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An Open Pancreaticoduedenectomy Vs Minimally Invasive: A Propensity Matched Analysis From A Group of Patients

Bhushan Hemraj Mahajan[1*], Altaf Ahmed[2], Saravanan P.S[3], Revanth[4], Amit Rai[5], Suresh Babu[6]

[1*,2,4] Post Graduate Student, Department of General Surgery, Meenakshi Medical College, Hospital and Research Institute, Kanchipuram

[3]Head of Department, Department of General Surgery, Meenakshi Medical College, Hospital and Research Institute, Kanchipuram

[5]Assistant Professor, Department of General Surgery, Meenakshi Medical College, Hospital and Research Institute, Kanchipuram

[6]Associate Professor, Department of General Surgery, Meenakshi Medical College, Hospital and Research Institute, Kanchipuram

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Abstract

Background: There aren't many well-controlled research evaluating the perioperative results of OPD with MIPD. **Methodology:** This was a retrospective study of elective MIPD and OPD performed at 120 visiting Department of General Surgery, Meenakshi Medical College, Hospital and Research Institute, Kanchipuram. The NSQIP program collects more than 150 variables from 500 participating hospitals, including preoperative, intraoperative, and 30-day postoperative mortality, and morbidity outcomes. **Results:** 334 (7.4%) of the 4484 patients who were found underwent MIPD. Patients with MIPD were less likely to lose weight, younger, and more likely to be White. They were more likely to have a drain installed and to have a classic Whipple procedure. Following a 3:1 matching procedure, 334 MIPD patients and 1002 OPD patients were compared. Individuals with MIPD exhibited decreased rates of transfusion (7.9% vs. 14.4%; P = 0.02) and total surgical site infection (13.4% vs. 19.6%; P = 0.04), according to a secondary analysis comparing MIPD without conversion or open assist with OPD. **Conclusions:** Although an increased readmission rate somewhat offsets the advantages of a lower incidence of prolonged length of stay, MIPD had an identical morbidity and death rate to OPD.

Introduction

The most popular operation for removing pancreatic tumours is called a pancreaticoduodenectomy, or Whipple operation. Of all the kinds of pancreatic cancer, surgery for eliminating a tumour provides the best opportunity for long-term control. The Whipple is a challenging and intricate procedure that involves removing and reconstructing a sizable portion of the digestive system. The utilisation of minimally invasive surgery has become the norm for many surgeries in various fields; nevertheless, due to the intricacy of the procedures and the lengthy learning process involved in their commencement, its adoption in pancreatic surgery has been cautious.1. This is especially true for patients who need pancreaticoduodenectomy (PD), which necessitates intricate repair. In spite of high-volume centres, postoperative morbidity is still substantial despite significant advancements in pancreatic resection. Even though minimally invasive Parkinson's disease (MIPD) was initially documented in 1994 and the robotic technique in 2003, it still remains uncommon and only makes up 4.4% to 14% of all Parkinson's disease cases in the country.[2,3]

This is probably due to worries about sufficient oncological results when it is done for cancer as well as worries about the possibility of serious perioperative complications or even death. In comparison to open PD (OPD), MIPD is linked to shorter hospital stays, lower blood loss, lower transfusion rates, and delayed emptying of the stomach when oncological outcomes and postoperative mortality are comparable, according to a number of recent systematic reviews and meta-analyses.4,5 However, the vast majority of these investigations have involved highly chosen individuals in tiny single-institution settings, which introduces selection bias and restricts the generalizability of the findings.[3] These research populations, nevertheless, were not matched, and as a result, there was probably a substantial potential selection bias. Furthermore, pancreatic-specific effects such postoperative pancreatic

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fistula and delayed gastric emptying rates have not been included in these investigations. Propensity matching was employed in a recent multi-institutional investigation that showed comparable postoperative mortality. The MIPD cases, however, were from a single, very skilled centre, so it's possible that the findings wouldn't apply to other centres.

Utilising the pancreas-targeted American College of Surgeons National Surgical Quality Improvement Programme (ACS-NSQIP) database, we compare MIPD to OPD in the present assessment's propensity score matched assessment of intraoperative and postoperative outcomes. Because all of the data have been abstracted by qualified medical professionals and contain pancreas-specific factors that enable us to investigate pancreatectomy-specific outcomes, this national database is unique.

