

Case Report

Pancreaticoduodenal resection with marginal resection of the portal vein: case study

**Belyuk Konstantin Sergeevich, Mahiliavets Edward Vladislavovich,
Poorna Gayan Wattaladeniya*, M. G. W. M. Varsha Priyadarshani**

Department of Surgical Diseases, Grodno State Medical University, Grodno, Belarus

Received: 25 September 2023

Accepted: 01 November 2023

*Correspondence:

Dr. Poorna Gayan Wattaladeniya,

E-mail: gayan.wattaladeniya@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Pancreatic cancer (PC) represents a challenging manifestation of a gastrointestinal tumour, which poses a formidable impediment for healthcare professionals and patients alike. The prognosis for this condition is often discouraging, particularly following a pancreatectomy, which has a poor five-year survival rate. The sole practical cure for PC is surgical resection, despite the negative outcomes. The standard surgical procedure for pancreatic head cancer is pancreaticoduodenectomy (PD). Although PD has been associated with higher morbidity and mortality rates, recent advancements have reduced the risks associated with this operation. When it comes to PC surgery, one promising approach is the resection of the portal vein. This technique has been shown to improve the ability to remove the cancerous tissue (resectability) and to remove it completely (radicality). This study was carried out at the department of pancreatology hepatology and transplantation of organs and tissues, Grodno regional clinical hospital in Grodno, Belarus. Our team treated a patient with pancreatic adenocarcinoma, who underwent a pancreaticoduodenal resection and marginal resection of the portal vein as part of their treatment plan. PD with marginal resection of the portal vein reduces risks and improves patient outcomes, as confirmed by CT and ultrasound data. Further research is needed to expand its efficacy and improve patients' recovery and quality of life post-surgery.

Keywords: Pancreatic head cancer, Portal vein, Superior mesenteric vein, Pancreatoduodenal resection, Gastropancreatoduodenal resection, Hepaticojejunostomy

INTRODUCTION

Pancreatic cancer (PC) is a highly consequential health concern, ranking as the seventh primary cause of mortality across the globe. This is especially pertinent in developed nations.¹ PC is accountable for the fourth-highest number of cancer-related fatalities in the United States.¹ Based on research; it has been discovered that the occurrence of PC within Belarus stands at 4.9 cases per 100,000 individuals. Pancreatic head cancer occurs in 50-60% of cases.² PC is classified into two primary categories, namely exocrine PCs and neuroendocrine PCs. Each group contains several diverse types that might display unique clinical presentations, indications, and

prognoses. Exocrine PC is a type of cancer that develops from exocrine cells. It includes adenocarcinoma, squamous cell carcinoma, adenosquamous carcinoma, and colloid carcinoma. Out of all the different types of exocrine PC, it's important to note that adenocarcinoma is the most frequently occurring type. Neuroendocrine tumours originate from the endocrine glands in the pancreas, involved in the secretion of glucagon and insulin hormones into the blood circulation to regulate blood glucose levels. Pancreatic neuroendocrine tumours are classified into several types, including gastrinoma, insulinoma, glucagonoma, VIPoma, and somatostatinoma. The risk factors associated with PC can be divided into two categories, namely modifiable and

non-modifiable. Modifiable factors include smoking, alcohol consumption, and a diet rich in red and processed meats. Other factors that can be modified include exposure to toxic substances and being overweight or obese. In contrast, non-modifiable factors include age, gender, ethnicity, family history of PC, genetic factors, chronic infections, non-O blood group, and chronic pancreatitis. Several probable hazards have been evaluated, covering both vocational and ecological aspects, gene-environment interactions, and the existence of cystic neoplasms in the pancreas. It is imperative to recognize that inconsistencies in diagnostic instruments and methodologies may result in varied occurrences and mortality rates of PC in developed and underdeveloped countries. Detecting PC at an early stage can be challenging, with only a small percentage of patients, ranging from 5-10%, having operable tumours at the time of diagnosis. Symptoms associated with PC are often vague and can include abdominal discomfort in the upper quadrant, jaundice, and digestive problems, but these symptoms can also be indicative of other conditions, leading to delayed or incorrect diagnoses. A wide variety of diagnostic tests are available to diagnose PC. These include triphasic pancreatic-protocol CT, abdominal ultrasonography, magnetic resonance imaging (MRI), fine-needle aspiration guided by endoscopic ultrasound, and biomarker CA19-9. However, the existing diagnostic biomarker, CA19-9, lacks sensitivity and specificity. Therefore, exploring other potential biomarkers is important. Promising developments comprise the identification of microRNA (miRNA) in serum and circulating tumour cells (CTCs), which display potential for early detection of PC. Diagnostic panels featuring multiple candidate markers are deemed more effective than single markers and should be further evaluated in multi-center studies. While research on biomarkers as a screening tool has been limited, it is imperative to investigate their potential application in population-wide screening programs. Future research ought to prioritize non-invasive testing methods like salivary, urinary, faecal, and serum testing since they are more practical on a population scale. However, the lack of symptoms in early-stage PC can make detection difficult. Furthermore, the wide range of nonspecific symptoms can make diagnosing the disease even more complex, as these symptoms can also be caused by a variety of other conditions.³⁻⁵ A significant trend in pancreatic surgery is the improvement of methods of treatment for PC; direct contact of the pancreas with the aorta and its visceral branches, the portal vein and its tributaries, as well as the inferior vena cava, predispose to the initial prevalence of the process, even with small tumour size.^{1,6} The early spread of the tumour to retroperitoneal tissues, lymph nodes, perineural spaces, and peripancreatic vessels is characteristic of pancreatic tumours.⁷ Due to the technical complexity of the operation, there is an increased risk of postoperative complications and a low survival rate; historically, pancreaticoduodenal resection was rarely performed.⁸ The first successful resection of major duodenal papillae was performed in 1899 by American

