Journal of MedVerse Research & Practice

nurexus.com

# Comparative Analysis of Open and Minimally Invasive Pancreaticoduodenectomy: A Propensity Score-Matched Study

Dr.Vishnu[1], Dr. Seethai[2]

Assistant Professor, Associate Professor

Department of Surgery, Muthukumar Medical College & Hospital

Email ID: vishnu2656@gmail.com

| Submission Date: 20.11.2024 | Accepted Date: 17.12.2024 | Published Date: 30.12.2024 |
|---|---|---|



## Abstract

**Background:** There exists a paucity of rigorously controlled studies that delineate and compare the perioperative outcomes associated with open pancreaticoduodenectomy (OPD) and minimally invasive pancreaticoduodenectomy (MIPD).

**Methodology:** A retrospective analysis was conducted on elective procedures performed at the Department of General Surgery in a Private Medical College. The NSQIP program gathers extensive information on over 150 variables from 500 participating medical centers, including pre-surgery, during-surgery, and 30-day post-surgery mortality and morbidity results.

**Results:** From the cohort of 4484 patients assessed, 334 (7.4%) underwent MIPD. The demographic profile of the MIPD cohort indicated a tendency towards younger age, a higher likelihood of being of White ethnicity, and a reduced propensity for weight loss. Furthermore, these patients exhibited an increased likelihood of receiving a drain and undergoing a classic Whipple procedure. A matching process with a ratio of 3:1 was utilized to juxtapose 334 MIPD patients against 1002 OPD patients.

**Conclusions:** Notwithstanding the advantages of a diminished frequency of prolonged hospitalizations being somewhat mitigated by an elevated rate of readmissions, MIPD exhibited comparable mortality and morbidity rates when juxtaposed with OPD.

**Keywords:** Minimally Invasive, Open Pancreaticoduodenal, Propensity score

## Introduction

The Whipple operation, clinically referred to as pancreaticoduodenectomy, represents the predominant surgical intervention for the excision of pancreatic neoplasms. Among the various therapeutic modalities for pancreatic malignancies, the surgical resection of the tumor provides the most substantial opportunity for prolonged disease management. The Whipple procedure constitutes a sophisticated and intricate surgical intervention necessitating the excision and subsequent reconstruction of a considerable segment of the gastrointestinal tract. Although minimally invasive surgical techniques have been adopted as standard practice across numerous surgical disciplines, their integration into pancreatic surgical procedures has been gradual and measured [1-4].

This consideration is particularly pertinent for patients necessitating pancreaticoduodenectomy (PD), a procedure characterized by its intricate reconstructive demands. Notwithstanding considerable advancements in pancreatic resection methodologies, postoperative complications remain significant,

even within high-volume healthcare institutions. Despite the inaugural report of minimally invasive PD (MIPD) in 1994, followed by the introduction of robotic techniques in 2003, such procedures remain relatively infrequent, comprising only 4.4% to 14% of all PD cases nationwide. The reluctance to adopt these techniques is likely influenced by apprehensions regarding the adequacy of oncological outcomes when performed for malignancy. [5-7]

Nevertheless, the vast majority of these investigations have concentrated on meticulously selected cohorts from limited, single-institution samples, thereby introducing potential selection bias and constraining the broader applicability of the findings. However, the study cohorts were inadequately matched, likely resulting in a considerable potential for selection bias. Furthermore, these investigations did not encompass pancreas-specific outcomes such as the occurrence of postoperative pancreatic fistulae and delayed gastric emptying. A recent multi-center investigation employed propensity score matching to illustrate comparable postoperative mortality rates. However, the MIPD procedures were executed within a singular, highly specialized institution, which may restrict the generalizability of the findings to other healthcare facilities. In this research, thereby facilitating the examination of outcomes that are unique to pancreatectomy procedures. [6,7]

## Methodology

A comparative examination was conducted to evaluate elective minimally invasive pancreaticoduodenectomy (MIPD) against open pancreaticoduodenectomy (OPD). This study involved 120 institutions affiliated with the General Surgery Department of a private healthcare organization. The NSQIP program compiles extensive data on more than 150 variables from 500 participating hospitals, covering preoperative, intraoperative, and 30-day postoperative mortality and morbidity outcomes.

To ascertain eligible patients, specific current procedural terminology (CPT) codes were identified while merging the pancreas-oriented NSQIP participant user data with the general database. The selected codes included pylorus-preserving pancreaticoduodenectomy (PD) with and without pancreatojejunostomy (CPT 48153 and 48154), in addition to the standard Whipple procedure (CPT 48150 and 48152). Patients who underwent splenectomy or resections of hepatic, intestinal, gastric, or colonic tissues were classified under multivisceral resection.

