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Clinical Profile of Benign Biliary Structure in a Tertiary Care Center from Western India

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Abstract

Objectives: Benign Biliary Stricture (BBS) often cause a significant amount of morbidity and mortality in patients due to its relatively painless course of progression and subtle clinical manifestations. This hospital-based study primarily focuses on BBS in Indian patients intending to find out its different etiologies and clinical manifestations; to observe clinical progression and response to the different treatment measures.

Materials and methods: This observational study was conducted in a tertiary care hospital in western India for one year. Patients with age ≥ 18 years and diagnosed with benign biliary stricture were included in the study. Their socio-demographic details and clinical history were recorded. Routine blood testing and special tests for tumor markers were done. Ultrasonography (USG), Contrast Enhanced Computed Tomography (CECT) abdomen, Magnetic Resonance Cholangio-Pancreatography (MRCP), Endoscopic Ultrasound (EUS) and Endoscopic Retrograde Cholangio-Pancreatography (ERCP) were performed for evaluation of BBS. The total number of stents used, stents exchanged and duration of use in months till the resolution of symptoms were noted.

Statistical analysis: The descriptive analysis was done on demographic details and blood test results. Spearman's Rank Correlation test was used to find out the association and correlation respectively between different variables.

Results: Out of 100 recruited patients, 56 were females and 44 were males with an overall mean age of 48.5 ± 14.96 years. Abdominal pain (90%), jaundice (42%) and fever (25%) were the most common clinical manifestations. Most of the BBS were of indeterminate cause (56%). Laparoscopic Cholecystectomy (LC) was the most common etiology in the remaining patients. Most of them were having altered liver function tests. CECT, MRCP and EUS-ERCP showed distal common bile duct as the most common location for stricture. All patients were negative for malignancy in brush cytology. The mean number of stent exchanges and mean number of stents used were 2.68 ± 0.69 and 4.16 ± 1.52 respectively. The average mean duration of stent use was found to be 8.77 ± 2.02 months.

Conclusion: BBS is a less studied subject in the Indian scenario. CECT and MRCP are more useful for diagnostic purposes. ERCP should be preferred as a therapeutic procedure over other surgical methods.

Keywords: Chronic pancreatitis; Common bile duct; Endoscopic retrograde cholangio-pancreatography; Laparoscopic cholecystectomy; Magnetic resonance cholangio-pancreatography

Introduction

Biliary stricture can be defined as a narrowed area of the bile duct (extrahepatic or intrahepatic) which results in obstruction of the antegrade flow of bile, biliary dilation in the upper part of the narrowed area and resultant pathologic sequelae of biliary obstruction [1]. Benign Biliary Stricture (BBS) often cause a significant amount of morbidity and mortality in patients due to its relatively painless course of progression and subtle clinical manifestations up to one year of the initial injury [2]. This non-malignant and difficult-to-treat condition may complicate into a stage where intensive multidisciplinary management becomes a necessity which may add to out-of-pocket expenditure to the patient. BBSs most commonly arise from post-operative procedures and inflammatory conditions [3]. Apart from these two reasons, autoimmune disease (IgG4 Sclerosing Cholangitis, Sarcoidosis, Eosinophilic cholangitis), infections, ischemia and obstructions are responsible to form BBS [4]. Post-operative BBS (often termed as iatrogenic) can be caused after Laparoscopic Cholecystectomy (LC), bile-duct surgery, and liver transplantation. The incidence of BBS after LC is around 0.5% and is caused by direct injury to the bile duct due to surgical procedures. BBS after liver transplantation occur in approximately 10%–40% of cases and the anastomotic site is the most common location of stricture [5,6]. In non-surgical causes, Chronic Pancreatitis (CP) related BBS are the most common and occurs in 13%-21% of the patients [7,8]. The distal part of the Common Bile Duct (CBD) is usually involved in it and fibrosis, scarring, and calcification of the bile duct wall are some of

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the common causes. Additionally infections like recurrent pyogenic cholangitis and HIV-induced cholangiopathy can induce BBS [9].