surgeon William Halsted.⁹ Vascular invasion is a frequent finding in PC, found in 21-64% of patients depending upon the population studied. From the perspective of arterial vessels, it is essential to thoroughly analyse tumour infiltration in a major trunk such as the celiac axis, superior mesenteric artery, or hepatic artery as it presents a definite contraindication to surgery. Surgery may still be possible even if there is limited involvement in smaller branches like the gastro-duodenal artery. In cases where pancreatic head cancer patients may require the resection of major vessels such as the superior mesenteric artery, superior mesenteric vein, portal vein or celiac axis, it is crucial to conduct a thorough evaluation to determine if the cancer has spread. This evaluation is necessary to ensure that metastasis has not occurred before proceeding with the complex and high-risk procedure of resection. It is important to note that the potential risks and benefits of this procedure should be carefully considered and weighed for the patient's overall health and well-being.¹⁰ Various techniques can be employed to remove the superior mesenteric or portal vein, which depends on the extent of the tumour's spread to the main vessels. These methods include circular resection of the vessels with their intersection in the unaffected section, end-to-end angioplasty, functional vascular prosthesis, longitudinal venography or another type of venography.²

CASE REPORT

Upon arrival at the Grodno regional clinical hospital in Grodno, Belarus, the patient conveyed concerns about skin yellowing and darkening of stool to the department of pancreatology hepatology and transplantation of organs and tissues. These symptoms had been bothering for two weeks before seeking medical attention, and though the patient had experienced abdominal pain, no significant worry was expressed.

The patient's health condition was evaluated as moderate-severe, with visible jaundice on their skin and eyes. A comprehensive range of laboratory and diagnostic tests were carried out, including an MRI and ultrasound of the abdominal cavity. The blood analysis indicated elevated levels of blood transaminases: aspartate aminotransferase (92 U/l) and alanine aminotransferase (135 U/l), with a total bilirubin level of 210 µmol/l, direct bilirubin at 93.7 µmol/l, and, alkaline phosphatase at 364 U/L. The ultrasound indicated an enlarged liver of 2 cm, with increased echogenicity throughout the tissue. The gallbladder with dimensions 110×38 mm, which revealed stagnant contents suspended in it, as well as small stones. The gall bladder preserved its wall consistency even though it was dilated. The examination of the biliary tree revealed the presence of the common bile duct measuring 19-20 mm, accompanied by dilated intrahepatic ducts measuring up to 3-4 mm. Subsequently, upon thorough examination of the pancreas, revealed dimensions, 30 mm of the head, 18 mm of the body, and 23 mm of the tail. Additionally, the contours appeared to be blurred and

the echogenicity in the head region was heterogeneous. The duct of Wirsung was measured to be 3mm in size and demonstrated a decreased level of echogenicity.

