AIM OF THE WORK

The aim of this work is to study the predictors of the clinical outcome after Kasai portoenterostomy done for cases with biliary atresia.

PATIENTS

Twenty patients diagnosed as biliary atresia during the period from January 2013 to January 2014 were included in our study. They were subjected to Kasai portoenterostomy. The operation was done in the National Liver Institute, Menoufia University and Pediatric Surgery Department, Alexandria University, Children's Hospital (AUCH). An informed consent was obtained from the parents or from the legal guardians of the patients.

Inclusion criteria

- Patients less than 3 months old
- Patients with Child-Pugh classification A or B (**Table 3**) [115,116]

Exclusion criteria

- Patients more than 3 months old
- Patients with advanced liver failure (Refractory ascites, esophageal varices, hepatic encephalopathy)
- Patients with general contraindications to surgery

Follow up for 6 months postoperatively was done by examination & assessment of total serum bilirubin and liver profile.

Table 3: Child-Pugh classification of liver disease[115,116]

Parameter	1 point	2 points	3 points
Total bilirubin (mg/dl)	<2	2-3	>3
Serum albumin (g/dl)	>3.5	2.8-3.5	<2.8
INR	<1.7	1.71-2.30	> 2.30
Ascites	None	Mild or medically controlled	Moderate to Severe or refractory
Hepatic encephalopathy	None	Grade I-II (or suppressed with medication)	Grade III-IV (or refractory)
Interpretation: Child-Pugh A (5-6), B (7-9), C (10-15)			

METHODS

All cases included in this study were subjected to the following:

Preoperative workup

❖ History

Detailed history was taken from all patients with special emphasize on:

1. Demographic data (Age, sex, residence)

2. Thorough history taking (Onset of jaundice, colour of stool and urine)

3. Family history: of any similar conditions

❖ Clinical examination

All patients were subjected to clinical examination with special emphasize on the following points:

1. Anthropometric measurements

2. Abdominal examination

3. Other associated congenital anomalies (BASM, other syndromes, non-syndromic anomalies)

❖ Investigations

1. **Laboratory**

All patients were investigated for CBC and liver function profile as following:

► CBC
► Biochemical tests of liver function
  - PT, PTT, INR
  - Plasma proteins and serum albumin levels.
  - Serum bilirubin (total, direct, indirect).

  - Liver enzymes: Alanine aminotransferase (ALT) & aspartate aminotransferase (AST).

  - Cholestatic enzymes: γ-Glutamyl transpeptidase (GGT) & alkaline phosphatase (ALP)

2. **Radiology**

Abdominal US was done to all patients with special emphasize on

  ☒ Liver size & echogenicity
  ☒ Splenic size

☒ Presence or absence of ascites and its degree if present
☒ Biliary system:
   1) Gall bladder: presence, pre and post-prandial size, shape, postprandial contractions and any cystic dilatation
   2) TC sign (Triangular cord sign)

3. Percutaneous liver biopsy

Percutaneous liver biopsy was done for all patients preoperatively confirming diagnosis & excluding other causes of cholestasis. The specimens were stained with hematoxylin and eosin (H and E).

Six variables of liver histology were assessed:[118]
1) Bile ductular proliferation
2) Hepatocyte alteration
3) Cholestasis
4) Bile duct edema, inflammation
5) Bile duct thrombi
6) Fibrosis

And two variables of the portal tract were also evaluated:[118]

1) Portal tract inflammation
2) Portal tract fibrosis.

These features were graded from grade 0 to grade 3 reflecting increasing intensity of the feature (Table 4). However liver fibrosis was graded from grade 0 to grade 4 according to its degree (Table 5).[118]

Table 4: Grades of hepatic pathological changes in preoprative liver biopsy

Grade	Pathological change
0	No changes
1	Mild changes
2	Moderate changes
3	Severe changes

Table 5: Grades of liver fibrosis in preoperative liver biopsy

Grade	Portal tract fibrosis
0	No fibrosis
1	Mild portal fibrosis
2	Porto-septal; non bridging fibrosis
3	Bridging fibrosis
4	Cirrhosis

Operative data

All patients were subjected to open Kasai portoenterostomy[9] & the following data were collected:

1. Intraoperative cholangiogram
2. Procedure (Kasai portoenterostomy).[9]
3. Duration of surgery
4. Procedure for any associated anomalies
5. Management of immediate postoperative complications

Postoperative follow up

All cases were followed up for 6 months by clinical examination and evaluation of postoperative serum bilirubin, GGT and alkaline phosphatase.[118]

❖ Clinical outcome

According to the postoperative findings; the studied patients were divided into three groups:

1. Mortalities

2. Survival non-icteric

These patients are in whom total serum bilirubin was < 2 mg/dl

3. Survival icteric

These patients are in whom total serum bilirubin was > 2 mg/dl.[71,119]

❖ Complications

Non-functioning portoenterostomy, cholangitis and/or end stage liver failure were assessed.