Symptoms of BBS can vary from totally asymptomatic patients to jaundice and pruritus. Asymptomatic patients are usually diagnosed incidentally on different imaging modalities such as Ultrasonography (USG), Contrast Enhanced Computed Tomography (CECT) abdomen, Magnetic Resonance Cholangiopancreatography (MRCP) etc. Clinical manifestations of BBS usually depend on the cause of stricture, location within the biliary tree, and degree of narrowing [10]. Complaints such as fatigue, nausea, vomiting, abdominal pain, jaundice, and darkened urine in case of underlying liver pathology or fever in the setting of cholangitis are evident in many patients [11]. It is highly recommended to perform blood tests such as Complete Blood Count (CBC), Liver Function Tests (LFT) and coagulation profile before going to the higher diagnostic modalities to have an idea about potential causes. Elevated White Blood Cell (WBC) count (in infectious etiology), elevated serum levels of total and direct bilirubin, Aspartate and Alanine Aminotransferase (AST and ALT), Alkaline Phosphatase (ALP), and Gamma-Glutamyl Transferase (GGT) (in liver pathology) and altered coagulation profile are some of the common findings in BBS.

Biliary strictures usually form upstream bile duct dilatation due to obstruction, therefore USG is considered the first choice screening test for the detection of biliary obstruction (90% sensitivity [9,12]. However, due to its poor ability to detect the degree of stricture and underlying potential cause, multiphase CECT is a useful diagnostic tool. It also helps in detecting biliary enhancement, wall thickness, symmetric or asymmetric wall thickening and long segment strictures which help in differentiating benign and malignant Biliary Strictures (BS). Furthermore, MRCP being more accurate than CECT in diagnosing BBS, has been widely used to evaluate biliary obstruction with sensitivity up to 98% [13]. MRCP can confirm the anatomy of stricture location, visualize small intraductal stones and exclude an underlying mass [14]. Smooth, segmental narrowing of the bile duct without underlying mass is shown in MRCP as well as CECT suggesting benign etiology [15]. Another valuable diagnostic modality is Endoscopic Ultrasound (EUS) with or without Endoscopic Retrograde Cholangiopancreatography (ERCP), with 97% sensitivity and 88% specificity in differentiating benign and malignant bbs by allowing tissue sampling with brush cytology or Fine Needle Aspiration (FNAC) [16]. Further interventions like balloon angioplasty or stent insertion are possible with EUS and ERCP.

BBS is a relatively well-studied topic in the Western world. However in the Indian context, research is done mainly pointing to the differentiation of benign and malignant BSs [17,18]. Hence we carried out this hospital-based study primarily focusing on BBS. The present study aimed to find out the different etiologies and clinical manifestations of BBS; to observe clinical progression and response to the different treatment measures.

