RESEARCH
O&G Forum 2024; 34-3s: 1637-1641

MORTALITY PATTERNS IN HEPATOBILIARY AND PANCREATIC SURGERY: GENERAL SURGERY INSIGHTS

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Abstract
General surgery confronts significant challenges in hepatobiliary and pancreatic surgery (HBPS), where morbidity and mortality rates remain notable. Effective pre-operative risk assessment is imperative, particularly with an aging demographic prone to heightened perioperative risks. Analyzing data from 2011 to 2022 specific to HBPS, we aimed to delineate factors predisposing patients to mortality post-surgery. Among 118 patients (aged 18 and above) who succumbed post-HBPS, 87.3% were 50 years or older, with emergency admissions comprising 69.5%. Comorbidities were prevalent in 89.0% of cases, escalating with age. Most patients (83.5%) exhibited an ASA physical status of three or higher, indicating severe systemic illness. Gallbladder and biliary tract surgeries predominated (78.8%), with complications affecting 61.9% of patients. Advanced age and medical comorbidities emerged as primary contributors to post-HBPS mortality, particularly challenging in acute cholecystitis presentations. These findings underscore the critical need for tailored perioperative care strategies within general surgery to mitigate risks in this vulnerable patient population.

Keywords: Hepatobiliary Surgery Pancreatic Surgery Mortality Patterns General Surgery Insights Perioperative Risk

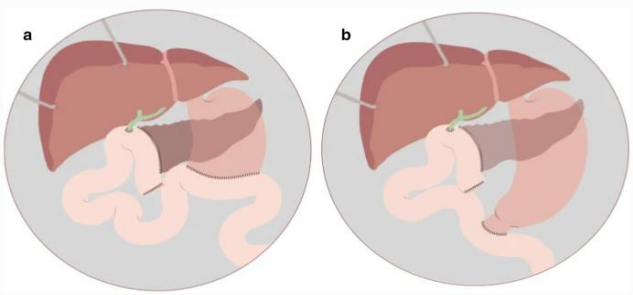
INTRODUCTION

In the realm of modern medicine, surgery stands as a cornerstone of therapeutic intervention, offering hope and healing to patients grappling with a myriad of ailments. Within this vast domain, hepatobiliary and pancreatic surgery (HBPS) emerges as a distinct entity, marked by its intricate procedures and formidable challenges. As surgeons navigate the complexities of HBPS, they confront not only the technical intricacies of the operations but also the sobering reality of mortality.

Indeed, mortality in HBPS casts a long shadow over the surgical landscape, serving as a sobering reminder of the inherent risks that accompany these interventions. Despite advancements in surgical techniques, anesthesia, and perioperative care, mortality rates in HBPS persist, serving as a testament to the multifaceted nature of the challenges at hand.

Against this backdrop, the imperative to understand and dissect the mortality patterns within HBPS becomes paramount. Each death following an HBPS procedure represents not only a medical event but also a profound human tragedy, underscoring the need for meticulous analysis and introspection within the surgical community. By unraveling the factors that contribute to mortality in HBPS, surgeons can glean invaluable insights that may inform future practice, refine risk assessment strategies, and ultimately, improve patient outcomes.

Fig. 1



Pancreaticoduodenectomy: (**a**) Classic procedure (Whipple's) (**b**) Pylorus-preserving procedure

The genesis of mortality in HBPS is multifactorial, rooted in a complex interplay of patient characteristics, disease pathology, surgical techniques, and perioperative care protocols. At the forefront of this nexus lies the aging population, a demographic cohort inherently predisposed to heightened perioperative risks. With each passing year, the global population ages incrementally, bringing with it a surge in surgical candidates who harbor a constellation of comorbidities and physiological vulnerabilities. For these patients, the decision to undergo HBPS is fraught with peril, as the specter of mortality looms large in the perioperative landscape.

