

COMPARISON OF SAFETY AND EFFECTIVENESS BETWEEN LAPAROSCOPIC AND OPEN PANCREATODUODENECTOMY: A SYSTEMATIC REVIEW

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Abstract

Introduction: Despite using open and laparoscopic pancreatoduodenectomy methods. However, clinicians worldwide are still unsure regarding laparoscopic adoption. This technique's challenging dissection and anastomosis may explain this. The oncological outcomes of open and laparoscopic pancreatoduodenectomy are uncertain and maybe disputed. The procedure uses these methods.

The aim: This article compared safety and effectiveness between laparoscopic and open pancreatoduodenectomy.

Methods: By comparing itself to the standards set by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. So, the experts were able to make sure that the study was as up-to-date as it was possible to be. For this search approach, publications that came out between 2013 and 2023 were taken into account. Several different online reference sources, like Pubmed and SagePub, were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.

Result: In the PubMed database, the results of our search brought up 176 articles, whereas the results of our search on SagePub brought up 82 articles. The results of the search conducted for the last year of 2013 yielded a total 43 articles for PubMed and 21 articles for SagePub. In the end, we compiled a total of 27 papers, 19 of which came from PubMed and eight of which came from SagePub. We included seven research that met the criteria.

Conclusion: Studies show that LPD is associated with good short-term outcomes, high survival rates, short length of stay, and less bleeding. The operating time for patients with LPD is longer than for patients with OPD.

Keyword: Laparoscopic pancreatoduodenectomy; Open pancreatoduodenectomy; Pancreatic cancer

INTRODUCTION

Even with advances in medical care, chemotherapy, radiotherapy, and molecular biology, the 5-year survival rate for pancreatic cancer is just about 12%. This is despite the fact that pancreatic cancer is the fourth most common cause of death from cancer.^{1,2} The pancreatoduodenectomy, which is often referred to as the Whipple procedure, is the operation of choice for resectable and borderline resectable pancreatic ductal adenocarcinomas.³ This technique removes both the pancreas and the duodenum. Due to the intricate and highly difficult intra-abdominal dissection as well as the repair of the digestive system, this surgical treatment presents the surgeons with a significant challenge.⁴

Historically speaking, greater rates of mortality and perioperative morbidity have been linked to this surgery due to the complexity of the procedure itself. In the annals of medical history, the first pancreaticoduodenectomy was carried out in the year 1898 by the Italian surgeon Dr. Alessandro Codivilla, and the procedure was later refined by Dr. Walter Kausch in the year 1912. Initially, the operation was carried out as a two-stage process; however, by 1940, Dr. Allen Whipple had modified it so that it could be carried out as a single-stage Whipple procedure.⁵⁻⁷

Later on, it was determined that this operation is linked to a high mortality rate; nevertheless, thanks to advances in medical understanding and surgical technology, there has been a significant decline in the fatality rate. When a skilled surgeon is present in high-volume facilities, the death rate can be reduced to between 3 and 5 percent. Pancreatoduodenectomies can be broken down into two primary categories: the more comprehensive "classical Whipple (CW)" procedure and the "pylorus sparing pancreatoduodenectomy (PSD)" procedure.⁶

The CW necessitates the removal of the pancreatic head, the duodenum, a portion of the stomach, the gallbladder, and a portion of the bile duct, whereas the PSD just requires the removal of the gallbladder and a portion of the bile duct. In addition, the pancreaticoduodenectomy can be carried out by either an open or a laparoscopic method. However, recent data related to the feasibility and shorter postoperative outcomes following both open and laparoscopic approaches for pancreatoduodenectomy have suggested that the laparoscopic approach is associated with shorter lengths of stay, less blood loss, and better lymph node dissection.⁸

This is despite the fact that both open and laparoscopic approaches for pancreatoduodenectomy have been used. However, doctors all over the world are still hesitant about the universal adaption of the laparoscopic method. This is most likely because to the extremely difficult dissection and the anastomosis that are involved in this technique. Additionally, the oncological end results following the open and laparoscopic technique for pancreatoduodenectomy are still unclear and perhaps debatable. This is due to the fact that these approaches are used to do the procedure.^{9,10} This article compared safety and effectiveness between laparoscopic and open pancreatoduodenectomy.

