

# ISLS STS 2024 Seoul

INTERNATIONAL SOCIETY OF  
LIVER SURGEONS  
SINGLE TOPIC SYMPOSIUM

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## Postoperative care following laparoscopic pancreatoduodenectomy: Are there distinctions from open surgery?

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# Laparoscopic pancreatoduodenectomy

## Textbook outcome:

### Absence of:

- Postoperative pancreatic fistula
- Bile leakage
- Postpancreatectomy hemorrhage (all ISGPS grade B/C)
- Severe complications (Clavien–Dindo  $\geq$ III)
- Readmission within 30 days
- in-hospital mortality
- 30-day mortality

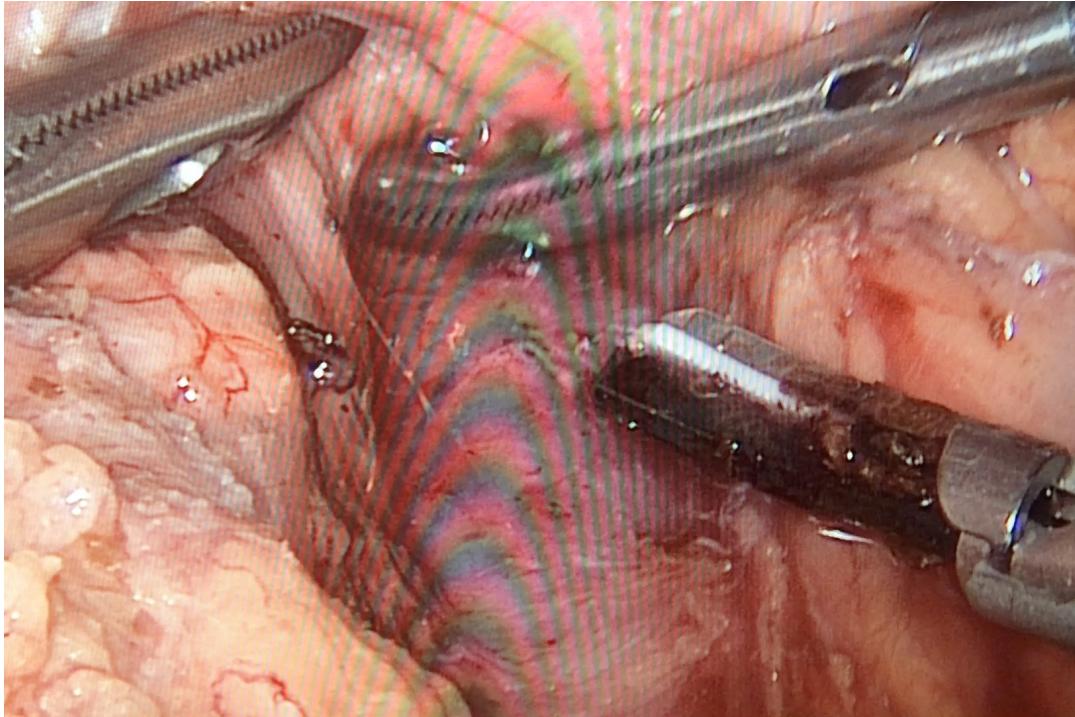
### Worse textbook outcome

- ASA class 3

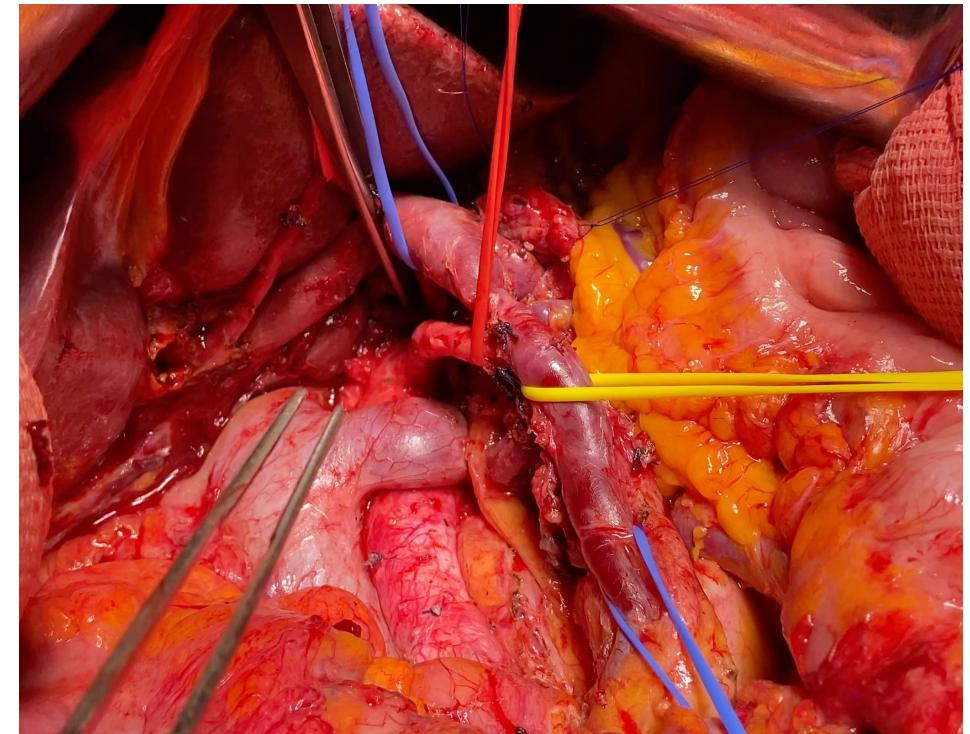
### Better textbook outcome

- Dilated pancreatic duct ( $>3$  mm)
- Pancreatic ductal adenocarcinoma

Laparoscopic



Open



Laparoscopic versus open pancreatectoduodenectomy for pancreatic or periampullary tumours (LEOPARD-2): a multicentre, patient-blinded, randomised controlled phase 2/3 trial