Materials and Methods

This observational study was conducted in a tertiary care hospital in Western India from August 2021 to August 2022. After taking ethical approval from the Institutional Ethics Committee, a sample size of 100 was calculated with the help of formula $(DEFF\times N\times p(1-p))/((d^2/(Z1-\alpha/2)^2\times(N-1)+p(1-p))$ (where DEFF=1, N=180, $Z\alpha/2=1.96$, p=17%, d=5%). Patients with age ≥ 18 years and diagnosed with benign biliary stricture were included in the study, whereas participants of age <18 years, or with known coagulopathy or inconclusive biopsy reports were excluded. Patients were selected from the hospital wards and after taking written informed consent their socio-demographic details (age, sex, address, contact numbers, height, weight, body mass index etc.) and clinical history were recorded. Routine blood testing which included Complete Blood Count (CBC), Liver Function Test (LFT), Renal Function Tests (RFT) and tests for Human Immunodeficiency Virus (HIV), Australian antigen of Hepatitis B Virus (HbsAg) and antibodies of Hepatitis C Virus (HCV) were performed in each selected participants and their results were noted. Special tests for tumor marker Carbohydrate Antigen 19-9 (CA19-9) were performed on participants with suspicion of carcinogenicity and their results were also noted. Trans-abdominal Ultrasonography (USG) by Samsung RS80A Ultrasound Machine (©Samsung), CECT abdomen by Toshiba Aquilion Prime 160 Slice machine (©Toshiba Private Limited) and MRCP by Philips Achieva 3.0 Machine (©Koninklijke Philips N.V.) were done to find out details of pathologies in CBD and surrounding structures. For biliary drainage as well as in inconclusive cases EUS by EVIS EXERA III CV-190 (©Olympus Corporation) and ERCP by Olympus CV-160 Duodenoscope (©Olympus Corporation) were performed along with brush cytology to rule out malignancies. Most of the patients were managed with Multiple Plastic Biliary Stents and Fully Covered Self-Expanding Metal Stents (FCSEMS). The total number of stents used, stents exchanged and duration of use in months till the resolution of symptoms were noted down for descriptive analysis. All the collected data were entered in Microsoft Excel (©Microsoft Incorporation) and analyzed in SPSS version 21.0 (©IBM Incorporation). The descriptive analysis (mean, standard deviation etc.) was run on demographic details as well as on blood test results. Spearman's rank correlation test was used to find out the correlation between different variables.

Results

During the study period of one year, all the IPD patients diagnosed with BBS fulfilling the inclusion criteria were observed till the 100 sample size was achieved. This observation study yielded the following results:

Socio-demographic information: Out of 100 patients, 56 (56%) were females and 44 (44%) were males. The overall mean age of patients was 48.5 ± 14.96 years. Most of the patients belonged to the 41-50 age group.

Symptoms of patients: According to the history given by the patients, abdominal pain (90%) was the most common complaint followed by jaundice (42%) and fever (25%). The presenting complaints on admission along with age and sex-wise distribution were computed in Table 1.

Symptoms		11-20 years		21-30 years		31-40 years		41-50 years		51-60 years		61-70 years		71-80 years		Total
		Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	
Abdominal pain	No	Nil	Nil	Nil	Nil	Nil	Nil	1	1	2	Nil	1	4	1	Nil	10
	Yes	3	Nil	5	2	13	7	12	13	9	12	7	1	2	4	90
Jaundice	No	1	Nil	3	Nil	4	5	11	8	6	8	7	1	1	3	58
	Yes	2	Nil	2	2	9	2	2	6	5	4	1	4	2	1	42
Vomiting	No	1	Nil	4	2	9	4	11	12	9	12	8	5	2	3	82
	Yes	2	Nil	1	Nil	4	3	2	2	2	Nil	Nil	Nil	1	1	18
Fever	No	3	Nil	3	2	6	5	11	9	8	10	7	5	3	3	75
	Yes	Nil	Nil	2	Nil	7	2	2	5	3	2	1	Nil	Nil	1	25
Confusion	No	3	Nil	5	2	11	7	11	14	9	12	8	5	3	4	94
	Yes	Nil	Nil	Nil	Nil	2	Nil	2	Nil	2	Nil	Nil	Nil	Nil	Nil	6
Weight loss	No	3	Nil	4	2	13	5	11	11	11	8	6	1	3	4	82
	Yes	Nil	Nil	1	Nil	Nil	2	2	3	Nil	4	2	4	Nil	Nil	18
Abdominal distention	No	3	Nil	5	2	10	6	13	14	11	10	8	5	3	3	93
	Yes	Nil	Nil	Nil	Nil	3	1	Nil	Nil	Nil	2	Nil	Nil	Nil	1	7
GI Bleed	No	3	Nil	5	2	13	7	13	13	11	12	8	5	3	4	99
	Yes	Nil	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	Nil	1
Pruritus	No	3	Nil	5	2	13	7	13	13	11	12	8	5	3	4	99
	Yes	Nil	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	Nil	1
Total		27	Nil	45	18	117	63	117	126	99	108	72	45	27	36	

Note: The values are not mutually exclusive; GI: Gastro Intestinal.

