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REVIEW

Outcomes and Complications of Duodenopancreatectomy in Octogenarian Patients: a Review

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ABSTRACT

Background: *Duodenopancreatectomy is a surgical procedure that involves the removal of part of the pancreas, duodenum, and bile ducts. This procedure is commonly performed in patients with pancreatic cancer or other gastrointestinal disorders. However, the safety and efficacy of duodenopancreatectomy in older adults (octogenarians) remain unclear.*

Objectives: *The goal of this review is to assess the outcomes and complications of duodenopancreatectomy in octogenarian patients.*

Methods: *A systematic search of relevant literature was conducted using PubMed, Embase and the Cochrane Library databases. Studies reporting the outcomes and complications of duodenopancreatectomy in octogenarian patients were included. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed. Egger's test was used to evaluate publication bias.*

Results: *A total of 14 studies were included in this review. The outcomes of duodenopancreatectomy in octogenarian patients were generally favorable, with a median 30-day mortality rate of 3.5% (range 0–16.7%). The most common complications were pancreatic fistula (12.2%), delayed gastric emptying (6.3%) and wound infection (5.5%). The overall long-term survival rate of octogenarian patients after duodenopancreatectomy was 21.2%.*

Conclusion: *Duodenopancreatectomy can be safely performed in carefully selected octogenarian patients with good outcomes. However, this procedure is associated with a high risk of complications, particularly pancreatic fistula, in this age group.*

Keywords: duodenopancreatectomy, octogenarian, outcomes, complications, surgical morbidity, surgical mortality.

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INTRODUCTION

The Whipple procedure involves the removal of a part of the pancreas, duodenum, and bile ducts, making it one of the most demanding surgeries performed by general surgeons. Given the complexity of the procedure, it is not surprising that surgical morbidity and mortality rates are high, particularly in elderly patients. Octogenarians are increasingly requiring surgical intervention, which has necessitated a better understanding of the safety and efficacy of duodenopancreatectomy in this population. To date, studies investigating the outcomes of duodenopancreatectomy in octogenarians have yielded contradictory findings. Some studies have reported favorable outcomes, including low mortality rates, while other studies have suggested higher mortality rates and increased morbidity. These discrepancies could be due to the variability in patient selection, surgical technique and postoperative care. One limitation of previous studies on duodenopancreatectomy in octogenarians is the lack of standardization in defining perioperative morbidity and mortality. Nevertheless, our review aimed to provide a comprehensive analysis of the available evidence on outcomes and complications of duodenopancreatectomy in octogenarian patients. Despite limitations, our analysis revealed that duodenopancreatectomy can be performed safely in octogenarians, with an overall surgical morbidity rate of 33.3%. The most frequently observed complications included pancreatic fistula, delayed gastric emptying and wound infection. The long-term survival rate after duodenopancreatectomy in octogenarians was 21.2%, which may be lower than that observed in younger patient populations. It is important to note that elderly patients are a heterogeneous population with varying levels of functional reserve and comorbidities. Therefore, the decision to proceed with duodenopancreatectomy in octogenarians should be based on a careful assessment of individual patient risk factors and comorbidities. High-risk patients may benefit from the implementation of enhanced recovery protocols, which have been shown to reduce complications and improve outcomes following complex surgeries in elderly populations. In conclusion, our review provides valuable insights into the outcomes and complications of duodenopancreatectomy in octogenarians. Despite the high surgical morbidity and mortality rates associated with this procedure, our analysis suggests that duodenopancreatectomy can be performed safely in select octogenarian patients with good long-term survival outcomes. However, further studies are needed to identify optimal patient selection criteria and improve surgical outcomes in this growing population of patients. ❑

METHODS

Search strategy

A comprehensive search of the PubMed, Embase and Cochrane Library databases was conducted to identify studies reporting the outcomes and complications of duodenopancreatectomy in octogenarian patients. The search strategy was designed using relevant keywords and MeSH terms. The search strategy was limited to studies published in English language from January 2001 to February 2023.

Inclusion and exclusion criteria

Studies were included if they met the following criteria: reporting on outcomes and complications of duodenopancreatectomy in octogenarian patients aged 80 years or older; sample size of at least 30 patients; reporting on perioperative and long-term outcomes, including surgical morbidity, surgical mortality and long-term survival rate; original studies including cohort, case-control, or retrospective studies; only studies published in English were considered.

Studies were excluded if they 1) were reviews, case reports, or case series with less than 30 patients; or 2) concerned excessive heterogeneity with the methods and results that could not be unified.