MRI scan was conducted on the abdominal cavity, as depicted in Figure 1. It was observed that the liver was in the anatomical state, the right lobe was 119mm along the mid-clavicular line, and the left lobe was 32 mm. No focal pathologies were detected. The intrahepatic bile ducts showed moderate dilation, while the gallbladder was approximately 41 mm in width, with uniform wall thickness and no clear contours. Furthermore, no suspicious formations of calculi were found in the gall bladder, but a level of thicker liquid was detected in the lumen. The common bile duct was expanded to 18.2 mm, with no visible suspicious calculi formations in the lumen. There is a narrowing of the common bile duct at the edge of the pancreatic head with a thickened duct wall at that point. The portal vein measured up to 9 mm in diameter. The pancreas was observed to be situated in its anatomical location and exhibited distinct, irregular contours. However, the signal from the pancreatic parenchyma was diffusely increased, with an irregularly shaped zone in the back of the head that was significantly reduced in signal, measuring approximately 28 by 20 by 25 mm in size. The head of the pancreas measured 31mm, while the body and tail measured 17.5 and 19.5 mm, respectively. The Wirsung duct had a width of 2 mm, the upper limit of normal, and terminated in the head region. The para pancreatic tissue was unchanged.

Findings of MRI-signs of additional tissue formation in the head of the pancreas, chronic pancreatitis, and bile stasis in the gallbladder.

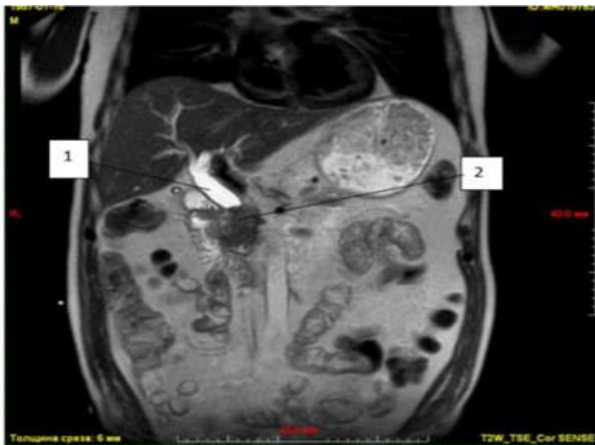


Figure 1: MRI of the hepatobiliary system 1-Common bile duct and 2-head of the pancreas.

After conducting extensive laboratory and instrumental examinations, it has been ascertained that the patient is afflicted with chronic indurative pancreatitis. This condition encompasses anomaly in the pancreatic head, mechanical jaundice, IHD, atherosclerotic cardiosclerosis and atherosclerosis of the aorta. Subsequently, a cholecystostomy was carried out to correct the

hyperbilirubinemia, and conservative treatment was continued. After four days, the patient was discharged under the careful supervision of a surgeon and duly advised to consider returning for readmission once the bilirubin level had been normalized. After 28 days, the patient was re-admitted to the department of pancreatology hepatology and organ and tissue transplantation of the state clinical hospital in Grodno, Belarus, and biochemical blood test was carried out which showed an elevated total bilirubin level of 28 $\mu\text{mol/L}$ and hepatic transaminases, specifically aspartate aminotransferase (78 U/l) and alanine aminotransferase (120 U/l).

On the subsequent day, a follow-up MRI scan was conducted on the abdominal cavity. The findings indicated moderately dilated intrahepatic bile ducts, common bile ducts and collapsed gallbladder. To alleviate this manifestation, a drainage tube was inserted into the gallbladder. Following the drainage, the observed dilated common bile duct, with a current measurement of 16 mm, has exhibited a reduction from its previous measurement of 18.2 mm. Moreover, the common bile duct's wall appeared thickened, and the duct was only visible up to the pancreatic head, more specifically at the head level, the contours of the pancreas appeared distorted, and the signal from the pancreas' parenchyma remained diffusely increased. Additionally, there was an enlargement of the dorsal part of the irregularly shaped head of the pancreas, from 16×28 mm to 20×40 mm. A cyst measuring 14×22 mm was found in the anterior head of the pancreas, causing the head to enlarge to 33 mm and the body to enlarge to 17 mm. The Wirsung duct measured up to 4mm in diameter, and its course was not evident in the head region. The examination also revealed that some para-aortic lymph nodes were enlarged up to 13 mm, while the rest along the vessels of the mesentery were enlarged up to 11 mm. The lymph nodes in the Para pancreatic tissue, at the level of the pancreatic head, were unaffected, and the portal vein diameter was within normal limits, measuring up to 14 mm.

