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Incidence of Post-Operative Stricture Following Hepaticojejunostomy for Benign and Malignant Disease

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ABSTRACT

Hepaticojejunostomy remains essential for biliary obstruction management, yet postoperative strictures significantly impact outcomes. Current incidence estimates (4-19%) vary widely due to methodological differences, and recent evidence questions the validity of the commonly referenced 12.5% benchmark used for study design. **Objective:** To: 1) determine contemporary stricture incidence using standardized criteria, 2) compare benign versus malignant cases, and 3) evaluate 3-month follow-up adequacy. **Methods:** A prospective cohort study was conducted involving 52 consecutive patients who underwent hepaticojejunostomy, with a mean age of 53.8 years (95% CI: 50.5-57.1). Strictures required both clinical (ICD-9 coding plus symptoms/biochemical evidence) and radiographic confirmation (CT/MR cholangiography). Statistical analyses included exact binomial CIs and chi-square tests (significance at p<0.05). **Results:** The overall stricture incidence was 19.2% (10/52, 95% CI: 9.6-32.5%). Benign cases showed significantly higher stricture rates (33.3% [8/24], 95% CI: 15.6-55.3%) versus malignant cases (7.1% [2/28], 95% CI: 0.9-23.5%; p=0.017). **Conclusions:** This study confirmed significantly higher stricture risk in benign disease and suggests current surveillance protocols may require pathology-specific modifications. The statistically significant association (p=0.017) between benign pathology and stricture formation underscores the need for risk-adapted management. Future research should prioritize multicenter cohorts with extended follow-up to validate these findings and refine surveillance guidelines.

INTRODUCTION

Biliary tract diseases requiring surgical intervention affect approximately 1 in 1,000 individuals annually, with hepaticojejunostomy remaining the reconstruction technique of choice for both benign and malignant obstructions [1]. Since its initial description in the early 20th century, this procedure has undergone significant technical evolution yet continues to be complicated by anastomotic stricture formation in a substantial proportion of cases [2]. The clinical consequences of these strictures are profound, often leading to recurrent cholangitis, secondary biliary cirrhosis, and the need for repeated interventions that collectively represent a major source of patient morbidity [3]. The reported incidence of post-hepaticojejunostomy strictures varies remarkably from 4-19% across different studies, reflecting fundamental methodological differences in study design and patient populations [4]. This variability is particularly evident when comparing reports from high-volume specialty centers versus population-based analyses, with the former typically reporting lower rates that may reflect referral bias or technical expertise [5]. More importantly, the majority of existing evidence derives from retrospective case series plagued by inconsistent follow-up protocols and non-standardized diagnostic criteria,

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making it difficult to establish true population-level risk estimates[6]. Several critical knowledge gaps limit current understanding of this important surgical complication. Foremost is the lack of contemporary validation for the frequently cited 12.5% stricture incidence rate that serves as the foundation for most sample size calculations in biliary reconstruction studies [7]. This benchmark originates from studies using surgical techniques and perioperative care protocols that differ substantially from current practice, potentially leading to underpowered studies that fail to detect clinically important risk factors or treatment effects [8]. The literature also demonstrates a persistent failure to adequately distinguish between benign and malignant cases when analyzing stricture outcomes, despite their likely differences in underlying pathophysiology[9]. Benign strictures typically result from fibrotic healing responses influenced by local inflammation and ischemia, while malignant strictures often reflect disease progression rather than purely technical factors. This biological distinction has important clinical implications that current evidence fails to address, particularly regarding optimal surveillance strategies and timing of intervention [10]. The duration and intensity of postoperative surveillance represents another significant evidence gap. While conventional practice typically involves clinical monitoring for 3-6 months, emerging data suggest 15-20% of strictures present beyond this window, sometimes years after the initial operation [11]. This late presentation pattern appears particularly common in benign cases where slow fibrotic progression may delay clinical manifestations, yet no prospective studies have systematically evaluated long-term stricture risk or developed evidence-based surveillance protocols. These knowledge gaps have direct clinical consequences. Surgeons lack reliable data for preoperative risk stratification and patient counseling. Institutions struggle to establish meaningful quality benchmarks due to absent contemporary population-level data. Most importantly, the field lacks evidence-based guidelines for postoperative surveillance, resulting in either excessive testing for low-risk patients or inadequate monitoring of high-risk cases. This prospective cohort study was designed to address these limitations through rigorous methodology and comprehensive follow-up. The primary aim was to establish contemporary, procedure-specific stricture incidence rates using standardized diagnostic criteria incorporating both clinical and radiographic parameters.

By prospectively tracking a well-characterized patient cohort, will overcome the limitations of retrospective studies while generating robust epidemiological data to inform surgical decision-making.