Methodology

This was a retrospective study of elective MIPD and OPD performed at 120 visiting Department of General Surgery, Meenakshi Medical College, Hospital and Research Institute, Kanchipuram. The NSQIP program collects more than 150 variables from 500 participating hospitals, including preoperative, intraoperative, and 30-day postoperative mortality, and morbidity outcomes.

The categories of current procedural terminology (CPT) codes were chosen when the pancreas-targeted NSQIP participant user data files were combined with the general database to identify patients: Pylorus-preserving perforation-decoration (PD) with and without pancreatojejunostomy (CPT 48153 and 48154) and the traditional Whipple-type technique (CPT 48150 and 48152). A group known as multivisceral resection was formed from patients who had splenectomy, hepatic, intestinal, gastric, and colonic resections. The patients listed below were not included (Fig. 1): 1. Patients whose records were incomplete. 2. Individuals who experienced a hybrid procedure. 3. Individuals who experienced non-elective surgery or other non-PD-related procedures.

By doing this, the confounding influence of other procedures on the results following surgery was eliminated. Supplementary Table 2 provides a complete list of concurrent procedures that were not included. The socioeconomic characteristics of the patients (age, sex, race, and body mass index (BMI)), ASA class, diabetes, hypertension, obstructive jaundice, preoperative biliary stent, weight loss, intraoperative drain placement, preoperative chemotherapy or radiotherapy, and vascular resection were all extracted. Pancreatitis, T0-T2 malignant, T3-T4 malignant, 5 cm benign, and >5 cm benign lesions were the different diagnosis categories.

Any of the following actions was considered a major complication: dehiscence, pneumonia, deep surgical site infection, organ space surgical site infection, sepsis/septic shock, deep vein thrombosis/thrombophlebitis, renal failure, cardiac arrest, myocardial infarction, unforeseen intubation, pulmonary embolism, ventilator for more than 48 hours, bleeding requiring transfusion within the first 72 hours of surgery begin time, or postoperative pancreatic fistula (POPF). Continuous variables were shown as means and medians, whereas categorical ones were displayed as counts and proportions. We compared the minimally invasive and open approaches using univariate logistic regression for patient and tumour variables across the whole dataset. Next, we used multivariable logistic regression to assess the conditional likelihood (the propensity score) of receiving the minimally invasive operation. A comparison of MIPD (laparoscopic, laparoscopic with open assist, laparoscopic with unplanned conversion, robotic, robotic with open assist, and robotic with unplanned conversion) versus OPD using intention-to-treat methodology was the main analytical approach. We had to include both laparoscopic and robotic instances with open assist in our analysis since the transformation variable did not indicate whether the procedure began solely with a minimally invasive approach or with open assistance. The evaluation that comes after compared laparoscopic/robotic cases without open assist or conversion to OPD.

Results

4484 individuals who received PD and satisfied the study's inclusion and exclusion criteria were found between 2014 and 2015. Just 334 (7.4%) of the total cases that were chosen had minimally invasive procedures. Of the MIPD cases, 102 (39.5%) were done by laparoscopy; 54 (16.2%) under open assist; 44 (13.2%) under laparoscopy with unplanned conversion; 110 (32.9%) under robotics; 12 (3.6%) under open assist; and 12 (3.6%) under robotics with unexpected conversion.

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TABLE 1. Preoperative Patient Tumor and Operative Characteristics (Intent-to-Treat Analysis)