Table 1: Age-sex wise distribution of symptoms in the participants (N=100).

Blood investigations: Routine blood investigations and special tests were performed on the patients after admission. These include hemoglobin (11.32 ± 1.58 gm/dl); WBC (7686.4 ± 3539.14 per mm^3); platelets (294611.5 ± 113614.5 per mm^3); total bilirubin (3.9 ± 5.71 mg/dl); direct bilirubin (2.31 ± 3.72 mg/dl); AST (67.74 ± 56.64); ALT (66.26 ± 63.05); ALP (250.23 ± 183.84); total protein (6.96 ± 0.77); albumin (3.77 ± 0.56); Blood Urea Nitrogen (BUN) (13.19 ± 7.7); serum creatinine (0.89 ± 0.55); CA19-9 (13.85 ± 14.4). Three patients were found positive for HIV. Rest all the patients were negative for HIV, HBs Ag and HCV. Anemia was reported in 75 (75%) patients, hyperbilirubinemia in 57 (57%), leukocytosis in 20 (20%) while leukocytopenia in 23 (23%) and thrombocytopenia in 8 (8%). Altered levels of ALT in 54 (54%), AST in 89 (89%), ALP in 75 (75%), hypoproteinemia in 6(6%), hypoleukemia in 23 (23%), raised creatinine in 3 (3%) and high BUN in 12 (12%) were reported.

Etiology of BBS: As per the investigation results, in most of the patients (56%) the exact etiology was BBS was not found. In those, where exact etiology was confirmed, LC (21%) was overall the most common cause followed by CP (16%). These two etiologies were the most common surgical and non-surgical causes respectively. Figure 1 depicts the pictorial representation of various etiologies of BBS found in the study.

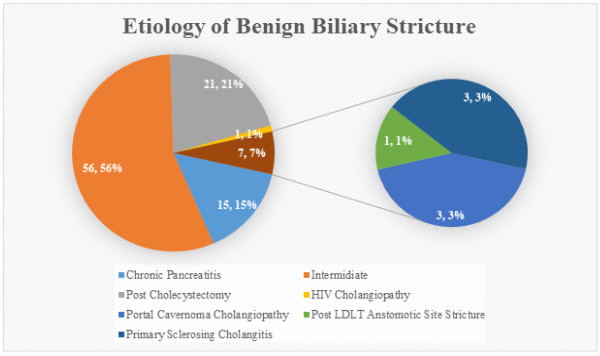

Figure 1: Etiology of benign biliary stricture.

Findings of USG and CECT: Out of 100 patients 99 were undergone USG abdomen. It showed the average CBD width to be 11.2 mm. Fifty-four patients (54%) had CBD dilatation, eight (8%) had CBD calculi and five (5%) had unexplained obstruction. Nine patients (9%) had normal findings on USG. Out of 100 patients, CECT abdomen was performed on 98. It showed the average CBD width to be 11.44 mm. Forty-three patients (43%) were found with stricture and 28 (28%) had distal CBD tapering on CECT.

Findings of MRCP: All patients underwent MRCP. According to its findings, most strictures were singular (82, 82%), located at distal CBD (6, 66%), non-enhancing (95, 95%), with pre-stricture dilatation (90, 90%) and with symmetrical thickness in 96 (96%). Other findings such as CBD stone, IHBRD and CP were also reported in 30 (30%), 88 (88%) and 15 (15%) patients respectively. Detailed findings of MRCP are presented in Table 2.