METHODS

The author of this study made sure it met the standards by following the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 rules. This is done to make sure that the results of the investigation are correct. For the objective of this literature review, we compared safety and effectiveness between laparoscopic and open pancreatoduodenectomy. As the primary objective of this piece of writing, demonstrating the relevance of the identified challenges will occur throughout its entirety.

In order to participate in the study, researchers were required to meet the following requirements: 1) The paper must be composed in English and will focus on osteosynthesis in patients with femoral neck fractures. For the manuscript to be considered for publication, it must satisfy both of these conditions. 2) Several of the examined papers were published after 2013, but prior to the time period deemed pertinent by this systematic review. Examples of studies that are not permitted include editorials, submissions without a DOI, previously published review articles, and entries that are essentially identical to previously published journal papers.

We used "safety"; "effectiveness"; "laparoscopic"; "open"; and "pancreatoduodenectomy" as keywords. The search for studies to be included in the systematic review was carried out from July, 28th 2023 using the PubMed and SagePub databases by inputting the words: (*"safety"[MeSH Terms] OR "safety"[All Fields] OR "safeties"[All Fields]*) AND (*"effect"[All Fields] OR "effecting"[All Fields] OR "effective"[All Fields] OR "effectively"[All Fields] OR "effectiveness"[All Fields] OR "effectivenesses"[All Fields] OR "effectives"[All Fields] OR "effectivities"[All Fields] OR "effectivity"[All Fields] OR "effects"[All Fields]*) AND (*"laparoscopes"[MeSH Terms] OR "laparoscopes"[All Fields] OR "laparoscope"[All Fields] OR "laparoscopical"[All Fields] OR "laparoscopically"[All Fields] OR "laparoscopies"[All Fields] OR "laparoscopy"[MeSH Terms] OR "laparoscopy"[All Fields] OR "laparoscopic"[All Fields]*) AND *"open"[All Fields]* AND (*"pancreatoduodenectomy"[MeSH Terms] OR "pancreatoduodenectomy"[All Fields] OR "pancreatoduodenectomies"[All Fields] OR "pancreatoduodenectomy"[All Fields]*) AND (*(y_10[Filter]) AND (clinicaltrial[Filter])*) used in searching the literature.

