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Corresponding Author	FamilyName	**Pavel**
	Particle	
	Given Name	**Mihai C.**
	Suffix	
	Division	Servei de Cirurgia General i de l'Aparell Digestiu, Institut d'Investigació Sanitària Pere Virgili (IISPV)
	Organization	Hospital Universitari de Tarragona Joan XXIII, Universitat Rovira i Virgili (URV)
	Address	Dr Mallafré Guasch, 4, 43005, Tarragona, Spain
	Phone	
	Fax	
	Email	mpavel.hj23.ics@gencat.cat
	URL	
	ORCID	
Author	FamilyName	**Jorba-Martin**
	Particle	
	Given Name	**Rosa**
	Suffix	
	Division	Servei de Cirurgia General i de l'Aparell Digestiu, Institut d'Investigació Sanitària Pere Virgili (IISPV)
	Organization	Hospital Universitari de Tarragona Joan XXIII, Universitat Rovira i Virgili (URV)
	Address	Dr Mallafré Guasch, 4, 43005, Tarragona, Spain
	Phone	
	Fax	
	Email	rjorba.hj23.ics@gencat.cat
	URL	
	ORCID	http://orcid.org/0000-0003-3307-4340
Author	FamilyName	**Estalella**
	Particle	
	Given Name	**Laia**
	Suffix	
	Division	Servei de Cirurgia General i de l'Aparell Digestiu, Institut d'Investigació Sanitària Pere Virgili (IISPV)
	Organization	Hospital Universitari de Tarragona Joan XXIII, Universitat Rovira i Virgili (URV)
	Address	Dr Mallafré Guasch, 4, 43005, Tarragona, Spain
	Phone	
	Fax	
	Email	laiaestalella2@gmail.com
	URL	
	ORCID	
Author	FamilyName	**Llàcer-Millán**
	Particle	
	Given Name	**Erik**
	Suffix	
	Division	Servei de Cirurgia General i de l'Aparell Digestiu, Institut d'Investigació Sanitària Pere Virgili (IISPV)
	Organization	Hospital Universitari de Tarragona Joan XXIII, Universitat Rovira i Virgili (URV)
	Address	Dr Mallafré Guasch, 4, 43005, Tarragona, Spain
	Phone	
	Fax	
	Email	erik.llacer.millan@gmail.com
	URL	
	ORCID	

Author	FamilyName	**Julià**
	Particle	
	Given Name	**Elisabet**
	Suffix	
	Division	Servei de Cirurgia General i de l'Aparell Digestiu, Institut d'Investigació Sanitària Pere Virgili (IISPV)
	Organization	Hospital Universitari de Tarragona Joan XXIII, Universitat Rovira i Virgili (URV)
	Address	Dr Mallafré Guasch, 4, 43005, Tarragona, Spain
	Phone	
	Fax	
	Email	elisabet.julia.verdaguer@gmail.com
	URL	
	ORCID	
Author	FamilyName	**Ramírez-Maldonado**
	Particle	
	Given Name	**Elena**
	Suffix	
	Division	Servei de Cirurgia General i de l'Aparell Digestiu, Institut d'Investigació Sanitària Pere Virgili (IISPV)
	Organization	Hospital Universitari de Tarragona Joan XXIII, Universitat Rovira i Virgili (URV)
	Address	Dr Mallafré Guasch, 4, 43005, Tarragona, Spain
	Division	Servei de Anatomia Patològica
	Organization	Hospital Universitari de Tarragona Joan XXIII
	Address	Dr Mallafré Guasch, 4, 43005, Tarragona, Spain
	Phone	
	Fax	
	Email	elena.ramirezmaldonado@gmail.com
	URL	
	ORCID	
Author	FamilyName	**Pueyo**
	Particle	
	Given Name	**Eva**
	Suffix	
	Division	Servei de Cirurgia General i de l'Aparell Digestiu, Institut d'Investigació Sanitària Pere Virgili (IISPV)
	Organization	Hospital Universitari de Tarragona Joan XXIII, Universitat Rovira i Virgili (URV)
	Address	Dr Mallafré Guasch, 4, 43005, Tarragona, Spain
	Phone	
	Fax	
	Email	epueyoperiz@gmail.com
	URL	
	ORCID	
Author	FamilyName	**Geoghegan**
	Particle	
	Given Name	**Justin**
	Suffix	
	Division	Hepato-Pancreato-Biliary and Liver Transplant Surgery Department
	Organization	St. Vincent's University Hospital
	Address	Elm Park, Dublin 4, Ireland
	Phone	
	Fax	
	Email	justin.geoghegan@st-vincent.ie
	URL	
	ORCID	

Author	FamilyName	**Memba**
	Particle	
	Given Name	**Robert**
	Suffix	
	Division	Servei de Cirurgia General i de l'Aparell Digestiu, Institut d'Investigació Sanitària Pere Virgili (IISPV)
	Organization	Hospital Universitari de Tarragona Joan XXIII, Universitat Rovira i Virgili (URV)
	Address	Dr Mallafré Guasch, 4, 43005, Tarragona, Spain
	Phone	
	Fax	
	Email	rmembai.hj23.ics@gencat.cat
	URL	
	ORCID	

