Laparoscopic hybrid pancreaticoduodenectomy: Initial single center experience

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Backgrounds/Aims: Pancreaticoduodenectomy (PD) is the gold standard for the treatment of periampullary tumors. Many specialized centers have adopted the totally laparoscopic or hybrid laparoscopic PD (LPD). However, this procedure has not yet been standardized and serious debate is taking place towards its safety and feasibility. Herein, we report our recent experience whit hybrid-LPD. **Methods:** During 2019 in our department 56 PD were performed and 21 (37.5%) underwent hybrid-LPD. We have retrospectively reviewed the short-term outcomes of these patients. **Results:** Main indication was pancreatic adenocarcinoma (71,4%). The median operative time and intraoperative blood loss were respectively 425 min (range, 226 to 576) and 317 ml (range 60 to 800 ml). Conversion to an open procedure was required in 4 patients (19%): 2 with suspected vein involvement, 1 for mesenteric panniculitis and 1 for biliary injury. The post-operative complication rate was 42.8% (9/21). Regarding post-operative pancreatic fistula, three patients (14.2%) had grade B and 1 grade C (4.7%). Median length of hospital stay was 14 days (range 9-23) and 90- days mortality was 4.7%. The mean number of harvested lymph nodes was 17.7 (range 12 to 26). The rate of margins R0 was 80%; R1 $>0<1$ mm was 10.5% and R1 0 mm was 9.5%. **Conclusions:** Hydrid−LPD is safe and feasible. Careful patient selection and increasing experience can reduce the risk of post-operative complications. **(Ann Hepatobiliary Pancreat Surg 2021;25:102-111)**

Key Words: Laparoscopic pancreaticoduodenectomy; Artery first approach; Whipple procedure; Pancreatic surgery; LN 16 dissection; Pancreatic cancer

INTRODUCTION

Pancreatic surgery is considered to be of one of the most complicated procedures in digestive surgery. Despite being technically challenging, it did not resist to the development of mini-invasive approach. Laparoscopic left pancreatectomy is now validated and considered by several authors as the gold standard even for pancreatic ductal adenocarcinoma (PDAC).[1]

Pancreaticoduodenectomy (PD) is a complex surgical procedure with high morbidity and mortality.[2] Larger indications have been endorsed since the development of neoadjuvant therapy and induction chemo/radiation therapy for borderline and locally advanced tumors leading to a more complex procedures with challenging dissection techniques and higher rates of vascular resection.[3,4]

The first laparoscopic pancreaticoduodenectomy (LPD) was described in 1994.[5] Since then and with the advance-

ment in technology many specialized centers have adopted the LPD. Several studies have been published including three randomized controlled trials (RCT) with inconclusive results regarding the superiority of LPD over OPD.[6-8]

In the present study, we report our initial experience over the last year with LPD for the resection phase and mini-incision for the reconstructive phase (hybrid-LPD).

MATERIALS AND METHODS

Case series

Patients

In 2019, 56 PD were performed at University Hospital Robert Debre of Reims (France) among them 21 were hybrid−LPD.

Surgical indications were discussed during our weekly institutional multidisciplinary oncological meeting (MOM). Demographic characteristics, intraoperative variables and postoperative variables were prospectively collected.

We stratified margins into R0 or absence of tumoral contact and R1 with invasion within 1 mm of the margin (R1 less than 1 mm), and R1 with direct invasion of the resection margin (R1 direct).[3]

Surgical procedure

Resection stage (laparoscopic phase)

Patient under general anesthesia is placed in the supine position with open legs and slightly inclined on the left side. Open laparoscopy is performed in the umbilical region. Three trocars, two 10 mm and one 5 mm, are positioned in the right hypochondrium; a 10 mm trocar is positioned to the left of the optical trocar and a 5 mm trocar

is positioned in the xiphoid region, for liver retraction (Fig. 1). Exploration of peritoneal cavity is performed to rule out peritoneal carcinomatosis or liver metastases. After mobilization of the hepatic flexure, Kocher maneuver is performed and routine dissection of aortocaval lymph nodes (LN 16) is done.

