Laparoscopic assisted pancreaticoduodenectomy vs. totally laparoscopic pancreaticoduodenectomy for malignant tumor: a retrospectively controlled study

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Research article

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Abstract

Background Laparoscopic pancreaticoduodenectomy was now accepted worldwide with potential advantages over open pacreaticoduodenectomy. The defect was time wasting with the prone of increased postoperative complications. To assess the potential superiority and feasibility of laparoscopic assisted pancreaticoduodenectomy (LAPD) comparing to totally laparoscopic pancreaticoduodenectomy (TLPD), we introduce this study.

Methods Retrospectively analyzed the relation data from the patients who had laparoscopic pancreaticodedunostomy due to malignant tumor in The First Affiliated Hospital of Henan University of Science and Technology during January 2015 to July 2019. Complications and operation time were compared. SPSS 16.0 was employed for analysis.

Results Both groups had almost the same baseline characteristics, such as Sex (P=0.880), Age (P=0.861), ASA (P=0.559), BMI (P=0.854), pancreatic duct size (P=0.623), pancreatic texture (P=0.573) and tumor origin (P=0.878). LAPD was association to shorter operation time (231.6±43.7 min VS. 305.4±55.3 min; P=0.047), pancreaticojejunostomy time (13.8±4.2 min VS. 41.6±9.4 min; P=0.007), gastrojejunostomy time (10.9±3.0 min VS. 24.8±6.5 min; P=0.014) and jejunojejunostomy time (7.8±2.4 min VS. 23.4±5.8 min; P=0.005). No statistical difference was observed relation to resection time (P=0.864), cholangiojejunostomy time (P=0.897), blood loss (P=0.723), number of required transfusion (P=0.809), and incision length (P=0.183). Both groups had comparable conversion to open approach (P=0.402). LAPD had comparable complications to TLPD, such as pancreatic leakage (P=0.328), biliary leakage (P=0.673), bleeding (P=0.889), pneumonia (P=0.809) and thrombosis (P=0.443) and incision infection (P=0.889). No statistical difference was observed relation to visual analogue score at 1 day postoperatively (P=0.913) and hospitalization (P=0.137).

Conclusions Laparoscopic assisted pancreaticoduodenectomy with open pancreaticojejunostomy should be a choice for certain surgeons with less operation time.

Background

Laparoscopic surgery is now more and more popular worldwide. Most operations can be completed under laparoscopy with some advantages over laparotomy approach. Laparoscopic radical resection of rectal cancer [1] and laparoscopic distal gastrectomy [2] had been approved by guidelines. Laparoscopic hepatic left lateral lobectomy [3] and laparoscopic distal pancreatectomy [4, 5] were also proved superiority over open approach with less blood loss and more safety. More and more pancreaticoduodenectomy (PD), which is considered as the most complicated operation for general surgeons, is now completed under laparoscopy [6, 7]. Its safety and oncological noninferiority was widely accepted with relative longer learning curve [8] which may hamper it’s popular for the most small center. The difficult was relation to reconstructions under laparoscopy which cost a lot of operation time with high morbidity. Whether there is a laparoscopic approach that greatly lowered the technical threshold to

make it facilitate to all the general surgeons, is still unclear. Some reported hybrid technique with acceptable results [9, 10]. Their reconstruction was completed by laparotomy. This technique need relative longer incision, which may cause server postoperatively pain and offset certain superiority of laparoscopic surgery. Now, we practiced a pattern of laparoscopic assisted pancreaticoduodenectomy (LAPD), which well integrated the advantages of both open pancreaticoduodenectomy (OPD) and totally laparoscopic pancreaticoduodenectomy (TLPD).

Materials And Methods

Patients characteristic

All the patients administrated in The First Affiliated Hospital of Henan University of Science and Technology during January 2015 to July 2019 who had laparoscopic pancreaticoduodenectomy (LPD) for malignant tumor. All the operations were completed by the same team. This was a retrospectively designed trial. This clinical trial was approved by the ethics committee of The First Affiliated Hospital of Henan University of Science and Technology.

All the patients involved had diagnosed pathologically. All patients included were aged 18 to 80 years old; the American society of anesthesiologists (ASA) classification should be at 1 to 3. All the patients had enhanced CT and /or MRI to assess the resectability. Patients with vessel invasion weren't recommended for LPD. Patients with distal metastasis during exploration were excluded. According to the different pattern of surgery, they were divided them into two groups: TLPD group and LAPD group.

