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CORPOROCAUDAL PACREATECTOMY WITH RESECTION OF THE COELIAC TRUNK WITHOUT ARTERIAL RECONSTRUCTION

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ABSTRACT

Introduction: Super-extended surgeries performed for locally advanced distal pancreatic cancer are extremely rare and unique procedure, which require high experience and top tier hospital level. Aim of the study is to share our own clinical experience of radical corporocaudal pancreatectomy with resection of the coeliac trifurcation. **Case Presentation:** A 54-year-old female patient, from Uzbekistan, with locally advanced pancreatic (corporocaudal localization) cancer. At initial diagnosis ultrasound revealed formation, measuring 62x37x48 mm. Contrast-enhanced MSCT demonstrated the mass, measuring 37×53×27 mm. The celiac trunk has a diameter of 6.0 mm, with a 20% stenosis at its origin and 30% stenosis at its trifurcation. The common hepatic artery in its proximal third is narrowed to 2.2 mm (55%) over a length of 9 mm; the splenic artery in its proximal third is narrowed to 1.8–2.5 mm (50–65%) over 2.5 cm; the left gastric artery shows critical narrowing at its origin (up to 80%). Core biopsy revealed a pancreatic adenocarcinoma. Given the initial stage of the disease, 8 cycles of chemotherapy with FOLFIRINOX scheme were administered to the patient. Control MSCT revealed the stabilization of the process. Given the local advancement, ineffectiveness of chemotherapy and absence of distant metastases, the multidisciplinary tumor team proposed performing a combined surgical intervention – modified Appleby operation was performed with simultaneous resection of the coeliac trunk with its branches: common hepatic, splenic and left gastric arteries. **Conclusion:** Neoadjuvant chemotherapy for locally advanced pancreatic cancer makes possible surgical treatment for initially unresectable cases. In the presence of collaterals that allow maintaining satisfactory blood supply to the liver, it is advisable to perform distal pancreatectomy with resection of the celiac triangle.

KEYWORDS: pancreatic cancer, coeliac trunk, Haller's trifurcation, coeliac axis resection, Appleby's surgery.

INTRODUCTION

The development of modern medical technologies and the modernization of the intensive care service have expanded the possibilities for performing extended interventions for pancreatic cancer (PC). Over the past 30 years, several super-extended operations have been performed for locally advanced distal PC. In particular, there are research on the possibility of achieving good results with systemic and radical surgical treatment of locally advanced PC.[1,2,3,4,5]

Usually, the circular involvement of the main arterial structures in the pathological process is a sign of unresectability. However, as experience growth, various authors are convinced that despite the high mortality and severe complications, the performance of such operations contributes to an increase in oncological effectiveness. The increased risk of surgical aggression is undoubtedly due to the performance of arterial resection. In this case, the median survival varies from 6 to 43 months. The implementation of neoadjuvant chemotherapy regimens helps to justify such surgical aggression, as well as to adequately select patients for extended distal pancreatectomy.[6,7,8,9,10,11,12,13,14,15,16]

Distal pancreatectomy with resection of the celiac axis was first proposed by Appleby in 1952 to increase the curative volume of gastrectomy for gastric cancer [(4)]. First time for the PC, the method was used in 1976.[17,18] Subsequently, with preservation of the stomach, the method was called the modified Appleby operation. This operation is anatomically based on the development of

arterial collateral blood supply to the head of the pancreas (PG), liver and stomach from the a. pancreatoduodenalis inferior, a. gastroduodenalis and a. gastrica dextra.

The first documented series of celiac axis resections (CARs) for pancreatic distal adenocarcinoma (PDAC) involving six patients was published in 1997. In 2005, Makary and his team at Johns Hopkins became the first group in the U.S. to report performing an en-bloc celiac resection combined with a distal pancreatectomy for PDAC. Since those early reports, most CAR procedures have been described in small patient series or individual case reports, and the surgery remains relatively uncommon in the United States. Data from the American College of Surgeons NSQIP showed that out of 822 cases across 43 institutions, only 20 (2.4%) involved CAR. A more recent European retrospective study involving 20 hospitals across 12 countries included just 68 patients who underwent the procedure.