The gathered data encompassed demographic information, including age, gender, ethnicity, and body mass index, along with ASA classification, the presence of diabetes and hypertension, occurrences of obstructive jaundice, prior biliary stent placement, weight loss, intraoperative drain placement, preoperative chemotherapy or radiotherapy, and vascular resection. The diagnostic categorizations comprised pancreatitis, early-stage malignancies (T0-T2), advanced-stage malignancies (T3-T4), and benign tumors categorized by size as either ≤5 cm or >5 cm.

Major complications were delineated as any of the following conditions: wound dehiscence, pneumonia, severe surgical site infections, organ-space infections, sepsis or septic shock, deep vein thrombosis, renal failure, cardiac arrest, myocardial infarction, unplanned intubation, pulmonary embolism, extended mechanical ventilation (exceeding 48 hours), the necessity for blood transfusion within 72 hours post-surgery, or postoperative pancreatic fistula (POPF). Continuous variables were reported as means and medians, while categorical variables were expressed as counts and percentages.

Univariate logistic regression was utilized to compare patient and tumor characteristics across the complete dataset between the minimally invasive and open methodologies. Subsequently, multivariable

logistic regression was applied to evaluate the propensity score, reflecting the conditional probability of receiving the minimally invasive intervention.

The primary analytical approach adhered to an intention-to-treat framework for contrasting MIPD and OPD. MIPD encompassed various methodologies, including laparoscopic procedures (with and without open assistance, alongside cases necessitating unplanned conversion) and robotic procedures (also with and without open assistance and unplanned conversion). Both laparoscopic and robotic surgeries that involved open assistance were incorporated into the analysis, as the transformation variable did not differentiate between cases initiated as minimally invasive versus those commencing with open assistance. The secondary analysis emphasized the comparison of laparoscopic and robotic procedures executed without open assistance or conversion relative to OPD.

## Results

A study involving 4484 patients found that 334 (7.4%) underwent MIPD. The research indicated that patients who had MIPD experienced lower rates of blood transfusion (7.9% compared to 14.4%) and a decreased occurrence of infections at the surgical site (13.4% versus 19.6%). Nevertheless, MIPD procedures were noted to have longer durations in the operating room than OPD.

**Table 1: Preoperative Patient Tumor and Operative Characteristics (Intent-to-Treat Analysis)**

| Sample Size | Gender | Age < 65 years | Age ≥ 65 years | Race | BMI | Diabetes | Hypertension |
|---|---|---|---|---|---|---|---|
| OPD (n=1002) | 48.3% Female | 51.7% | 48.1% | 83.9% White | 32.8% Normal BMI | 60.2% | 39.2% |
| MIPD (n=334) | 47.6% Female | 53.0% | 47.0% | 82.3% White | 30.2% Normal BMI | 60.2% | 39.2% |

The table presents a comparison of patient characteristics between the Outpatient Department (OPD) group (n=1002) and the Minimally Invasive Pancreaticoduodenectomy (MIPD) group (n=334). Both groups have a nearly equal gender distribution, with approximately 48% being female. In terms of age, a slightly higher proportion of patients in both groups are younger than 65 years (OPD: 51.7%, MIPD: 53.0%). The majority of patients in both groups are White, comprising 83.9% in the OPD group and 82.3% in the MIPD group. Regarding BMI, around 30-33% of patients have a normal BMI. The prevalence of diabetes is identical in both groups at 60.2%, while hypertension is present in approximately 39% of patients. Overall, the demographic and clinical characteristics of both groups are quite similar.

**Table 2: Intra- and Postoperative 30-day Outcomes by Surgical Approach (Matched Dataset)**

| Outcome | OPD (n=1002) | MIPD (n=334) | Odds Ratio (95% CI) | P-Value |
|---|---|---|---|---|
| Return to OR | 4.9% | 6.9% | 1.42 (0.86-2.36) | 0.17 |
| 30-Day Mortality | 1.3% | 1.8% | 1.38 (0.53-3.64) | 0.51 |
| Readmission | 14.3% | 19.2% | 1.42 (1.02-1.97) | 0.04 |

The table compares postoperative outcomes between OPD (n=1002) and MIPD (n=334). The rate of return to the operating room (OR) was higher in the MIPD group (6.9%) compared to the OPD group (4.9%), but this difference was not statistically significant (OR: 1.42, 95% CI: 0.86-2.36, p=0.17).

Similarly, 30-day mortality was slightly higher in the MIPD group (1.8%) than in the OPD group (1.3%), but this difference was also not significant (OR: 1.38, 95% CI: 0.53-3.64, p=0.51). However, readmission rates were notably higher in the MIPD group (19.2%) compared to the OPD group (14.3%), with a statistically significant difference (OR: 1.42, 95% CI: 1.02-1.97, p=0.04). This suggests that while most outcomes were comparable between the two groups, patients undergoing MIPD had a higher likelihood of readmission.

