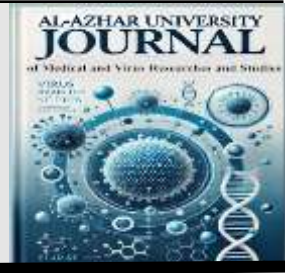




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Prevalence and Patient Characterization of Obstructive Jaundice in Studied Group Underwent Endoscopic Retrograde Cholangiopancreatography (ERCP) in National Liver Institute

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Abstract

Long-term obstruction of biliary tree can induce pathophysiological changes involving malnutrition, acute renal failure, and infections that may be fatal. Nowadays, Endoscopic retrograde cholangiopancreatography (ERCP) is an essential endoscopic technique for various pancreaticobiliary disorders, ERCP has significantly revolutionized the management of obstructive jaundice and significantly reduced the role of surgery, but it may have some complications such as post-ERCP pancreatitis. The aim of study aims to determine the different etiologies of biliary obstruction and the prevalence and patient characterization of obstructive jaundice in studied group underwent endoscopic retrograde cholangiopancreatography (ERCP), and to reveal the short-term outcome of ERCP and possible complications. It was a retrospective study, and data was collected from medical records of patients presented to the inpatient or outpatient clinic at the National Liver Institute hospital and diagnosed as biliary obstruction and underwent ERCP. Data was collected from March 2016-March 2022. 6000 patients with biliary obstruction were enrolled in our study. Those cases underwent ERCP and were presented to the inpatient or outpatient clinic at the National Liver Institute hospital. The age of included patients ranged from 14 years to 97 years with mean of 54.98 ± 15.63 years. The most common age group represented was >50 years group (65.7%). There were 3270 (54.5%) males and 2730 (45.5%) females with male to female ratio 1.2: 1 and regarding medical history and comorbidities, 1304 (21.7%) patients had a history of DM, 1474 (24.6%) patients were hypertensive, 586 (9.8%) had cardiac diseases, and 622 (10.4%) were smokers. The most common cause of biliary obstruction was biliary stones in 4030 (67.2%) cases followed by malignant causes (28.8%). The current study, we determined the different etiologies of biliary obstruction and showed common symptoms and presentations of those patients. Biliary obstruction relief occurred in most of the patients and post ERCP pancreatitis was the most common complication.

Keywords: Endoscopic Retrograde cholangiopancreatography (ERCP), Biliary obstruction, Short-term outcome, Pancreatitis, Mucocele, Perforation.

1. Introduction

Obstructive jaundice (OJ) is a common problem in daily clinical practice. However, completely understanding the pathophysiological changes in OJ remains a challenge for planning current and future management [1].

The incidence of gallstones causing biliary obstruction is approximately 5 in 1000 people, whereas 10% to 15% of the adult U.S. population will develop gallstones in their lifetime [2]. Gallstones or Cholelithiasis, including gall bladder sludge formation, is the precursor of choledocholithiasis, where gallstones pass through the cystic duct and get lodged into the common hepatic ducts causing an obstruction. Between 10 and 15% of patients with gallstones are also noted to have common bile duct stones at diagnosis [3].

Women are at greater risk of developing gallstones than men and hence increased risk for choledocholithiasis. This is likely secondary to estrogen increasing hepatic uptake of cholesterol, which increases bile production and some degree of cholestasis [4].

Gallstones are the most common cause of biliary obstruction in Hispanics, Northern Europeans, and Native Americans. Northern Native Americans have the highest reported rates of cholelithiasis at 64% for females and 29% for males. Asian and African Americans have an intermediate prevalence of cholelithiasis, with 13.9% in women and 5.3% in men. The lowest prevalence of cholelithiasis is in sub-Saharan Black Africa, with an overall prevalence of less than 5%. White races North Americans have an overall prevalence of cholelithiasis of 16.6% and 8.6% in females and males, respectively [5].

Extraductal obstruction caused by external compression of the biliary ducts may be secondary to neoplasms, pancreatitis (acute and chronic), pancreatic pseudocysts, collaterals of portal hypertension (portal biliopathy), or cystic duct stones with subsequent gallbladder distension.

Neoplasms are various tumors that may lead to biliary obstruction [6].

- Cholangiocarcinomas (rare tumors arising from the biliary epithelium), ampullary carcinomas (neoplasms of the ampulla of Vater), and gallbladder carcinomas (tumors with extension into the common bile duct [CBD]) cause obstruction within the ducts.
- Of pancreatic tumors, 60% occur in the head of the pancreas and manifest early with obstructive jaundice.
- Metastatic tumors (usually from the gastrointestinal tract or the breast) and the secondary adenopathies in the porta hepatis that may be associated with these tumors can cause external bile duct compression.

