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Relationship between Preoperative Aspartate Aminotransferase-To-Platelet Ratio Index (APRI) and Gamma Glutamyl Transpeptidase (GGT) With Early Postoperative Jaundice Clearance and Native Liver Survival in Biliary Atresia

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Abstract

Original Research Article

Purpose: The purpose of this study was to observe the relationship between Preoperative Aspertate Aminotransferase to Platelet Ratio Index (APRI) and Gamma-Glut amyl Transpeptidase (GGT) with early postoperative jaundice clearance and native liver survival that were operated in this institution. This study will help to identify the children who are likely candidates for early liver transplantation. ***Methods:*** This Observational Longitudinal study was conducted in the Department of Paediatric Surgery, BSMMU with the study period of24 months. Total 25 patients of biliary atresia were included in this study. 3 patients were excluded for death in early post operative period. All the patients were categorized according to age at operation as Group A(<60 days), Group B(61-90 days), Group C(>90 days). Measurement of serum bilirubin, Gamma-glutamyl transpeptidase (GGT), Aspertate aminotransferase to platelet ratio index (APRI)was done in preoperative and postoperative period (at 14-day, 1 month, 3 month and 6 month). ***Results:*** Total 3 patients were in Group A, 11 in Group B, 8 in Group C. Mean age atoperation was 86.2(±18.8SD) days and range was 57days to 140 days. Total 10 (45.5%) patient was jaundice free at 3 months after extended KPE and they were also remained jaundice free at 6 months while 12 (54.5%) patients had persistent jaundice. Mean preoperative Gamma-Glutamyl Transpeptidase (GGT) in persistent jaundice group was1208.42 (±855.82 SD) U/L and at 6 month after operation it was 711.3(±446.4 SD) U/L while in Jaundice free group preoperative Gamma-Glutamyl Transpeptidase (GGT) value was 900.40(±582.81SD) U/L and 6 month after operation it was 213.1(±89.1SD), (P=0.003) which is statistically significant. Mean preoperative APRI in persistent jaundice was1.95 (±1.52SD) and at 6 month it was 1.22(±0.53SD) while in Jaundice free group preoperative value was 1.10(±0.54SD) and 6 month of operation it was 0.39(±0.14SD), (P=0.004) which is statistically significant. Correlation between preoperative APRI and Gamma-Glutamyl Transpeptidase (GGT) with postoperative jaundice clearance shows positive correlation. Native liver survival was assessed after 6 months of extended KPE and it showed 45.5% of total study population retained their native liver and also Correlation between preoperative Aspertate aminotransferase to platelet ratio index (APRI) and Gamma-Glutamyl Transpeptidase (GGT) with native liver survival at 6month after surgery was showed a positive correlation for native liver survival. ***Conclusion:*** This study concluded that after successful Kasai Porto Enterostomy (KPE) bile drainage is ensured and patients become jaundice free. High Gamma-Glutamyl Transpeptidase (GGT) value and APRI are associated with poor outcome. So preoperative Gamma-Glutamyl Transpeptidase (GGT) and APRI can act as prognostic factor to determine the outcome after extended KPE and thus we can categorize the patients who have long time native liver survival and who needs early liver transplantation.

Keywords: Biliary Atresia (BA), Kasai Porto Enterostomy (KPE), Jaundice Free (JF), Persistent Jaundice (PJ), Aspertate aminotransferase to Platelet Ratio Index (APRI), Gamma Glut amyl Transferase (GGT), Jaundice Clearance (JC), Bile drainage, Native Liver Survival (NLS), Liver Transplantation (LT).