"Artery first approach" starts at the origin of superior mesenteric artery (SMA) from the aorta with incision of the perivascular connective tissues and is continued in a caudal direction along the vascular axis for 4-5 cm. During this dissection we can identify, if present, the origin of the replaced right hepatic artery (rRHA). In case of suspicion of SMA involvement, a fresh-frozen section examination of the arterial sheath is performed. If the examination is negative the LPD continue with the opening of gastro-colic ligament, section of Henle's trunk and completely dissection of right margin of SMA in mesopancreas (operator returns between the patient's legs). The division of the gastro-colic ligament is performed at the level of the superior border of the colon. At this level, the stomach is firmly retracted toward the right and medial side and the pancreatic neck is separated from the venous axis. Superior mesenteric vein (SMV) is identified by pulling up and following the stump of Henle's trunk at the inferior border of the pancreas. At this step, a grasper is used to retract the SMV to the right exposing thus the right margin of the SMA as well as the left margin of the mesopancres. Proceeding in a caudal-cranial fashion, the dissection of anterior and posterior dissection of SMA are joined.

Transection of distal stomach and dissection of lymph node N8a allow the identification of common hepatic artery (CHA). This latter is dissected until the origin of gas-
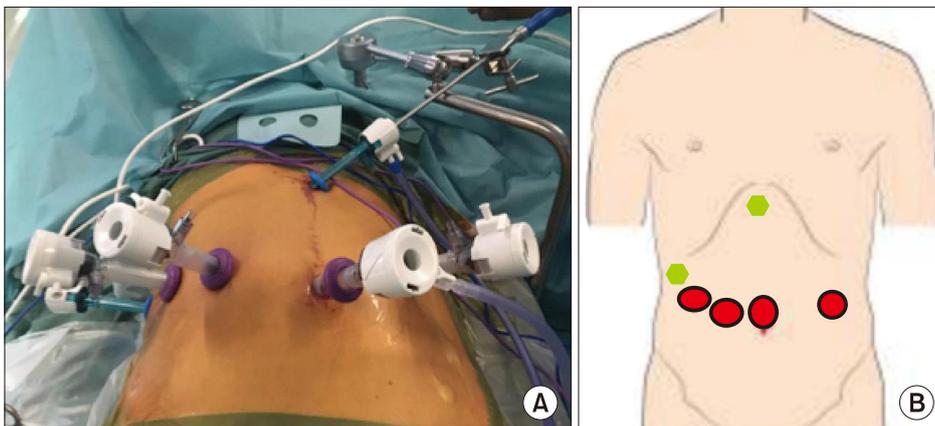
Fig. 1. (A) Trocars' position. (B) Red trocars 10 mm, green trocars 5 mm.

troduodenal artery (GDA). Special care is undertaken during control of GDA to preserve a small stump. Prior to ligation of GDA, clamping test is always performed with intraoperative ultrasound to check intrahepatic arterial flow. The procedure continue with a standard lymphadenectomy.

Cholecystectomy and section of common bile duct (CBD) with frozen section are routinely realized. Lymphadenectomy along the portal vein will expose the upper part of the retroportal lamina.

The pancreatic parenchyma is transected by Ultracision®. At this step, precise care is undertaken to identify the pacreatic duct. Scissors are used to avoid thermal damage. Before dissection of the uncinate process, the jejunum is sectioned using an Endo GIA stapler and its mesenteric vessels sectioned using a LigaSure®. The uncinate process is resected along the right margin of SMA and the dissection of the retroprtal lamina is performed in a cranial fashion.

Reconstruction stage (mini-laparotomy phase)

A 10-11 cm incision midline incision is used to remove the specimen and to perform the anastomosis (Fig. 2). Duct-to-duct wirsung-jejunal anastomosis is performed by four 5/0 prolene on posterior and anterior layer or modified Blumgart pancreatico-jejunal anastomosis with trans anastomotic stent by 3/0 prolene single stich . Hepatico-jejunal end-to-side with 5/0 or 6/0 PDS single stich and gastro-jejunal end-to-side anastomosis with 4/0 PDS running suture. A tubular drain is placed behind the pancreatic ana-

Fig. 2. Mini-laparotomy incision detail, between the xyphoid process and umbilical site.

stomosis and was extracted through the 5 mm right orifice. We start the octreotide therapy after the section of pancreas parenchyma and an antibiotic prophylaxis at the pre-operative induction.

Follow up

According to international and institutional guidelines, all patients are followed after surgery with biological markers (CA 19.9) and radiological examination (CT scan) every 3 months for the first 2 years and every 6 months thereafter.

