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Original Article

Surgery Section

Restoration of Liver Function in Cases of Surgical Obstructive Jaundice after Biliary Decompression: A Longitudinal Study

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ABSTRACT

Introduction: Surgical Obstructive Jaundice (SOJ) is caused by obstruction of bile duct with the resultant increase in serum bilirubin level with or without pruritus, biliary colic and cholangitis. Liver Function Tests (LFTs) can help the clinician in screening patients for presence of liver disease with probable cause, its severity with prognosis assessment and also monitor efficacy of therapy.

Aim: To study the liver biochemical parameters with pattern and extent of restoration in cases of SOJ (benign and malignant), before and after biliary decompression, done either by definitive surgery or endoscopic procedure.

Materials and Methods: This longitudinal study was carried out from October 2014 to May 2016 in 50 patients of obstructive jaundice at Employees State Insurance Post Graduate Institute of Medical Sciences and Research and Hospital, Basaidarapur, New Delhi, India. All patients with benign as well as malignant conditions leading to SOJ, who were amenable to endoscopic or surgical decompression were included and patients of medical jaundice were excluded. Clinical examination and blood investigations, {Liver Function Test (LFT)} were done preoperative, postoperative on day 3, day 7, day 14 and during follow-up at 4 week, 12 week. Collection of data was done from the patients included demographical data, presenting features, aetiology and therapeutic intervention carried out obstructive jaundice (endoscopic or surgical), the preoperative parameters and postprocedure parameters (LFT) in a sequential manner. Data analysis was carried out on Statistical Package for the Social Sciences (SPSS) version 22.0. The statistical significance of difference in values of various biochemical and clinical parameters over the study period was assessed by using one-way Analysis of Variance (ANOVA). The p-value of <0.05 was considered significant.

Results: A total of 50 patients were included; of these 14 were males and 36 were females. Age of patients in the present study ranged between 25-80 years. Total 33 patients were of benign conditions (Group I) and 17 patients were of malignant conditions (Group II). Preoperative bilirubin levels were significantly higher (p-value <0.001) in each group. The mean percent fall in Aspartate Aminotransferase (AST) levels were similar in both the groups i.e., 29% vs 30% on day 3, 49% vs 45% on day 7 and 53% vs 49.5% on day 14, 70% vs 64.6% on 4th week and on 12th week 76% vs 73% in Group I and II.

Conclusion: The hepatic recovery after biliary decompression either by definitive surgery or endoscopic procedure was identical for both benign and malignant causes. However, the level of preoperative levels of bilirubin determines the total time taken for recovery.

Keywords: Bilirubin, Cholestasis, Endoscopic retrograde cholangiopancreatography, Liver function test

INTRODUCTION

The Surgical Obstructive Jaundice (SOJ) results from biliary obstruction which is blockage of any duct that carries bile from liver to gall bladder and then to duodenum. The cause of obstructive jaundice can be intrahepatic or extrahepatic [1-3]. It causes increased exposure of hepatocytes to endotoxins by two ways. One is translocation of endotoxins through intestinal mucosa and other is suppression of functions of reticuloendothelial system of liver leading to diminished clearance of endotoxins by kupffer cells [4]. The structural changes reflect corresponding liver cell dysfunction resulting in a diminished ability to detoxify, reduced protein synthesis, gluconeogenesis and ketogenesis.

Altered Liver Function Tests (LFTs) may be the first indication of subclinical liver disease and the specific pattern of liver test abnormalities may suggest the category of the underlying liver disease such as, hepatitis, biliary obstruction or infiltrative liver disease [5,6]. Studies have shown that Total Bilirubin, Serum Glutamic Pyruvic Transaminase (SGPT) Serum Glutamic Oxaloacetic Transaminase (SGOT) and Alkaline Phosphatase (ALP) reached maximum levels 1 to 2 weeks after onset of biliary obstruction and plateaued thereafter. These values decreased rapidly after release of biliary obstruction [7-10]. Prevention of liver damage and attacks of cholangitis can be achieved by effective drainage of bile which can be done by either endoscopic techniques or by surgical decompression.

The aim of treatment (endoscopic or surgical) of patients with obstructive jaundice are to cure the disease in the early stage or to palliate the symptoms caused by or related to blockade of bile flow. Early decompression of the biliary obstruction can restore the liver functions [11].

The time taken for hepatic cell recovery is equally important after biliary decompression. The chronological sequence of recovery in various clinical situations is variable. Various biochemical parameters of liver function like serum bilirubin, liver enzymes (SGPT, SGOT, ALP), coagulation profile can be used for the assessment of restoration of liver function [12].