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INTRODUCTION

Biliary atresia (BA) is a progressive, obliterative, cholangiopathy of the extrahepatic and intrahepatic bile ducts commonly occurs in neonates, which lead to hepatic fibrosis and end-stage liver disease [1]. The incidence of BA is higher in Japan, China and South Asia (~1 in 8-9 000) than in Europe and the USA (~ 1 in 12 - 15 000 live births) [2]. It is considered a common cause of death in childhood. Patient will develop biliary cirrhosis and chronic liver failure within 2 -3 year if it is not treated [3]. Jaundice is a common finding in neonate and is due to elevated unconjugated bilirubin, which resolves spontaneously. It is important to identify the neonate or young infant who has persistent jaundice beyond 2 weeks of life. These neonates are likely to have biliary obstruction due to biliary atresia or choledochal cyst or a cholestatic process. A predominance of females exists with a female-to-male ratio ranging between1.4 to 1.7 to 1 [4]. The appropriate etiology of biliary atresia is unknown and likely multifactorial, though various etiological mechanisms have been asserted, including intrauterine or perinatal viral infections, genetic mutations, abnormal ductal plate remodeling, vascular or metabolic insult to the developing biliary tree, pancreatico biliary ductal malunion, and immunologically mediated inflammation. Reovirus type 3 infections, Rotavirus, Cytomegalovirus, Papillomavirus and Epstein-Barr virus have all been proposed as possible etiological agents [5]. Anumber of investigations are needed to confirm the diagnosis like liver functiontest, ultrasound, MRCP, HIDA scan, liver biopsy [5,6]. Restoration of bile flow and improvement of Native Liver Survival (NLS) can be achieved by early diagnosis and timely performance of Kasai Porto Enterostomy (KPE) [1]. In 1959 Japanese surgeon Morio Kasai described this procedure and till date it is considered as palliative treatment option for biliary atresia, as liver transplantation remains cornerstone of treatment for biliary atresia [6]. The overall 5-year and 10-year survival rates following KPE are about 50% and 30% respectively [7]. After KPE, there are a number of prognostic factors for liver failure, among which clearance of jaundice is considered the most important one, Others are patient's age at the time of KPE, severity of cirrhosis, experience of the surgeon, occurrence of postoperative cholangitis, duct diameter at the portahepatis, and hepatic hilum morphology, and the effect of circulating mediators of inflammation [1]. Hepatic fibrosis and NLS can be assessed by various biochemical and hematological values, like Aspartate Aminotransferase-to-Platelet Ratio Index (APRI) and Gamma-Glutamyl Transpeptidase (GGT). High platelet count and low Aspartate Aminotransferase (AST) level had a significantly improved prognosis and predict the outcome [8]. Gamma-Glutamyl Transpeptidase (GGT) is an epithelial enzyme that catalyzes extracellular glutathione and it's conjugate. Due to hepatic immaturity in neonatal period GGT level is 5 to 7 times higher than upper normal level of adulthood. High levels of serum GGT level indicate cholestatic, alcoholic and fatty liver diseases, and also have high accuracy for differentiating suspected BA from other cases of neonatal cholestasis [1]. Aspartate Aminotransferase-to-Platelet Ratio Index (APRI) has been introduced as a useful noninvasive tool to evaluate liver fibrosis and prognosis in BA. The APRI was calculated as the serum AST level (IU/L)/upper normal limit (50 IU/L) × 100/platelet count (10^9/L). This study aimed how APRI correlates to biochemical signs of liver injury and fibro genesis at the time of KPE, and whether APRI predicts native liver survival [9]. A fall in total bilirubin and clearance of clinical jaundice after 3 month of KPE is considered as successful surgery and in children who do not have reduction in bilirubin and disappearance of clinical jaundice after 3 month of KPE are likely candidate for early liver transplantation [10]. Native liver survival means longevity of survival of patient with his own liver after successful KPE deferring Liver Transplantation. So, the purpose of this study is to make a relationship between Preoperative Aspartate Aminotransferase-To-Platelet Ratio Index (APRI) and Gamma Glutamyl Transpeptidase (GGT) and to observe early postoperative jaundice clearance and native liver survival in Biliary Atresia after KPE.

MATERIALS AND METHODS

Study Type: Observational Longitudinal study

Study Place: Department of Pediatric Surgery, BSMMU, Dhaka, Bangladesh.

Study Period: March'2018 to February'2020

Study Population: Infants with Biliary Atresia were treated by extended Kasai Portoenterostomy.

Sample Size: Thus, sample size(n) =25

Selection Criteria:

Inclusion criteria:

- Infants who underwent extended Kasai operation for biliary atresia

Exclusion criteria:

- Parents not willing to participate in the study
- Biliary atresia patients with poor liver synthetic functions (uncorrectable coagulopathy, decreased level of serum albumin, severe ascites).

Study Procedure:

History and clinical examination: Detailed history was taken and clinical examination was done for each patient and recorded in designed data collection sheet.

Pre-procedure evaluation / investigations: Diagnosis of Biliary atresia was made by laboratory findings of

liver function tests, ultrasonography of hepatobiliary system, Hepatobiliary scintigraphy and liver biopsy.

Operative Procedure: All the patients in this study underwent extended type of Kasai portoenterostomy, which includes mobilization and exteriorization of liver, wide dissection of portal plate and funnel shaped portoenterostomy to ensure adequate bile drainage. The patients were categorized according to age at operation as Group A (<60 days), Group B (61-90 days), Group C (>90 days).

Follow-up plan: All the study populations were followed at defined time schedule (at 14 days,1 month,3 months,6 month) following surgery and clinical findings, liver function test, complete blood count were obtained. Biochemical and hematological investigations were done by maintaining aseptic precaution and standard techniques.