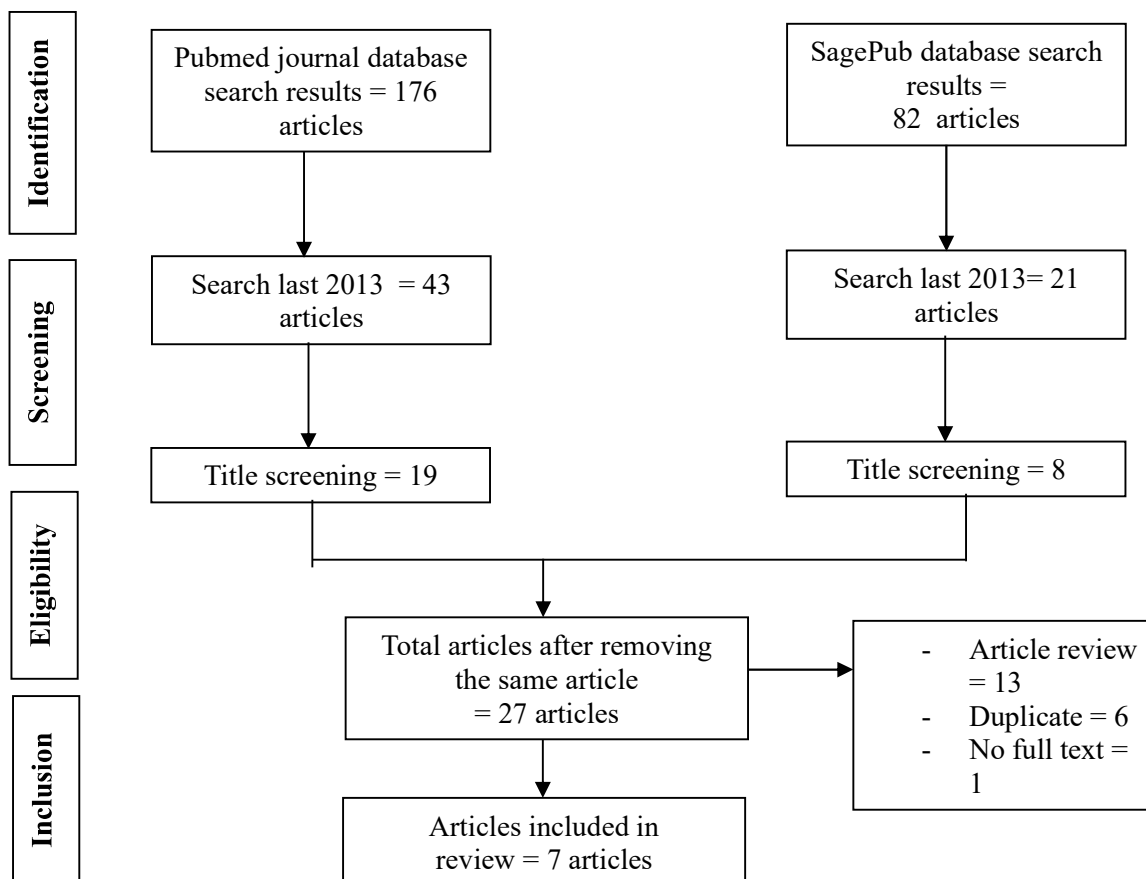


Figure 1. Article search flowchart

After perusing the abstract and title of each study, the authors conducted an evaluation to determine if the study met the inclusion criteria. The authors then determined which previous studies would serve as sources for the article and chose those studies. This conclusion was reached after examining a variety of studies that all appeared to indicate the same trend. All submissions must be written in English and must not have been previously published.

For the systematic review, only those papers that satisfied all inclusion criteria were considered. This narrows the search results to only those that are relevant to the query. We do not take into account the findings of any study that does not meet our standards. Following this, the research findings will be analysed in depth. As a consequence of the research conducted for the purpose of this study, the following information was uncovered: names, authors, publication dates, location, study activities, and parameters.

Before deciding which publications to investigate further, each author conducted their own research on the research included in the title and abstract of the publication. The next stage is to evaluate all of the articles that meet the review's inclusion criteria. Then, based on the findings, we will choose which articles to include in the review. This criterion is utilised in the selection of documents for further evaluation. To facilitate the process of selecting papers for evaluation as much as possible. This section discusses which earlier studies were conducted and what aspects of those studies made it appropriate to include them in the review.

RESULT

In the PubMed database, the results of our search brought up 176 articles, whereas the results of our search on SagePub brought up 82 articles. The results of the search conducted for the last year of 2013 yielded a total 43 articles for PubMed and 21 articles for SagePub. In the end, we compiled a total of 27 papers, 19 of which came from PubMed and eight of which came from SagePub. We included seven research that met the criteria.

Wang, et al (2021)⁹ showed postoperative length of stay was significantly shorter for patients in the laparoscopic pancreaticoduodenectomy (LPD) group than for patients in the open pancreaticoduodenectomy (OPD) group (median = 15 days [95% CI = 14–16] vs 16 days [15–17]; p = 0.02). 90-day mortality was similar in both groups (five of 297 patients in the LPD group vs six of 297 in the OPD group, risk ratio [RR] = 0.83 [95% CI = 0.26–2.70]; p = 0.76). The incidence rate of serious postoperative morbidities was not significantly different in the two groups (29% in the LPD group vs 23% in OPD group, RR = 1.23 [95% CI = 0.94–1.62]; p = 0.13).