The patient underwent a surgical procedure called a pancreatoduodenal resection, which involves the removal of the head of the pancreas, the duodenum, and other nearby tissues. During this procedure, a marginal resection of the portal vein was also performed. Upon revision of the Liver and Peritoneum, surrounding the pancreas, metastatic infiltration was not found, but there was a noticeable enlargement observed in the pancreatic head concomitant with the existence of a growth resembling a tumour that partially infiltrated the portal vein. In addition, there was a set of enlarged lymph nodes along the gastroduodenal artery. An emergency cytological study was performed, which examined the cells under a microscope to check for abnormalities. The study found a tumour-like formation in the head of the pancreas containing cancer cells. This indicates that the patient has a cancerous growth in the pancreas. Subsequently, mobilization of the duodenum according

to Kocher was performed, which is usually done to expose structures in the retroperitoneum behind the duodenum and pancreas. In terms of the Kocher Maneuver, the gastrocolic ligament was dissected followed by vessel ligation, and the right flexure of the colon was mobilized. The ligation of the right gastroepiploic vein and the superior mesenteric vein (SMV) was then carried out followed by isolation below the pancreatic neck, and then a canal was formed in between the SMV and the pancreatic neck. Afterwards, a dissection of the caudal portion of the hepatogastric ligament was performed lymph nodes along the gastroduodenal artery and the common and proper hepatic artery were dissected. These lymph nodes were then sent for histopathological examination to examine the presence of cancerous cells. The gastroduodenal artery was isolated and ligated after clamping and ascertaining a satisfactory pulsation of the hepatic artery. The portal vein was isolated above the neck of the pancreas and then formed a canal in between the portal vein and the neck of the pancreas. However, after ligation of the branches of the right gastroepiploic artery and vein, and the right gastric artery and vein, resection of the antrum of the stomach was performed followed by cholecystectomy. The common hepatic duct was isolated and transected above the confluence of the cystic duct, while the jejunum was transected at a distance of 10 cm from the ligament of Treitz using an intestinal suture machine. The mesentery of the proximal jejunum and duodenojejunal flexure is ligated and transected. Then trans-section of the neck of the pancreas over SMV and portal vein was performed followed by ligation of upper and lower pancreatoduodenal arteries and veins. The head of the pancreas was mobilized, and it was discovered that the tumour had invaded the portal vein along the right semicircle with a section measuring 3×5 mm. To address this, marginal compression of the portal vein was performed using the Satinsky clamp (Figure 2).

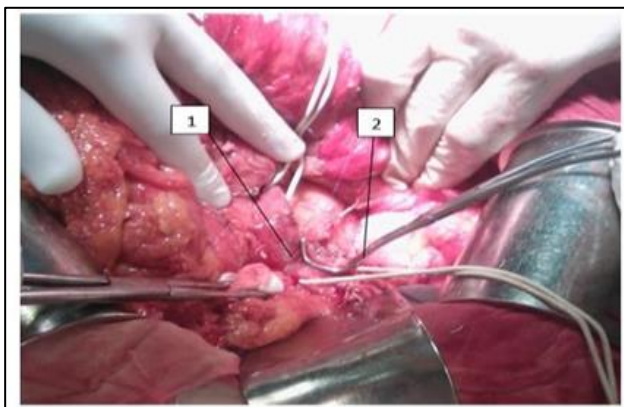


Figure 2: Applying a Satinsky clamp to the portal vein: 1-portal vein; 2-Clamp.

Performed marginal ellipsoid resection of right semicircle of portal vein. Suturing with a twisting suture with polypropylene 5.0 (Figure 3). A satisfactory diameter of the anastomosis and blood flow through vein was stated.

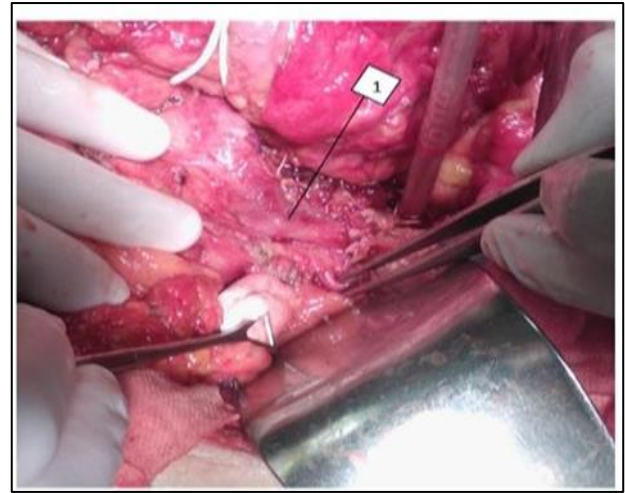


Figure 3: Closure of the portal vein with a twisted suture, 1-Portal vein.

During the surgery, the lymph nodes in the aortocaval region were dissected. The jejunum was moved to the right of the middle colic vessels and positioned on the upper level of the abdominal cavity. The window in the mesentery of the transverse colon, which is a fold of tissue that attaches the colon to the abdominal wall, was sutured closed. Pancreatojejunostomy was formed with a double-row invagination suture "end to side" with atraumatic thread size 4.0. Hepaticojejunostomy was performed at a distance of 8 cm distally with separate interrupted sutures with atraumatic thread size 5.0. Gastrojejunostomy was performed, 40 cm distal to hepaticojejunostomy using a linear suture machine. PVC drains were installed into the operation area's left sub-diaphragmatic space followed by the wound's layer-by-layer suture.