In some cases of arterial aberrations associated with anatomical features of the branches of the celiac trunk - a separate left hepatic artery or onset of the a. hepatica dextra from the celiac trunk. Achieving a resection level of R0 may require resection or excision of one of the hepatic arteries in addition to resection of the celiac trunk. Given the increased risk of liver ischemia, reconstruction of the arterial blood supply is advisable. However, according to Glebova N. et al.[19] and Ozer I. et al.[20] due to the involvement of portal vein confluence to the tumor or increased risk of pancreatic fistula, resection of the gland at the level of the isthmus is considered unsuccessful. Therefore, many authors are inclined to perform resection at the level of the body of the pancreas.

Studying the current state of surgical treatment options for locally advanced distal PC, to share our own clinical experience of radical corporocaudal pancreatectomy with resection of the gland at the level of the isthmus and with resection of the triangle of the celiac axis (Haller's triangle) without arterial reconstruction.

CASE PRESENTATION

A 54-year-old female patient was admitted to the oncology center complaining of general weakness, a feeling of heaviness and pain in the epigastric region and at the level of the lumbar vertebrae. The first signs of pain were noted 2 months before admission to the hospital and are not associated with any other physical condition. Oral nutrition is preserved, in 2 months the patient lost 1.5-2 kg. Upon examination, the woman is overweight with a body mass index of 27.8 kg/m^2. She has no smoking and alcohol consumption history. From the anamnesis, she suffered from viral hepatitis A in childhood, and COVID -19 infection in 2021. No other somatic pathologies were diagnosed.

Examinations: complex examination methods were carried out to adequately assess the resectability of the process and to clarify the stage of the disease according to the standard, adopted in Uzbekistan. Consequently, during laboratory studies, the alpha-amylase level in the blood was 268.98 U/L and the expression of CA 19-9 was 342 U/ml. Other indicators of the biochemical composition of the blood, general blood test and hemocoagulogram were within normal values.

Ultrasound scanning of the abdominal cavity and pelvis revealed the presence of a heterogeneous formation of irregular shape, measuring 62x37x48 mm with uneven contours. The liver has a fine-grained structure, no intraparenchymatous formations were detected. The spleen measures 102x40 mm, the contours are even, crescent-shaped. The tissue is homogeneous. No pathology was detected on the part of other organs and systems of the abdominal cavity, retroperitoneal space and pelvis.

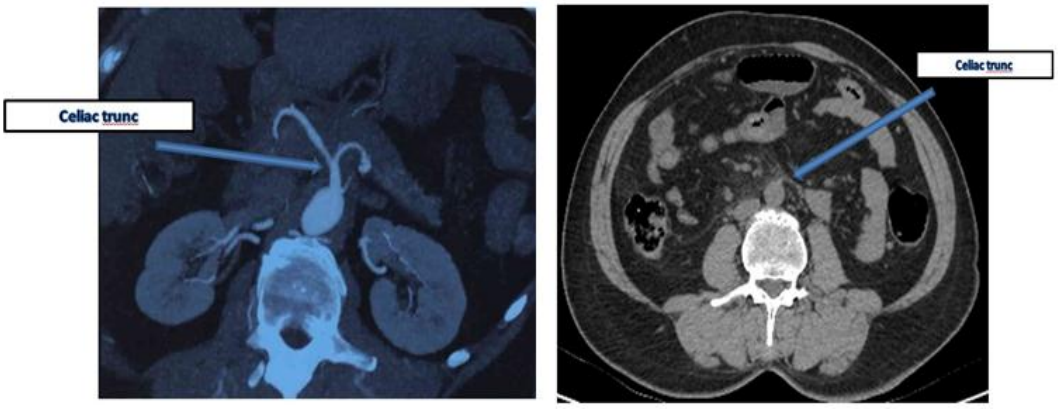

Fig 1: A. MSCT angiography before neoadjuvant chemotherapy. B. MSCT angiography after 8 cycles of neoadjuvant FOLFIRINOX regimen.

Before polychemotherapy, a contrast-enhanced MSCT was performed using 80 ml of contrast agent Unigexol 350 mg. In the arterial phase of contrast enhancement (Fig. 1a).

The celiac trunk has a diameter of 6.0 mm, with a 20% stenosis at its origin. In the region of the celiac trunk trifurcation (Haller's point), there is a 30% stenosis. It's branches:

1. The common hepatic artery in its proximal third is narrowed to 2.2 mm (55%) over a length of 9 mm; distally, the lumen is 4.4 mm.
2. The splenic artery in its proximal third is narrowed to 1.8–2.5 mm (50–65%) over 2.5 cm; distally, the lumen reaches up to 4.5 mm.
3. The left gastric artery shows critical narrowing at its origin (up to 80%), then measures up to 2.5 mm.