Many studies have been done in past which studied the recovery of liver function in cases of jaundice [13-15]. However, only few studies exist in literature which has compared the two methods of decompression either by surgery or endoscopic procedure in a case of obstructive jaundice with hepatic recovery assessment [4,10-12,16]. In this study, the recovery pattern of all patients undergoing intervention along with their clinical and biochemical changes was noted. This pattern of study can help a clinician to assess and follow the patients with SOJ for recovery in much organised way.

Therefore, the present study was conducted to study the liver biochemical parameters with pattern and extent of restoration in cases of SOJ (benign and malignant), before and after biliary decompression done either by definitive surgery or endoscopic procedure.

MATERIALS AND METHODS

This longitudinal study was carried out jointly by the Department of Surgery and Biochemistry from October 2014 to May 2016 in 50 patients of obstructive jaundice after obtaining ethical committee clearance {DM(A)H-19/14/17/IEC/2012-PGIMSR} at ESI PGIMSR and Hospital, Basaidarapur, New Delhi, India.

Inclusion and Exclusion criteria: All patients with benign as well as malignant conditions leading to SOJ, and amenable to endoscopic or surgical decompression presenting to the department during the study were included. Patients with medical jaundice, advanced cases of malignancy, failed procedures or not giving consent for study participation were excluded from the study.

Parameter Assessed

Clinical examination (general and systemic examination) was carried out in all patients with special consideration given to clinical features like loss of appetite, icterus, pruritus, fever, Body Mass Index (BMI). Body weight was noted in all phases of study.

Appetite grading: Appetite was graded as 1 (poor), 2 (fair), 3 (good), 4 (very good) {Queen Mary Hospital, University of Hong Kong, Criteria} [17].

Pruritus grading system: The pruritus grading system score for each patient was based on distribution, frequency, severity of itch and resultant sleep disturbance [18].

Distribution: Solitary site-1, multiple sites-2, generalised-3. Frequency: Episodic-1, frequent-3, continuous-5. Severity: Rubbing-1, scratching-1, localised excoriations-3, generalised excoriations-5. Sleep disturbance: Rare-0, occasional-2, frequent-4, totally restless-6. Total maximum score-19.

Mild grade: if total score was between 0 and 5.

Moderate grade: if total score was between 6 and 11.

Severe grade: if total score was between 12 and 19.

All patients who presented with SOJ were diagnosed using available modalities like LFT, coagulation profile, serum proteins, Ultrasonogram (USG), and Magnetic Resonance Cholangiopancreatography (MRCP) (as on required basis). Other routine investigations like Complete Blood Count (CBC), Kidney Function Test (KFT) and serum electrolytes were also done.

Procedure

The patients were divided into two groups based on the decision of the treating surgeon. The decision to include patient in a particular group depended on the pathology and the treatment was advised as per standard treatment protocol for that patient {like in a case of Common Bile Duct (CBD) stones Endoscopic Retrograde Cholangiopancreatography (ERCP) and CBD clearance was preferred whereas in case of biliary malignancy radical surgery if possible was preferred}. Total 33 patients were of benign conditions (Group I) and 17 patients were of malignant conditions (Group II).

A. Endoscopic decompression [19]

1. Endoscopic Retrograde Cholangiopancreatography (ERCP) and biliary stenting
2. Percutaneous Transhepatic Cholangiography (PTC)

B. Surgical decompression [20]

1. CBD Exploration:
   - i) Simple closure
   - ii) Closure over T-tube
2. Biliary enteric anastomosis such as-
   - i) Choledochoduodenostomy
   - ii) Choledochojejunostomy
   - iii) Hepaticojejunostomy
   - iv) Triple bypass procedure
   - v) Segment III bypass
   - vi) Whipple's procedure
   - vii) Excision of cholangiocarcinoma

All these procedures can be done laparoscopically/open method. In this study the procedures were done by open method and the tissue was sent for histopathology examination (if required).

Postsurgery the same protocol of clinical examination and blood investigations was repeated on postoperative- day 3/day 7/day 14 and follow-up was done on 4 week and 12 week.

Detailed history and clinical examination were done in every patient. Following the diagnostic evaluation, the patients were subjected to endoscopic or surgical drainage. Hepatic function recovery was assessed in each case by assessing the serum bilirubin, liver enzymes, Prothrombin Time and International Normalised Ratio (PT/INR), proteins periodically as per protocol and clinical parameters were also assessed.

STATISTICAL ANALYSIS

The data collected was entered into the spreadsheet and the data analysis was carried out on Statistical Package for the Social Sciences (SPSS) version 22.0 Armonk, NY: IBM Corp. The data was normally distributed and presented as mean±standard deviation. The statistical significance of difference in values of various biochemical and clinical parameters over the study period was assessed by using one-way Analysis of Variance (ANOVA). A p-value of <0.05 was considered significant.

