IMPACT OF DIABETES ON OUTCOMES OF LAPAROSCOPIC CHOLECYSTECTOMY: A PROSPECTIVE STUDY

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ABSTRACT

OBJECTIVES

This study aims to assess the impact of diabetes on laparoscopic cholecystectomy (LC) outcomes, as optimizing results for diabetic patients undergoing this common surgery presents unique clinical challenges.

METHODOLOGY

We comprehensively analyzed 258 participants, comparing 60 individuals with diabetes to 198 non-diabetic counterparts. Key variables, including age, gender, BMI, comorbidities, ASA grade, and CCI index, were assessed. Additionally, intraoperative and postoperative characteristics, ultrasound findings, and outcomes were analyzed.

RESULTS

Diabetic individuals exhibited advanced age, a higher BMI, and increased severity of illness based on their ASA grade and CCI index. Intraoperatively, diabetic individuals showed higher probabilities of empyema of the GB (23.3%), thick wall gallbladder (3.8%), mucocele (8.3%), gangrenous (10.8%), and other complications. The model explained variability in outcomes such as severe complications (6.6%), intraoperative hemorrhages (5%), conversion to open surgery (4.2%), and length of hospital stay (1.58±1.01 SD). Persistent pain 13 (5.03%), port site infection 30 (11.6%), intraabdominal abscess 5 (1.9%), bile duct injury 8 (3.1%), jaundice 8 (3.1%), and readmission to the hospital 4 (1.5%) were noted.

CONCLUSION

Diabetic individuals undergoing laparoscopic cholecystectomy present distinct clinical features and higher probabilities of specific intraoperative and postoperative complications. The multivariate analysis provides insights into the variability of outcomes, emphasizing the importance of tailored approaches for diabetic patients in this surgical context.

KEYWORDS: *Diabetes, Intraoperative Findings, Complications, Laparoscopic Cholecystectomy*

INTRODUCTION

Gallstone disease is a prevalent global health concern, with substantial associated management costs and potential complications. The relationship between cholelithiasis and diabetes mellitus (DM) has garnered significant attention, with numerous studies suggesting a higher prevalence of gallbladder disease in individuals with DM.[1,2,3] In people with diabetes, GB function is altered compared to those without diabetes. The main problem for diabetic patients is a functional deficit caused by unclear factors, leading to a larger and less efficient organ.[4,5] These patients often have higher levels of bile acid and lipids, causing obesity, dyslipidemia, type 2 diabetes, hyperinsulinemia, hypertriglyceridemia, and metabolic syndrome. They also tend to have more bacteria in the bile and are more prone to infections than non-diabetic individuals.[1,2] Specifically, gallbladder inflammation (cholecystitis) is more severe in diabetic patients, with more serious illnesses and faster disease progression.[6,7,8] Diabetes is also a factor that increases the chances of problems before and after surgery.[5,6] Fortunately, careful preparation before surgery and improvements in surgical techniques have shown promise in making outcomes similar for people with and without diabetes.[6,7] some experts suggest that diabetic patients with gallstones who show no symptoms should consider having prophylactic cholecystectomy.[8,9] Some reports suggest early cholecystectomy for diabetic patients to prevent serious complications because of the perceived surgical risks and high postoperative complications associated with diabetes.[6,10,11] While some studies suggest higher rates of morbidity and mortality in diabetic individuals undergoing Laparoscopic Cholecystectomy, others propose prophylactic or early cholecystectomy to mitigate complications. Despite these observations, there remains a gap in our understanding of how diabetes influences outcomes in LC for gallbladder diseases.[7,10,11,12] Uncontrolled diabetes has been shown to correlate with a higher incidence of emergency cholecystectomy, intraoperative complications, conversions from laparoscopic to open cholecystectomy, and less favorable overall outcomes when contrasted with outcomes in non-diabetic individuals.[4,12,13,14,15] The study aims to determine whether diabetes significantly affects patient outcomes in laparoscopic cholecystectomy (LC) done for gallbladder diseases. The goal is to carefully compare these outcomes with those of individuals without diabetes to know the risks associated with diabetes in this situation. To uncover significant disparities in clinical features and outcomes between diabetic and non-diabetic groups and to identify complications and improve management of diabetics.

