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Early Complications of Internal Versus External Pancreatic Duct stent in Patients with Pancreaticoduodenectomy

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Abstract

Background: Pancreaticoduodenectomy (PD) is a complex surgical procedure with significant postoperative complications, including pancreatic fistula, delayed gastric emptying, and intra-abdominal infections. This study aims to compare the early postoperative complications of internal versus external pancreatic duct stents in patients undergoing PD. **Material & Methods:** This prospective observational study was conducted at Dhaka Medical College Hospital from January 1, 2023, to December 27, 2023. A total of 40 patients scheduled for PD were divided into two groups: 20 managed with internal stents and 20 with external stents. Data on demographic characteristics, per-operative factors, and postoperative complications were collected and analyzed. **Results:** The study population had a mean age of 56.78 years, with males constituting 65%. The most common histopathological diagnosis was periampullary carcinoma (50%). In the internal stenting group, 10% had a soft pancreas, 65% had a firm pancreas, and 25% had a hard pancreas. In the external stenting group, 40% had a soft pancreas, 50% had a firm pancreas, and 10% had a hard pancreas. Wound infections occurred in 10% of the internal stenting group and 15% of the external stenting group. Intra-abdominal collections were found in 5% of the internal stenting group and 10% of the external stenting group. GI bleeding was absent in the internal stenting group but occurred in 5% of the external stenting group. Intra-abdominal bleeding was absent in the internal stenting group but present in 10% of the external stenting group. Delayed gastric emptying was noted in 5% of participants in both groups. Grade A pancreatic fistula was observed in 10% of the internal stenting group and 15% of the external stenting group. Grade B and C pancreatic fistulas were only present in the external stenting group, at rates of 10% and 5%, respectively. **Conclusions:** Internal pancreatic duct stents are associated with lower incidences of wound infections, intra-abdominal collections, and severe pancreatic fistulas compared to external stents. These findings suggest that internal stents may offer better postoperative outcomes, although stent selection should be individualized based on patient-specific factors. Further research is warranted to confirm these results and guide clinical practice.

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Keywords:- Pancreaticoduodenectomy, Pancreatic Duct Stents, Internal Stents, External Stents, Postoperative Complications, Pancreatic Fistula, Delayed Gastric Emptying, Intra-Abdominal Collections.

INTRODUCTION

Pancreaticoduodenectomy (PD), commonly known as the Whipple procedure, is a complex and challenging surgical operation primarily used to treat malignant and benign diseases of the pancreas, duodenum, and bile duct. It is the standard surgical approach for resectable pancreatic cancer, offering the best chance for long-term survival. The procedure involves the resection of the pancreatic head, duodenum, part of the bile duct, and occasionally a portion of the stomach, followed by the reconstruction of the digestive tract.[1] While PD has become safer due to advancements in surgical techniques and perioperative care, it is still associated with significant morbidity and mortality rates, largely due to postoperative complications.[2] Postoperative management of the pancreatic duct is critical in reducing these complications. The use of pancreatic duct stents, both internal and external, has been adopted to mitigate the risks of pancreatic fistula (PF), delayed gastric emptying (DGE), and intra-abdominal abscesses, which are among the most common and severe complications following PD.[3] PF, characterized by the leakage of pancreatic fluids, remains a leading cause of postoperative morbidity and can lead to prolonged hospital stays and increased healthcare costs.[4] Managing the pancreatic duct during surgery is thus crucial to ensuring better patient outcomes. The role of pancreatic duct stents in reducing postoperative complications has been extensively studied. External stents, which drain pancreatic secretions outside the body, have been shown to significantly reduce the rates of PF and overall morbidity compared to no stent.[5] A multicenter randomized trial demonstrated that external stents lowered the PF rate to 26%, compared to 42% in the non-stented group, highlighting their effectiveness in managing pancreatic duct secretions post-surgery.[6] However, external stents are associated with tube-related complications and patient discomfort, making their use sometimes controversial.[7] Internal stents, on the other hand, drain pancreatic secretions internally into the digestive tract. These stents simplify postoperative management and reduce tube-related complications. A study comparing internal and external drainage found that internal stents were associated with a shorter hospital stay and fewer complications related to the stent itself.[8] Despite these advantages, the choice between internal and external stents often depends on the surgeon's preference and the patient's specific risk factors. The comparative clinical outcomes of internal versus external stents have been the focus of numerous studies. One randomized controlled trial comparing long-term outcomes of internal and external stents in PD patients found no significant differences in late complication rates, pancreatic function, or quality of life.[9] Another study focusing on high-risk patients indicated that internal stents prevented liquid loss and tube-related complications, suggesting a potential advantage over external stents in specific patient populations.[10] These findings underscore the importance of individualized patient management based on risk stratification. Despite these findings, the incidence of PF

