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Original Research

Clinical Correlation Between Pre and Post ERCP Laboratory Values

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Abstract

Background: Endoscopic retrograde cholangiopancreatography (ERCP) has evolved from a diagnostic modality to a primarily therapeutic procedure for pancreatic as well as biliary disorders. However, several complications were described post-procedure such as pancreatitis, perforation, cholangitis, post-sphincterotomy bleeding, etc. Data concerning variation in laboratory values before and after ERCP and its clinical significance with respect to endoscopic findings and possible complications is lacking in the literature.
Aim: To analyze the clinical significance of laboratory values in patients before and after ERCP.
Methods: From a total of 723 patients, 363 with different sets of findings on ERCP were eligible to be included in the study and were divided into 8 different groups. Serum levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), Gamma-glutamyl transferase (GGT), Alkaline phosphatase (ALKP), bilirubin, amylase, lipase, C-reactive protein (CRP), white blood count (WBC), neutrophils, lymphocytes, monocytes, eosinophils, basophils, platelet count and creatinine were determined preoperatively as well as postoperatively in these patients.
Results: AST and direct bilirubin showed a significant difference in all patients between pre and post-ERCP (p-value<0.01 and p-value <0.05, respectively). Liver tests were significantly higher in the malignant obstruction group than in the bile duct stones group (p-value <0.05) and decrease more significantly (p-value <0.05) after the procedure. A significant increase in lipase (p-value<0.05) among all groups was found, and interestingly, the lymphocytic count showed a significant decrease (p-value<0.01).
Conclusion: In conclusion, (1) ERCP significantly decreases AST, direct bilirubin, lymphocytes, and monocytes count post procedure among all stratified groups of obstructive etiology thus proving its therapeutic value for biliary system obstructions. (2) Higher baseline disturbances in laboratory values at T0, especially in liver function tests such as ALT, AST, GGT, and ALKP as well as a bigger decrease in lymphocyte count at T1 are noted to be linked with malignant obstructions (tumor group), rather than benign obstructions (stone, sludge, stone + sludge, and stricture). (3) Finally, stone and stricture groups are at the highest risk of post-ERCP pancreatitis owing to those groups having the highest pancreatic enzyme levels post ERCP, and thus should be the best candidates for a pre-ERCP pharmacologic prophylaxis (such as diclofenac, etc) and post ERCP close monitoring.

Keywords: Endoscopy, Endoscopic retrograde cholangiopancreatography, Pancreatitis, Cholangitis, Choledocholithiasis, Biliary sphincterotomy, Stricture

Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) has been a procedure that created a turning point in the field of endoscopic gastroenterology. It was originally founded in 1968 as a diagnostic tool to evaluate the biliary and pancreatic ductal systems [1]. With the introduction of the first biliary sphincterotomy five years later in 1973 [2], this technique evolved to become a therapeutic procedure that rendered many surgical interventions obsolete. This procedure is a combination of endoscopy and fluoroscopy, where an endoscope is advanced in the second part of the duodenum where entry through the major duodenal papilla allows access to the biliary and pancreatic system and use of contrast material for radiologic diagnosis and treatment of specific etiologies [3]. Indications for the use of ERCP include "obstructive jaundice, biliary or pancreatic ductal system disease treatment or tissue sampling, suspicion for pancreatic cancer, pancreatitis of unknown cause, manometry for sphincter of Oddi, nasobiliary drainage, biliary stenting for strictures and leakage, drainage of pancreatic pseudocysts, and balloon dilation of the duodenal papilla and ductal strictures" [3]. However, several complications were described post-procedure such as pancreatitis, perforation, cholangitis and cholecystitis, post sphincterotomy bleed and restenosis, cardiovascular events, pneumothorax, mediastinal or subcutaneous emphysema, splenic injury and mortality [3,4]. Prognosis is related to the timing of the intervention as well as etiology; a recent study by Tan et al. [5], showed that for acute cholangitis, early ERCP within 24 hours is associated with lower 30-day mortality. What is notable is that until now, data concerning variation in laboratory values before and after ERCP and its clinical significance, is lacking in the literature.

On this basis, we conducted a retrospective study over the last two years, in our gastroenterology and hepatology unit at Saint George Hospital University Medical Center (SGHUMC) to try to find a correlation between laboratory values before and after ERCP with respect to endoscopic findings and possible complications.