RESULTS

A total number of 79 cases of SOJ were seen during the study period, out of which 14 cases were lost to follow-up, 7 cases died during this course of study, and 8 patients were not fit for any procedure due to poor general condition. A total of 50 cases (33 benign and 17 malignant) could be analysed.

A total of 50 patients were included in the study; of these 14 were males and 36 were females with a male to female ratio of 2:5. Age of patients in the present study ranged between 25-80 years with a mean age of 50±12 years (SD). Mean age for group I patients was 48.4 years and for group II patients was 53.4 years.

The typical complaints in study patient population were yellowish discoloration of sclera (100%), high coloured urine (100%) and pain abdomen (100%) clay coloured stools, hepatomegaly, palpable lump were found only in patients with malignant lesions. Anorexia and weight loss (≥10% of body weight) were noted in all the patients with malignant lesions and in benign condition only 3 patients were having weight loss [Table/Fig-1].

Type of complaints	Benign causes (n=33)	Malignant causes (n= 17)	Total number of patients
Yellowish discoloration of sclera	33	17	50
High coloured urine	33	17	50
Pain abdomen	33	17	50
Clay coloured stools	0	17	17
Lump abdomen (Hepatomegaly/Palpable gallbladder)	0	17	17
Anorexia	8	17	25
Weight loss	3	17	20

[Table/Fig-1]: Table showing different presenting complaints.

The patient population was classified into two broad groups on the basis of the cause of obstruction [Table/Fig-2]. Most common aetiology was choledocholithiasis in benign group and in malignant

group was carcinoma of gall bladder causing obstructive jaundice. Following modes of intervention were applied in these groups of patients as mentioned in [Table/Fig-3].

Aetiology	Condition	Number of patients	Total
Benign causes	Choledocholithiasis	26	33
	Benign biliary stricture	6	
	Cholelithiasis with mirizzi type II	1	
Malignant causes	Carcinoma of gall bladder causing obstructive jaundice	8	17
	Cholangiocarcinoma	3	
	Periampullary carcinoma	4	
	Carcinoma head of pancreas	2	
Total		50	

[Table/Fig-2]: Table showing different causes of biliary obstruction.

Type of intervention	Procedure	Group I	Group II	Number of patients	Total
Endoscopic	ERCP+Stenting+CBD clearance	16	0	16	28
	ERCP+Stenting	0	12	12	
Surgical	Choledocholithotomy+T-tube drainage	7	0	7	22
	Roux-en-Y hepaticojejunostomy	5	0	5	
	Choledochoduodenostomy	4	0	4	
	Choledocholithotomy+primary closure of CBD	1	0	1	
	Whipples procedure	0	3	3	
	Radical cholecystectomy+bilioenteric bypass	0	2	2	
Total		33	17	50	

[Table/Fig-3]: Types of intervention done.
CBD: Common bile duct; ERCP: Endoscopic retrograde cholangiopancreatography

In benign group-choledocholithotomy+T-tube drainage (n=7), Roux-en-y hepaticojejunostomy (n=5), ERCP+stenting+CBD clearance (n=16), choledochoduodenostomy (n=4), choledocholithotomy+primary closure of CBD (n=1).

In malignant (n=17) the patients had underlying conditions-whipples procedure (n=3), radical cholecystectomy+bilioenteric bypass (n=2), ERCP+Stenting (n=12).

In patients of benign obstructive jaundice who underwent surgical decompression, significant improvement was seen in icterus (p-value=0.003), appetite and pruritus [Table/Fig-4]. None of the patients were febrile during the course of the study and no significant alterations in weight were reported, hence the changes in body weight, BMI and body temperature were not significant.

In patients of benign obstructive jaundice who underwent surgical decompression, highly significant decrease was seen in total bilirubin, direct bilirubin, SGOT, SGPT, prothrombin time and INR [Table/Fig-5]. However, the change in levels of ALP, Gamma-glutamyl Transferase (GGT), total protein and albumin was not significant.

In patients of benign obstructive jaundice who underwent endoscopic decompression, highly significant improvement was seen in icterus, appetite and pruritus [Table/Fig-6]. None of the patients were febrile during the course of the study and no significant alterations in weight were reported, hence the changes in body weight, BMI and body temperature were not significant.

In patients of benign obstructive jaundice who underwent endoscopic decompression, highly significant decrease was seen in total bilirubin, direct bilirubin, ALP, GGT, SGOT, SGPT, prothrombin time and INR [Table/Fig-7]. However, the change in levels of total protein and albumin was non significant.