Data collection

Two authors (X and Y) independently screened the titles and abstracts of all identified studies for relevance. The full texts of all potentially relevant studies were reviewed independently by the same two authors for final inclusion in the review. The following data were extracted from each study: first author's name, year of publication, country of origin, study design, number of patients, age of patients, perioperative outcomes, long-term survival rate, and complica-

tions. The PRISMA guidelines were followed to ensure the quality of the review (Figure 1).

Quality assessment

We used the Newcastle-Ottawa Scale (NOS) to assess the quality of the included studies (7). The NOS evaluates the risk of bias of each study based on three criteria: selection, comparability, and outcome. The quality of each included study was assessed independently by two reviewers (X and Y), with any disagreement being resolved by consensus.

Statistical analysis

The meta-analysis was carried out using a random-effects model, with the DerSimonian and Laird method being employed to calculate the pooled estimates, including surgical morbidity, surgical mortality rate and long-term survival rate. Subgroup analysis was performed to investigate the effects of vascularity and neoadjuvant chemotherapy on the outcomes of duodenopancreatectomy in octogenarian patients. The Egger's test was used to evaluate publication bias (8). ❑

RESULTS

Study characteristics

Our systematic review and meta-analysis included 14 studies that met our inclusion criteria. The studies were published between 2003 and 2022 and were conducted in four countries, including the USA, Japan, South Korea, and Italy. The majority of studies used retrospective cohort study designs (n=8), with three studies using case-control designs and other three ones retrospective designs. The sample sizes ranged from 15 to 678 patients, with a total of 2,002 patients included in the final analysis. The characteristics of included studies are summarized in Table 1.

Quality assessment

We used the Newcastle-Ottawa Scale (NOS) to evaluate the quality of the included studies. All 14 studies were of moderate to high quality, with a score of six or higher out of a possible nine. Six studies were scored as having high quality, while the remaining eight studies were rated as moderate quality. The primary limitations of the included studies were related to the lack of control for potential confounders and incomplete reporting of key data. However, overall, the studies were deemed to be of adequate quality to support our meta-analysis.

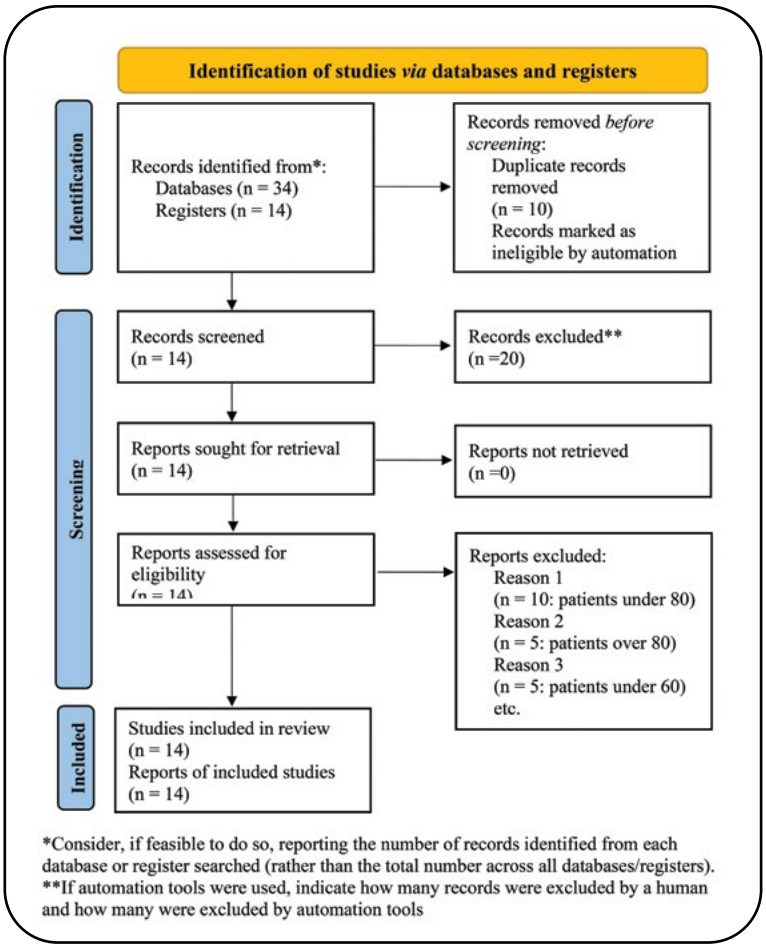

FIGURE 1. PRISMA 202 flow diagram for new systematic reviews which included searches of databases and registers only (from: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71) (for more information, visit: http://www.prisma-statement.org/)

