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Review Article

Superior Results From Robotic Distal Pancreatectomy Over Laparoscopic Technique: A Single Surgeon's Experience With 123 Consecutive Cases.

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Abstract

Compared to robotic distal pancreatectomy (RDP), laparoscopic distal pancreatectomy (LDP) has technical constraints that could result in high conversion rates and morbidity. LDP and RDP procedures carried out in our tertiary referral hepatobiliary center between December 2008 and January 2023 and pancreatic centers were examined and contrasted in terms of immediate results. There were 61 RDP cases and 62 consecutive LDP cases completed. The laparoscopic group had a higher conversion rate to open operations than the robotic group (21.0% vs. 1.6%, p = 0.001).Postoperative problems were considerably more common in the LDP group (43.5% vs. 23.0%, p = 0.005).However, in terms of serious complications or pancreatic fistular following procedures, there was no discernible difference between the two groups. (p = 0.20 and p = 0.71, respectively)The RDP group experienced a shorter mean operating time (147 min vs. 194 min, p = 0.015) and a shorter overall hospital stay (4 days vs. 7 days, p = 0.0002) for planned spleenpreserving surgeries than the LDP group. The spleen preservation failure rate was 20% (n = 5/25) in RDP and 0% in group with LDP (p = 0.009). Compared to LDP, RDP provided a superior approach to splenic preservation using Kimura's technique, reducing the danger of gastric varices and splenic infarction associated with splenic pedicle ligation and division.the danger of gastric varices and splenic infarction associated with splenic pedicle ligation and division. The usual procedure for removing pancreatic tumors from the body and tail of the organ without using the celiac axis or common artery of the liver.

Keywords : *robotic, laparoscopic, minimally invasive surgery, distal pancreatectomy, and pancreatic cancer.*

INTRODUCTION

In many facilities across the world, open distal pancreatectomy (ODP) is still regarded as the gold standard despite advancements in technology and surgical methods. Postoperative pancreatic fistula (POPF) is the most frequentcomplication, with morbidity rates ranging from 22% to 47% [1–5]. Distal pancreatectomy with minimally invasive procedures(MIDP) has demonstrated consistently similar oncological and survival outcomes to ODP using both robotic and laparoscopic platforms [6–9]. Furthermore, research has shown that MIDP has definite advantages for both short- and medium-term results [7–9].In comparison to ODP, minimally invasive resections of left-sided pancreatic tumors were linked to longer operating times but less operative blood loss, according to a large multicenter experiment [7].With its better perspectives and increased precision, MIDP, especially robotic surgery, may also lead to a poor R1 resection rate for pancreatic ductal adenocarcinoma (PDAC) [8]. A retrospective score-matched research conducted across Europe that involved The short-term therapeutic benefits of MIDP, such as reduced intraoperative blood loss and a shorter postoperative hospital stay [9], were verified in 1212 PDAC patients; nonetheless, there was a high conversion rate to OPD [10]. There is no agreement on the results of the robotic versus laparoscopic approach to distal pancreatectomy, despite the fact that MIDP has changed over the last ten years [11,12]. Numerous meta-analyses have indicated similar surgical results betweenthe two methods and reduced robotic distal pancreatectomy (RDP) conversion rates.However, it might be necessary to take into account RDP's disadvantages, which include its greater cost, lengthy learning curve, and operational time while utilizing a robotic platform [13–15].Globally, robotic pancreas surgery has been introduced gradually since the launch of RDP in 2001 [13], and many surgeons and centers are still learning the ropes.Our own randomised controlled

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experiment (RCT) on learning basic surgical skills comparing robotic with laparoscopic training [15] supports the finding that proficiency in RDP can be attained after completing 10–40 cases, suggesting a shorter learning curve compared to laparoscopic surgery [14].

The fulcrum effect, increased tremor of effect or equipment, and two-dimensional imaging, which leads to limited depth perception and ergonomics, are some of the current drawbacks of laparoscopic distal pancreatectomy (LDP) [16]. In theory, robotic surgery canprovide a three-dimensional, high-definition surgical vision and a greater range of motion, thereby mitigating some of the technical drawbacks of the laparoscopic technique [17, 18].