The superior mesenteric artery has a diameter of 5.6 mm. The pancreas is deformed, with a mass located in the projection of the isthmus and body of the pancreas. The mass is irregularly shaped, with relatively well-defined but uneven contours, measuring 37×53×27 mm. It has a heterogeneous structure and appears to encase and infiltrate (invade?) the region of the celiac trunk trifurcation and the origins and proximal thirds of its branches, causing luminal narrowing (with indistinct contours). The Wirsung's duct is dilated up to 7 mm in the region of the tail.

After 8 cycles of chemotherapy with FOLFIRINOX scheme, a control MSCT was performed with contrast, by introducing the contrast agent Biomexol 100 ml 350 mg (Fig. 1b), where the visual characteristics of the tumor, its relation to the main vessels and the presence of other signs of locoregional spread, as well as the presence of collateral blood supply to the head of the pancreas were assessed. With contrast tomography, the pancreas was visualized with a head size of 34 mm, body - 30 mm and tail 20 mm with a density variation of +46+50 H units. In the body area extending to the tail, a formation with uneven fuzzy contours is visualized, measuring 43x46x36 mm with a native density of +27+30 H units, in the arterial phase +33+42 H units, in the portal phase +58+72 H units, in the parenchymatous phase +55+81 H units. The formation adjacent to the antral part of the stomach. The surrounding tissue is infiltrated, which extends to the mesentery of the small intestine. The Wirsung duct distal to the formation is 5 mm. The lumen of the splenic artery at the level of the formation is deformed, moderately narrowed. The distal parts of the celiac trunk, its bifurcation, the proximal part of the common hepatic and left gastric arteries pass along the contour of the formation.

V. portae and v. mesenterica superior at the level of confluence are tightly adjacent to the formation and were involved in tumor in 3 cm long. The lumen of v. lienalis at the level of the formation is not contrasted for 40 mm. Parapancreatic lymph nodes are from 7 to 23 mm in maximal size.

In the arterial phase of contrasting, the walls of the abdominal aorta and its branches are unevenly thickened due to mixed-type plaques. In the venous phase, the lumen of the remaining veins is uniformly contrasted, without defects. No pathological changes were detected on the part of other organs and systems during the MSCT study.

Conclusion of MSCT: volumetric formation of the pancreas body with invasion of the splenic artery, inferior mesenteric vein, thrombosis of the splenic vein. Narrowing of the lumen of the portal and superior mesenteric veins in the confluence area. Enlarged retroperitoneal and mesenteric lymph nodes.

During MSCT angiography, blood supply to the head of the pancreas from the left gastric artery, as well as from the gastroduodenal artery and the right gastroepiploic artery were revealed.

Gastroduodenoscopy visualized moderate gastritis. No changes were detected on the part of the large duodenal papilla, secretion is released without obstruction. Also, echocardiography and chest X-ray revealed no pathological changes.

Final diagnosis and treatment strategy. Based on the conducted research methods, taking into account laboratory parameters, results of instrumental research methods and data of contrast MSCT, the patient was clinically diagnosed with a tumor of the body and tail of the pancreas with invasion into the celiac trunk, common hepatic and left gastric artery, splenic vein. Given the local advance and absence of distant metastases, the general condition of the patient, the multidisciplinary tumor team proposed performing a combined surgical intervention. Accordingly, on March 28, 2025, after standard preparation of the patient, a modified Appleby operation was performed with simultaneous resection of the coeliac trunk with its branches: common hepatic, splenic and left gastric arteries.

The surgery was started with upper-middle midline laparotomy with standard mobilization of the pancreas in the caudal direction. Intraoperatively, involvement of the celiac trunk, proximal parts of the common hepatic area and left gastric artery in the pathological process was confirmed. The formation was 6x5 cm in size, occupied the entire body and tail of the pancreas, mobility was limited. The splenic artery and vein were ligated and transected at the level of the upper border of the transition from the body to the tail of the pancreas, where the splenic vessels were uninvolved by the pathological process.