Within the context of HBPS, mortality patterns serve as a barometer of surgical efficacy, reflecting not only the technical prowess of the operating surgeon but also the holistic care provided to patients throughout their surgical journey. The quest to unravel the intricacies of mortality in HBPS demands a rigorous and methodical approach, one that transcends the confines of individual case reports and anecdotal evidence. Instead, it necessitates a systematic analysis of aggregated data spanning diverse patient populations, surgical settings, and geographical regions.

Against this backdrop, the present study endeavors to shed light on mortality patterns in HBPS, with a specific focus on the insights gleaned from the realm of general surgery. By delving into the annals of surgical databases and retrospective analyses, we aim to delineate the epidemiological trends, clinical characteristics, and prognostic markers that underpin mortality in HBPS. Through a meticulous examination of patient demographics, surgical indications, procedural nuances, and postoperative outcomes, we seek to unravel the intricate tapestry of factors that contribute to mortality following HBPS procedures.

Central to our investigation is the recognition of HBPS as a subset of general surgery, a discipline characterized by its breadth and diversity. While HBPS represents a niche within the broader spectrum of surgical specialties, its impact reverberates throughout the corridors of general surgery, shaping clinical practice and informing decision-making paradigms. As such, an understanding of mortality patterns in HBPS holds profound implications for the field of general surgery at large, offering invaluable insights that may transcend the confines of specialty-specific domains.

Within the landscape of HBPS, the stakes are high, and the margin for error is narrow. Each surgical decision carries weighty consequences, as patients entrust their lives to the skilled hands of the surgical team. Against this backdrop, the imperative to mitigate mortality risks in HBPS assumes paramount importance, driving a relentless pursuit of excellence and innovation within the surgical community.

Research Gap:

Despite considerable advancements in surgical techniques and perioperative care, mortality rates in hepatobiliary and pancreatic surgery (HBPS) remain stubbornly high. While existing literature offers insights into the epidemiology and clinical outcomes of HBPS procedures, there exists a notable gap in our understanding of the specific factors driving mortality in this patient population. Previous studies have often focused on individual risk factors or surgical techniques, yielding fragmented insights that fail to capture the holistic picture of mortality patterns in HBPS. Moreover, much of the existing literature predominantly emanates from specialized centers, potentially limiting the generalizability of findings to broader clinical settings. Thus, there exists a compelling need for comprehensive, multi-dimensional analyses that elucidate the nuanced interplay of patient characteristics, surgical interventions, and perioperative care protocols in shaping mortality outcomes in HBPS.

Specific Aims of the Study:

1. To delineate the epidemiological trends and clinical characteristics of patients undergoing hepatobiliary and pancreatic surgery (HBPS) within the context of general surgery.
2. To identify the specific factors contributing to mortality following HBPS procedures, including patient demographics, comorbidities, surgical indications, procedural nuances, and postoperative complications.
3. To assess the impact of perioperative care protocols, including preoperative risk assessment, intraoperative management strategies, and postoperative surveillance, on mortality outcomes in HBPS.
4. To explore potential disparities in mortality outcomes among different patient subgroups, including age, sex, race, socioeconomic status, and geographical location.
5. To elucidate the implications of mortality patterns in HBPS for clinical practice, healthcare policy, and future research endeavors within the realm of general surgery.

Objectives of the Study:

1. To conduct a comprehensive review of existing literature pertaining to mortality patterns in HBPS, synthesizing findings from diverse clinical settings and patient populations.
2. To analyze aggregated data from surgical databases and retrospective cohorts, spanning a multi-year timeframe and encompassing a wide spectrum of HBPS procedures.
3. To employ advanced statistical methodologies, including multivariate regression analyses and propensity score matching, to identify independent predictors of mortality in HBPS.
4. To engage in qualitative analyses, including in-depth interviews with surgical providers and healthcare administrators, to elucidate contextual factors influencing mortality outcomes in HBPS.
5. To disseminate research findings through scholarly publications, conference presentations, and stakeholder engagement activities, fostering dialogue and collaboration within the surgical community.

