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· 专题研究 ·

## 基于膜解剖理念的腹腔镜胰十二指肠切除术：附17例报告

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### 摘要

**背景与目的:** 近年来腹腔镜胰十二指肠切除术 (LPD) 发展迅速, 但因该手术所涉及的解剖分离与吻合等关键技术的复杂性, 限制了其广泛应用。笔者团队借鉴膜解剖理念在胃肠外科领域的成功应用, 初步探讨膜解剖理念在 LPD 中的临床应用价值。

**方法:** 回顾性收集 2021 年 3 月—9 月广西医科大学附属柳州市人民医院 17 例胰头及壶腹部肿瘤术中行基于膜解剖理念的 LPD 的患者的临床病理资料, 分析患者围手术期情况及近期预后。

**结果:** 17 例患者中男 10 例, 女 7 例; 中位年龄 58 (42~76) 岁。术前平均体质量指数 ( $22.95 \pm 2.73$ )  $\text{kg}/\text{m}^2$ 、CA19-9 ( $147.59 \pm 23.04$ ) U/mL、总胆红素 ( $124.50 \pm 26.26$ )  $\mu\text{mol}/\text{L}$ 。17 例患者均顺利完成 LPD, 平均手术时间为 ( $324 \pm 58$ ) min; 中位消化道重建前手术时间 160 (120~320) min; 平均出血量为 ( $353 \pm 192$ ) mL; 病灶大小 ( $2.75 \pm 0.21$ ) cm。术后病理十二指肠乳头癌 4 例, 胰腺癌 7 例, 胆道壶腹癌 5 例, 十二指肠神经内分泌瘤 1 例; 淋巴结清扫数目 12 (5~17) 枚, 淋巴结阳性 7 (0~11) 枚。术后 2 例发生生化漏, 无 B、C 级胰瘘; 1 例发生胃排空延迟, 经再置胃管并对症处理后, 于术后 10 d 内恢复固体饮食; 术后均无腹腔感染及腹腔出血发生; 17 例患者术后住院时间为 11 (9~21) d; 无术后 30 d 内死亡病例。17 例患者均获得完整的术后随访, 随访时间为 3.0~9.0 个月, 中位随访时间为 5.7 个月, 无死亡、复发病例。

**结论:** 基于膜解剖理念的 LPD 术式, 术中出血少, 有利于保持术野解剖清晰, 遵守外科手术“无瘤原则”, 减少手术并发症的发生和患者的住院时间, 使得手术安全可行, 近期效果满意, 远期效果有待进一步观察, 一定程度上值得应用与推广。

### 关键词

胰十二指肠切除术; 腹腔镜; 膜; 解剖

中图分类号: R657.5

## Application of laparoscopic pancreaticoduodenectomy guided by membrane anatomy: a report of 17 cases

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**Abstract**

**Background and Aims:** Laparoscopic pancreaticoduodenectomy (LPD) has developed rapidly in recent years. However, the complexity of the essential techniques such as dissection, separation, and anastomosis involved in this operation limits its widespread application. Based on the successful application of the membrane anatomy concept in the field of gastrointestinal surgery, the author's team preliminarily explored the clinical application value of the membrane anatomy concept in LPD.

**Methods:** The clinicopathologic data of 17 patients with pancreatic head and ampullary tumors who underwent LPD based on the concept of membrane anatomy from March to September 2021 in Liuzhou People's Hospital Affiliated with Guangxi Medical University were retrospectively collected. The perioperative conditions and short-term outcomes of the patients were analyzed.

**Results:** Among the 17 patients, 10 cases were males and 7 cases were females, with a median age of 58 (42–76) years; the preoperative body mass index was  $(22.95 \pm 2.73)$  kg/m<sup>2</sup>, CA19-9 value was  $(147.59 \pm 23.04)$  U/mL, and total bilirubin level was  $(124.50 \pm 26.26)$  μmol/L. LPD was successfully completed in all 17 patients. The average total operative time was  $(324 \pm 58)$  min, the median operative time before digestive tract reconstruction was 160 (120–320) min, the average bleeding volume was  $(353 \pm 192)$  mL, and the size of the lesion was  $(2.75 \pm 0.21)$  cm. There were 4 cases of duodenal papillary carcinoma, 7 cases of pancreatic cancer, 5 cases of ampullary cancer of the pancreaticobiliary subtype, and 1 case of duodenal neuroendocrine tumor; the number of harvested lymph nodes was 12 (5–17), and the number of positive lymph nodes was 7 (0–11). After the operation, biochemical leakage occurred in 2 cases, and no grade B or C pancreatic fistula occurred; delayed gastric emptying occurred in one case who resumed a solid diet within postoperative 10 d after replacing the gastric tube and symptomatic treatment; no abdominal infection and bleeding occurred; The postoperative hospitalization time of 17 patients was 11(9–21) d; No death occurred within 30 d after operation. All the 17 patients were followed up for 3.0–9.0 months with a median follow-up time of 5.7 months. No death and recurrence occurred.

