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Central pancreatectomy - a suitable candidate for robotic surgery

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ABSTRACT

Background: In the last few decades central pancreatectomy is increasedly adopted in treatment of benign pancreatic lesions situated in the body of the pancreas, especially in young patients. With recent advances in technology, patients with these lesions could benefit from the advantages of the robotic approach.
Case presentation: We present the case of a 30-years old woman investigated for epigastric pain. CT showed a 3 cm cystic tumor located in the proximal part of the pancreas body. Robotic central pancreatectomy with pancreatogastrostomy was performed.
Results: Operative time was 220 minutes with minimal blood loss. The postoperative course was marked by a basal left pneumonia on postoperative day 3 treated conservatively. The patient was discharged home on postoperative day 8. Pathology showed a 30 mm well differentiated neuroendocrine tumor with free resection margins.
Conclusions: Robotic systems offer several advantages compared to laparoscopy: increased and stabile tridimensional view of the operative field and articulated instruments. Robotic central pancreatectomy seems to be a suitable candidate for robotic surgery requiring delicate vascular dissection and a safe reconstruction. Although there are only few cases published in the literature so far, robotics could lead to an increased adoption of minimally invasive techniques in difficult pancreatic procedures, especially in those requiring reconstructions.

Key words: central pancreatectomy, robotic surgery, minimally invasive, pancreatogastrostomy

INTRODUCTION

Recognized as one of the most challenging fields in abdominal surgery, pancreatic surgery is associated with a low adoption rate of minimally invasive procedures. (1) Intraoperatively the main problem is the dissection of the mesenteric/portal vessels associated with a potential increased risk of bleeding. Postoperatively the main risk is pancreatic leak, a life threatening complication. These are the reasons for the slow adoption rate of minimally invasive surgery in pancreatic procedures.

In procedures with no reconstruction needed, such as distal pancreatectomy or enucleations the laparoscopic approach is nowadays increasedly performed, especially in benign tumors. (2-4) In procedures requiring reconstruction (pancreaticoduodenectomy and central pancreatectomy) the minimally invasive approach is limited to selected centers with experience in both open pancreatic resections (high volume centers) and in advanced minimally invasive procedures. (5) The number of cases reported is significantly lower compared to distal pancreatectomy.

The significant advantages of the robotic platform (tridimensional view, stabile camera, articulated instruments, tremor filtration and improved ergonomy for the surgeon) recommend the robotic approach for difficult and complex procedures in pancreatic surgery (the procedures that require reconstructions)

CASE REPORT

A 30-year-old female was investigated for epigastric pain. CT exam revealed a hypervascularized tumoral mass located in the proximal body of the pancreas, 3/2 centimeters in diameter with no vascular invasion. (*figure 1*)

Standard blood tests and chest X-rays were normal. Preoperative investigations revealed a hepatitis B infection. Tumoral markers were within the normal range. Upper and lower endoscopy showed no modifications. Robotic central pancreatectomy was performed

Surgical technique

The operation was performed under general anesthesia. Intravenous prophylactic venous antibiotic was administrated. The patient was positioned in the supine position with legs apart and right arm tucked on the side. Robotic system is placed at the head of the patient, with fourth robotic arm on the right side of the patient. Pneumoperitoneum was obtained via Veress needle insertion after a small incision was performed at the cranial part of the ombilicus, until 12 mmHg of pressure was obtained. A 12 mm trocar (optical trocar) was inserted at this level and inspection of the abdominal cavity was performed using the robotic 30° angle scope. A fourth arm DaVinci Surgical System was used to perform this operation. The robotic trocars (8 mm) were inserted along a concave line directed toward the cranial region, as follows: right mid clavicular line, right mid axilary line (used for retraction of stomach and liver) and left lateral clavicular line.