Endoscopic retrograde cholangiopancreatography (ERCP) is a combined endoscopic and fluoroscopic procedure in which an upper endoscope is led into a second part of the duodenum, making it possible for passage of other tools via the major duodenal papilla into the biliary and pancreatic ducts. Contrast material may be injected in these ducts, allowing for radiologic visualization and therapeutic interventions when indicated. ERCP initially started as a diagnostic procedure through cannulation of the pancreatic and biliary ducts but has evolved over the years to a predominantly therapeutic tool. Difficult biliary cannulation is proposed to be defined as cannulation attempts duration of more than 5 minutes, more than five cannulation attempts, or at least two pancreatic guidewire passages. Direct visualization of the ducts is done through cholangiopancreatography [7]. Endoscopic ultrasonography (EUS)-guided biliary interventions are the subject of increasing interest (eg, in patients with unresectable distal biliary malignant obstruction who failed ERCP [8]). The most common indication for biliary stenting is for

treatment of obstructive jaundice from either benign or malignant causes. On occasion, stents are placed for the management of bile leaks. Stents are made of either plastic or metal, and they are placed to provide internal drainage, eliminating the need for an external catheter [9].

Complications directly attributed to ERCP are as high as 6.8%. A quarter of these are severe and most commonly require intervention, blood transfusion more than 4 units, or hospitalization over 10 days. Mortality rates are about 0.3%. The incidence of post-ERCP pancreatitis (PEP) is 3.5%, making it the most frequent complication following the procedure. In 90% of cases, pancreatitis is mild-to-moderate in severity [10].

Definite risk factors that increase the incidence of PEP include increased cannulation attempts duration (more than 10 minutes and possibly more than 5 minutes), pancreatic guidewire passage more than once, pancreatic injection of high-osmolality contrast material, previous pancreatitis, suspected sphincter of Oddi dysfunction, and female gender. Likely risk factors include intraductal ultrasound, failure to remove bile duct stones, endoscopic papillary balloon dilation, and pancreatic sphincterotomy [11].

Precut sphincterotomy is not a certain risk factor as increased PEP risk may be related to increased cannulation attempts associated with this procedure. Needle-knife fistulotomy is recommended to other precut techniques, as it carries fewer complications, including PEP. Other likely risk factors that are patient-related include previous PEP, younger age, absence of chronic pancreatitis, and normal serum bilirubin levels. Serum amylase levels obtained 2-6 hours post-ERCP are considered normal if less than 1.5 times the upper limit of normal. Similarly, serum lipase levels obtained at the same time are considered normal if less than 4 times the upper limit of normal. When indicated, endoscopic papillary balloon dilation should be longer than 1 minute [12].

2. Patients and Methods

This retrospective study and data were collected from medical records of patients presented to the inpatient or outpatient clinic at the National Liver Institute hospital diagnosed as biliary obstruction and underwent ERCP.

-All patients diagnosed with biliary obstruction and who underwent ERCP were included.

- Patients with medical cholestasis and Post liver transplantation patients and Patients with biliary leak were excluded.

The following parameters were collected:

1- Complete full history taking, including:

- a. Personal history
- b. History of smoking.
- c. Drug history
- d. History of other comorbid conditions

2- Clinical examination focusing on:

➤ General examination:

Vital signs (Blood pressure, Temperature, Heart rate, Respiratory rate).

Signs of: (Pallor, Cyanosis, Jaundice, and Lymph node enlargement).

➤ Abdominal examination.

3-Laboratory findings were reported:

- Complete blood counts (CBC).
- Serum bilirubin, serum albumin, ALT, AST, prothrombin time and INR.
- Renal function tests.
- Alkaline phosphatase and GGT if present.
- Tumor markers if done.

4- Imaging:

- pe-lvi-abdominal ultrasonography
- MRCP if done
- Tri-phasic CT on abdomen and pelvis with contrast or dynamic MRI if done

5- Endoscopic Retrograde CholangioPancreatography (ERCP):

All included patients underwent drainage of the obstructed biliary system through therapeutic Duodenoscope; Olympus, Exera TJF 190, Tokyo, Japan with the use of different interventional procedures such as lithotripsy, stenting or dilatation at endoscopy unit in NLI under general anaesthesia.

