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CASE REPORT

Beyond Laparoscopy for Pancreatic Surgery in the Caribbean: A Report on Robot Assisted Radical Antegrade Modular Pancreatico-Splenectomy (RAMPS)

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ABSTRACT:
In the Anglophone Caribbean, laparoscopic surgery for pancreatic malignancies has been reported at low volumes and there has been no report of radical antegrade modular pancreatico-splenectomy (RAMPS), which is increasingly replacing conventional distal pancreatectomy. Performing RAMPS with laparoscopic instruments is technically difficult, but it is feasible. We report our experience performing minimally invasive RAMPS using the FreeHand® robotic camera holder (Freehand 2010 Ltd., Guildford, Surrey, UK) in Trinidad & Tobago.

INTRODUCTION

Patients with left-sided pancreatic carcinomas are likely to present with advanced disease. Fewer than 10% of these patients are candidates for operative resection at the time of presentation.[1] Due to the advanced disease stage, there has been a recent shift from the conventional distal pancreatectomy (DP) toward radical antegrade modular pancreatico-splenectomy (RAMPS) for better disease clearance.[2]

In the past two decades, we also witnessed a trend toward the use of laparoscopic techniques for left sided pancreatic resections.[3-7] A major limitation, however, is limited maneuverability of straight instruments deep in the retroperitoneum. Robotic systems can overcome this limitation with full articulating wrist movements, thereby facilitating dissections with greater dexterity.[8-11] Full robotic platforms, however, are expensive and are not available in low and middle-income Caribbean nations.[12]

In the Anglophone Caribbean, there have been few reports of laparoscopic DP at low volumes,[3] but we have encountered no reports of laparoscopic RAMPS in our literature review. We report our initial experience using the FreeHand® robotic camera holder (Freehand 2010 Ltd., Guildford, Surrey, UK) to assist in the completion of laparoscopic RAMPS in Trinidad & Tobago.

REPORT OF A CASE:

A 61-year-old man was admitted to hospital after experiencing acute epigastric pain. Serum amylase levels were significantly elevated 10-fold above normal values. A contrast-enhanced computerized tomography scan revealed a 2.5cm mass in the pancreatic tail with duct dilatation distal to the mass. The mass did not penetrate the body posteriorly and there was no evidence of metastasis. After a multidisciplinary team meeting, a decision was taken to offer a RAMPS.

The patient was prepared for anaesthesia and taken to the operating theatre. Access to the peritoneum was achieved using an open technique to insert a 12mm trocar at the umbilicus. A FreeHand® Robotic Arm was fixated to the operating bed rail over the patient's left arm and this was used to control a 10mm thirty-degree laparoscope through the umbilical trocar. This arrangement allowed the operating surgeon to have working space after the robotic arm was docked. Figure 1 demonstrates the operating field setup.

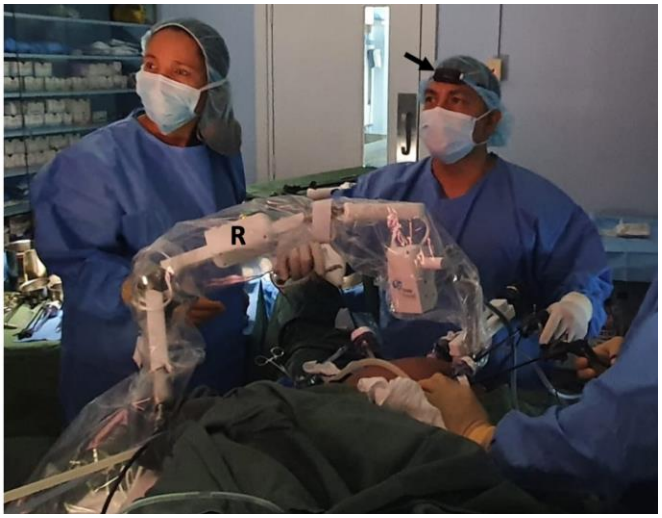

Figure 1: External view of the operating field. The robotic arm (R) is fixated to the left operating bed rail above the patient's left arm and the robotic arm reaches over the patient's torso toward the umbilicus. The surgeon controls the robotic arm using a head-mounted infrared communication device (arrow).