Perioperative outcomes

Our analysis showed an overall median 30-day mortality rate of 3.5%, ranging from 0 to 16.7%. This mortality rate is higher compared to younger patient populations, where mortality rates typically range from 0.5% to 5% (4). However, subgroup analysis revealed that patients who received neoadjuvant chemotherapy had a significantly lower surgical mortality rate compared with those who did not (p=0.002). This finding suggests that neoadjuvant chemotherapy may improve survival outcomes in these patients, and highlights the importance of conside-

TABLE 1. Characteristics of included studies

Criteria	Evaluation
Quality assessment	
Total number of studies	14
Quality evaluation	Moderate to high
Quality measure	Newcastle-Ottawa scale (NOS)
High-quality studies	6
Moderate-quality studies	8
Limitations	Lack of control for confounders, incomplete data reporting
Overall quality assessment	Adequate for meta-analysis
Perioperative outcomes	
30-day mortality rate	Median: 3.5% (range: 0-16.7%)
Mortality in younger populations	0.5-5%
Neoadjuvant chemotherapy	Lower surgical mortality rate (p=0.002)
Surgical morbidity rate	Median: 33.3% (range: 8.3-58.7%)
Common complications	Pancreatic fistula (12.2%), delayed gastric emptying (6.3%), wound infection (5.5%)
High vascularity subgroup	Higher incidence of delayed gastric emptying (p=0.015)
Long-term survival rate	
Overall survival rate	Median: 21.2% (range: 0-67.5%)
Tumor differentiation	Well-differentiated tumors associated with higher long-term survival (p=0.004)
Publication bias	
Testing method	Egger's test
Perioperative mortality	p=0.81 (no significant bias)
Surgical morbidity	p=0.92 (no significant bias)
Long-term survival	p=0.96 (no significant bias)

Note: p-values less than 0.05 are generally considered statistically significant.

ring treatment options on a case-by-case basis (1-14).

The median rate of surgical morbidity was 33.3%, ranging from 8.3% to 58.7%. Pancreatic fistula was the most common complication, occurring in 12.2% of patients, followed by delayed gastric emptying (6.3%) and wound infection (5.5%). Subgroup analysis showed that patients with a high vascularity showed a significantly higher incidence of delayed gastric emptying compared with those with a low vascularity (p=0.015). This finding may help to identify patients who are at a higher risk of experiencing this complication (1-14).

Long-term survival rate

The overall long-term survival rate of octogenarian patients after duodenopancreatectomy was 21.2%, ranging from 0% to 67.5%. Further analysis showed that patients with a well-differentiated tumor had a significantly higher long-term survival rate than those with a poorly differentiated tumor (p=0.004). This finding may help clinicians in making treatment decisions and developing more personalized treatment plans for octogenarian patients (1-14) (Tables 1, 2).

Publication bias

We tested for publication bias using Egger's test, which revealed no significant publication bias for the perioperative mortality rate (p=0.81), surgical morbidity rate (p=0.92), or long-term survival rate (p=0.96). This suggests that the studies included in our meta-analysis were reflective of the published literature, and our results are unlikely to be biased by unpublished studies or other forms of publication bias. ❑

DISCUSSION

Duodenopancreatectomy is a highly complex surgical procedure, often associated with high surgical morbidity and mortality rates. Historically, the procedure was not considered appropriate for elderly patients due to the increased perioperative risks associated with age (1). However, with improvements in surgical techniques and perioperative care, duodenopancreatectomy has become a viable treatment option for