❖ Schedule for liver transplantation

Number of patients who were scheduled for liver transplantation was recorded and the indications for transplantation were assessed.

Statistical analysis

Comparison of the groups according to preoperative predictors of clinical outcome was taken by statistical analysis. Data were coded, entered and analyzed using the Statistical Package for Social sciences (SPSS, version 18). Multiple checks were carried out to ensure correct data entry and coding. For quantitative variables, mean, standard deviation and median were used for presentation, while for qualitative variables; numbers and percentages were used. Studied patients were divided into three groups based on their outcome. Comparison between them were carried out using Mann-whitney U test of significance for testing the statistical difference in quantitative variables and Fisher's Exact test and Monte-Carlo test for qualitative variables. All results were interpreted at 5% level of significance.

Multiple logistic regression of the factors affecting the clinical outcome was performed to reach the factors which are directly predicting this outcome.

RESULTS

Preoperative data

❖ Demographic data

This study included 20 patients with biliary atresia who were treated by Kasai portoenterostomy. The demographic data were as following:

➲ The age of the studied patients at time of presentation ranged from 1-21 days & at operation from 50-90 days as represented in Table 6:

Table 6: Age at presentation and at time of surgery of studied patients

	Onset of jaundice (days)	**Age at Kasai (days)**
Mean ± SD	١٢.٥ ± 5.2	64.05 ± 11.99
Median	14	60
Total	20	20

➲ The current study included eleven females (55%) and nine males (45%) with female to male ratio 1.2:1.

➲ The distribution of patients according to their residence was as shown in Table 7:

Table 7: Distribution of patients according to their residence

	Frequency	**Percentage**
Alexandria	4	20
Elbehira	6	30
Elsharqia	4	20
Elmenoufia	2	10
Cairo	3	15
Aswan	1	5
Total	20	100

❖ Presenting history

Thorough history taking including onset of jaundice, colour of stool and urine were taken and declared that all patients had jaundice and dark colour urine at time of presentation but only 14 patients (70%) presented with clay colour stools and 6 patients (30%) didn't show any change of stool colour. (**Figure 19**)

❖ Family history

There was no definite family history among the studied group.

❖ Clinical examination

1. Anthropometric measurement

The weight & height at time of operation were different among the studied patients. The body weight was about 4.46 ± 0.47 Kg and their height was about 51.26 ± 1.13 cm as shown in Table 8**:**

Table 8: Anthropometric distribution of the studied group

	Weight (kg)	Height (cm)
Mean ± SD	4.46 ± 0.47	51.26 ± 1.13
Median	4.5	51.35
Total	20	20

2. Clinical presentation

Although the presentation was variable among the studied patients; jaundice, hepatomegaly and liquorice urine were present in all patients. 75% of the patients had splenomegaly; in comparison to ascites and associated congenital anomalies which were present in small percentage of patients. (**Figure 19**)
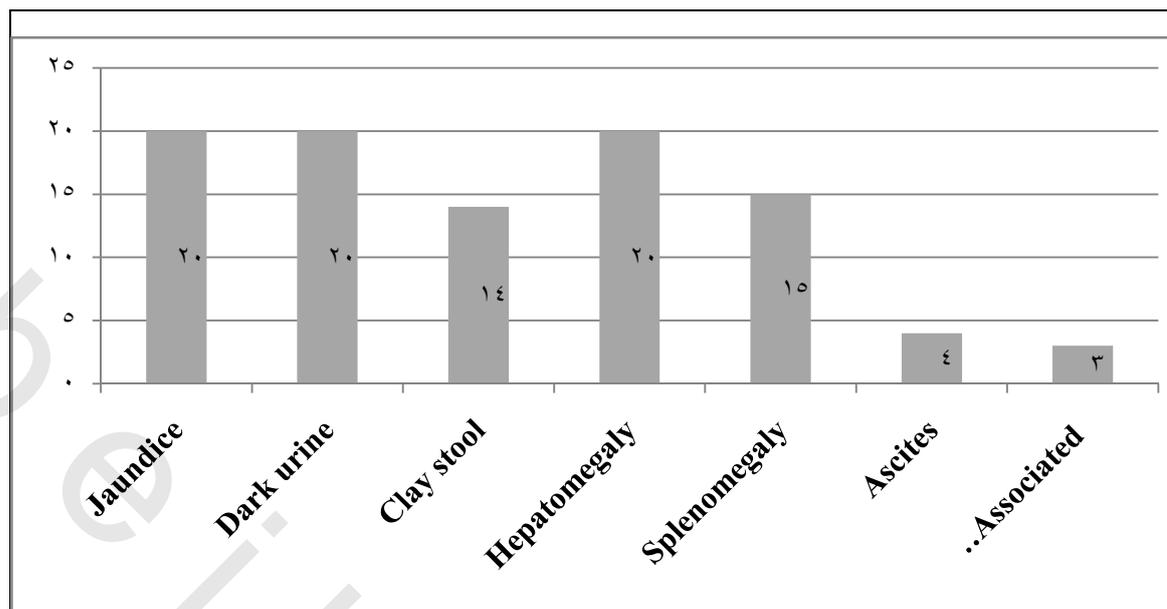
Figure 19: Clinical presentation of studied patients