METHODOLOGY

this study was done in the General Surgical unit of Hayatabad medical complex Peshawar, Pakistan, from Jan 2023 to Jan 2024 after ethical approval from the ethical committee of Hayatabad medical complex. The study encompassed all patients undergoing elective Laparoscopic Cholecystectomy who were diagnosed with gallbladder stones during the study period. After strict inclusion criteria, 258 patients were included in the study. Forty-eight patients were excluded based on exclusion criteria. Written and informed consent was obtained from each patient. Under a standardized proforma, patient's preoperative, intraoperative, and postoperative data were collected. Each patient was followed for 1 month to collecpostoperative data. Proforma included demographic details, body mass index (BMI), preoperative signs and symptoms, history of pancreatitis or cholecystitis, diabetes control with oral or insulin (or both), or uncontrolled. Tokyo grades of cholecystitis, ASA (American society of anesthesiologists) score, Charlson Comorbidity Index (CCI), ultrasound findings, blood tests, intraoperative findings, and postoperative follow-up information. Patients underwent echocardiography and lung function tests based on their situations. Once the patient was prepared, general anesthesia was given, and sterile draping was applied. Four ports were strategically placed, including a camera allbports Based on intraoperative observations, the cystic duct and artery were tied and cut to release and retrieve the gallbladder. A drain was inserted when needed, and the ports were removed. The patient recovered well from anesthesia and was moved to postoperative care. Consultants did Consultants did all the surgeries. surgery-related complications like intraoperative hemorrhage, bile leak into the peritoneum, conversion to open surgery, length of post-op stay, length of total hospital stay, total operative time taken, and severe complications like anesthesia, death, shift to the ICU, AKI, stroke, and MI were noted. During of follow-up or a a 1-month: persistent pain, port site infection (umbilical port or epigastric port site), bile duct injury, intra-abdominal abscess, jaundice, or common bile duct injury, and readmissions were noted. The data underwent statistical analysis and p-value (with significance set at $p < 0.05$) to ensure data validity. The inclusion criteria were gallbladder stones, mild cholecystitis (TOKYO grade 1) whereas acalculous cholecystitis, GB malignancy, pregnancy, acute pancreatitis, cholangitis, choledocholithiasis, loss of follow-up, moderate or severe cholecystitis were excluded. statistical analyses to compare results among the mentioned data. Descriptive analysis involved using medians, means, and standard deviations. Associations between different variables were evaluated using the Pearson chi-square or Fisher's exact test and the t-test. Relative risk and odds ratio were calculated for diabetic vs. non-diabetic patients regarding major complications and surgery-related complications. For comparing preoperative characteristics, Pearson's Chi-square or Fisher's exact test was used for categorical variables, and the Mann-Whitney u-test independent sample t-test and Kruskal-Walli's test were used for continuous variables, as appropriate. Univariate and multivariate analyses were employed to assess variable features and complications for each study group, adjusting for significant factors identified at $p < 0.05$ in the analysis. Adjusted odds ratios with 95% confidence intervals were derived from the multivariate analysis. Sub-features of the dependent variable diabetes were analyzed using the t-test, chi-square test, and univariate and multivariate analysis. Data were entered and analyzed using the Statistical Package for Social Sciences (SPSS), version 23.0.

RESULTS

258 patients were included in our study, consisting of 60 (23.3%) diabetics and 198 (77.1%) non-diabetics. Regarding age, diabetic individuals had a slightly higher mean age of 45.18 ± 11.81 years compared to non-diabetic individuals, who had a mean age of 42.02 ± 12.93 years. No significant differences among age groups. Gender distribution revealed that 35.6% of diabetic participants were male, while 64.3% were female. In the non-diabetic group, 22.8% were male and 77.1% were female. No significant differences were observed between genders. Analysis of Body Mass Index (BMI) indicated that diabetic individuals had a significantly higher mean BMI (30.17 ± 6.73) compared to non-diabetic individuals (25.93 ± 4.32). Diabetic