Statistical analysis

Patients were identified in a prospectively maintained database and analyzed retrospectively. Categorical variables were reported as numbers and percentages, continuous variables were reported as medianes and ranges. All statistical analyses were performed using SPSS 21.

RESULTS

The data of the operated patients are summarized in Table 1. During the study period, twenty-one patients underwent hydrid−LPD at University Hospital Robert Debre of Reims.

Mean age of the patients was 67.9 years old (range, 43 to 84 y), and mean body mass index was 24.5 kg/m^2 (range, 20.7 to 32 kg/m^2). Most of the patients (15/21) had pancreatic adenocarcinoma. The tumor size was 21 mm (15-55), 14.2% had a vascular invasion and 73.3% received neo-adjuvant therapy.

The median operative time and intraoperative blood loss were respectively 425 min (range, 226 to 576) and 317 ml (range 60 to 800 ml) respectively. Three patients required intraoperative transfusions (14.2%). In 2 cases a preservation of replaced RHA was achieved. Conversion to an open procedure was required in 4 (19%) patients: 2 with suspected vein involvement; 1 for mesenteric panniculitis which did not allow the progression of the intervention and 1 for biliary injury in anatomical variation with insertion of the left biliary brunch below the origin of the cystic duct just above the margin of the pancreas.

The complication rate was 42.8% (9/21) among them 3 (14.2%) had severe complications ($\geq$ grade 3 of Clavien-Dindo Classification). Three patients (14.3%) had grade B and 1 grade C (4.7%) post-operative pancreas fistula (POPF) as classified by the International Study Group on

Table 1. Baselines characteristics of twenty-one patients underwent Hybrid-DPC

	n or mean	% or range
Men	11	53.3%
Age (years)	67.9	43-84
BMI (kg/m^2)	24.5	20.7-32
ASA		
II	7	33
III	14	67
Tumor Size (mm)	21	15-55
Vascular invasion	3	14.2
Neoadjuvant therapy	11	73.3
Operative time (minutes)	425	226-576
Conversion to open surgery	4	19
Estimated blood loss (ml)	317	60-800
Intraoperative transfusion	3	14.2
Total post-operative complications	9	42.8
Major post-operative complication*	3	14.2
Pancreatic fistula	4	19
Grade B	3	14.3
Grade C	1	4.7
Post-pancreatectomy hemorrhage	1	4.7
Delayed gastric emptying	4	19
Bile leak	2	9.5
Pulmonary embolism	2	9.5
Reoperation	1	4.7
Length of hospital stay (days)	14	9-23
90-days readmission	4	19
90-days mortality	1	4.7
Histologic subtype		
Adenocarcinoma	15	71.4
AAC	2	9.5
IPMN	2	9.5
CA	1	4.8
DA	1	4.8
Number of harvested LN	17.7	12-26
Invaded LN	1.7	1-7
R0 rate	17	80
R1 >0<1 mm	2	9.5
R1 0 mm	2	9.5
Postoperative chemotherapy	15	71.4
Follow-up (months)	7.5	3-12

*≥grade 3 of Clavien-Dindo Classification
LN, limph-nodes; AAC, ampullary adenocarcinoma; CA, cholongiocarcinoma; DA, duodenaladenocarcinoma; IPMN, intraductal papillary mucinous neoplasm

Pancreatic Fistula criteria.[9] The same patient with grade C POPF had a postoperative bleeding on Bühler artery. Initially treated with radiological embolization, he developed a thrombosis of the celiac trunk with hepatic and gastric ischemia. The patient underwent a spleno-aortic by-pass but he died in the post-operative period. The other

major complications were described in Table 1. Four patients (19%) were readmitted in the first 90 days. The median length of hospital stay was 14 days (range 9-23) and 90-days mortality was 4.7%. Regarding the oncological status the mean of tumor dimension was 2.12 cm (range 1.5 to 5.5 cm); the mean number of harvested LN were 17.7 (range 12 to 26) with mean invaded LN 1.7 (range 1 to 7) and the rate of margins R0 were 80%; R1 >0<1 mm 10.5% and R1 0 mm 9.5%.

The median follow-up was 7.5 months (3-12). All patients are alive at the last follow-up. Two patients 2/20 (10%) developed respectively local recurrences and liver metastases. Thus, the overall recurrence rate per patient was 36.5% (7/19).