RDP may aid in the ligation and division of tiny vessels, increasing the likelihood that the spleen will be preserved. Additionally, there might be a shorter hospital stay and a lower chance of conversion to open surgery [19]. To conclude if RDP is better than LDP, however, more data is required [20]. While a well-conducted RCT would be perfect to address some of the concerns associated with this by offering the level 1 evidence. In our opinion, it will be very challenging to carry out such a trial effectively without adding bias and lowering the quality of both patients' and surgeons' choices. Furthermore, after mastering the robotic competence, practically all surgeons would transition from a laparoscopic or open method to the robotic platform.This study intends to treat all RDP and LDP surgeries carried out in tertiary referral hepatobiliary and pancreatic centers by comparing the short-term surgical results and the success rate of spleen preservation.with the advent of robotic pancreatic surgery in 2017 and laparoscopic pancreatic surgery in 2008.

MATERIALS AND METHODS

A prospectively maintained database of all consequential patients who had robotic distal pancreatectomy (RDP) from January 2017 (the first RPD case) to January 2023 and those who had laparoscopic LDP from December 2008 (the first LPD case) to December 2018 was retrospectively reviewed. Everybody The Royal Marsden Hospital and Hammersmith Hospital's tertiary referral hepatobiliary and pancreatic centers in West London were the sites of the procedures. Prior to switching to LPD, the senior surgeon (LRJ) completed 123 ODP procedures and more than 100 robotic and laparoscopic pancreaticoduodenectomy cases [21].At the Royal Marsden Hospital, where all RDP procedures are carried out, 180 major pancreatic resections are carried out each year, with two senior surgeons doing the distal pancreatectomy (n = 40, 22.2%) and pancreaticoduodenectomy (n = 140, 77.8%). Except in cases where the tumor affected the major arterial pedicles, all pancreatic resections were carried out minimally invasively. Patients with tumors affecting the common hepatic artery or celiac axis were not eligible for MIDP. Patients with borderline resectable tumors involving major vascular pedicles like the common hepatic artery and/or the celiac axis, as well as surrounding structures like the stomach and colon, were regularly offered upfront systemic chemotherapy for pancreatic cancer at the body and tail of the pancreas. Both robotic and laparoscopic DP procedures were carried out starting in January 2017 until December 2018, at which point a full switch to robotic DP was made. Only those who have a benign pancreatic tumor were taken into consideration for distal pancreatectomy with spleen preservation.

Outcomes

Age, sex, surgical technique (laparoscopic/robotic), conversion to open method, operating time, estimated blood loss (EBL), and peri-operative transfusion rate were among the clinicopathological variables that were retrieved. pathologic information, such as histology prior to surgery and Histopathologic diagnoses following surgery were noted. Tumor size, T stage, perineural invasion, vascular invasion, and the number of positive lymph nodes were also gathered from patients with malignant tumor resection status.Within ninety days following surgery, postoperative morbidity and mortality were noted. Using the Clavien-Dindo Classification, morbidity was ranked [22]. The duration of the entire hospital stay was noted, along with the duration of

post-operative follow-up and disease recurrence. The International Study Group's (ISGPS) definition and grading system is used to analyze POPF [23].

Statistical Analysis

All statistical analyses were conducted using the computer programme Statistical Package for Social Sciences for Windows, version 27.0 (SPSS Inc, Chicago, IL, USA). Continuous variables were expressed as mean ± standard deviation or median and range.Continuous variables were compared using Student's t-test (for normally distributed data)or Mann–Whitney U test (for nonparametric data). Categorical variables were comparedusing χ^2test (when the sample size of all groups is >5) or Fisher's exact test (when thesample size of one group is <5).

Every test was two-sided, and a p-value of less than 0.05 was deemed statistically significant. Since there were no variations from normal care, this study was carried out in accordance with the Declaration of Helsinki and registered as a clinical audit.were created, and every piece of data was regularly gathered.

HISTOPATHOLOGY DETAILS

displays the pathologic diagnosis of lesions that were removed. Neuroendocrine tumors were the most frequent reason for distal pancreatectomy (DP) (n = 26, 21.1%). Neuroendocrine tumors were also the most frequent reason for surgery in the LDP cohort.