2.4 Statistical analysis

Quantitative variables were expressed as mean \pm standard deviation or a median (minimum-maximum) depending on the nature of the data, while qualitative variables were expressed as the number (percentage) of individuals with a condition. For quantitative data, statistical significance was tested by independent samples *t*-test or by the non-parametric Mann-Whitney U test as indicated. The significance of qualitative data was tested with the Chi-square test or Fisher's exact test. Results were considered significant if the *P*-value was < 0.05 . Statistical analysis was performed using SPSS, version 22 (SPSS Inc., Chicago, IL, USA).

3. Results

The age of included patients ranged from 14 years to 97 years with a mean of 54.98 ± 15.63 years. The most common age group represented was >50 years group (65.7%). There were 3270 (54.5%) males and 2730 (45.5%) females with male to female ratio of 1.2: 1. Table .1. Regarding medical history and comorbidities, 1304 (21.7%) patients had a history of DM, 1474 (24.6%) patients were hypertensive, 586 (9.8%) had cardiac diseases, and 622 (10.4%) were smokers Table .2. Regarding clinical symptoms, abdominal pain was the most frequent symptom in 4598 (76.6%) patients followed by jaundice (58.3% cases) then vomiting (35.4% cases), itching (18% cases), fever (11.1% cases), rigours (6.9% cases), weight loss (4.2% cases) and

swelling (0.7% cases). (Figure a) Routine laboratory test results were: The mean hemoglobin was 12.16 ± 1.87 g/dl. The mean WBCs and platelets count were $9.96 \pm 31.39 \times 10^3/\mu\text{L}$ and $246.52 \pm 108.8 \times 10^3/\mu\text{L}$ respectively. The mean AST & ALT was 99.72 ± 88.83 U/L and 98.89 ± 97.46 U/L respectively. The mean albumin level was 3.79 ± 0.79 g/dl. The mean total and direct bilirubin were 7.18 ± 7.15 mg/dl and 5.25 ± 5.48 mg/dl respectively. The mean INR was 1.23 ± 0.44 . The mean ALP, GGT & AFP was 1.23 ± 0.44 U/L, 399.92 ± 324.07 U/L and 1019.35 ± 4055.27 ng/ml respectively. The mean serum creatinine was 1.1 ± 0.93 mg/dl. The mean CEA & CA19-9 were 30.95 ± 92.76 ng/ml and 7720.49 ± 23468.41 U/ml respectively as demonstrated in Table .3. According to gall bladder, calculi gall bladder was found in 64.9% cases, cholecystectomy in 7.6% cases (6.5% of them due to stone & 1.1% due to stricture), mud in 3.5% cases, mucocele in 1% cases and gall bladder mass in 0.03% cases as shown in Figure (b). The most common cause of biliary obstruction was biliary stones in 67.2% of cases followed by malignant causes in 28.8% then other causes or unknown causes were reported in 4% of cases. Figure .c illustrates the distribution of malignant cases. The short-term outcome of ERCP was assessed by biliary obstruction relief. Biliary obstruction relief was reported in 5634 (93.9%) cases as shown in figure (d). Table .4 illustrates complications of ERCP among studied cases. 994 (16.6%) cases had post-ERCP pancreatitis (10.2% of them had chemical pancreatitis while the other 6.4% had clinical pancreatitis). 256 (4.3%) cases had bleeding. 38 (0.6%) cases had perforation.

Table (1): Demographic characteristics among the studied patients.

		Studied patients %
Gender	Male	54.5%
	Female	45.5%
Age (years)	Mean ± SD	54.98± 15.63
	Median	57.0
	Range	14.0 – 97.0
Age group	≤ 18 years	0.3%
	19-50 years	34.0%
	> 50 years	65.7%

Table (2): Medical history among the studied patients.

Items	Studied patients %
DM	
No	78.3%
Yes	21.7%
HTN	
No	75.4%
Yes	24.6%
Cardiac	
No	90.2%
Yes	9.8%
Smoking	
No	89.6%
Yes	10.4%

Table (3): Baseline laboratory investigations among the studied patients.