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Abstract

Spleen-preserving distal pancreatectomy (SP-DP), for patients with benign or small low-grade malignant tumors of the body or tail of the pancreas, is the ideal procedure although it is technically demanding. The robotic da Vinci system has been introduced to overcome these technical challenges and reduce operative risks. We report our experience of a new variation in surgical technique: the left lateral approach robotic spleen-preserving distal pancreatectomy (RSP-DP) in right lateral decubitus position. We performed this new variant of SP-DP, in five patients, using the da Vinci Xi system. Technical and clinical feasibility are described. The mean age and body mass index were 53.4 years and 31.4 kg/m2, respectively. The mean total operative time was 323 min. The estimated mean blood loss was 240 ml. In all patients, the spleen could be preserved. In four patients, the splenic vessels were also preserved. One patient required a Warshaw technique due to significant fibrosis attached to the splenic vein. The postoperative period of all patients was uneventful except the presence of biochemical leak (BL) in two patients that only required maintenance of the drainage at home. The mean length of hospital stay was 6 days after surgery. The left lateral approach robotic SP-DP in right lateral decubitus position is a feasible and safe procedure for distal benign or small low-grade malignant tumors of the left pancreas. The right lateral decubitus position associated to robotic surgery can facilitate this complex procedure, especially when splenic vessels preservation is indicated, with a lower risk of conversion and shortening of the learning curve.

Keywords (separated by '-'): Left lateral approach - Robotic distal pancreatectomy - Minimally invasive pancreatic surgery - Splenic vessel preservation - Spleen-preserving distal pancreatectomy - Distal pancreatectomy

Footnote Information

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RESEARCH

Preliminary experience with a new robotic technique to facilitate distal pancreatectomy with spleen preservation: left lateral approach in right lateral decubitus position

Rosa Jorba-Martin[1] · Mihai C. Pavel[1] · Laia Estalella[1] · Erik Llàcer-Millán[1] · Elisabet Julià[1] · Elena Ramírez-Maldonado[1] · Eva Pueyo[1] · Justin Geoghegan[3] · Robert Memba[1]

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Abstract

Spleen-preserving distal pancreatectomy (SP-DP), for patients with benign or small low-grade malignant tumors of the body or tail of the pancreas, is the ideal procedure although it is technically demanding. The robotic da Vinci system has been introduced to overcome these technical challenges and reduce operative risks. We report our experience of a new variation in surgical technique: the left lateral approach robotic spleen-preserving distal pancreatectomy (RSP-DP) in right lateral decubitus position. We performed this new variant of SP-DP, in five patients, using the da Vinci Xi system. Technical and clinical feasibility are described. The mean age and body mass index were 53.4 years and 31.4 kg/m^2, respectively. The mean total operative time was 323 min. The estimated mean blood loss was 240 ml. In all patients, the spleen could be preserved. In four patients, the splenic vessels were also preserved. One patient required a Warshaw technique due to significant fibrosis attached to the splenic vein. The postoperative period of all patients was uneventful except the presence of biochemical leak (BL) in two patients that only required maintenance of the drainage at home. The mean length of hospital stay was 6 days after surgery. The left lateral approach robotic SP-DP in right lateral decubitus position is a feasible and safe procedure for distal benign or small low-grade malignant tumors of the left pancreas. The right lateral decubitus position associated to robotic surgery can facilitate this complex procedure, especially when splenic vessels preservation is indicated, with a lower risk of conversion and shortening of the learning curve.

Keywords Left lateral approach · Robotic distal pancreatectomy · Minimally invasive pancreatic surgery · Splenic vessel preservation · Spleen-preserving distal pancreatectomy · Distal pancreatectomy

✉ Mihai C. Pavel
mpavel.hj23.ics@gencat.cat

Rosa Jorba-Martin
rjorba.hj23.ics@gencat.cat

Laia Estalella
laiaestalella2@gmail.com

Erik Llàcer-Millán
erik.llacer.millan@gmail.com

Elisabet Julià
elisabet.julia.verdaguer@gmail.com

Elena Ramírez-Maldonado
elena.ramirezmaldonado@gmail.com

Eva Pueyo
epueyoperiz@gmail.com

Justin Geoghegan
justin.geoghegan@st-vincent.ie

Robert Memba
rmembai.hj23.ics@gencat.cat

[1] Servei de Cirurgia General i de l'Aparell Digestiu, Institut d'Investigació Sanitària Pere Virgili (IISPV), Hospital Universitari de Tarragona Joan XXIII, Universitat Rovira i Virgili (URV), Dr Mallafré Guasch, 4, 43005 Tarragona, Spain

[3] Hepato-Pancreato-Biliary and Liver Transplant Surgery Department, St. Vincent's University Hospital, Elm Park, Dublin 4, Ireland

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Abbreviations

ASA	American Society of Anesthesiologists
BL	Biochemical leak
BMI	Body mass index
CCI	Comprehensive Complication Index
CT	Computed tomography
DP	Distal pancreatectomy
EBL	Estimated blood loss
EUS	Endoscopic ultrasonography
HPB	Hepatobiliary and pancreatic
IOUS	Intraoperative ultrasound
IPMN	Intraductal papillary mucinous neoplasm
IQR	Inter-quartile range
ISGPF	International Study Group of Pancreatic Fistula classification
LoH	Length of hospitalization
MI-DP	Minimally invasive distal pancreatectomy
MRI	Magnetic resonance image
pNET	Pancreatic neuroendocrine tumor
POPF	Postoperative pancreatic fistula
Qol	Quality of life
RSP-DP	Robotic spleen-preserving distal pancreatectomy
SP-DP	Spleen-preserving distal pancreatectomy
SVP-DP	Splenic vessel-preserving distal pancreatectomy

Introduction

Spleen-preserving distal pancreatectomy (SP-DP), with or without splenic vessel preservation, is the technique of choice for patients with benign or small low-grade malignant tumors of the body or tail of the pancreas, as it avoids the potential side effects of splenectomy.

