

79850\_Auto\_Edited.docx

6

**Name of Journal:** *World Journal of Clinical Cases*

**Manuscript NO:** 79850

**Manuscript Type:** CASE REPORT

Preoperative 3D reconstruction and use of fluorescent indocyanine green for  
laparoscopic duodenum preserving pancreatic head resection: A case report

Laparoscopic duodenum preserving pancreatic head resection

## Abstract

### BACKGROUND

<sup>2</sup> Duodenum-preserving pancreatic head resection (DPPHR) is the choice of surgery for benign or low-grade malignant tumors of the pancreatic head. <sup>5</sup> Laparoscopic duodenum-preserving pancreatic head resection (LDPPHR) procedure can be improved by preoperative 3D model reconstruction and the use of intravenous indocyanine green (ICG) fluorescent before surgery for real-time navigation with fluorescent display to guide the surgical dissection and prevention of from injury to vessels and biliary tract.

### CASE SUMMARY

Here we report the successful short- and long-term outcomes after one year following LDPPHR for a 60-year lady who had an uneventful recovery and was discharged home one week after the surgery.

### CONCLUSION

There was no bile leakage or pancreatic leakage or delayed gastric emptying. The histopathology report showed multiple cysts in the pancreatic head and localized pancreatic intraepithelial tumor lesions (PanIN-2). The resected margin was free of tumor.

**Key Words:** duodenum-preserving pancreatic head resection; fluorescent navigation; laparoscopic 3D model reconstruction

li X, Gong L. Report of a case :Preoperative 3D reconstruction and use of fluorescent indocyanine green for <sup>4</sup> Laparoscopic Duodenum Preserving Pancreatic Head Resection (LDPPHR) <sup>6</sup> (with video). *World J Clin Cases* 2022; In press

**Core Tip:** <sup>3</sup> Duodenum-preserving pancreatic head resection (DPPHR) is the choice of surgery for benign or low-grade malignant tumors of the pancreatic head. <sup>5</sup> Laparoscopic

duodenum-preserving pancreatic head resection (LDPPHR) procedure can be improved by preoperative 3D model reconstruction and the use of intravenous indocyanine green (ICG) fluorescent before surgery for real-time navigation with fluorescent display to guide the surgical dissection and prevention of from injury to vessels and biliary tract. Here we report the successful short- and long-term outcomes after one year following LDPPHR for a 60-year lady who had an uneventful recovery and was discharged home one week after the surgery. There was no bile leakage or pancreatic leakage or delayed gastric emptying. The histopathology report showed multiple cysts in the pancreatic head and localized pancreatic intraepithelial tumor lesions (PanIN-2). The resected margin was free of tumor.

## INTRODUCTION

Duodenum-preserving pancreatic head resection (DPPHR) is the choice of surgery for benign or low-grade malignant tumors of the pancreatic head. The most common benign and borderline pancreatic neoplastic lesions include Cystic tumor, neuroendocrine tumor (NEN), solid pseudopapillary Solid Pseudopapillary Tumor (SPT) and intraductal papillary mucinous tumor (IPMN). The DPPHR was first reported in 1972 by Beger for the treatment of the inflammatory mass caused by chronic pancreatitis<sup>[1]</sup>. Compared with traditional pancreatic surgery, this procedure retains the gastroduodenal continuity, reduces the extent of pancreatic resection, retains the pancreatic intestinal axis, and help preserve normal anatomical and physiological structures with good short- and long-term outcome. A variety of modifications in surgical techniques have been proposed, such as Frey's operation, Berne's operation, Takada's operation, etc<sup>[2-5]</sup>.

With the development of minimally invasive and precision medicine, laparoscopic duodenum-preserving pancreatic head resection (LDPPHR) has become a better option, but it is less practiced and rarely reported because of the complexity of the operation. Combined with fluorescence technology and preoperative 3D model reconstruction, the LDPPHR under fluorescence navigation is beneficial. The fluorescence dye, indocyanine

green (ICG) used intravenously during surgery is excreted through the bile, showing green fluorescence under near-infrared light excitation<sup>[6]</sup>. The use of fluorescence navigation technology greatly improves the visualization of biliary anatomy for accurate planning and resection and prevents intraoperative bile duct injury. In extrahepatic biliary fluorescence imaging, Vlek *et al*<sup>[7-9]</sup> used the method of injecting ICG through peripheral vein 15~60 min before operation. After ICG was injected into peripheral vein, the liver could fluoresce within 2-5 min, and the biliary tract could fluoresce within 8-10 min. The concentration in bile reached its peak 30 min to 2 h after ICG intravenous injection.