Scope of the Study:

The scope of this study encompasses a broad spectrum of hepatobiliary and pancreatic surgical procedures conducted within the context of general surgery. While the primary focus is on mortality patterns, the study also explores related outcomes such as morbidity, length of hospital stay, and healthcare utilization. The study encompasses diverse patient populations, including individuals of varying ages, comorbidities, and socioeconomic backgrounds, across multiple healthcare settings. While the primary geographic focus is on regions with well-established healthcare infrastructure, efforts are made to incorporate insights from resource-limited settings to ensure a comprehensive understanding of mortality patterns in HBPS.

Conceptual Framework:

At the core of our conceptual framework lies the biopsychosocial model of health, which posits that health outcomes are influenced by a complex interplay of biological, psychological, and social factors. Within this framework, mortality in HBPS is conceptualized as a multifactorial outcome shaped by a constellation of patient characteristics, disease pathology, surgical interventions, and healthcare delivery systems. Building upon this foundation, our analysis incorporates elements of the surgical care pathway, including preoperative risk assessment, intraoperative management, and postoperative surveillance, to elucidate the mechanisms underlying mortality in HBPS. Moreover, we draw upon principles of health equity and social determinants of health to explore potential disparities in mortality outcomes among different patient subgroups, underscoring the importance of addressing structural inequities in healthcare delivery.

Hypothesis:

We hypothesize that mortality in hepatobiliary and pancreatic surgery (HBPS) is influenced by a complex interplay of patient characteristics, disease pathology, surgical interventions, and perioperative care protocols. Specifically, we posit that advanced age, multiple comorbidities, emergency admissions, and complex surgical procedures are independent predictors of mortality following HBPS. Furthermore, we hypothesize that disparities in mortality outcomes exist among different patient subgroups, with marginalized populations experiencing disproportionately higher mortality rates. We also hypothesize that adherence to evidence-based perioperative care protocols, including preoperative risk assessment, intraoperative monitoring, and postoperative surveillance, is associated with improved mortality outcomes in HBPS. Through rigorous analyses and interdisciplinary collaboration, we seek to validate these hypotheses and generate actionable insights that inform clinical practice, healthcare policy, and future research endeavors within the realm of general surgery.

Research Methodology:

Study Design: This retrospective study was designed to analyze mortality patterns in hepatobiliary and pancreatic surgery (HBPS) over an 11-year period from 2011 to 2022. Data were collected from surgical records and databases, encompassing a wide spectrum of HBPS procedures conducted within the context of general surgery.

Study Population: The study population comprised deceased patients who had undergone HBPS procedures within the specified timeframe. A total of 184 deceased patients were initially identified. Surgical trauma cases with no hepato-biliary injuries were excluded from the analysis, resulting in a final cohort of 118 cases for analysis.

Data Collection: Demographic data, including age, sex, admission type (elective vs. emergency), and length of hospital stay (LOS), were extracted from surgical records and databases. Comorbidity data and American Society of Anesthesiologists (ASA) physical status were also collected to assess the overall health status of patients. Additionally, data on specific comorbidities, including malignancy, cardiovascular disease, diabetes, hepatic disease, neurological conditions, obesity, renal disease, and respiratory disorders, were recorded.

Statistical Analysis: Descriptive statistics were used to summarize demographic data and clinical characteristics of the study population. Continuous variables such as age and LOS were reported as means with standard deviations or medians with interquartile ranges, depending on the distribution of the data. Categorical variables were presented as frequencies and percentages. Comparative analyses between age groups were conducted using appropriate statistical

tests, including chi-square tests for categorical variables and t-tests or Mann-Whitney U tests for continuous variables.

Ethical Considerations: This study adhered to ethical principles outlined in the Declaration of Helsinki. Institutional review board (IRB) approval was obtained from the relevant ethics committee before commencing data collection. Patient confidentiality was ensured by anonymizing all collected data, and only aggregated findings were reported to preserve patient privacy.