MRCP findings		Number	Percentage
Number of strictures	1	82	82
	2	10	10
	3	3	3
	Not reported	5	5
Location of stricture	Distal CBD	66	66
	Proximal CBD	3	3
	Mid CBD	2	2
	Proximal and mid CBD	8	8
	Intrapancreatic duct	3	3
	Common hepatic duct	5	5
	Common and right hepatic duct	2	2
	Common, right and left hepatic duct	3	3
Pre-stricture dilation	Yes	90	90
	No	10	10
MRCP thickness	Symmetrical	96	96
	Asymmetrical	4	4
Stone	Yes	30	30
	No	70	70
Stricture enhancement	Hypo-enhancing	5	5
	Non-enhancing	95	95
Intra hepatic biliary radicle dilatation	Yes	88	88
	No	12	12
MRCP associated with chronic pancreatitis	Yes	15	15
	No	85	85

Note: MRCP: Magnetic Resonance Cholangio-Pancreatography; CBD: Common Bile Duct

Table 2: Findings reported in study participants on MRCP.

Findings of EUS and ERCP: EUS showed stricture in 98 patients (98%), in which distal CBD was the most common location of it (n=69) followed by proximal CBD (n=13). Sixty-six patients (66%) had IHBRD, whereas 62 patients (62%) had dilatation in CBD. ERCP also showed similar findings where distal CBD was found to be the most common location of stricture. Brush cytology was done in all the patients and there was no positive result for malignancy (Tables 3 and 4).

Findings on EUS		Number	Percentage
Stricture	Yes	98	98
	No	2	2
Location of stricture	Distal CBD	69	69
	Proximal CBD	13	13
	Proximal and mid CBD	2	2
	Intrapancreatic duct	3	3
	Common hepatic duct	8	8
	Common hepatic duct and right and left hepatic duct	2	2
	Prominent CBD	1	1
	Not reported	2	2
IHBRD	Yes	66	66
	No	44	44
CBD	Dilated	62	62
	Filling defect seen	3	3
	Normal	7	7
	Prominent CBD	25	25
	Not reported	3	3

Note: EUS: Endoscopic Ultrasound; CBD: Common Bile Duct; IHBRD: Intra-Hepatic Biliary Radicles Dilatation

Table 3: Findings reported in study participants on EUS.

Finding on ERCP		Number	Percentage
ERCP done	Yes	87	87
	No	13	13
CBD	Dilated	52	52
	Normal	5	5
	Prominent	1	1
Stricture	CHD	7	7
	CHD-CBD junction	2	2
	Distal	54	54
	Proximal	10	10
IHBRD	Yes	4	4

	No	96	96
Location of dilatation	CBD	52	52
	LHD, RHD and CHD	5	5
Stricture	Yes	73	73
	No	27	27

Note: ERCP: Endoscopic Retrograde Cholangio Pancreatography; CHD: Common Hepatic Duct; LHD: Left Hepatic Duct; RHD: Right Hepatic Duct; CBD: Common Bile Duct; IHBRD: Intra-Hepatic Biliary Radicles Dilatation

Table 4: Findings reported in study participants on ERCP.

Stent usage: Most of the patients 42 (42%) had three stent exchanges and 29 (29%) patients had four stents used. The mean number of stent exchanges and mean number of stents used were 2.68 ± 0.69 and 4.16 ± 1.52 respectively. The average mean duration of stent use was found to be 8.77 ± 2.02 months.

Correlation analysis: According to Spearman's rank correlation, the mean duration of stent use (in months) had a weak positive monotonic correlation with number of stents exchanged (ρ=0.337, p=0.001) and number of stents used (ρ=0.284, p=0.004) which was statistically significant.

Discussion

This study was conducted in a tertiary care centre in Western India which included 56% males and 44% females, mean age of 48.5 years and a range of 19-80 years. A similar study was conducted in Amsterdam differentiating malignant and benign strictures. The BBS study group included 30% males and 70% females with a mean age of 61 years and a range of 40-71 years.