METHODS

This prospective cohort study was conducted at the Department of General Surgery, MTI-Khyber Teaching Hospital, Peshawar from Jan 2024 to Dec 2024 after obtaining ethical approval (Ref: 935/DME/KMC). The study enrolled 52 consecutive patients aged 18-90 years undergoing hepaticojejunostomy for confirmed benign or malignant biliary tract disease, excluding those with non-biliary indications or ASA score >3. Sample size was calculated using WHO software based on an expected 12.5% stricture rate from previous literature, with 80% power and 5% significance level, though the final enrollment of 52 patients represents a pragmatic clinical sample [12]. The initial sample size calculation using WHO software indicated a requirement of 168 patients to detect a 12.5% stricture rate with 80% power and 5% significance level. However, the final enrollment of 52 patients reflects real-world constraints including the single-center design and specific inclusion criteria. A post-hoc power analysis reveals this sample provides 78% power to detect the observed 19.2% stricture rate (95% CI: 9.6%-32.5%), which remains clinically meaningful. While this reduction may limit subgroup analyses, it does not invalidate the primary findings regarding overall stricture incidence. All procedures were performed by fellowship-trained hepatobiliary surgeons using standardized techniques including mucosa-to-mucosa anastomosis with interrupted absorbable sutures under optical magnification.Patients underwent comprehensive postoperative evaluation at 3 months incorporating both clinical assessment and objective testing. Stricture diagnosis required fulfillment of all three criteria: (a) ICD-9 coding for biliary obstruction, (b) biochemical evidence (alkaline phosphatase >1.5×ULN or bilirubin >2 mg/dL), and (c) radiographic confirmation via CT/MR cholangiography demonstrating anastomotic narrowing with upstream dilation. For equivocal cases, additional confirmatory testing with ERCP or PTC was performed. This multimodal diagnostic approach addressed known limitations of administrative coding data while providing pathological correlation. Statistical analysis utilized SPSS version 23.0 with continuous variables reported as mean ± SD and categorical variables as frequencies and percentages. Between-group comparisons employed Chi-square tests with significance set at $p<0.05$. Given the observed stricture rate of 19.2%, post-hoc power calculation confirmed 78% power to detect clinically relevant differences between benign and malignant subgroups. The 3-month follow-up period was selected based on evidence that 80-85% of technical anastomotic failures manifest within this window [12, 15], though this may acknowledge miss later fibrotic strictures as discussed in the limitations. All imaging studies were independently reviewed by two radiologists blinded to clinical data to minimize interpretation bias.

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RESULTS

The study cohort comprised 52 patients with a mean age of 53.8 years (95% CI: 50.5-57.1), demonstrating a slight female predominance (29 patients, 55.8%; 95% CI: 41.3-69.5%) compared to males (23 patients, 44.2%; 95% CI: 30.5-58.7%). Disease pathology at surgery was nearly evenly distributed between benign (24 patients, 46.2%; 95% CI: 32.2-60.5%) and malignant conditions (28 patients, 53.8%; 95% CI: 39.5-67.8%). Comorbidity burden, as assessed by the Charlson Comorbidity Index, showed 15 patients (28.8%; 95% CI: 17.1-43.1%) had no significant comorbidities, while 14 (26.9%; 95% CI: 15.6-41.0%), 16 (30.8%; 95% CI: 18.7-45.1%), and 7 patients (13.5%; 95% CI: 5.6-25.8%) had scores of 1, 2, and 3 respectively. Preoperative biliary drainage procedures were common, with 22 patients (42.3%; 95% CI: 28.7-56.8%) undergoing Endoscopic Biliary Stenting (EBS) and 13 (25.0%; 95% CI: 14.0-39.0%) receiving Percutaneous Transhepatic Cholangiography (PTC), while 17 patients (32.7%; 95% CI: 20.3-47.1%) required no preoperative intervention. Clinical jaundice was present at surgery in 21 cases (40.4%; 95% CI: 27.0-54.9%). Postoperative strictures developed in 10 patients (19.2%; 95% CI: 9.6-32.5%), while the majority (42 patients, 80.8%; 95% CI: 67.5-90.4%) maintained patent anastomoses during the study period. The stricture rate among benign cases was notably higher (8/24, 33.3%; 95% CI: 15.6-55.3%) compared to malignant cases (2/28, 7.1%; 95% CI: 0.9-23.5%), a difference that reached statistical significance (p=0.017). Details are presented in Table 1.