	N	Studied patients (N= 6000)						
		Mean	± SD	Median	IQR	Range		
Hb (g/dl)	2576	12.16	1.87	12.2	11.0	13.4	6.0	25.0
WBCS (×10 ³ / μL)	2554	9.96	31.39	7.4	5.6	10.0	1.2	801.0
Platelets count (×10 ³ / μL)	2546	246.52	108.80	230.0	176.0	300.0	4.7	1172.0
AST (U/L)	152	99.72	88.83	78.0	35.5	118.0	8.0	383.0
ALT (U/L)	148	98.89	97.46	72.0	35.0	115.0	10.0	506.0
Albumin (g/dl)	110	3.79	.79	3.90	3.40	4.30	1.50	5.50
T. bilirubin (mg/dl)	5990	7.18	7.15	5.0	1.8	10.0	0.1	76.0
D. bilirubin (mg/dl)	5984	5.25	5.48	3.6	1.0	8.0	0.0	32.0
INR	208	1.23	0.44	1.1	1.0	1.3	1.0	4.7
ALP (U/L)	150	399.92	324.07	299.0	161.0	518.0	61.0	1800.0
GGT (U/L)	92	382.57	423.73	190.5	75.0	580.0	10.0	1695.0
AFP (ng/ml)	150	1019.35	4055.27	4.1	2.1	16.0	0.1	30000
Creatinine (mg/dl)	186	1.10	0.93	0.8	.6	1.1	0.3	6.3
CEA (ng/ml)	126	30.95	92.76	3.2	2.1	9.6	0.1	525
CA19-9 (U/ml)	146	7720.49	23468.41	228	32.2	1000	0.2	100000

SD: standard deviation, IQR: Inter-quartile range

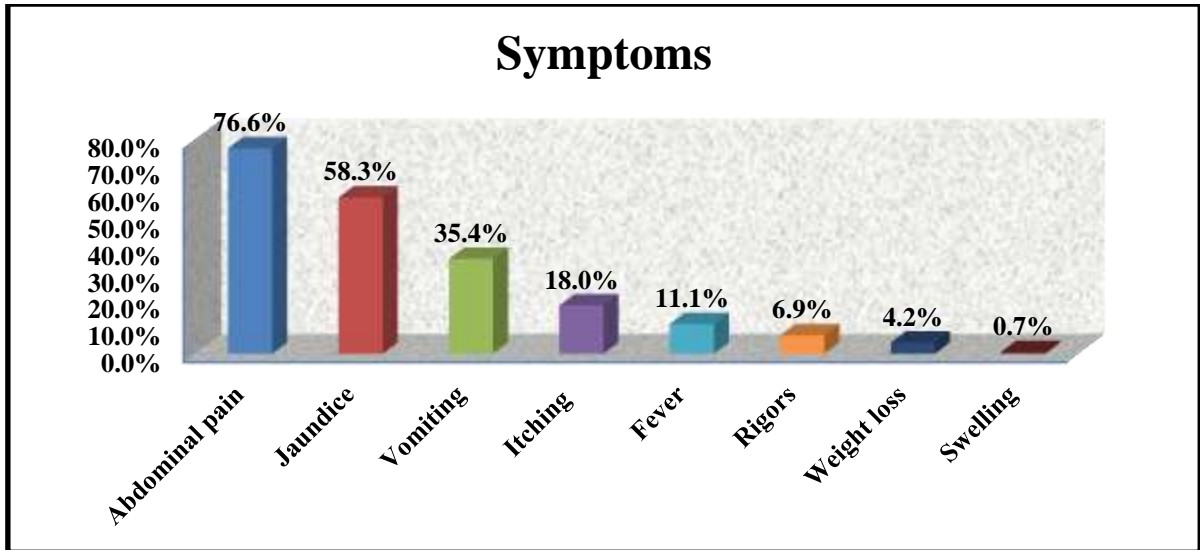


Figure (1): Distribution of studied patients regarding symptoms.