**Conclusion:** The LPD based on the concept of membrane anatomy has less bleeding during the operation, and is helpful for keeping the clear vision of the surgical field, following the "tumor free principle" of surgery, reducing the occurrence of surgical complications, and shortening the length of hospitalization of patients, which makes the operation safe and feasible. Its short-term effect is satisfactory, and the long-term effect needs to be further observed. To a certain extent, it is worth to be widely applied and popularized.

**Key words**

Pancreaticoduodenectomy; Laparoscopes; Membranes; Dissection

**CLC number:** R657.5

胰十二指肠切除术 (pancreaticoduodenectomy, PD) 已被普遍认为是外科手术根治胰头部肿瘤、胆总管远端肿瘤、壶腹周围恶性肿瘤的主要方法<sup>[1-3]</sup>。随着微创外科理念、设备及技术的进步,近年来腹腔镜胰十二指肠切除术 (laparoscopic pancreaticoduodenectomy, LPD) 发展迅速,在大型医学中心已广泛成熟开展<sup>[4-6]</sup>,目前关于LPD技术的研究,主要集中在手术入路<sup>[7-9]</sup>及胰肠吻合方法<sup>[10-11]</sup>上。但该手术涉及大范围的关键组织结构解

剖以及复杂的消化道重建,是目前最复杂的腹腔镜手术之一<sup>[12]</sup>,因此目前LPD术式大多在水平相对较高的医院实施,并未得到普遍推广。膜解剖理念是指筋膜和(或)浆膜,信封样包绕着器官及其血管,悬挂于体后壁,强调了膜的整体性和完整性<sup>[13]</sup>,其广泛应用于胃肠手术。膜解剖理念的兴起与发展使胃肠手术达到“微出血”和“无血”的效果,保证了器官的功能<sup>[14-15]</sup>。大部分胰腺及部分十二指肠位于腹膜后,不仅表面被多层筋

膜和腹膜覆盖,其边缘还存在着数个膜结构的融合,且这些腹膜后筋膜和腹膜,随着毗邻大血管和十二指肠升部走行胰颈下方至腹腔,发生了特有的折叠或迂曲融合。因此,将膜解剖理念应用在LPD中的临床价值,是一个值得探讨的问题。

## 1 资料与方法

### 1.1 一般资料

回顾性收集2021年3月—9月间在广西医科大学附属柳州市人民医院肝胆胰外科接受LPD的17例病例的临床资料,其中男10例,女7例;中位年龄为58岁,年龄范围为42~76岁。本研究通过医院医学伦理委员会审批[审批号:2021(KY-E-08-01)],患者及家属术前均签署知情同意书。

### 1.2 纳入标准和排除标准

纳入标准:(1)术前经过影像学或内镜检查初步诊断为壶腹周围、十二指肠、胆管下端或胰头部肿瘤;(2)一般状况可,美国东部肿瘤协作组(Eastern Cooperative Oncology Group, ECOG)评分为0或1分,无心、肝、肺、肾、脑等重要器官功能障碍;(3)无其他肿瘤病史及消化道重建手术史;(4)手术为同一手术团队完成。排除标准:(1)需要进行胰体尾切除,胰腺中段切除或全胰切除,而非PD手术;(2)术前评估存在远处转移或有动脉侵犯的患者;(3)无法耐受手术者;(4)术中探查发现无法行根治性手术而实施姑息手术的患者;(5)接受新辅助治疗患者。

### 1.3 手术方法

患者呈“大”字体位,气管内插管全身麻醉。采用双主刀模式,2名主刀分别站于患者的左右侧,持镜者站于两腿之间。按五孔法施行,于脐下置观察孔,切口穿刺制作气腹(12~14 mmHg, 1 mmHg=0.133 kPa),直视下分别于左、右两侧脐水平的腹直肌外侧缘置12 mm Trocar作为主操作孔。分别于左、右侧腋前线肋缘下置5 mm Trocar作为辅助孔。术中头高脚低位以利于暴露术野和操作。常规初步探查:检查有无腹水、腹盆腔有无远处转移。依膜解剖为导向的手术路径,重要的膜解剖有三处,顺述如下:(1)第一处膜解剖:适度下降横结肠肝曲,超声刀切开胃结肠韧带,离断胃网膜右静脉根部后,向右侧切开、下降大网膜至十二指肠降部,可见腹膜返折处(图1A),