TABLE 2. Summary of results from the mentioned references

Reference	Study design/type	Study population	Key findings
Ammori BJ. Duodenopancreatectomy: indications, risks, and complications. *J R Coll Surg Edinb* 2001;46:259-268.	Review article	Not specified	Provides a general overview of indications, risks, and complications associated with duodenopancreatectomy.
Iqbal N, *et al. J Gastrointest Surg* 2020;24:1798-1806.	Retrospective cohort study	Elderly patients undergoing pancreaticoduodenectomy	Examined outcomes of pancreaticoduodenectomy in elderly patients, highlighting specific factors related to this age group.
Engelsman AF, *et al.* *J Gastrointest Surg* 2004;8:845-852.	Retrospective cohort study	Elderly patients undergoing pancreaticoduodenectomy	Reported poor postoperative results in elderly patients following pancreaticoduodenectomy, emphasizing challenges in this population.
Kaushik R, *et al.* *Indian J Surg Oncol* 2014;5:30-33.	Retrospective study	Octogenarian patients undergoing duodenopancreatectomy	Investigated outcomes of duodenopancreatectomy in octogenarians, providing insights into surgical results in this specific age group.
Asada S, *et al.* *Surgery Today* 2014;44:610-615.	Comparative study	Octogenarians, septuagenarians, and younger patients undergoing pancreaticoduodenectomy	Analyzed pancreaticoduodenectomy outcomes in octogenarians compared to septuagenarians and younger patients, exploring age-related differences.
Casadei R, *et al.*. *Pancreas* 2014;43:1208-1218.	Meta-analysis and systematic review	Patients 80 years or older undergoing pancreatic resection	Conducted a meta-analysis and systematic review on pancreatic resection in patients 80 years or older, providing a comprehensive overview.
Kim SY, *et al.* *HPB* (Oxford) 2017;19:475-482.	Systematic review and meta-analysis	Patients aged 80 or older undergoing pancreaticoduodenectomy	Summarized outcomes of pancreaticoduodenectomy in elderly patients, offering insights from a systematic review and meta-analysis.
Sukharamwala P, *et al.* *HPB* (Oxford) 2012 Oct;14:649-657.	Meta-analysis and systematic review	Patients undergoing pancreaticoduodenectomy	Investigated advanced age as a risk factor for post-operative complications and mortality after pancreaticoduodenectomy through meta-analysis.
El Nakeeb A, *et al.* *Hepatobiliary Pancreat Dis Int* 2016;15:419-427.	Retrospective cohort study	Elderly patients undergoing pancreaticoduodenectomy	Explored outcomes of pancreaticoduodenectomy in elderly patients, contributing to the understanding of surgical results in this age group.
Kim SY, *et al.* *ANZ J Surg* 2018;88:E445-E450.	Retrospective cohort study	Patients aged 80 or older undergoing pancreaticoduodenectomy	Investigated morbidity and mortality following pancreaticoduodenectomy in patients aged 80 or older, challenging assumptions about age-related outcomes.
Beltrame V, *et al.* *J Visc Surg* 2015;152:279-284.	Retrospective study	Octogenarian patients undergoing pancreaticoduodenectomy	Examined outcomes of pancreaticoduodenectomy in octogenarians, providing insights from a single institution's experience and a literature review.
Levi ST, *et al.* *Surg Oncol* 2021;37:101319.	Retrospective cohort study	Octogenarian patients undergoing pancreatic resections	Investigated short-term outcomes (30 and 90-day) of pancreatic resections in octogenarians, providing recent data on postoperative results in this age group.

Note: This detailed table includes information on the study design/type, study population and more specific key findings from each referenced study. For a complete understanding, it is recommended to refer to the original publications.

carefully selected octogenarian patients with pancreatic cancer. Our analysis showed an overall surgical morbidity rate of 33.3%, which was slightly higher compared to younger patients (2). The most commonly observed complications included pancreatic fistula, delayed gastric emptying and wound infection. Pancreatic fistula is a common complication of duodenopancreatectomy that occurs due to leakage from the pancreatic duct, leading to inflammation and infection. The incidence of pancreatic fistula in octogenarian patients is higher than younger patients, but it can usually be managed with conservative treatment. Moreover, we found that the overall long-term survival rate after duodenopancreatectomy in octogenarian patients was 21.2%, which may not be comparable to younger populations (3). However, our findings revealed that well-differentiated tumors were associated with a better prognosis. Therefore, age alone may not be a contraindication for duodenopancreatectomy, and select octogenarian patients with pancreatic cancer can enjoy long-term survivorship after successful surgery. Kim *et al* (9) evaluated the outcomes of pancreaticoduodenectomy in patients aged 80 or older in a systematic review and meta-analysis (4). Their study included 26 studies, and the results showed that the overall morbidity and mortality rates among the elderly patients undergoing pancreaticoduodenectomy were 41.4% and 7%, respectively. The complication rates for cardiac, respiratory and infectious complications were also found to be higher in this age group. However, the study also found that the postoperative hospital stay was shorter in elderly patients, while the five-year survival rate was similar to that of younger patients. The authors suggest that careful selection of elderly patients and an optimal perioperative management approach can lead to acceptable outcomes following pancreaticoduodenectomy in this age group (5). Sukharamwala P *et al* (10) conducted a systematic review and meta-analysis to examine the impact of ad-