However, SP-DP is a complex abdominal surgical procedure, generally carried out only by experienced surgeons in specialized centers [1]. Traditionally, concomitant splenectomy was performed during distal pancreatectomy because of the anatomic proximity of the pancreas and the splenic vessels. In recent years, splenic preservation has increasingly been recommended because of a better understanding of splenic function and the risk of significant complications associated with splenectomy. These include overwhelming post-splenectomy infection, thrombocytosis, increased cancer risk, immunodeficiency, and the possible need for chronic anticoagulant treatment [2].

Two surgical techniques have been adopted for SP-DP. In the Warshaw technique, the spleen's blood supply relies on the short gastric vessels and the left gastroepiploic artery which provide arterial flow instead of the ligated splenic vessels [3]. In the splenic vessel-preserving distal pancreatectomy (SVP-DP), first described by Kimura, the splenic vessels are preserved to maintain blood supply to the spleen [4]. The Warshaw technique is easier to perform, however, the Kimura technique is associated with lower spleen-related morbidity, e.g., infarction (because of an inadequate splenic blood supply) and secondary sectoral portal hypertension [5–8]. Therefore, SVP-DP seems to be the ideal procedure, although it is technically demanding, even when performed by open surgery.

Currently, minimally invasive SP-DP has been endorsed as a standard procedure for benign and low-grade malignant tumors of the distal pancreas [6, 9]. However, whether the splenic vessels need to be preserved or not remains controversial [10].

Regardless of the issue of splenic preservation, several approaches for the dissection of the pancreas have been described. The traditional approach starts with medial dissection of the upper and lower borders of the pancreas close to the superior mesenteric vessels, to gain control of the splenic artery and vein, as well as to perform medial division of the pancreas. The dissection of the pancreas is then carried out from medial to lateral toward the splenic hilum. However, in lesions located distally, in the tail of the pancreas, this medial approach may be challenging [11].

The main alternative to the traditional technique is the lateral approach. This simplifies the preservation of the splenic blood supply, requiring lesser mobilization, and therefore reducing the operating time [12]. Apart from these two standard approaches, other techniques have been described for laparoscopic SP-DP, including the posterior, the infero-posterior or the retroperitoneal approaches [13–18].

The position of the patient is also a factor that may facilitate the surgical technique, as well as whether splenic vessels preservation is planned. Most authors describe the technique with the patient in the supine decubitus position, although some recent works suggest better access to the tail of the pancreas with the patient positioned in the right lateral decubitus position [19].

Finally, even though, there is sufficient evidence supporting the benefits of minimal invasive distal pancreatectomy, there are no randomized studies comparing robotic versus laparoscopic distal pancreatectomy. Recently, a multicenter propensity score-matched study has demonstrated that robotic distal pancreatectomy when compared with the laparoscopic approach is associated with improved rates of conversion, splenic preservation, and readmission, without a detrimental effect on duration of surgery or hospital stay [20].

We describe a new surgical technical variant to facilitate the performance of splenic preservation and especially, splenic vessel preservation: the left lateral approach robotic spleen-preserving distal pancreatectomy (RSP-DP) in right lateral decubitus position. We performed this technique at our center in five patients with benign and low-grade malignant lesions of the pancreatic tail.

This is the first description in the literature of this robotic technique. Although the lateral approach has already been described laparoscopically, we believe that adding the right decubitus lateral position and robotic surgery facilitates splenic preservation in patients with benign or small low-grade malignant lesions in the body or tail of the pancreas.

Materials and methods

Patients and techniques

A descriptive case-series study method was used to retrospectively collect the data from a prospectively maintained database. Patients who underwent distal pancreatectomy (DP) at the Department of General and Digestive Surgery between July 2020 and October 2022 were reviewed. Our hospital is the HPB surgery reference hospital for an area of population of 800,000 inhabitants. This is a medium-volume center for pancreatic surgery. The same experienced surgeon (RJ) performed or supervised, using the second console, all robotic procedures using the Da Vinci Xi® robotic system (Intuitive Surgical, Sunnyvale, CA, USA).

Inclusion criteria for this study were the patients who underwent left lateral, totally robotic approach, spleen-preserving distal pancreatectomy (RSP-DP) in right lateral decubitus position, with splenic vessels preservation or not.

The type of intervention to achieve splenic preservation (with or without preservation of the splenic vessels) was decided based on the proximity or involvement of the splenic vessels by the tumor. A total of six patients underwent DP with the intent of preserving the spleen and splenic vessels. All these procedures were performed totally robotic (RSP-DP). One of them was operated in the supine decubitus position and 5 were operated in the right lateral decubitus position by left lateral approach. We included only the patients operated in right lateral decubitus position.

In the initial imaging study by computed tomography (CT) and magnetic resonance imaging (MRI), all patients were diagnosed with benign or low-grade pancreatic lesions located in the pancreatic body or tail.

The Institutional Review Board (Ethics Committee) of Institut Investigació Sanitària Pere Virgili (IISPV) determined that our study did not need ethical approval (Code 149/2022). Written informed consent was obtained from all patients.

The demographic and clinicopathologic characteristics and postoperative outcomes are summarized in Table 1.

Operative time was only console time, excluding the time required to dock the robot.

Position of the patient, surgeons, and trocars

Under general anesthesia, the patient was positioned in total right lateral decubitus (Fig. 1a). The first assistant and the scrub nurse stood on the right side of the patient.

A nasogastric tube and a urinary catheter were inserted. Pneumoperitoneum was achieved using a Veress needle. Four robotic ports (three 8 mm and one 12 mm) and one 12 mm additional laparoscopic port were placed. A 10 mm 30º robotic telescope for visualization was used.