Data processing and analysis: All the data was compiled and sorted properly and analyzed, the numerical data was presented by percentage, ratio, mean ± SD and p value of <0.05 considered as significant. Statistical analysis of the results was done by using computer based statistical software, statistical package for social sciences (SPSS), application of standard statistical tool. Comparison of pre-operative and postoperative Serum Bilirubin, GGT, APRI value was done with unpaired t test for inter group and pair t test for intra group. Correlation between preoperative Aspertate Aminotransferase to Platelet Ratio index (APRI)and Gamma Glutamyl Transpeptidase (GGT) with early postoperative jaundice clearance and native liver survival was assessed by Pearson's correlation coefficient test and positive value of "r" was considered as positive correlation between two variables.

RESULTS

Table-1: Demographics status of the study patients (n=22)

Gender	**Frequency**	**Percentage (%)**
Male	10	45.5
Female	12	54.5
Total	22	100.0
Male: Female ratio	**1: 1.2**	
Age (days)		
<60 (Group A)	3	13.6
61-90 (Group B)	11	50.0
>90 (Group C)	8	36.4
Total	22	100.0
Mean±SD	**86.2±18.8**	
Range	**(57 – 140) days**	

This table-1 shows demographic distribution of patients. Total 22 number of patients were included in this study. Out of 22 patients, male were 10(45.5%) and female12(54. 5%). Maleto female ratio were 1:1.2. Total number of patients were divided into 3 groups. Below 60 days age patient in Group A, 61-90 days patient in Group B and more than 90 days age patient in group C.3 patients (13.6%) were in Group A, 11(50%) in group B, 8(36.4%) in Group C. Mean age at operation was 86.2±18.8, while age range (57-140) days.

Table-2: Preoperative laboratory profile (n=22)

	N	**Minimum**	**Maximum**	**Mean**	**SD**	**Median**
Serumbilirubin (mg/dl)	22	5.10	21.30	11.21	4.16	10.8
GGT (U/L)	22	109.00	3124.00	1068.41	744.22	877.5
APRI	22	0.14	4.74	1.56	1.23	1.42

Table-2 showing pre operative laboratory profile. Mean serum bilirubin was 11.21 mg/dl and range was 5.10 mg/dl to 21.30mg/dl while median value was10.8 mg/dl. Mean preoperative GGT was 1068.41(U/L) and range was 109(U/L) to 3124(U/L) while median value was877.5(U/L). Mean preoperative APRI was 1.56 and range was 0.14to4.74 while median value was 1.42.

Table-3: Comparison of serum bilirubin preoperative to postoperative at 14 day, 1 month, 3 month,6 month follow up (n=22)

	Serum bilirubin (mg/dl)			**p-value**
	Mean	**SD**	**Mean difference**	
Preoperative	11.21	4.16		

Postoperative At 14 days	9.07	3.53	2.14	0.015*
At 1 month	7.56	5.22	3.65	0.011*
At 3 months	5.95	6.19	5.26	0.004*
At 6 months	6.59	6.62	4.62	0.012*

Paired t-test was done, *significant

Table-2 shows comparison of serum bilirubin at preoperative to postoperative period (at 14 day, at 1month, at 3 month, at 6 month).Mean preoperative serum bilirubin was 11.21. Mean Serum bilirubin at 14 days of operation was 9.07, at 1 month was 7.56, at 3 month was 5.95 and at 6 month was 6.59 mg/dl. It showed serum bilirubin was gradually decreasing up to 3 month after operation but at 6 month after operation it was slightly increased. P value is 0.004 and 0.012 respectively for 3 month and 6 month after operation which was statistically significant.

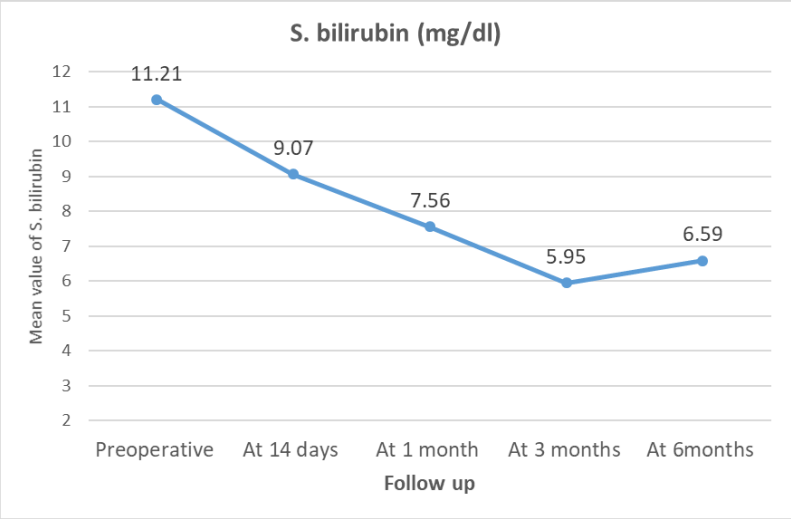


Figure 1: Trend of serum bilirubin in different follow up period

This line diagram showing fall of serum bilirubin from preoperative period to post-operative period upto 3 month but it was slightly increased at 6 month after surgery.