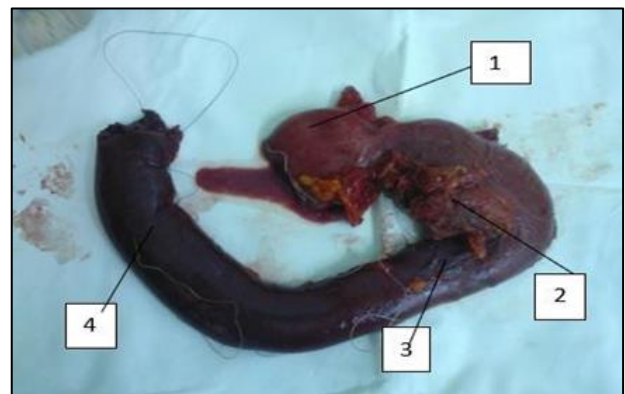


Figure 4: Macroscopic preparation including: 1- Antral stomach, 2 head of the pancreas, 3-duodenum, and 4-proximal 10 cm of the jejunum.

The histological analysis revealed that the patient was suffering from chronic indurative pancreatitis, and was diagnosed with a well-differentiated adenocarcinoma G1, which was found in a cyst located within the pancreas after a comprehensive evaluation. This category of

neoplasm arises from glandular cells and is categorized as low-grade (G1) based on the morphology of the malignant cells when viewed under a microscope. There were no atypical cells discovered in the margins of surgical incisions. The conclusive diagnosis was C 25.0 Disease of the head of the pancreas T2 N0 M0 2b stage, II clinical group. The patient exhibited favourable progress and recovery without any postoperative complications following a successful surgical procedure and was discharged from the facility after a three-week hospital stay. Subsequently, the patient was then assessed four months after the operation. As per the CT and ultrasound data, the portal vein lumen was clear and unobstructed, and there was no indication of progression of the invasion.

DISCUSSION

Pancreatoduodenal resection with marginal resection of the portal vein is a complex surgery that requires a highly qualified experienced surgeon despite poor prognosis in post-operative outcomes. Patients suffering from pancreatic adenocarcinoma are often asymptomatic, especially during the early stages. However, certain individuals might develop jaundice, characterized by yellowing of the skin and eyes, generally due to obstruction of the common bile duct. Furthermore, certain individuals may acquire pancreatic exocrine and endocrine insufficiencies. Exocrine insufficiency may cause a broad range of manifestations, such as steatorrhea (loose, greasy, fatty, frothy, and foul-smelling stools), malabsorption, stomach pain, weight loss, and abdominal bloating, while endocrine insufficiency manifests nausea, vomiting, diarrhoea, and new-onset diabetes mellitus also known as pancreatogenic diabetes.¹¹ The symptoms experienced by a patient with a pancreatic tumour can vary depending on the location and severity of the tumour. For instance, if a tumour is in the head of the pancreas, it may obstruct the common bile duct, causing obstructive jaundice. Jaundice is identified by yellowing of the skin and eyes. This was the case with the patient in question who reported such symptoms. There are several potential risk factors associated with PC preferably smoking (accounting for approximately 20% of cases), age older than 55 years, diabetes, morbid obesity, chronic pancreatitis, cirrhosis of the liver, helicobacter pylori infection, family history (3 or more first-degree relatives affected by the cancer), males more than females are affected, and African Americans are affected more than whites. Around 10% of cases have a genetic cause as genetic mutations such as BCRCA 1 and 2 gene mutations, PRSS1 gene mutation (Familial Pancreatitis), P16 (CDKN2A) gene mutation, KRAS2 gene mutation, or sometimes associated with syndromes such as MEN 1, lynch syndrome, Peutz Jeghers syndrome, Von Hippel Lindau syndrome.^{12,13} Our patient presented with chronic indurative pancreatitis, which included anomaly in the pancreatic head, mechanical jaundice, IHD, atherosclerotic cardiosclerosis, and atherosclerosis of the aorta. Besides, the patient did not disclose any inherited genetic conditions in the family history. The majority of individuals suffering from pancreatic adenocarcinoma

