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ORIGINAL ARTICLE

Frequency and outcomes of liver resection in patient presenting with complex bile duct injury following cholecystectomy in hepatobilliary unit: A cross-sectional study.

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ABSTRACT… Objective: To assess frequency of hepatectomy for bile duct injuries at a hepatobiliary unit and post-operative outcomes. **Study Design:** Cross-sectional Comparative study. **Setting:** Hepatobiliary Unit, Shaikh Zayed Hospital, Lahore. **Period:** January 2022 to July 2022. **Methods:** Nonprobability consecutive sampling method included diagnosed 79 BDIs patients. Ultrasound and MRCP aided injury site identification, with surgical decisions made by consultants. Outcomes, like postoperative bile leaks, surgical site infections, and in-hospital deaths, were followed for six months. SPSS 23 handled statistical analysis. **Results:** Among 79 BDIs, mean age was 39.9±9.96, with 81% females and 19% males. 51.9% of BDIs had previous open cholecystectomy procedure while 44.3% had laparoscopic cholecystectomy. Most cases (88.6%) had no arterial injuries; 11.4% had right hepatic artery injuries. Hepatectomy was done in 22.8%, and 77.2% had hepaticojejunostomy. No hepatectomy-related deaths were observed. Both procedures had 12.5% SSIs. Hepatectomy had 12.5% post-operative leaks, but no strictures in the 6-month follow-up. **Conclusion:** 22.8% of BDI cases received liver resection, mainly with concomitant arterial injuries. Post-operative complications, including SSIs and leaks, were comparable. Surgical history influenced procedure choice, but in-hospital mortality was low, with no strictures reported within six months post-surgery.

Key words: Bile Duct Injury, Cholecystectomy, Hepatectomy, Roux En-y Hepaticojejunostomy.

INDRODUCTION

Iatrogenic bile duct injuries (IBDI) represents a complex and formidable surgical complications that can lead to severe morbidity and mortality.[1] Despite the learning curve, incidents in laparoscopic surgery have proven to be more intricate compared to those in open procedures due to their frequent association with vascular injury and their occurrence closer to the biliary tree's proximal region.[2] The initial widespread adoption of laparoscopic cholecystectomy led to a concerning 0.5% incidence of CBD injury, notably surpassing the 0.1% rate observed in open cholecystectomy.[3] Over time, diverse classifications for biliary injuries have emerged, alongside various preventive techniques to mitigate iatrogenic biliary tract damage. Timely identification of BDI holds significant importance.[4] Minor bile duct injuries (BDIs) are commonly managed effectively through endoscopic procedures, whereas substantial BDIs typically necessitate surgical intervention.[5] While Roux-En-Y Hepaticojejunostomy (RYHJ) is the established approach for addressing the majority of post cholecystectomy BDIs, intricate cases might entail hepatectomy as a treatment option.[6,7,8]

One of the most dreaded forms of harm involves the confluence, denoted as Bismuth IV and Strasberg E4 injuries, which pose a formidable surgical and multidisciplinary test.[7] A recent analysis of hepatic resection for post cholecystectomy BDI, encompassing experiences from 99 out of a total of 1,756 patients (5.6%), revealed that injuries falling under Strasberg classification types E4 and

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E5, coupled with hepatic artery damage, stood as independent factors contributing to the need for hepatectomy.[8] Limited existing literature pertains to hepatectomy undertaken for complex BDIs and its ensuing outcomes. This study's objective was to ascertain the prevalence of hepatectomies conducted for BDIs within the hepatobiliary unit and to assess the aftermath of the procedure.

METHODS

Following approval from the ethical review committee of the institution (IRB No: SZMC/TERC/Internal/475/2023), we conducted a prospective cross-sectional study on referred patients diagnosed with BDIs after laparoscopic or open cholecystectomy at the hepatobiliary unit of Sheikh Zayed Hospital, Lahore, spanning from January 1, 2022, to July 31, 2022. Total sample size was 79 patients, with 6 patients excluded based on exclusion criteria. The non-probability consecutive sampling technique was employed, and written informed consents were obtained from the patients. Clinicodemographic data included gender, age, prior history of laparoscopic or open surgery, presentation during the visit, previous surgery history for BDI, presence of abdominal drain, and T-tube. Laboratory investigations comprised total bilirubin, alanine transaminase levels, aspartate transaminase levels, alkaline phosphatase levels, and serum albumin levels. Specific investigations, including abdominal ultrasonography (US), ERCP, and MRCP, were performed to establish a definitive diagnosis. The Strausberg Classification was employed for BDI classification. Patients were prepared for surgery, with the specialist surgeon determining the type of surgery (Hepaticojejunostomy or liver resection) based on the extent of injury. Postoperatively, patients were monitored for complications over a 6-month period.

Inclusion Criteria

Patients aged 18 or above diagnosed with BDIs following laparoscopic or open cholecystectomies present to hepatobiliary unit of Sheikh Zayed Hospital, Lahore irrespective of gender and ethnicity.