Two additional 5mm trocars were inserted in the upper abdomen and used to introduce conventional working instruments that were controlled by the surgeon. An additional 10mm assistant port was inserted in the right upper quadrant. This was also used to accommodate the surgical stapler.

The operation commenced by gaining access to the lesser sac after dividing the gastrocolic ligament and short gastric vessels. A ligasure device was used to dissect the peritoneum at the inferior border of the pancreas, allowing identification of the superior mesenteric vessels. Blunt dissection was used to create a retro-pancreatic tunnel. A surgical gauze was passed through the tunnel and used to elevate the pancreas from the great vessels.

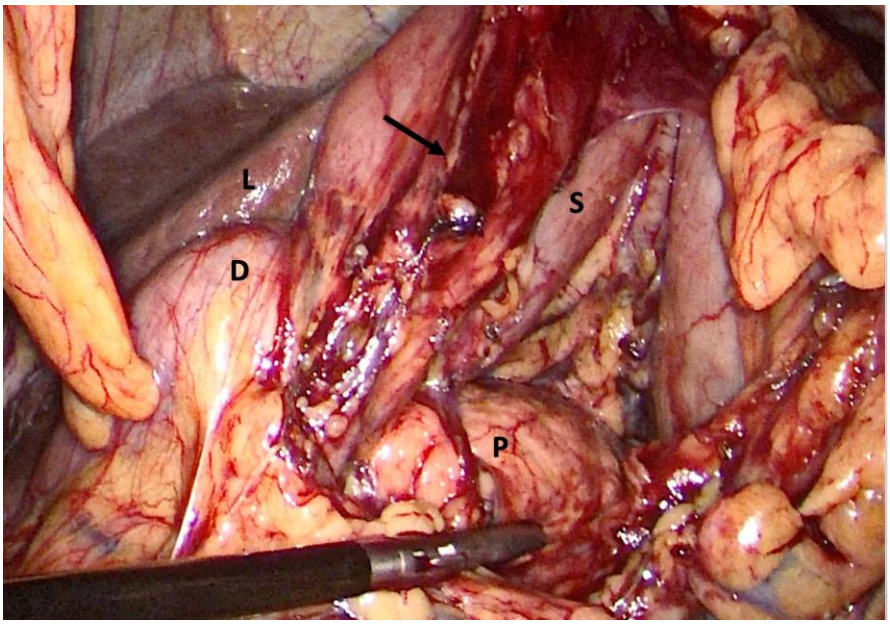

Figure 2: An intra-operative image showing exposure of the lesser sac. The gastro-colic ligament (arrow) has been divided to allow entry into the lesser sac. This allows the stomach (S), liver (L) and duodenum (D) to be retracted anteriorly to expose the pancreatic neck (P). The operating instrument points to the location of the great vessels (not yet dissected) posterior to the pancreatic neck.