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remains a significant challenge. External drainage of the pancreatic duct has been shown to reduce PF rates significantly. A study reported that external stents reduced the PF rate to 6.7% compared to 20% in the non-stented group, illustrating their effectiveness in high-risk patients.[11] Another prospective study found that external stents were more effective in preventing PF in patients with a soft pancreas and small pancreatic duct, further supporting their use in specific clinical scenarios.[12] The impact of stent choice on patient quality of life is also a critical consideration. Studies have shown that while external stents effectively reduce complications, they can negatively impact patient comfort and quality of life due to the external tubing.[13] Internal stents, by eliminating external drainage, can improve postoperative comfort and reduce the psychological burden on patients, contributing to a better overall recovery experience.[6] In conclusion, managing the pancreatic duct during and after PD is pivotal in reducing postoperative complications and improving patient outcomes. Both internal and external pancreatic duct stents play significant roles in this management. The choice between these stents should be based on individual patient risk factors, surgical preferences, and the potential impact on quality of life. Future research should continue to explore the optimal use of these stents to enhance surgical outcomes and patient well-being.

MATERIAL AND METHODS

This study was conducted at the Department of Surgery, Dhaka Medical College Hospital, Dhaka, encompassing all patients who underwent pancreaticoduodenectomy (PD) during the specified study period. The research was carried out over nearly a year, from January 1, 2023, to December 27, 2023. This period was selected to ensure an adequate sample size and comprehensive data collection. The study included all patients admitted to the Department of Surgery at Dhaka Medical College Hospital who were scheduled to undergo PD, providing a broad spectrum of cases for evaluating the efficacy and complications associated with internal and external pancreatic duct stents. The research was designed as a prospective observational study, chosen to observe and record data in real-time, ensuring accurate and timely data collection on postoperative complications. A total of 40 patients were included, with 20 patients managed using internal pancreatic duct stents and 20 patients managed using external stents. This sample size was deemed sufficient to detect significant differences in early postoperative complications between the two groups. Purposive sampling was employed to select participants, ensuring that all patients who met the inclusion criteria and required PD during the study period were included, providing a focused and relevant sample. Inclusion criteria were patients undergoing pancreaticoduodenectomy for various reasons and aged between 16 and 65 years, ensuring the inclusion of a relevant patient population for evaluating the outcomes of PD with different stenting methods. Exclusion criteria were patients with a history of previous ERCP stenting or previous gastrointestinal surgery, set to exclude individuals whose previous medical interventions could confound the study results, ensuring a more homogeneous study population. Patients were monitored from the day of their surgery until their discharge from the hospital, recording all relevant clinical data

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including demographic information, surgical details, and postoperative outcomes. The primary endpoints were the incidence of pancreatic fistula, delayed gastric emptying, intra-abdominal abscess, and overall morbidity. Data were analyzed to compare the outcomes between the internal and external stent groups, with statistical significance set at $p<0.05$. By maintaining a structured and rigorous approach, this study aimed to provide valuable insights into the comparative effectiveness and safety of internal versus external pancreatic duct stents in patients undergoing pancreaticoduodenectomy.

RESULTS

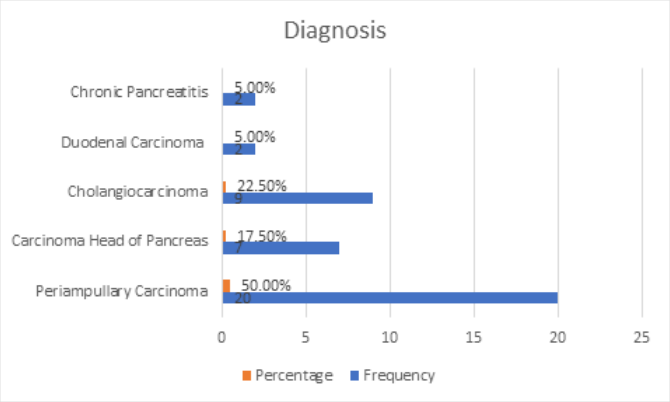

Figure 1: Distribution of histopathological diagnosis of the participants (N=40)

The age distribution of the participants was varied, with the majority falling in the age range of 51 to 60 years, accounting for 47.5% of the sample. Participants aged 61 to 65 years made up 25%, while those in the 41 to 50 age range comprised 17.5%. A smaller proportion of participants were aged 31 to 40 years (7.5%) and 21 to 30 years (2.5%). The mean age of the participants was 56.78 years with a standard deviation of 4.27 years. Regarding the sex distribution, males predominated, representing 65% of the sample, while females constituted 35%. [Table 1]

Periampullary carcinoma was the most common diagnosis, observed in 50% of the participants. This was followed by cholangiocarcinoma, which was present in 22.5% of the cases. Carcinoma of the head of the pancreas was diagnosed in 17.5% of the participants. Duodenal carcinoma and chronic pancreatitis were less common, each accounting for 5% of the diagnoses.