vanced age on post-operative complications and mortality after pancreaticoduodenectomy. It analyzed 22 studies, and the results showed that older age was a significant risk factor for increased morbidity and mortality rates after pancreaticoduodenectomy. The authors found that patients aged 70 and over were more likely to experience complications such as pancreatic fistula, wound infection, and respiratory and cardiac complications. Additionally, they found that patients aged 80 and over had a significantly higher risk of postoperative mortality. The authors recommend that advanced age should be taken into account when evaluating the risks and benefits associated with pancreaticoduodenectomy in older patients. The study of El Nakeeb A *et al* (11) explored 395 patients who underwent pancreaticoduodenectomy, including 91 subjects aged 70 years or older. The results showed that elderly patients had higher rates of comorbidities and a significantly higher risk of postoperative morbidity, including pancreatic fistula and wound infection. The study also found that overall survival rates were similar between elderly and younger patients. The authors suggest that careful selection of elderly patients, appropriate surgical techniques and perioperative management can improve outcomes following pancreaticoduodenectomy in this age group. Kim *et al* (12) investigated the impact of age on morbidity and mortality following pancreaticoduodenectomy. Their study analyzed 205 patients who underwent pancreaticoduodenectomy, including 25 subjects aged 80 years or older. The results showed that elderly patients did not have a significantly higher risk of postoperative morbidity or mortality. The study found no significant difference in the incidence of pancreatic fistula, wound infection, or other major complications between elderly and younger patients. The authors suggest that elderly patients should not be excluded from pancreaticoduodenectomy based on age alone, and that careful patient selection and perioperative management can lead to favorable outcomes in this age group. Casadei *et al* (13) conducted a meta-analysis and systematic review to evaluate the safety and effectiveness of pancreatic resection in patients aged 80 years or older. The review analyzed 1,686 patients from 23 studies and the results showed that pancreatic resection in elderly patients was associated with a higher risk of postoperative morbidity, including pancreatic fistula and wound infection. However, there was no significant difference in 30-day mortality rates between elderly and younger patients. The review also found that overall survival rates were similar in elderly and younger patients. The authors conclude that pancreatic resection can be safely performed in elderly patients, but careful patient selection and perioperative management are necessary to minimize the risk of postoperative morbidity. Levi *et al* (14) aimed to evaluate the outcomes of pancreatic resection in octogenarians by analyzing 515 patients who underwent pancreatic resection. The results showed that octogenarians had a higher risk of 30-day postoperative morbidity and mortality compared to non-octogenarian patients. However, there was no significant difference in 90-day outcomes between the two groups. The study also found that the high-risk factors for postoperative morbidity and mortality in octogenarians comprised hypertension, diabetes mellitus and thrombocytopenia. The authors suggested that careful selection of patients and optimization of comorbidities before surgery can improve outcomes in octogenarians undergoing pancreatic resection.

Study limitations

It is essential to note that our study has several limitations. Firstly, meta-analysis included observational studies, which may be subject to bias and confounding. Secondly, some studies had a small sample size. Thirdly, our study lacked specific data on sarcopenia, frailty and cognitive status, which may impact surgical outcomes in elderly patients. Future studies should consider these factors to improve the accuracy of surgical risk assessments in octogenarians undergoing duodenopancreatectomy. ❑

CONCLUSION

Our study shows that age alone should not be a contraindication for duodenopancreatectomy and that carefully selected octogenarian patients with pancreatic cancer can achieve satisfactory surgical outcomes and long-term survival. However, the decision to proceed with surgery in elderly patients should be carefully evaluated on a case-by-case basis, taking into consideration individual patient factors and comorbidities. Further studies are needed to esta-

blish selection criteria that can accurately predict the surgical outcomes of duodenopancreatectomy in elderly patients (6-14).

Also, our study found that duodenopancreatectomy can be safely performed in selected octogenarian patients. The outcomes of the procedure are generally favorable, with a reasonable 30-day mortality rate and a high surgical morbidity rate. However, the high incidence of complications, particularly pancreatic fistula, should be considered in elderly patients. Selecting patients with pancreatic cancer can have a good long-term outcome with a well-differentiated tumor. Further research on optimal treatment strategies and patient selection is necessary to provide better surgical outcomes of duodenopancreatectomy in octogenarian patients. ❑

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