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Robot-assisted Laparoscopic Central Pancreatectomy with Pancreaticogastrostomy (Transgastric Approach)

Chang Moo Kang, M.D.
Department of Surgery, Yonsei University College of Medicine, Korea

1. Introduction

The pancreatic surgeons need to consider patients' quality of life when treating benign and borderline malignant tumor of the pancreas because the patients' long-term survival is highly expected following successful pancreatectomy. Ideally, function-preserving minimally invasive surgery is thought to be quite adequate approach for them. Pancreaticoduodenectomy (PD) or extended distal pancreatectomy (EDP) with splenectomy was traditional treatment option for the benign and borderline malignant tumors locating in the pancreatic neck portion. Central pancreatectomy (CP) was just selectively applied in the past because of its frequent combined-morbidity.[1, 2] Recently, revisiting role of CP seems to be lightened by several authors.[1-5] With the development of laparoscopic experiences and instruments, only a few reports of conventional laparoscopic central pancreatectomy have been published by some expert surgeons[6-7]. However, the several disadvantages of conventional laparoscopic surgery, such as limited range of motion, fulcrum effect and two-dimensional operative view, could not encourage liberal attempts of various pancreas surgeries. Recent advances in computer technology are providing surgical robot system especially with multi-articulated joint and three-dimensional (3-D) operating view[9]. This surgical system is thought to provide more precise, safe, and effective laparoscopic performance, which might result in expanding the indication for minimally invasive surgery in benign and borderline malignant tumors of pancreas. Herein, we demonstrate a case of robot-assisted laparoscopic central pancreatectomy with pancreaticogastrostomy (transgastric approach) in neuroendocrine tumor of the pancreas locating in neck of the pancreas and briefly discuss the feasibility and benefit of this procedure.

2. Case presentation

Patient: A 64-year-old female patient visited our institution (Yonsei University Health System) for incidental discovery of pancreatic mass during routine medical check-up. Abdominal CT scan showed about 1.5cm sized hypervascular mass in the proximal body of the pancreas (Figure 1). Blood laboratory examinations were normal and tumor markers (CEA, CA19-9) were also within normal range without any clinical symptoms Preoperative clinical diagnosis was non-functioning neuroendocrine tumor tumor of the pancreas. We

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planned for minimally invasive and function-preserving surgery (robot assisted central pancreatectomy).

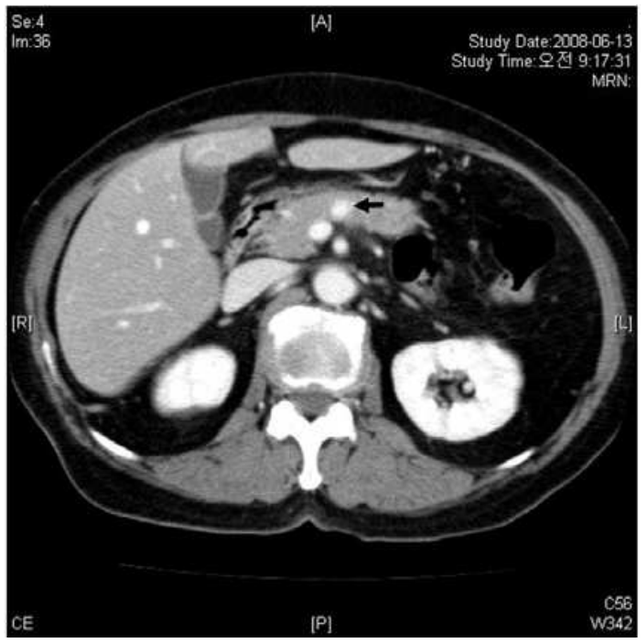

Fig. 1. Abdominal CT scan. About 1.5cm sized hypervascular mass was noted near the neck of the pancreas (arrow)