Table 1: Demographic and Clinical Characteristics of Patients (n=52)

Variables	Mean ± SD/Frequency (%)
Age	53.79 ± 11.65 Years
Gender	
Male	23 (44.2)
Female	29 (55.8)
Disease at Surgery	
Benign	24 (46.2)
Malignant	28 (53.8)
Charlson Comorbidity Index	
0	15 (28.8)
1	14 (26.9)
2	16 (30.8)
3	07 (13.5)
Pre-operative Procedure	
Non	17 (32.7)
PTC	13 (25.0)
EBS	22 (42.3)
Jaundice at Surgery	
Yes	21 (40.4)
No	31 (59.6)
Incidence of Stricture	
Yes	10 (19.2)
No	42 (80.8)

The analysis of 52 patients revealed an overall postoperative stricture incidence of 19.2% (10/52) following hepaticojejunostomy. Table 2 demonstrated the association between stricture incidence and underlying disease pathology. Patients with benign disease showed higher stricture rates (8/24, 33.3%) compared to malignant cases (2/28, 7.1%), with this difference approaching statistical significance (p=0.017). Notably, among the 10 stricture cases, 80% occurred in benign disease patients while only 20% developed in malignant cases.

Table 2: Association of Incidence of Post-Operative Stricture with Disease at Surgery (n=52)

Variable		Frequency (%)		Total Frequency (%)	p-Value
		Benign Frequency (%)	Malignant Frequency (%)		
Incidence of Stricture	Yes	8 (80.0)	2 (20.0)	10 (100.0)	0.017
	No	16 (38.1)	26 (61.9)	42 (100.0)	
Total		24 (46.2)	28 (53.8)	52 (100.0)	

DISCUSSION

This prospective study identified a 19.2% incidence of postoperative strictures following hepaticojejunostomy, consistent with the upper range of contemporary reports (12.5-20%) [12, 13]. The elevated rate compared to historical data likely reflects the prospective design and standardized diagnostic approach. Notably, 80% of strictures occurred in benign cases versus 20% in malignant disease, supporting emerging evidence of distinct pathophysiological mechanisms [7, 14].The selection of a 3-month primary follow-up window was based on multiple considerations from existing literature and clinical practice realities. While some studies have reported strictures presenting up to 2 years postoperatively, the majority of anastomotic complications (approximately 80-85%) typically manifest within the first 90 days according to recent prospective data [7, 12, 15].This early presentation pattern is particularly true for technical failures and acute inflammatory strictures, which represent the primary outcomes of interest in this study. However, we fully acknowledge that this timeframe may miss later-onset fibrotic strictures, especially in benign cases where slow progression can delay clinical presentation [16-19].This limitation is explicitly addressed in the discussion, where it was noted that approximately 15-20% of strictures may present beyond this window based on longer-term studies [20, 21].The 3-month endpoint represents a practical balance between detection sensitivity and study feasibility, while providing meaningful data about the early complication rate that is most relevant for initial postoperative management decisions.The borderline significant association (p=0.017) between benign pathology

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and stricture development merits attention. This aligns with recent findings that chronic inflammation promotes fibrotic remodeling in benign disease, while malignant cases may benefit from technical advantages despite poorer survival [16, 17]. These biological differences suggest postoperative protocols may require pathology-specific modifications. Comparative analysis reveals important temporal patterns. While previous work reported 12.5% incidence at 2 years, the higher early detection rate suggested many strictures manifest sooner than historically recognized, potentially reflecting improved diagnostics [12, 18]. The 33.3% stricture rate in benign cases particularly underscores the need for enhanced early surveillance [19, 20]. The study has several important limitations that should be considered when interpreting the findings [21]. The modest sample size may restrict more detailed subgroup analyses and reduce the precision of some estimates, particularly for less common outcomes. As a single-center study conducted at a tertiary referral hospital, the results may not fully generalize to other practice settings with different patient populations or surgical volumes. Additionally, the predetermined 3-month follow-up period, while capturing the majority of early stricture presentations, likely missed later-onset cases that typically emerge beyond this surveillance window based on existing literature. These limitations collectively underscore the importance of developing pathology-specific monitoring protocols and more accurate sample size estimation methods for future investigations. Moving forward, the field would benefit from multicenter collaborative studies to validate these findings across diverse clinical environments, along with research focused on technical innovations in anastomotic methods and the development of robust risk prediction tools to guide individualized patient management.

CONCLUSIONS

This study confirmed that anastomotic stricture remains a frequent complication of hepaticojejunostomy, particularly among patients with benign biliary disease. The observed 19.2% incidence rate, coupled with the differential risk patterns between benign and malignant cases, underscores the need for tailored postoperative surveillance protocols.These findings highlight the importance of developing evidence-based strategies for early detection and management to improve long-term surgical outcomes.Future research should focus on optimizing anastomotic techniques and establishing risk-adapted follow-up algorithms to mitigate this significant cause of postoperative morbidity.

Authors Contribution

Conceptualization: MM
Methodology: MA, IU
Formal analysis: MA, MU, IU
Writing, review and editing: MU, MM

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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