Operation procedure

All the operations were performed under general anesthesia. Patients were placed in French position. 5 trocars were employed for the operation. Anticlockwise pattern was adopted for the resection. After exploration of whole abdominal cavity, resection was beginning. Treitz ligament was cut off first to mobilize the beginning of jejunum which facilitated the mobilization of duodenum and uncinate process of pancreas. Second step was creating a tunnel behind the pancreatic neck. Gastrocolic ligament was cut off along the right gastroepiploic artery to access into the lesser sac; then, dissection was performed along the inferior board of pancreatic neck to detect superior mesenteric vein and Helen trunk. Gastroepiploic vessels were cut off near the Helen trunk. Stomach was cut off by an endo linear stapler to expose the pancreatic neck behind. A harmonic scalpel was employed for cutting pancreatic neck. Pancreatic duct was separated for about 2 mm before cutting to facilitate the following anastomosis. Lymph nodes dissection was along the common hepatic artery and proper hepatic artery. Gastroduodenal artery was cut off near to common hepatic artery. Kocherization of duodenum was performed. Mobilization of duodenum and pancreatic uncinate process were performed with local lymph node dissection. The beginning of jejunum was pulled retrocolic root to the right and then cut off. Pancreatic uncinate process was mobilized from superior mesenteric artery with dissection of mesentery of uncinate process of pancreas. Lymphadenectomy was simultaneously along common hepatic artery and portal vein to the level of common hepatic duct. Common hepatic duct was cut off with cholecystectomy. The

difference of the two groups was the pattern of reconstruction. Four anastomoses were routinely performed. Those were pancreaticojejunostomy (PJ), cholangiojejunostomy (CJ), gastrojejunostomy and jejunojejunostommy. All the four anastomosis were completed under laparoscopy for TLPD group. The specimen was taken out through upper abdominal incision. For the LAPD, CJ was performed under laparoscopy; other three anastomoses were completed by gently lengthened upper abdominal incision. PJ was performed as modified duct to mucosa anastomosis with stent implantation in pancreatic duct. Drainages were positioned around PJ and CJ with additional pelvic drainage if necessary after a wholly peritoneal lavage by distilled water.

Perioperative management

Percutaneous transhepatic cholangial drainage (PTCD) was performed when cholangitis existed. Anemia correction should be performed routinely to 90 g/L at least. Serum albumin should be maintained at normal level. Breathing exercises were performed at least 2 days before operation. The pressure of O_2 and CO_2 should be at normal level by arterial blood gas analysis.

Postoperative management was performed according to the principle of Enhanced Recovery after Surgery (ERAS) [11]. Gastric tube was removed after operation when the patient recovered from anesthesia. Abdominal drainage amylase test was routinely performed at 1, 3, 7 day postoperatively with additional test when pancreatic leakage was suspected. Abdominal drainage tubes were removed when the drainage was less than 20 ml/d, which should be retained at least 7 days postoperatively. Abdominal CT scan was routinely performed to ensure no ascites before drainage removal. Discharged criteria were set as recovery to semifluid diet without symptomatic pancreatic leakage or biliary leakage at least 7 days postoperatively.

Definition

Pancreatic leakage was detected following the International Study Group of Pancreatic Fistula (ISGPF) [12]. The severity of pancreatic leakage was classified according to the criteria of ISGPF. Bleeding means hematochezia or haematemesis or blood drainage from abdominal cavity. Mortality was limited to 30 days postoperatively. Total operation time counted from first skin incision to the end of abdominal closure.

Statistical analysis

SPSS 16.0 was employed to analyze the data. The measurement data, including age, BMI, pancreatic duct size, operation time, resection time, pancreaticojejunostomy time, cholangiojejunostomy time, gastrojejunostomy time, jejunojejunostomy time, blood loss, retrieved lymph nodes, incision length, visual analogue score (VAS) and postoperative hospitalization, were compared with t tests. The numerical data, such as sex, ASA classification, pancreas texture, tumor origin, number of required transfusion, conversion to open approach, pancreatic leakage, biliary leakage, bleeding, pneumonia, thrombosis, incision infection, mortality and re-operation, were compared with chi square tests. $P < 0.05$ was considered to be significant.