Materials and Methods

Patients

Data collection was done for "in" and "out" patients who have undergone an ERCP done at Saint George University Medical Center (SGHUMC), a tertiary medical center, between the years 2018 and 2020 using Microsoft Excel Spreadsheet Software. The collected data consisted of patients' names, sex, age, ERCP report, and laboratory values including alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma-glutamyl transferase (GGT), alkaline phosphatase (ALKP), bilirubin, amylase, lipase, C-reactive protein (CRP), white blood count (WBC), neutrophils, lymphocytes, monocytes, eosinophils, basophils, platelets counts and creatinine. Laboratory values were recorded for two specific times called T0 and T1. T0 was defined as lab values taken 24-48 hours before the ERCP procedure, more specifically the last value available Before ERCP. T1 was defined as lab values taken 24-48 hours after the ERCP procedure, more specifically the first value available post ERCP.

The total number of patients was 723, of which 360 patients had incomplete data and thus were excluded (figure 1). 363 patients had compatible data for inclusion (N= 363). Consent for the participation of patients was obtained. Medical students responsible for data collection and revision had no known conflict of interest to be reported.

Patients were divided into 8 groups using ERCP reports for each: "Normal" findings group (N= 38), "Stone" group (N= 122), "Stricture" group (N= 49), "Sludge" only group (N= 36), "Stone + sludge" group (N=34), "Tumor" group (N=19), "Stricture + stone" group (N=5) and "Other" group (N= 60).

To be noted, the "Tumor" group included any suspected malignant obstructions (i.e. bile duct cancer, duodenal papillary cancer, etc.)

and the "Other" group included: pre-existing stent replacement, pre-existing stent removal as well as the failure of opacification/catheterization.

Statistical analysis

In the descriptive statistics part, mean, standard deviation, minimum and maximum are the indicators used to present the results of the quantitative variables. As per the nominal variables such as Gender and ERCP findings, the frequencies and the percentages are used to present their results.

For the bivariate analysis, Paired Sample t-test is applied to compare the results of the patients before and after the ERCP.

The results are considered significant whenever the p-values were less than 0.05.

According to the type of disease, all patients undergoing ERCP were divided into 8 groups, (table 1). Statistical analysis was conducted using bivariate analysis.

Results

Of the 363 enrolled patients, the mean age was 63.8 years (ranging from 15-96 years) with a predominance of patients aged 50 and above (79.3%), (table 1). 56.7% of patients were males with a male-to-female ratio of 1.31, with the majority having bile duct stones (~33.6%). Comparison of laboratory values among all groups at T0 and T1 showed a significant decrease in AST and direct bilirubin (p-value<0.01 and p-value<0.05, respectively), and a significant increase in lipase (p-value<0.05) among all groups, (table 2). In addition, the lymphocytic and monocytic counts at T0 and T1 showed a significant decrease (p-value<0.01 and p-value<0.05, respectively).

For the 122 patients who were found to have stones, AST showed a significant decrease from T0 to T1 (p<0.01), compared to ALT, direct bilirubin, GGT, and alkaline phosphatase, amylase, lipase, and CRP which did not change significantly, (table 3). As well, the stricture group had a significant decrease in AST from T0 to T1 (p<0.05), (table 4). Of note, both the stone group and the stricture group showed a significant increase in neutrophil count (p<0.01) as well as a decrease in the lymphocyte count (p<0.01).

However, when looking at the group with sludge + stone, no significant changes in laboratory tests were seen at T0 and T1, (table 5). In addition, for the sludge group, a significant decrease in platelet count was found only (p<0.05), (table 6).

In contrast to the groups with benign obstructions (stone, stricture, and sludge), the group with tumors showed a significant decrease in all liver tests ALT, AST, GGT, ALP, and bilirubin at T1; GGT and ALT had a decrease at a higher level of significance (p<0.01), as compared to the other liver function tests (p<0.05) (table 7).

For the patients in the group with normal ERCP findings, the difference between liver function tests at T0 and T1 was not statistically significant (table 8).

With respect to gender, among all groups when comparing indicators at T0 and T1, AST and lymphocyte count both decreased significantly for both sexes (p<0.01), (table 9 and 10 respectively). In addition, ALT decreased significantly and exclusively in male patients (p<0.05), while neutrophils increased significantly and exclusively in female patients.