The per-operative characteristics of these participants varied across several parameters. Regarding pancreatic texture, 40% of participants in the external stenting group had a soft pancreas, compared to 10% in the internal stenting group. Conversely, 65% of participants with internal stents had a firm pancreas, while 50% of those with external stents had a firm pancreas. Hard pancreatic texture was observed in 25% of the internal stent group and 10% of the external stent group. The diameter of the pancreatic duct also differed between the groups. In the internal stenting group, 40% of participants had a duct diameter of 0-3 mm, 10% had a diameter of 3-5 mm, and 50% had a diameter greater than 5 mm. In the external stenting group, 15% had a duct diameter of 0-3 mm, 25% had a diameter of 3-5 mm, and 60% had a diameter greater than 5 mm. Regarding the anastomotic technique used, duct-to-mucosa anastomosis was the most common in both groups, employed in 65% of the internal stenting group and 55% of the external stenting group. The Dunkin technique was used in 25% of the internal stenting group and 35% of the external stenting group, while other techniques were used in 10% of each group. The operative

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time showed that 60% of participants in the internal stenting group had surgeries lasting 2-3 hours, compared to 50% in the external stenting group. Surgeries lasting 3-4 hours were observed in 40% of the internal stenting group and 35% of the external stenting group. A longer operative time of more than 4 hours was noted in 10% of the internal stenting group and 15% of the external stenting group. Net blood loss during surgery also varied. In the internal stenting group, 55% of participants had less than 300 ml of blood loss, compared to 45% in the external stenting group. Blood loss between 300-500 ml was observed in 20% of the internal stenting group and 30% of the external stenting group. More than 500 ml of blood loss was noted in 25% of both groups. [Table 2]

Table 1: Distribution of demographic characteristics among the participants (N=40)

Variable	**Frequency**	**Percentage**
Age		
21 – 30	1	2.50%
31 – 40	3	7.50%
41 – 50	7	17.50%
51 – 60	19	47.50%
61 – 65	10	25.00%
Mean±SD	56.78±4.27	
Sex		
Male	26	65.00%
Female	14	35.00%

Table 2: Distribution of participants by per-operative characteristics (N=40)

Per-operative Characteristics	**Internal Stenting (n=20)**		**External Stenting (n=20)**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Pancreatic Texture				
Soft	2	10.0%	8	40.0%
Firm	13	65.0%	10	50.0%
Hard	5	25.0%	2	10.0%
Pancreatic Duct Diameter				
0-3 mm	8	40.0%	3	15.0%
3-5mm	2	10.0%	5	25.0%
>5 mm	10	50.0%	12	60.0%
Anastomotic Technique				
Dunkin	5	25.0%	7	35.0%
Duct To mucosa	13	65.0%	11	55.0%
Others	2	10.0%	2	10.0%
Operative Time				
2-3 Hours	12	60.0%	10	50.0%
3-4 hours	8	40.0%	7	35.0%

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More than 4 hours	2	10.0%	3	15.0%
Net Blood loss(ml)				
Less than 300	11	55.0%	9	45.0%
300-500	4	20.0%	6	30.0%
More than 500	5	25.0%	5	25.0%

Table 3: Distribution of participants by post-operative complications (N=40)

Complications	**Internal Stenting (n=20)**		**External Stenting (n=20)**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Wound Infection/SSI	2	10.0%	3	15.0%
Intra-Abdominal Collection	1	5.0%	2	10.0%
GI Bleeding	0	0.0%	1	5.0%
Intra-abdominal Bleeding	0	0.0%	2	10.0%
Delayed gastric emptying	1	5.0%	1	5.0%
Pancreatic Fistula (Grade A)	2	10.0%	3	15.0%
Pancreatic Fistula (Grade B)	0	0.0%	2	10.0%
Pancreatic Fistula (Grade C)	0	0.0%	1	5.0%

Wound infections or surgical site infections (SSIs) were observed in 10% of participants with internal stents and 15% of those with external stents. Intra-abdominal collections occurred in 5% of the internal stent group compared to 10% in the external stent group. Gastrointestinal bleeding was not reported in the internal stent group but was observed in 5% of the external stent group. Intra-abdominal bleeding was absent in the internal stent group but present in 10% of the external stent group. Delayed gastric emptying was reported in 5% of participants in both the internal and external stent groups. Pancreatic fistula, a significant postoperative complication, showed varied incidence based on the stent type and grade. Grade A pancreatic fistula occurred in 10% of the internal stent group and 15% of the external stent group. Grade B pancreatic fistula was not observed in the internal stent group but was present in 10% of the external stent group. Similarly, Grade C pancreatic fistula was not reported in the internal stent group but was seen in 5% of the external stent group. [Table 3]