Two additional 12 mm trocars were placed infraombilically between camera port and lateral robotic

Figure1 - Preoperative CT

ports. These were used for traction, aspiration, stappler aplication and Ligasure. (*figure 2*)

The dissection was begun by entering the lesser sac which was performed by opening the gastrocolic ligament. The stomach was lifted cranially by the fourth robotic arm. The splenic flexure was taken down using ultrasound dissection. (*figure 3*)

Complete examination of pancreatic region was obtained at this level. A tumoral mass of approximately 3 /3 cm was identified in the corporeal region of the pancreas. (*figure 4*)

Further dissection was done at the superior edge of the pancreas where the splenic artery was identified and the taped in order to avoid injury and to facilitate dissection of the tumor. (*figure 5*)

The SMV(superior mesenteric vein) was identified at the inferior edge of the corporeal region of the pancreas and it was is done by mobilizations of the transverse mesocolon. The Henle trunk was identified

Figure 2 - Robotic cart positioning for robotic central pancreatectomy

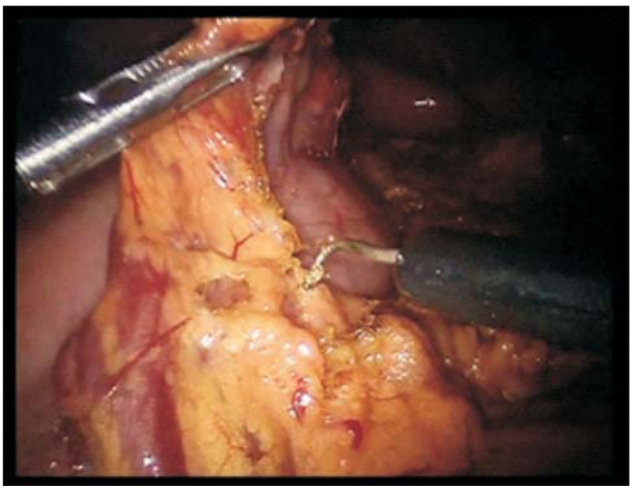

Figure 3 - Opening of the gastrocolic ligament

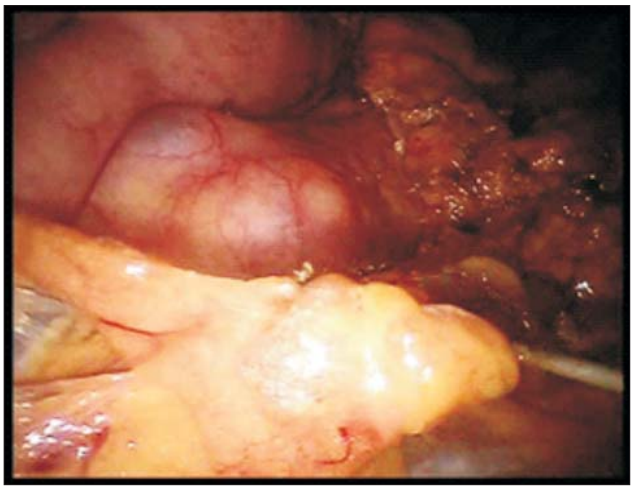

Figure 4 - intraoperative aspect of the tumor

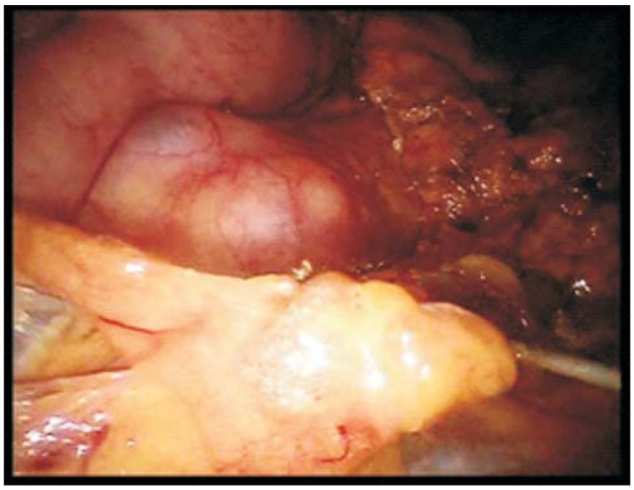

Figure 5 - dissection of the splenic artery

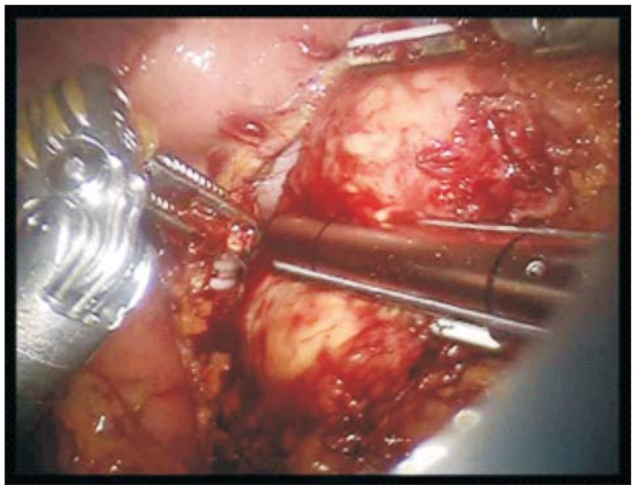

Figure 6 - parenchimal transsection using EndoGIA stapler

along with its insertion in the SMV. After identification of the SMV a tunnel was made between the portal vein and the neck of the pancreas. Any collateral vessels from the PV were identified and coagulated using ultrasound dissection.