Then, taking into account the tumor infiltration to the isthmus of the pancreas, resection was performed at the level of the isthmus without preliminary application of a mechanical suture to the pancreatic tissue. The stump of the Wirsung duct was ligated, and the stump of the pancreas was sutured with maximum approximation of the anterior and dorsal leaflets of the fascial membrane of the pancreas with careful hemostasis. Having

previously mobilized the posterior surface of the pancreas and completely mobilized spleen, the proximal parts of the common hepatic, splenic and left gastric arteries were mobilized with distal resection of vessels. In this case, mobilization and resection of the left ventricle was performed with preservation of the aberrant left hepatic artery. Then, the celiac trunk was mobilized with exposure of the bifurcation (Fig. 2).

Fig 2: Resection of coeliac trunk and its branches.

By resecting the celiac trunk, the pancreas was removed as a single block with vascular structures. Then, local lymph node dissection was performed (Fig. 3). Taking into account the collateral blood supply and the presence of the left additional hepatic artery and visual assessment of the adequacy of the hepatic blood supply (Video), vascular reconstruction of the common hepatic artery considered unnecessary. Affected part of the portal vein confluence was resected (Fig. 4), with consequent end-to-end anastomosis (Fig. 5).

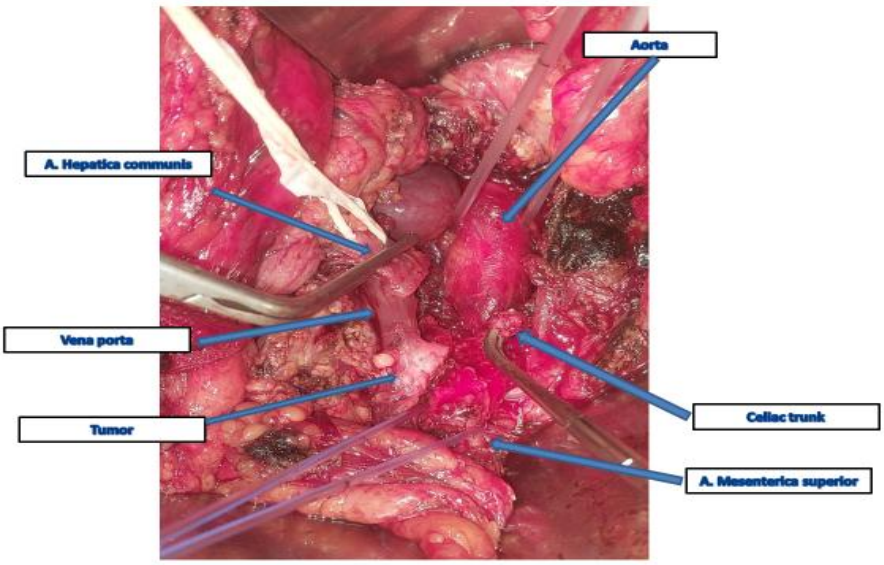

Fig 3: Lymph node dissection around coeliac trunk. Resection of coeliac trunk and Haller's trifurcation. Resection of pancreatic tumor at the confluence of portal vein.

When studying the macroscopic specimen, tumor ingrowth into the main vessels was confirmed. Postoperative histological report (from 04.04.2025): therapeutic pathomorphosis 3rd degree, pancreatic adenocarcinoma. Confirmed invasion to spleen, coeliac trunk and portal vein.

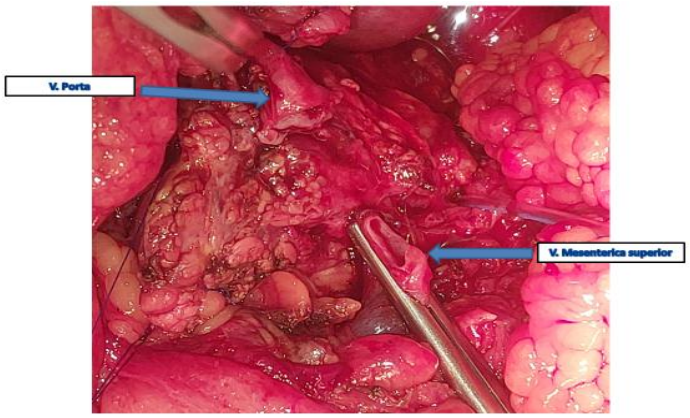

Fig 4: Resection of veins. 1) Portal vein. 2) Upper mesenteric vein.