		Original Dataset					3:1 Matched Dataset		
	Open	Minimally Invasive	SD	*P*		Open	Minimally Invasive	SD	*P*
Sample size Sex Female	4150 1927 (46.4)	334 159 (47.6)	 0.02	 0.6 8		1002 484 (48.3)	334 159 (47.6)	 0.01	 0.80
Male Age <65 years	2223 (53.6) 1938 (46.7)	175 (52.4) 177 (53.0)	0.02 0.13	 0.0 3		518 (51.7) 520 (51.9)	175 (52.4) 177 (53.0)	0.01 0.02	 0.68
≥65 years (53.3)	2212	157 (47.0)	0.13			482 (48.1)	157 (47.0)	0.02	
Race/Ethnicity Whites	 3204 (77.2)	 275 (82.3)	 0.13	0.0 2		 841 (83.9)	 275 (82.3)	 0.04	0.59
Blacks	350 (8.4)	30 (9.0)	0.02			89 (8.9)	30 (9.0)	0.00	
Others BMI <18.5	596 (14.4) 117 (2.8)	29 (8.7) 11 (3.3)	0.18 0.03	 0.2 9		72 (7.2) 37 (3.7)	29 (8.7) 11 (3.3)	0.06 0.02	 0.66
18.5-24	1458 (35.1)	101 (30.2)	0.10			329 (32.8)	101 (30.2)	0.06	
25-29	1507 (36.3)	125 (37.4)	0.02			344 (34.3)	125 (37.4)	0.06	
≥30	1068 (25.7)	97 (29.0)	0.07	292 (29.1) 0.06			97 (29.0)	0.00 0.58	
No	2214 (53.3)	201 (60.2)	0.14			581 (58.0)	201 (60.2)	0.04	
Yes	1911 (46.0)	131 (39.2)	0.14			417 (41.6)	131 (39.2)	0.05	
Insulin Weigh loss ≤10% loss	487 (11.7) 3455 (83.3) 695 (16.7)	32 (9.6) 305 (91.3) 29 (8.7)	0.07 0.24 0.24	<0. 01		93 (9.3) 908 (90.6) 94 (9.4)	32 (9.6) 305 (91.3) 29 (8.7)	0.01 0.02 0.02	 0.65
Hypertension No	 1992 (48.0)	 173 (51.8)	 0.08	0.1 8		 537 (53.6)	 173 (51.8)	 0.04	0.50
Yes ASA Class Class I/II	2158 (52.0) 992	161 (48.2) 88 (26.3)	0.08 0.06	 0.3 2		465 (46.4) 257 (25.6)	161 (48.2) 88 (26.3)	0.04 0.02	 0.78

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	(23.9)							
Class III/IV Diagnosis group Chronic pancreatitis	3158 (76.1) 227 (5.5)	246 (73.7) 14 (4.2)	0.06 0.06	0.0 6	745 (74.4) 43 (4.3)	246 (73.7) 14 (4.2)	0.02 0.00	0.86
<5 cm, benign	387 (9.3)	48 (14.4)	0.16		152 (15.2)	48 (14.4)	0.02	
>5 cm, benign	110 (2.7)	8 (2.4)	0.02		30 (3.0)	8 (2.4)	0.04	
T0-T2, malignant	802 (19.3)	70 (21.0)	0.04		217 (21.7)	70 (21.0)	0.02	
T3-T4, malignant	2440 (58.8)	181 (54.2)	0.09		533 (53.2)	181 (54.2)	0.02	
Unknown ChemotherapyNo	184 (4.4) 3580 (86.3)	13 (3.9) 281 (84.1)	0.03 0.06	0.5 0	27 (2.7) 854 (85.2)	13 (3.9) 281 (84.1)	0.07 0.03	0.84
Yes	553 (13.3)	52 (15.6)	0.06		144 (14.4)	52 (15.6)	0.03	
Unknown RadiotherapyNo	17 (0.4) 3883 (93.6)	1 (0.3) 312 (93.4)	0.02 0.01	0.9 8	4 (0.4) 939 (93.7)	1 (0.3) 312 (93.4)	0.02 0.01	0.93
Yes	253 (6.1)	21 (6.3)	0.01		59 (5.9)	21 (6.3)	0.02	
Unknown Surgery type Whipple w PJ	14 (0.3) 2352 (56.7)	1 (0.3) 242 (72.5)	0.01 0.33	<0. 01	4 (0.4) 736 (73.5)	1 (0.3) 242 (72.5)	0.02 0.02	0.82
Whipple w/o PJ	66 (1.6)	2 (0.6)	0.10		5 (0.5)	2 (0.6)	0.01	
PPPD w PJ	1674 (40.3)	87 (26.0)	0.31		256 (25.5)	87 (26.0)	0.01	
PPPD w/o PJ Multivisceral resectionNo	58 (1.4) 3857 (92.9)	3 (0.9) 307 (91.9)	0.05 0.04	0.4 9	5 (0.5) 923 (92.1)	3 (0.9) 307 (91.9)	0.05 0.01	0.90
Yes Vascular resection No	293 (7.1) 3481 (83.9)	27 (8.1) 281 (84.1)	0.04 0.01	0.9 1	79 (7.9) 840 (83.8)	27 (8.1) 281 (84.1)	0.01 0.01	0.89
Yes	669 (16.1)	53 (15.9)	0.01		162 (16.2)	53 (15.9)	0.01	