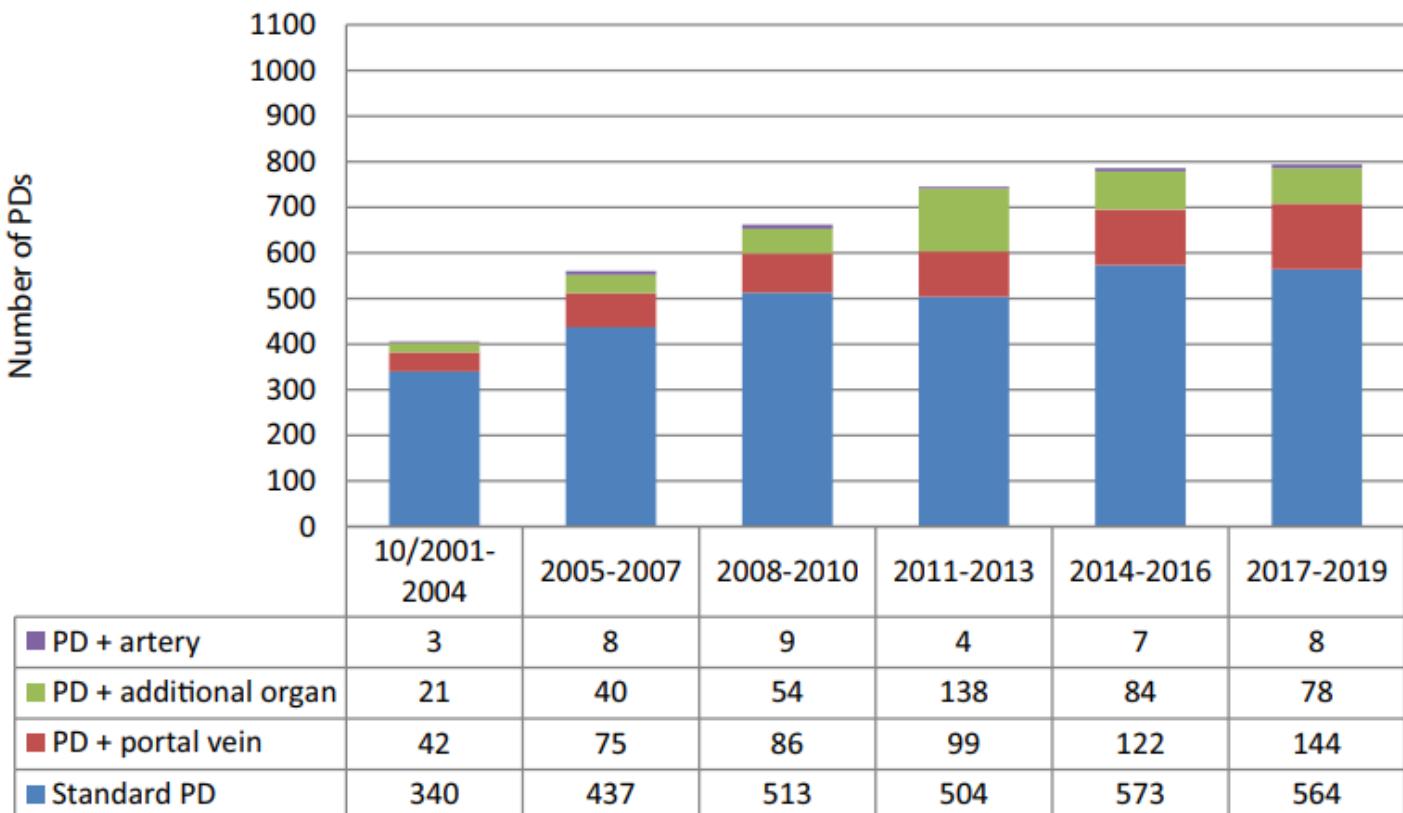


Phase 2 trial	Laparoscopic (20)	Open (20)	p
Mortality	3 (15%)	0 (0%)	
Proceed with phase 3			
Phase 3 trial	Laparoscopic (50)	Open (49)	p
Mortality	5 (10%)	1 (2%)	0.20
Prematurely terminated			



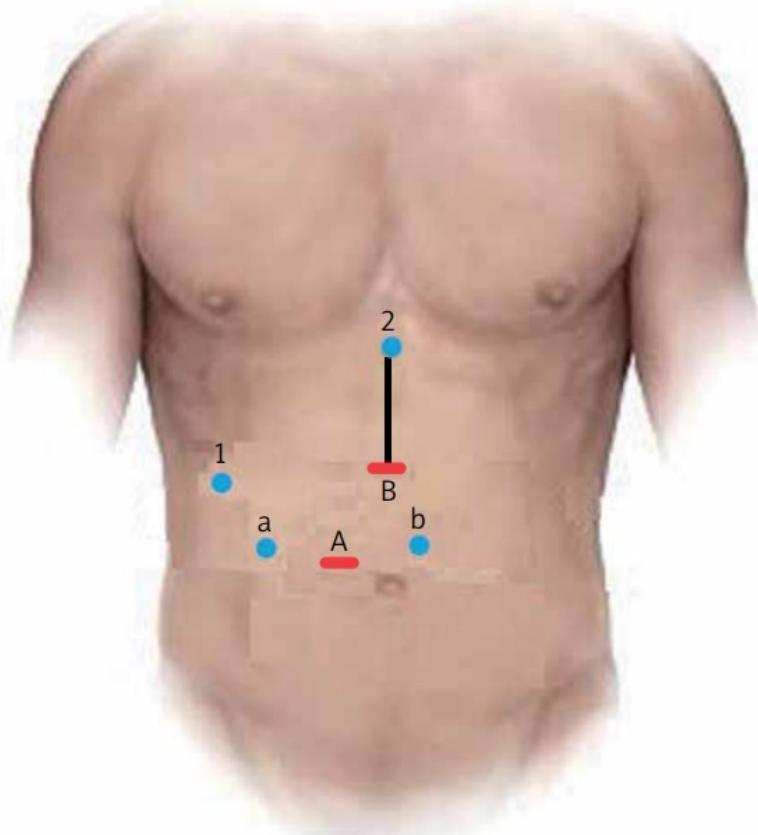
## Not all Whipple procedures are equal: Proposal for a classification of pancreateoduodenectomies

- 1 Standard PD (74.1%)**
- 2 Portal/SM Vein resection (14.4%)**
- 3 Additional organ (10.5%)**
- 4 Arterial resection (1.0%)**



# Postoperative care

Laparoscopic



Pain control

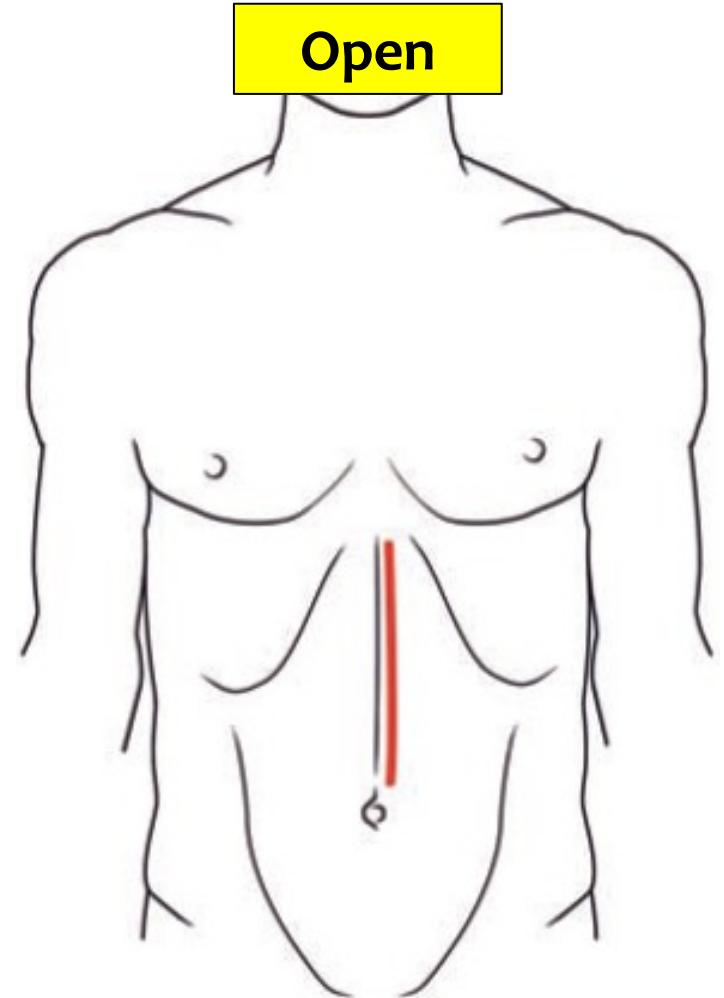
Operative time

Blood loss

Pulmonary complication

Surgical site infection

Open



Venous thromboembolism

## Postoperative care

### FUNCTIONAL RECOVERY

- I) Adequate pain control with oral analgesia only
- II) Restoration of mobility to an independent level
- III) Ability to maintain sufficient caloric intake ( $\geq 50\%$ )
- IV) Absence of intravenous fluid administration;
- V) No signs of active infection

Laparoscopic versus open pancreateoduodenectomy for pancreatic or periampullary tumours (LEOPARD-2): a multicentre, patient-blinded, randomised controlled phase 2/3 trial



	Laparoscopic group (n=50)	Open group (n=49)	Risk ratio (95% CI)	p value
Pain control				
Epidural	24 (48%)	24 (49%)	..	..
Wound catheters and intravenous analgesia	23 (46%)	24 (49%)	..	..
Intravenous analgesia only	3 (6%)	1 (2%)	..	..
Intraoperative metastases*	3 (6%)	2 (4%)	1.47 (0.26–8.42)	>0.99†
Intraoperative locally advanced disease*	1 (2%)	0 (0%)	..	>0.99†
Conversion from laparoscopy to open	10 (20%)‡	..	..	..
Soft/normal pancreatic texture§	33 (66%)	19 (39%)	1.70 (1.15–2.50)	0.004
Pancreatic duct diameter (mm)	3 (3–4)	3 (2–5)		0.66
Somatostatin analogue administration	35 (70%)	28 (57%)	1.23 (0.91–1.66)	0.18
Operative time (min)	410 (252–481)	274 (212–317)	..	<0.0001
Estimated operative blood loss (mL)	300 (200–438)	450 (300–1000)	..	0.13

**TABLE 2.** Intraoperative and Postoperative Data Among the LPD and OPD

Variables	LPD	OPD	P
Operative time (min)	475.0 (420.0-546.3)*	335.0 (275.0-405.0)*	<0.001†
Intraoperative transfusion [n (%)]	11 (18.97)	9 (15.52)	0.623‡
Estimated blood loss (mL)	200.0 (100.0-325.0)*	220.0 (150.0-400.0)*	0.334†
Pancreas texture (soft) [n (%)]	28 (48.28)	26 (44.83)	0.710‡
Postoperative ICU utility [n (%)]	9 (15.52)	7 (12.07)	0.590†
Demand for analgesia [n (%)]	26 (44.83)	54 (93.10)	<0.001‡
Postoperative stay (d)	14.0 (11.0-17.3)*	13.0 (11.0-20.0)*	0.608†
Time to first passage of flatus (d)	4.0 (3.0-5.0)*	5.0 (4.0-5.0)*	<0.001†
Time to oral intake (d)	6.0 (5.0-8.0)*	7.0 (6.0-11.0)*	<0.001†

\*Data are expressed as median and interquartile range.