Table-4: Comparison of preoperative and postoperative serumbilirubin between jaundice free and persistent group (n=22)

Variables	**Persistent jaundice (n=12) Mean ± SD (mg/dl)**	**Jaundice free (n=10) Mean ± SD (mg/dl)**	**p-value**
Preoperative S. bilirubin	11.18±3.44	11.26±5.09	0.963
Postoperative S. bilirubin at 14 days	9.80±3.89	8.20±3.02	0.302
at 1 month	9.09±4.62	5.73±5.54	0.136
at 3 month	9.91±5.90	1.12±0.72	<0.001*
Sat 6month	11.38±5.33	0.84±0.54	<0.001*

Unpaired student t-test, *significant

Total patient (n=22) was categorized among Persistent Jaundice (n=12) and Jaundice Free (n=10) group. Then comparison between this 2 group was done with serum bilirubin (pre-operative period, at 14 days of operation, at 1 month of operation, at 3 month of operation, at 6 month of operation).Gradual decrease in serum bilirubin was observed in jaundice free group at 3 month of operation and it was 1.12(±0.72SD)mg/dl and in persistent jaundice group bilirubin was 9.91(±5.90SD)mg/dl, P value is <0.001which was statistically significantor jaundice free group and at 6 month of operation serum bilirubin was 0.84(±0.54SD)mg/dl while in persistent group was11.38(±5.33SD)mg/dl and P value was<0.001 which was statistically significant for jaundice free group (Table-4).

Table-5: Comparison of preoperative and postoperative GGT between jaundice free and persistent group (n=22)

Variables	Persistent jaundice (n=12) Mean ± SD(U/L)	Jaundice free (n=10) Mean ± SD(U/L)	p-value
Preoperative GGT	1208.42±855.82	900.40±582.81	0.346
Postoperative GGT at 14 days	1463.33±1145.49	1048.80±389.57	0.289
at 1 month	1667.58±1058.04	1143.1±550.0	0.173
at 3 month	784.7±668.8	306.1±91.6	0.037*
at 6month	711.3±446.4	213.1±89.1	0.002*

Unpaired student t-test, *significant

This table-5 shows comparison of pre-operative and post-operative GGT at different time interval between Persistent Jaundice (n=12) and Jaundice Free (n=10) group. Mean GGT was decreasing after surgery and in persistent jaundice group it was 711.3(±446.4SD)U/L at 6 months of operation while in jaundice free group it was 213.1(±89.1SD)U/Land P value was0.002 which was statistically significant.

Table-6: Comparison of preoperative and postoperative APRI between jaundice free and persistent group (n=22)

Variables	Persistent jaundice (n=12) Mean ± SD	Jaundice free (n=10) Mean ± SD	p-value
Preoperative APRI	1.95±1.52	1.10±0.54	0.110
Postoperative APRI at 14 days	2.26±4.01	1.10±0.44	0.376
at 1 month	1.08±0.57	1.07±0.44	0.979
at 3 month	1.61±1.11	0.80±0.40	0.041*
at 6month	1.22±0.53	0.39±0.14	<0.001*