individuals demonstrated a higher ASA grade, indicating a greater severity of illness, with significant differences observed in ASA grade categories. Further categorizing ASA grade into <3 Or three or >3, it was noted that 92.63% of diabetic individuals had ASA grade <3, whereas 75% of non-diabetic individuals fell into this category, which was statistically significant (Table 1). The Charlson Comorbidity Index (CCI) showed diabetic individuals having a significantly higher mean CCI index (2.11 ± 1.26) compared to non-diabetic individuals (0.33 ± 0.71). These findings have implications for LC outcomes in further study. Regarding symptoms, pain in the right hypochondrium (RHC) was not significantly higher in people with diabetes 9 (1.5%) compared to non-diabetics 28 (4.57%) (p = 0.112). Nausea or vomiting was more prevalent in people with people with diabetes (18.33%) than in non-diabetics (1.52%) (p = 0.000). Murphey's sign positivity was significantly higher in people with diabetes (25%) compared to non-diabetics (1.01%) (p = 0.000). In summary, there are significant differences between diabetic and non-diabetic groups in terms of nausea/vomiting, Murphey's sign positivity, and generalized abdominal pain (Table 1). Also, significant differences were observed in ultrasound findings and WBC counts between diabetic and non-diabetic groups. (Table 1) People with diabetes had a significantly higher incidence of empyema of GB (23.3% vs. 0.5%), thick wall GB (3.8% vs. 7%), and gangrenous GB (30% vs. 4.5%) compared to non-diabetics. People with diabetes also had longer total operative time (102.66 minutes vs. 44.7 minutes), a significant difference. Intraoperative hemorrhages (5% vs. 0%), bile leaks from GB (56.6% vs. 2.02%), and more extended hospital stays were significantly higher in people with diabetes. Diabetes had a higher conversion rate to open surgery (11.6% vs. 2.0%). Persistent pain (20% vs. 6%), port-site infection (31.1% vs. 5.5%), intra-abdominal abscess (8.3% vs. 0%), bile ducts injury (8.3% vs. 1.51%), and jaundice (8.3% vs. 1.51%) were significantly higher in diabetes. Readmission rates were similar between diabetics and non-diabetics (3.39% vs. 1.5%). (Table 2).

Table 1: Demographic Profile, Clinical Features, and Ultrasound & Lab Findings of Study Population

Variables		Overall (n = 258)	Diabetics (n = 60)	Non-diabetics (n = 198)	p-value (CI 95%)
Age in years (mean ± SD)		42.75 ± 12.73	45.18 ± 11.81	42.02 ± 12.93	0.043 t*
Age Groups (years)	18-29	47 (18.2%)	05 (8.3%)	42 (21.2%)	
	30-39	72 (27.9%)	18 (30%)	54 (27.3%)	
	40-49	60 (23.3%)	14 (23.3%)	46 (23.2%)	
	50-59	43 (16.7%)	14 (23.3%)	29 (14.6%)	
	60-70	36 (14.0%)	09 (15%)	27 (13.6%)	0.222 b
Gender	Male	92 (35.6%)	21 (22.8%)	71 (77.1%)	
	Female	166 (64.3%)	39 (23.5%)	127 (76.5%)	0.749 b
BMI (mean ± SD)		26.98 ± 5.28	30.17 ± 6.73	25.93 ± 4.32	0.000 t*
Comorbiditi es	COPD	01 (0.38%)	0 (0%)	01 (0.5%)	0.191 b
	Hypertension	44 (17.0%)	11 (18.3%)	33 (16.6%)	0.97 b
	Past hx of upper GI surgery	03 (1.16%)	02 (3.3%)	01 (0.5%)	0.201 b
	Past hx of cholecystitis	37 (14.3%)	26 (43.3%)	11 (5.5%)	0.000 b*
	Past hx of pancreatitis	22 (8.52%)	15 (25%)	07 (3.53%)	0.000 b*
	ASA Grade (mean ± SD)	1.41 ± 0.69			0.000 t*
	ASA Grade 1	177 (68.60%)	10 (16.67%)	166 (84.34%)	
	ASA Grade 2	62 (24.03%)	35 (58.33%)	27 (13.64%)	
	ASA Grade 3	13 (5.04%)	11 (18.33%)	02 (1.01%)	
	ASA Grade 4	06 (2.33%)	04 (6.67%)	02 (1.01%)	
	ASA Grade <3	239 (92.63%)	45 (75%)	194 (97.9%)	0.001 b* (5.12-51.03)
	ASA Grade ≥3	19 (7.4%)	15 (25%)	04 (2.1%)	
Clinical Features	Pain RHC	37 (14.34%)	09 (15%)	28 (14.57%)	0.112 b
	Nausea/vomiting	14 (5.43%)	11 (18.33%)	03 (1.52%)	0.000 b*
	Murphey's sign positive	17 (6.59%)	15 (25%)	02 (1.01%)	0.000 b*
	Palpable mass in RHC	02 (0.78%)	01 (1.67%)	01 (0.51%)	0.661
	Generalized abdominal pain	06 (2.33%)	05 (8.33%)	01 (0.51%)	0.002 b*
Ultrasound Findings	Pericholecystic edema present	24 (9.3%)	21 (35%)	03 (1.51%)	0.000 b*
	GB wall thickness > 3mm	54 (20.9%)	37 (61.6%)	17 (8.58%)	0.000 b*
	<10k	222 (86%)	37 (61%)	185 (93.4%)	
	>10k	36 (13.9%)	23 (38%)	12 (6.06%)	0.000 b*
	WBC (mean ± SD)	8567.87 ± 3007	75.8 ± 14.81	68.51 ± 10.9	0.022 t*
Serum Creatinine	>2 mg/dl	0 (0%)	0 (0%)	0 (0%)	-