DISCUSSION

The LPD was described for the first time by Gagner and Pomp in 1994[5]: after this case report, multiple series showed the safety and feasibility of the laparoscopic approach[6,7,10-21] even with vascular resection.[22,23] These studies showed comparable outcomes between mini-invasive approach and open approach with reduced intraoperative blood loss and hospital stay.

For the first time, Dokmak et al.[24] showed more complication rate with laparoscopic approach in non-selected tumors, a significant increase of POPF grade C and post-operative bleeding. For the author a selection of the patients is mandatory, especially for obese patients and for the patients with a high risk of pancreatic fistula.[24]

To date, three randomized control studies (RCTs)[6-8] have been published in the literature, one of which LEOPARD-2 trial showed a statistically significant increase of complication-related death in the laparoscopic approach: the study was prematurely stopped and the authors suggest to consider carefully the indication to LPD.[25] In this study, the authors described a fully LPD with modified Blumgart pancreaticojejunostomy using 3/0 v-loc barbed sutures.[25]

We started our LPD experience without restrictive selection criteria. As previously decribed, conversion was required in obese patients and for borderline tumors. Analyzing our series, one biliary injury (lateral transection of right posterior sectoral duct) occurred and conversion was immediately performed. Imaging showed a low insertion of this duct into the CBD. Several approaches and

techniques have been reported in the literature.

The first question might be performing a total LPD[8,12-14,22,23] or a hybrid-LPD.[11,16,17,20,21] It is true that the LPD is even more challenging especially during the reconstructive phase in particular with regard to pancreatic anastomosis. The absence of severe postoperative adhesion might enhance the risk of postoperative severe complications and in particular of POPF and hemorrhage. This might explain the higher rates of severe complications and mortality of the LEPOARD2 RCT.

In view of these considerations, we decided to perform a hybrid approach.

The second point might be the technical steps to follow as several authors reported slight technical modifications in comparison to the open technique. Indeed, Chapman et al.[26] started with pancreas parenchyma transection after GDA ligation, then they make the gastric resection and finally they make a Kocher maneuver. After the section of the jejunum and complete mobilization of the specimen, they explore the superior mesenteric artery.[26] This technique has the advantage of its reproducibility but raises the question of the surgical attitude towards the discovery of a non resectable tumor infiltrating SMA with the GDA, stomach and jejunum already controlled.

Routine sampling of aortocaval node (LN 16) is widely spread in the open approach as LN 16 metastases are equivalent to distance metastasis (M1) considered by most of HPB teams as a major prognostic factor contraindicating PD[27]. Somehow, few retrospective studies reported usefulness of PD event if LN16 are invaded in patients with CA19-9 level <350 U/ml.[28]

Although widely used in open approach, several authors did not describe in their laparoscopic technique a routine sampling of the aortocaval lymph nodes.[29] After rouling out metastases, dissection of paraaortic LN was performed with frozen section analysis. In literature, concerning LPD, various options are reported ranging from no routine sampling with on demand dissection in case of pre[30] and/or intraoperative[9,20,31] suspected LN 16 invasion.

In our experience, we try to emulate the open technique during the laparoscopic approach and we realize always the LN 16 picking: in all 21 cases treated, none of the patients presented a LN 16 metastatic invasion on fresh-frozen section.

Recently the concept of "artery fist" exploration, before the resection stage, has become common. A recent recommendations of HPB and transplant French surgical association (ACHBT) recommend the first approach of mesenteric vessels.[32] This technique allows to find a possible tumor infiltration of SMA origin, which represents a contra-indication for PD and thus to increase R0 resection rate. Several approaches to the SMA have been described and the results of a recent meta-analysis indicated that the "artery first" approach (AFA) has a significant decrease in post-operative complications, a better operative outcome, a high rate of R0, a lower local recurrence rate and an increases survival.[33]

Reviewing the literature (Table 2),[6-8,11,15,18,20,21,23,24,26,34-47] there are only 6 series that describe laparoscopic approach of SMA.[22,31,33,48-50]