manifest painless icterus (70%) accompanied by an enlarged gall bladder, commonly referred to as Courvoisier's sign. Furthermore, significant weight loss is observed in 90% of patients, and approximately 75% of patients exhibit left upper quadrant abdominal pain upon physical examination. Sometimes pruritus from bile salts in the skin, anorexia, alcoholic stools and dark urine can be seen. Meanwhile, certain individuals may present with recurrent deep vein thrombosis as a result of hypercoagulability, which is commonly referred to as Trousseau's sign, prompting medical professionals to suspect PC. In addition, some patients can also present with new-onset diabetes.¹¹ Before hospitalisation, our patient had been experiencing unusual stomach discomfort in the right upper quadrant, which was overlooked at the time, but the development of painless jaundice signs and yellowing of the skin and eyes led to hospitalization. However, upon physical examination, the patient did not exhibit any signs of recurrent DVT or pruritus other than painless jaundice. Pancreatic adenocarcinoma is a form of cancer that originates from the exocrine cells of the pancreas. Over 90% of adenocarcinomas are duct cell adenocarcinomas, which are often accompanied by other types as well, such as cystadenocarcinoma and acinar cell carcinoma. Approximately two-thirds of the disease occurs in the head of the pancreas, and one-third occurs in the body and tail of the pancreas.¹² A comprehensive histological examination was done on our patient which revealed well-differentiated adenocarcinoma grade 1, which was found in the cyst located within the head of the pancreas after a comprehensive evaluation. PC has a high mortality rate, and early diagnosis is crucial for successful treatment. However, it is difficult to identify PC as it often remains asymptomatic during its initial stages. Based on recent studies, it is imperative to carefully assess the associated risk factors and remain cognizant of non-specific manifestations like painless jaundice, nausea, vomiting, weight loss, poor appetite, right upper quadrant abdominal pain, an enlarged gallbladder, and, in certain instances, hepatomegaly. Additionally, the rational application of endoscopic methods and imaging techniques such as CT, MRI, and ultrasound, along with biochemical analysis of blood transaminase levels (including total bilirubin level, hepatic transaminases such as aspartate aminotransferase and alanine aminotransferase), and tumour markers including CA 19-9 may help to diagnose PC.^{5,10} Upon admission to the hospital for suspected obstructive jaundice, our patient underwent a biochemical analysis on the same day. The analysis revealed increased levels of blood transaminases, such as aspartate aminotransferase (AST) and alanine aminotransferase (ALT), as well as levels of total and direct bilirubin, and alkaline phosphatase (ALP). In this case, ultrasound and MRI were used to further differentiate the cause of the obstructive jaundice. The ultrasound revealed an enlarged liver with elevated echogenicity, stagnant contents, and small stones in the gallbladder. Additionally, the sonography results indicate a slightly enlarged common bile duct and intrahepatic ducts along with blurred contours and heterogenous echogenicity in the head region of the pancreas.

Furthermore, the duct of Wirsung demonstrated a reduced level of echogenicity. An abdominal MRI revealed a normal liver, moderately dilated intrahepatic bile ducts, and a dilated common bile duct with narrowing at the level of the pancreas head. The gallbladder had uniform wall thickness and no clear contours, with thicker liquid in the lumen. The pancreas had distinct, irregular contours, with diffusely increased signal from the pancreatic parenchyma and an irregularly shaped zone in the back of the head that was significantly reduced in signal. A cholecystostomy was then performed to relieve signs of hyperbilirubinemia which was not effective as the patient was re-admitted to the hospital after 28 days with increased levels of total bilirubin and hepatic transaminases. On the subsequent day, an MRI follow-up was carried out, which revealed moderately dilated intrahepatic bile ducts, a common bile duct, and a collapsed gallbladder. Meanwhile, a drainage tube was placed in the gall bladder to reduce the dilatation of the common bile duct. Moreover, the pancreas manifested distorted contours, a diffusely amplified signal, an enlarged head, and a cyst in the anterior region. Subsequently, tumour marker analysis for PC was carried out, which revealed elevated CA 19-9 levels in the blood, indicating a positive result.

