Assessment of Portal Venous Pressure and its Correlation with Obstructive Jaundice.

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ABSTRACT

INTRODUCTION: Obstructive jaundice due to blockage in the biliary system causes change in the liver milieu and can be manifested as liver dysfunction which carries increased risk of postoperative morbidity and mortality. Knowledge of portal pressure in patients with normal liver function and without history of biliary obstruction is important as it gives the base line portal pressure of our patients. Similarly, knowing the change in portal pressure secondary to bile duct obstruction and its relation with liver function can help to differentiate those patients which are prone to high risk of postoperative morbidities and mortalities so that preventive measure can be applied. This study was designed to find the base line portal venous pressure and changes in the portal pressure due to biliary obstruction in patients operated in National Academy of Medical Sciences (NAMS) Bir Hospital.

METHOD: Patients with clinical, laboratory and radiological parameters suggestive of obstructive jaundice who had not undergone any form of preoperative biliary drainage were subjected as study group after taking informed consent and approval from the Institutional Review Board (IRB). Similarly patients with normal liver function and without clinical history, radiology and laboratory parameters suggestive of biliary obstruction and had undergone laparotomy for other indications were included as control group after taking consent. Right gastroepiploic vein or its major tributaries in the greater omentum was used for pressure measurement with the help of inbuilt pressure transducer manometer of Min Ray ventilator system.

RESULT: Twenty patients in each arm were included for the study and sex distribution in each arm was comparable. There were no difference in the mean age of the study population in two arms (p=0.446). Mean portal pressure in control group was 8.8 mm of Hg (SD=0.767) and median value of 9 mm of Hg. Mean portal pressure of study group was 12.95 (SD 2.605) with significant statistical difference between two groups (P=<0.001). There were no correlation between age and measured portal pressure in control group. Similarly duration of jaundice did not show any correlation with the portal pressure. However, preoperative total bilirubin level and alkaline phosphatase level showed strong positive correlation with measured portal pressure in study group. Regression analysis also showed preoperative total bilirubin and alkaline phosphatase level are determining factor for increased portal pressure in study group. Increased portal pressure did not show significant correlation with other liver function test parameters.

CONCLUSION: Mean portal pressure of nonjaundiced patients without deranged liver function did not show any change in value with the age of the patients. There was significant rise in the portal pressure than the control group in patients with obstructive jaundiced and it positively correlates with total bilirubin level and alkaline phosphatase level.

KEY WORDS: Portal pressure, obstructive jaundice, Gastroepiploic vein

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INTRODUCTION

The internal milieu of the liver depends mainly on portal venous and hepatic artery inflow and the biliary and hepatic venous outflow. Change of any of these...
inflow and outflow systems cause serious impairment of the hepatocytes leading to local and systemic consequences.

Obstructive jaundice results from partial or complete obstruction of the bile flow to intestine. Site of the obstruction may be intrahepatic or extra hepatic. Obstruction may be due to external compression, intramural or intraluminal pathology. Whatever the cause, after mechanical obstruction of biliary outflow, hepatocytes function decreases significantly.\(^1,2\)

Patients of obstructive jaundice may have multiple systems dysfunction such as hepatic, renal, cardiovascular system and nutritional deficiencies.\(^3,4,5\) These symptoms complex cannot be explained by only one mechanism. So the studies to explore the relations between the important determining factors of liver milieu are still required. There are literatures to support the utility of portal pressure measurement to prognosticate and start therapy in cirrhosis of the liver. Similarly, there is a role of portal pressure measurement in the management of patient waiting for liver transplant, acute alcoholic hepatitis and viral hepatitis.\(^6,7\) Diagnosis of liver status in cholestasis is difficult as functional status of liver and hematological conditions precludes for liver biopsy and fibroscan measurements are increased due to dilated ducts and cholestasis.\(^9,10\)

The exact duration for change of portal pressure due to biliary obstruction is not reported in a convincing manner. Some had reported perportal and portal fibrosis in 4 months, severe fibrosis in 22 months and cirrhosis in 62 months\(^1\) and some reported for secondary biliary cirrhosis 15 to 62 months.\(^11,12\) Although, clinically no evident cirrhosis, patient may have increased in portal pressure during initial phase of cholestasis. If 5-7 mmof Hg portal pressure is regarded as normal portal pressure, there have been 15-20% prevalence of portal hypertension in the presence of benign biliary stricture.\(^13,14\) The exact mechanism of change in the portal pressure in biliary obstruction is not known however it is presumed that intrahepatic mechanical compression of small portal veins causes portal hypertension.\(^15\) In long standing cases, normal arrangement of hepatocytes in plates with flow of blood from portal triad to central veins along the sinusoids is disturbed. As the pressure in the biliary tree increases, bile duct and bile canalicul permeability increases and bile refluxed in the sinusoids thus activating the inflammatory response. As neutrophils infiltrate in the sinusoids and venules as a part of inflammation, fibrinogenesis starts and ultimately leading to fibrosis and it increases the resistance of blood flow thus the portal pressure.\(^1,2,9\) Another mechanism is compression of capacitance vessels of portal vein by dilated bile ducts in limited space in portal triad (space of Mall).\(^16\)