†Rank sum test.

‡The  $\chi^2$  test.

ICU indicates intensive care unit; LPD, laparoscopic pancreaticoduodenectomy; OPD, open pancreaticoduodenectomy.

	Laparoscopic	Open	p
<b>Max pain score</b>	<b>7.2% ±2.0</b>	<b>7.4±1.9</b>	<b>0.11</b>
<b>Discharge pain score</b>	<b>1.7±1.6</b>	<b>2.0±1.7</b>	<b>0.003</b>

Pain control

**Open pancreateoduodenectomy**

## Blood loss

**Table 2.** Intraoperative characteristics in the LPD and OPD groups.

Characteristic	LPD group	OPD group	P
Operative time (minutes, mean $\pm$ SD)	450.39 $\pm$ 96.96	391.74 $\pm$ 85.32	0.035
Estimated blood loss volume (mL, median (IQR))	100 (100, 285)	200 (200, 300)	0.042
R0 resection (cases (%))	22 (95.7)	20 (87.0)	0.601
Lymph node enlargement (cases (%))	12 (52.2)	18 (78.3)	0.063
Tumor diameter (cm, median (IQR))	2 (2, 2.5)	3 (2, 3.5)	0.003
Invasion of the superior mesenteric vein (cases (%))	2 (8.7)	4 (17.4)	0.662

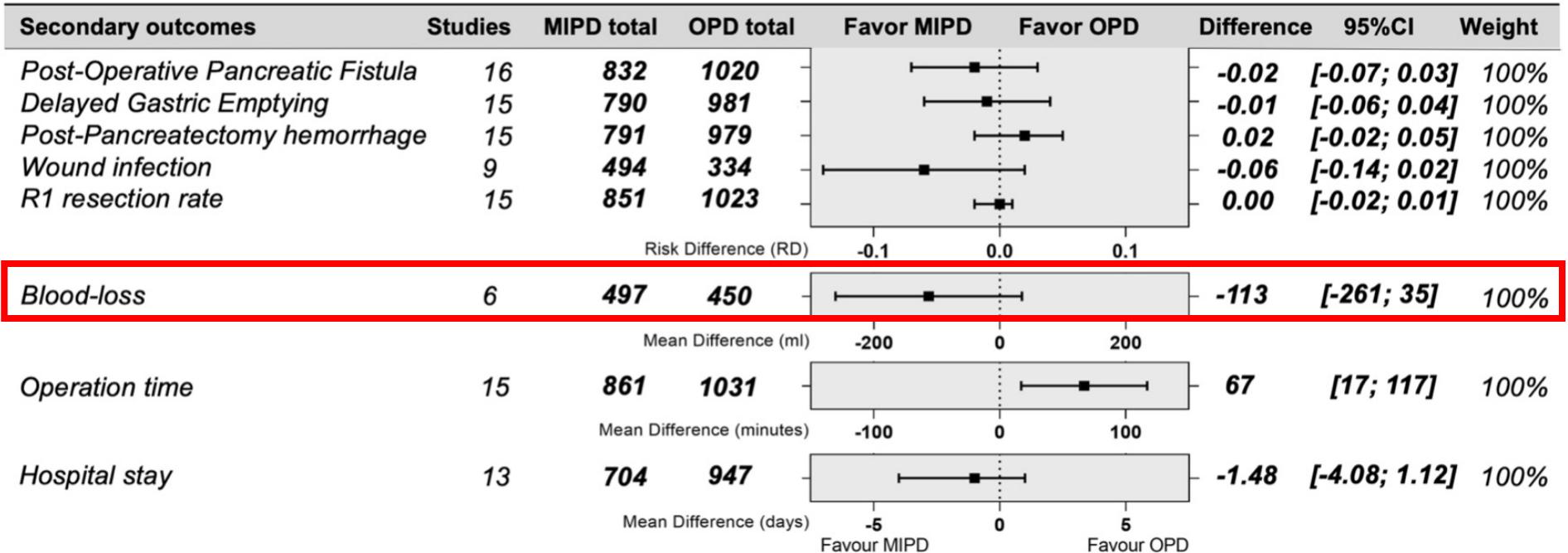
LPD, laparoscopic pancreaticoduodenectomy; OPD, open pancreaticoduodenectomy; SD, standard deviation; IQR, interquartile range.

**Table 2** Operative parameters.  
Converted cases were excluded  
from the matching procedure

## Blood loss

Characteristic	PS-matched cohort		<i>p</i> value
	LPD ( <i>n</i> =38)	OPD ( <i>n</i> =38)	
<b>Procedure type</b>			
Pancreatoduodenectomy (Whipple)	6 (15.8)	8 (21.1)	
Pylorus-preserving pancreateoduodenectomy	32 (84.2)	30 (78.9)	
Duration of surgery, mean min (SD)	320.1 ( $\pm$ 53.8)	277.7 ( $\pm$ 63.8)	.008
Estimated blood loss, median mL (IQR)	100 (100–300)	250 (100–600)	.117
Conversion to open, <i>N</i> (%)	-	-	
Portal vein resection, <i>N</i> (%)	0 (0)	3 (7.9)	.240
Diameter Wirsung, median (IQR)	3.5 (2.0–6.0)	2.5 (2.0–4.0)	.237
Type of pancreateojejunostomy, <i>N</i> (%)			.002
Duct-to-mucosa	23 (60.5)	35 (92.1)	
Dunking	15 (39.5)	3 (7.9)	
Type of gastrojejunostomy, <i>N</i> (%)			<.001
Handsewn	17 (44.7)	37 (97.4)	
Stapled	21 (55.3)	1 (2.6)	
Drain perdu, <i>N</i> (%)	23 (60.5)	31 (81.6)	.075
Intraoperative transfusion, <i>N</i> (%)	1 (2.6)	-	
Intraoperative complications, <i>N</i> (%)	2 (5.3)	6 (15.8)	.262
Bleeding	2 (5.3)	6 (15.8)	
Chyle leak	-	-	