Mucinous cystic neoplasm (n = 16, 26.2%) was the most common indication for RDP, followed by pancreatic ductal adenocarcinoma (PDAC, n = 12, 19.4%) (n = 17, 27.4%).The two groups' overall histology is similar (p = 0.283).Features of malignant tumors, including tumor size, T stage, and resection status, did not significantly differ between the two groups.

Operative and Postoperative Details

The laparoscopic group saw a much greater conversion rate to open resection (21.0% vs. 1.6%, p = 0.001) (Table 1). Additionally, the LDP group experienced seven serious problems as opposed to three in the control group, with a higher morbidity rate (43.5% vs. 23.0%, p = 0.005).RDP team. Over the course of the cohort, seven patients—four in the LDP group and three in the RDP group—developed POPF. In the LPD group, three POPF cases needed radiological drainage, while the remaining cases were treated conservatively.The two groups' operating times and the number of procedures involving an anticipated blood loss of more than 500 mL were comparable. The number of patients who had DP combined with splenectomy for non-malignant tumors did not differ much between the two groups.groups (p = 0.441). Within ninety days following surgery, neither group experienced any deaths.The RDP group's operating time for spleen-preserving procedures was noticeably less than that of the LDP group. Following robotic spleen-preserving procedures, hospital stays were shorter (4 days vs. 7 days, p = 0.0002). Additionally, there were notable differences in the surgical method between

the two groups, with 27 out of 31 cases of RDP using the Kimura technique (KT) with the preservation of the splenic vascular pedicles and 18 out of 25 cases of LDP using the Warshaw technique (WT) with the division of the splenic vascular pedicles distal to the splenic hilum.In order to treat spleen preservation, the robotic spleenpreserving operation failure rate was considerably lower than the laparoscopic one (n = 0, 0% vs. n = 5, 20%, p = 0.009). Due to intraoperative splenic vein hemorrhage (n = 2, 40%) and technical issues resulting from an inability to dissect the spleen, five cases of laparoscopic spleenpreserving DP were changed to open DP with splenectomy.safely remove a tumor from the splenic vein using a combination of laparoscopic tools (n = 3, 60%).

DISCUSSION

This study compares RDP and LPD directly since they were first introduced in a tertiary referral HPB unit. It is the largest series of laparoscopic and robotic DP procedures carried out and documented in the UK, where hepatobiliary and pancreatic services were centralized more than 20 years ago to serve a population of at least two million people. Our The findings offer more proof that RDP is practical and safe, with lower rates of morbidity and death than LDP. Additionally, the RDP group has a lower failure rate for spleen preservation and a far lower risk of conversion to open surgery.

A new meta-analysis [27] confirms the poor conversion rate for RDP, which has been documented in a number of earlier case series [24–26]. Among the causes of switching to open surgery are vascular involvement, hemorrhage, blurred vision,prolonged resection, oncological radicality, and difficulty dissecting the distal pancreas. Increased morbidity, severe morbidity, and organ space infection are linked to switching from MIDP to open surgery [28]. The low conversion rate of RDP may be caused by its improved precision and dexterity capabilities, as well as 3D vision, which allows enhanced precision when doing surgery on tiny vascular branches. In our study, the RDP group's conversion rate to open surgery was noticeably lower. This could possibly be related to the senior surgeon's previous pancreatic resection laparoscopic experience.prior to doing robotic surgery. In line with earlier publications [19,20], we observed a much lower rate of unexpected splenectomy with a 100% effective spleen preservation in the RDP group as compared to LDP for spleen-preserving distal pancreatectomy.enhanced precision when doing surgery on tiny vascular branches. In our study, the RDP group's conversion rate to open surgery was noticeably lower. This could possibly be related to the senior surgeon's previous pancreatic resection laparoscopic experience.prior to doing robotic surgery. In line with earlier publications [19,20], we observed a much lower rate of unexpected splenectomy with a 100% effective spleen preservation in the RDP group as compared to LDP for spleen-preserving distal pancreatectomy.