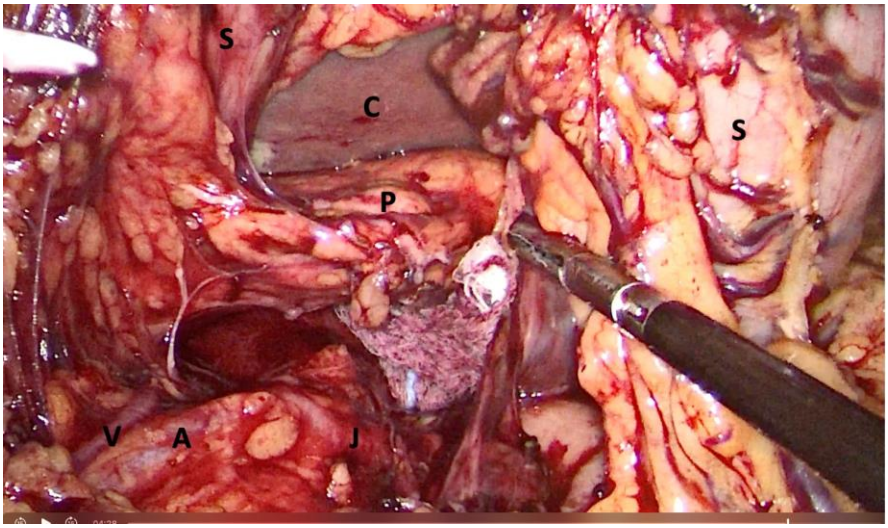

Figure 3: This image shows the completely dissected retro-pancreatic tunnel. The pancreatic neck (P), caudate lobe of liver (C) and stomach (S) have been retracted anteriorly. A surgical gauze has been inserted into the tunnel for hemostasis. There has been complete skeletonization of the superior mesenteric vein (V), superior mesenteric artery (A) and the first jejunal branch (J).

At the upper border of the pancreas the arteries were skeletonized up to the celiac trunk to ensure complete lymphadenectomy and allowing the splenic artery to be secured and transected. The splenic vein was individually ligated. At this point the pancreas was transected using a linear stapler. The pancreas was retracted anteriorly to facilitate division of the anterior layer of renal fascia and the spleno-phrenic ligament. The specimen was removed using a Phannesteil incision. A 19Fr blake drain was left at the pancreatic bed.

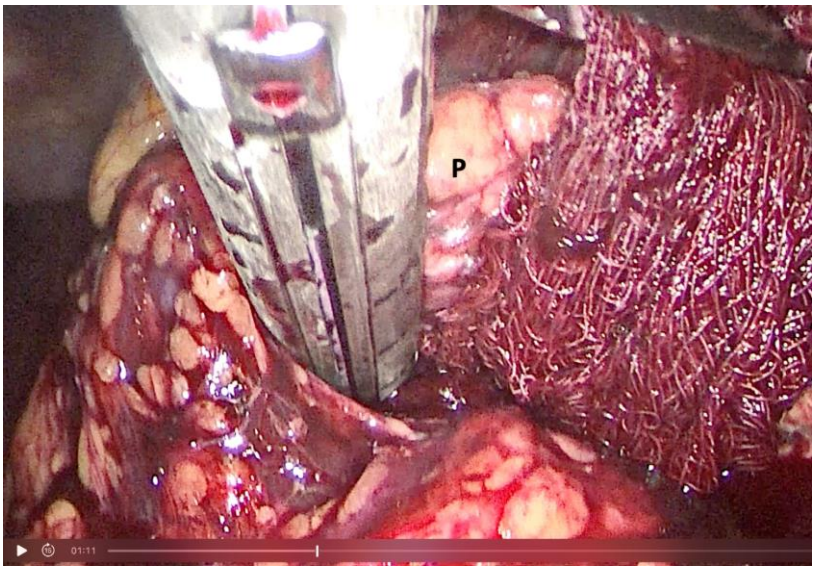

Figure 4: The surgical gauze is wrapped around the mobilized pancreatic body (P) and used to manipulate the pancreas with laparoscopic instruments. The pancreatic neck was transected with an Endo-GIA 60mm stapler.