# Blood loss

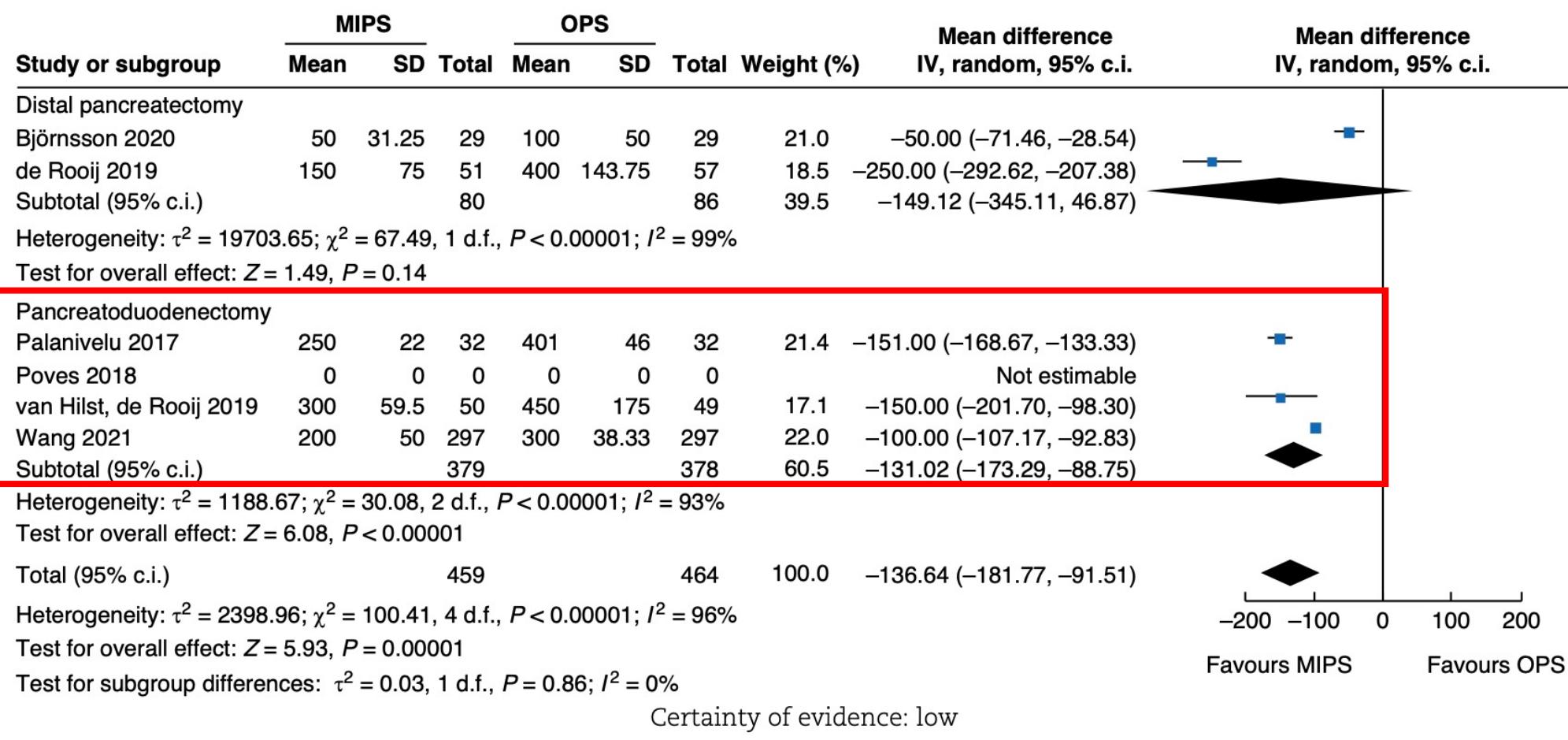


**Fig. 4** Summary of the meta-analysis with the risk difference or mean difference of the included studies combined. Displayed ranges correlate with the 95% confidence interval. Operation time significance,  $P=0.009$ . Abbreviations: MIPD, minimally invasive pancreateodu-

denectomy; OPD, open pancreateoduodenectomy; POPF, postoperative pancreatic fistula; DGE, delayed gastric emptying; PPH, postpancreatectomy hemorrhage; WI, wound infections; R1, resection margin  $< 1$  mm

# Blood loss

## Blood loss



**Blood loss**

**Open pancreateoduodenectomy**

**Not associated with postoperative complication**

# Surgical site infection

**Table 4.** Postoperative outcomes in the LPD and OPD groups.

Characteristic	LPD group	OPD group	P
Postoperative length of stay (days, mean±SD)	16.35 ± 4.74	20.35 ± 12.47	0.162
PPH	3 (13.0)	3 (13.0)	1.000
CR-POPF	3 (13.0)	5 (21.7)	0.697
BL	6 (26.1)	2 (8.7)	0.243
Intra-abdominal infection	4 (17.4)	5 (21.7)	1.000
DGE	2 (8.7)	2 (8.7)	1.000
<b>Wound infection</b>	<b>3 (13.0)</b>	<b>0 (0.0)</b>	<b>0.232</b>
Overall complications	21 (91.3)	17 (73.9)	0.243
Reoperation	1 (4.3)	2 (8.7)	1.000
Adjuvant chemotherapy	14 (60.9)	14 (60.9)	1.000
Recurrence	17 (73.9)	16 (69.6)	0.743

Values are cases (%) unless otherwise stated.

LPD, laparoscopic pancreaticoduodenectomy; OPD, open pancreaticoduodenectomy; PPH, postpancreatectomy hemorrhage; CR-POPF clinically-relevant postoperative pancreatic fistula; BL, biliary leakage; DGE, delayed gastric emptying.

Laparoscopic versus open pancreatectoduodenectomy for pancreatic or periampullary tumours (LEOPARD-2):  
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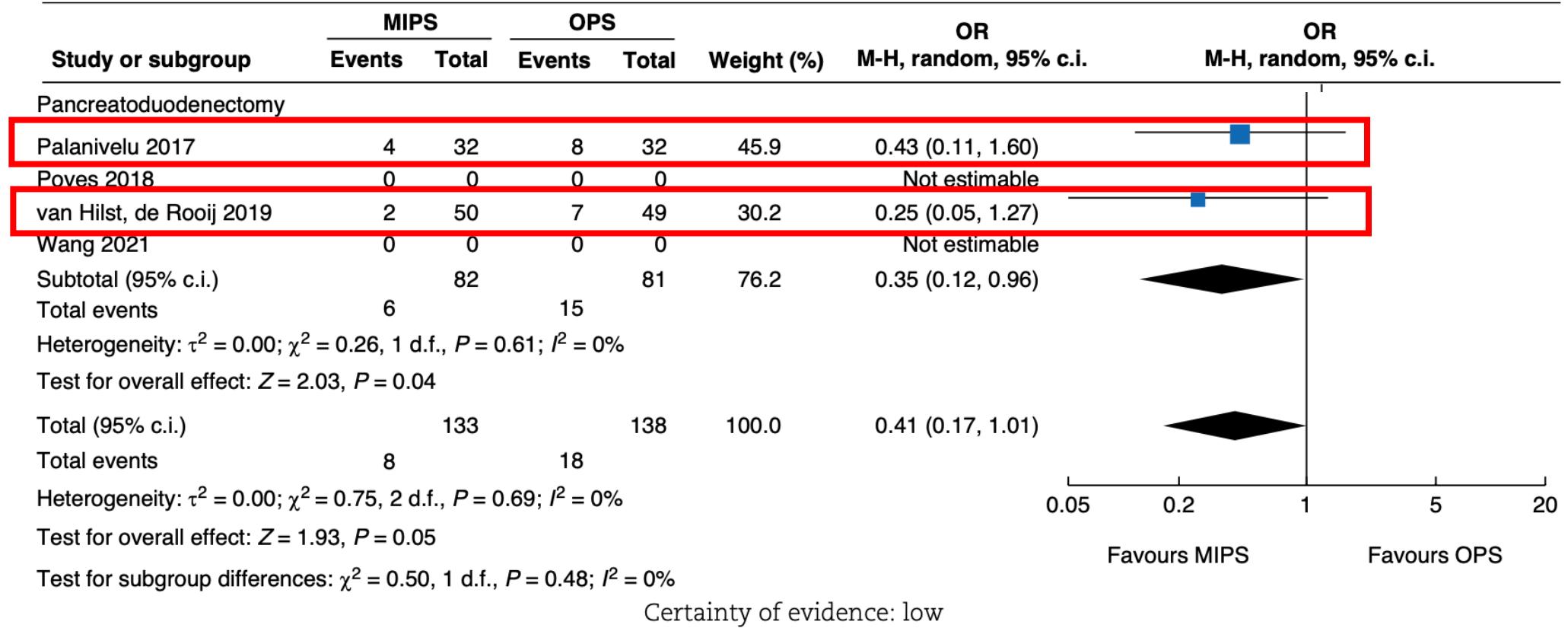
	Laparoscopic group (n=50)	Open group (n=49)	Risk ratio (95% CI)	p value
Clavien-Dindo grade ≥III	25 (50%)	19 (39%)	1.29 (0.82–2.02)	0.26
IIIA	11 (22%)	11 (22%)	..	..
IIIB	0 (0%)	1 (2%)	..	..
IVa	9 (18%)	5 (10%)	..	..
IVb	0	1 (2%)	..	..
Surgical re-intervention	6 (12%)	3 (6%)	1.96 (0.52–7.40)	0.49*
Unplanned ICU admission	12 (24%)	7 (14%)	1.68 (0.72–3.91)	0.22
Length of ICU stay (days)	2 (1–3)	2 (2–5)	..	0.47
Pancreatic fistula (B/C)	14 (28%)	12 (24%)	1.14 (0.59–2.22)	0.69
Surgical site infection	2 (4%)	7 (14%)	0.28 (0.06–1.28)	0.09*
Length of initial hospital stay (days)	11 (7–20)	10 (7–20)	..	0.73
Length of total hospital stay (days)	12 (7–21)	11 (7–24)	..	0.86
Readmission	8 (16%)	10 (20%)	0.78 (0.34–1.82)	0.57
Complication-related mortality	5 (10%)	1 (2%)	4.90 (0.59–40.44)	0.20*
Cancer-related mortality	2 (4%)	0	..	0.50*

Data are n (%), median (IQR), unless otherwise indicated. ICU=intensive care unit. \*Fisher's exact test.