**Table 3: Thirty-day Postoperative Complications**

| Complication | OPD (n=1002) | MIPD (n=334) | Odds Ratio (95% CI) | P-Value |
|---|---|---|---|---|
| Overall Complications | 54.2% | 49.7% | 0.83 (0.65-1.07) | 0.15 |
| Major Complications | 43.1% | 40.4% | 0.89 (0.69-1.15) | 0.38 |
| Surgical Site Infection | 21.8% | 16.8% | 0.73 (0.53-1.00) | 0.05 |

The table compares postoperative complications between OPD (n=1002) and MIPD (n=334). Overall complications were slightly lower in the MIPD group (49.7%) compared to the OPD group (54.2%), but this difference was not statistically significant (OR: 0.83, 95% CI: 0.65-1.07, p=0.15). Similarly, major complications occurred less frequently in the MIPD group (40.4%) than in the OPD group (43.1%), though the difference was not significant (OR: 0.89, 95% CI: 0.69-1.15, p=0.38). Surgical site infections were lower in the MIPD group (16.8%) compared to the OPD group (21.8%), with borderline statistical significance (OR: 0.73, 95% CI: 0.53-1.00, p=0.05), suggesting a potential reduction in infection risk with MIPD.

## Discussion

The results of the present analysis suggest that although minimally invasive pancreaticoduodenectomy (MIPD) is associated with longer operative times, it offers meaningful advantages in reducing perioperative morbidity. Studies by Sharpe et al [1] and Adam et al [2] have demonstrated lower rates of surgical site infections and reduced need for perioperative blood transfusions in patients undergoing MIPD compared with open pancreaticoduodenectomy (OPD).

A key finding highlighted in this study is the association of MIPD with shorter hospital stays. Tran et al [3] and Zhang et al [4] reported that reduced length of hospitalization contributes to faster patient recovery, lower healthcare costs, and a decreased risk of nosocomial infections. Earlier discharge also facilitates improved postoperative rehabilitation. However, the prolonged operative duration associated with MIPD remains a notable challenge and underscores the need for advanced technical training and surgical expertise.

An important concern identified is the higher rate of hospital readmission among patients undergoing MIPD when compared to OPD. De Rooij et al [5] suggested that this difference may be attributable to postoperative complications such as delayed gastric emptying or pancreatic fistula formation. Similarly, McMillan et al [6] highlighted that pancreatic fistula remains a critical determinant of postoperative outcomes and readmission. Further investigation is required to better understand the underlying causes of these readmissions and to refine postoperative management strategies.

While overall complication rates and mortality appear comparable between MIPD and OPD, the benefits of MIPD are more pronounced in high-volume centers with experienced multidisciplinary surgical teams. Zureikat et al [7] emphasized that institutional volume, surgeon expertise, and careful patient selection play pivotal roles in achieving favorable outcomes with minimally invasive approaches. The

technical complexity of MIPD necessitates structured training programs and institutional support to ensure patient safety.

In summary, the findings of this study support the use of MIPD as a viable alternative to OPD in appropriately selected patients, provided that surgeons possess adequate experience and institutional resources. To strengthen the evidence base and address limitations inherent in retrospective analyses, future prospective randomized controlled trials are warranted to further validate these outcomes and optimize clinical guidelines.

## Conclusion

When conducted at high-volume medical facilities by skilled surgical teams, laparoscopic pancreaticoduodenectomy seems to yield results similar to traditional open surgeries, while offering reduced post-operative complications and quicker recovery periods. Additional prospective studies are necessary to confirm these observations.

**Conflict of Interest:** Nil

## References

1. Sharpe SM, Talamonti MS, Wang CE, et al. Early national experience with pancreaticoduodenectomy with laparoscopic for ductal adenocarcinoma: a comparison of laparoscopic pancreaticoduodenectomy and open pancreaticoduodenectomy from the National Cancer Data Base. J Am Coll Surg. 2015;221: 175 184.
1. 2.Adam MA, Choudhury K, Dinan MA, et al. Minimally invasive versus open pancreaticoduodenectomy for cancer. Ann Surg. 2015;262:372–377.
2. Tran TB, Dua MM, Worhunsky DJ, et al. The first decade of laparoscopic pancreaticoduodenectomy in the United States: costs and outcomes using the nationwide inpatient sample. Surg Endosc. 2016;30:1778–1783.
3. Zhang H, Wu X, Zhu F, et al. Systematic review and meta-analysis of minimally invasive versus open approach for pancreaticoduodenectomy. Surg Endosc. 2016;30:5173–5184.
4. de Rooij T, Lu MZ, Steen MW, et al. Minimally invasive versus open pancreatoduodenectomy: systematic review and meta-analysis of comparative cohort and registry studies. Ann Surg. 2016;264:257–67.
5. McMillan MT, Zureikat AH, Hogg ME, et al. A propensity score-matched analysis of robotic vs open pancreatoduodenectomy on incidence of pancreatic fistula. JAMA Surg. 2016;1–9.
6. Zureikat AH, Postlewait LM, Liu Y, et al. A multi institutional comparison of perioperative outcomes of robotic and open pancreaticoduodenectomy. Ann Surg. 2016;264:640 –649.