Results

Finally, 34 in LAPD and 28 in TLPD were included. Both groups had parallel baseline characteristics (table 1), such as sex (P=0.880), age (P=0.861), ASA (P=0.559), BMI (P=0.854), pancreatic duct size (P=0.623), pancreatic texture (P=0.573) and tumor origin (P=0.878).Comparing to TLPD, LAPD had shorter operation time (231.6±43.7 min VS. 305.4±55.3 min; P=0.047). This difference mainly came from the anastomosis. LAPD was relation to shorter pancreaticojejunostomy time (13.8±4.2 min VS. 41.6±9.4 min; P=0.007), gastrojejunostomy time (10.9±3.0 min VS. 24.8±6.5 min; P=0.014) and jejunojejunostomy time (7.8±2.4 min VS. 23.4±5.8 min; P=0.005). The procedure of resection and cholangiojejunostomy were completed under laparoscopy for both groups. Both groups had comparable resection time (148.5±38.6 min VS. 154.3±42.5 min; P=0.864) and Cholangiojejunostomy time (15.7±3.6 min VS. 14.2±4.3 min; P=0.897). The blood loss for both groups was comparable (181.5±42.7 ml VS. 165.2±50.6 ml; P=0.723). 3 in LAPD and 2 in TLPD required transfusion. The difference wasn't significant (P=0.809). The incision length for both groups was parallel (5.9±1.7 cm VS. 7.6±2.0 cm; P=0.183). Retrieved lymph nodes in both groups was comparable (P=0.372). 3 in LAPD and 1 in TLPD converted to open approach due to bleeding, this difference didn't reach significance (P=0.402). The operation outcomes were show in table 2.

Postoperative complications were shown as table 3. Pancreatic leakage was the most serious complication after PD; while, no statistical difference was observed between the two groups (P=0.328). No pancreatic leakage of grade C was observed in each group. 2 in LAPD group and 5 in TLPD group developed grade B pancreatic leakage; while, this difference didn't reach significance (P=0.138). 1 in LAPD and 2 in TLPD had percutaneous drainage; and others were cured conservatively. 5 in LAPD and 4 in TLPD had grade A pancreatic leakage; while, this difference didn't reach significance(P=0.963). All of them were cured conservatively. Both groups had comparable biliary leakage (2/34 VS. 1/28; P=0.673). None of them needed special intervention. 1 patient in LAPD developed abdominal bleeding, who was cured by pharmacological treatment and blood transfusion without re-operation. 1 patient in TLPD had hemotochezia who was cured by pharmacological treatment without blood transfusion. No statistical difference was observed (1/34 VS. 1/28; P=0.889). 3 in LAPD and 2 in TLPD had pneumonia, all of whom were cured conservatively. This difference didn't reach significance (3/34 VS. 2/28; P=0.809). 1 in LAPD and 2 in TLPD developed venous thrombosis of lower extremity, all of whom were cured conservatively. This difference didn't reach significance (1/34 VS. 2/28; P=0.443). Each group had 1 incision infection, while, this difference didn't reach significance (1/34 VS. 1/28; P=0.889). Both groups had no mortality. No re-operation was needed for each group. VAS at first day postoperatively was comparable (5.2±1.9 VS. 4.8±2.0; P=0.913). LAPD had relatively shorter postoperative hospitalization (11.5±3.1 d VS. 14.1±5.6 d), but, that didn't reach significance (P=0.137).

Discussion

Minimal invasion era had been arrived along with the completion of laparoscopic pancreaticoduodenectomy (LPD) which was considered as the most complicated surgery for the general surgeons. As it was shown before, its safety and oncological noninferiority was approved by most large

center [13–15]. The defect was also the same. Laparoscopic approach cost longer operation time [14, 16] and even longer learning curve [17]. As it was reported, surgeons who want to facilitated to this operation need more than 50 LPD [17] which was more than the total operations per year in most small center. Robotic pancreaticoduodenectomy was convenient for the surgeons ergonomically; while, its learning curve was longer either and its cost was even higher which prevent its popular in china. Laparoscopic assisted surgery which was introduced as a transition approach was extensively used. LPD indeed had three approaches. Those were laparoscopic assisted pancreaticoduodenectomy (LAPD), totally laparoscopic pancreaticoduodenectomy (TLPD) and robotic pancreaticoduodenectomy (RPD). LAPD had the same procedure of resection as that of TLPD. The difference was relation to the reconstruction. Partial anastomoses were completed laparoscopically for LAPD; while, TLPD completed them all laparoscopically. As the most problematic procedure of LPD, anastomosis cost a lot of operation time and induced potential higher complication. That was the main reasons of its longer learning curve of this approach. When took out the specimen from abdominal cavity, a mini laparotomy was still needed. For the most time, a median incision of upper abdominal was made. Theoretically, this incision could be used for partial anastomoses by open approach. Some LPD in our center completed as LAPD. The reconstructions were performed through this incision except cholangiojejunostomy.