**Table 3: Postoperative complications**

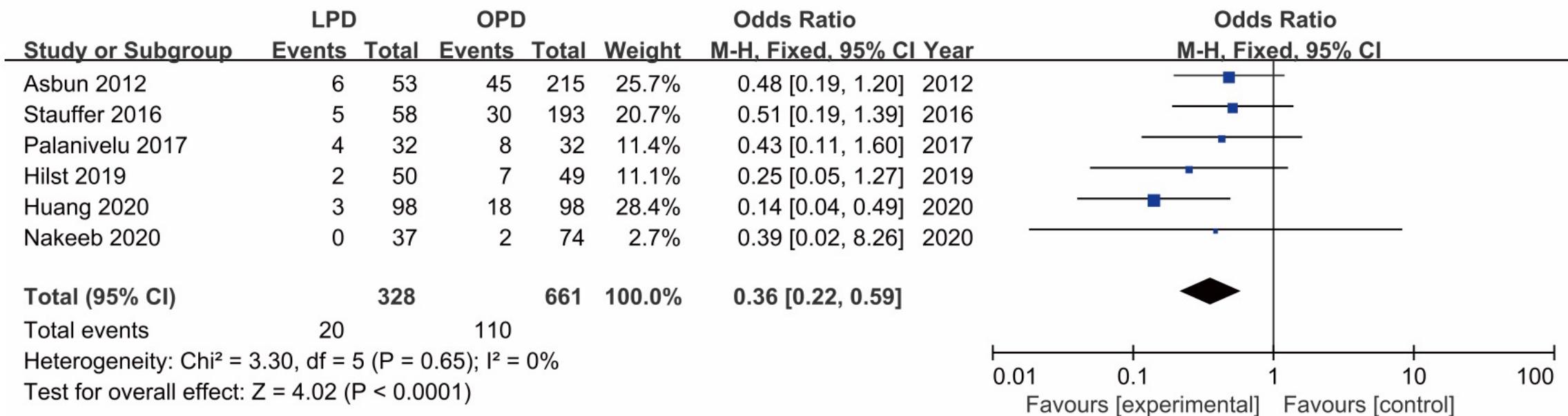
# Surgical site infection

## Surgical site infection



# Surgical site infection

B



# Surgical site infection

**Table 3 Subgroup analysis of categorical outcomes**

Outcomes	PD			
	n	MIPS	OPS	OR (95% c.i.)
Mortality rate	818	13 (3.2)	10 (2.5)	1.18 (0.30 to 4.63)
Clavien-Dindo ≥grade III	818	118 (28.7)	103 (25.3)	1.01 (0.55 to 1.86)
POPF	818	49 (11.9)	57 (14.0)	0.83 (0.54 to 1.25)
PPH	818	48 (11.7)	50 (12.3)	0.95 (0.62 to 1.45)
DGE	818	115 (27.9)	120 (29.5)	0.93 (0.53 to 1.63)
Bile leakage	818	49 (11.9)	52 (12.8)	0.93 (0.61 to 1.42)
SSI	163	6 (7.3)	15 (18.5)	0.35 (0.12 to 0.96)
Readmission	818	27 (6.6)	23 (5.7)	1.16 (0.63 to 2.12)
Reoperation	818	24 (5.8)	20 (4.9)	1.08 (0.29 to 3.97)
R0 resection	818	381 (92.7)	370 (90.9)	1.41 (0.80 to 2.46)

## **Wound edge protection**

**ERAS protocols:**  
**Postoperative prophylaxis, piperacillin/tazobactam sodium**

# Pulmonary complication

**Table 2 Overall short-term surgical outcomes**

<b>Variables</b>	<b>MIPD (N = 26)</b>	<b>OPD (N = 119)</b>	<b>P-value</b>
EBL (mL, IQR)	300 (87–562)	300 (150–400)	0.981
Operation time (min, IQR)	540 (420–662)	462 (370–596)	0.011
Conversion (n, %)	3 (11.5%)	–	–
PPH (Grade B and C)	2 (7.7%)	10 (8.4%)	0.633
DGE (Grade B and C)	2 (7.7%)	28 (24.6%)	0.071
POPF (Grade B and C)	2 (7.7%)	26 (21.8%)	0.077
Pulmonary complication	0 (0%)	10 (8.4%)	0.129
IAI	5 (19.2%)	40 (33.6%)	0.113
30-day readmission	1 (3.8%)	7 (5.8%)	0.865
Mortality	0 (0%)	6 (5.0%)	0.299

