Factors, Prevention, Management and Outcomes. *World J. Surg.* **2018**, *42*, 675–681. [CrossRef] [PubMed]
- Hansen, K.; Singer, D.B. Asplenic-hyposplenic Overwhelming Sepsis: Postsplenectomy Sepsis Revisited. *Pediatr. Dev. Pathol.* 2001, 4, 105–121. [CrossRef]
- 30. Tahir, F.; Ahmed, J.; Malik, F. Post-splenectomy Sepsis: A Review of the Literature. Cureus 2020, 12, e6898. [CrossRef]
- Sinwar, P.D. Overwhelming post splenectomy infection syndrome—Review study. Int. J. Surg. 2014, 12, 1314–1316. [CrossRef] [PubMed]
- 32. Sarangi, J.; Coleby, M.; Trivella, M.; Reilly, S. Prevention of post splenectomy sepsis: A population based approach. *J. Public Health* **1997**, *19*, 208–212. [CrossRef]
- 33. Davidson, R.; Wall, R. Prevention and management of infections in patients without a spleen. *Clin. Microbiol. Infect.* 2001, 7, 657–660. [CrossRef]
- 34. Edgren, G.; Almqvist, R.; Hartman, M.; Utter, G.H. Splenectomy and the Risk of Sepsis: A population-based cohort study. *Ann. Surg.* **2014**, *260*, 1081–1087. [CrossRef] [PubMed]
- 35. Jain, G.; Chakravartty, S.; Patel, A.G. Spleen-preserving distal pancreatectomy with and without splenic vessel ligation: A systematic review. *HPB* **2013**, *15*, 403–410. [CrossRef] [PubMed]
- Shoup, M.; Brennan, M.; McWhite, K.; Leung, D.H.Y.; Klimstra, D.; Conlon, K.C. The Value of Splenic Preservation with Distal Pancreatectomy. *Arch. Surg.* 2002, 137, 164–168. [CrossRef] [PubMed]
- 37. Lillemoe, K.D.; Kaushal, S.; Cameron, J.L.; Sohn, T.A.; Pitt, H.A.; Yeo, C.J. Distal Pancreatectomy: Indications and Outcomes in 235 Patients. *Ann. Surg.* **1999**, 229, 693–698; discussion 698–700. [CrossRef] [PubMed]
- Carrère, N.; Abid, S.; Julio, C.H.; Bloom, E.; Pradère, B. Spleen-preserving Distal Pancreatectomy with Excision of Splenic Artery and Vein: A Case-matched Comparison with Conventional Distal Pancreatectomy with Splenectomy. *World J. Surg.* 2007, 31, 375–382. [CrossRef]
- 39. Jusoh, A.C.; Ammori, B.J. Laparoscopic versus open distal pancreatectomy: A systematic review of comparative studies. *Surg. Endosc.* 2012, *26*, 904–913. [CrossRef]
- 40. Paiella, S.; De Pastena, M.; Korrel, M.; Pan, T.L.; Butturini, G.; Nessi, C.; De Robertis, R.; Landoni, L.; Casetti, L.; Giardino, A.; et al. Long term outcome after minimally invasive and open Warshaw and Kimura techniques for spleen-preserving distal pancreatectomy: International multicenter retrospective study. *Eur. J. Surg. Oncol.* **2019**, *45*, 1668–1673. [CrossRef]
- 41. Iacobone, M.; Citton, M.; Nitti, N. Laparoscopic distal pancreatectomy: Up-to-date and literature review. *World J. Gastroenterol.* **2012**, *18*, 5329–5337. [CrossRef]
- 42. Merchant, N.B.; Parikh, A.A.; Kooby, D.A. Should All Distal Pancreatectomies Be Performed Laparoscopically? *Adv. Surg.* 2009, 43, 283–300. [CrossRef]
- Butturini, G.; Damoli, I.; Crepaz, L.; Malleo, G.; Marchegiani, G.; Daskalaki, D.; Esposito, A.; Cingarlini, S.; Salvia, R.; Bassi, C. A prospective non-randomised single-center study comparing laparoscopic and robotic distal pancreatectomy. *Surg. Endosc.* 2015, 29, 3163–3170. [CrossRef] [PubMed]
- Cao, H.S.T.; Lopez, N.; Chang, D.C.; Lowy, A.M.; Bouvet, M.; Baumgartner, J.M.; Talamini, M.A.; Sicklick, J.K. Improved Perioperative Outcomes with Minimally Invasive Distal Pancreatectomy: Results from a population-based analysis. *JAMA Surg.* 2014, 149, 237–243. [CrossRef]
- 45. De Rooij, T.; Van Hilst, J.; Van Santvoort, H.; Boerma, D.; Boezem, P.V.D.; Daams, F.; Van Dam, R.; DeJong, C.; Van Duyn, E.; Dijkgraaf, M.; et al. Minimally Invasive Versus Open Distal Pancreatectomy (LEOPARD): A Multicenter Patient-blinded Randomized Controlled Trial. *Ann. Surg.* 2019, 269, 2–9. [CrossRef] [PubMed]
- Asbun, H.J.; Moekotte, A.L.; Vissers, F.L.; Kunzler, F.; Cipriani, F.; Alseidi, A.; D'Angelica, M.I.; Balduzzi, A.; Bassi, C.; Björnsson, B.; et al. The Miami International Evidence-based Guidelines on Minimally Invasive Pancreas Resection. *Ann. Surg.* 2020, 271, 1–14. [CrossRef] [PubMed]
- Troisi, R.I.; Pegoraro, F.; Giglio, M.C.; Rompianesi, G.; Berardi, G.; Tomassini, F.; De Simone, G.; Aprea, G.; Montalti, R.; De Palma, G.D. Robotic approach to the liver: Open surgery in a closed abdomen or laparoscopic surgery with technical constraints? *Surg. Oncol.* 2020, *33*, 239–248. [CrossRef]
- 48. Hu, Y.; Strong, V.E. Robotic Surgery and Oncologic Outcomes. JAMA Oncol. 2020, 6, 1537–1539. [CrossRef] [PubMed]
- Ceccarelli, G.; Andolfi, E.; Biancafarina, A.; Rocca, A.; Amato, M.; Milone, M.; Scricciolo, M.; Frezza, B.; Miranda, E.; De Prizio, M.; et al. Robot-assisted surgery in elderly and very elderly population: Our experience in oncologic and general surgery with literature review. *Aging Clin. Exp. Res.* 2017, 29, 55–63. [CrossRef] [PubMed]
- Daouadi, M.; Zureikat, A.; Zenati, M.S.; Choudry, H.; Tsung, A.; Bartlett, D.L.; Hughes, S.J.; Lee, K.K.; Moser, A.J.; Zeh, H.J. Robot-Assisted Minimally Invasive Distal Pancreatectomy Is Superior to the Laparoscopic Technique. *Ann. Surg.* 2013, 257, 128–132. [CrossRef]
- 51. Huang, B.; Feng, L.; Zhao, J. Systematic review and meta-analysis of robotic versus laparoscopic distal pancreatectomy for benign and malignant pancreatic lesions. *Surg. Endosc.* **2016**, *30*, 4078–4085. [CrossRef]