After complete tunnelisation the proximal pancreas was divided using an endoscopic stapler (Endo-GIA – white 30 mm cartridge). Right side of the transection line was carefully doubled by interrupted stitches of Prolene 4-0 for perfect hemostasis. (*figure 6*)

The body of the pancreas, including the tumoral mass, was progressively lifted from the splenic vessels using ultrasound dissection. Branches of the splenic vessels towards the pancreas were controlled by using clips (robotic or laparoscopic). After obtaining clear tumoral margins the pancreas was transected by ultrasound dissection. The Wirsung duct was identified and stented using a 8 Fr diameter tube, which was stitched in order to prevent mobilization from the duct. From the edge of the transection line, another centimeter and a half of pancreatic body was mobilized from splenic vessels in order to facilitate pancreatico-gastric anastomosis.

A small incision was made on the posterior wall of the stomach using the ultrasound dissector. The breach was well calibrated according to the diameter of the pancreatic stump. Using resorbable 4-0 stitches the anterior side of the pancreas was anastomosed to the gastric wall (pancreatic parenchyma to gastric seromuscular layer). The fourth robotic arm was used to retract and hold the stomach into a stable position. The posterior side of the anastomosis was done after a thorough inspection of hemostatis was performed. (*figure 7*)

The specimen was placed into a Endobag and extracted through a enlarged assistant's port, which was closed with resorbable 1 sutures. (*figure 8*)