TABLE 2. Intra- and Postoperative 30-day Outcomes by Surgical Approach, Matched Dataset (Intent-to-Treat Analysis)

	Open	Minimally Invasive	MI Versus Open	*P*
Frequency (%)	1002	334	OR (95% CI)	
Return to operating room	49 (4.9)	23 (6.9)	1.42 (0.86, 2.36)	0.17
30-Day mortality	13 (1.3)	6 (1.8)	1.38 (0.53, 3.64)	0.51
Readmission	143 (14.3)	64 (19.2)	1.42 (1.02, 1.97)	0.04
Discharge to nonhome	132 (13.4)	26 (8.0)	0.56 (0.36, 0.88)	0.01
Length of stay >14 days	216 (21.6)	55 (16.5)	0.72 (0.52, 0.996)	0.047
Mean (median)			Mean difference (95% CI)	
Operative time (minutes)	359.6 (348.5)	426.6 (410.0)	þ67.1 (51.6, 82.5)	<0.010.
Length of stay (days)	10.8 (8.0)	9.9 (7.0)	—0.9 (—2.0, 0.3)	13

TABLE 3. Thirty-day Postoperative Complications by Surgical Approach, Matched Dataset

	Open	Minimally Invasive	OR (95% CI)	*P*
Sample size	1002	334	MI vs Open	
Overall complication	543 (54.2)	166 (49.7)	0.83 (0.65, 1.07)	0.15
Major complication	432 (43.1)	135 (40.4)	0.89 (0.69, 1.15)	0.38
Superficial SSI	74 (7.4)	15 (4.5)	0.60 (0.34, 1.05)	0.08
Deep SSI	24 (2.4)	5 (1.5)	0.62 (0.23, 1.64)	0.33
Organ space SSI	139 (13.9)	40 (12.0)	0.84 (0.58, 1.23)	0.38
Overall SSI	218 (21.8)	56 (16.8)	0.73 (0.53, 1.00)	0.05
Dehiscence	9 (0.9)	4 (1.2)	1.33 (0.41, 4.33)	0.63
Pneumonia	36 (3.6)	5 (1.5)	0.42 (0.16, 1.06)	0.07
Unplanned intubation	43 (4.3)	12 (3.6)	0.83 (0.43, 1.59)	0.57
Pulmonary embolism	15 (1.5)	7 (2.1)	1.42 (0.57, 3.53)	0.46
Ventilator for >48 hours	31 (3.1)	11 (3.3)	1.07 (0.53, 2.15)	0.86
Urinary tract infection	30 (3.0)	11 (3.3)	1.10 (0.55, 2.19)	0.79
Bleeding	169 (16.9)	51 (15.3)	0.89 (0.63, 1.25)	0.50
DVT/thrombophlebitis	23 (2.3)	10 (3.0)	1.32 (0.62, 2.82)	0.47
Sepsis/septic shock	107 (10.7)	28 (8.4)	0.77 (0.50, 1.18)	0.23
Pancreatic fistula	193 (19.4)	66 (19.9)	1.05 (0.77, 1.44)	0.75
Without intervention	130 (13.1)	46 (13.9)		
With intervention	63 (6.3)	20 (6.0)		
Percutaneous drain[ω]	129 (13.2)	43 (13.0)	1.01 (0.70, 1.46)	0.96
Amylase-rich fluid	47 (4.8)	18 (5.4)		
Bile	12 (1.2)	9 (2.7)		
Pus	53 (5.4)	14 (4.2)		
Other	34 (3.5)	10 (3.0)		
Delayed gastric emptying	158 (16.2)	55 (16.7)	1.03 (0.73, 1.44)	0.87

TABLE 4. Intra- and Postoperative 30-day Outcomes by Surgical Approach, Matched Dataset

	Open	Minimally Invasive	MI Versus Open	*P*
Frequency (%)	606	202	OR (95% CI)	
Return to operating room	32 (5.2)	15 (7.3)	1.41 (0.76, 2.62)	0.27
30-Day mortality	9 (1.5)	2 (1.0)	0.67 (0.14, 3.09)	0.60
Readmission	99 (16.1)	48 (23.4)	1.55 (1.06, 2.26)	0.02
Discharge to nonhome	72 (11.9)	14 (6.9)	0.58 (0.32, 1.05)	0.07