Unpaired student t-test, *significant

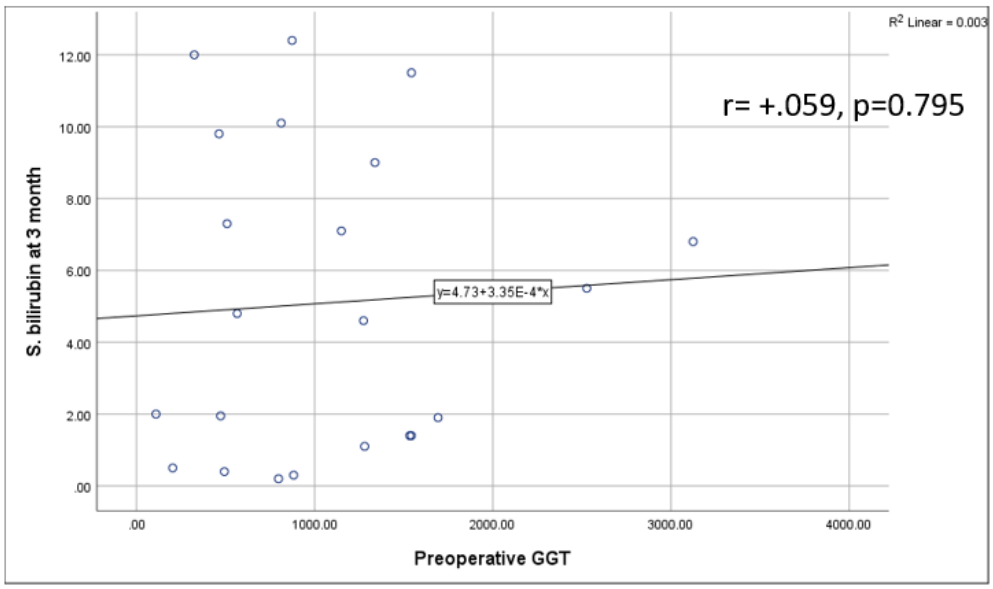
This table-6 shows comparison of pre-operative and post-operative APRI at different time interval between Persistent Jaundice (n=12) and Jaundice Free (n=10) group. Mean APRI value in persistent jaundice group at 6 month of operation was 1.22(±0.53SD) while in jaundice free group it was 0.39 (±0.14SD) and P value was <0.001, which was statistically significant.

Table-7: Comparison of native liver survival between Jaundice Free and Persistent Jaundice Group (n=22)

Native liver survival levels (parameters at 6 months)	Persistent jaundice (n=12) Mean ± SD	Jaundice free (n=10) Mean ± SD	p-value
S. Bilirubin (mg/dl)	11.38±5.33	0.84±0.54	<0.001*
ALT(U/L)	125.17±49.28	60.90±36.76	0.003*
ALP(U/L)	400.50±238.36	440.20±240.85	0.703
Albumin(gm/L)	25.08±5.90	37.90±2.69	<0.001*
GGT(U/L)	711.33±446.36	213.10±89.11	0.002*
APRI	1.22±0.53	0.39±0.14	<0.001*

Unpaired student t-test, *significant

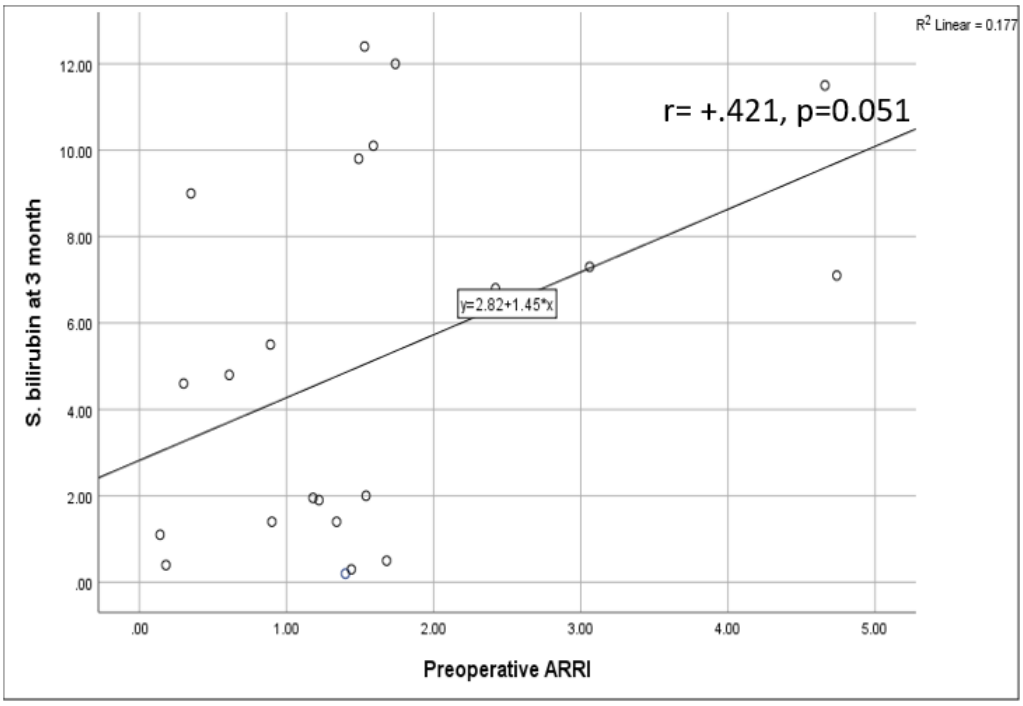
Table-7 shows patients who were jaundice free at 3 month after extended KPE they were remained jaundice free at 6 month also, mean bilirubin at 6 month after extended KPE was 0.84(±0.54SD), P value was <0.001, which was statistically significant. As well as SGPT, Albumin, GGT, APRI were also in normal range and P value was 0.003, <0.001, 0.002, <0.001 respectively which were statistically significant. This reflects patient who remained jaundice free at 3 month they also remained jaundice free at 6 month also and they survive with their native liver.