Table 1. The literature include in this study

Author	Origin	Method	Sample Size	Result
Wang, 2021 ⁹	China	Randomized clinical trial (RCT)	762 patients, 656 were randomly assigned to either the laparoscopic group (n=328) or the open group (n=328)	LPD is a risk-free and doable operation when performed by those with extensive knowledge. It was linked to a shorter duration of stay as well as morbidity and death rates in the near term that were comparable to OPD. Despite the substantial procedural competence, there was not much of a difference in terms of the clinical benefits of LPD versus OPD. The populations that stand to gain from LPD should be the primary focus of research to be conducted in the future.
Chen, 2018 ¹¹	China	Retrospective cohort study	102 patients who underwent pancreaticoduodenectomy	LPD with the uncinate process-first technique combines the benefits of laparoscopy with a minimal risk of postoperative complications and a high rate of curative resection. This procedure is known as LPD with the uncinate process-first approach.
Chapman, 2018 ¹²	United State of America (USA)	Retrospective cohort study	1768 patients aged ≥ 75	The vast majority of NCDB facilities perform fewer than five LPD cases annually, which is associated with an increased risk of perioperative mortality. After adjusting for patient and tumor-related characteristics, 90-day mortality was substantially lower in the LPD group and there was a trend towards improved OS in the LPD group compared to the OPD group. Before definitive conclusions can be drawn, studies with larger sample sizes and extended follow-up periods are required.
Stauffer, 2017 ¹³	United State of America (USA)	Prospective cohort study	251 patients were found to have PDAC	In the treatment of PDAC, LPD produces short-term results and long-term survival that are comparable to those produced by OPD.
Kantor, 2016 ¹⁴	United State of America (USA)	Retrospective cohort study	828 (10%) patients underwent LPD and 7385 (90%) OPD	LPD gives equivalent short-term oncologic and long-term overall survival outcomes to OPD for patients who have localised pancreatic adenocarcinoma. Additionally, LPD is related with decreased rates of readmission and a trend towards quicker recovery.
Dokmak, 2015 ¹⁵	France	Retrospective cohort study	46 LPD were performed and compared with 46 OPD	According to the findings of this study, LPD is linked to a greater morbidity rate, which is mostly attributable to more severe PF. Only the subset of patients who are at a low risk of pancreatic fibrosis (PF) should be considered for laparoscopic pancreaticoduodenectomy.
Croome, 2014 ¹⁶	United State of America (USA)	Retrospective cohort study	TLPD (N = 108) or OPD (N = 214)	The TLPD is not only viable in the setting of pancreatic ductal adenocarcinoma, but it also provides advantages such as shorter hospital stays and faster recovery, which enables patients to recuperate in a more timely manner and explore adjuvant treatment alternatives. In addition to this, the researchers found that patients who underwent TLPD had a longer progression-free survival than those who underwent OPD.

Chen, et al (2018)¹¹ showed mean operation time was significantly longer in LPD (410 ± 68 min) than OPD group (245 ± 70 min; $P < 0.05$). LPD produced significantly less intraoperative blood loss (210 ± 46 mL vs 420 ± 50 mL, $P < 0.05$), shorter first flatus time (1.5 d vs 4 d, $P < 0.05$) and shorter diet start time (2 d vs 5 d, $P < 0.05$). The total hospital stay was significantly shorter in the LPD group, with a median of 13 ± 4 days versus 18 ± 5.5 days in the OPD group ($P < 0.05$). The postoperative complication rates of the LPD group and OPD group were 21.3% and 27.3%, respectively ($P > 0.05$). The rate of category I-II complications and rate of category III-IV complications did not significantly differ ($P > 0.05$).