3. Other associated congenital anomalies

Three patients (15%) suffered from associated congenital anomalies. One of them had cardiac anomaly in the form of ventricular septal defect. The second one had cardiac anomaly in the form of patent foramen ovale associated with situs inversus, and the last patient had preduodenal portal vein. **(Figure 20)**

Figure 20: Malrotation in case of biliary atresia, the arrow points to left side appendix

❖ Investigations

1. Laboratory (Table 9)

- **CBC**

All patients had normochromic normocytic anemia with normal WBCs and platelet count.

- **Serum bilirubin**

The total serum bilirubin among the studied patients was 14-23 mg/dl and the range of its direct fraction was 9-19.7 mg/dl. The indirect fraction of bilirubin was 10.7-5.1 mg/dl.

- **Liver enzymes:**

The preoperative liver enzymes were elevated about 2-3 times the upper limit of normal as the level of ALT was 160-200 U/L and that of AST was 200-300 U/L. However, the preoperative cholestatic enzymes were shooting being elevated 5-6 times the upper limit of normal as GGT was 450-1090 U/L and alkaline phosphatase was 950-1450 U/L.

- **PT, PTT, INR**

The bleeding profile was highly affected in most patients and it was corrected by vitamin K preoperatively.

- **Plasma proteins and serum albumin levels:**

Most of the patients suffered from hypoprotienemia & hypoalbuminemia. The total plasma proteins ranged from 3-4.3 g/dl and the range of serum albumin was 1.6-2.4 g/dl.

Table 9: Preoperative laboratory investigations

	Mean ± SD	Median	Normal value[117]
Bilirubin total (mg/dl)	18.79 ± 2.77	18.75	<1
Bilirubin direct (mg/dl)	15.28 ± 2.82	15.3	0.1-0.3
Bilirubin indirect (mg/dl)	3.51 ± 1.03	3.5	0.7-0.9
AST (U/L)	254.35 ± 32.81	250	30-80
ALT (U/L)	186.15 ± 12.56	190	5-50
GGT (U/L)	721.7 ± 236.17	595	6-19
ALP (U/L)	1119.8 ± 169.5	1075	30-120
PTT (Seconds)	42.55 ± 11.84	38.1	25-38
INR	1.42 ± 0.36	1.26	<1
PT activity (%)	60.18 ± 18.31	190	5-50
PT (Seconds)	15.78 ± 4.25	14.15	11-13
Plasma proteins (g/dl)	3.61 ± 0.51	3.5	4.6-7.4
Serum albumin (g/dl)	2.07 ± 0.28	3	2.5-3.4

2. Radiological examination

US abdomen was done for all patients revealing the following results:

► Hepatomegaly

All patients had hepatomegaly however with different degrees; the median length of which is 2.9 cm. The length of lower hepatic margin below costal margin ranged from 1.6 cm to 4.5 cm with average of 2.97±0.92 cm.

► Liver echogenicity

There was diffuse hepatic parenchymal heterogeneity in 12 patients (60%)

► Splenomegaly

The presence of splenomegaly was confirmed by US in all patients similar to the results of clinical examination. (**Figure 19**)

► Ascites

US abdomen detected the presence of minimal amount of ascites in 4 patients (20%) and absence in 16 patients (80%). (**Figure 19**)

► Biliary tract:

1. TC Sign (Triangular cord sign)

The TC sign was found in only 12 patients (60%) however, 8 patients (40%) didn't show TC sign.