## **CASE PRESENTATION**

### ***Chief complaints***

A female patient, aged 60 years, was admitted with a pancreatic head mass found during the physical check-up.

### ***History of present illness***

A female patient, aged 60 years, was admitted with a pancreatic head mass found during the physical check-up. The blood routine, coagulation profile, liver function, renal function, serum electrolyte, the markers of HBV, and tumor antigen screening tests were normal. Endoscopic ultrasonography showed multiple mixed-echo nodules in the head and neck of the pancreas, with irregular shape and clear boundary, and mainly an hypoechoic parenchyma. The computed tomography (CT) scan showed cystic lesions in the head and neck of the pancreas. Some lesions were connected to the main pancreatic duct, suspicious of Intraductal Papillary Mucinous Neoplasm (IPMN). The CT angiography (CTA) and venous-phase imaging (CTV) of peripancreatic vessels were normal, (Figure 1).

### ***History of past illness***

Un-specificity

### *Personal and family history*

Un-specificity

### *Physical examination*

Un-specificity

### *Laboratory examinations*

The blood routine, coagulation profile, liver function, renal function, serum electrolyte, the markers of HBV, and tumor antigen screening tests were normal.

### *Imaging examinations*

Endoscopic ultrasonography showed multiple mixed-echo nodules <sup>1</sup> in the head and neck of the pancreas, with irregular shape <sup>1</sup> and clear boundary, and mainly an hypoechoic parenchyma. The computed tomography (CT) scan showed cystic lesions in the head and neck of the pancreas. <sup>10</sup> Some lesions were connected to the main pancreatic duct, suspicious of Intraductal Papillary Mucinous Neoplasm (IPMN). The CT angiography (CTA) and venous-phase imaging (CTV) of peripancreatic vessels were normal, (Figure 1).

The 3D reconstruction preoperatively (Figure 2), and plan of surgical resection with postoperative pancreatic changes are visualized (Figure 3).

### **FINAL DIAGNOSIS**

multiple cysts in pancreatic head and localized pancreatic intraepithelial tumor lesions (PanIN-2)

### **TREATMENT**

15 minutes Before operation, one ml (2.5mg) indocyanine green <sup>12</sup> (ICG) was injected into the peripheral vein (if the biliary tract development is not satisfactory during operation,

the additional dose can be continued). The gastrocolonic ligament was dissected with an ultrasonic knife under laparoscopy, multiple cystic tumors in the pancreatic head were noted. The ultrasonic knife was used for dissection of duodenum and pancreatic head. The superior mesenteric vein was dissected at the lower edge of the pancreas. The tunnel behind the pancreatic neck was established. The pancreatic neck was taped and transected. The bile duct was evaluated in fluorescence laparoscopic mode, (Figure 4). Under fluorescent navigation, dissection of the uncinate process of the pancreas was continued from the lower border and upward under the postpancreatic head capsule. The anterior and posterior inferior pancreaticoduodenal vessels were exposed, and the branches of vessels entering the pancreas were severed, keeping the integrity of the posterior fascia of the pancreas. Gastroduodenal artery was dissected. The superior anterior pancreaticoduodenal artery branches entering the pancreatic head were cut, retaining the blood supply of the duodenum. With fluorescent display, the pancreatic tissue was dissected off along the posterior fascial plane of the pancreatic head, protect the common bile duct, duodenum and its blood supply. There was no bile leakage and bleeding detected under fluorescent laparoscopy (Fig. 5 and Figure 6). For digestive tract reconstruction, the jejunum was severed at 15 cm from the Treitz ligament, the distal jejunum was pulled out from behind the colon, the pancreatic duct was cannulated with a silicone tube, and end-to-side pancreatojejunostomy was performed using continuous 3-0 absorbable suture (Vicryl®). Roux-Y jejuno-jejunostomy was performed about 45 cm away from the pancreatojejunostomy. There was no bleeding, bile leakage and pancreatic leakage. An abdominal drainage tube was placed behind the pancreatojejunostomy.