Surgery: The patient was placed in supine position with her head and left side slightly elevated. Four ports were placed for robotic arms and another one for assistant surgeon (Figure 2). After dividing the gastrocolic ligament, pancreatic neck mass could be well visualized. Intraoperative ultrasound was perform to identify the exact tumor location (Figure 3) Careful dissection was carried out by use of wrist function of robotic arms and 3-D good visual surgical field between SMV-SV confluence and pancreas containing mass to ensure space for pancreas division (Figure 4-A). After completion of making window

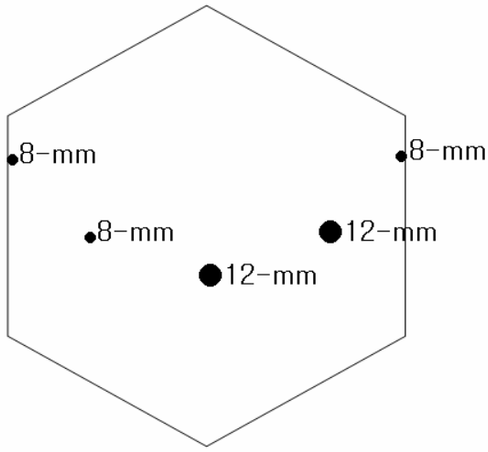

Fig. 2. The ports placement. The left-sided 12-mm port was used for assistant-surgeon and endo-GIA application.

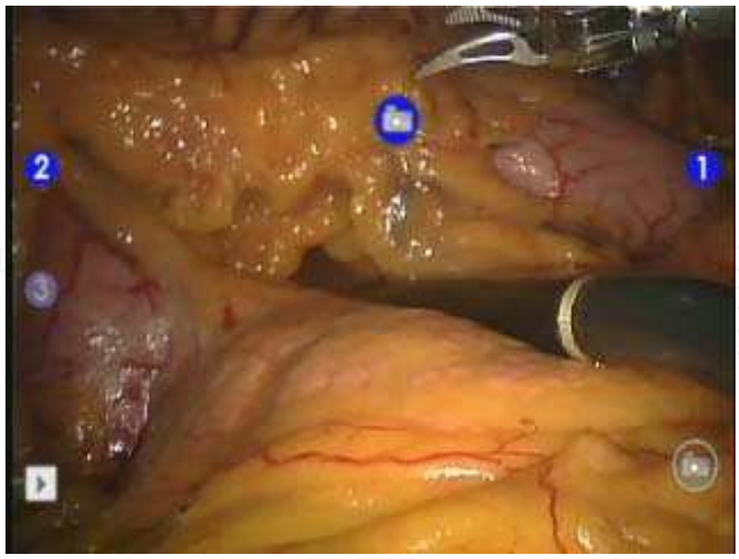

Fig. 3. intraoperative laparoscopic ultrasonography is applied to identify the exact location of the pancreatic tumor.