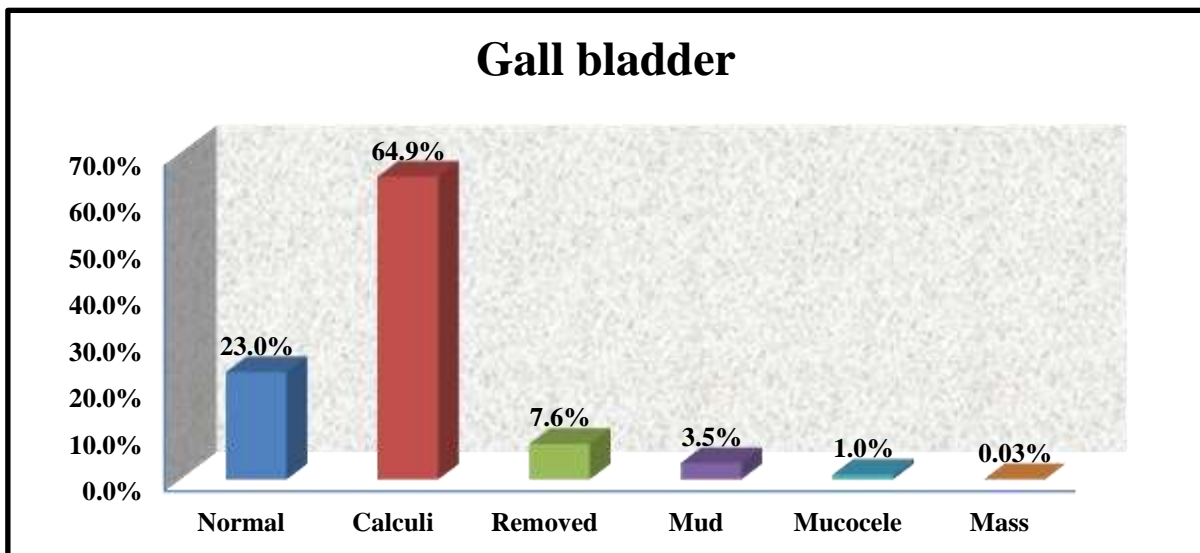


Figure (2): Distribution of studied patients regarding gall bladder appearance in imaging.

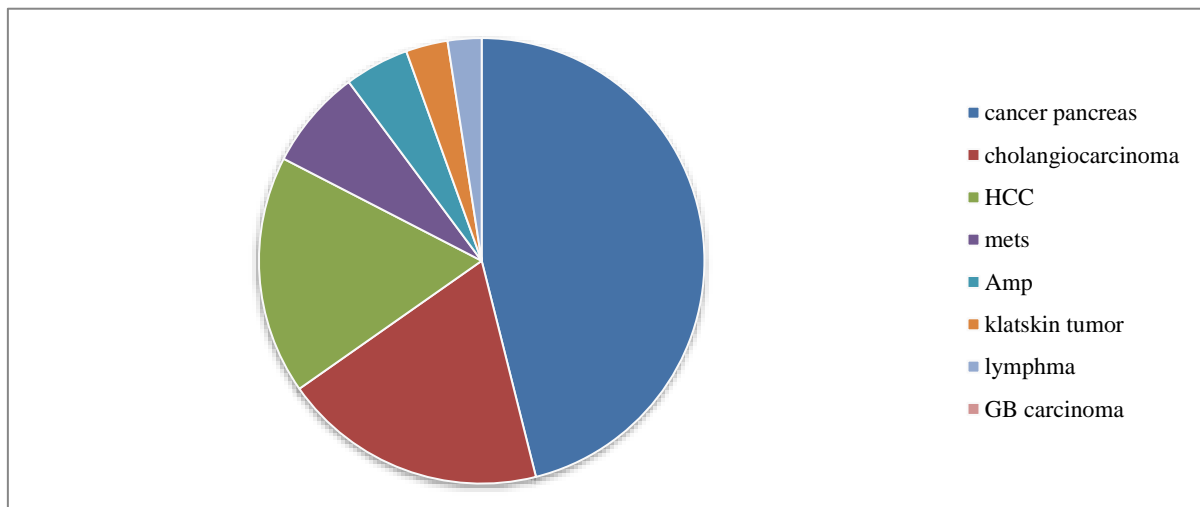


Figure (3): Distribution of malignant causes.