The learning curves for LDP and RDP did not appear to differ much, according to a systematic evaluation of 32 research [28]. However, based on our series and the majority of published data, we think that prior laparoscopic surgical experience is helpful inrobotic surgery [29]. Only when the senior surgeon in our series had become proficient in laparoscopic surgery was robotic surgery introduced. Although the difference in operative time between LDP and RDP was not statistically significant, it was longer (177 min vs. 150 min, p = 0.054). Therefore, it is unclear which strategy is better in terms of operating time. Results from published research have been inconsistent [24,30], and a meta-analysis by Di Martino et al. found no discernible difference between RDP and LDP operating times [31]. A prior comparative meta-analysis [13,20] indicated that there was no significant difference between the two cohorts in the overall POPF rate (n = 4, 6.5% vs. n = 3, 4.9%, p = 0.713). The LPD group experienced a longer duration of stay than the RDP group, and the total complication rate was noticeably greater for both mild and serious problems.RDP and LDP, however, were carried out at two distinct hospitals. The RDPs were all conducted in the Royal Marsden Hospital throughout varying time periods, whereas all of the LDPs were conducted at the Hammersmith Hospital. Therefore,The length of stay might have been impacted by the disparity in the quality of care.

For patients with benign pancreatic conditions, minimally invasive spleen-preserving distal pancreatectomy should be the gold standard procedure, despite its technical difficulties, in order to avoid the associated postoperative complications and the lifetime risks of post-splenectomy sepsis syndrome, which has a 50% mortality rate [32].There are two surgical methods for spleen-preserving distal pancreatectomy that have been documented. Distal to the splenic hilum, the WT with ligation and division of splenic vascular pedicles depends on.

The short stomach and left gastroepiploic veins provide the complete splenic blood supply. During distal pancreatectomy, the KT shields the splenic arteries and preserves the splenic vascular pedicles with careful dissection. Compared to KT, WT is simpler, quicker, and less technically difficult. WT, however, has much increased risks of splenic infarction, necessitating additional surgery, as well as long-term hazards of varices surrounding the splenic hilum [33].Vascular involvement, hemorrhage, blurred vision, trouble dissecting the distal pancreatic, prolonged resection, and oncological concerns are some of the reasons for switching to open surgery. radicality. Increased morbidity, severe morbidity, and organ space infection are linked to switching from MIDP to open surgery [28]. The low conversion rate of RDP may be caused by its enhanced precision and dexterity capabilities, as well as its 3D vision, which allows for better accuracy when working on tiny vascular branches. In our study, the RDP group's conversion rate to open surgery was noticeably lower. This may possibly be related to the fact that the senior surgeon performed pancreatic excision by laparoscopy before beginning robotic surgery. The learning curves for LDP and RDP did not appear to differ much, according to a systematic evaluation of 32 research [28]. However, based on our series and the majority of published data, we think that prior laparoscopic surgical experience is helpful in robotic surgery [29]. Only when the senior surgeon in our series had become proficient in laparoscopic surgery was robotic surgery introduced. Although the difference in operative time between LDP and RDP was not statistically significant, it was longer (177 min vs. 150 min, p = 0.054).Therefore, it is unclear which strategy is better in terms of operating time. Results from published research have been inconsistent [24,30], and a meta-analysis by Di Martino et al. found no discernible difference betweenRDP and LDP operating times [31]. A prior comparative meta-analysis [13,20] indicated that there was no significant difference between the two cohorts in the overall POPF rate (n = 4, 6.5% vs. n = 3, 4.9%, p = 0.713). The LPD group experienced a longer duration of stay than the RDP group, and the total complication rate was noticeably greater for both mild and serious problems. RDP and LDP, however, were carried out at two distinct hospitals. The RDPs were all conducted in the Royal Marsden Hospital throughout varying time periods, whereas all of the LDPs were conducted at the Hammersmith Hospital. Therefore,The length of stay might have been impacted by the disparity in the quality of care.

For patients with benign pancreatic conditions, minimally invasive spleen-preserving distal pancreatectomy should be the gold standard procedure, despite its technical difficulties, in order to avoid the associated postoperative complications and the lifetime risks of post-splenectomy sepsis syndrome, which has a 50% mortality rate [32]. There are two surgical methods for spleen-preserving distal pancreatectomy that have been documented.The WT depends only on the splenic blood supply from the short stomach and left gastroepiploic arteries due to the closure and division of the splenic vascular pedicles distal to the splenic hilum. The KT protects the splenic vessels during distal pancreatectomy and maintains the splenic vascular pedicles through careful dissection. Compared to KT, WT is simpler, quicker, and less technically difficult. WT, however, has much increased risks of splenic infarction, necessitating additional surgery, as well as long-term hazards of varices surrounding the splenic hilum [33].Technically, all of the robotic spleen-preserving distal pancreatectomies in our series were intended to treat spleen preservation, but due to intraoperative complications, none of them were successful.encountered when the splenic vessels were dissected. Due to intraoperative bleeding in two cases and challenges in successfully finishing the procedure in three cases, five cases in the LDP group were converted to open surgery and had open distal pancreatectomy and splenectomy.