In patients with prolonged biliary obstruction up to 20% may have clinically significant portal hypertension but literatures did not give data of subclinical portal hypertension.\(^17,18\)

As patients with clinically significant portal hypertension leads to increase blood loss due to bleeding from the subhepatic and periduvalvarices, they may also develop post-operative liver failure. Thus knowing the portal pressure might help to guide optimal timing of surgery in some of the benign disease like post cholecystectomy bile ducts injury. As in our population the normal value of portal pressure is not known this study was conducted to know the normal portal pressure in patients without history of jaundice and having normal liver function tests and also to see the change in portal pressure due to biliary obstruction in jaundiced patients.

**METHOD**

This study was done in National Academy of Medical Sciences Bir Hospital (NAMS) from May 2015 to May 2016. Sample size was calculated with formula \(\mu_1-\mu_2) = f(\alpha, \beta) = f(1/n_1+1/n_2)\), where \(\mu_1\) and \(\mu_2\) are mean portal venous pressure of the control and jaundiced patients, \(n_1\) and \(n_2\) are sample size of the control and test groups. \(\alpha\) is standard deviation. Difference in portal pressure of 2 mm of Hg between mean of control and study population was taken as significant. \(P\) value of 0.05 and confidence interval of 90% was taken as significant. Calculated sample size in each arm was 20.

One of the primary objective of the study was to determine portal pressure in patients with normal liver function and without history of biliary obstruction. Another objective was to find any changes in portal pressure with obstructive jaundice. Obstructive jaundice was diagnosed based on conjugated hyperbilirubinemia of > 50 % with rise in alkaline phosphatase level with radiological or clinical evidence of etiology of obstruction. In jaundiced patients, the relation between measured portal pressure and duration of symptoms, age and total bilirubin level
were also determined. All the cases of obstructive jaundice who were not subjected to preoperative drainage and willing to participate in the study were included. Similarly patients undergoing laparotomy who possessed normal liver function test and did not have past history of obstructive jaundice and willing to participate in the study were included as control group. Ethical clearance from Institutional Review Board (IRB) was taken before the start of this study.

Portal pressure was measured immediately after opening the peritoneal cavity before starting dissection either in right gastroepiploic vein or its major tributaries in the greater omentum. After selecting a good caliber vein it was cannulated with number 22 intravenous cannula and free backflow of the blood was confirmed. Connecting catheter was flushed with heparin saline and attached to number 22 intravenous cannula in one side and pressure transducer monitor machine adjusted to zero (Inbuilt Transducer system in Min Ray Ventilator) reading in other side. A valid tracing was observed for 1 minute and mean venous pressure was recorded (figure 1 and 2). Puncture site was secured for hemostasis by suture ligation and again inspected before closure of abdomen at the end of procedure.

**RESULT**

Total number of patients in each arm was 20. Study group had equal number of sex distribution of the patients. However control group had 11 male and 9 female. Most of the patients had malignant obstructive jaundice in the case group (Table 1) whereas most of the patients in the control group had colorectal disease (14, 70%). Another Four (20%) patients having gastric pathology and 2 patients of small intestinal pathology fulfilled the required sample size in control group. Preoperative parameters between control and study group is given in Table 2.

### Table 1: Diagnosis of study group

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. of cases</th>
<th>% of patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periampullary carcinoma</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>(Ampullary carcinoma = 5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholelithiasis</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Carcinoma GB</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Benign biliary stricture</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>others</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>100</td>
</tr>
</tbody>
</table>

Table showing highest number of periampullary carcinoma in the study population

### Table 2: Preoperative comparison between control and study group

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control Mean (SD)</th>
<th>Case Mean (SD)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Years)</td>
<td>48.65 (15.0377)</td>
<td>48 (14.1793)</td>
<td>0.446</td>
</tr>
<tr>
<td>Preoperative bilirubin level(mg %)</td>
<td>0.855 (0.3186)</td>
<td>8.956 (7.5769)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Assessment of portal venous pressure and its correlation with obstructive jaundice.