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Length of stay >14 days	129 (21.3)	25 (12.4)	0.53 (0.33, 0.83)	<0.01
Mean (median)			Mean difference (95% CI)	
Operative time (minutes)	353.4 (343)	411.7 (394)	þ58.3 (39.7, 77.0)	<0.01
Length of stay (days)	10.8 (8)	9.0 (7)	—1.8 (—3.2, —0.4)	0.01

Discussion

This is the initial large-scale propensity-matched study including pancreas-specific factors comparing MIPD vs OPD from a nationwide population. The lack of pancreatic-targeted characteristics in the databases of the three large national studies that have already been conducted on the perioperative and short-term outcomes of the two methods prevented the examination of outcomes unique to the pancreas. Furthermore, in an attempt to reduce the bias inherent in these retrospective investigations, propensity matching of patients from different centers was not done in these trials.[1,3] In a multi-institutional study, McMillan et al.[6] did propensity match OPD patients to their MIPD cohort; however, as all MIPD was conducted at a single institution, their findings might not be generalizable to a larger population. A subsequent publication similarly compared robotic patient management with outpatient physical therapy; however, the robotic cases were conducted at a single institution, which further limited the applicability of the findings.[7] This work eliminates some of these constraints and enables the investigation of a more representative sample from numerous institutions by utilising the pancreas-targeted NSQIP database. Furthermore, the availability of a sizable pool of control open cases made it feasible for us to match each MIPD with an OPD case, enabling us to present results on a patient cohort that was fairly balanced. We discovered in the current study that MIPD was linked to decreased rates of discharge to a non-home setting and prolonged length of stay. There was no variation in the 30-day total morbidity, mortality, POPF, or delayed gastric emptying. MIPD was associated with a higher mean operative time and readmission rate as compared with matched OPD. MIPD was linked to a reduction in 30-day overall and infectious complications as well as a reduced requirement for perioperative transfusion if it was carried done in a minimally invasive manner with no conversion or open assist. A recent meta-analysis incorporating two original registry studies (19,996 patients) and nineteen contrasting investigations (1833 patients) also revealed no statistically significant difference in postoperative mortality (odds ratio, OR 1.1, 95% confidence interval, CI: 0.6–1.9).[8] The first extensive multi-institution study comparing robotic patient handling with open patient handling was published by Zureikat et al.[7] They discovered no correlation between the technique and postoperative mortality.

On the other hand, two National Cancer Database (NCDB) investigations that contrasted MIPD and OPD for pancreatic cancer revealed a greater postoperative death rate for MIPD.[4,5] Sharpe et al1 discovered that in low-volume centres (< 10 MIPDs/2 years), the 30-day mortality was higher for MIPD (OR 2.27; P 0.002), but at high-volume centres (10 MIPDs/2 years), it was the same (OR 0.46; P 0.428). This highlights the significance of implementing these cutting-edge surgical methods within the framework of a busy pancreas centre staffed by skilled pancreatic surgeons and dedicated to providing the tools necessary to carry out these intricate treatments in a safe manner.

The primary reason for this study's limitations is that it is retrospective in character. Propensity score matching allowed us to try controlling for known factors in both groups, but there are still unidentified confounders that could have an impact on the results. The surgeon and hospital volume are two of these variables that are not included in the NSQIP database. However, given the low perioperative fatality rates observed in both the MIPD and OPD groups (1.8% and 1.3%, correspondingly), we can assume that these centres very probably reflect high-volume centres. Furthermore, we were unable to evaluate the rate of positive margin, the sufficiency of lymphadenectomy, or the probability of survival for patients who were diagnosed with malignancy because there were no pathological or oncological outcomes accessible. Lastly, due to the relatively small number of participants of the minimally invasive surgery group, we were unable to distinguish between laparoscopic and robotic procedures and as a result, we are unable to offer opinions on the outcomes of each minimally invasive strategy independently. When more cases are added to the pancreas-focused NSQIP database, this will become feasible soon.

Conclusion

In summary, MIPD appeared to be associated with a lower likelihood of prolonged duration of stay and equivalent rates of cumulative complications, POPF,

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delayed stomach emptying, and 30-day postoperative mortality, based on a survey of likely high-volume pancreas centers. When MIPD is performed in a purely minimally invasive manner, it is linked to fewer overall difficulties, particularly those related to infection and bleeding; however, these advantages are mostly lost when all patients are evaluated using an intention-to-treat analysis, making the two methods nearly equal. While a randomized controlled trial would be the best way to validate these results, it is unlikely to happen because potential locations do not appear to be equipoised.

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