2. Gall bladder:

The shape of the gall bladder was different among the different patients. The different presentations are shown as following: **(Table 10)**

Table 10: The findings of gall bladder in studied group

Gall bladder	Frequency	Percent
Non visualized	2	10
Normal size & appearance however there was no increase in contractions postprandial	2	10
Flat & small	13	65
Flat & small with proximal cystic dilatation 12mm*9mm	2	10
Streak gallbladder without capsular space	1	5
Total	20	100

3. Preoperative liver biopsy

Six variables in the preoperative liver biopsy were assessed including hepatocyte alteration, cholestasis, bile ductular proliferation, bile duct edema, inflammation and fibrosis. The studied patients showed different grades of these variables as shown in the following table: (**Table 11**)

Table 11: Grades of change in preopreative liver biopsy

	Frequency	Percent
Grade 0 (No changes)	8	40
Grade 1 (Mild changes)	3	15
Grade 2 (Moderate changes)	2	10
Grade 3 (Severe changes)	7	35
Total	20	100

The grade of liver fibrosis was different among the studied patients with nearly 40% of them showing no fibrosis as shown in the following table: (**Table 12**)

Table 12: Distribution of the studied group according to level of hepatic fibrosis

	Frequency	Percent
Grade 0 (No fibrosis)	8	40
Grade 1 (Mild portal fibrosis)	3	15
Grade 2 (Porto-septal; non bridging fibrosis)	1	5
Grade 3 (Bridging fibrosis)	3	15
Grade 4 (Cirrhosis)	5	25
Total	20	100

Operative data

❖ Intraoperative cholangiogram

Sixteen patients were subjected to intraoperative cholangiogram showing no dye flowing into the intrahepatic bile ducts confirming the diagnosis. However, four patients had no intraoperative cholangiogram. They had preoperative MRCP confirming the diagnosis. **(Figure 21,Figure 22)**
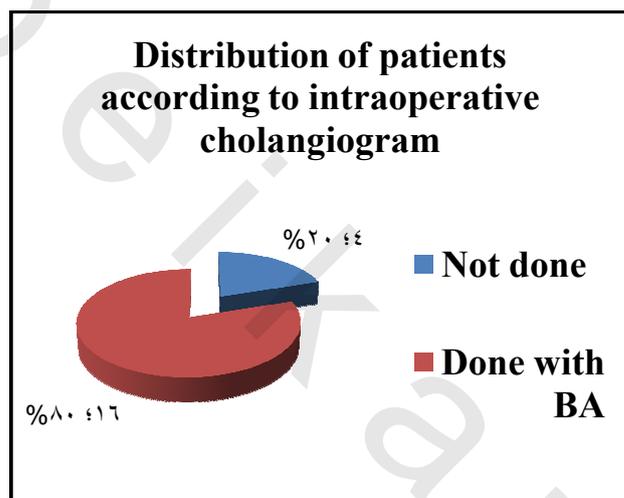

Figure 21: Results of intraoperative cholangiogram

Figure 22: Intraoperative cholangiogram with non-visualization of intrahepatic bile duct

❖ Kasai portoenterostomy

All patients were subjected to classical open Kasai portoenterostomy and there were no immediate intraoperative complications and the associated anomalies were not managed in the same session.

❖ Operative duration

The operative duration differed among the studied patients ranging from 120 to 200 minutes with average of 164.5 ± 27.04 min and median of 165.

Postoperative follow up

❖ Postoperative clinical outcome

Postoperative steroids were not used however; cholegogues and multivitamin oral supplement were used with the start of oral feeding on long term bases. Antibiotics were used for only two weeks postoperatively.

There were no mortalities among the studied group during the period of follow up. The outcome was assessed among the studied patients by follow up for six months post-operatively by measuring the level of serum bilirubin , GGT and ALP.

There were 11 patients who showed gradual decrease of serum bilirubin and stabilization of the liver function tests and 9 patients showed sustained high levels of serum bilirubin and deterioration of liver function tests. As a result; patients were divided into; patients who survived non-icteric and those who survived icteric. **(Figure 23)**
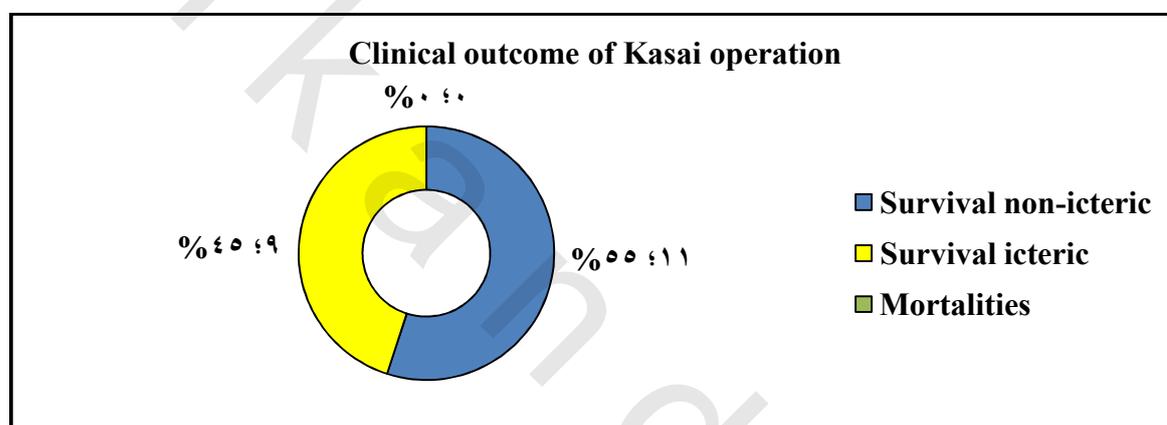