The first robotic trocar (R1) was placed 2 cm to the left of and below the xiphoid, the second, for the robotic camera (C), was inserted on the anterior axillary line at the level of the umbilicus. The third 12 mm robotic trocar (R3), was placed on the anterior axillary line, 10 cm below the transverse umbilical line. The fourth 8 mm port (R4) was inserted at the level of the posterior axillary line near the anterosuperior iliac spine. Finally, one 12-mm extra-port (A) was located between R2 and R3 for use of laparoscopic instruments by the first assistant (Fig. 1b).

Patient cart positioning and robot docking

The robot was placed on the left side of the patient. Robotic instruments included: 8 mm fenestrated bipolar cautery grasper in arm 1, 8 mm Tip-Up Fenestrated Grasper in arm 4, and 8 mm monopolar cautery hook instrument (or scissors) in arm 3. A EndoWrist® Vessel SealerTM was used to coagulate and to divide tissue (arm 3). A robotic 45 mm stapler (EndoWrist Stapler, Intuitive Surgical, Inc.) introduced trough a 12 mm robotic trocar was used to transect the pancreatic parenchyma.

Surgical steps

The procedure is described in nine steps which are referred to in the attached figures.

Mobilization and dissection steps (Fig. 2a)

Step 1 After dividing the splenorenal, splenocolic and pancreaticosplenic ligaments, the splenic flexure of the colon is mobilized downward (Fig. 3a).

Step 2 The gastrocolic omentum is opened up to the level of the pancreatic lesion, and the body-tail of the pancreas is then visualized. The anterior aspect of the pancreas is exposed by dividing the adhesions between the posterior surface of the stomach and the pancreas. Care must be

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Table 1 Demographic, clinicopathologic characteristics and intra/postoperative outcomes

Variables	Case 1	Case 2	Case 3	Case 4	Case 5	Median (IQR)
Age	38	53	54	52	70	53.4 (38–70)
Sex	Female	Female	Male	Male	Female	
BMI (kg/m^2)	36	34	33	31	23	31.4 (23–36)
ASA	3	2	2	1	2	
Location of the lesion	Tail	Tail	Tail	Body/tail	Body	
Preoperative diagnosis	Solid pseudopapillary tumor	Mucinous cystadenoma	Solid pancreatic tumor*	IPMN	IPMN	
Preoperative EUS and Biopsy	No	No	Yes	Yes	Yes	
Splenic vessels preservation	Yes	Yes	Yes	No (Warshaw technique)	Yes	
Successful spleen preservation	Yes	Yes	Yes	Yes	Yes	
EBL (ml)	300	200	300	300	100	275 (200–300)
Transfusion	No	No	No	No	No	
conversion to open or laparoscopic procedure	No	No	No	No	No	
Total operating time (min)	380	325	320	300	290	342 (320–380)
POPF and grade	No	BL	No	BL	No	
Post-operative morbidity grade**	0	I	0	I	0	
CCI	0	0	0	0	0	0
Post-operative mortality	No	No	No	No	No	0
LoH (days)	5	6	7	6	6	6 (5–7)
Histologic diagnosis	Solid pseudopapillary tumor	Serous cystadenoma	Chronic pancreatitis	pNET + pseudocyst	Mixed-type IPMN	
Tumor size (mm)	55	32	12	15 + 40	25	37.8 (12–65)
Resection margins status	Free	Free	Free	Free	Free	

Patients are in chronological order of the date of the operation

BMI Body mass index, *ASA* American Society of Anaesthesiologists, *IPMN* Intraductal Papillary Mucinous Neoplasm, *EUS* Endoscopic Ultrasonography, *EBL* Estimated Blood Loss, *POPF* postoperative pancreatic fistula, defined according to the International Study Group of Pancreatic Fistula (ISGPF) classification, *BL* Biochemical leak ("grade A" POPF, is not considered a true pancreatic fistula or an actual complication), *CCI* Comprehensive Complication Index, *LoH* length of hospitalization, *pNET* pancreatic neuroendocrine tumor, *IQR* inter-quartile range

*Indeterminate tumor with growth during follow-up

**Clavien-Dindo Classification

taken to preserve the short gastric and the left gastroepiploic vessels (Fig. 3b).

Step 3 The peritoneum along the inferior border of the pancreas is incised with monopolar hook cautery. After dividing the fusion fascia of Told, the pancreatic tail and body can be elevated, and the splenic vein identified posteriorly. The splenic artery is identified at the superior border of the pancreas. A vessel loop can be placed and dissected circumferentially to help dissection and preservation of the vessels (Fig. 3c).

Step 4 The inferior border of the pancreas is dissected, and the body and tail of the pancreas are completely detached from the retroperitoneum. At that point, the tail of the pancreas is raised anteriorly (Fig. 3d).

This maneuver allows the identification of the tumor on the anterior surface of the tail of the pancreas, as well as the visualization of the posterior surface of the gland, where the splenic vein is easily identified. Intraoperative ultrasound (IOUS) can be used to identify small lesions and their relationships to the splenic vessels, as well as to delineate the border of the transection.