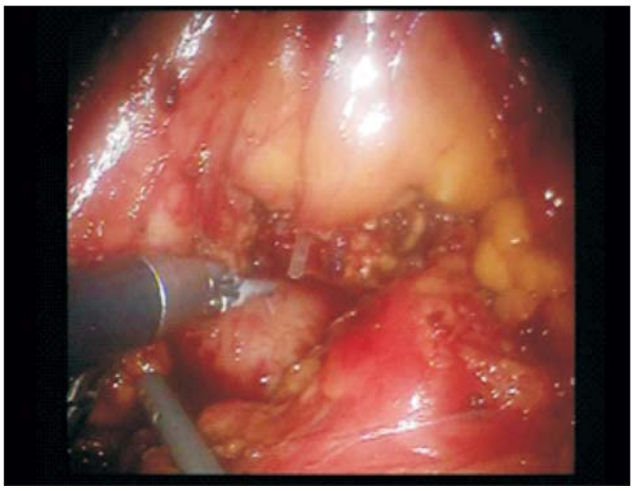

Figure 7 - Pancreatogastrostomy

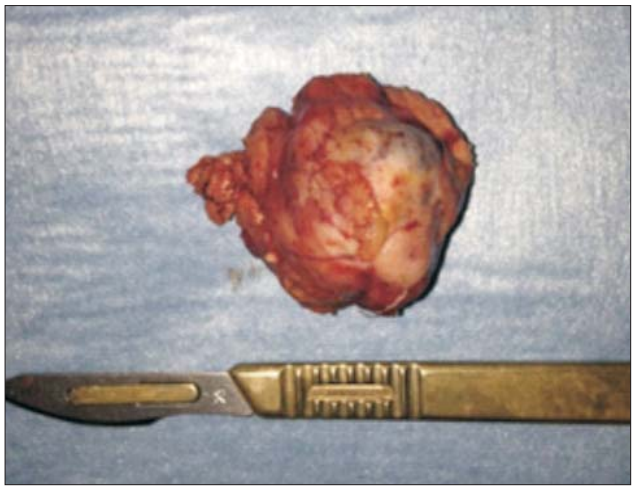

Figure 8 - the specimen

Two drainage tubes were inserted one through the left side robotic port and one through the assistant's port located in the left side. One drainage tube was located under the pancreaticogastrostomy and one near the head of the pancreas (right transected pancreas).

RESULTS

Frozen section examination described a neuroendocrine proliferation. Operative time was 220 minutes with minimal blood loss. The postoperative course was marked by a basal left pneumonia on postoperative day 3 treated conservatively. The patient was discharged home on postoperative day 8 . Pathology showed a 30 mm well differentiated neuroendocrine tumor with free resection margins (NET- G1). Immunohistochemistry revealed a Ki67 index below 2 %.

Postoperative follow-up at one year, with 2 CT exams (6 months and one year) showed no sign of recurrence.

DISCUSSION

Central pancreatectomy, known as Dagradi-Serio-Iacono operation, was first performed in 1982. (6) The main advantages of this procedure are related to the preservation of the exocrine and endocrine functions of the pancreas, as compared with standard pancreatic resections.

A paper published by Xu el al. (7) in 2013 focused on long term outcomes following distal pancreatectomy vs central pancreatectomy showed that patients with DP are more likely to suffer pancreatic exocrine insufficiency and endocrine impairment compared to patients in with central pancreatectomy was performed. Although after central pancreatectomy the rate of complication was higher (including the pancreatic fistula rate), the severe postoperative complications (significant pancreatic leakage, postoperative bleeding and reinterventions) were not significantly different compared to patients after distal pancreatectomy.

Several terms were used to describe the central pancreatectomy: median pancreatectomy, middle segmental pancreatectomy, conservative pancreatic resection and intermediate pancreatectomy. (8)

The initial indications for central pancreatectomy proposed by Iacono et al were: benign and low malignant tumors located in the body of the pancreas (neuroendocrine tumors, serous and mucinous cystadenoma, non-invasive intraductal mucinous neoplasm and solid pseudopapillary tumors), tumors between 2-5 cm unsuitable for simple enucleation, focal chronic pancreatitis with isolated stenosis of the pancreatic duct. (6) Nowadays, the main indication for central pancreatectomy in literature is neuroendocrine tumors. Some case reports showed the benefit of central pancreatectomy in pancreatoblastoma (9) and solitary metastases of the pancreatic neck. (10)

In 2003, Baca and Bokan performed the first laparoscopic central pancreatectomy for a case of cyst adenoma in a 55-year-old woman. (11)

Since then there were published a limited number of papers, most of them case reports and small series. For example, there are only 4 papers published in the literature based on 5 patients or more. (12-15)