沿此腹膜返折行Kocher切口,深入至肾前筋膜间隙,向左充分游离胰头、十二指肠背侧。上述步骤亦将相应的胰后淋巴管网廓清于拟切除的标本内。(2)第二处膜解剖:离断Helen干根部后,沿胰腺下筋膜向后上方显露至胰腺固有筋膜的胰腺背侧,显露肠系膜上静脉(superior mesenteric vein, SMV)前壁(图1B),沿胰颈后隧道向上至门静脉前壁;使用切割吻合器离断远端胃向右侧翻转;游离肝总动脉,切断胃十二指肠动脉;切断肝总管,分离门静脉右侧筋膜,同步廓清了相关区域淋巴于拟切除的标本内;切断胰颈。(3)第三处膜解剖:于Treitz韧带远端10 cm左右离断空肠,贴肠壁离断Treitz韧带,由肠系膜血管根部后方将近端空肠残端拉至右侧;由腹腔内再返回腹膜后的筋膜操作,此后的膜解剖主要涉及胰腺固有筋膜及肠系膜上动脉右侧附属组织,悬吊肠系膜血管根部(图1C-D),沿肠系膜上动脉(superior mesenteric artery, SMA)右侧壁筋膜,切开上述组织;沿门静脉右侧筋膜,切断胰十二指肠上后静脉(图1E),至此完成膜解剖为导向的LPD的标本切除部分。消化道重建,采用镜下或上腹取标本切口,采用陈氏胰肠间断吻合法行胰肠吻合;基于Child消化道重建基础上行P襻消化道重建<sup>[16]</sup>,在此不再赘述。

### 1.4 观察指标和评价标准

1.4.1 观察指标 (1)术前一般情况:性别、年龄、术前BMI、CA19-9、总胆红素水平;(2)手术情况包括总体手术时间,消化道重建前手术时间,术中出血量;(3)术后情况:术后并发症及其治疗情况、术后住院时间、术后病理学检查结果;(4)随访情况:获得随访的患者例数、随访时间、生存情况、术后患者不良反应情况。

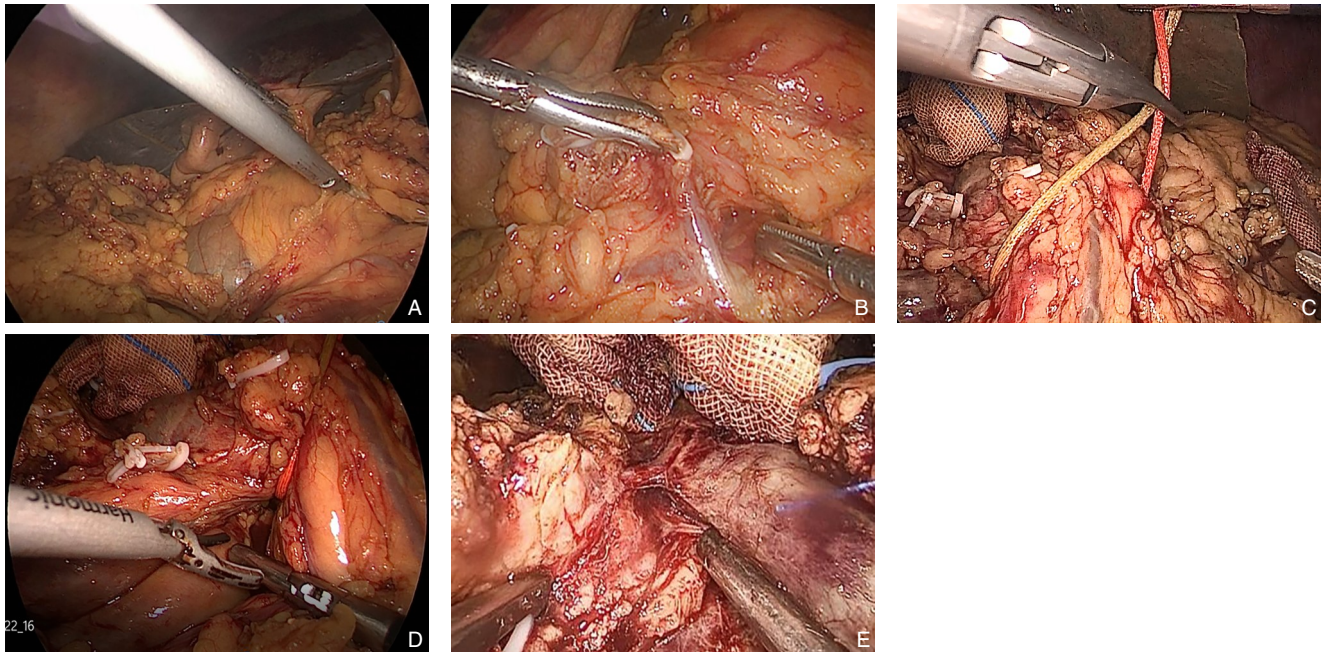
1.4.2 评价标准 胰瘘的定义及分级参照文献<sup>[17]</sup>,胆汁漏的定义参照文献<sup>[18]</sup>,胃排空延迟的定义参照文献<sup>[19]</sup>。