Pancreatectomy remains the most widely used surgical procedure for the treatment of PC, even though there is considerable disagreement regarding this approach. Studies have demonstrated classical PD, i.e. radical resection of PC, regional pancreatectomy, total pancreatectomy, expanding pancreatectomy, and pylorus-preserving PPD have been used in clinical practice. Moreover, standard PD was proposed for PC in Italy in 1998. SPD refers to PD with the dissection of the lymph nodes in the right hepatic ligament, precancerous pancreatic lymph nodes, hepatic artery group and the superior mesenteric artery. In contrast, the Extended PD is involved in vascular resections including the portal vein, superior mesenteric veins and many more. If local excision or SPD surgery can't remove tumours with negative margins, vascular resection and reconstructions and/or extended scope of LN dissection are required.¹⁴ In terms of lymphadenectomy, extended lymphadenectomy and standard lymphadenectomy do not show any significant differences. Nevertheless, it must be noted that extended lymphadenectomy prolongs the operation time. Furthermore, procedures that involve celiac plexus resection can cause severe complications like diarrhoea and delayed gastric emptying.¹¹ Pylorus-preserving PD is used to treat PC and offers several advantages over other surgical procedures, such as reducing the operation time, simplifying the procedure, and improving patients' quality of life. Both PPPD and SPD have been found effective in treating pancreatic and ampullary cancer, according to clinical research. However, there was no statistically significant difference in disease-free survival rates observed between PPPD and SPD techniques. Total pancreatectomy (TP), is a type of whole pancreas resection used to treat tumours that have spread to the whole pancreas but have no liver or peritoneal metastasis. While TP is supposed to increase the opportunities for

radical resection and reduce post-operative complications, a study by Casadei et al suggests that TP does not lead to improved survival rates in individuals with PC and may be connected to a range of metabolic and nutritional complications, particularly secondary diabetes (pancreatic diabetes).¹⁴ Pancreatic diabetes differs from diabetes mellitus type 1 and 2 by its hyperglycaemia and insulin sensitivity. Moreover, pancreatogenic diabetes can lead to hypoglycemic attacks due to increased insulin sensitivity and reduced glucagon levels. Pancreatic resection for pancreatogenic diabetes has good short-term and long-term survival outcomes, but can negatively impact quality of life in terms of travel and physical activity. Moreover, total pancreatectomy can lead to weight loss or weight gain, changes in bowel movements, and the need for pancreatic enzyme supplements; however, liver and renal functions remain normal, and nutritional markers remain within normal ranges. Therefore, TP should only be used in patients with strictly controlled clinical indications.¹⁵ Our patient underwent a pancreaticoduodenal resection. The procedure involved a marginal ellipsoid resection of the right semicircle of the portal vein, which was sutured using polypropylene 5.0. The anastomosis was satisfactory and blood flow was confirmed. Aortocaval lymph nodes were dissected, and the jejunum was moved to the right of the middle colic vessels. The window in the mesentery of the transverse colon was sutured. Pancreatojejunostomy, hepaticojejunostomy, and gastrojejunostomy were performed. The patient recovered without complications. Four months later, a follow-up CT and Ultrasound revealed a clear portal vein lumen and no evidence of invasion progression. Despite the availability of various surgical approaches, post-operative survival rates have not improved significantly over the years. A recent review has shown that new therapeutic approaches, including maintenance switching with cytotoxic therapies, the use of targeted drugs for patients with actionable variants, and induction maintenance therapy have improved the outcomes for end-stage PC patients. Adjuvant therapy is a treatment given after surgery to prevent the recurrence of PC. Current guidelines recommend adjuvant therapy, but its value has been questioned. Chemotherapy for metastatic disease is not curative and can have toxic side effects. Treatment options include combination therapy with FOLFIRINOX or gemcitabine plus nab-paclitaxel or gemcitabine alone. Response to treatment is assessed with imaging studies, serum markers, and changes in symptoms. Locally advanced PC may be treated with SBRT, a high-dose targeted radiation therapy over a short time. Common side effects include fatigue and nausea. A new therapy called IRE (irreversible electroporation) may be useful in treating locally advanced PC, as it achieves soft tissue ablation without causing coagulative necrosis. However, the activity of immunotherapies has been unsatisfactory and further research is needed. Overall, continued research and development in the systemic treatment of PC is important to improve patient outcome.^{11,16} In our case, adjuvant therapy was not indicated, as the patient had a well-differentiated adenocarcinoma tumour (G1

(T2 N0 M0 2b stage, II clinical group), locally advanced without any metastatic signs to the liver and peritoneum, and post-operative investigations suggested there is no recurrence of the tumour invasion. However, our approach to PC treatment has yielded favourable outcomes, while more investigation must be conducted to support its efficacy in a wider population.