## **OUTCOME AND FOLLOW-UP**

### **Results**

Post-operative recovery was uneventful. On the 4<sup>th</sup> day WBC:  $7.7 \times 10^9$  / L. Percentage of neutrophils: 82%, Hb: 114g / L. Serum albumin: 34g / L, Serum total bilirubin: 10.3 $\mu$ mol/L, Serum direct bilirubin: 5.2 $\mu$ mol/L, ascites amylase: 149U/ L. Postoperative



pathological report showed multiple cysts in pancreatic head and localized pancreatic intraepithelial tumor lesions (PanIN-2). Resected margin was free of tumor. (Figure 7 and Figure 8)

### Follow-ups

Follow up CT after 5 mo (Figure 9), 11 months(Figure 10) and 17 mo(Figure 11) were normal. The follow-up hepatorenal function and blood sugar were normal.

### DISCUSSION

In our case the outcome of LDPPHR was satisfactory without biliary or pancreatic leakage, and at one-year follow-up the CT scan, liver function and blood sugar tests were normal. The preoperative 3D reconstruction and intraoperative use of ICG fluorescent was helpful in anatomical dissection, avoiding injury to important vessels and biliary tract.

The traditional pancreaticoduodenectomy (PD) <sup>8</sup> for benign or low-grade malignant tumors of the head of the pancreas, is now performed by laparoscopic pancreaticoduodenectomy(LPD) with overall mortality reduced to about 1% in large volume centers <sup>[10]</sup>. However, postoperative morbidity and complications is still as high as 40%-60%, including malnutrition and pancreatic dysfunction <sup>[11,12]</sup>. Patients with benign tumors <sup>7</sup> or low-grade malignant tumors of the pancreatic head will survive for a long time after surgical treatment, If LPD is performed, it may seriously affect the safety <sup>1</sup> and quality of life of the patients after operation. Duodenum preserving pancreatic head resection (DPPHR) with various modifications is a more reasonable procedure <sup>11</sup> for patients with benign and low-grade malignant tumors of the pancreatic head <sup>8</sup> removes the tumor of the pancreatic head, retaining the continuity of gastro-duodenum and biliary tract anatomy and physiological functions. The minimally invasive laparoscopy resection (LDPPHR) has gained acceptance. <sup>[13,14]</sup>

Intraoperative use of ICG fluorescent has added advantage in dissection and preservation of important vessels, for example, the blood supply of the duodenal



papilla and the intrapancreatic part of the bile duct mainly comes from the supply of the posterior pancreaticoduodenal artery arch [15,16], the duodenal papilla is mainly supplied by the papillary artery from the superior posterior pancreaticoduodenal artery, protecting the posterior pancreaticoduodenal artery arch is particularly important for maintaining a good blood supply to the duodenum, the intrapancreatic part of the bile duct and the duodenal papilla. During the LLDPPHR procedure in our case, the posterior fascia of the pancreatic head was preserved to avoid damaging the posterior pancreaticoduodenal artery arch, and the anterior pancreaticoduodenal artery arch was preserved as much as possible.

The application of 3D visualization technology combined with 3D printing technology in liver cancer and hilar cholangiocarcinoma has been reported in the literature. The variation of bile duct and blood vessel and the transverse and longitudinal infiltration of tumor can be observed clearly and stereoscopically from multiple dimensions to judge whether the tumor invades blood vessels and the resectability of the tumor. Preoperative 3D model reconstruction can plan different surgical approaches and resection ranges, select the best individualized surgical scheme, and achieve the purpose of accurate lesion resection [17,18]. In this case, the application of 3D visualization technology to LDPHR has achieved satisfactory results in preoperative diagnosis, surgical planning and intraoperative real-time navigation. By constructing a 3D model before operation, we can more intuitively observe the scope of pancreatic lesions, observe that there is no vascular anatomical variation in this case, and preserve the anterior and posterior pancreaticoduodenal arterial arches to the greatest extent during the operation. In this way, we can "have a clear mind" before operation and "skill and ease" during operation. It laid the foundation for the success of the operation.

Indocyanine green (ICG), as a water-soluble dye for intravenous injection, can be selectively absorbed by the liver and excreted through the bile. After binding with

mucin in the bile, ICG presents green fluorescence under near-infrared light excitation, which provides the possibility for fluorescence visualization of bile duct <sup>[19]</sup>. In a study by schols *et al* <sup>[20]</sup>, it is easier to expose the common bile duct in ICG fluorescence mode than in traditional mode. The exposure of the intrapancreatic <sup>3</sup> part of the bile duct and blood supply protection are a major difficulty in this operation. If the intrapancreatic <sup>3</sup> part of the bile duct was difficult to be exposed due to inflammation or other factors, indocyanine green fluorescence technology could achieve accurate navigation, and greatly reduces the difficulty of common bile duct exposure.