### 1.5 随访

采用面诊或电话进行随访。随访内容为患者生存情况,以及患者不适症状(腹痛、腹胀、腹泻、消化不良等)。随访时间截至2021年12月31日。

### 1.6 统计学处理

应用SPSS 22.0统计软件进行分析。正态分布的计量资料以均数±标准差( $\bar{x} \pm s$ )表示,偏态分布的计量资料以中位数(范围)[M(范围)]表示。计数资料以绝对数或百分比表示。



**图1 手术步骤** A: 下降大网膜至十二指肠降部可见腹膜返折处; B: 沿胰腺下筋膜向后上方显露至胰腺固有筋膜的胰腺背侧, 显露肠系膜上静脉前壁; C: 悬吊肠系膜血管根部; D: 显露胰腺固有筋膜及SMA右侧附属组织; E: 沿门静脉右侧筋膜, 切断胰十二指肠上后静脉

**Figure 1 Surgical procedures** A: Presence of the peritoneal fold after decreasing the great omentum to the descending part of the duodenum; B: Exposure of the dorsal aspect of the pancreas posteriorly along the subpancreatic fascia of the pancreas and exposure of the anterior wall of the superior mesenteric vein; C: Suspension of the root of the mesenteric vessel; D: Exposure of the inherent fascia of the pancreas and the right collateral tissue of the SMA; E: Division of the superior posterior pancreaticoduodenal vein along the fascia of the right portal vein

## 2 结果

### 2.1 术前一般情况

全组患者中男10例, 女7例; 中位年龄58(42~76)岁; 术前BMI( $22.95 \pm 2.73$ ) kg/m<sup>2</sup>; 术前CA19-9( $147.59 \pm 23.04$ ) U/mL, 术前总胆红素( $124.50 \pm 26.26$ ) μmol/L(表1)。

**表1 患者一般资料**

**Table 1 The general data of patients**

指标	数据
年龄[岁, M(范围)]	58(42~76)
性别[n(%)]	
男	10(58.82)
女	7(41.18)
BMI(kg/m <sup>2</sup> , $\bar{x} \pm s$ )	$22.95 \pm 2.73$
CA19-9(U/mL, $\bar{x} \pm s$ )	$147.59 \pm 23.04$
胆红素(μmol/L, $\bar{x} \pm s$ )	$124.50 \pm 26.26$

### 2.2 术中情况

17例膜解剖为导向的LPD均顺利完成, 手术时间( $324 \pm 58$ ) min, 消化道重建前手术时间160(120~320) min, 出血( $353 \pm 192$ ) mL, 未予输血。

### 2.3 术后情况

术后病理学检查: 十二指肠乳头癌4例、胰腺导管癌7例、胆道壶腹癌5例、十二指肠神经内分泌肿瘤1例; 病灶大小( $2.75 \pm 0.21$ ) cm; 淋巴结清扫数目12(5~17)枚, 淋巴结阳性7(0~11)枚。术后2例发生生化漏, 无B、C级胰瘘; 1例发生胃排空延迟, 经再置胃管并对症处理后, 于术后10 d内恢复固体饮食; 术后无腹腔感染及腹腔出血病例; 术后住院时间为11(9~21) d; 无术后30 d内死亡病例(表2)。