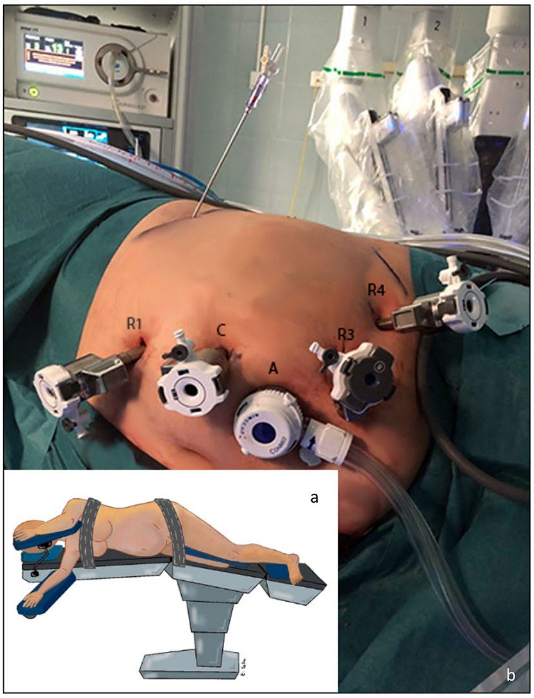

Fig. 1 **a** The patient is placed in the total right lateral decubitus on the operating table. Care must be taken to ensure that all pressure points are padded to reduce the risk of skin injury. The table is placed in an oblique position so that it flexed to extend the upper flank to the maximum. Appropriate supports are placed to ensure stable position with table movements. **b** Trocar site positioning. Three 8 mm robotic ports (R1, C and R4), one 12 mm robotic port (R3) and an additional 12-mm laparoscopic trocar for the assistant (A). Camera is placed through a pararectal incision (denoted C), robotic instruments are introduced through incisions R1, R3 and R4

The tail of the pancreas is grasped and retracted anteriorly. This traction is applied to expose the small branches of both splenic artery and vein. The splenic vein is pushed away from the posterior pancreatic surface by gentle blunt dissection.

Transection and resection steps (Fig. 4)

Step 5 Visual magnification permits excellent control of the small pancreatic veins and arteries, which are cauterized using the vessel sealer device or clipped either with titanium or polymeric clips.

In this step, we identify if the tumor or the pancreatic parenchyma can be correctly separated from the splenic vessels and if its preservation is possible. If it is not feasible or uncontrollable bleeding occurs, we can easily ligate them at this step (Warshaw technique).

The dissection is continued medially to achieve an adequate mobilization of the distal pancreas and a sufficient pancreatic neck margin. When dissection of the distal pancreas along the axis of the splenic vessels is achieved the cut-off line is determined by direct vision or by IOUS (Fig. 4a).

Step 6 For pancreatic parenchymal division, the robotic 45 mm stapler is inserted through the 12-mm robotic trocar and then articulated perpendicularly to the pancreas. The gland is transected using two staplers (Fig. 4b).

Step 7 If a defective closure of the stump is detected due to the thickness of the pancreatic parenchyma, the stump should be reinforced with a manual suture. Barbed monofilament 4/0 sutures (V-Loc™, Medtronic) are commonly used at this stage to close the stump in a fish-mouth fashion (Fig. 4c).

Step 8 After verification of hemostasis, the resected specimen is prepared for extraction (Fig. 4d).

Specimen extraction and drain placement

Step 9 Once freed, the pancreatic specimen is retrieved using an endo-bag by slightly enlarging the 12 mm R4 port incision. A closed system suction drain is placed in the pan-

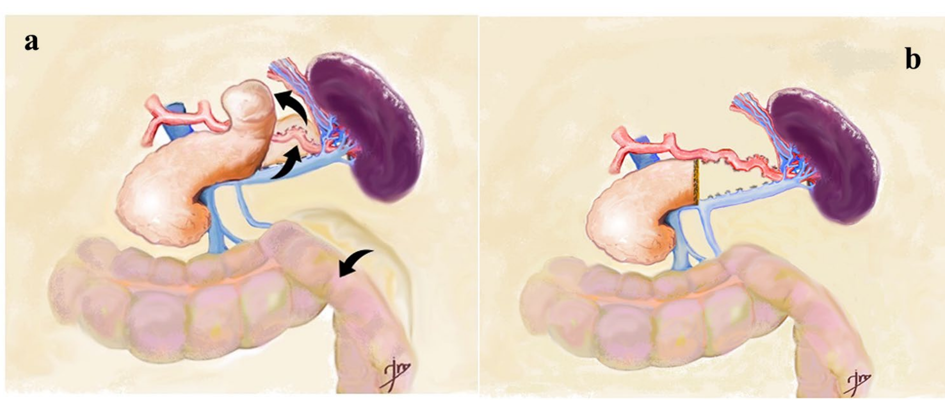

Fig. 2 Steps in lateral approach splenic vessel-preserving distal pancreatectomy. **a** Distal pancreatic dissection and mobilization steps. **b** Transection of the pancreatic parenchyma and distal pancreatic resection preserving splenic vessels (vein and artery)