Many of the series published to date report R0 rates approaching 85-100% but no definition of R0 was reported. Surgical margin has been reported to be an independent prognostic factor. The revised R0 definition (R0=1 mm margin) has been endorsed by an International consensus meeting;[51] Strobel et al.[52] has demonstrated that it is necessary to maintain at least 1 mm to have a better survival at 5 years. In our experience, we found an 80% R0 higher than what we normally report in open surgery. This might be explained by magnification of traditional vision of the mesopancreas (and uncinate process) in the laparoscopic approach. Honda et al.[53] described a technique for which the right margin artery of the uncinate process is visualized in a caudo-cranial sense putting the camera in the 10 mm trocart to the right of the optical trocar (umbilical site). However, the key-factor remains that the execution of the Kocher maneuver as a subsequent time will put the operator at risk of finding "nasty surprises" related to the presence of tumor infiltration. It could be suggested that even if not performing an "artery first" as a first step, the complete mobilization of the duodenum allows us to visualize possible distal metastases.

With laparoscopic approach, authors did not change their technique of anastomosis. Reconstruction was reported either with PJ or PG.[11,16,20,21] Only Deichmann report is POPF grade B/C rate of 15%, similar to our result. Probably, the increase of POPF in LPD, more than in robot-assisted LPD or hybrid-LPD, is linked to perform a single-row pancreatojejunal anastomosis: this technique increase de POPF risk of 4.6 times.[54] In a recent pan-euro-

Table 2. Review of the literature

Author / Study period / Study type	Tot pts (disease) Open L	OR time mean	Blood loss ml	CD>3	Reoperation <30 d	POPF	PPH	DGE	Lymph nodes number	R0	Length of stay Mean days	Mortality <30 d
2009 - Cho et al.[20] (2007-2008) Prospective	T 30 (M): O 15; LA 15 (Mes)	NS; L 338; O 287	NS; L 445; O 552	NS		NS; L 13%; O 13%		NS; L 7%; O 0%	NS; L 18; O 20	NS	NS; L 16.4; O 15.6	NS
2011 - Zureikat et al.[34] (2006-2010) Retrospective	T 28 (M): O 14; TL 14 (Mes)	Open; L 456; O 372	NS; L 300; O 400	NS	NS; L 7%; O 7%	NS; L 36%; O 42.8%		NS	NS; L 18; O 19	NS; L 100%; O 91.7%	NS; L 8; O 8.5	NS; L 7%; O 0%
2012 - Asbun and Stauffer[35] (2005-2011) Retrospective	T 268 (M): O 215; TL 53 (Std)	Open; O 401; L 541	L; O 1,032; L 195	NS; O 24.9%; L 24.5%	NS; O 7%; L 3.8%	NS; O 17.3%; L 16.7%	NS; O 5.6%; L 9.4%	NS; O 15.3%; L 11.3%	L; O 16; L 23	O 83%; L 94.9%	L; O 12; L 8	O 8.8%; L 5.7%
2013 - Mesleh et al.[36] (2009-2012) Cost analysis	T 123 (NM): O 75; TL 48 (NM)	Open; O 355; L 551	NS	NS; O 31%; L 31%	NS; O 2%; L 4%	NS; O 6%; L 9%	NS	NS; O 8%; L 13%	NS	NS	O 8; L 7	NS
2014 - Hakeem et al.[37] (2005-2009) Retrospective	T 24 (Ca): O 12; TL 12 (Std)		NS	NS; L 16.7%; O 50%		NS; L 16.7%; O 8.3%	NS		NS; L 20; O 18	NS; L 75%; O 66.7%	NS; L 14.9; O 14.9	NS; L 0%; O 0%
2014 - Langan et al.[15] (2010-2013) Retrospective	T 53 (M): O 25; LA 28 (Std)	NS; O 347; L 355	NS; O 454; L 336		NS; O 7%; LA 10%	NS; O 11%; LA 7%	NS; O 3%; LA 5%	NS; O 11%; LA 5%	NS; O 19; LA 15	NS	L; O 9.4; L 7.1	NS; O 0%; LA 1%
2014 - Wang et al.[21] (2009-2013) Retrospective	T 33 (M): O 20; LA 13 (Std)	Open; LA 594; O 553 (303-892)	L; LA 450; O 1000	NS; LA 2%; O 8%		NS; LA 4%; O 6%	NS	NS	NS; LA 22; O 20	NS; LA 70%; O 53%	L; LA 8; O 12	NS; LA 8%; O 20%
2014 - Wellner et al.[38] (2010-2013) Retrospective	T 80 (NM): O 40; LA 40 (Std)	NS; O 410; LA 343	Lap	NS; O 7%; LA 10%	NS; O 7%; LA 10%	NS; O 11%; LA 7%	NS; O 3%; LA 5%	NS; O 11%; LA 5%	NS; O 19; LA 15	NS	O 16; LA 14	NS; O 0%; LA 1%
2015 - Croome et al.[23] (2008-2013) Retrospective	T 322 (PDAC): O 214; TL 108 (Mes)	NS; TL 379.4; O 387.6	L; TL 492; O 866	NS; TL 5.6%; O 13.6%	NS	NS; TL 11%; O 12%	NS; TL 7%; O 6%	NS; TL 9%; O 18%	NS; TL 21; O 20	NS; TL 77.8%; O 76.6%	L; TL 6; O 9	NS; TL 1%; O 2%
2015 - Adam et al.[39] (2010-2011) Retrospective	T 7061 (Ca): O 6078; TL, TR 983 (NM)					Open	Open				NS	Open RR 1.87
2015 - Dokmak et al.[24] (2011-2014) Prospective	T 92 (M): O 46; TL LA 46 (Std)	Open; L 342; O 264	NS; L 368; O 293	NS; L 28%; O 20%	NS; L 24%; O 11%	Open; L 24%; O 6%	Open; L 24%; O 7%	NS; L 17%; O 15%			NS; L 25; O 23	NS; L 2%; O 0%
2015 - Liang and Jayaraman[40] (2011-2013) Retrospective	T 44 (M): O 29; TL,LA 15 (Std)	NS; L 342; O 358	NS	NS; L 33%; O 17%		NS; L 20%; O 14%			NS; L 9; O 14	NS; L 100%; O 90%	NS; L 8; O 9	NS
2015 - Sharpe et al.[18] (2010-2011) Retrospective	T 4421 (PDAC): O 4037; TL 384 (NM)								L; O 15; L 17	L; O 74%; L 80%	L; O 12; L 10	NS; O 3.7%; L 5.2%