Pearson's correlation coefficient test

Figure 2: Correlation between preoperative GGT with serum bilirubin at 3 months after surgery

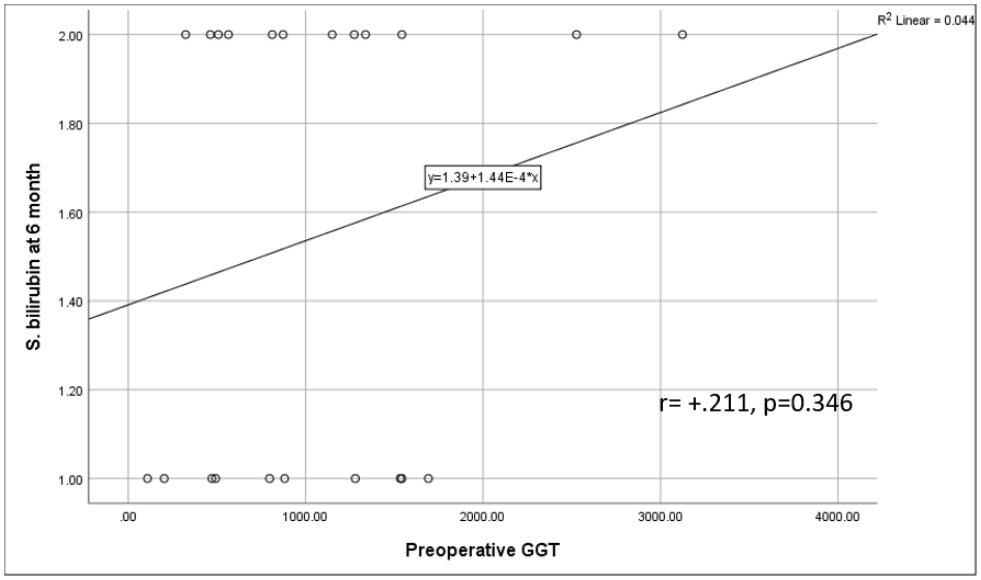
This figure shows positive correlation (r= +.059) between preoperative GGT with postoperative serum bilirubin at 3 months. Here independent variable (preoperative GGT) in X axis and dependent variable (serum bilirubin at 3 month after surgery) in Y axis.



Pearson's correlation coefficient test

Figure 3: Correlation between preoperative APRI with serum bilirubin at 3 months after surgery

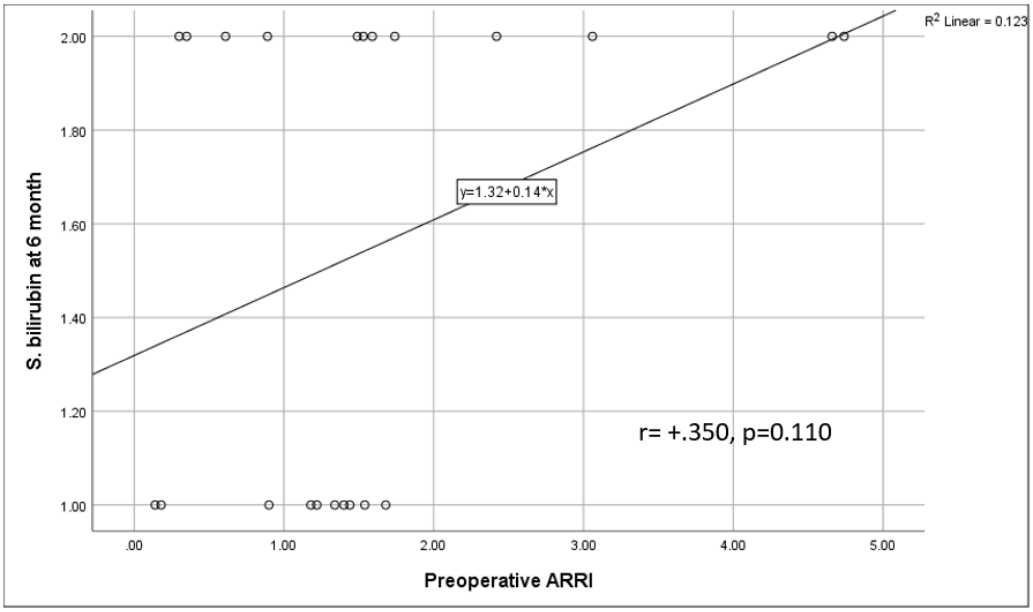
This figure shows positive correlation (r= +.421) between preoperative APRI with postoperative serum bilirubin at 3 months. Here independent variable (preoperative APRI) in X axis and dependent variable (serum bilirubin at 3 month after surgery) in Y axis. P value was 0.051, which was statistically significant.