Discussion

Many studies, including that of Al Quorain et al. [6] and Ott et al. [7] (1996 and 1994 respectively), reported choledocholithiasis as the most common reason for therapeutic endoscopy, which was also the case in this study (33.6% of patients). Those patients were noted to have on average in liver function tests, a mixed cholestatic and hepatocellular pattern of laboratory values elevation which is not the most common tableau for this type of presentation.

Some of the laboratory values are significantly affected by the ERCP procedure; a downward trend was significantly noted for AST, direct bilirubin, lymphocytes, and monocytes, while an

upward trend was observed for lipase. Our findings were not in concordance with that of Song et al [8], who found in 2013, that among their group, ERCP does not increase the incidence of liver dysfunction, as no significant changes in liver function tests were observed before and after the procedure. Despite methodology similarities, this study included an increased number of patients, a wide selection of measured laboratory values as well as a big number of stratified groups based on endoscopic findings. As a consequence, the difference in the level of the results for liver function tests can be attributed to increased sample size as well as the heterogeneity of endoscopic findings. We can see that ERCP helps in decreasing essential markers in the process of biliary obstruction with an effect starting to be visible in the next 24 hours post-ERCP. Indeed, our results prove once again the status of ERCP as a minimally invasive, irreplaceable procedure, which is the preferred method not only for diagnosis but also for treatment for any obstruction in the biliary system, all while avoiding surgical treatment and its complications. Lipase is considered to be an outlier and non-significant exception in our results because in none of the groups its increasing value was significant. This can be attributed to the fact, that for some of the patients in the small groups, lipase was not ordered and in consequence, no value was available for comparison in those small samples thus explaining its non-significance.

As cited in 2019 by Yao Yu et al [9], liver function test patterns before ERCP, cannot be a predictor of endoscopic findings. However, in this study, many interesting observations were made. Group stratification of the endoscopic findings, lead us to observe that malignant obstructions (tumor group), when compared to benign obstructions (stone, sludge, stone+ sludge, and stricture), tend to have higher baseline disturbances in laboratory values at T0, especially in liver function tests such as ALT, AST, GGT, and ALKP. This can be most probably attributed to the increased intensity as well as the duration of stenosis seen in malignant obstructions. Paradoxically, pancreatic enzymes (amylase and lipase) tended to have lower baselines at T0 for malignant obstructions as compared to the benign ones.

Post ERCP, some laboratory values can help reflect the endoscopic findings; laboratory values, especially liver function tests were observed to decrease more intensely in the malignant obstruction (tumor group) when compared to the malignant groups (stone, sludge, stone+ sludge, and stricture). These findings might be attributed to factors related to the procedure like edema post sphincterotomy, poor drainage, and incomplete sphincterotomy for the benign group.

In addition, another interesting finding is that benign obstructions, more specifically stone group and sludge group, had a significant decrease in their lymphocyte count post ERCP, thus maybe proving to be a marker that confirms the benign rather than malignant nature of the obstruction.

Post-ERCP pancreatitis has been the most commonly reported complication after the procedure; Andriulli et al. [10], in a meta-analysis of 21 prospective studies in 2007, reported pancreatitis as the most common complication happening in 3.47% of patients. Many other publications between 2002 and 2021 also report similar findings [11-14]. Based on the latter findings, we can observe that in this study as well; at T1, pancreatic enzyme levels increased from T0 with the highest levels of increase being noted in the stone group and stricture group (3 times above the upper normal limit; 375 U/L for amylase and 480 U/L for lipase respectively). Indeed, in 2020, Ze-Hui et al found that the levels of amylase or lipase three hours post ERCP can early predict pancreatitis [15], and thus those latter two groups (stone and stricture) are observed to be at high risk for post ERCP pancreatitis. Studies such as the one done by Geraci et al. [16], showed that "100 mg dose rectal diclofenac administered 30-60 minutes before ERCP can effectively prevent Post-Endoscopic Retrograde Cholangio-

Pancreatography pancreatitis (PEP)". Thus, when related to our findings, the use of such medication would be most beneficial in the two aforementioned groups to help prevent such important complications.

An abundance of our observations seem highly interesting, but what is sure is that further investigations are required to assess the implications of these test variations in predicting endoscopic findings pre-ERCP, as well as complications post ERCP.