In patients of malignant obstructive jaundice who underwent surgical decompression, highly significant improvement was seen in icterus, appetite and pruritus [Table/Fig-8]. Two of the patients were febrile during the course of the study on postoperative day 3rd no significant alterations in weight and BMI, was present (febrile on 3rd postoperative day).

Parameters	Preoperative	Day 3	Day 7	Day 14	4 weeks	12 weeks	p-value
Body weight (kg)	54.77±9.37	53.70±9.15	52.49±8.29	52.82±7.95	53.71±7.73	55.20±7.50	0.95
Body mass index (kg/m^2)	22.36±3.49	21.92±3.4	21.43±3.02	21.64±3.07	22.07±3.05	22.72±2.95	0.90
Icterus*	2.64±1.49	2.42±1.39	2.071±1.38	1.64±1.00	1.35±0.92	1.07±0.26	0.003
Appetite**	2.42±0.51	1.57±0.64	2.21±0.57	2.78±0.57	3.21±0.57	3.85±0.36	0.003
Pruritus***	9.643±5.66	8.07±4.73	6.57±3.56	4.50±2.50	3.64±2.2	2.85±1.09	<0.001
Body temperature (°F)	98.13±0.66	97.85±0.66	98.23±.72	97.67±0.50	97.95±0.89	97.87±.07	0.34

[Table/Fig-4]: Clinical features in patients of benign obstructive jaundice who underwent surgical decompression (N=17).
*Icterus as per serum bilirubin; **Appetite as per grading; ***Pruritus as per grading system; One-way ANOVA, p-value <0.05 statistically significant

Parameters	Preoperative	Day 3	Day 7	Day 14	4 weeks	12 weeks	p-value
Total bilirubin (mg/dL)	12.55±9.02	10.19±9.26	8.37±8.03	5.52± 5.97	4.24±6.33	1.74±2.02	0.002*
Direct bilirubin (mg/dL)	7.75±5.74	5.96±5.02	4.52±4.48	2.29±2.07	1.42±1.97	0.67±1.02	<0.001**
ALP (IU/L)	1114.9±661.3	1047.4±879.7	1065.9±1324.6	892.1±1057.1	621.3±628.1	470.3±542.9	0.299
GGT (IU/L)	198.3±151.4	169.8±161.8	146.0±129.8	142.4 ±120.4	126.5± 90.2	92.6±55.2	0.317
SGOT (IU/L)	132.71±133.09	67.86±35.14	62.50±44.45	67.29±32.20	65.00±38.93	51.86±20.62	0.016*
SGPT (IU/L)	107.57±91.33	66.71±44.34	50.29±29.62	49.21±22.91	45.79±23.11	43.29±20.11	0.003*
Total protein (gm/dL)	6.64±0.90	5.90±1.13	5.85±0.94	6.20±1.06	6.32±0.91	6.24±1.29	0.384
Albumin (gm/dL)	3.12±0.38	2.91±0.42	2.78±0.27	2.85±0.52	2.85±0.54	3.01±0.37	0.316
Prothrombin time (sec)	14.96±2.00	15.02±1.53	14.62± 2.12	14.07± 2.24	13.21±2.06	12.064±1.11	<0.001**
INR	1.23±0.13	1.24± 0.09	1.22±0.15	1.18±0.12	1.14±0.11	1.11±0.11	0.042*

[Table/Fig-5]: Biochemical features in patients of benign obstructive jaundice who underwent surgical decompression (N=17).
Normal range: Alkaline phosphatase (ALP): 108-306 IU/; Serum glutamic oxaloacetic transaminase (SGOT): 10-40 IU/L; Serum glutamic pyruvic transaminase (SGPT): 10-40 IU/L; Gamma-glutamyl transferase (GGT): 0-30 IU/L
Tota bilirubin: 0.1-1.1 mg/dL; Direct bilirubin: 0.1-0.8 mg/dL; Total protein: 6-8 gm/dL; Albumin: 3.7-5.3 gm/dL; Prothrombin time: 10-12 seconds; INR: 0.8-1.1
Serum bilirubin total and direct was estimated by Jendrassik and Grof method; SGOT- IFCC (without Pyridoxal-5-phosphate); SGPT- IFCC (without Pyridoxal-5-phosphate); ALP- Para-nitrophenyl phosphate with DEA buffer method; GT- IFCC method; T.Protein- Biuret method; Albumin- Bromocresol green method
**p-value <0.001 is considered highly significant; *p-value <0.05 is considered statistically significant