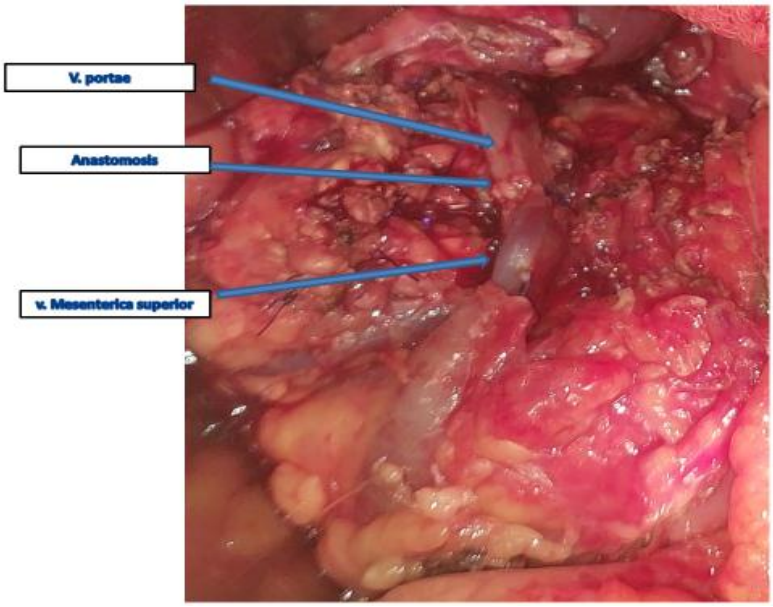

Fig 5: Portal-mesenteric end-to-end anastomosis.

The postoperative period was uneventful. Drains were removed on the 7th day of the postoperative period. Control ultrasound imaging did not reveal any pathology on the bedside of the removed structures.

DISCUSSION

Previous studies indicate that satisfactory immediate and long-term results can be achieved in carefully selected patients with borderline resectable or locally advanced forms of distal prostate cancer, especially after neoadjuvant chemotherapy.[6,7,13,16,21]

The safety and success of DP - CAR directly depends on the experience of the surgical team and the capabilities of the hospital.[22,23,24,25,26,27,28,29] At the same time, the effectiveness of the surgery and the achievement of satisfactory results are based on adequate patient selection, a modern neoadjuvant chemotherapy regimen, prevention of postoperative complications and the absence of arterial reconstruction.[13,15]

According to the 2020 review by Mark J. Truty and colleagues, a 3-tier classification system for pancreatectomy with CAR was developed using preoperative cross-sectional imaging (multiphase CT/MRI), intraoperative findings, types of resections performed, and final pathology. This system categorizes tumors based on their location, which in turn determines the extent of arterial resection needed, the type of pancreatectomy to be performed, whether arterial reconstruction is necessary, and the likelihood of requiring elective gastrectomy due to ischemia caused by surgery.[30]

Class 1 tumors are those involving the main celiac axis and its proximal branches, without reaching the bifurcation of the proper hepatic artery and gastroduodenal artery (Fig. 6). This class is further divided into three subtypes:

1. Class 1A includes standard Appleby or distal pancreatectomy with celiac axis resection (DP-CAR) procedures. These cases have sufficient collateral circulation after celiac axis resection, where hepatic blood flow is maintained through the pancreaticoduodenal arcades from the superior mesenteric artery to the GDA and PHA. Gastric

perfusion is preserved through the right gastric and gastroepiploic arcades.

2. Class 1B refers to "modified Appleby" procedures where intraoperative evaluation reveals that collateral blood flow is inadequate. In these cases, formal reconstruction of the hepatic artery is required to prevent ischemic complications.
3. Class 1C also involves insufficient collateral flow, similar to 1B, but additionally necessitates gastrectomy—either because dual gastric perfusion cannot be maintained even with hepatic artery reconstruction, or due to direct tumor invasion into the stomach, making it unresectable without removing part of the stomach.