表2 LPD患者术后资料

Table 2 The postoperative data of LPD patients

指标	数据
术后住院时间[d, M(范围)]	11(9~21)
术后病理	
病理类型[n(%)]	
十二指肠乳头癌	4(23.5)
胰腺癌	7(41.2)
胆道壶腹癌	5(29.4)
十二指肠神经内分泌瘤	1(5.9)
淋巴结清扫	
清扫淋巴结数[枚, M(范围)]	12(5~17)
淋巴结阳性[枚, M(范围)]	7(0~11)
术后并发症[n(%)]	
胰瘘	
生化漏	2(11.8)
B级	0(0.0)
C级	0(0.0)
胃排空延迟	1(5.9)
二次手术[n(%)]	0(0.0)
死亡[n(%)]	0(0.0)

## 2.4 随访情况

17例患者均获得完整的术后随访,随访时间为3.0~9.0个月,中位随访时间为5.7个月;无死亡病例;无复发病例。

## 3 讨论

膜解剖理念带来的术中“微出血”以及保留器官功能,使其在胃肠外科得到兴起与发展<sup>[20-21]</sup>。随着LPD的逐步开展,相关研究<sup>[22-24]</sup>已展现其可行性和优势。

胰腺大部分及部分十二指肠位于腹膜后,被筋膜和壁腹膜覆盖,而与其毗邻的胃网膜及肠系膜血管也属于“膜”的一部分<sup>[13]</sup>。本研究中,笔者总结LPD术中有三处关键的膜融合或折叠处:(1)胰头十二指肠融合筋膜区,由结肠肝曲与胰头十二指肠直接贴附形成。该区域也是结肠系膜、胰头十二指肠系膜以及胃背侧系膜(大网膜)相互贴附融合区域,是三处系膜回流静脉的交汇处<sup>[25]</sup>。三个不同系膜的回流静脉,包括中上右结肠静脉(superior right colonic vein, SRCV),胰十二指肠前上静脉(anterior superior pancreaticoduodenal vein, ASPDV),胃网膜右静脉(right gastroepiploic vein, RGEV)在胰头十二指肠前间隙形成变异复

杂的共干Henle干。笔者在术中通过充分游离下降结肠肝曲以及轻柔地向左侧牵拉十二指肠降部,可清晰看到胰头十二指肠融合区的界线,沿此界线切开该融合筋膜后可顺利进入胰头后方Treitz间隙,完成Kocher切口。同时该界线也是大网膜右侧边界,可借此解剖标准辨认RGEV,从而顺其右侧缘游离确定Henle干,以避免过度牵拉导致Henle干出血。(2)胰腺十二指肠后筋膜,在胰腺的下缘分为前后两层,前层包裹着肠系膜血管与胰腺十二指肠前筋膜融合,向下延长与横结肠系膜前叶融合,后层向下与肾前筋膜融合<sup>[26]</sup>。循Henle干注入SMV的汇入点向上,在胰颈部下缘切开胰十二指肠前筋膜及横结肠系膜后,可将SMV主干显露,进一步切开胰十二指肠后筋膜前叶,可实现胰后隧道的操作。胰后隧道层面为一无血管区且SMV-PV很少发生变异,因此在没有胰后侵犯的情况下,可轻松地沿着SMV-PV中线进行胰后隧道的游离。(3)从胰腺颈部至被脾肾韧带的两层腹膜包绕处的胰尾右侧,此段胰部下缘为胰腺固有筋膜和胰后筋膜融合;切开此处两层融合筋膜,向胰体后方分离,即进入胰后间隙,此间隙与肾前筋膜间隙相通,为无血管间隙。Treitz韧带左缘左外侧为腹腔,左缘右内侧却也与肾前筋膜间隙相通,亦借此可与胰后间隙相通;SMV由门静脉延续至胰颈而下,而SMA由腹主动脉向前下发出,其穿越胰后筋膜至胰颈处,从空间位置上看,SMA走行于SMV的左侧或左前方最为常见<sup>[27-28]</sup>,SMA走行与SMV右侧或两者交叉走行的情况约10%<sup>[29-30]</sup>。由此可见,SMA与SMV在肠系膜血管根部并非固定角度与水平的相距,但无论如何变异,两者均为肠系膜根部“膜”中的结构,与常见的在离断胰腺钩突时分别悬吊SMA和(或)SMV不同,笔者在LPD术中离断Treitz韧带并把十二指肠及部分空肠牵拉至肠系膜根部右侧后,利用此时空虚的Treitz韧带左缘右内侧肾前筋膜间隙,从肠系膜血管根部右侧,向左上方则进入肾前筋膜间隙及胰后间隙。切开少许胰部下缘的筋膜,通过悬吊带即可将肠系膜根部组织作为整体悬吊起来。此时将悬吊带向左上腹腔牵拉,使肠系膜血管根部筋膜组织与钩突成角,此角即为钩突左侧缘,此角左上方即为SMA,在该角处循SMA外侧缘足侧向头侧完成钩突离断。