t = Mann Whitney U test / independent sample t-test, b = Chi-square test. * = statistically significant, SD = standard deviation.

Table 2: Comparison of Intraoperative and Postoperative Characteristics

Features intraoperative	Over all n(%)	Diabetics	Non-Diabetics	Univariate P	Univariate odd (CI 95%)	Multivariate p	Multivariate odd (CI 95%)
Empyema of GB	15(5.8%)	14(23.3%)	1(0.5%)	0.000	0.233(0.179-0.288)	0.000	2.40(0.179-0.288)
Anatomic anomaly	08(3.1%)	04(6.6%)	04(2%)	0.088	0.574(0.528-0.62)	0.000	0.574(.074-0.159)
Thick wall GB	37(14.34%)	23(3.8%)	14(7%)	0.000	15.13(14.9-15.37)	0.000	53.6(.519to 0.648)
Adhesions Soft adhesions Dense adhesions	16(6.2%) 15(5.8%)	12(20%) 15(25%)	04(20%) 0(0%)	0.000	53.68(53.269-54.109)	0.000	15.13(.993-1.207)
Mucocele	5(1.93%)	05(8.3%)	0(0%)	0.000	0.320(0.238-0.402)	0.000	0.32(.04-0.117)
Gangrenous GB	27(10.4%)	18(30%)	09(4.5%)	0.000	9.116(7.242-10.98)	0.000	9.11(.387-0.513)
Iatrogenic injury(CBD,gut,vessels, stomatch,)	17(6.5%)	17(28.3%)	0(0%)	0.000	3.7(2.499-4.895)	0.000	3.69(.228-.339)
Bleeding from GB bed	37(14.3%)	23(38.3%)	14(7.07%)	0.000	21.28(20.50-22.054)	0.000	21.27(.635-0.765)
Rupture of GB	43(16.6%)	39(65%)	04(2.02%)	0.000	21.27(0.635 to 0.765)	0.000	18.264(.583-0.717)
Total operative time in mins((mean±SD))	58.18±1.98	102.66±34.38	44.7±13.7	0.001	na(97.47-107.8)	0.011	Na (97.57-107.85)