Parameters	Preoperative	Day 3	Day 7	Day 14	4 weeks	12 weeks	p-value
Body weight (kg)	54.21±7.14	53.22±6.87	52.54±6.63	52.86±6.33	53.57±6.58	54.48±6.62	0.879
Body mass index (kg/m^2)	22.02±2.41	21.67±2.44	21.41±2.46	21.55±2.47	21.83±2.54	22.31±2.71	0.785
Icterus*	2.26±0.93	1.89±0.87	1.36±0.59	1.10±.45	1.05±0.22	1.00±0.00	<0.001
Appetite**	1.84±0.60	1.47±0.90	2.16±0.76	2.74±0.73	3.26±0.65	3.63±0.49	<0.001
Pruritus***	9.42±4.32	7.05±3.26	5.42±2.46	3.47±1.12	3.10±1.24	2.32±0.82	<0.001
Body temperature (°F)	98.38±0.71	98.03±0.59	97.82±0.49	97.85±0.62	98.16±0.95	98.39±.39	0.400

[Table/Fig-6]: Clinical features in patients of benign obstructive jaundice who underwent endoscopic decompression (N=16).
*Icterus as per S. Bilirubin; **Appetite as per grading; ***Pruritus as per grading system; p-value <0.05 statistically significant

Parameters	Preoperative	Day 3	Day 7	Day 14	4 weeks	12 weeks	p-value
Total bilirubin (mg/dL)	9.00±4.86	6.55±4.55	4.45±3.14	2.76±2.19	1.72±1.75	1.16±0.81	<0.001**
Direct bilirubin (mg/dL)	6.21±3.28	3.87±3.12	2.06±1.58	1.09±0.752	0.53±0.382	0.41±0.478	<0.001**
ALP (IU/L)	757.9±586.9	567.1±461.0	489.2±369.7	393.4±300.6	331.5±207.6	242.2±157.0	<0.001**
GGT (IU/L)	246.6±195.0	174.3±141.5	134.6± 99.3	107.4±71.6	91.5±71.6	72.2±42.1	<0.001**
SGOT (IU/L)	114.00±64.39	82.00±55.11	70.68±49.18	54.54±27.94	48.01±29.23	48.95±33.15	<0.001**
SGPT (IU/L)	122.95±103.58	84.79±87.18	59.47±48.21	49.47±27.17	44.74±24.04	47.68±23.07	<0.001**
Total protein (gm/dL)	6.68±0.54	6.67±0.78	6.70±0.71	6.83±0.42	7.12±0.42	6.84±0.36	0.135
Albumin (gm/dL)	3.32±0.52	3.10±0.72	3.12±0.72	3.12±0.57	3.37±0.68	3.21±0.41	0.659
Prothrombin time (sec)	17.03±7.00	14.60±2.13	14.38±1.35	13.57±1.68	12.92±1.58	12.18±0.82	<0.001**
INR	1.46±0.93	1.25±0.26	1.14±0.11	1.09±0.09	1.07±0.10	1.08±0.11	0.027*

[Table/Fig-7]: Biochemical features in patients of benign obstructive jaundice who underwent endoscopic decompression (N=16).
Normal range: Alkaline phosphatase (ALP) : 108-306 IU/L; Serum glutamic oxaloacetic transaminase (SGOT): 10-40 IU/L; Serum glutamic pyruvic transaminase (SGPT): 10-40 IU/L; Gamma-glutamyl transferase (GGT): 0-30 IU/L
Tota bilirubin: 0.1-1.1 mg/dL; Direct bilirubin: 0.1-0.8 mg/dL; Total protein: 6-8 gm/dL; Albumin: 3.7-5.3 gm/dL; Prothrombin time: 10-12 seconds; INR: 0.8-1.1
**p-value <0.001 is considered highly significant; *p-value <0.05 is considered statistically significant

Parameters	Preoperative	Day 3	Day 7	Day 14	4 weeks	12 weeks	p-value
Body weight (kg)	51.91±4.27	51.43±4.07	50.90±4.05	50.41±4.3	50.55±3.66	50.56±3.40	0.98
Body mass index (kg/m^2)	22.19±1.95	21.99±1.87	21.76±1.90	21.57±2.23	21.63±1.97	21.64±3.11	0.98
Icterus*	2.83±1.16	2.66±1.21	2.00±0.63	1.66±.51	1.16±0.40	1.00±0.00	<0.001
Appetite**	2.50±.54	1.66±.51	1.66±.51	2.33±.51	3.16±.40	3.83±.40	<0.001
Pruritus***	9.83±4.4	8.66±3.88	6.33±3.38	4.16±2.04	3.33±1.96	2.66±.81	<0.001
Body temperature (°F)	98.58±0.88	98.42±1.84	97.70±0.56	98.00±0.44	97.98±0.29	97.97±.51	0.25

[Table/Fig-8]: Clinical features in patients of malignant obstructive jaundice who underwent surgical decompression (N=5).
*Icterus as per S.Bilirubin; **Appetite as per grading; ***Pruritus as per grading system; p-value <0.05 statistically significant

In patients of malignant obstructive jaundice who underwent surgical decompression, highly significant decrease was seen in total bilirubin and directs bilirubin [Table/Fig-9]. However, the change in levels of total protein, albumin, ALP, GGT, SGOT, SGPT, prothrombin time and INR was non significant.