近年来基于膜解剖的腹腔镜胃肠道肿瘤根治

术由于系膜的完整剥离、切除，术中可实现微出血，并有效防止系膜的癌细胞泄漏到手术野，得到广泛应用<sup>[14,31]</sup>。本研究中，17例LPD均在腹腔镜下完成，术中出血量与总手术时间为 $(353 \pm 192)$  mL、 $(324 \pm 58)$  min，与本团队前期报道<sup>[16]</sup>的开放胰十二指肠术（open pancreaticoduodenectomy, OPD）数据 $[375 (100\sim 800)$  mL、 $(317 \pm 74)$  min]相比，符合LPD学习曲线学习期规律<sup>[24]</sup>。且术后无B及以上胰瘘发生，2例胃排空延迟经短期治疗后好转，初步显示了膜解剖理念运用于LPD术的可行性与安全性，与国内外其他处于同期学习曲线团队报道的结果相似<sup>[32]</sup>。

笔者在LPD的实践中体会到如下优势：(1) 在进行Kocher切口游离以及建立胰后隧道时，遵循膜解剖的入路进入正确的手术层面，所遇多为疏松结缔组织，出血少，有利于保持术野清晰，并减少小出血点电凝止血的操作，使得手术更流畅。Henle干是LPD术中容易损伤出血的危险区域之一，操作不当可能出现难以控制的出血<sup>[33]</sup>，运用膜解剖理念在胰头十二指肠融合筋膜区分离横结肠系膜与大网膜时，解剖层次分明，有利于RGEV与Henle干的辨认与显露，有助于避免Henle干的损伤。(2) 虽然胰腺系膜是否存在及其范围的界定仍有争议<sup>[34]</sup>，但全胰腺系膜切除可提高胰头癌的R<sub>0</sub>切除率已无争议<sup>[35-36]</sup>。Adham等<sup>[37]</sup>将胰腺钩突与肠系膜血管间的解剖结构定义为“胰腺系膜三角”，该三角前界为SMV及PV后壁，内界为SMA及腹腔干右缘，后界为主动脉表面。胰腺系膜三角的重要性体现在胰腺钩突部供血血管通过此区域，同时也是胰头癌最易淋巴转移及神经、血管侵犯的部位<sup>[38]</sup>。笔者根据膜解剖理念利用Treitz韧带后方左右侧的左肾前筋膜间隙和胰后间隙，设置肠系膜血管根部悬吊带，可克服使用直杆类器械左右牵拉血管相对困难，以及由于SMV与SMA间不恒定的位置关系造成单独悬吊SMV可能无法恒定暴露SMA右侧缘的不足，可将胰腺系膜三角区域良好地暴露，自足侧向头侧沿着SMA右侧缘薄层化游离胰腺钩突系膜，在薄层组织中解剖出IPDA及胰十二指肠上后静脉（posterior superior pancreaticoduodenal vein, PSPDV）等重要分支血管，可安全地进行结扎离断操作。同时也对胰腺系膜三角整体廓清，促进术者肿瘤根治性切除的术中管理，体现肿瘤外科的无瘤原则理念。(3) 团队的

默契配合对于LPD的重要性远超OPD，因为OPD中术者的丰富经验可以弥补助手经验的不足，但LPD中术者的丰富经验无法弥补助手配合不到位的情况。笔者团队处于LPD学习曲线学习期，借鉴其他中心经验采用“双主刀”模式<sup>[39-40]</sup>。膜解剖的理念有助于统一手术团体成员对解剖层次、手术关键步骤的理解以及对高危出血部位的防范意识，以提高团队默契程度，避免术中出血难以控制的出血。

本研究为回顾性研究，入组病例较少，基于手术团队处于LPD学习曲线学习期的现状，入组病例术前评估均无血管侵犯，难免存在偏倚，且随访时间较短，仍需进一步通过大样本的对照研究进一步证实膜解剖理念在LPD术中的应用价值。

综上所述，本研究初步显示膜解剖理念运用于LPD术是完全安全可行的，也利于手术团队克服学习曲线，一定程度上值得推广与借鉴。

利益冲突：所有作者均声明不存在利益冲突。

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