<table>
<thead>
<tr>
<th></th>
<th>Direct bilirubin level (mg %)</th>
<th>Preoperative SGOT level (U/L)</th>
<th>Preoperative SGPT level (U/L)</th>
<th>Alkaline phosphatase level (U/L)</th>
<th>Preoperative protein level (gram %)</th>
<th>Preoperative albumin level (gram %)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.325 (0.2314)</td>
<td>23.05 (18.5939)</td>
<td>22.85 (15.0971)</td>
<td>76.35 (22.8778)</td>
<td>6.445 (0.7472)</td>
<td>3.59 (0.6897)</td>
</tr>
<tr>
<td></td>
<td>5.480 (4.5311)</td>
<td>63.7 (50.4924)</td>
<td>49.55 (31.4851)</td>
<td>249.2 (198.6408)</td>
<td>6.73 (0.7115)</td>
<td>3.30 (0.6021)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.008</td>
<td>0.833</td>
<td>0.517</td>
</tr>
</tbody>
</table>

Table showing significant differences between control and study group in total and direct bilirubin, SGOT, SGPT, Alkaline phosphatase level

In control group we had noted that there was no relation of portal pressure with the age of the patients (figure 3)

Mean intraoperative portal venous pressure in control group was 8.8 mm of Hg (SD 0.767, Range 8-10 mm of Hg) and median of 9 mm of Hg and in study group was 12.95 (SD 2.605, Range 8-17 mm of Hg) which was statistically different between two groups (P<0.001). There was no correlation between duration of jaundice and intraoperative portal venous pressure (correlation coefficient -0.134, p =0.572). On categorization of duration of jaundice less than 1 month and more than one month, we found that measured intraoperative portal pressure between two groups were not statistically different (mean 11.75 mm Hg vs 13.75 mm of Hg, p=0.93) However, there was positive correlation between the intraoperative portal venous pressure and preoperative bilirubin level (Correlation coefficient 0.62 and P= <0.01) and with preoperative alkaline phosphatase (Correlation coefficient 0.582 and P= <0.01)

On regression analysis, we found that 38.8% variance in portal venous pressure can be explained by preoperative bilirubin level (r² =0.388, P=0.003). Similarly preoperative alkaline phosphatase was another determining factor for portal venous pressure (correlation coefficient 0.582, r² = 0.339, p=0.007). Portal venous pressure had no correlation with preoperative value of SGPT (correlation coefficient of 0.4, p= 0.072), SGOT (Correlation coefficient of 0.276, p=0.239), protein (correlation coefficient of 0.243, p=0.301) and albumin (correlation coefficient of 0.40, p=0.865). No procedure related complications were seen with the portal pressure measurement in both groups.

**DISCUSSION**

There are different methods of measuring the portal pressure in literature. Hepatic venous wedge pressure is regarded as gold standard for the indirect assessment of the portal venous pressure. Portal pressure has also been measured by umbilical vein cannulation during surgery. However, some had reported EUS guided portal vein cannulation and measurement of portal pressure as a safe procedure in animal model but its safety to human is yet to be determined. In our case thinking that direct puncture of portal vein may carry risk of bleeding, we tried indirect way of measuring the portal pressure by cannulating the one of the tributaries of the portal venous system. This method was applied by in to measure portal pressure in benign biliary stricture following cholecystectomy.

As portal venous system is valve less venous system, our way of measurement may indirectly reflect the actual pressure in the portal system.

Tamakuma and colleagues demonstrated that hypotension and shock after sudden decompression of obstructed biliary system in postoperative period. As portal pressure is the surrogate to liver function, identifying patients with higher portal pressure in...
obstructive jaundice is helpful for postoperative management as these patients could receive due care to prevent postoperative complications.

Our study showed that in patients without biliary obstruction (control group) had mean portal pressure of 8.08 mm of Hg and median of 9 mm of Hg which is different than reported normal portal pressure of 5 to 7 mm of Hg by Sherlock S.13 This difference may be due to difference in the method of measurement of portal pressure. Similarly, we found that there were no correlation of portal venous pressure and age of the patients in control group. There were no reported value of portal pressure in different age groups.

Our study showed that there is significant change in portal pressure due to biliary obstruction than those having no biliary obstruction (8.8 mm of Hg VS 12.95 mm of Hg, p=0.001). This change in portal pressure was not dependent on the duration of jaundice. This is contradictory to other results.5,11 This may be due to inclusion of the periampullary carcinoma (mostly ampullary carcinoma) and choledocholithiasis as a major bulk of sample of study population. In carcinoma of ampulla, patients presented early because of jaundice and these patients also had history of remission and exacerbation of jaundice. Most of the ampullary carcinoma did not require stenting before operation and easily met inclusion criteria. Similarly in choledocholithiasis, patients presented with long history of jaundice with history of remission and exacerbation and operated without stenting once ERCP clearance not possible. In both the cases, due to partial relief of obstruction during the course of disease, the portal pressure may not have changed with duration of jaundice as reported by others. We found that preoperative bilirubin level and alkaline phosphatase level correlate well with intraoperative measured portal venous pressure which is similar to other reports.19, 24

Limitations of this study is, firstly we could not include large number of patients with very high bilirubin level because most of them were stented preoperatively. Another limitation is the reliance on indirect method of portal venous pressure measurement due to ethical issue of puncturing portal venous pressure directly.

CONCLUSION
There is significant rise of portal pressure after biliary obstruction and it correlate with preoperative total bilirubin level and serum alkaline phosphatase level. There is no change of portal pressure with the age of patients in control group.

CONFLICT OF INTEREST: No conflict of interest

REFERENCE