Table 2. Continued

Author / Study period / Study type	Tot pts (disease) Open / L	OR time mean	Blood loss ml	CD>3	Reoperation <30 d	POPF	PPH	DGE	Lymph nodes number	R0	Length of stay Mean days	Mortality <30 d
2015 - Song et al.[41] (2007-2012) Case control	T 2192 (Ca): O 1524, TL 137 (Std)	**Open** L 480.4, O 351.9	NS L 592, O 555	NS L 8.2%, O 7.1%	NS	NS L 6.3%, O 7.5%	NS	NS L 3.2%, O 7.5%	NS L 15, O 16.2	NS L 72.7%, O 81%	**L** L 14.1, O 20	NS
2015 - Tan et al.[42] (2009-2014) Retrospective	T 60 (NM): O 30, TL 30 (Std)	**Open** TL 513, O 371.67	NS	NS	NS	NS TL 10%, O 6%	NS TL 1%, O 1%		NS TL 8, O 9	NS	**L** TL 10, O 11.8	NS TL 0%, O 1%
2016 - Delitto et al.[43] (2010-2014) Cohort	T 102 (Ca): O 50, TL 52 (NM)	NS L 361, O 360	**L** L 260, O 518	NS L 25%, O 32%	NS	**L** L 17%, O 36%	NS L 10%, O 6%	NS	**L** L 23, O 20	**L** L 90.4%, O 74%	**L** L 9., O 11.9	NS L 2%, O 0%
2017 - Stauffer et al.[44] (1995-2014) Retrospective	T 251 (PDAC): O 193, TL 58 (Std)	**Open** O 375, L 518	**L** O 600, L 250	NS O 30.1%, L 22.4%	NS O 6.2%, L 1.7%	NS O 12.3%, L 11.8%	NS O 4.1%, L 6.9%	NS O 14.5%, L 17.2%	**L** O 17, L 27	NS O 94%, L 97%	**L** O 9, L 6	NS O 5.2%, L 3.4%
2017 - Conrad et al.[45] (2000-2010) Propensity score	T 65 (PDAC): O 25, TL 40 (NM)	NS	NS	NS L 70%, O 68%	NS	NS L 30.5%, O 42%	NS	NS	NS L 20, O 17	NS L 84.1%, O 85.8%	NS L 23, O 28	NS
2017 - Palanivelu et al.[6] (2013-2015) RCT	T 64 (Ca): O 32, TL 32 (Std)	**Open** O 320, L 359	**L** O 401, L 250	NS O 10%, L 8%	NS O 1%, L 1%	NS O 6%, L 5%	NS O 4%, L 3%	O 7%, L 5%	NS O 17, L 18	NS O 94%, L 97%	**L** O 13, L 7	NS O 1%, L 1%
2018 - Chapman et al.[26] (2012-2016) Retrospective	T 47 (Amp): O 25, TL 22 (Std)	**Open** TL 314, O 359	**L** TL 300, O 500	NS	NS	NS TL 36.4%, O 28.0%	NS	NS TL 27.3%, O 32.0%	NS TL 19, O 15	NS TL 100%, O 100%	NS TL 11.5, O 9	NS TL 0%, O 0%
2018 - Meng et al.[46] (2010-2015) Retrospective	T 116 (NM): O 58, TL 58 (NM)	**Open** L 475, O 335	NS L 200, O 220	NS	NS L 15.52%, O 15.52%	NS L 55.17%, O 58.62%	NS L 8.62%, O 8.62%	NS L 15.52%, O 15.52%	NS L 16, O 15	NS L 100.0%, O 94.83%	NS L 14, O 13	NS L 1.72%, O 1.72%
2018 - Chen et al.[47] (2013-2017) Retrospective	T 102 (M): O 55, TL 47 (AF)	**Open** L 410, O 245	**L** L 210, O 420	NS L 4.26%, O 5.45%	NS	NS L 12.8%, O 14.5%	NS L 2.13%, O 3.63%	NS L 4.26%, O 3.63%	NS L 20, O 19	NS L 100%, O 100%	**L** L 13, O 18±5.5	NS L 0%, O 0%