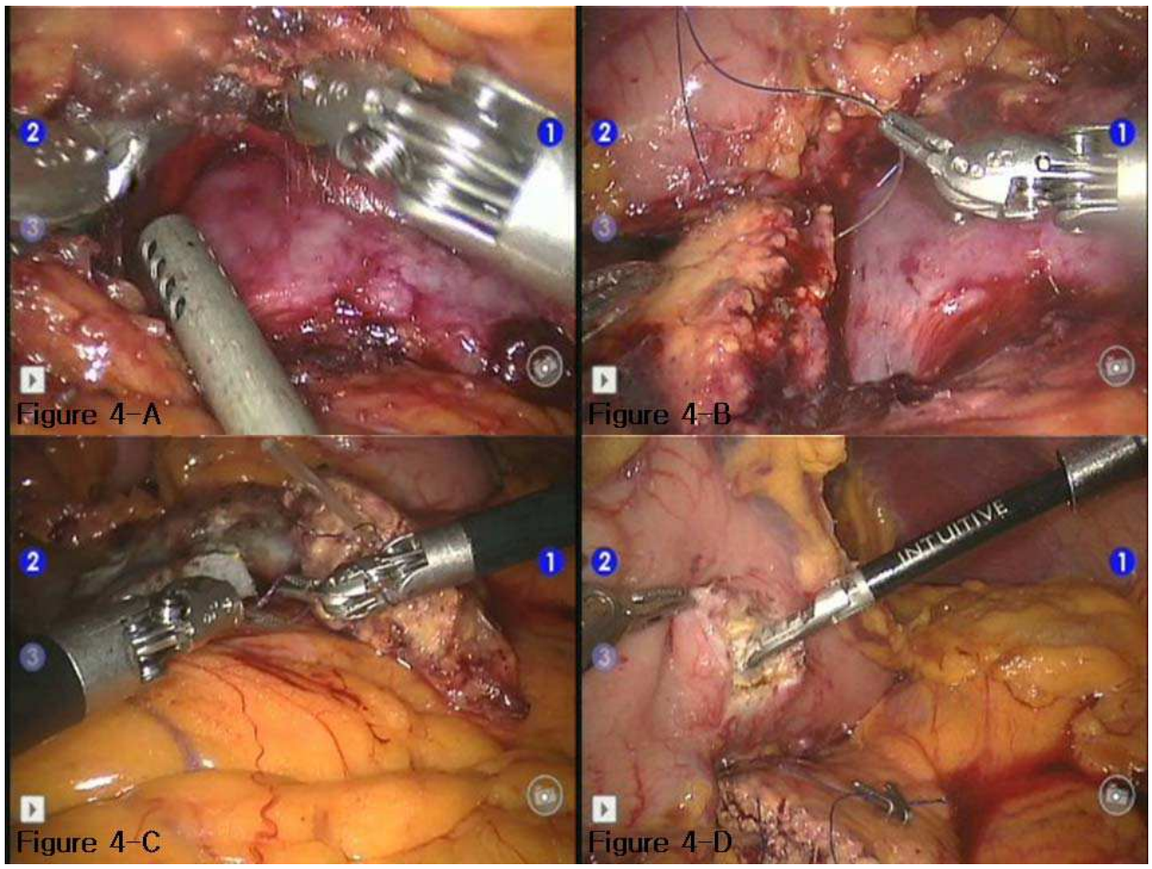

Fig. 4. Intraoperative surgical view

through the avascular space between pancreas and portal vein, endo-GIA was applied to divide proximal part of pancreas. For the safety of proximal pancreatic stump, several additional figure of eight interrupted suture were applied (Figure 4-B). The dissection between pancreas and splenic vessels was continued distally to ensure distal resection margin and to facilitate pancreatigogastrostomy. Distal part of pancreas was divided by harmonic scalpel. The stable operative field and articulating movement of instrument in robotic system were very appropriate for identify the pancreatic duct and preparing for reconstruction in remnant pancreas. The short pancreatic stent was inserted into the pancreatic duct and fixed as usually done in open surgery (Figure 4-C). Two stay sutures were placed at both upper and lower border of the pancreas to retract remnant distal pancreas into the stomach. And, appropriate size of gastrotomy for pancreas-invagination was made at posterior part of stomach (Figure 4-D). Anterior gastrotomy corresponding to posterior gastrostomy site was made (Figure 5-A). Pancreas-invagination through transgastric approach was done and serial interrupted sutures (4-0 PDS) were placed between pancreas and gastric posterior wall (Figure 5-B and 4-C). Wrist-like movements and good visual field provided by robotic system played important role in this procedure. After completion of pancreaticogastrostomy, anterior opening of gastric wall was safely closed by continuous suture (Figure 5-D). Resected specimen was delivered through small vertical extension of camera port site. Two-armed closed suction drains were placed around surgical field.