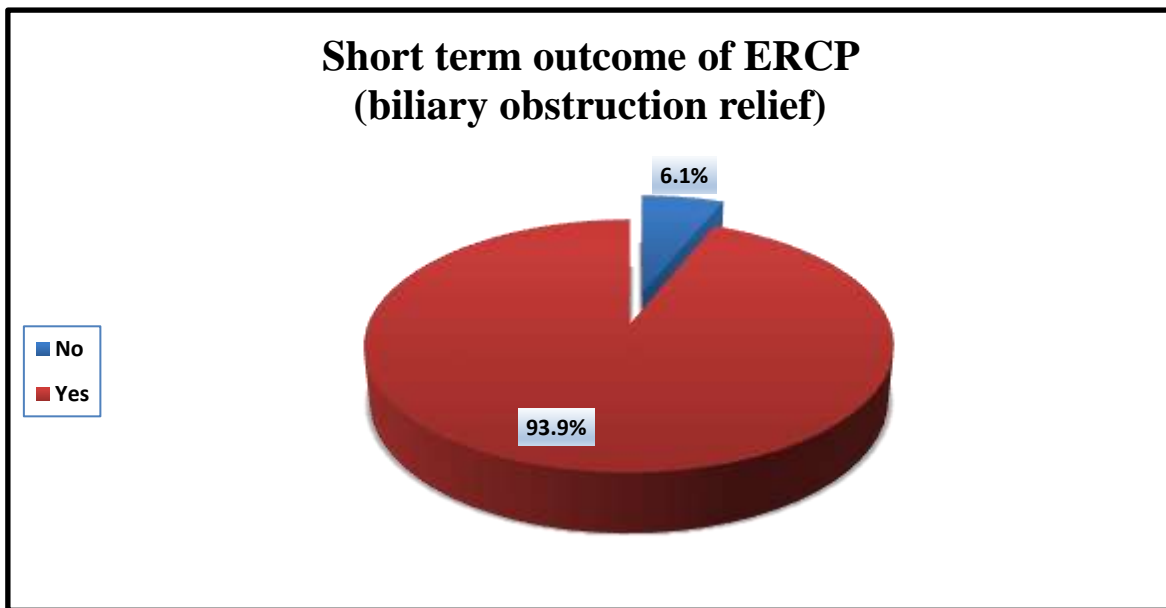


Figure (4): Distribution of studied patients regarding short term outcome of ERCP (biliary obstruction relief).

4. Discussion

In our study, we found that the age of included patients ranged from 14 years to 97 years with a mean of 54.98 ± 15.63 years. The most common age group represented was >50 years group (65.7%). There were 3270 (54.5%) males and 2730 (45.5%) females with male to female ratio 1.2: 1.

The present study can be supported by Atamanalp et al., [13] who aimed to discuss the outcomes of ERCP procedures performed in a general surgery department on 3136 patients over 10 years. They found that the age of included patients ranged from 4 years to 94 years with a mean of 55.1 years¹³.

Also, our results are consistent with Park et al., [14] who aimed to investigate the optimal timing of ERCP in patients with acute cholangitis associated with distal biliary obstruction with a naïve papilla. They reported that there were 251 (59.6%) males and 170 (40.4%) females¹⁴.

In our study we found that regarding medical history and comorbidities, 21.7% of patients had a history of DM, 24.6% of

patients were hypertensive, 9.8% had cardiac diseases, and 10.4% were smokers.

Our results consistent with Shaib et al., [15] who aimed to compare surgical outcomes in patients with malignant biliary obstruction who reported that regarding medical history and comorbidities, (25.6%) patients had a history of DM, 54.2% patients were hypertensive and 17.7% were smokers¹⁵.

In our study we found that regarding clinical symptoms, abdominal pain was the most frequent symptom in 76.6% of patients followed by jaundice (58.3% cases) then vomiting (35.4% cases), itching (18% cases), fever (11.1% cases), rigors (6.9% cases), weight loss (4.2% cases) and swelling (0.7% cases)

Our results consistent with, Zaheer et al., [16] who found that regarding clinical symptoms, there were 112 (27%) patients with jaundice, (13 (3% cases) with weight loss and jaundice with weight loss occurred in 12 (3% cases) ¹⁶.

In our study we found that the most common cause of biliary obstruction was biliary stones 67.2% of cases followed by malignant causes (28.8%) and other causes or unknown causes were reported in 4%

cases. The most frequent malignancy found was cancer pancreas that accounted for 13.1% of cases, cholangiocarcinoma that accounted for 5.5% of cases then HCC for 4.9% of cases.

Our results consistent with, Huang et al., [17] who aimed to evaluate ERCP for the diagnosis and therapy of biliary—pancreatic diseases They reported that there were 1542 cases, with 1073 of these had complicated gallstones. There were 251 cases with tumors including common bile duct tumor, carcinoma of the bile duct at the porta hepatis (n=54). One hundred and twenty-four patients had benign bile duct stenosis 69 had acute obstructive suppurative cholangitis, 8 had chronic pancreatitis. 1 had a foreign body in the pancreatic duct, 3 had iatrogenic bile duct injury. 4 had biliary tract round worm and 9 had choledochal cyst 17.

Our results are a little different from Navaneethan et al., [18] who aimed to identify potential factors that can predict adverse short-term outcomes in patients with acute cholangitis undergoing endoscopic retrograde cholangiopancreatography (ERCP) who found that bile duct stones (choledocholithiasis) were the most common etiology (n = 67, 39.2%). followed by Primary sclerosing cholangitis 45 (26.2%) then malignant causes 28 (16.3%) 18.