The participants in our study were patients diagnosed with BBS who underwent hematological followed by radiological investigations and managed with placement of stents. Clinically they presented with abdominal pain as the most common symptom in 90% followed by jaundice in 42% and fever in 25% of patients as compared to the study conducted by Kloek and Deldan where abdominal pain was seen in 60%, jaundice in 60%, fever in 20% and weight loss in 40% BBS patients. They had conducted a similar battery of hematological investigations to assess the liver function in which Bilirubin 107 ± 35 as compared to 3.9 ± 5.71, ALP 371 ± 64 to 250.23 ± 183.84, AST 58 ± 15 to 67.74 ± 56.64, ALT 88 ± 22 to 66.2 ± 63.05 in our patients.

BBS formation is a common complication of either injury due to hepato-biliary surgery or diseases such as CP, PSC etc. [19]. The present study shows that the majority of BBS arose from indeterminate causes (56%). However, diseases such as Primary Sclerosing Cholangitis (PSC) and IgG4-Related Sclerosing Cholangitis which are complicated into BBS have unknown etiology and further investigations are warranted to establish the diagnosis. Patients with the confirmed etiology showed that LC (21%) was the commonest cause for stricture. This is by the report of Altman and Zangan which states that iatrogenic injury (either due to cholecystectomy or liver transplant) is responsible for most of the BBS in the United States (US). Moreover, Dadhwal and Kumar state that injury during cholecystectomy is responsible for 80% of all BBS. The possible reason is the injury to CBD while surgical procedures and strictures usually occur in the common hepatic duct or CBD due to inadvertent ligation during surgery. In non-surgical causes, CP was the most common cause (16%) for BBS. Abdallah et al., stated that pancreatitis causes 10% of all BBS and the overall prevalence of strictures in CP cases is 46%. The authors also noted the distal CBD as the most commonly affected part in such cases. Furthermore, the current study shows three cases of Portal Cavernoma Cholangiopathy (PCC) and PSC as well as one case of HIV Cholangiopathy and post Living Donor Liver Transplantation (LDLT) anastomotic site stricture each. Sundaram et al., found that around 11% of all LT patients had strictures. However, they studied exclusively LT patients and that can be a possible reason for a higher proportion of strictures. Another etiology group is infections which contain HIV cholangiopathy and recurrent pyogenic cholangitis. The current study has three patients with HIV-positive status but only one patient had HIV cholangiopathy. It is a form of sclerosing cholangitis with a CD4 count of less than 100 cells/mm3. Opportunistic infections from Cytomegalovirus (CMV) and Cryptosporidium are responsible for biliary inflammation which ultimately turn into stricture. Apart from this, PSC-related BBS are diagnosed on MRCP findings which show multifocal strictures and saccular dilatations of the bile ducts ("beaded" appearance). Though the overall prevalence of PSC is low (0.77 per 100,000 person-years), 28% of intrahepatic biliary strictures are related to it. Apart from this, many other rare causes such as Mirizzi syndrome, duodenal diverticulum, Crohn's disease, hepatic artery aneurysm, cystic fibrosis with liver involvement, eosinophilic cholecystitis, cholangitis are associated with BBS and often classified as miscellaneous etiology group [20].

As BBS treatment dramatically differs from malignant subtypes, imaging modalities play a crucial in diagnosing and differentiating strictures, CECT and MRCP are superior to USG in terms of diagnosis and evaluation. Though USG can detect biliary dilatation with an accuracy of 90%, it is poor at detecting underlying causes. Furthermore, USG has limited ability to depict the stricture and hence cross-sectional imaging modality becomes a necessity in high clinical suspicion cases. In the current study, USG showed 54 patients with dilated CBD and the distal part of it as the most common location for stricture. Distal CBD is commonly involved in CP-related and IgG4 Sclerosing Cholangitis-related BBS. Similar findings were observed in this study for patients with CP. IgG4 Sclerosing Cholangitis was not reported. CECT findings of the current study showed most of the lesions as smooth, regular narrowing or tapering of CBD which denotes benign stricture. However, three patients had an abrupt cut-off in CBD which might raise suspicion of malignancy. Like USG, CECT showed the majority of strictures are at distal CBD. In the current study MRCP shows 96% of patients with symmetrical stricture and few with smooth tapering ends this finding is supportive of benign etiology of the strictures as suggested by Ma and Jayasekaran. ERCP being a safer, more effective, and lesser invasive therapeutic method is

a first-line option preferred for management. It is repeatable and causes lesser complications as compared to other surgical methods. The findings of ERCP were consistent with that of MRCP in our study.