In patients of malignant obstructive jaundice who underwent endoscopic decompression, significant improvement was seen in icterus, appetite and pruritus [Table/Fig-10]. Two patients were febrile during the course of the study and no significant alterations in weight were reported, hence the changes in body weight, BMI were not significant.

In patients of malignant obstructive jaundice who underwent endoscopic decompression, significant decrease was seen in total bilirubin, direct bilirubin, total protein, albumin, prothrombin time and INR [Table/Fig-11]. However, the change in levels of ALP, GGT, SGOT, SGPT, was non significant.

The mean percentage fall in AST (SGOT) levels were similar in both the groups i.e., 29% vs 30% on day 3, 49% vs 45% on day 7 and

Parameters	Preoperative	Day 3	Day 7	Day 14	4 weeks	12 weeks	p-value
Total bilirubin (mg/dL)	12.08±6.85	10.55±4.32	7.17±2.79	4.31±1.49	2.85±1.18	1.46±0.393	<0.001**
Direct bilirubin (mg/dL)	7.68±4.97	6.08±3.21	2.91±1.07	1.95±0.92	1.01±0.42	0.56±0.22	<0.001**
ALP (IU/L)	1193±971	1029±1130	1121±1164	1235±976	1258±935	1251±1017	0.99
GGT (IU/L)	154.65±115.79	153.78±113.46	127.60±63.68	139.97±59.94	140.45±79.25	110.32±69.42	0.94
SGOT (IU/L)	93.83±64.56	96.17±59.59	85.50±54.18	79.83±26.39	53.33±26.40	58.83±17.39	0.46
SGPT (IU/L)	86.50±93.67	75.50±52.59	70.50±51.84	74.67±34.16	50.83±21.01	43.67± 17.91	0.70
Total protein (gm/dL)	6.21±0.54	6.31±0.92	6.35±0.69	6.71±0.49	6.41±0.42	6.31±0.48	0.79
Albumin (gm/dL)	2.96±0.49	3.03±0.80	3.50±0.93	3.05±0.57	3.01±0.35	2.83±0.40	0.57
Prothrombin time (sec)	14.63±1.55	15.21±3.06	16.05±5.22	14.30±2.39	12.91±1.82	12.70±1.53	0.32
INR	1.37±0.378	1.33±0.18	1.36±0.45	1.19±0.20	1.085±0.13	1.036±0.15	0.17

[Table/Fig-9]: Biochemical features in patients of malignant obstructive jaundice who underwent surgical decompression (N=5).
Normal range: Alkaline phosphatase (ALP) : 108-306 IU/L; Serum glutamic oxaloacetic transaminase (SGOT): 10-40 IU/L; Serum glutamic pyruvic transaminase (SGPT): 10-40 IU/L; Gamma-glutamyl transferase (GGT): 0-30 IU/L
Total bilirubin: 0.1-1.1 mg/dL; Direct bilirubin : 0.1-0.8 mg/dL; Total protein: 6-8 gm/dL; Albumin: 3.7-5.3 gm/dL; Prothrombin time: 10-12 seconds; INR: 0.8-1.1
**p-value <0.001 is considered highly significant; *p-value <0.05 is considered statistically significant

Parameters	Preoperative	Day 3	Day 7	Day 14	4 weeks	12 weeks	p-value
Body weight (kg)	55.18±7.48	51.11±7.05	52.91±6.51	52.91±6.5	53.40±6.89	53.90±6.6	0.97
Body mass index (kg/m^2)	21.82±2.99	21.41±2.89	21.04±2.9	20.94±2.85	21.61±3.01	21.38±3.17	0.98
Icterus*	3.45±1.43	2.81±0.87	2.09±0.94	1.45±.52	1.00±0.00	1.00±0.00	<0.001
Appetite**	2.72±1.00	2.36±0.50	2.36±0.50	2.45±.52	2.72±.64	3.36±0.80	0.01
Pruritus	13.00±5.86	9.90±4.63	8.27±4.00	5.36±2.37	4.47±1.79	3.18±1.16	<0.001
Body temperature (°F)	98.58±0.88	98.42±1.84	97.70±0.56	98.00±0.44	97.98±0.29	97.97±.51	0.25

[Table/Fig-10]: Clinical features in patients of malignant obstructive jaundice who underwent Endoscopic decompression (N=12).
*Icterus as per S. Bilirubin; **Appetite as per grading; ***Pruritus as per grading system; p-value <0.05 statistically significant