Exclusion Criteria

1. BDIs resulting from surgeries aside from laparoscopic or open cholecystectomy.
2. BDIs accompanied by malignancies.
3. Emaciated patients.
4. Patients receiving immunosuppressants.
5. BDIs arise from penetrating abdominal trauma.
6. Patients unwilling to provide informed consents.
7. Patients lost to follow-up.

Statistical analysis was done using SPSS version 23.

RESULTS

A total of 79 patients were included in the study. The mean age of patients was 39.9 ±9.94 yrs. In terms of gender distribution, the majority of participants were female, constituting n=64(81%), while males accounted for the remaining n=15(19%). The previous initial surgical history of the participants revealed that laparoscopic cholecystectomy accounted for 44.3%, followed closely by open cholecystectomy at 51.9%, and a smaller percentage of cases (3.8%) that were converted from laparoscopic to open cholecystectomy.

The presentation symptoms varied among the participants, with 58.2% experiencing jaundice, 38.0% presenting with bile leak, and a smaller group (3.8%) reporting itching. When assessing the history of previous surgeries for bile duct injury (BDI), 21.5% of participants had undergone prior procedures, while the majority (78.5%) had not. A notable proportion (36.7%) had abdominal drains in situ, whereas the majority (63.3%) did not. Similarly, a small percentage (7.6%) had a T-tube in situ, while the majority (92.4%) did not have this feature.

Regarding procedures, hepatectomies were performed in n=18(22.8%) of the cases and RYHJ were performed in n=61(77.2%) of the cases.

Concerning associated arterial injuries, 88.6% of cases were free from any arterial injury, while 11.4% had a right hepatic artery injury.

Surgical site infections (SSI) were recorded in 11.4% of cases, while the majority (88.6%) remained infection-free. The post-operative course revealed that a minority (5.1%) experienced post-operative leaks, whereas the vast majority (94.9%) did not. In-hospital mortality was relatively low, with 3.8% of participants experiencing death during their hospital stay, while the remaining 96.2% survived their hospitalization. BDI classification revealed that most cases were classified as E2 (57.0%), followed by E3 (36.7%), and a smaller percentage falling under E4 (6.3%).

The laboratory parameters are summarized in Table-II.

Table-III presents an analysis of characteristics and their relation to the procedure performed for bile duct injury (BDI). Of all the characteristics only previous surgery parameter was significant with p value of 0.005.

Table-IV outlines post-operative outcomes in relation to the procedure performed for bile duct injury (BDI). When examining the occurrence of surgical site infections (SSI) after surgery, 7 cases treated with Hepaticojejunostomy experienced SSI, while 2 cases with liver resection did as well, resulting in a non-significant p-value of 0.666. Regarding post-operative leaks, 2 instances were observed in both hepaticojejunostomy and liver resection groups, with a p-value of 0.222. In-hospital mortality recorded 3 cases in the Hepaticojejunostomy group and none in the liver resection group, with a p-value of 0.455. None of the patients reported stricture in the following 6 months.

DISCUSSION

BDI is a rare event that carries a high burden for patients and surgeons. The former suffer long-term complications, unplanned operations and uncertain outcomes, and the latter face difficult decisions and technical complexity at surgery.[9]

Minor liver resections are sometimes necessary to address complications related to abscess formation and segmental ischemia. A study by Laurent et al. showed a 94% success rate in patients with IBDI and vascular injury undergoing liver resection. However, it is recommended to minimize the use of liver resection and only consider it when no other surgical options are available.[1,10]

In our study the median age of patients was 39.9±9.96 with female preponderance of 81% compared to 19% of male. While Martinez LS et al, in his study reported the mean age of 54 with female preponderance of 71%.[11]

In our study the most common procedure in which BDIs were reported was open cholecystectomy with 51.9% followed by laparoscopic cholecystectomy which was done in 44.3% of the cases. These findings are opposed by the general concept of increased BDIs in laparoscopic cholecystectomy compared to open cholecystectomy.[3] El Nakeeb A et al, reported 52.7% of patients had initial laparoscopic cholecystectomy compared to 37.6% and 9.7%, open and conversion to open procedure respectively in patients with BDIs.[12] Also opposed to our finding Martinez LS et al reported that the initial cholecystectomy approach was 58.7%, 38.1% and 3.2% in laparoscopic, laparoscopic converted to open and open approach respectively.[11]

In our study the frequency of hepatectomies was 22.8% and the RYHJ was done in 77.2% of the cases. Li J performed 13.2% hepatectomy in his study in patients with post cholecystectomy complications.[13]

On arrival the symptoms varied among the participants, with 58.2% experiencing jaundice, 38.0% presenting with bile leak, and a smaller group (3.8%) reporting itching. Same findings were reported by El Nakeeb A et al.[12]