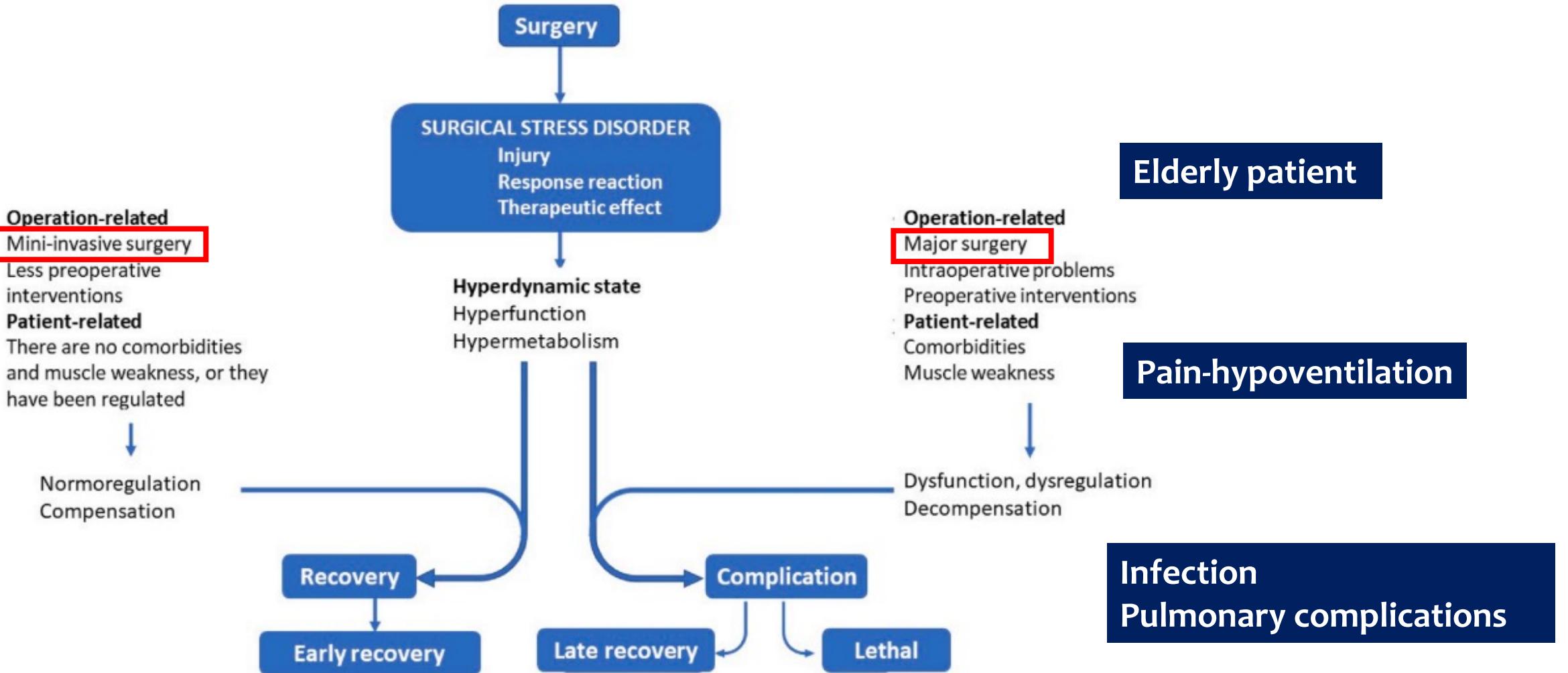
# Elderly patients

**Table 4 Short-term surgical outcomes in elderly patients: PSM analysis**

Variables	Original cohort		P-value	Matched cohort		P-value
	MIPD (N = 20)	OPD (N = 66)		MIPD (N = 17)	OPD (N = 34)	
EBL (mL, IQR)	275 (100–687)	300 (150–462)	0.822	200 (50–500)	300 (150–462)	0.880
Operation time (min, IQR)	525 (414–640)	467 (377–604)	0.161	420 (410–526)	456 (360–604)	0.181
P duct size (mm $\pm$ SD)	3.2 $\pm$ 1.46	3.6 $\pm$ 1.87	0.51	2.88 $\pm$ 1.30	3.66 $\pm$ 1.69	0.104
POHS (days, IQR)	18 (14–27)	24 (19–33)	0.014	18 (14–28)	25 (18–33)	0.028
Initiate oral diet (days, IQR)	5 (3–7)	5 (4–6)	0.946	5 (3–7)	5 (4–6)	0.992
Major complication ( $\geq$ CD Gr. 3)	3 (15.0%)	20 (30.3%)	0.142	3 (17.6%)	10 (29.4%)	0.290
PPH (Grade B and C)	2 (10.0%)	8 (12.1%)	0.577	2 (11.8%)	3 (8.8%)	0.546
DGE (Grade B and C)	2 (10.0%)	22 (33.3%)	0.042	1 (5.9%)	11 (32.4%)	0.036
POPF (Grade B and C)	2 (10.0%)	14 (21.2%)	0.217	2 (11.8%)	8 (23.5%)	0.273
Pulmonary complication	0 (0%)	10 (15.2%)	0.06	0 (0%)	6 (17.6%)	0.075
IAI	5 (25.0%)	19 (28.8%)	0.491	5 (29.4%)	11 (32.4%)	0.491
30-day readmission	1 (5.0%)	3 (4.5%)	0.856	1 (5.9%)	2 (5.9%)	>0.999
Mortality	0 (0%)	6 (9.1%)	0.193	0 (0%)	4 (11.8%)	0.186

Italic indicate statistic significance

*EBL* estimated blood loss, *IQR* interquartile range, *SD* standard deviation, *POHS* post-operative hospital stay, *ICU* intensive care unit, *TPN* total parenteral nutrition, *CD Gr.* Clavien–Dindo grade, *PPH* post-pancreatectomy hemorrhage, *DGE* delayed gastric emptying, *POPF* post-operative pancreatic fistula, *IAI* intraabdominal infection



**ERAS protocols:**

**Mobilization out of bed**

**Active pain control**

**Physiotherapy on POD 1**

**Postoperative prophylaxis, piperacillin/tazobactam sodium**

Laparoscopic versus open pancreatectoduodenectomy for pancreatic or periampullary tumours (LEOPARD-2):  
a multicentre, patient-blinded, randomised controlled  
phase 2/3 trial



	Laparoscopic group (n=50)	Open group (n=49)	Risk ratio (95% CI)	p value
Clavien-Dindo grade ≥III	25 (50%)	19 (39%)	1.29 (0.82–2.02)	0.26
IIIa	11 (22%)	11 (22%)	..	..
IIIb	0 (0%)	1 (2%)	..	..
IVa	9 (18%)	5 (10%)	..	..
IVb	0	1 (2%)	..	..
Surgical re-intervention	6 (12%)	3 (6%)	1.96 (0.52–7.40)	0.49*
Unplanned ICU admission	12 (24%)	7 (14%)	1.68 (0.72–3.91)	0.22
Length of ICU stay (days)	2 (1–3)	2 (2–5)	..	0.47
Pancreatic fistula (B/C)	14 (28%)	12 (24%)	1.14 (0.59–2.22)	0.69
Surgical site infection	2 (4%)	7 (14%)	0.28 (0.06–1.28)	0.09*
Length of initial hospital stay (days)	11 (7–20)	10 (7–20)	..	0.73
Length of total hospital stay (days)	12 (7–21)	11 (7–24)	..	0.86
Readmission	8 (16%)	10 (20%)	0.78 (0.34–1.82)	0.57
Complication-related mortality	5 (10%)	1 (2%)	4.90 (0.59–40.44)	0.20*
Cancer-related mortality	2 (4%)	0	..	0.50*

Data are n (%), median (IQR), unless otherwise indicated. ICU=intensive care unit. \*Fisher's exact test.

Table 3: Postoperative complications

**Table 1** Abbreviated ACS-NSQIP definitions of variables

Variable	Definition
Functional status	Ability to perform of activities of daily living (ADL) within 30 days prior to surgery Independent: Does not require assistance from another person for ADL, with or without prosthetics Partially dependent: Requires some assistance from another person for ADL Totally dependent: Requires total assistance from another person for all ADL
Pneumonia	Radiologic findings, AND Clinical signs with microbiological confirmation OR Respiratory symptoms
Reintubation	Unplanned endotracheal or other breathing tube with ventilator support intraoperatively or within 30 days
Failure to wean	Ventilator requirement > 48 h
Renal insufficiency	Creatinine increase > 2 mg/dl from preoperative value, without need for dialysis
Renal failure	Renal insufficiency with need for dialysis
Cardiac arrest	Need for chest compressions or defibrillations
Myocardial infarction	Indicative ECG changes OR new troponin elevation > 3× upper limit of reference range OR physician diagnosis
Stroke	Embolic, thrombotic or hemorrhagic vascular accident or stroke with dysfunction lasting > 24 h
Sepsis	Two or more SIRS criteria AND positive culture or source, OR Operative confirmation of infarcted bowel, purulence, enteric contents
Septic shock	Sepsis AND organ and/or circulatory dysfunction
Superficial infection	Infection involving only skin or subcutaneous tissue with purulent drainage OR microbiologic confirmation OR opening of wound with suspicion
Fascial dehiscence	Loss of integrity of fascial closure or total breakdown of closure
Organ space infection	Infection involved organs or spaces other than the incision, confirmed with purulence OR microbiologic confirmation OR physician diagnosis
VTE	New thrombus treated with anticoagulation or vena cava filter
Reoperation	Unplanned return to the operating room within 30 days
DGE	No oral intake by post-operative day 14, OR external gastric drainage tube or reinsertion of nasogastric tube
Pancreatic fistula	Clinical diagnosis OR persistent drainage with one of the following: <i>nihil</i> per os and parenteral nutrition, drain continued beyond 7 days, percutaneous drainage, reoperation, or spontaneous wound drainage

# Major morbidity

## Pancreatoduodenectomy

Variable	Major morbidity (n = 228)	No major morbidity (n = 1120)	P
Age (years), mean (s.d.)	66.0 (9.6)	66.0 (9.9)	0.905
Age ≥80 years	13 (5.7)	69 (6.2)	0.880
Female sex	96 (42.1)	491 (43.8)	0.660
BMI (kg/m <sup>2</sup> ), mean (s.d.)	25.5 (3.9)	25.5 (4.9)	0.990
BMI ≥30 kg/m <sup>2</sup>	21 (13.8)	100 (14.9)	0.801
<b>Preoperative co-morbidities</b>			
Diabetes	46 (20.2)	231 (20.6)	0.929
Cardiovascular	101 (44.3)	489 (43.7)	0.884
Respiratory	21 (9.2)	121 (10.8)	0.554
Preoperative biliary stent	141 (61.8)	734 (65.5)	0.288
<b>Preoperative blood tests, median (i.q.r.)</b>			
Bilirubin, µmol/l	19 (52)	21 (41)	0.573
Albumin, g/l	37 (13)	38 (10)	0.456
Neutrophils ×10 <sup>9</sup> /l	5.0 (2.7)	4.9 (2.9)	0.650
Lymphocytes ×10 <sup>9</sup> /l	1.8 (1.4)	1.8 (1.1)	0.463
ASA grade > II	81 (39.3)	271 (26.4)	0.0003*
Positive nodes on preoperative CT	56 (27.9)	268 (27.6)	0.931
Classic Whipple versus PPPD	123 (54.0)	537 (47.9)	0.110
P-J anastomosis versus P-G	176 (77.2)	888 (79.3)	0.477