Figure 23: Clinical outcome of Kasai portoenterostomy among studied group

❖ Postoperative serum bilirubin & liver enzymes:

In general, the level of total serum bilirubin and cholestatic enzymes 6 months postoperatively were as following: **(Table 13)**

Table 13: Postoperative serum bilirubin & liver cholestatic enzymes

	Serum bilirubin (mg/dl)	GGT (U/L)	ALP (U/L)
Mean± SD	5.82±4.55	188.3±131.33	419.75±234.06
Median	2	98.5	305

Comparing the two groups; the levels of serum bilirubin, GGT and ALP showed dramatic decline in the non-icteric group in comparison to the preoperative levels. However, patients in the icteric group showed maintained high levels of these tests postoperatively**. (Figure 24,Figure 25,Figure 26)**
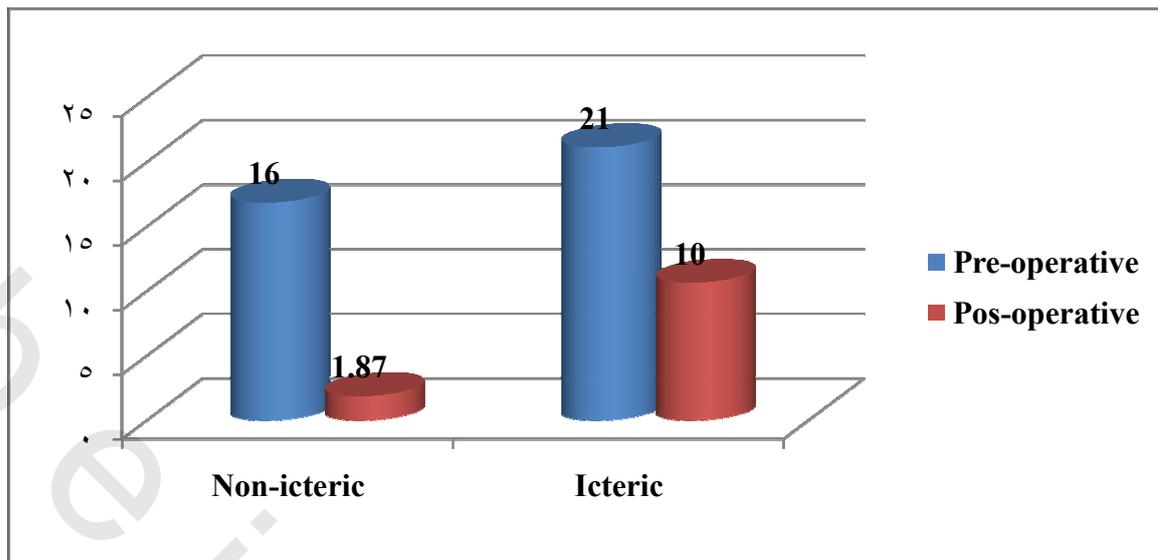
Figure 24: Perioperative change of serum bilirubin in non-icteric & icteric groups
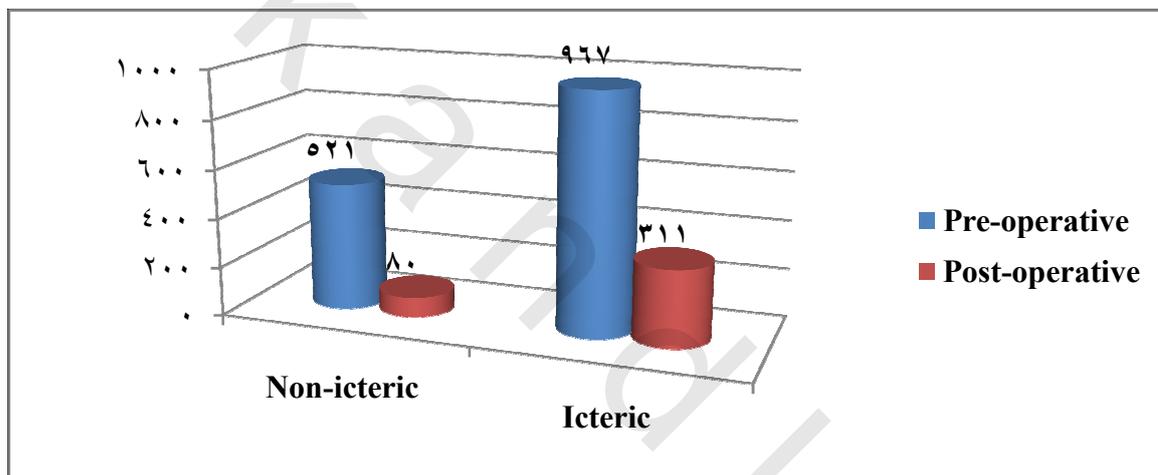