Pancreatic fistulae occurred in 6 patients (12.8%) in the LPD group and 8 patients (14.5%) in the OPD group ($P = 0.67$). Delayed gastric emptying occurred in 2 patients (4.26%) in the LPD group and 2 patients in the OPD group (3.63%; $P = 0.79$). Postpancreatectomy haemorrhage was not significantly different between the groups (2.13% vs 3.63%; $P = 0.66$).¹¹ Chapman, et al (2018)¹² showed majority of patients in the LPD group had their surgery at facilities performing less than 5 LPDs per year (66.5%). 90-day mortality was significantly lower in the LPD compared to the OPD (7.2 vs. 12.2%, $p = 0.049$). The laparoscopic conversion rate was 30% and was associated with higher readmission rates (13.5 vs. 8.1%), 30-day mortality (8.0 vs. 3.8%), and 90-day mortality (10.4 vs. 6.0%), but these did not reach statistical significance. Median OS was significantly longer in the LPD group (19.8 vs. 15.6 months, $p = 0.022$). After adjusting for patient and tumor-related characteristics, there was a trend towards improved survival in the LPD group ($HR = 0.85$, 95% $CI = 0.69-1.03$). Stauffer, et al (2017)¹³ showed operative time was significantly longer with LPD, but blood loss and transfusion rate were lower. Postoperative complications, intensive care unit stay, and overall hospital stay was similar. LPD was performed by hand-assist method in 3 (5.2 %) patients and converted to open in 14 (24.1 %). Neoadjuvant therapy was performed in 17 (8.8 %) patients for OPD and 4 (6.9 %) for LPD. The estimated median survival was 20.3 months for OPD and 18.5 months for LPD. Long-term survival was similar for 1-, 2-, 3-, 4-, and 5-year survival for OPD (68, 40, 24, 17 and 15 %) and for LPD (67, 43, 43, 38 and 32 %), respectively.

Kantor, et al¹⁴ showed no disparities between groups in terms of tumour or demographic characteristics. On multivariable analysis adjusting for hospital volume, LPD was associated with a lower readmission rate ($p < 0.01$) and trends towards shorter initial duration of stay ($p = 0.14$) and time to adjuvant chemotherapy ($p = 0.14$). There were no differences in the rates of margin-negative resection, number of lymph nodes examined, perioperative mortality, or median overall survival between LPD and OP patients ($p = 0.68$).

Dokmak, et al (2015)¹⁵ showed surgery lasted longer in the LPD group (342 vs 264 minutes, $p < 0.001$). One death occurred in the LPD group (2.1% vs 0%, $p = 0.28$) and severe morbidity was higher (28% vs 20%, $p = 0.32$) in LPD due to grade C PF (24% vs 6%, $p = 0.007$), bleeding (24% vs 7%, $p = 0.02$), and revision surgery (24% vs 11%, $p = 0.09$). Pathologic examination for malignant diseases did not identify any differences between the LPD and OPD as far as size (2.51 vs 2.82 cm, $p = 0.27$), number of harvested (20 vs 23, $p = 0.62$) or invaded (2.4 vs 2, $p = 0.22$) lymph nodes, or R0 resection (80% vs 80%; $p = 1$). Hospital stays were similar (25 vs 23 days, $p = 0.59$).

Croome, et al (2014)¹⁶ showed median length of hospital stay was significantly longer in the OPD group (9 days; range= 5-73 days) than in the TLPD group (6 days; range = 4-118 days; $P < 0.001$). There was a significantly higher proportion of patients in the OPD group (12%) who had a delay of greater than 90 days or who did not receive adjuvant chemotherapy at all compared with that in the TLPD group (5%; $P = 0.04$). There was no significant difference in overall survival between the 2 groups ($P = 0.22$). A significantly longer progression-free survival was seen in the TLPD group than in the OPD group ($P = 0.03$).