DISCUSSION

This study aimed to evaluate the early complications of internal versus external pancreatic duct stents in patients undergoing pancreaticoduodenectomy (PD) at Dhaka Medical College Hospital. Our findings reveal significant differences in postoperative outcomes between the two stenting methods. The demographic data showed that the majority of the participants were aged 51 to 60 years, with a mean age of 56.78 years, and males constituted 65% of the study population. This demographic distribution is consistent with previous studies, which have also reported a higher incidence of PD in older male patients due to the prevalence of pancreatic and periampullary cancers in this demographic group.[14,15] Histopathological diagnoses in our study predominantly included periampullary

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carcinoma (50%), cholangiocarcinoma (22.5%), and carcinoma of the head of the pancreas (17.5%). These findings align with the literature, where periampullary carcinoma is frequently the most common indication for PD, followed by cholangiocarcinoma and pancreatic head carcinoma.[16,17] The less common diagnoses of duodenal carcinoma and chronic pancreatitis, each accounting for 5%, also reflect the broader spectrum of indications for PD. The per-operative characteristics highlighted notable differences between the internal and external stenting groups. Specifically, a higher percentage of participants with a soft pancreas was observed in the external stenting group (40%) compared to the internal stenting group (10%). This difference is significant as a soft pancreas is a known risk factor for pancreatic fistula (PF), a common and severe complication after PD.[18] Our findings corroborate with Berger et al. (2009), who reported that a soft pancreatic texture increases the risk of PF significantly.[19] Additionally, the distribution of pancreatic duct diameters showed that the internal stenting group had a higher proportion of patients with duct diameters greater than 5 mm (50%) compared to the external stenting group (60%). Larger duct diameters are generally associated with a lower risk of PF, suggesting a possible inherent advantage in the internal stenting group.[20] Postoperative complications varied between the two groups. Wound infections were more common in the external stenting group (15%) compared to the internal stenting group (10%), which aligns with findings from Kulemann et al. (2017), who reported increased wound infections associated with higher intraoperative fluid administration and potentially more invasive procedures.[21] Intra-abdominal collections were also higher in the external stenting group (10%) compared to the internal stenting group (5%), further supporting the observation that external stents might contribute to higher morbidity.[22] Gastrointestinal (GI) bleeding and intra-abdominal bleeding were absent in the internal stenting group but present in the external stenting group (5% and 10%, respectively). These findings are consistent with the literature that external stenting, while effective in reducing PF rates, can increase other complications such as bleeding due to the invasiveness of the procedure.[23] Delayed gastric emptying (DGE) was noted in 5% of participants in both stenting groups, which is in line with the reported rates in various studies.[24] However, the grade and incidence of PF showed significant differences. Grade A PF was observed in 10% of the internal stenting group and 15% of the external stenting group, while grade B and C PF were more prevalent in the external stenting group. This higher incidence and severity of PF in the external stenting group are consistent with findings from Romero et al. (2020), who reported similar trends in their comparative study of stenting techniques.[8]

Overall, our study underscores the importance of selecting appropriate stenting techniques based on individual patient characteristics and risk factors. Internal stenting appears to offer advantages in terms of lower incidence of wound infections, intra-abdominal collections, and bleeding complications, making it a preferable option in many cases. However, the choice of stent should also consider the texture of the pancreas and the diameter of the pancreatic duct, as these factors significantly influence the risk of PF and other complications.

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Further research and larger randomized controlled trials are necessary to establish definitive guidelines for stent selection and management in PD patients. In conclusion, while both internal and external stenting techniques have their merits, our study suggests that internal stenting may provide better postoperative outcomes in terms of reduced complication rates. This finding, along with consistent results from other studies, advocates for a more tailored approach to stent selection to optimize patient outcomes in pancreaticoduodenectomy.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSIONS

In conclusion, this study highlights the differences in early postoperative complications between internal and external pancreatic duct stents in patients undergoing pancreaticoduodenectomy. Our findings suggest that internal stents are associated with lower incidences of wound infections, intra-abdominal collections, gastrointestinal bleeding, and intra-abdominal bleeding compared to external stents. The internal stenting group also demonstrated fewer severe pancreatic fistulas, underscoring its potential benefits in reducing postoperative morbidity. However, both stenting methods showed similar rates of delayed gastric emptying. Given these results, internal pancreatic duct stents may be considered a preferable option in many clinical scenarios, although the choice of stent should be individualized based on patient-specific factors such as pancreatic texture and duct diameter. Further large-scale studies are needed to validate these findings and refine stent selection criteria to optimize patient outcomes.

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