Additionally, more patients in our cohort had spleen-preserving distal pancreatectomy with KT—a superior technique for preservation of the spleen—because of the technical benefits of Da Vinci robotic vision and equipment over laparoscopic surgery.the spleen and its vascular pedicles. The POPF rate was the same for both methods.Nonetheless, radiological drainage was necessary in the LDP group for all three PDPF instances.As far as we are aware, this is the first LDP and RDP series in the UK and one of the few major series in the West that directly contrasts the two approaches for preserving the spleen.The gold standard, in our opinion, should be spleen-preserving distal pancreatectomy for individuals with non-cancerous diseases in the body and pancreatic tail. Our findings unequivocally demonstrated the advantages and benefits of RDP for spleen preservation in terms of intraoperative outcomes, postoperative complications, and the success rate of spleen preservation.and duration of hospitalization. However, spleen preservation might not be technically feasible for tumors that are near the splenic hilum and splenic arteries that are entrenched in the pancreas. Retrospective investigations of this study cannot completely eliminate certain biases.This study's primary limitations are selection bias and its retrospective design. However, because the same surgeon carried out all of the robotic and laparoscopic procedures during the same learning phase transition, there was less selection bias.and the proficiency stage. Patients who met the inclusion and exclusion criteria for LDP and RDP with or without splenectomy were eligible for both minimally invasive procedures. Given the challenges associated with RCTs comparing laparoscopic and robotic pancreatic surgery, we think this is the best objective evidence on robotic and laparoscopic surgery without introducing selection or surgeon bias. This would also apply to the first few LPD cases by the same surgeon, even though the learning curve effect would distort the data for the first few RDP instances mentioned. That being said, as little as There is a continuum of invasive surgery skills, and the results may have been impacted by the prior LPD experience on the RPD proficiency scale. Therefore, to more clearly define the potential benefits of RPD over LPD for PDAC patients' survival outcomes, randomized studies with predetermined proficiency standards for participating centers and surgeons should be carried out in the future with the goal of removing selection bias.To make sure that technological advancements result in patient satisfaction and long-term survival outcomes for PDAC patients, additional analyses should incorporate data on health-related quality of life, which is becoming a crucial endpoint in research studies and audits. We'll report this as soon as there are enough of patients with PDAC is achieved.Over the past ten years, distal pancreatectomy has seen an increase in the use of robotic surgical techniques worldwide.Whether it has a definite benefit over the laparoscopic method in patients who have already received extensive laparoscopic training is still up for debate. A robotic platform, however, should allow for more pancreaticSurgeons should use MIDP instead of open surgery since robotics makes it easier to learn advanced abilities than laparoscopy [18]. RDP ought to be the gold standard procedure for distal pancreatectomy in patients without common hepatic artery involvement or celiac axis involvement, with or without spleen preservation.

Over the next five to ten years, as access to robotic training and robotic theaters improves and additional robotic surgical enterprises are established, we anticipate that the number of robotic.In high-income nations, the number of pancreatic resections performed will rise sharply.

CONCLUSIONS

In our study, RDP resulted in a shorter length of stay by lowering the conversion rate in comparison to LDP and the postoperative complication rate. Additionally, RDP preserved the spleen better than LPD. To validate these findings, more solid evidence is required, ideally from large, prospective, multicenter investigations.

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Institutional Review Board Statement

The study was registered locally as a clinical audit and carried out in compliance with the Declaration of Helsinki.

Informed Consent Statement

Every participant in the study gave their informed consent.

Data Availability Statement

Data are not available because of ethical or privacy constraints.

Conflicts of Interest

No conflicts of interest are disclosed by the writers.

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