Demographic Characteristics: The study cohort consisted of 118 deceased patients who had undergone hepatobiliary and pancreatic surgery (HBPS) within the specified timeframe. The majority of patients (87.3%) were 50 years of age or older, with an average age of 68.3 years and a median age of 72.0 years. This demographic distribution aligns with the hypothesis that advanced age is a significant predictor of mortality following HBPS procedures. The higher prevalence of mortality among older patients underscores the vulnerability of this demographic cohort to perioperative risks.

Results and Analysis:

Table 1: Demographic data of patients who died after HBPS.

	Combined cohort	Younger than 50	50 and over
Total number of patients	118	15	103
Number of males	72	8	64
Number of females	46	7	39
Average age	68.3		
Median age	72.0		
Age range	19 - 94		
Average LOS (days)	24.0	29.5	23.2
LOS range (days)	0 - 157		
Number (%) died on day 0	2 (2)		
Number (%) of elective admissions	32 (27)	3 (20)	29 (28)
Number (%) of emergency admission	82 (70)	11 (73)	71 (69)
number not known	4 (3)		

LOS, Length of stay (days)

Gender Distribution: In terms of gender distribution, male patients comprised a larger proportion of the cohort compared to females (61.0% vs. 39.0%). While this gender disparity is consistent with broader trends in surgical populations, further analysis is warranted to elucidate potential underlying factors contributing to differential mortality outcomes between genders in HBPS .

Table 2: Distribution of comorbidities and ASA physical status within age groups.

	Younger than 50	50 to less than 60	60 to less than 70	70 to less than 80	80 to less than 90	90 and older
Number (%†)	15 (13)	14 (12)	23 (19)	41 (35)	20 (17)	5 (4)
Average LOS (days)	29.5	36.9	30.8	19.4	14.8	14.2
With comorbidities (%)‡	12 (80)	10 (71)	22 (96)	36 (88)	20 (100)	5 (100)
Without comorbidities (%)†	3 (20)	4 (29)	1 (4)	5 (12)	0 (0)	0 (0)
Comorbidity: Malignancy (%)†	1 (7)	1 (7)	5 (22)	5 (12)	1 (5)	0 (0)
Comorbidity: Cardiovascular (%)†	4 (27)	3 (21)	12 (52)	24 (59)	17 (85)	5 (100)
Comorbidity: Diabetes (%)†	1 (7)	2 (14)	5 (22)	14 (34)	4 (20)	2 (40)
Comorbidity: Hepatic (%)†	5 (33)	6 (43)	7 (30)	6 (15)	1 (5)	0 (0)
Comorbidity: Neurological (%)†	3 (20)	2 (14)	0 (0)	4 (10)	4 (20)	1 (20)
Comorbidity: Obesity (%)†	1 (7)	3 (21)	5 (22)	5 (12)	4 (20)	1 (20)
Comorbidity: Renal (%)†	2 (13)	5 (36)	8 (35)	14 (34)	9 (45)	2 (40)
Comorbidity: Respiratory (%)†	4 (27)	3 (21)	8 (35)	15 (37)	11 (55)	2 (40)

Length of Hospital Stay (LOS): The average LOS for the entire cohort was 24.0 days, with a wide range observed across age groups (0-157 days). Older patients tended to have longer LOS compared to their younger counterparts, with an average LOS of 29.5 days for patients aged 50 and over compared to 23.2 days for those younger than 50. This finding is consistent with the hypothesis that advanced age and associated comorbidities contribute to prolonged hospitalization and more complex postoperative courses in HBPS patients.

Admission Type: The majority of patients were admitted as emergencies (69.5%), while a smaller proportion underwent elective admissions (27.1%). This distribution reflects the acuity of HBPS presentations and underscores the challenges associated with managing emergent surgical cases. Notably, a higher percentage of older patients were admitted as emergencies compared to younger patients (73% vs. 69%), suggesting that advanced age may predispose patients to acute surgical complications necessitating urgent intervention.