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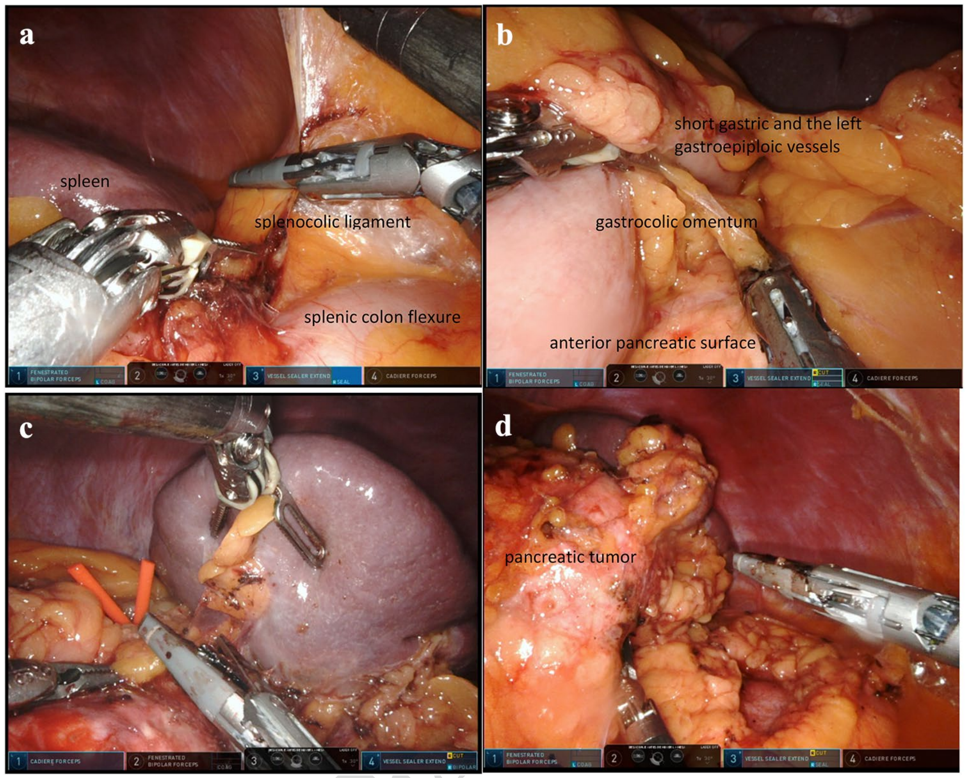

Fig. 3 Distal pancreatic dissection and mobilization steps: Left lateral approach. **a** Step 1: Mobilization of the splenic colon flexure. **b** Step 2: Dissection of the gastric curvature, preserving the gastro-epiploic arcade. **c** Step 3: Dissection in the superior border of the pancreas with identification and control of the splenic artery by a vessel loop. **d** Step 4: Total mobilization of the distal pancreas preserving splenic vein and artery. Visual localization of the tumor at distal pancreas

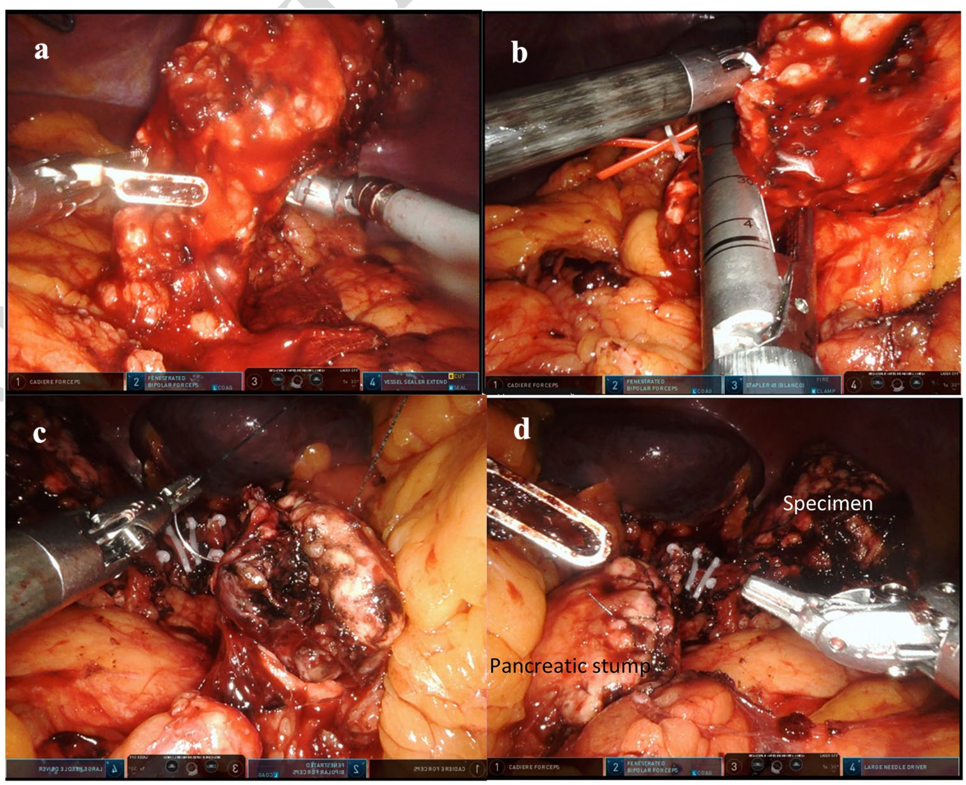

Fig. 4 Section of the pancreatic parenchyma and resection of the distal pancreas, preserving the splenic vessels. **a** Total pancreatic dissection along the axis of splenic vessels. **b** Pancreatic parenchyma stapling. The endo-stapler is inserted through the 12-mm robotic trocar and then articulated perpendicularly to the pancreas. **c** Manual closure of the pancreatic stump (optional). Barbed monofilament sutures are placed to close the stump like a fish-mouth. **d** Verification of hemostasis and visualization of the resection specimen prepared for extraction

creatic bed. Frozen section analysis is routinely performed to confirm negative margins.

No bleeding or signs of splenic ischemia were detected during or after any operation. The mean operative time was 240 min. The nasogastric tube was removed at the end of the operations. No transfusion was required in any patient.

Post-operative management

The patients were managed according to the Enhanced Recovery After Surgery (ERAS) protocol, which especially focused on early mobilization and early oral intake. Regional analgesia with epidural catheter was continued postoperatively. The urinary catheter was removed on postoperative day 1. Oral clear liquid diet was initiated in the afternoon of the first postoperative day and advanced according to tolerance up to a regular diet.