Our primary experience showed that LAPD was comparable with TLPD considered to oncological results. As the resection was the same as TLPD and the lymphadenectomy was performed according to the guidelines, the lymph nodes harvested was the same. LAPD showed a trend of decreased pancreatic leakage (7/34 VS. 9/28), though, significance didn’t reach. What should be emphasized was the operation time. LAPD was observed a significant shorter operation time regarding to pancreaticojejunosotmy, gastrojejunostomy and jejunojejunostomy, which resulted in shorter total operation time. As operation time was reported associated to the postoperative complications [18], this might potentially contribute to the trend of declined morbidity. The cost of LAPD was potential longer incision, though it was not significant. This prolonged incision didn’t increase postoperative pain or delayed hospitalization. As the assisted incision was located in upper abdominal, it wasn’t parallel to the cosmetology.

Every approach had its superiority and inferiority, as it was LPD or OPD. None could replace another. LAPD was well balanced both approach, especially for the surgeons from small center who was not well trained for TLPD. As a retrospectively designed trial with small volume, there must be some bias.

Conclusions

LAPD was just the same as TLPD relation to oncological index and safety index with shorter operation time. LAPD should be a choice for certain surgeons. TLPD was suitable for the patients who had strong desire of cosmetology.

Abbreviations

PD: pancreaticoduodenectomy ; LAPD: laparoscopic assisted pancreaticoduodenectomy; TLPD: totally laparoscopic pancreaticoduodenectomy; OPD: open pancreaticoduodenectomy; LPD: laparoscopic pancreaticoduodenectomy; ASA: American society of anesthesiologists; PJ: pancreaticojejunostomy; CJ: cholangiojejunostomy; PTCD: Percutaneous transhepatic cholangial drainage; ERAS: Enhanced Recovery after Surgery; ISGPF: International Study Group of Pancreatic Fistula; VAS: visual analogue score; RPD: robotic pancreaticoduodenectomy

Declarations

Ethics approval and consent to participate

This clinical trial was approved by the ethics committee of The First Affiliated Hospital of Henan University of Science and Technology. All the patients included had written consent to participate.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analysed during this study are included in this published article.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Yao GL and Zhai JM together extracted and analyzed the data. Yao GL was the major contributor in writing this manuscript. Yao GL and Zhai JM read and approved the final manuscript.

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Tables

Table 1, Characteristics of included patients

	LAPD (34)	TLPD (28)	P
Sex (M/F)	20/14	17/11	0.880
Age	56.3±11.7	58.1±12.4	0.861
ASA			0.559
	5	4	
	21	14	
	8	10	
BMI (Kg/m^2)	23.1±6.8	24.9±7.5	0.854
Pancreatic duct size (mm)	3.0±1.8	3.6±1.5	0.623
Pancreatic texture			0.573
Firm	22	20	
soft	12	8	
Tumor origin			0.878
Biliary duct	13	10	
Pancreas	8	9	
Duodenum	5	4	
Ampulla	8	5	

ASA: American society of Anesthesiologists classification

Table 2, Operative outcomes

	LAPD (34)	TLPD (28)	P
Operation time (min)	231.6±43.7	305.4±55.3	0.047
Resection time (min)	148.5±38.6	154.3±42.5	0.864
Pancreaticojejunostomy time (min)	13.8±4.2	41.6±9.4	0.007
Cholangiojejunostomy time (min)	15.7±3.6	14.2±4.3	0.897
Gastrojejunostomy time (min)	10.9±3.0	24.8±6.5	0.014
Jejunojejunostomy time (min)	7.8±2.4	23.4±5.8	0.005
Blood loss (ml)	181.5±42.7	165.2±50.6	0.723
Required transfusion	3	2	0.809
Retrieved lymph nodes	22.4±4.7	24.8±5.3	0.372
Incision length (cm)	5.9±1.7	7.6±2.0	0.183
Conversion to open approach	3	1	0.402

Table 3, postoperative outcomes

		LAPD (34)	TLPD (28)	P
Pancreatic leakage				0.328
	Grade A	5	4	0.963
	Grade B	2	5	0.138
	Grade C	0	0	
Biliary leakage		2	1	0.673
Bleeding		1	1	0.889
Pneumonia		3	2	0.809
Thrombosis		1	2	0.443
Incision infection		1	1	0.889
Mortality		0	0	
Re-operation		0	0	
VAS		5.2±1.9	4.8±2.0	0.913
Postoperative hospitalization (d)		11.5±3.1	14.1±5.6	0.137

VAS: visual analogue score