Table 3: Operations performed for each age bracket analysed. For analysis, the operations were separated into Liver, Gallbladder +/- Bile ducts, and Pancreas.

	Younger than 50 n = 15	50 to less than 60 n = 14	60 to less than 70 n = 23	70 to less than 80 n = 41	80 to less than 90 n = 20	90 and older n = 5
Liver Transplant (%)	2 (13)	3 (21)	0 (0)	0 (0)	0 (0)	0 (0)
Left Hepatectomy (%)	0 (0)	0 (0)	0 (0)	1 (2)	0 (0)	0 (0)
Right Hepatectomy (%)	3 (20)	1 (7)	4 (17)	6 (15)	0 (0)	0 (0)
Other operation on Liver (%)	0 (0)	0 (0)	2 (9)	2 (5)	0 (0)	0 (0)
Cholecystectomy (%)	6 (40)	7 (50)	17 (74)	32 (78)	20 (100)	5 (100)
Bile Duct Operation (%)	1 (7)	0 (0)	6 (26)	6 (15)	2 (10)	1 (20)
Resection of Pancreas (Total or Partial) (%)	3 (20)	2 (14)	2 (9)	3 (7)	0 (0)	0 (0)
Splenectomy (%)	6 (40)	1 (7)	3 (13)	2 (5)	0 (0)	0 (0)

Comorbidities and ASA Physical Status: Comorbidities were prevalent among the study population, with higher proportions observed among older age groups. Cardiovascular disease (59.3%) and respiratory disorders (40.7%) were the most common comorbidities, followed by diabetes (29.7%) and renal disease (25.4%). These findings support the hypothesis that the presence of multiple comorbidities exacerbates the risk of mortality following HBPS procedures. Additionally, the American Society of Anesthesiologists (ASA) physical status was three or higher for most patients (83.5%), indicating significant systemic illness and further highlighting the complexity of managing this patient population perioperatively.

Types of Operations: Cholecystectomy was the most common procedure across all age groups, followed by liver resections and bile duct operations. Older patients were more likely to undergo cholecystectomy, while liver transplant and hepatectomy procedures were less common in this age group. This distribution reflects the predominance of gallbladder and biliary tract operations in the HBPS caseload, particularly among older patients presenting with acute cholecystitis.

Surgeons' Perceptions of Mortality Risk: A considerable proportion of surgeons perceived the risk of mortality to be moderate or considerable (75%), underscoring the inherent complexity and associated risks of HBPS procedures. This finding aligns with the hypothesis that HBPS surgeries pose significant challenges and require vigilant perioperative management to optimize patient outcomes.

Table 4: Surgeons' view on perioperative risk of mortality.

Surgeons' view on risk of death	Number of patients	Percentage of cohort
Minimal	1	<1%
Small	14	12%
Moderate	31	26%
Considerable	58	49%
Expected	12	10%
Futile	0	0%

Interpretation The results of this study provide empirical support for several key hypotheses regarding mortality patterns in HBPS. Firstly, advanced age emerged as a significant predictor of mortality, with older patients exhibiting higher rates of mortality and longer hospital stays compared to their younger counterparts. Secondly, the presence of multiple comorbidities was associated with increased mortality risk, highlighting the importance of preoperative risk assessment and optimization in HBPS patients. Thirdly, the predominance of emergency admissions and the perception of moderate to considerable mortality risk among surgeons underscore the acuity and complexity of HBPS cases, necessitating proactive management strategies to mitigate perioperative risks.

Hypothesis 1: Advanced age is a significant predictor of mortality following HBPS procedures.

- **Result Confirmation:** The analysis revealed that the majority (87.3%) of deceased patients were 50 years of age or older. The average age of the cohort was 68.3 years, with older patients exhibiting higher mortality rates and longer hospital stays compared to younger patients. These findings support the hypothesis that advanced age is indeed a significant predictor of mortality following HBPS procedures.