CONCLUSION

A pancreaticoduodenal resection with marginal resection of the portal vein was performed. No metastasis infiltration or invasion was noted upon revision of the liver and peritoneum. It was observed that the pancreatic head has increased in size and a tumor-like formation is partially invading the portal vein. An emergency cytological study has revealed the existence of a group of cancer cells from the said tumour-like formation located in the pancreatic head. The esteemed procedure of mobilizing the duodenum according to Kocher was diligently executed, followed by a meticulous dissection of lymph nodes along the gastroduodenal artery, as well as the common and proper hepatic artery. The gastroduodenal artery was isolated and ligated. The stomach antrum was resected, and a cholecystectomy was done. The jejunum was transected and the pancreatic neck was trans-sectioned over SMV and portal vein. Ligation of upper and lower pancreatoduodenal arteries and veins was performed. It was detected that the tumor had invaded the portal vein along the right semicircle with a 3 by 5 mm section, following mobilization of the pancreatic head. A marginal ellipsoid resection of the right semicircle of the portal vein was performed, followed by suturing with a twisting suture with polypropylene 5.0. A satisfactory diameter of the anastomosis and blood flow through the vein were stated. Additionally, lymph nodes of the aorto-caval region were dissected. Pancreatojejunostomy, hepaticojejunostomy, and gastrojejunostomy were performed, and PVC drains were installed into the left sub-diaphragmatic space of the operation area. The wound was sutured layer by layer.

Based on clinical and histopathological studies, it is advised that portal vein resection should only be considered for PC patients if there are cancer-free surgical margins of the portal vein. It is crucial to understand that portal vein resection is a complex procedure that demands exceptional skills. Only proficient surgeons who specialize in PC surgery should attempt it. Nevertheless, Portal vein resection can be a valuable tool in fighting against PC with the right surgical team and approach.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: Not required

REFERENCES

1. Rawla P, Sunkara T, Gaduputi V. Epidemiology of Pancreatic Cancer: Global Trends, Etiology and Risk Factors. *World J Oncol.* 2019;10(1):10-27.
2. Clinical guidelines for the diagnosis and treatment of malignant tumours of the pancreas. Moscow, Russia, 2014;31-8.
3. Mostafa ME, Erbarut-Seven I, Pehlivanoglu B, Adsay V. Pathologic classification of 'pancreatic cancers': Current concepts and challenges. *Chinese Clin Oncol.* 2017;6(6):59.
4. Park W, Chawla A, O'Reilly EM. Pancreatic Cancer: A Review. *J Am Med Asso.* 2021;326(9):851-62.
5. O'Neill RS, Stoita A. Biomarkers in the diagnosis of pancreatic cancer: Are we closer to finding the golden ticket? *World J Gastroenterol.* 2021;27(26):4045-87.
6. Bachellier P, Nakano H, Oussoultzoglou PD, Weber JC, Boudjema K, Wolf PD et al. Is pancreaticoduodenectomy with mesentericoportal venous resection safe and worthwhile? *Am J Surg.* 2001;182(2):120-9.
7. Picozzi VJ, Kozarek RA, Traverso LW. Interferon-based adjuvant chemoradiation therapy after pancreaticoduodenectomy for pancreatic adenocarcinoma. *Am J Sur.* 2003;185(5):476-80.
8. Beger HG. Diseases of the Pancreas Current Surgical Therapy. Beger HG, Cameron JL edi. Berlin: Heidelberg. 2008;527-39.
9. Are C, Dhir M, Ravipati L. History of pancreaticoduodenectomy: Early misconceptions, initial milestones and the pioneers. *HPB.* 2011;13:377-84.
10. Buchs NC, Chilcott M, Poletti PA, Buhler LH, Morel P. Vascular invasion in pancreatic cancer: Imaging modalities, preoperative diagnosis and surgical management. *World J Gastroenterol.* 2010;16:818-31.
11. Vareedayah AA, Alkaade S, Taylor JR. Pancreatic Adenocarcinoma. *Mo Med.* 2018;115(3):230-35.
12. Puckett Y, Karen G. Pancreatic Cancer Continuing Education Activity. Treasure Island (FL): StatPearls Publishing. 2023.
13. Maitra A, Hruban RH. Pancreatic cancer. Mechanisms of Disease. *Ann Rev Pathol.* 2008;3:157-88.
14. Li HY, Cui ZM, Chen J, Guo XZ, Li YY. Pancreatic cancer: diagnosis and treatments. *Tumor Biol.* 2015;36(3):1375-84.
15. Coco D, Leanza S, Guerra F. Total Pancreatectomy: Indications, Advantages and Disadvantages - A Review. *Maedica (Bucur).* 2019;14:391-6.
16. Brown TJ, Reiss KA, O'Hara MH. Advancements in Systemic Therapy for Pancreatic Cancer. American Society of Clinical Oncology Educational Book. 2023;43:e397082.

Cite this article as: Sergeevich BK, Vladislavovich ME, Wattaladeniya PG, Priyadarshani MGWMV. Pancreaticoduodenal resection with marginal resection of the portal vein: case study. *Int Surg J* 2023;10:1993-9.