2018 - Deichman et al.[11] (2000-2015) Prospective	T 120 (M): O 60, LA 60 (NM)	**L** L 352, O 397	lap	NS	NS L 22%, O 20%	**L** L 15%, O 36%	NS L 8%, O 13%	**L** L 8%, O 20%	NS L 13, O 16	NS	**L** L 14, O 18	NS L 0%, O 3%
2018 - Poves et al.[7] (2013-2017) RCT	T 66 (M): O 32, TL, LA 34 (NM)	**Open**		**L** O 37%, L 0%	NS O 7.3%, L 0%	NS O 21.9%, L 15.4%	NS O 9.8%, L 7.7%	NS O 24.4%, L 7.7%	NS	NS	**L** O 21, L 14	**Lap** O 2.4%, L 0%
2019 - Van Hilst et al.[8] (2016-2017) RCT	T 99 (M): O 49, TL 50 (NM)	**Open** L 410, O 274	NS L 300, O 450	NS L 50%, O 39%	NS L 12%, O 6%	NS L 28%, O 24%	NS L 10%, O 14%	NS L 34%, O 20%	NS L 11, O 11	NS L 82%, O 76%	NS L 11, O 10	**Open** L 10%, O 2%

M, mixed tumors; Ca, cancer; Mes, mesenteric approach; Std, standard approach; T, total number of patients; POPF, postoperative pancreatic fistula; PPH, postpancreatectomy hemorrhage; DGE, delayed gastric emptying; CD>3, clavien-dindo grade >3; PDAC, pancreatic ductal adenocarcinoma; O, open; L, laparoscopic; NM, not mentioned; TL, totally laparoscopic; LA, laparoscopically assisted; NS, not significant

pean validation, the authors explain this increase risk of complication due to the single-row pancreatic anastomosis: for this reason they discouraged the use.[40] In our technique, as mentioned above, we performed a double-row pancreatic anastomosis.

In conclusion, in our initial experience of Hydrid−LPD, we observed the advantage of laparoscopic magnification in the resection phase and the precision of the reconstruction phase through a small incision. As reported in literature, the laparoscopic approach improves exposition and dissection, but at the same time could increase post-operative complication: for this reason we suggest to perform the reconstruction stage via a small incision.

CONFLICT OF INTEREST

The authors have no potential conflicts of interest to disclose.

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Analyzed the data and write the work: ARAS, AM. Designed the work: ARAS, AM, TP. Collected the data: FE, LJR, AT, PZ. Revised and approved the work: ARAS, AM, RR, RM, DS, RK, TP.

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