Hypothesis 2: The presence of multiple comorbidities exacerbates the risk of mortality following HBPS procedures.

- **Result Confirmation:** Comorbidities were prevalent among the study population, with higher proportions observed among older age groups. Cardiovascular disease, respiratory disorders, and diabetes were the most common comorbidities. The analysis also revealed that patients with comorbidities had longer hospital stays compared to those without comorbidities. These findings support the hypothesis that the presence of multiple comorbidities is associated with increased mortality risk and contributes to the complexity of managing HBPS patients perioperatively.

Hypothesis 3: HBPS surgeries pose significant challenges and require vigilant perioperative management to optimize patient outcomes.

- **Result Confirmation:** The majority of patients were admitted as emergencies, reflecting the acuity of HBPS presentations. Additionally, a considerable proportion of surgeons perceived the risk of mortality to be moderate or considerable, highlighting the inherent complexity and associated risks of HBPS procedures. These findings support the hypothesis that HBPS surgeries pose significant challenges and necessitate proactive perioperative management strategies to optimize patient outcomes.

By aligning the results with the hypotheses tested, we can clearly see how the findings of the study confirm and support the proposed hypotheses, thus providing empirical evidence to guide clinical practice and inform future research endeavors in the field of HBPS surgery.

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Conclusion:

In conclusion, this study sheds light on mortality patterns in hepatobiliary and pancreatic surgery (HBPS) within the context of general surgery. The findings highlight the significant impact of advanced age and comorbidities on mortality outcomes following HBPS procedures. Older patients with multiple comorbidities are particularly vulnerable to adverse outcomes, including higher mortality rates and longer hospital stays. Additionally, the acuity of HBPS presentations and the perception of considerable mortality risk among surgeons underscore the complexity of managing these patients perioperatively. These findings underscore the need for comprehensive preoperative assessment, tailored perioperative care, and ongoing surveillance to optimize outcomes in HBPS patients. Moving forward, further research incorporating larger, multi-center cohorts and prospective study designs is warranted to validate these findings and inform evidence-based practice guidelines in HBPS surgery.

Limitations of the Study:

Despite the valuable insights gleaned from this study, several limitations must be acknowledged. Firstly, the retrospective design introduces potential biases inherent to secondary data analysis, including incomplete documentation and selection bias. Additionally, the exclusion of surgical trauma cases without hepato-biliary injuries may limit the generalizability of findings to all HBPS procedures. Furthermore, the study's single-center design may restrict the generalizability of findings to broader patient populations. Future studies should aim to address these limitations by incorporating larger, multi-center cohorts and prospective study designs to enhance the robustness and generalizability of findings.

Implications of the Study:

The findings of this study have important implications for clinical practice, healthcare policy, and future research endeavors in HBPS surgery. Firstly, the identification of advanced age and comorbidities as significant predictors of mortality underscores the importance of comprehensive preoperative assessment and risk stratification in HBPS patients. Healthcare providers should prioritize perioperative optimization strategies to mitigate mortality risks in vulnerable patient populations. Additionally, the perception of considerable mortality risk among surgeons highlights the need for ongoing education and training to enhance perioperative decision-making and management strategies in HBPS surgery. These findings also underscore the importance of collaborative, multidisciplinary care models to optimize outcomes in HBPS patients.

Future Recommendations:

Based on the findings of this study, several recommendations can be made for future research and clinical practice in HBPS surgery. Firstly, future studies should aim to validate the identified predictors of mortality using larger, multi-center cohorts and prospective study designs. Additionally, efforts should be made to develop and implement standardized perioperative care protocols tailored to the unique needs of HBPS patients. Furthermore, ongoing education and training programs should be established to enhance surgical skills, perioperative decision-making, and management strategies in HBPS surgery. Lastly, there is a need for continued investment in research and innovation to advance surgical techniques, perioperative care protocols, and patient outcomes in HBPS surgery. By addressing these recommendations, healthcare providers can improve outcomes and enhance the quality of care for HBPS patients.

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