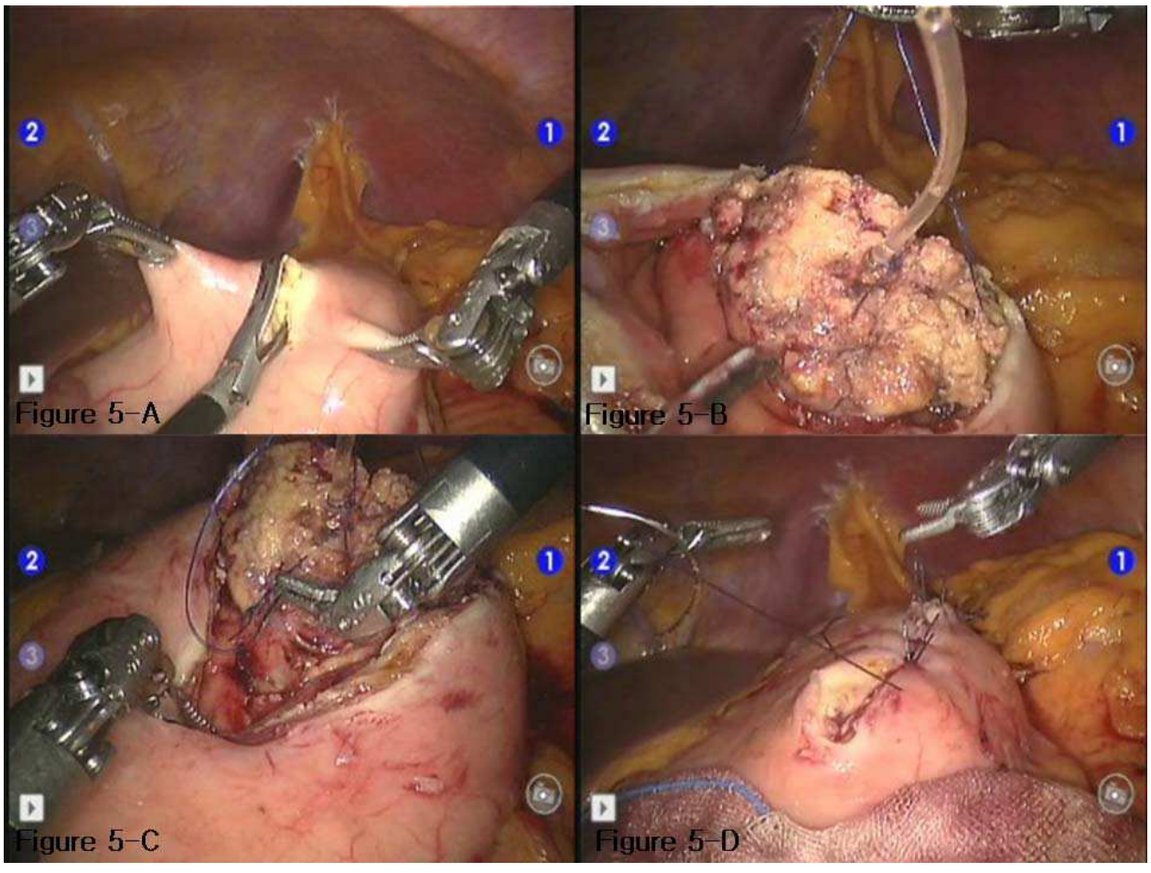

Fig. 5. Intraoperative surgical view

Postoperative course: She had no nasogastric tube after surgery. Oral intake was started on postoperative seventh day after surgery. She experienced transient pancreatic leak but surgical drain can be removed in eighth day postoperatively. She could go home on postoperative 12th day.

Pathology: Grossly resected pancreas was measured 4x2.5x2cm in size and about 1.2cm sized ill-defined solid pinky and brown mass was confined to the pancreas parenchyma (Figure6). Pathologic examination was reported as well-differentiated endocrine tumor of the pancreas without mitotic figure and low proliferative index (Ki-67 expression < 2%).