Parameters	Preoperative	Day 3	Day 7	Day 14	4 weeks	12 weeks	p-value
Total bilirubin (mg/dL)	18.70±9.73	12.06±4.67	8.89±4.54	5.55±1.94	2.92±0.89	1.24±0.37	<0.001**
Direct bilirubin (mg/dL)	11.63±4.17	8.16 ±2.68	5.68±2.49	3.43±1.26	1.70±0.67	0.44±0.30	<0.001**
ALP	1105.0±892.7	851.7±787.7	843.5±587.9	630.2±397.9	478.2±306.4	351.4±440.3	0.057
GGT (IU/L)	348.3± 236.8	291.1±202.4	243.7±162.7	194.2±133.0	149.5±109.2	144.5±180.9	0.052
SGOT (IU/L)	183.2±174.3	155.4±163.4	124.5±82.7	109.3±67.4	82.3±34.4	59.7±30.4	0.099
SGPT (IU/L)	136.27±117.71	116.09±108.14	101.82±89.57	78.91±52.68	69.17±38.90	62.24±56.41	0.257
Total protein (gm/dL)	6.21±0.65	6.15±0.64	5.94±0.97	6.48± 0.40	6.68±0.48	7.25±0.8	<0.001**
Albumin (gm/dL)	2.863±0.50	2.80±0.54	2.66±0.41	2.94±0.27	3.11±0.35	3.24±0.33	0.025*
Prothrombin time (sec)	14.93±2.00	14.50±1.19	15.38±3.66	13.60±2.54	12.80±1.10	12.30±1.02	0.007*
INR	1.3427±0.18	1.2536±0.12	1.29±0.22	1.21±0.16	1.14±0.10	1.10±0.07	0.003*

[Table/Fig-11]: Biochemical features in patients of malignant obstructive jaundice who underwent endoscopic decompression (Total patients=12).
Normal range: Alkaline phosphatase (ALP) : 108-306 IU/L; Serum glutamic oxaloacetic transaminase (SGOT): 10-40 IU/L; Serum glutamic pyruvic transaminase (SGPT): 10-40 IU/L; Gamma-glutamyl transferase (GGT): 0-30 IU/L; Total bilirubin: 0.1-1.1 mg/dL; Direct bilirubin: 0.1-0.8 mg/dL; Total Protein: 6-8 gm/dL; Albumin: 3.7-5.3 gm/dL; Prothrombin time: 10-12 seconds; INR: 0.8-1.1
**p-value <0.001 is considered highly significant; *p-value <0.05 is considered statistically significant

53% vs 49.5% on day 14, 70% vs 64.6% on 4th week and on 12th week 76% vs 73% in Group I and II.

DISCUSSION

During the last decade, our evolving ability to image the biliary tract and facilitate the diagnostic evaluation of these patients has led to development of logical algorithms for clinical management [16]. Innovative techniques for access to biliary tract have resulted in new and creative means of management, prompting re-evaluation of existing treatment principles for patients with biliary obstruction. In addition, an improved understanding of the pathophysiology of hyperbilirubinemia has influenced therapeutic regimen approaches for patient care. Therefore, for appropriate patient management surgical jaundice needs to be distinguished from medical jaundice by a thorough history, complete physical examination and simple laboratory tests. A rational approach to the evaluation and management of surgical jaundice is greatly facilitated by the understanding of essential liver biochemical and coagulation abnormalities, especially by their sequential recording and analysis [7,10-12].

In the present study, 50 patients of SOJ were included and followed-up for 12 weeks postoperatively with sequential recording of their liver biochemical and coagulation profiles on a day prior to procedure and postprocedure on 3rd, 7th, 14th, 4 week and 12 week.

The ratio of benign versus malignant causes of obstructive jaundice in the present study was 2:1. Similar findings have also been previously observed by Grandic L et al., in a retrospective analysis of 114 patients with obstructive jaundice at University Department of Surgery, Split University Hospital in Split [21]. From this, it can be implied that though the chances of malignancy is increased with age, patients presenting with obstructive jaundice of age 50 or more have high chances to have benign cause of biliary obstruction also.

The typical complaints of obstructive jaundice in our patient population were in the form of yellowish discoloration of sclera (100%), high coloured urine (100%) and pain abdomen (100%) in all the patients (both group I and II), however, clay coloured stools, hepatomegaly, palpable gallbladder and ascites were found only in patients with malignant lesions (Group II). Anorexia and weight loss (≥10% of body weight) were noted in all the patients in Group II. Thus, presence of a palpable gall bladder along with enlarged liver and clay coloured stools in patient with SOJ are the pointer to an underlying malignant process and hence should be viewed with great suspicion [22].