In our study we found that regarding laboratory tests, the mean hemoglobin was 12.16 ± 1.87 g/dl. The mean WBCs and platelets count were $9.96 \pm 31.39 \times 10^3/\mu\text{L}$ and $246.52 \pm 108.8 \times 10^3/\mu\text{L}$ respectively. The mean AST & ALT was 99.72 ± 88.83 U/L and 98.89 ± 97.46 U/L respectively. The mean albumin level was 3.79 ± 0.79 g/dl. The mean total bilirubin was 7.18 ± 7.15 mg/dl and 5.25 ± 5.48 mg/dl respectively. The mean INR was 1.23 ± 0.44 . The mean ALP, GGT & AFP was 1.23 ± 0.44 U/L, 399.92 ± 324.07 U/L and 1019.35 ± 4055.27 ng/ml respectively. The mean serum creatinine was 1.1 ± 0.93 mg/dl. The mean CEA & CA19-9 was

30.95 ± 92.76 ng/ml and 7720.49 ± 23468.41 U/ml respectively

Our results consistent with, Park et al., [14] who reported that the mean WBCs and platelets count were $8.0 \pm 3.8 \times 10^3/\mu\text{L}$ and $245.2 \pm 103.1 \times 10^3/\mu\text{L}$ respectively. The mean AST & ALT was 122.1 ± 138.9 U/L and 146.8 ± 134.5 U/L respectively. The mean albumin level was 3.2 ± 0.5 g/dl. The mean total bilirubin was 7.9 ± 6.4 mg/dl. The mean ALP & GGT was 461.4 ± 306.0 U/L, 674.7 ± 518.8 U/L respectively. The mean serum creatinine was 0.8 ± 0.6 mg/dl 19.

According to gall bladder, gall bladder stones were found in 64.9% cases, cholecystectomy in 7.6% cases (6.5% of them due to stone & 1.1% due to stricture), mud in 3.5% cases, mucocele in 1% cases and gall bladder mass in 0.03% cases.

Our results consistent with, Huang et al., [17] who aimed to evaluate ERCP for the diagnosis and therapy of biliary—pancreatic diseases They reported that there were 1542 cases, with 1073 of these had complicated gallstones. There were 251 cases with tumors including common bile duct tumor (n=83), carcinoma of the bile duct at the porta hepatis (n=54). One hundred and twenty-four patients had benign bile duct stenosis 69 had acute obstructive suppurative cholangitis, 8 had chronic pancreatitis. 1 had a foreign body in the pancreatic duct, 3 had iatrogenic bile duct injury. 4 had biliary tract round worm and 9 had choledochal cyst 20.

In our study we found that regarding complications of ERCP. 994 (16.6%) cases had post ERCP pancreatitis (10.2% of them had chemical pancreatitis while the other 6.4% had clinical pancreatitis). 256 (4.3%) cases had bleeding. 38 (0.6%) cases had perforation.

Our results consistent with Paik et al., [21] who found that regarding complications of ERCP, the most common complication was post procedure pancreatitis (14.8%) 21. As well our results consistent with, Coelho-Prabhu et al., [22] who aimed to determine

utilization of endoscopic retrograde cholangiopancreatography (ERCP); incidence of inpatient admissions for complications occurring within 30 days of ERCP. The complication rate was 5.3%, including pancreatitis (26, 2.4%), infection/cholangitis (16, 1.5%), bleeding (15, 1.4%) and perforation (4, 0.37%) 22.

5. Conclusion

In the current study, we determined the different etiologies of biliary obstruction (calcular and malignant) illustrated the distribution of malignant cases and showed common symptoms and presentations of those patients.

References

1. Jun-Jian Liu, Yi-Meng Sun, Yan Xu, Han-Wei Mei, Wu Guo, and Zhong-Lian Li *World J Gastrointest Surg.* 2023 Jul 27; 15(7): 1262–1276.
2. El-Gebaly AM, Abdelmoaty AA. The Incidence of Gallstone Complications in Patients with Cirrhosis. *Govaresh.* 2021;26(1):34–9.
3. Lam R, Zakko A, Petrov JC, Kumar P, Duffy AJ, Muniraj T. Gallbladder disorders: a comprehensive review. *Disease-A-Month.* 2021;67(7):101130.
4. Littlefield A, Lenahan C. Cholelithiasis: presentation and management. *J Midwifery Womens Health.* 2019;64(3):289–97.
5. DE EPSASD, DA GEENAD, BRASIL VBNO. A POPULATION STUDY ON GENDER AND ETHNICITY DIFFERENCES IN GALLBLADDER DISEASE IN BRAZIL.
6. Gao Y, Zhang H, Zhou N, Xu P, Wang J, Gao Y, et al. Methotrexate-loaded tumour-cell-derived microvesicles can relieve biliary obstruction in patients with extrahepatic cholangiocarcinoma. *Nat Biomed Eng.* 2020;4(7):743–53.
7. Beyna T, Gerges C. Clinical management of bile duct diseases: role of endoscopic ultrasound in a personalized approach. *J Pers Med.* 2020;11(1):1.
8. Hayat U, Bakker C, Dirweesh A, Khan MY, Adler DG, Okut H, et al. EUS-guided versus percutaneous transhepatic cholangiography biliary drainage for obstructed distal malignant biliary strictures in patients who have failed endoscopic retrograde cholangiopancreatography: a systematic review and meta-analysis. *Endosc Ultrasound.* 2022;11(1):4.
9. Abdulrahman HW, Jassem MK. Indications Of Stenting in ERCP: Single Center Experience.
10. Akshintala VS, Kanthasamy K, Bhullar FA, Weiland CJS, Kamal A, Kochar B, et al. Incidence, Severity and Mortality of Post ERCP Pancreatitis: An Updated Systematic Review and Meta-Analysis of 145 Randomized Controlled Trials. *Gastrointest Endosc.* 2023;
11. Endo R, Satoh A, Tanaka Y, Shimoda F, Suzuki K, Takahashi K, et al. Saline solution irrigation of the bile duct after stone removal reduces the recurrence of common bile duct stones. *Tohoku J Exp Med.* 2020;250(3):173–9.
12. Wen J, Li T, Liu L, Bie L-K, Gong B. Long-term outcomes of therapeutic ERCP in pediatric patients with pancreas divisum presenting with acute recurrent or chronic pancreatitis. *Pancreatology.* 2019;19(6):834–41.