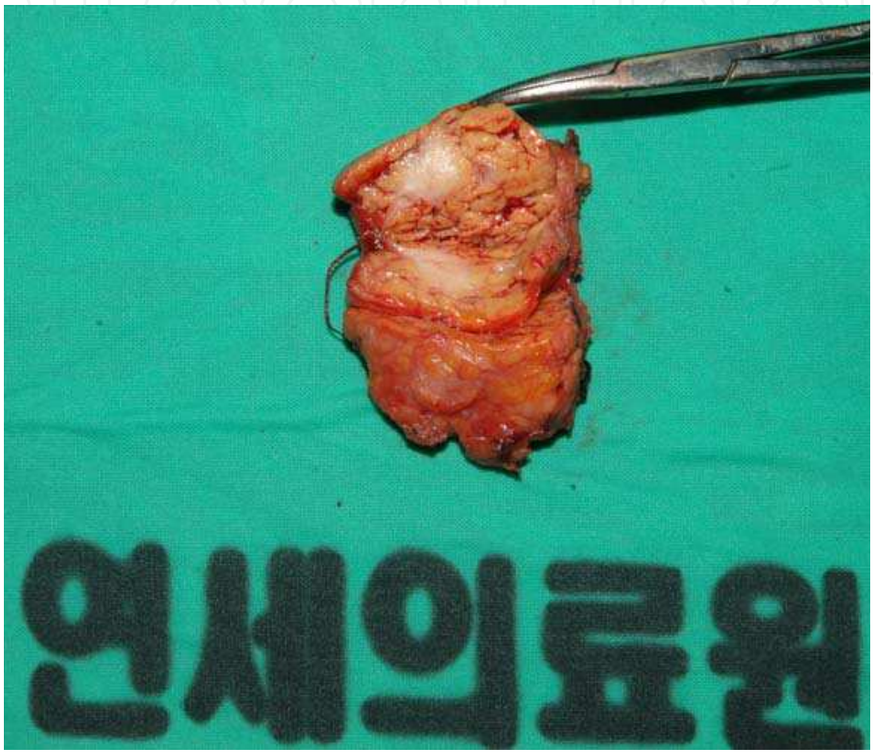

Fig. 6. Surgical pathology

3. Discussion

Since Guillemin and Bessot firstly reported central pancreatectomy in 1957,[9] only a few authors described this technique in the management of pancreatic tumor in the pancreatic neck area. The theoretic benefit of central pancreatectomy is preservation of remnant pancreas parenchyma enough to reduce an incidence of endocrine and exocrine insufficiency, conservation of spleen to maintain immunologic function, and continuity of biliary drainage which is thought to be more physiologic than choledochoenterosotmy after pancreaticoduodenectomy. By reconstruction of pancreaticogastrostomy following central pancreatectomy, conserving continuity of upper gastrointestinal tract can be another advantage of this procedure. Despite of controversy in reconstruction of remnant pancreas (pancreaticojejunosotmy vs. pancreaticogastrosotmy), potential advantages of pancreaticogastrostomy has been advocated.[10-13] Recently, Bassi, et. al[14] introduced their surgical technique, " open pancreaticogastrostomy after pancreaticoduodenectomy". Even

though their original work was published as pilot study, it seem that this technique is easy and safe due to excellent exposure of surgical field comparing with conventional anastomosing the remnant pancreas to the gastric posterior wall from the outside of the stomach.