Serum and drain fluid amylase activity were assayed on the morning of postoperative day 1 and 3. Drain was removed on day 4 after confirming a low volume and normal amylase levels. In the event of presenting a low-volume pancreatic fistula without clinical repercussions, the drain was maintained at home and later removed in the outpatient clinic. The final pathology report confirmed the diagnosis of benign or low malignancy lesions with negative resection margins in all cases.

Results

Table 1 shows patient's clinicopathological characteristics and operative results.

The mean age and body mass index were 53.4 (38–70) years and 31.4 (23–36) kg/m^2, respectively. Sixty percent were females. Preoperative diagnoses were in all cases suspicious for benign or low-malignant lesions. Preoperative EUS associated with biopsy was performed in 60% of patients.

Pathological diagnoses included solid pseudopapillary tumor, serous cystadenoma, chronic pancreatitis, IPMN and pNET associated with a pseudocyst.

The correlation with the final histological diagnosis was only correct in two patients, although a malignant lesion was not diagnosed in any patient and margins were free in all cases.

The mean total operative time was 323 (320–380) min. The estimated mean blood loss was 240 (200–300) ml.

All operations were successfully completed without conversion to laparoscopic or open surgery.

In all patients, the spleen could be preserved and in four of them, the splenic vessels were also preserved. In case 4, the splenic vein was compromised by the pseudocyst, and it was impossible to preserve it. Due to the significant fibrosis adhered to the vein a Warshaw technique was performed.

All patients were uneventfully discharged. No mortality was observed. Two patients presented BL pancreatic fistula that only required maintenance of the drainage at home. The median length of hospital stay was 6 days after surgery.

Discussion

Our experience aims to promote RSP-DP in the management of benign or small low-grade malignant tumors of the body or tail of the pancreas. Furthermore, when the proximity of the tumor to the splenic vessels allows their preservation, we prefer the Kimura technique (SVP-DP) [4].

Due to the current advances in image technology, an increasing number of patients are being diagnosed with benign or borderline malignant tumors of the pancreas. Since these patients are expected to have excellent long-term survival rates, quality of life considerations are also a priority when choosing a surgical option. With this in mind, function-preserving and minimally invasive pancreatectomy offers several advantages [21–23]

Laparoscopic distal pancreatectomy has become a widely accepted surgical approach for the treatment of left-sided pancreatic tumors [24]. However, to perform this procedure safely, finely honed skills and advanced surgical equipment are required [25]. Splenic salvation may be abandoned because of the technical complexity of dissecting splenic vessels with the conventional laparoscopic approach. Unfortunately, overwhelming post-splenectomy infection, although uncommon, is still a serious fulminant process with a high mortality rate [2].

To date, minimally invasive DP (MI-DP) with splenic vessel preservation is only performed in specialized centers and by surgeons with extensive experience in pancreatic and laparoscopic surgery. The Warshaw procedure [3] is the easier technique to preserve the spleen but has the potential risk of left-sided portal hypertension-related perigastric varices, severe splenic infarction, abscess formation and the eventual need for splenectomy. Furthermore, splenic artery and vein ligation may reduce blood supply to the residual proximal stomach which may complicate future gastric surgery if required [26]. This is not the case with the Kimura procedure [4].

Surgeons should be aware of the significance of conservation of the splenic artery and vein and be able to perform both procedures so that the technique can be tailored to the individual patient's circumstances.

Several systematic reviews along with meta-analysis and cohort studies have shown that MI-DP had better or equivalent perioperative outcomes when compared with open distal pancreatectomy [29–31]. The advantages of MI-DP are lower blood loss, decreased morbidity, shorter length of hospital stay and rehabilitation time, less postoperative pain,

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less adhesions, and better aesthetic results. These favorable outcomes have been confirmed also in larger series. The International Evidence-based Guidelines on Minimally Invasive Pancreas Resection were recently published following a meeting of experts in Miami [32]. They concluded that MI-DP for benign and low-grade malignant tumors should be considered superior to open distal pancreatectomy, since it is associated with a shorter hospital stay, reduced blood loss, equivalent complication rates and better postoperative quality of life (QoL). The laparoscopic procedure does not have a negative impact on the oncologic outcome. However, because of the risk of postoperative complications, this procedure should be reserved for specialized centers [32, 33]. Preservation of the splenic vessels would be particularly advantageous in those patients undergoing pancreatic resection for benign or low-grade tumors in whom normal life expectancy would be anticipated.

Robotic surgical systems have been applied to different types of surgery. Robotic technology adds precision to movements, increases surgeon comfort, enlarges the three-dimensional field of view, suppresses tremors, provides consistent traction, instrument flexibility, and facilitates surgical suturing. Accordingly, robotics should facilitate minimally invasive complex abdominal procedures. Waters et al. [35] reported the cost effectiveness and higher spleen preservation rate of robotic procedures. In addition, several investigations have been published supporting the idea that robotic surgery is superior to conventional laparoscopy for spleen preservation during distal pancreatectomy [20, 34]

However, at present, there is no conclusive evidence supporting the proposition that the robotic approach is superior to standard laparoscopy. In a recent multicenter propensity score-matched study [20], spleen preservation was planned for over one-third of patients and achieved in 72 per cent of these procedures. After matching, the robotic approach was associated with a higher splenic preservation rate than was seen during the laparoscopic approach. In addition, SVP-DP (Kimura technique) was used more often in the robotic than with the laparoscopic approach, whereas splenic vessel ligation (Warshaw technique) was more often applied in laparoscopic cases. These findings need to be confirmed in a multicenter randomized controlled trial (RCT) study which should also specifically compare cost effectiveness of the two approaches.