Pearson's correlation coefficient test

Figure 4: Correlation between preoperative GGT with native liver survival at 6 months after surgery

This figure shows positive relation (r= +.211) between preoperative GGT with native liver survival at 6 months after surgery. Here independent variable(preoperative GGT) in X -axis and dependent variable(serum bilirubin at 6 month after surgery) in Y-axis.



Pearson's correlation coefficient test

Figure 5: Correlation between preoperative APRI with native liver survival at 6 months after surgery

This figure shows positive relation (r= +.350) between preoperative APRI with native liver survival at 6 months after surgery. Here independent variable(preoperative APRI) in X- axis and dependent variable(serum bilirubin at 6 month after surgery) in Y -axis.

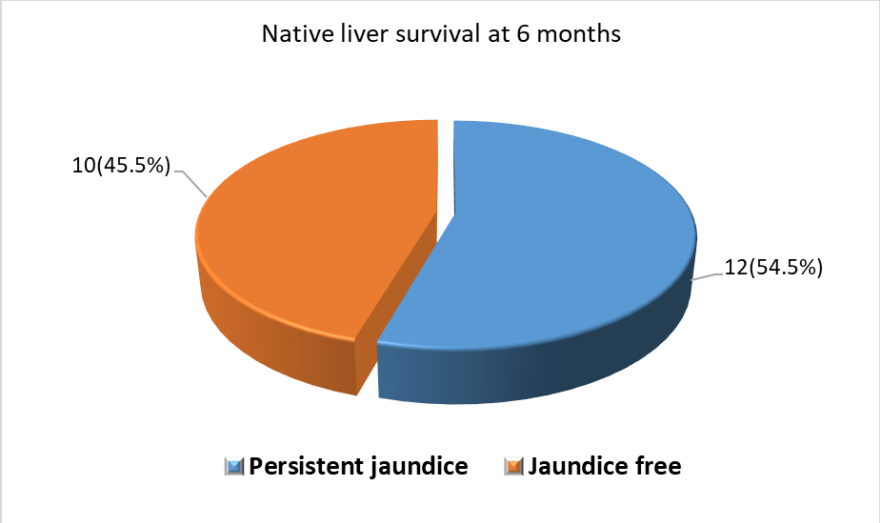


Figure 6: Pie diagram showing native liver survival at 6 months

This pie diagram shows (45.5%) patient had native liver survival at 6 month after surgery.