When treating benign and borderline malignant pancreatic pathology near the neck or proximal body of the pancreas, function-preserving minimally invasive surgery is theoretically appropriate treatment option for them. Although there are a few clinical report of laparoscopic CP, we need to admit that this procedure should require far advanced laparoscopic technique and experiences. Only a few expert surgeons in the world are believed to be qualified for this fulfillment for laparoscopic central pancreatectomy. However, we used da Vinci surgical robot system to complete central pancreatectomy with transgastric pancreaticogastrostomy. By the help of surgical robot system, more effective and safe surgical procedure could be obtained. Endo-wrist instrument and good 3-D visualization enhanced precise and secure performance during surgical procedure. Especially, dissecting of the pancreatic neck portion, preparing remnant pancreas for pancreaticoenterostomy, and final pancreaticogastrostomy were performed safely as usually done in open surgery. This transgastric approach basically provided excellent surgical field for intracorporial robot movement. Additionally, three dimensional views of operative field and wrist-like movement of effector instruments provided by da vinci robot system were enough to fulfill the safe central pancreatectomy and reconstruction of pancreaticogastrostomy. We believe surgical performance in this robot surgery would be almost similar to open surgery. The patient experienced postoperative pancreatic leak (Grade A[15]), however, which was successfully managed by conservative management in usual manner. Additional small extension of umbilical wound was enough to deliver resected specimen. Follow up observation revealed good cosmetic effect from this procedure (Figure 7). Currently, total five patients underwent robot-assisted central pancreatectomy

Fig. 7. Postoperative wound

for benign and borderline malignant tumors in our institution during the last one year. Asymptomatic patients with benign and borderline malignant tumor of the pancreas are expected to be discovered more frequently due to easy accessibility to medical care and improvement socioeconomic status. Therefore, the role of functiong-preserving minimal invasive surgery would be emphasized and robot-assisted surgery may be quite appropriate approach for safe and effective function preserving minimal invasive surgery. More experiences including clinical follow-up information is mandatory.

4. Conclusion

Based on our initial experience of robot-assisted central pancreatectomy and transgastric pancreaticogastrostomy, it is thought to be safe and ideal for well-selected patients with benign or borderline malignant tumor of the pancreatic neck area. No one deny the real benefit and effectiveness of laparoscopic surgery over conventional open surgery in general surgical field. In this point, we would like to say the surgical robot system could play a role to compensate conventional laparoscopic surgery particularly in case where the pure laparoscopic approach would be technically difficult. Therefore, it is thought that the surgical robot system is able to extend surgical indication for function-preserving minimally invasive surgery. We need to accumulate more experiences of robot surgery in pancreas to address the real benefit of robot in far advanced laparoscopic era.

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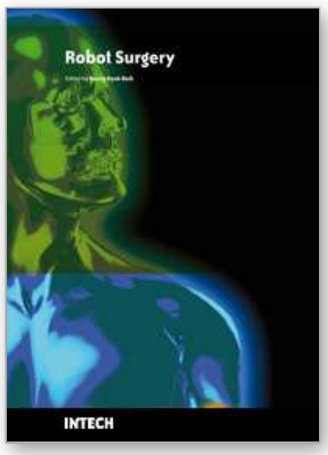

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Robotic surgery is still in the early stages even though robotic assisted surgery is increasing continuously. Thus, exact and careful understanding of robotic surgery is necessary because chaos and confusion exist in the early phase of anything. Especially, the confusion may be increased because the robotic equipment, which is used in surgery, is different from the robotic equipment used in the automobile factory. The robots in the automobile factory just follow a program. However, the robot in surgery has to follow the surgeon's hand motions. I am convinced that this In-Tech Robotic Surgery book will play an essential role in giving some solutions to the chaos and confusion of robotic surgery. The In-Tech Surgery book contains 11 chapters and consists of two main sections. The first section explains general concepts and technological aspects of robotic surgery. The second section explains the details of surgery using a robot for each organ system. I hope that all surgeons who are interested in robotic surgery will find the proper knowledge in this book. Moreover, I hope the book will perform as a basic role to create future prospectives. Unfortunately, this book could not cover all areas of robotic assisted surgery such as robotic assisted gastrectomy and pancreaticoduodenectomy. I expect that future editions will cover many more areas of robotic assisted surgery and it can be facilitated by dedicated readers. Finally, I appreciate all authors who sacrificed their time and effort to write this book. I must thank my wife NaYoung for her support and also acknowledge MiSun Park's efforts in helping to complete the book.

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中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
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