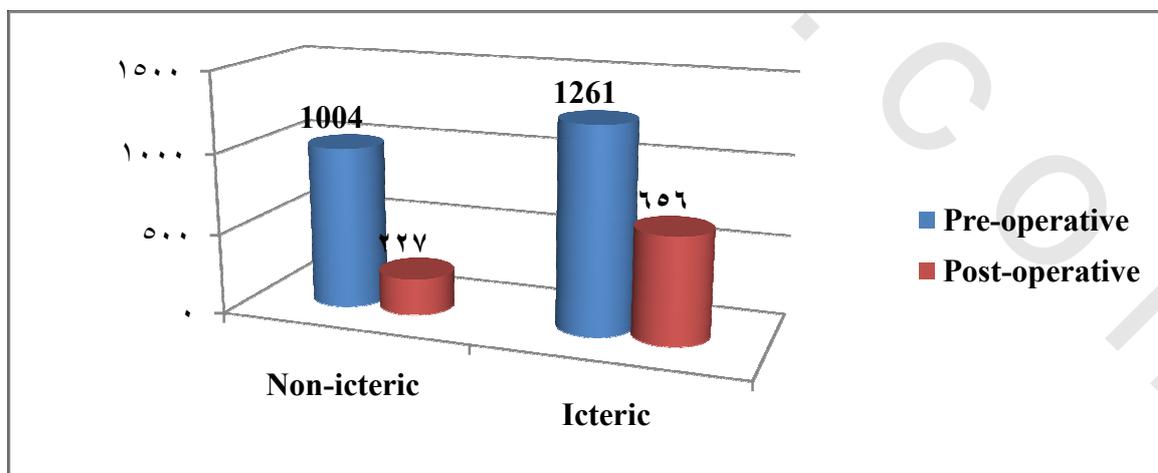**Figure 25:** Perioperative change of GGT level in non-icteric & icteric groups.

Figure 26: Perioperative change of alkaline phosphatase in non-icteric & icteric groups**.**

❖ Postoperative complications

The post-operative complications were encountered among 12 patients during the follow up period. The distribution of these complications among the studied patients is shown in the following table: (**Table 14**)

Table 14: Distribution of postoperative complications

	Complications	Number	Percent in the group
Non-icteric group (number = 11)	No complications	8	73%
	Cholangitis	1	9%
	Adhesive IO	1	9%
	Biliary anastomotic leakage	1	9%
Icteric group (Number = 9)	Non-functioning portoenterostomy	9	100%
	Severe ascites	2	22%
	Moderate ascites	7	78%
	Progressive splenomegaly	9	100%

Among the non-icteric patients; one patient developed biliary anastomotic leakage on the 5th postoperative day. There was neither peritonitis nor systemic manifestations with open bowel and sustained decrease in serum bilirubin and liver profile tests. Conservative measures were initiated by starting broad-spectrum intravenous antibiotics effective against Gram-negative organisms (Gentamicin and Tazocin {piperacillin/tazobactam}) and close follow up. The leakage responded to conservative measures with gradual decrease in the leaking amount till spontaneous closure.

There was only one patient who developed acute attack of cholangitis postoperatively and belonged to the non-icteric group. The patient presented with pyrexia, worsening jaundice and change in liver biochemistry. He was treated aggressively with broad-spectrum intravenous antibiotics effective against Gram-negative organisms (Gentamicin and Tazocin{piperacillin/tazobactam}) with gradual improvement.

The last patient among the non-icteric group who developed postoperative complications developed adhesive intestinal obstruction 4 months postoperatively with bilious vomiting, abdominal distension and constipation. There was neither local signs of peritonitis nor associated deterioration of the general condition. Investigations revealed mild leukocytosis, multiple air fluid levels in the standing view of X-ray abdomen with no abdominal collection. Conservative measures were started by inserting nasogastric tube, nothing per os, IV fluids and antibiotics. The decision for abdominal exploration was taken after failed conservative measures. Abdominal exploration revealed massive adhesions with viable bowel; adhesiolysis was done with smooth postoperative period.