DISCUSSION

Biliary atresia is a destructive, progressive, inflammatory and obliteration of extra hepatic and or intra hepatic bile duct and ductules which lead to progressive liver fibrosis to end state liver failure [11]. After KPE restoration of bile drainage is ensured in approximately 62%-80% of infants who are operated before 60 days of age [12]. They also retain their native liver 55% for 10 year, 43% for 20 year and 38% for 30 year. Thus it delays the need for Liver Transplantation [13]. There are various studies regarding early predictor of outcome of Biliary atresia after KPE, among which age at operation, early jaundice clearance and APRI and GGT value at different time interval after KPE with predict the outcome. This will help to assess the Native Liver Survival and early candidate of Liver Transplantation [1,8-10]. In this study, total 25 patients with Biliary atresia underwent extended KPE among them 3 patients were excluded for death in early post-operative period. There were 10(45.5%) male and 12 (54.5%) female and male to female ratio was 1:1.2. Coran *et al.,* [4] also found a predominance off males exists with a female-to-male ratio was ranging between 1.4 to 1.7 to 1. In this study mean age at operation was 86.2 (±18.8SD) days. As there was delay in diagnosis and referral system in Bangladesh, we found these patients mostly at late age. Even though we operated 3 patients before 60 days of age. The patients who were operated before 90 days, showed a good outcome. Redkar *et al.,* [14] showed that best outcome was observed when operation was done before 60 day age and worsened with increasing age. Nio *et al.,* [13] did a retrospective study on 242 patients and showed that jaundice disappearance rates among <30 day age at KPE group was 100%, 31-60 day was 69.8%, both these groups had 10 year NLSR was 74.4%. 61-90 day age group had JDR 57% with NLSR was 74.5%. In >90 day age group had JDR 47.7% and NLSR was 7.7%. In this Observational Longitudinal study, we had done preoperative investigations as baseline marker. Mean serum bilirubin was started to decrease significantly after extended KPE which indicated adequate bile drainage. After 3 month of extended KPE 45.5% patients had jaundice clearance and this group of patients was also remained jaundice free after 6 month of extended KPE. Shneider *et al.,* [15] showed that after 3 month of KPE 50% had total bilirubin <2.0 mg/dl and their transplant free survival were 2 year. Bhatnagar *et al.,* [10] did a study with 61 patients which showed that 44.39% patients were anicteric 3 month after KPE. Early jaundice clearance can be a good predictor of long time survival. In this study high level of Preoperative mean GGT was observed among the study population which indicates cholestesis. Serum GGT levels for the Jaundice Free and Persistent Jaundice groups were obtained over different time interval after extended KPE. GGT was started to decrease significantly 3 months after operation in Jaundice Free group and significant low level of mean GGT was also found 6 month after operation. But GGT in Persistent Jaundice group was remained high after operation. Cirillo *et al.,* [16] did a retrospective analysis with 28 patients where pre-operative and postoperative GGT was analyzed. At diagnosis median GGT was 716 IU/L and 6 month after KPE GGT was 172 IU/L which shows that after successful KPE there is gradual decrease in GGT value. Ihn K *et al.,* [1] did a study with 169 infants of BA and they found that mean GGT was increased in both Jaundice Free and Persistent Jaundice groups before operation. GGT was started to decrease significantly after 2 month of KPE in Jaundice Free, where as in Persistent Jaundice groups PJ group GGT was increasing. Koga *et al.,* [17] analyzed that postoperative GGT at 3 month by dividing the Biliary Atresia patients treated by KPE into groups based on NLS after Jaundice Free and Liver Transplantation after Jaundice Free. They found that GGT levels for the group with Native Liver Survival after Jaundice Free were significantly lower than that of the group with Liver Transplantation after Jaundice Free. In this study I had

also found decrease in GGT value in jaundice free patients 6 month after operation. In this study Native Liver Survival was assessed at 6 month after extended KPE among Persistent Jaundice and Jaundice Free group using some variables like serum Bilirubin, Alkaline phosphatase (ALP), Aspartate Aminotransferase (AST), serum Albumin, GGT, APRI. The patients who were jaundice free at 3month after extended KPE they also remain jaundice free at 6 month and there were significant native liver survival among Jaundice Free group than Persistent Jaundice group. Witt *et al.*, [18] showed that six month post Kasai procedure Native Liver Survival positive patients had higher clearance of jaundice rate, significantly lower total and direct serum bilirubin, Alkaline phosphatase (ALP), Aspartate Aminotransferase (AST) levels compared to Native Liver Survival negative patients. In this study relationship between preoperative GGT and APRI with jaundice clearance after 3 months of operation by measuring serum bilirubin was done. Both preoperative GGT and APRI have a positive correlation for jaundice clearance. Redkar *et al.*, [14] showed that 42 (47.2%) patients had complete clearance of jaundice at 3 months post procedure. Jaundice clearance at 3 months post-surgery is a good early indicator of long term success. Grieve, Makin and Davenport *et al.*, [8] showed that APRI had moderate degree of correlation with age at surgery, bilirubin and spleen size. Suominen JS *et al.*, [9] showed that median APRI had a strong positive correlation with patient age, bilirubin. Here also a relationship between preoperative GGT and APRI with native liver survival at 6month after surgery is done which shows a positive correlation for native liver survival. In this study Native Liver Survival Rate was 45.5% among total study population. Though it is very early to draw conclusion regarding Native Liver Survival Rate.

CONCLUSION

Biochemical marker preoperative APRI and Get-together have a relationship to predict early jaundice clearance and the native liver survival. So this study concludes that preoperative PRI and GGT along with jaundice clearance rate act as a significant prognostic factor to assess the native liver survival rate and can predict who will be the early candidate of liver transplantation.

Limitations

1. There was delay in diagnosis of Biliary Atresia and also referral system in our country, we found these patients in late age, so there was delay in operation and outcome was varied as we know earlier the operation better will be the outcome.
2. Due to time constrain long term follow up was not possible, which is very early to comment regarding native liver survival.
3. All the extended KPE was done by single surgical team so the operative outcome of other surgical team was not evaluated.

Recommendation

1. Preoperative APRI and GGT can be used as a predictive marker of outcome.
2. Larger scale study is required to establish the findings.
3. Early diagnosis and referral system should be ensured for early surgical intervention which leads to long time survival with native liver.

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