Despite the extra costs involved, robotic devices may facilitate SVP-DP and have the potential to become the standard treatment for this kind of procedure [13, 35].

To our knowledge, this is the first description of the left lateral approach RSP-DP in total right lateral decubitus position. We hypothesized that this technique could benefit patients in terms of shorter operative time, lower estimated blood loss, easier dissection, and higher preservation rate of the spleen and the splenic vessels.

To date, the lateral approach for laparoscopic distal pancreatectomy has only been evaluated primarily in technical reports or small non-comparative case series [11]. The only comparative cohort was reported by Nakamura et al., in 2011. Twenty-three patients underwent laparoscopic SP-DP. After the adoption of the lateral approach SVP-DP, none of the patients required conversion to an open operation. The authors concluded that, although the Warshaw method was acceptable with a low incidence of gastric varices, the laparoscopic lateral approach SV-DP may contribute to a safer and easier procedure [12].

Our group has been performing MI-DP with splenic vessel preservation in patients with benign or borderline (low-grade) malignant tumors during the last decade. Attempting the laparoscopic lateral approach SVP-DP through the total right lateral decubitus position provides several potential technical advantages. Placing the patient in this position (nephrectomy-like) allows gravity to help retract the stomach, colonic splenic flexure, and pancreas, facilitating access and dissection. By holding the spleen attachments in place, the autotraction of the pancreatic tail makes it easier to lift and visualize the small venous and arterial branches that need to be ligated or sealed to separate the tail of the pancreas from the splenic vessels. The easier access and better exposure allow a more precise and faster dissection that can potentially reduce operative time and blood loss. With this approach, we believe that splenic vessels are easier to visualize, identify, and isolate at the level of the tail of the pancreas than in the medial approach.

Proximal control of splenic vessels is generally performed. If unexpected bleeding occurs, these vessels can be rapidly clamped or ligated, converting the technique to a Warshaw procedure, or even associating the splenectomy if needed.

Another advantage of the left lateral approach is that the pancreas is sectioned more distally, which could preserve more pancreatic parenchyma and decrease the risk of postoperative pancreatic insufficiency in these patients with anticipated long survival [11, 12].

In our series, we observed a mean total operative time of 323 min. This may be justified because we are still on the learning curve of robotic pancreatic surgery. But in addition, the average BMI of our patients was and 31.4 kg/m^2, which represents a greater difficulty at the time of dissection. In patients with fatty splenic hilum distal dissection was more challenging but nevertheless successful. Furthermore, we believe that lateral DC position facilitates the intervention in this particular scenario, when compared to supine DC.

Another difficulty in our experience was the transection of the parenchyma with the robotic stapler. In four of the five cases, we had to reinforce it with an additional manual suture because the thickness of the pancreatic parenchyma did not result in a secure stapled closure, although this did

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not mean an increase in grade B pancreatic fistula in the postoperative period.

The robotic stapler is introduced in the operation field by the assistant but is fully controlled by the surgeon operator. The stapler has a side-to-side articulation range of 108° and 54° up and down, allowing for more precise positioning, compared to 100° side-to-side for laparoscopic staplers. The autonomy of the surgeon from the console in the placement of the robotic stapler allows an easy placement of the stapler in the patient's position in lateral DC, compared with the laparoscopic stapler. In addition, the stapler is capable of measuring tissue compression before and during stapler firing, making automatic adjustments. Despite these advantages, given that the pancreatic parenchyma at the body level is generally bulkier than at the pancreatic neck, staple closure at the level of the pancreatic body is often unsatisfactory. In this circumstance, we would consider not using stapled transection and going directly to transection and manual suture.

There are limitations in the analysis of the long-term outcome of the patients because the median follow-up was of only 18 months. However, at present, there have been no late postoperative complications, including de novo diabetes, or deaths.

The "da Vinci" robotic system adds a wide three-dimensional field of view, constant traction, suppression of physiological tremor, and has tools that allow seven degrees of freedom. The surgeon experiences increased dexterity, the ability to perform precise tissue dissections and advanced suturing. Application of the robotic approach to this technique could also reduce of the learning curve for junior surgeons.

Conclusion

The left lateral approach RSP-DP in right lateral decubitus position is a feasible and safe approach for distal benign or small low-grade malignant tumors on the pancreatic tail. The improved exposure and ease of locating the splenic vessels offers the possibility of a shorter surgical time, less blood loss, and a higher percentage of splenic preservation when compared to the traditional medial approach. Robotic assistance can facilitate this technique and shorten the learning curve for this complex procedure.

Author contributions All authors contributed to the study conception and design. The first draft of the manuscript was written by J-MR, PM and MR commented and reviewed the manuscript. Material preparation, data collection and analysis were performed by EL, R-ME, and LE. JE, PE and GJ, contributed to critical revision of the manuscript. J-MR and JE designed the illustrations. All authors have given final approval of this version to be published.

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Declarations

Conflict of interest Rosa Jorba-Martin, Mihai C. Pavel, Laia Estalella, Erik Llàcer-Millán, Elisabet Julià, Elena Ramírez-Maldonado, Eva Pueyo, Justin Geoghegan and Robert Memba have no conflicts of interests or financial ties to disclose.

Ethical approval This research study was conducted retrospectively from data obtained for clinical purposes. We consulted extensively with the Institutional Review Board (Ethics Committee) of Institut Investigació Sanitària Pere Virgili (IISPV) who determined that our study did not need ethical approval. An official waiver of ethical approval was granted (code 149/2022).

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