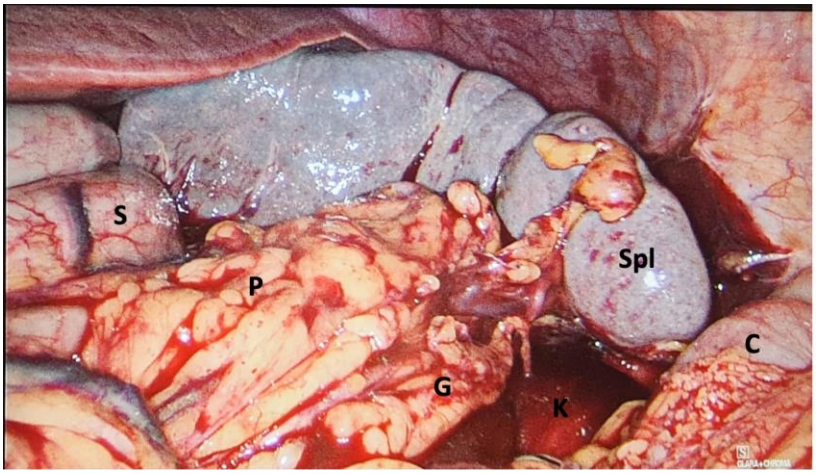

Figure 5: The inferior border of the pancreas (P) has been mobilized en bloc with lymphatic tissue, the anterior layer of Gerota's fascia (G) and spleen (S). The exposed upper pole of the left kidney (K) and splenic flexure of colon (C) have been preserved.

The operation was completed in 215 minutes, with 485mls estimated blood loss and no adverse events. The patient was allowed diet and ambulation on the first post-operative day, and the drain was removed on day 3 after confirming normal amylase levels in the effluent. The patient was discharged from hospital on day 4 and no complications were encountered.

A moderately-differentiated pancreatic adenocarcinoma ($_pT_2N_0M_0$) was confirmed on histopathologic assessment. There was R0 resection, with negative margins and 0/8 nodes involved. Adjuvant systemic therapy was planned.

DISCUSSION

The traditional operative procedure for left-sided pancreatic carcinoma was a DP. However, the long-term survival was poor, with only 6-30% five-year survival post DP.[13-15] In attempts to reduce short-term morbidity and improve recovery, surgeons began to use minimally invasive techniques regularly at the turn of the 21st century.[3] After sufficient data were accrued, three large metanalyses were published showing that laparoscopic DP resulted in significantly better peri-operative outcomes, without compromising oncologic adequacy.[4-6] However, most experts agreed that, while feasible, laparoscopic DP was technically challenging because the straight instruments were difficult to maneuver deep in the retroperitoneum.

In the year 2000, Intuitive Ltd (Sunnyvale, California, USA) received approval from the United States Food and Drug Administration to use the DaVinci surgical robot in human patients.[16] Pancreatic surgeons rapidly embraced the

technology after robotic DP was reported in 2003 by Melvin et al[17] and Guillanotti et al.[18] The full wrist movements of the surgical robot facilitated the retroperitoneal dissections near critical structures, making the DaVinci robot more popular than conventional laparoscopy for DP. Within only a decade, sufficient data were collected to support metanalyses comparing laparoscopic and robotic DPs.[19-24] These metanalyses were unable to demonstrate superiority of the robotic DP over laparoscopic DP, although all authors agreed that robotic DP was an alternative with oncologic equivalence.[19-24]

However, these minimally invasive techniques focused on peri-operative recovery, and long-term survival remained poor regardless of the operative approach. Strasberg et al[25] revolutionized the surgical approach in 2003 when they described the RAMPS procedure. This involved more extensive dissection up to the celiac trunk and its branches, the gastroduodenal artery and the gastrocolic vessels.[2,8,25] Additionally, the anterior renal fascia was resected once there is no tumour penetration through the posterior pancreatic capsule.[25] If posterior capsular breach was suspected, a posterior RAMPS was required where the left adrenal gland was also removed.[25] These maneuvers resulted in increased nodal harvest and had the potential to increase posterior margin clearance. This was attractive since nodal metastasis is a recognized independent prognostic factor for left sided pancreatic cancer.[26-27] Pancreatic surgeons readily adopted the RAMPS technique and there were increasing reports in the surgical literature.[28-32]

Once sufficient data were accrued to compare the surgical approaches, Cao et al[2] reported a metanalysis comparing RAMPS and conventional DP in 378 patients across 6 retrospective trials.[29-34] They were able to demonstrate that 152 patients with left-sided pancreatic carcinomas who underwent RAMPS had significantly greater R0 resection rates and significantly greater lymph node harvest than the 226 patients undergoing conventional DPs, without an increase in blood loss, post-operative morbidity or hospitalization.[2]