# Grade B/C POPF

Variable	Grade B/C POPF (n = 142)	No grade B/C POPF (n = 1206)	P
Age (years), mean (s.d.)	65.6 (10.5)	66.0 (9.8)	0.595
Age ≥80 years	11 (7.7)	71 (5.9)	0.355
Female sex	45 (31.7)	542 (44.9)	0.003*
BMI ( $\text{kg}/\text{m}^2$ ), mean (s.d.)	27.1 (4.5)	25.3 (4.3)	0.0002*
BMI ≥30 $\text{kg}/\text{m}^2$	21 (20.1)	100 (13.8)	0.070
<b>Preoperative co-morbidities</b>			
Diabetes	23 (16.2)	254 (21.1)	0.119
Cardiovascular	71 (50.0)	519 (43.0)	0.128
Respiratory	21 (14.8)	121 (10.0)	0.084
Preoperative biliary stent	95 (66.9)	780 (64.7)	0.643
<b>Preoperative blood tests, median (i.q.r.)</b>			
Bilirubin ( $\mu\text{mol}/\text{l}$ )	19 (54)	21 (42)	0.992
Albumin ( $\text{g}/\text{l}$ )	37 (11)	38 (10)	0.828
Neutrophils ( $\times 10^9/\text{l}$ )	4.9 (3.1)	4.9 (2.7)	0.831
Lymphocytes ( $\times 10^9/\text{l}$ )	1.9 (1.35)	1.8 (1.35)	0.195
ASA grade >II	51 (37.8)	301 (27.4)	0.0152*
Positive nodes on preoperative CT	35 (27.3)	289 (27.7)	1.00
Classic Whipple versus PPPD	76 (53.5)	584 (48.5)	0.287
P-J anastomosis versus P-G	111 (78.7)	953 (81.5)	0.425

**Table 2**

**Univariate and multivariable logistic regression analysis of factors associated with textbook outcomes after laparoscopic pancreaticoduodenectomy.**

Patient variables	Univariate analysis		Multivariate analysis	
	OR (95% CI)	P value	OR (95% CI)	P value
Age ( $\leq$ 65 years)	Ref		Ref	
66–74	0.816 (0.586–1.139)	0.232	0.891 (0.627–1.265)	0.518
$\geq$ 75	0.535 (0.310–0.922)	0.024	0.545 (0.307–0.965)	0.037
Sex (female)	0.855 (0.656–1.114)	0.246		
BMI ( $18.5$ – $24$ kg/m $^2$ )	Ref			
$< 18.5$	0.994 (0.670–1.477)	0.978		
$> 24$	0.805 (0.589–1.100)	0.174		
ASA score (III–IV)	1.190 (0.804–1.760)	0.385		
TBIL ( $> 51.3$ $\mu$ mol/l)	0.792 (0.607–1.033)	0.086	0.793 (0.601–1.046)	0.100
Comorbidity				
Cardiovascular disease	0.570 (0.411–0.790)	0.001	0.614 (0.434–0.867)	0.006
Chronic pancreatitis	2.394 (1.109–5.167)	0.026	2.049 (0.929–4.519)	0.075
Hepatitis	0.563 (0.299–1.058)	0.074	0.613 (0.314–1.195)	0.151
Pancreatic anastomosis (invagination)	0.714 (0.537–0.949)	0.020	0.737 (0.510–1.064)	0.103
Pylorus-preserving LPD	1.653 (1.153–2.368)	0.006	1.117 (0.744–1.679)	0.593
Time of pancreatic anastomosis ( $\geq 40$ min)	0.579 (0.420–0.798)	0.001	0.712 (0.495–1.025)	0.068
Time of biliary anastomosis ( $> 30$ min)	0.655 (0.502–0.854)	0.002	0.764 (0.571–1.022)	0.070
Removal of NGT during operation	0.633 (0.484–0.827)	0.001	0.826 (0.582–1.174)	0.288
Estimated blood loss ( $\geq 400$ ml)	0.748 (0.550–1.017)	0.064	0.855 (0.616–1.188)	0.351
Dilated pancreatic duct ( $> 3$ mm)	1.565 (1.200–2.042)	0.001	1.564 (1.189–2.058)	0.001
Texture of pancreas (soft)	0.804 (0.614–1.052)	0.112		
Pathological outcomes (malignant)	1.045 (0.772–1.413)	0.777		
Number of lymph nodes ( $> 14$ )	1.306 (0.961–1.776)	0.088	1.301 (0.942–1.796)	0.110

ASA, American Society of Anesthesiologists; LPD, laparoscopic pancreaticoduodenectomy; NGT, nasogastric tube; OR, odds ratio; TBIL, total bilirubin.

# Venous thromboembolism

## VTE Risk

Laparoscopic	Open	p
5.3%	6.2%	

thromboprophylaxis

## Operative time

**TABLE 2.** Intraoperative and Postoperative Data Among the LPD and OPD

Variables	LPD	OPD	P
Operative time (min)	475.0 (420.0-546.3)*	335.0 (275.0-405.0)*	<0.001†
Intraoperative transfusion [n (%)]	11 (18.97)	9 (15.52)	0.623‡
Estimated blood loss (mL)	200.0 (100.0-325.0)*	220.0 (150.0-400.0)*	0.334†
Pancreas texture (soft) [n (%)]	28 (48.28)	26 (44.83)	0.710‡
Postoperative ICU utility [n (%)]	9 (15.52)	7 (12.07)	0.590‡
Demand for analgesia [n (%)]	26 (44.83)	54 (93.10)	<0.001‡
Postoperative stay (d)	14.0 (11.0-17.3)*	13.0 (11.0-20.0)*	0.608†
Time to first passage of flatus (d)	4.0 (3.0-5.0)*	5.0 (4.0-5.0)*	<0.001†
Time to oral intake (d)	6.0 (5.0-8.0)*	7.0 (6.0-11.0)*	<0.001†

\*Data are expressed as median and interquartile range.

†Rank sum test.

‡The  $\chi^2$  test.

ICU indicates intensive care unit; LPD, laparoscopic pancreaticoduodenectomy; OPD, open pancreaticoduodenectomy.

# Operative time

**Table 2** Operative parameters. Converted cases were excluded from the matching procedure

Characteristic	PS-matched cohort		
	LPD (n=38)	OPD (n=38)	p value
<b>Procedure type</b>			
Pancreatoduodenectomy (Whipple)	6 (15.8)	8 (21.1)	
Pylorus-preserving pancreateoduodenectomy	32 (84.2)	30 (78.9)	
<b>Duration of surgery, mean min (SD)</b>	<b>320.1 (<math>\pm</math> 53.8)</b>	<b>277.7 (<math>\pm</math> 63.8)</b>	<b>.008</b>
Estimated blood loss, median mL (IQR)	100 (100–300)	250 (100–600)	.117
Conversion to open, N (%)	-	-	
Portal vein resection, N (%)	0 (0)	3 (7.9)	.240
Diameter Wirsung, median (IQR)	3.5 (2.0–6.0)	2.5 (2.0–4.0)	.237
Type of pancreateojejunostomy, N (%)			.002
Duct-to-mucosa	23 (60.5)	35 (92.1)	
Dunking	15 (39.5)	3 (7.9)	
Type of gastrojejunostomy, N (%)			<.001
Handsewn	17 (44.7)	37 (97.4)	
Stapled	21 (55.3)	1 (2.6)	
Drain perdu, N (%)	23 (60.5)	31 (81.6)	.075
Intraoperative transfusion, N (%)	1 (2.6)	-	
Intraoperative complications, N (%)	2 (5.3)	6 (15.8)	.262
Bleeding	2 (5.3)	6 (15.8)	
Chyle leak	-	-	

# Operative time

**Table 2** Operative and postoperative 90-day outcomes

Outcomes	LPD (n = 114)	OPD (n = 110)	Incremental effect	(95% c.i.)	P-value
			Unadjusted OR <sup>c</sup>		
Major complications – n (%)	33 (29)	34 (31)	0.6 (0.3–1.4)	0.6 (0.3–1.4)	0.257
Operative time	420	318	92 (67.1–117.5)	102 (77.1–126.5)	<b>&lt;0.001</b>
Blood loss (ml) <sup>a</sup>	326	585	-114 (-294.5–67.4)	-126 (-308.7–56.7)	0.176
Conversion – n. (%)	20 (18)	NA	NA	NA	NA
Reintervention – n (%)	28 (25)	19 (17)	0.6 (0.3–1.3)	0.6 (0.3–1.3)	0.180
Radiological– n (%)	19 (17)	13 (12)	0.7 (0.3–1.7)	0.6 (0.3–1.6)	0.332
Surgical <sup>a</sup> – n (%)	7/82 (9)	4/81 (5)	0.5 (0.1–2.0)	0.6 (0.1–2.5)	0.445
POPF Grade B/C – n (%)	20 (18)	24 (22)	0.8 (0.3–2.1)	0.8 (0.3–1.9)	0.599
DGE Grade B/C <sup>b</sup> – n (%)	20/82 (24)	16/78 (21)	0.5 (0.0–1.2)	0.6 (0.2–1.4)	0.220
PPH Grade B/C – n (%)	10 (9)	15 (14)	1.5 (0.4–5.1)	1.4 (0.4–4.9)	0.564
Bile leakage Grade B/C <sup>b</sup> – n (%)	7/82 (9)	7/78 (9)	0.8 (0.2–2.9)	0.8 (0.2–2.8)	0.720
Length of stay	13	20	-6.4 (-10.6–2.2)	-7 (11.3–2.6)	<b>0.002</b>
Total length of stay <sup>b</sup>	17	26	-6.4 (-10.6–2.2)	-9.5 (-16.2–2.7)	<b>0.006</b>
90 day mortality – n (%)	8 (7)	4 (4)	0.1 (0.02–1.1)	0.2 (0.02–1.3)	0.080