All the patients were screened for malignancy with CA19-9 testing and confirmed with brush cytology sampling. Seven out of 100 patients showed CA19-9 values of more than 37 units per mm^3 which is higher than the normal range (0-37 units per mm^3). CA19-9 levels of more than 100 units per mm^3 suggest unrespectability or metastatic disease. Current study had no patients with such increased values. Additionally, none of them were found positive for malignancy in brush cytology. Tumor markers such as CA 19–9, CEA and α-fetoprotein (AFP) are commonly used for the evaluation of suspected malignant strictures. However, it should be noted that, CA19-9 is also increased in biliary obstruction regardless of etiology; therefore, it should not be considered as a valid marker. This specifies the need of confirmatory procedures such as brush cytology or FNAC to rule out malignancy. None of the patients showed evidence of malignancy on brush cytology which is having 45% sensitivity and 99% specificity for malignancy.

Traditionally, extrahepatic BBS has been managed by dilatation followed by putting multiple plastic stents side by side across a stricture. This method may provide equivalent or superior outcomes than that of surgical intervention. As per a systematic review done by van Boeckel et al., placement of multiple plastic stents had a higher clinical success rate and lower adverse effects than that of a single plastic stent. Typically, treatment of BBS involves the exchange of plastic stent every three months with increasing number and/or diameter of the stent up to 12 months. However present study shows the average mean duration of stent use was 8.77 ± 2.02 months. This can be explained by the observation noted by Brunet et al., that if index ERCP is used to put maximum number of stents, it can reduce frequency of both the ERCP and stent exchange, resulting in longer duration of stent in the body. However, these approaches have similar efficacy in stricture resolution. It was found that mean number of stents used was 4.16 ± 1.52 which was similar to the study done by Ohyama et al., where they found the mean as 4.1 ± 1.2. Additionally, in the current study, a positive correlation was found between the mean duration of stent use and number of stents exchanged (ρ=0.337, p=0.001) as well as number of stents used (ρ=0.284, p=0.004). This finding may indicate that as stent exchange increases the average duration of stent placement inside the duct improves which can indicate clinical improvement with less clogging and reduced events of cholangitis. Biliary stenting has a periodic routine exchange of stents to avoid clogging and resulting inflammation. Therefore further trials are necessary to find out the correlation and association between clinical improvement through smoother bile flow and stent exchanges.

Along with stenting, other surgical methods can be required in refractory BBS or patients not compliant with endoscopic interventions. Similar to stenting methods, the goal of surgical management is to establish bile flow to relieve jaundice and to prevent cholangitis, choledocholithiasis, and recurrent stricture. Additionally, newer techniques such as magnetic compression anastomosis, intraductal radiofrequency ablation, and biodegradable stents can be used in selected cases.

Conclusion

BBS is a less studied subject in the Indian scenario hence this study tries to gather more epidemiological data about it. USG being the first choice for screening of BBS can evaluate biliary dilatation, but is poor in fetching details about stricture. CECT and MRCP are more useful in evaluating stricture anatomy and underlying causes. The distal part of CBD is the most common location for BBS. Though ERCP is an invasive procedure, it enables to perform diagnostic tests such as brush cytology or FNAC which ultimately help in ruling out malignancy, and hence should be preferred as a therapeutic procedure. Finally, stenting is done to relieve the obstruction and channel the bile flow.

Limitations

The present study was carried out in a hospital setting on previously diagnosed patients in India. Therefore, the results may differ from the worldwide data. Additionally, they cannot be generalized to other ethnic groups. At the time of recruitment, all the patients were in different phases of treatment, hence results can be different if a similar study is carried out exclusively in newly diagnosed patients.

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