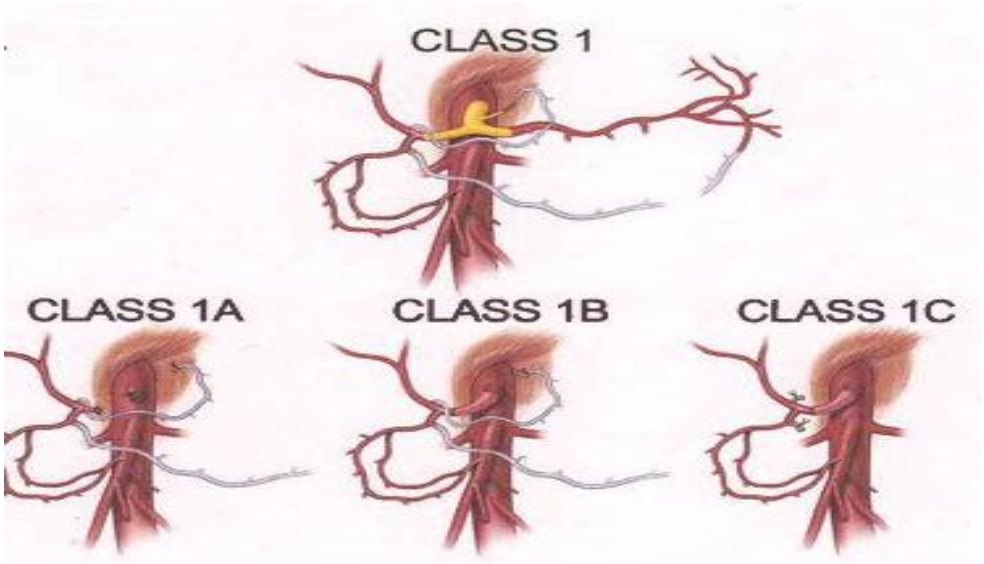

Fig 6. Celiac axis resection with variants.

DP - CAR is a highly aggressive and complex surgery, due to the need to resect a significant number of anatomic structures, tissues and large vessels. In some cases, to ensure the radicality of the surgery, it may be necessary to perform a resection of the hepatic artery. However, this situation can also cause the refusal of the operation or risky arterial reconstructions. Also, total damage to the body and tail of the pancreas requires resection at the level of the isthmus or head of the pancreas, which in most cases, due to the high risk of damage to additional structures, is the reason for refusing radical treatment.[31,32]

Our experience demonstrates the possibility of performing super-extended combined interventions in widespread distal pancreatic cancer. Resection of the gland at the isthmus level is advisable in case of damage to the mesenteric-portal venous anastomosis, which can be restored by veno-venous anastomosis without increasing the risk of surgery. Preoperative and intraoperative assessment of collateral blood supply to the liver and head of the pancreas facilitates resection of the trifurcation of Haller (celiac trunk) without reconstruction of the common hepatic artery.

The possibility of collateral arterial blood supply to the liver and stomach after resection of the celiac trunk was first described by N. Michels on cadavers, which was confirmed clinically by Appleby. After DP - CAR, the liver is supplied with blood through its own hepatic artery and the pancreatico-omental artery, which originates from the superior gastrico-diodenal artery and inferior pancreatico-diodenal artery, which are considered permanent vessels.[33] Anatomical studies by N. Michels showed the absence of intraparenchymal significant direct connections between the hepatic arteries against the background of the presence of various collateral arterial pathways. Consequently, some authors[34] report the possibility of performing several variations of extrahepatic vascular anastomoses between the RHA and LHA, LHA and LGA, CHA or RHA with GDA. T. Thoma et al.[35] comparing CT and angiography data showed the presence of permanent communicating arteries between the RHA and LHA, which are permanent interlobar collaterals of the liver, responsible for the arterial network of the liver portal.

CONCLUSIONS

Conducting neoadjuvant chemotherapy for locally advanced distal pancreatic cancer contributes to the revision of the possibilities of surgical treatment for initially unresectable cases.

In the presence of preoperatively established collaterals that allow maintaining satisfactory blood supply to the liver, it is advisable to perform distal pancreatectomy with resection of the celiac triangle. In this case, resection of the gland at the level of the isthmus of the gland with restoration of the mesenteric-portal venous communication contributes to achieving R0 radicality and good immediate results.

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Authors' contribution

Yusuf Kendjaevich Yakubov, Surat Nematovich Temirov and Bobur Bakhtiyarovich Saipov performed the surgery and collected clinical data. Mirzagaleb Nigmatovich Tillyashaykhov and Abrorjon Akhmedjanovich Yusupbekov drafted and edited the manuscript. All authors of the research have read and approved the final manuscript to publication. Each author agrees to be held accountable for all aspects of the research.

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethics approval received

Ethical committee of the Republic specialized scientific practical medical center of oncology and radiology of Ministry of Healthcare of the Republic of Uzbekistan. Date 10.04.2025, Auditee number: №11/25.

Consent of publication

Written consent, of the patient and her relatives, to publication of her case, examinations' results, illustrations from surgery etc. in international research sources was obtained without patient's photo and name.

All authors declare no competing interests

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