Laparoscopic versus open pancreatectoduodenectomy for pancreatic or periampullary tumours (LEOPARD-2):  
a multicentre, patient-blinded, randomised controlled  
phase 2/3 trial



	Laparoscopic group (n=50)	Open group (n=49)	Risk ratio (95% CI)	p value
Pain control				
Epidural	24 (48%)	24 (49%)	..	..
Wound catheters and intravenous analgesia	23 (46%)	24 (49%)	..	..
Intravenous analgesia only	3 (6%)	1 (2%)	..	..
Intraoperative metastases*	3 (6%)	2 (4%)	1.47 (0.26–8.42)	>0.99†
Intraoperative locally advanced disease*	1 (2%)	0 (0%)	..	>0.99†
Conversion from laparoscopy to open	10 (20%)‡	..	..	..
Soft/normal pancreatic texture§	33 (66%)	19 (39%)	1.70 (1.15–2.50)	0.004
Pancreatic duct diameter (mm)	3 (3–4)	3 (2–5)		0.66
Somatostatin analogue administration	35 (70%)	28 (57%)	1.23 (0.91–1.66)	0.18
Operative time (min)	410 (252–481)	274 (212–317)	..	<0.0001
Estimated operative blood loss (mL)	300 (200–438)	450 (300–1000)	..	0.13

## **Operative time**

**Laparoscopic pancreatectoduodenectomy**

**Not associated with different postoperative care**



## Morbidity and survival after laparoscopic versus open pancreateoduodenectomy: propensity score matched comparison

Characteristic	PS-matched cohort		
	LPD (n=38)	OPD (n=38)	p value
ICU stay, median days (IQR)	2.0 (1.0–3.0)	2.0 (1.0–4.0)	.979
Length of hospital stay, median days (IQR)	13.5 (10.6–20.3)	17.0 (13.8–25.3)	.039
Total complication rate, N (%)	28 (73.7)	33 (86.8)	.249
Major complication rate (CD grade ≥ III), N (%)	10 (26.3)	4 (10.5)	.137
Postoperative transfusion need, N (%)	10 (26.3)	5 (13.2)	.259
Duration drain in situ, median days (IQR)	9.0 (6.0–17.3)	10.0 (6.0–14.0)	.965
Clinically relevant POPF, N (%)*	5 (13.2)	3 (7.9)	.711
Delayed gastric emptying, N (%), ISGPS classification [16]	11 (28.9)	8 (20.5)	.498
Post-pancreatectomy haemorrhage, N (%), ISGPS classification [18]	6 (15.8)	1 (2.6)	.140
Grade A	1 (2.6)	-	
Grade B	2 (5.3)	1 (2.6)	
Grade C	3 (7.9)	-	
Biliary leak, N (%)	4 (10.5)	1 (2.6)	.358
Embolization for bleeding, N (%)	2 (5.3)	-	
Revision laparotomy, N (%)	4 (10.5)	1 (2.6)	.358
Readmission rate < 30 days, N (%)	8 (21.1)	3 (7.9)	.193
90-day mortality rate, N (%)	2 (5.3)	-	.493

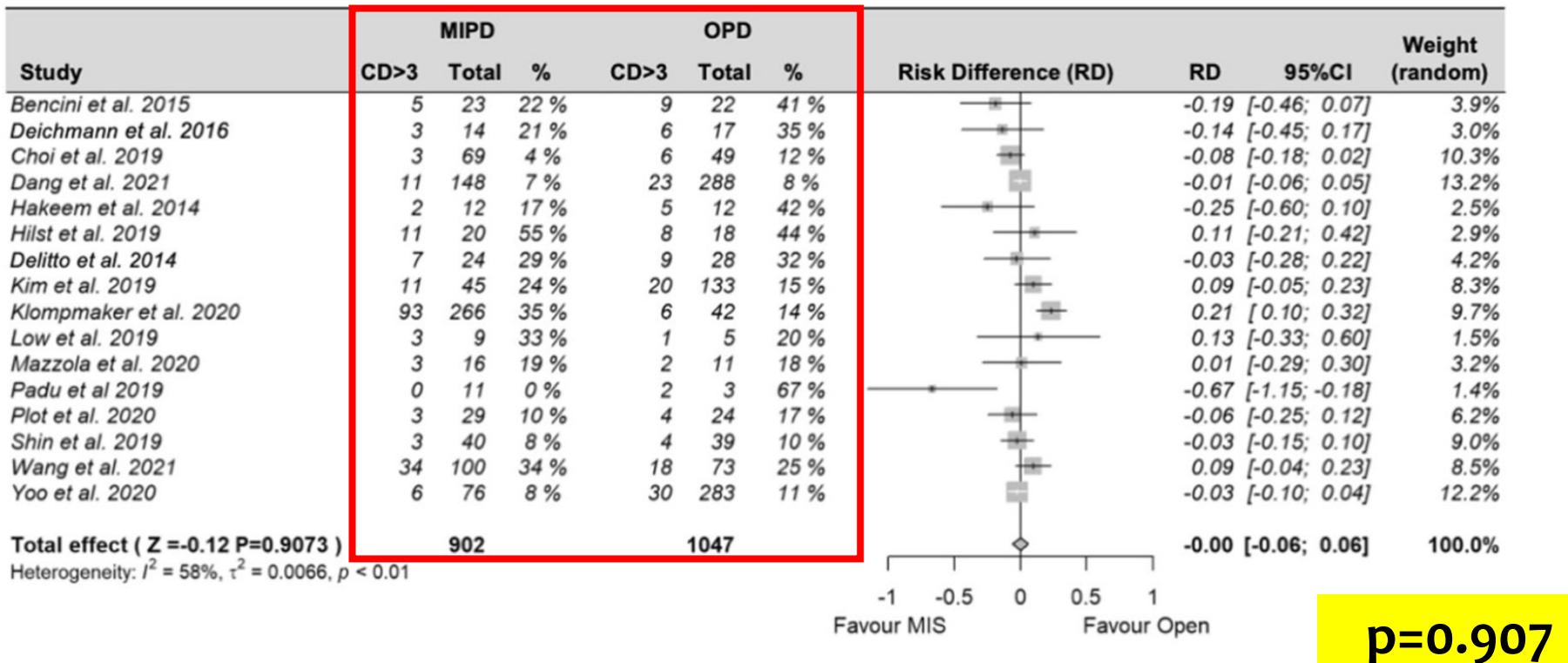
# COMPLICATIONS

## Postoperative care

	Laparoscopic	Open	p
<b>Total complication rate</b>	73.7%	86.8%	0.249
<b>Clavien-Dindo ≥ III</b>	26.3%	10.5%	0.137
<b>Haemorrhage</b>	15.8%	2.6%	0.140
<b>DGE</b>	28.9%	20.5%	0.498
<b>CR-POPF</b>	13,2%	7.9%	0.711

# Morbidity

## Clavien-Dindo > 3



**Fig. 3** Meta-analysis of major morbidity (Clavien-Dindo 3a – 5) between MIPD and OPD. Abbreviations: CD > 3, Clavien-Dindo 3a-5; MD, mean difference; SD, standard deviation; 95% CI, confidence interval

# Conclusion

- No significant differences in postoperative care
  - CR-POPF
  - DGE
  - PPH
- LPD increased operative time
- OPD longer hospital stay

## ERAS protocols:

Mobilization out of bed

Active pain control

Postoperative fluid management

Anti-thrombotic prophylaxis

Physiotherapy on POD 1

Postoperative prophylaxis, piperacillin/tazobactam sodium

## Patient selection

- High BMI
- Elderly

Laparoscopic pancreateoduodenectomy

- Vascular involvement
- Chemoradiotherapy

Open pancreateoduodenectomy



Thanks !