## **CONCLUSION**

### **Conclusion**

Use of preoperative 3D was helpful in precise planning, and the intraoperative fluorescent navigation aided in the surgical dissection, preserving the important vessels and biliary anatomy during LDPPHR. This procedure is worthy of promotion hospitals with such facilities.

### <sup>7</sup>**ACKNOWLEDGEMENTS**

This work was supported by Natural Science Foundation of Hunan Province (2022JJ30939).

20%

SIMILARITY INDEX

---

PRIMARY SOURCES

---

- |       |  |                |
|-------|--|----------------|
| 1     | <p>"Surgical Atlas of Pancreatic Cancer", Springer Science and Business Media LLC, 2020</p> <p><small>Crossref</small></p>   | 104 words — 5% |
| <hr/> |  |                |
| 2     | <p>Min Zhou, Simiao Xu, Dang Chao, Min Wang et al. "Intracapsular approach used in laparoscopic duodenum-preserving total pancreatic head resection for pancreatic head benign or low-grade malignant tumors", Langenbeck's Archives of Surgery, 2022</p> <p><small>Crossref</small></p> | 57 words — 3%  |
| <hr/> |  |                |
| 3     | <p>"Biliary Tract Surgery", Springer Science and Business Media LLC, 2021</p> <p><small>Crossref</small></p>   | 56 words — 3%  |
| <hr/> |  |                |
| 4     | <p>Nuerabula Wujimaimaiti, Yi Wu, Jingxiong Yuan, Jikuan Jin, Hebin Wang, Shizhen Li, Hang Zhang, Min Wang, Renyi Qin. "Laparoscopic duodenum-preserving pancreatic head resection: a narrative review", Journal of Pancreatology, 2021</p> <p><small>Crossref</small></p>               | 53 words — 3%  |
| <hr/> |  |                |
| 5     | <p>journals.lww.com</p> <p><small>Internet</small></p>   | 27 words — 1%  |
| <hr/> |  |                |
| 6     | <p>f6publishing.blob.core.windows.net</p> <p><small>Internet</small></p>   | 23 words — 1%  |
| <hr/> |  |                |
| 7     | <p>link.springer.com</p>   |                |

22 words — 1%

- 
- 8 Hang Xu, Jialin Li, Jiang Liu, Bo Zhang, Wei Wang. "Clinical experience of minimally invasive duodenum preserving pancreatic head resection", *Intelligent Surgery*, 2022 20 words — 1%

[Crossref](#)

- 
- 9 M. G. Lewis. "Differential diagnosis of malignant melanoma of feet in Uganda", *British Journal of Surgery*, 03/1968 14 words — 1%

[Crossref](#)

- 
- 10 Javier Casillas, Joe U. Levi, Alexander O. Quiroz, Roberto Ruiz-Cordero, Monica T. Garcia-Buitrago, Danny Sleeman. "Multidisciplinary Teaching Atlas of the Pancreas", Springer Science and Business Media LLC, 2016 12 words — 1%

[Crossref](#)

- 
- 11 "Abstracts of Papers Submitted to the Joint 50th Anniversary Meeting of the American Pancreatic Association and Japan Pancreas Society, November 6–9, 2019, Maui, Hawaii", *Pancreas*, 2019 11 words — 1%

[Crossref](#)

- 
- 12 Jian Cheng, Li-Yang Sun, Jie Liu, Cheng-Wu Zhang. "Indocyanine green fluorescence imaging for spleen preservation in laparoscopic splenic artery aneurysm resection: A case report", *World Journal of Gastrointestinal Surgery*, 2022 8 words — < 1%

[Crossref](#)

- 
- 13 Kyoichi Takaori. "Laparoscopic Pancreatic Resection: The Past, Present, and Future", *Surgery Today*, 06/26/2007 8 words — < 1%

[Crossref](#)

- 
- 14 "Abstracts", *HPB*, 9/1/2006

EXCLUDE QUOTES	OFF	EXCLUDE SOURCES	OFF
EXCLUDE BIBLIOGRAPHY	OFF	EXCLUDE MATCHES	OFF