13. Atamanalp, S. S., Yildirgan, M. I., & Kantarci, A. (2011). Endoscopic retrograde cholangiopancreatography (ERCP): outcomes of 3136 cases over 10 years. *Turkish Journal of Medical Sciences*, 41(4), 615-621.
14. Park, N., Lee, S. H., You, M. S., Kim, J. S., Huh, G., Chun, J. W. & Kim, Y. T. (2021). Optimal timing of endoscopic retrograde cholangiopancreatography for acute cholangitis associated with distal malignant biliary obstruction. *BMC gastroenterology*, 21(1), 1-10.
15. Shaib, Y., Rahal, M. A., Rammal, M. O., Mailhac, A., & Tamim, H. (2017). Preoperative biliary drainage for malignant biliary obstruction: results from a national database. *Journal of Hepato-Biliary-Pancreatic Sciences*, 24(11), 637-642.
16. Zaheer, A., Anwar, M. M., Donohoe, C., O'Keeffe, S., Mushtaq, H., Kelleher, B. & O'Toole, D. (2013). The diagnostic accuracy of endoscopic ultrasound in suspected biliary obstruction and its impact on endoscopic retrograde cholangiopancreatography burden in real clinical practice: a consecutive analysis. *European journal of gastroenterology & hepatology*, 25(7), 850-857.
17. Huang, L. Y., Liu, Y. X., Wu, C. R., Jun, C. U. I., & Zhang, B. (2009). Application of endoscopic retrograde cholangiopancreatography in biliary-pancreatic diseases. *Chinese medical journal*, 122(24), 2967-2972.
18. Navaneethan, U., Gutierrez, N. G., Jegadeesan, R., Venkatesh, P. G., Sanaka, M. R., Vargo, J. J., & Parsi, M. A. (2014). Factors predicting adverse short-term outcomes in patients with acute cholangitis undergoing ERCP: a single center experience. *World journal of gastrointestinal endoscopy*, 6(3), 74.
19. Park, J. K., Woo, Y. S., Noh, D. H., Yang, J. I., Bae, S. Y., Yun, H. S., ... & Lee, K. H. (2018). Efficacy of EUS-guided and ERCP-guided biliary drainage for malignant biliary obstruction: prospective randomized controlled study. *Gastrointestinal Endoscopy*, 88(2), 277-282.
20. Huang, L. Y., Liu, Y. X., Wu, C. R., Jun, C. U. I., & Zhang, B. (2009). Application of endoscopic retrograde cholangiopancreatography in biliary-pancreatic diseases. *Chinese medical journal*, 122(24), 2967-2972.
21. Paik, W. H., Lee, T. H., Park, D. H., Choi, J. H., Kim, S. O., Jang, S., ... & Kim, M. H. (2018). EUS-guided biliary drainage versus ERCP for the primary palliation of malignant biliary obstruction: a multicenter randomized clinical trial. *Official journal of the American College of Gastroenterology/ACG*, 113(7), 987-997.
22. Coelho-Prabhu, N., Shah, N. D., Van Houten, H., Kamath, P. S., & Baron, T. H. (2013). Endoscopic retrograde cholangiopancreatography: utilisation and outcomes in a 10-year population-based cohort. *BMJ open*, 3(5), e002689.