Watanabe et al[35] subsequently published an updated meta-analysis in 2022 that compared RAMPS and DP in 1641 patients across 13 studies. In this study, patients undergoing RAMPS had significantly increased nodal harvest, reduced blood loss and increased diseased free survival, without an increase in morbidity, operative time or hospital stay. Interestingly, Watanabe et al[35] reported similar R0 resection rates and overall survival in the large cohort, but on sub-group analysis the patients who underwent RAMPS in Asian countries had higher nodal harvests, increased R0 resection rates and better overall survival than those undergoing DP – a difference not seen in Western countries.[35] When comparing the approaches, it is important to make the distinction between local recurrence and systemic recurrence. Both will affect disease free and overall survival, but the more extensive dissection in RAMPS could not be reasonably expected to affect systemic recurrence. Cao et al[2] pointed out that few existing studies have attempted to differentiate local recurrence from systemic recurrence.

While there is data to suggest that RAMPS achieves better R0 resection,[2] greater node harvest,[2,29,30,35] and possible improved disease-free survival,[35] most experts also agree that it is technically difficult with conventional straight laparoscopic instruments. This is because extensive dissection is required around retroperitoneal vessels in RAMPS.[8,25] It was not unexpected, therefore, that robotic platforms facilitated the extensive retroperitoneal dissection in robotic RAMPS,[36] leading to its use in many high-income countries.

In the Caribbean, however, the healthcare landscape differs considerably. The Anglophone Caribbean is comprised of 17 low and middle-income countries that have been slow to adopt minimally invasive techniques due to a combination of resource unavailability, financial limitations and leadership deficiencies.[12,37,38] To illustrate this, consider the fact that the initial report on laparoscopic DP from the Caribbean[3] was published 27 years after it was first reported by Cuschieri et al in 1996.[39] There have been no reports of RAMPS from the Caribbean to date.

Similarly, the first reports of Robotic DP were published in 2003[17,18] but to the best of our knowledge, there has been no report of pancreatic resections using the DaVinci or any other full robotic platform from the Caribbean. The first small step toward robotics in the Caribbean was this FreeHand robot-assisted laparoscopic RAMPS performed on November 29, 2021 - 20 years after robotic DP was first described.

In this report RAMPS was performed with the assistance of the FreeHand robot (Freehand 2010 Ltd., Guildford, Surrey, UK). This is a single robotic arm allowing the surgeon to control the laparoscope via an infrared communicator. We acknowledge that this system does not provide the advantage of intra-corporeal articulation that the DaVinci or similar platforms can provide. Therefore, surgeon ergonomics were still compromised as the conventional straight laparoscopic instruments were constrained when pivoted around the abdominal wall trocar.

On the other hand, we found this system to be a good intermediary with advantages over conventional laparoscopy while balancing cost. Since the surgeon controlled the laparoscope, there was less human error from separate camera persons. This was critical for technically complex maneuvers such as creating the retropancreatic tunnel and dissecting around the retroperitoneal vessels. Although some argued that the additional responsibility to control their own vision would distract the surgeon from completing the operative procedure, we found that being in control of your own vision reduced the operating surgeon's fatigue and discomfort. We believe the explanation for this was well articulated by Ballantyne et al[40] who wrote that "*inexperienced or bored camera-holders move the camera frequently and rotate it away from the horizon.*"

We believe that the FreeHand robotic arm did facilitate the completion of RAMPS in our case and advocate for it to be incorporated in technically complex pancreatic operations. We do recognize that appropriate training with the robotic arm is required, as well as appropriate mentoring from experts.[40,41] In our report, the case was performed by advanced pancreatic surgeons who were already facile with laparoscopic DP and trained in the use of the FreeHand system. Therefore, it was not surprising that the mean operating time was comparable to those in published reports from the Caribbean,[3] as well as reports from international literature.[5,6,7]

CONCLUSION:

Although the Caribbean is a resource-poor surgical environment, FreeHand Robot-Assisted RAMPS is feasible. With appropriate training, mentoring and institutional credentialing, we believe it is a good intermediary to contain expenditure while eliminating human error while viewing the operating field. Overall, this technology may contribute to the advancement of minimally invasive pancreatic surgery in the Caribbean.

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