Table 2B: Comparison of Postoperative Characteristics

Outcomes and complications after surgery during same admission	Overall	Diabetics	Non-diabetics	Univariate P	Univariate odd (CI 95%)	Multivariate p	Multivariate odd (CI 95%)
Intraoperative hemorrhages cystic artery laceration	03(1.16%)	03(5%)	0(0%)	0.001	0.115(0.019-0.081)	0.000	0.115(.023-0.077)
Leak of bile for GB	38(14.7%)	34(56.6%)	04(2.02%)	0.001	13.75(0.498-0.625)	0.000	13.75(.498-0.635)
Length of hospital stay (mean±SD)	1.58±1.01	2.56±1.44	1.28±0.58	0.000	75.8(2.34-2.78)	0.001	75.9(2.34-2.78)
Post op hospital stay in days(mean±SD))	0.78±1.17	1.86±1.5	0.45±0.8	0.000	91.82(1.61-2.12)	0.000	91.82(1.61-2.12)
Conversion to open surgery	11(4.2%)	07(11.6%)	04(2.0%)	0.001	1.28(0.121-0.213)	0.000	1.279(.121-0.213)
Severe complications (during post op to 1 month)							
Anesthesia complication	06(2.3%)	04(6.6%)	02(1.01%)	0.11	2.062(0.164-0.27)	0.51	Na
AKI	03(1.16%)	02(3.3%)	0				
Cardiac ie MI	0	0	0				
Shift to icu	0	01(1.6%)	0				
Stroke	02(0.77%)	01(1.6%)	01(0.5%)				
Death	01(0.38%)	0	01(0.5%)				
Persistent pain (PCS)	24(9.3%)	12(20%)	12(6%)	0.001	5.58(0.308-0.449)	0.000	6.589(.321-0.445)
Por site infection	030(11.6%)	19(31.3%)	11(5.5%)	0.000	7.85(0.34-0.491)	0.000	7.859(.365-0.502)
Intraabdominal abscess	05(1.9%)	05(8.3%)	0	0.001	2.878(0.19-0.311)	0.000	2.878(.197-0.303)
Bile ducts injury	08(3.1%)	05(8.3%)	03(1.51%)	0.001	1.28(0.121-0.213)	0.000	1.279(.121-0.213)
Jaundice	08(3.1%)	05(8.3%)	03(1.51%)	0.000	0.82(0.091-0.175)	0.000	0.819(.091-0.175)
Readmission to hospital	04(1.5%)	02(3.39%)	02(1.5%)	0.111	1.3(0.01-0.03)	0.61	1.1(0.022-0.06)