Nonfunctioning portoenterostomy developed in nine patients (icteric group). Among these patients; liver related complications in the form of signs of portal hypertension progressively developed in all patients. Massive ascites was encountered in two patients; in

whom paracentesis was done beside medical treatment. Moderate to severe ascites developed in 7 patients who were controlled with medical treatment and paracentesis. Progressive increase in splenic size was detected in all icteric patients.

❖ Schedule for liver transplant

All the nine patients in the icteric group were scheduled for liver transplant as soon as possible.

Factors affecting the clinical outcome

❖ Preoperative factors

1. Demographic data

➔ Age at Kasai operation

The age at operation differed between the two groups being lower in the non-icteric group (56.91±5.77) days than in the icteric group (72.78 ±12.02) days. This difference was statistically significant by using Mann-Whitney U test (Z= 2.987, P=0.003).

➔ Sex distribution

There was no statistically significant difference between the two groups regarding sex distribution as shown in the following table: **(Table 15)**

Table 15: Association between sex distribution and clinical outcome

Sex	Non-icteric	Icteric	Fisher's Exact test of significance
Male	7	2	
Female	4	7	P=0.092
Total	11	9	

2. Clinical examination

➔ Ascites

Mild ascites was detected in 4 patients preoperatively and 16 patients didn't show ascites. All of the patients with preoperative ascites survived icteric postoperatively with statistically significant difference between the two groups (P=0.026). (**Table 16**)

Table 16: Association between preoperative ascites and the clinical outcome post KPE.

Ascites	Non-icteric		Icteric		Fisher's Exact test of significance
	N	%	N	%	
Nil (N=16)	11	68.7	5	31.3	**P=0.026***
Mild (N=4)	0	0	4	100	

➔ **Splenomegaly**

The presence of splenomegaly showed no statistically significant difference between the two groups using Fisher's Exact test of significance (P=1) as shown in Table 17.

Table 17: Association of preoperative splenomegaly & the clinical outcome:

Splenomegaly	Non-icteric		Icteric		Fisher's Exact test of significance
	N	%	N	%	
Nil (N=5)	3	60	2	40	P=1
Positive(N=15)	8	53.3	7	46.7	

➔ **Child-Pugh score**

The mean of child-Pugh in the non-icteric group was 7.27±0.47; however it was higher in the icteric group being 8.22±0.67. This difference was statistically significant by Mann-Whitney U test (Z= -2.895, P= 0.006)

➔ **Associated congenital anomalies**

Although all patients who had associated congenital anomalies survived icteric postoperatively; the difference between the two groups according to the presence of associated anomalies didn't show statistical significance as shown in Table 18.

Table 18: Association between presence of other congenital anomalies and outcome

Associated congenital anomalies	Non-icteric		Icteric		Fisher's Exact test of significance
	N	%	N	%	
No (N=17)	11	64.7	6	35.3	P=0.07
Yes (N=3)	0	0	3	100	

3. Preoperative laboratory investigations

The difference in preoperative laboratory investigations and their effect on the the clinical outcome is summarized as following: (**Table 19**)

➔ **Preoperative serum bilirubin**

The total serum bilirubin as well as its direct fraction were lower in the non-icteric group preoperatively & showed statistically significant difference between the two groups.

➔ **Preoperative liver enzymes**

The preoperative levels of liver and cholestatic enzymes showed statistically significant difference between the two groups

➔ **Preoperative plasma proteins, serum albumin & bleeding profile**

The preoperative levels of plasma proteins and serum albumin were different between the two groups. Both of them showed statistical significance (P=0.000). However, the difference in bleeding profile between the two groups didn't show statistical significance.

Table 19: Comparison of the two groups regarding preopertive laboratory investigations

Variable	Non icteric	Icteric	Mann-Whitney U test of significance
	Mean ± SD	**Mean ± SD**	
Bilirubin total (mg/dl)	16.86±1.67	21.44 ±1.85	**Z=-3.424** **P=0.001***
Bilirubin direct (mg/dl)	13.6±2.26	17.33±1.97	**Z=-3.082** **P=0.002***
Bilirubin indirect (mg/dl)	3.26±1.23	3.81±0.66	**Z=-1.256** **P=0.2**
AST (U/L)	232.09±22.7	281.56 ±19.96	**Z=-3.432** **P=0.001***
ALT (U/L)	178.36±11.81	195.67±3.91	**Z=-3.137** **P=0.002***
GGT (U/L)	520.82±53.47	967.22±74.8	**Z=-3.764** **P=0.000***
ALP (U/L)	1004.18±77.62	1261.11±140.93	**Z=-3.434** **P=0.001***
Plasma proteins (g/dl)	4±0.31	3.13±0.19	**Z=-3.6467** **P=0.00026***
Serum albumin (g/dl)	2.3±0.06	1.78±0.15	**Z=-3.7227** **P=0.0002***
PT (sec)	17.36±4.9	13.85±2.29	**Z=-1.563** **P=.118**
PT activity (%)	53.99±19.62	67.74±14.07	**Z=-1.523** **P=0.128**
PTT (sec)	46.48±14.09	37.75±6.13	**Z=-1.334** **P=0.182**
INR	1.55±0.41	1.26±0.21	**Z=-1.486** **P=0.137**