The largest series so far was published in 2014 by Byung Song et al. and it was a comparative study. (14) The authors analyzed the results of pancreatectomies performed for lesions located in the neck and proximal

body of the pancreas: 26 laparoscopic central pancreatectomies, 14 open central pancreatectomies and 96 laparoscopic extended distal pancreatectomies. The conclusion of the study was that in selected patients with small and benign tumors in the pancreatic neck and proximal body laparoscopic central pancreatectomy leads to increased postoperative morbidity but earlier postoperative recovery than open central pancreatectomy, and excellent postoperative pancreatic function (compared to laparoscopic extended distal pancreatectomies).

Cunha et al. reports in 2007 a series of 6 laparoscopic central pancreatectomies.(15) In the authors opinion the most critical and difficult part of the procedure in the laparoscopic approach is pancreaticoenteric reconstruction, requiring one third of the total operative time. The pancreaticogastrostomy was the procedure of choice for the reconstruction because was found to be technically easier than pancreaticojejunostomy due to the anatomic proximity of the stomach and the pancreas and because it reduces the number of anastomoses.

The risk associated with pancreaticoenteric reconstruction was the main reason for the slow adoption rate of laparoscopy in central pancreatectomy along with intrinsic limitations of laparoscopy.

Robotic surgery was developed to overcome the technical limitations of laparoscopy (mainly 2D visualization and straight instruments). With improved 3D visualization and Endowrist technology (instruments with 7 degrees of freedom) in robotics the surgeon can perform difficult tasks (fine vascular dissection, sutures) with great accuracy. Robotic surgery offers the opportunity to combine the advantages of both minimally invasive and open surgery. (1)

First robotic central pancreatectomy was performed in 2004 by Giulianotti et al. (16) There are important steps of the surgical intervention that are much more easier performed in robotic approach then in laparoscopy: dissection along the mesenteric vessels, retropancreatic tunnel, identification of the pancreatic duct and pancreaticoenteric reconstruction. (1)

Since then a few papers pointed out the advantages of robotics in central pancreatectomy. (17-20) Current data suggests that robotic central pancreatectomy is a safe and feasible operation and it can be performed with 0 conversion rate to open surgery. The intraoperative bleeding ranged between 190-230 ml. The incidence of pancreatic fistula ranged from 20-71%. For the reconstruction, the preferred modality was posterior pancreaticogastrostomy, but in some papers simple end-to-side pancreaticojejunostomy, duct-to-mucosa pancreaticojejunostomy, transgastric pancreaticogastrostomy were applied.

One of the main drawbacks of robotic surgery, besides the high cost, was the fact that robotic surgery was associated with increased operative time. A comparative study between open and robotic central pancreatectomy was published in 2012 by Cheng et al. (18)and showed an important fact in favor of robotic surgery: operative time required to complete robotic central pancreatectomy was comparable with that required for open central pancreatectomy.

Since the da Vinci® surgical system became available in our institution January 2008, we have performed more than 900 robotic procedures. A selective robotic approach in pancreatic surgery has been adopted: at the beginning we choose to perform simple pancreatic procedures such as enucleations and distal pancreatectomies (procedures already performed in laparoscopic approach). The next step was spleen preserving distal pancreatectomy. After gaining experience we have decided to perform robotic complex procedures such as robotic pancreaticoduodenectomies and central pancreatectomy that we have never performed in the laparoscopic approach. There is a chance robotics could lead to a higher adoption rate of minimally invasive surgery in pancreatic resections. The ideal result would be not an improved cosmesis but a reduction in morbidity rate.

Due to its high cost, robotics will not replace laparoscopic surgery in the fields in which nowadays laparoscopy is already the gold standard. For robotics there is a place in challenging laparoscopic surgeries, where the role of laparoscopy is controversial due to its technical limitations. Pancreatic procedures, especially those that require reconstructions appear to be a suitable candidate for robotic surgery.

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