DISCUSSION

The primary treatment for resectable and borderline resectable pancreatic ductal adenocarcinoma (PDAC) is a procedure called pancreaticoduodenectomy (PD), which may be found in. PD is difficult for surgeons to treat because of the intricacies required in intra-abdominal dissection and the difficulty in reconstructing the alimentary canal. Additionally, PD is associated with substantial risks of perioperative morbidity and mortality.¹⁷ Encouraging statistics have emerged as a result of the increasing number of laparoscopic pancreatic procedures that have been conducted.¹⁸

Laparoscopic distal pancreatectomy is the treatment of choice for adenocarcinoma of the pancreatic tail. This procedure has been utilised extensively for the treatment of benign tumours. The first laparoscopic pancreaticoduodenectomy (LPD) was completed by Ganger in the year 1994.¹⁹ However, during the course of the past ten years, LPD has not achieved widespread adoption. It is possible that the difficulty of the process, the challenges associated in anastomoses, and the potential for postoperative problems all contribute to the impossibility of using this approach on a large scale.²⁰

Asbun et al. revealed the findings of a study that demonstrated that LPD was feasible and could result in shorter hospital stays, reduced blood loss, and improved lymph node dissection. In recent years, numerous research have been conducted to investigate whether LPD or OPD is more effective and safe. Studies have demonstrated that low-power deconvolution (LPD) results in better visual magnification, better exposure, and more sensitive manipulation of the deep and difficult to reach tissues.²⁰

Patients are benefiting from this growing technology as laparoscopic surgeons get more adept and gain more experience thanks to the introduction of new surgical equipment. Patients also stand to gain from the expansion of technology. Following decades of research and development, there is no question that the method is at this point in its development where it is mature and the operation is both safe and reliable. However, the primary concern of both medical professionals and patients continues to be whether or not LPD is capable of achieving the same cancer results as OPD, such as progression-free survival and overall survival.¹⁸

There are a number of additional benefits associated with LPD, in addition to the oncology-related outcomes, which are our primary interest. Some experts, for instance, are of the opinion that the fact that laparoscopic surgery requires less

manipulation than traditional surgery does may be connected to the fact that there is a lower risk of postoperative adhesion and delayed gastric emptying (DGE). LPD may also have benefits for the postoperative combined usage of enhanced recovery after surgery (ERAS), a technique that has gained popularity in recent years to allow quicker recovery as a result of a lower rate of postoperative problems and less surgical intervention.^{11,21,22}

It has been found that patients with colon cancer who have laparoscopic surgery as part of an ERAS protocol have a higher chance of having their immunity preserved effectively following the procedure. There have been no other studies on PD to date; nevertheless, in the near future, large-scale randomised controlled clinical trials should be conducted about this topic. In addition, in order to get rid of the selection bias that was done for the LPD group, the comparison between LPD and OPD should only be done in patients who are appropriate for the ERAS programme.²¹

Because of the greater expenditures incurred throughout the operation, the question of cost is frequently seen to be a barrier to the widespread implementation of LPD. In contrast, a study conducted by Gerber et al. indicated that the cost of LPD was comparable to that of OPD, and the overall episode-of-care cost was even lower than that of OPD.²³ Tran et al. also showed that LPD was associated with a reduction in hospital costs in high-volume pancreatic centers in comparison with OPD.²⁴ This may be mainly due to a shorter length of hospital stay and less intensive ward costs. Therefore, though the current milieu of healthcare reform mandates better surgical performance and more accountability, the value of complex surgical procedures depends on outcomes achieved per dollar spent, and these studies show that cost should not be the problem for LPD.

CONCLUSION

Studies show that LPD is associated with good short-term outcomes, high survival rates, short length of stay, and less bleeding. The operating time for patients with LPD is longer than for patients with OPD.

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