4. Preoperative abdominal ultra sonographic findings

➔ Preoperative liver size under costal margin by US

The liver size under the costal margin in the non-icteric group was (2.62±0.86) cm being smaller than in the icteric group (3.4±0.85) cm. This difference showed statistical significance by Mann-Whitney U test (Z= -2.064, P= 0.038).

➔ Preoperative liver echogenicity

Parenchymal liver heterogeneity was detected preoperatively in 12 patients only; 3 from the non-icteric group and in the entire icteric group. The difference between the two groups of the clinical outcome regarding this variable showed statistical significance. (**Table 20**)

Table 20: Effect of liver echogenecity on the clinical outcome

Liver echogenecity	Survival non-icteric		Survival icteric		Test of significance
	N	%	N	%	Fisher's Exact test P= 0.001381*
Homogenous	8	100	0	0	
Heterogenous	3	25	٩	75	

➔ Preoperative TC sign

Presence of preoperative TC sign didn't show statistically significant difference between the two groups by Fisher's Exact test as shown in Table 21.

Table 21: Correlation of preoperative TC sign with the outcome

TC sign	Survival non-icteric		Survival icteric		Test of significance
	N	%	N	%	Fisher's Exact test P=0.19
Nil	6	75	2	25	
Positive	٥	58.3	٧	41.7	

5. Preoperative liver biopsy

A. Grade of liver fibrosis

The degree of liver fibrosis showed statistically significant difference between the two groups of the clinical outcome. All the patients who had no fibrosis in the preoperative liver biopsy showed good outcome postoperatively. However, patients with preoperative cirrhosis didn't show improvement postoperatively. **(Table 22)**

Table 22: Association between the grade of liver fibrosis and the clinical outcome

Liver fibrosis grade	Non-icteric		Icteric		Monte Carlo test of significance
	N	%	N	%	
0: (No fibrosis, N=8)	8	٧٣	0	0	
1: (Mild portal fibrosis, N=3)	3	٢٧	0	0	
2: (Porto-septal; non bridging fibrosis, N=1)	0	0	1	11	X2= 20
3: (Bridging fibrosis, N=3)	0	0	3	33	P=0.000*
4: (Cirrhosis, N=5)	0	0	5	56	
Total	11	100	9	100	

B. Other parameters in liver biopsy

The degree of pathological changes in parameters of preoperative liver biopsy rather than fibrosis including hepatocyte alteration, cholestasis, bile ductular proliferation, bile duct edema and inflammation were different between the two groups. This difference between the two groups was statistically significant as shown in Table 23.

Table 23: Association between the other liver biopsy parameters and outcome

Grade of pathological change	Non-icteric		Icteric		Monte Carlo test of significance
	N	%	N	%	
0: No change, N=8	8	73	0	0	
1: Mild changes, N=3	3	27	0	0	X2= 20
2: Moderate changes, N=2	0	0	2	22	P=0.000*
3: Severe changes, N=7	0	0	7	78	
Total	11	100	9	100	

❖ Operative factors

There was a slight difference between the two groups regarding the operative duration being (161.8±24.8) min in the non-icteric group with median of 150 and (167.8±30.7) min in the icteric group with median of 180 min. This difference wasn't statistically significant. (Mann-Whitney U test of significance, Z=0.594, P=0.6)

Independent predictors of the clinical outcome

Multiple logistic regression analysis of the significant factors of the non-icteric outcome revealed that only preoperative total bilirubin is a significant predictor of the non-icteric outcome.

Table 24 shows that, every 10% decrease in the patient's total bilirubin preoperatively, there are 2.5 times increase in the probability of success of Kasai portoenterostomy that is the occurrence of the non-icteric outcome.

Table 24: Multiple logistic regression analysis

Variable	Relative risk	Significance	B
Total bilirubin	0.264	0.035	-1.403

- Model Chi-Square 17.221   P=0.000
- Constant   26.725   P=0.034