BDI classification revealed that most cases were classified as E2 (57.0%), followed by E3 (36.7%), and a smaller percentage falling under E4 (6.3%). These results correspond to results of other study which reported BDIs in E Strasberg Category.[13]

Clinicodemographic Characteristics	Categories	Frequency	Percentage
Gender	Female	64	81
	Male	15	19
Previous Surgery	Laproscopic Cholecystectomy	35	44.3
	Open Cholecystectomy	41	51.9
	Converted to Open	3	3.8
Presentation	Jaundice	46	58.2
	Bile Leak	30	38.0
	Itching	3	3.8
Previous HX of surgery for BDI	Yes	17	21.5
	No	62	78.5
Abdominal Drain in SITU	Yes	29	36.7
	No	50	63.3
T Tube in SITU	Yes	6	7.6
	No	73	92.4
Current Procedure For BDI	Hepaticojejunostomy	61	77.2
	Hepatectomy	18	22.8
SSI	Yes	9	11.4
	NO	70	88.6
Post Operative Leak	Yes	4	5.1
	No	75	94.9
In Hospital Death	Yes	3	3.8
	No	76	96.2
Associated Arterial Injury	None	70	88.6
	Right Hepatic Artery Injury	9	11.4
BDI Classification	E2	45	57.0
	E3	29	36.7
	E4	5	6.3

Table-I. Clinicodemographic characteristics of patients with BDI

Laboratory Parameters	N	Minimum	Maximum	Mean	Std. Deviation
Total Bilirubin Level	79	.40	25.31	6.1023	5.80933
Alanine Transaminase Level	79	23	211	73.09	49.457
Aspartate Transaminase Level	79	23	390	82.94	62.299
Alkaline Phosphatase Levels	79	96	1862	503.76	373.732
Serum Albumin Level	79	1.5	4.7	2.910	.5995

Table-II. Laboratory parameters of patients undergoing surgery for BDI

Regarding mortality following hepatectomy, no patient died. This is comparable to outcomes of other study by Laurent S et al.[12]

Regarding the site of BDIs, in E4 Strasberg category only hepatectomy was performed in all 5 cases of E4 category. Which shows that the more complex the BDIs are, hepatectomy is most likely to be performed in those cases.

Post operative leak was noted in 2(12.5%) cases of hepatectomy, which is similar to RYHJ with no statistical significance noted.

Characteristics	Categories	Procedure done for BDI		P-Value	Odds Ratio
		HEPJEJ	Liver Resection		
Gender of the Patient	Female	49	15		.817
	Male	12	3	0.538	
Previous Surgery Done	Laproscopic Cholecystectomy	33	2	**0.005**	-
	Open Cholecystectomy	26	15		
	Converted to Open	2	1		
Presenting Sign and Symptoms	Jaundice	37	9	0.698	-
	Bile Leak	22	8		
	Itching	2	1		
Drain In situ	Yes	20	9	0.146	0.488
	No	41	9		
T Tube In situ	Yes	3	3	0.128	0.259
	No	58	15		
Age in Categories	18 to 40yrs	36	11	0.549	0.916
	41 or above	25	7		
Concomitant Arterial Injury	None	61	9		0.129
	Right Hepatic Artery Injury	0	9	0.001	
Site of BDI	E3	21	8	0.001	-
	E4	0	5		
	E2	40	5		

Table-III. Comparison of clinicodemographic characteristics with procedure done for BDI

Post op Outcomes	Categories	Procedure done for BDI		P-Value
		HEPJEJ	Liver Resection	
SSI after Surgery	Yes	7	2	0.666
	No	54	16	
Post Operative Bile Leak	Yes	2	2	0.222
	No	59	16	
In hospital Death	Yes	3	0	0.455
	No	58	18	

Table-IV. Comparison of post operative outcomes

Three other series reported bile leak of less than 5 % after hepatectomy for complex BDI.[14,15,16]

In our study, in all cases of hepatic artery injury hepatectomy was performed. Same findings and procedure were performed by other authors too.[10,17,18,19]

In our study no stricture post operatively was recorded after 6 months of follow up. This is comparable to other study findings.[15,16] While Perine MV et al and Pikolji J et al reported repeated stricture of 2 out of 22 and 3 out of 20 in their case series.[14,20]

Our study just like other studies is subjected to few limitations worth mentioning. First the sample size was low. Second, we were encountered with only type E Strasberg BDIs. Third, it was a cross sectional study with non-probability consecutive sampling. Fourth we didn't specify the timing of injuries, whether late or early referral was done.

Despite limitations this study gives an insight into the frequency and better outcomes following hepatectomy in patients with complex BDIs.

CONCLUSION

22.8% of BDI cases received liver resection, mainly with concomitant arterial injuries. Post-operative complications, including SSIs and leaks, were comparable. Surgical history influenced procedure choice, but in-hospital mortality was low, with no strictures reported within six months post-surgery.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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