"na" means not available

DISCUSSION

Our study aims to determine the interaction between diabetes and gallstone disease management by examining the clinical features, intraoperative variables, and postoperative outcomes in diabetic and non-diabetic individuals. Significantly, diabetic patients in our study displayed a higher mean age than non-diabetic patients. This age disparity raises questions about the potential role of aging as a predisposing factor for gallstone formation in diabetic individuals, supported by previous studies such as the Cleveland Clinic, Dragos Serban et al., and dagfinn Aune et al.[9,16,17] while gender distribution across both groups suggests gender-specific considerations in understanding gallstone disease, our findings differ from Abdulmohsen et al. and Monika Laka et al.[11,18] Our study showed a notable prevalence in the non-diabetic group compared to the person with diabetes of prior upper GI surgery, prompting reflection on the impact of prior surgical interventions on the trajectory of gallstone disease. A similar study by Matheus Bartolomei de Siqueira et al.[19] Moreover, past episodes of cholecystitis and pancreatitis were more frequent in the diabetic groups, consistent with existing literature, further highlighting the heightened risk associated with diabetes in these conditions. Similar research was conducted by Karamanos Efstathios et al., Serbon Dragos et al., Monika and Laka et al., Petra Maria et al., Noel RA et al., and Dagfinn Aune et al.[4,9,11,17,20,21] BMI emerged as a crucial determinant in our study, emphasizing the intricate relationship between adiposity and gallstone pathophysiology, which aligns with previous findings by Tandon et al.[22] Our study revealed significant and frequent intraoperative adverse findings in diabetic patients compared to non-diabetics, corroborating similar findings in previous studies. Our study's findings align with those of Abdulkadir Bedril et al., Karamonas et al., Shirinov et al., and Bourikian et al. reinforcing the significance of our results in the context of cholecystectomy in diabetic patients. These findings underscore the importance of meticulous surgical management for diabetic patients undergoing LC.[6,20,23,24] Conversion to open surgery rates were higher in diabetic patients, 7 (11.6%) vs. 4 (2.0%), highlighting the need for careful consideration and preparedness for potential complications during laparoscopic procedures. Although multi-institutional studies have indicated average conversion rates ranging from 5.3% to 8.2% in similar patient populations, ABDUL KADIR BEDIRLI et al., Ihász and Hung et al., Trondsen et al. and Z'graggen et al. (6,25–27). Total operative time was prolonged in diabetic patients in our study, consistent with findings by Al-Mulhim et al. and Luthra Ashish et al., emphasizing the need for efficient surgical techniques in this patient population. (28,29). Diabetic patients experienced more extended hospital stays (2.56 ± 1.44) and increased rates of postoperative complications (1.86 ± 1.5) compared to non-diabetics (0.45 ± 0.8), reflecting the complex clinical course associated with diabetes in the context of LC, similar findings reported by Al-Mulhim et al.[28] Early postoperative outcomes showed a notable absence of mortality in diabetic patients, consistent with some studies but contrasting with others, suggesting the need for further investigation into factors contributing to postoperative mortality in diabetic populations. Our study, consistent with Łącka et al., Dragos Serban et al., and Louis St. et al., found no mortality among diabetic patients, contrasting with Patiño et al.'s findings.9,11,13. Follow-Up Postoperative Outcomes: Persistent pain and port-site infections were more prevalent in diabetic patients in our study, aligning with findings from previous studies and emphasizing the importance of vigilant postoperative care in this population. Yousfani et al., Saleem Saad et al., Zackria et al. and Jaunoo et al.[14,30,31,32] Port site infections were more prevalent among diabetic patients in our study, with over 30 cases identified, aligning with the findings of Monika et al., who reported a surgical site infection rate out of 11.6%, 19(7.3%) in people with diabetes compared to 11(4.2%) in the control group.[33] Deep infections or intra-abdominal abscesses were exclusively observed in diabetic patients in our study, highlighting the need for proactive measures to prevent such complications in diabetic individuals undergoing LC. Nonetheless, a case report by Doru Moga et al. highlighted increased stone spillage during LC as a potential cause of deep-site infections. In our study, we also observed more spillage in people with diabetes.[34] Bile duct injury and jaundice-related complications were more frequent in diabetic patients, underscoring the importance of careful surgical technique and postoperative monitoring in this population. In literature, Thurley et al. report that surgical complications, notably bile duct complications, accounted for a significant portion of reasons for readmission, with no specific studies comparing diabetic and non-diabetic bile duct injuries.[35] Hyperglycemia impairs wound healing and immune function by reducing blood circulation and oxygenation, decreasing leukocyte migration, suppressing immune responses, and prolonging inflammation. These effects hinder infection control and delay recovery by limiting nutrient delivery and impairing red and white blood cell function. These mechanisms may explain the increased rates of surgical site infections, prolonged inflammation, and delayed recovery observed in diabetic patients undergoing LC.[36,37] Our study sheds light on the complex interplay between diabetes and non-diabetic having gallstone disease, providing valuable insights into the clinical features, intraoperative variables, and postoperative outcomes associated with LC in diabetic patients. These findings underscore the importance of tailored diagnosis, surgical management, and postoperative care approaches in diabetic populations to optimize outcomes and minimize complications. Further research is warranted to elucidate the underlying mechanisms driving the observed disparities and inform evidence-based strategies for managing gallstone disease in diabetic individuals. By addressing these factors, clinicians emphasize the need for customized surgical and perioperative approaches to improve care for diabetics.

LIMITATIONS

Firstly, we could not compare blood glucose values and HbA1c levels between the diabetic and non-diabetic groups due to the unavailability of this data in our dataset. This is because glycated hemoglobin is not routinely measured in acute admissions at our institution. Additionally, the diagnosis of diabetes in our study was based on retrospective data, which may have led to bias. Some patients may have been diagnosed with diabetes after their cholecystectomy, as our database did not show real-time changes in diagnosis. Furthermore, our study did not match patients based on comorbidities, which could have influenced our results.

CONCLUSIONS

In this study, we meticulously examined the impact of diabetes on LC outcomes for gallstone disease. We found distinct clinical profiles in diabetic patients, with higher comorbidity rates and increased intraoperative challenges, such as a greater need for conversion to open surgery. Postoperatively, diabetic patients experienced prolonged hospital stays and higher complication rates. These findings highlight the need for tailored management strategies in this population. Future research should focus on prospective, multi-center studies to validate these findings and optimize care for diabetic patients undergoing LC.

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