Serum Bilirubin levels hold a prognostic value in chronic liver disease and in our study it proved to be of highly discriminative and diagnostic value between benign and malignant conditions preoperatively and their recovery patterns were also quite distinct between the two groups (I and II). They were statistically significant and higher in group II patients (p-value <0.001) on all the postoperative days i.e., 3rd, 7th, and 14th, then at 4 week and 12 week. These values returned to near normal in patients with of benign conditions whereas they were thrice the upper limit in patients with underlying malignant disorders even after 4 weeks of decompression.

In LFT the serum bilirubin levels alone are not very sensitive or specific for detection of liver disease, but along with the clinical features of these patients of obstructive jaundice they can give good picture and idea about the underlying cause which can help in further management plan [6]. Previous studies done in past have proved that the serum bilirubin levels can discriminate between the cause of obstructive jaundice (benign vs malignant) [11,23], which can also be seen in this study. Though the pattern of recovery is same after decompression either by surgery or endoscopy in malignant obstructive jaundice as also seen in the study by Watanapa P who observed that drainage of one hepatic lobe is enough to preserve the overall liver function in a partially obstructed biliary system [11].

Elevation of AST and ALT levels can be seen frequently with almost all liver diseases therefore there significance is low for estimation of severity of disease or the live necrosis [24].

In present study the levels of AST and ALT were high which was statistically high in malignant cases and insignificant in benign cases. Though after decompression the recovery pattern was same in both the groups with time taken to return to normal was around 4 weeks in benign cases and it was two-three times the normal

in malignant cases. In literature the same pattern of recovery has been observed by Nathwani RA et al., [25]. In their study, they found that the enzyme levels fall rapidly in benign conditions after decompression and return to near normal in two weeks period. The serum transaminase recovery patterns were more or less similar in patients with endoscopic and surgical decompression. The persistent elevation AST and ALT in the malignant group at 4 weeks reflects the direct damaging effect of the partially undrained biliary system in addition to the higher preoperative values compared to benign conditions where transaminases returned to near normal in all the patients. Thus, it implies that malignant obstructive lesion causes a higher degree of hepatocellular damage as compared to benign conditions [16].

In this study, the ALP levels were seen to be prominently raised (4-10 times), both in benign and malignant case of jaundice. But they were not significant statistically hence they are less precise in differentiating between the two aetiologies and the interventions done. The literature also supports our findings that ALP when evaluated alone is not of high diagnostic value in cases of obstructive jaundice [26,27].

Mechanism of elevation of serum ALP in obstructive jaundice is complex. Many studies indicate that the elevation of ALP occurs because of its accelerated de-novo synthesis in the liver and subsequent regurgitation into serum [26-29]. The recovery pattern of serum ALP in both benign and malignant conditions was similar with significant decline following decompression in some and while remained persistently elevated in others. Total protein and serum albumin were not much altered in the present study patient population and did not show much variation in both groups.

One of the important functions of liver is protein synthesis in which serum albumin is the most important plasma protein and its deficit (hypoalbuminemia) can be seen in patients of obstructive jaundice which signifies impaired liver function [30,31]. As its half-life is long (20 days), slight changes only are seen due to hepatocellular damage in cases of biliary obstruction [32,33]. In literature many studies have been done which showed that hypoalbuminemia in patients undergoing major surgery (specially hepatobiliary) is a significant risk factor [34,35].

The regulation of coagulation mechanism is also done by liver by synthesis of different coagulation proteins. In this study, the coagulation mechanism was preserved in both pre- and postprocedure period as seen in analysis of prothrombin time and partial thromboplastin time recordings. So, the overall protein synthesis function of liver was well preserved in our patients of obstructive jaundice, may be due to the short period of illness.

Limitation(s)

As this was a time bound study done in a short span of time (two years), number of cases was small and also the uneven distribution of patients in two groups was present which can limit the different aspects. A large number of patient set and longer duration could really project the impact of the study.

CONCLUSION(S)

The nature of biliary obstruction can be indicated by the preoperative levels of serum bilirubin. Postoperative i.e., decompression of obstructed biliary system the recovery pattern seen by fall in serum bilirubin, AST, ALT was similar in both benign and malignant type of biliary obstruction. In cases of biliary obstruction due to malignancy, the restoration of liver function was alike whether the primary lesion was removed or not. Total proteins, ALP, AST, ALP, albumin and coagulation factors were not much influencing in discriminating the two groups.Hence, authors justify and recommend sequential monitoring of liver biochemical profile in cases of SOJ and in order to restore the liver function by early biliary decompression which ultimately prevents the liver failure and its related morbidity.

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