Study limitations include the inability to properly assess the true significance of findings for some laboratory values such as lipase for example, which is attributed to the heterogeneity in laboratory orders between different attending doctors for their respective patients.

Conclusion

In conclusion, (1) ERCP significantly decreases AST, direct bilirubin, lymphocytes, and monocytes count post procedure among all stratified groups of obstructive etiology thus proving its therapeutic value for biliary system obstructions. (2) Higher baseline disturbances in laboratory values at T0, especially in liver function tests such as ALT, AST, GGT, and ALKP as well as a bigger decrease in lymphocyte count at T1 are noted to be linked with malignant obstructions (tumor group), rather than benign obstructions (stone, sludge, stone+ sludge, and stricture). (3) Finally, stone and stricture groups are at the highest risk of post-ERCP pancreatitis owing to having the highest pancreatic enzyme levels post-ERCP and thus should be the best candidates for pre-ERCP pharmacologic prophylaxis (such as diclofenac, etc) and post ERCP close monitoring.

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Appendix

Figures:

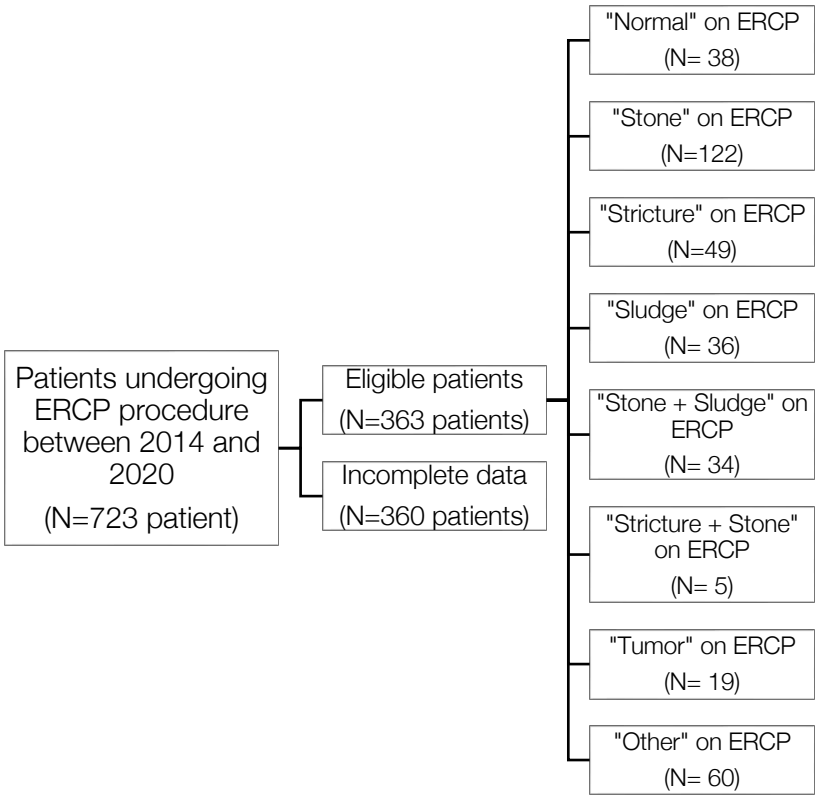

Figure 1: Flow chart depicting patient selection

Tables:

Table 1: Demographic characteristics of the study population.

SD: Standard Deviation

		Total
Gender		
	Male	206 (56.7%)
	Female	157 (43.3%)
Age (Years)		
	Mean	63.8
	SD	18.2
ERCP findings		
	Stone	122 (33.6%)
	Stricture	49 (13.5%)
	Normal	38 (10.5%)
	Sludge	36 (9.9%)
	Stone + sludge	34 (9.4%)
	Tumor	19 (5.2%)
	Stricture + stone	5 (1.4%)
	Other	60 (16.5%)

Table 2: General comparison between the indicators Pre and Post ERCP. SD: Standard Deviation

	Pre ERCP	Post ECRP	p-value	% of variation
	(mean ± SD)	(mean ± SD)	(Paired t-test)	
ALT	123.5±145.4	118.2±133.9	0.322	-4.29%
AST	105.2±125.4	81.2±88.7	0.000*	-22.81%
GGT	362.1±427.7	360.3±388.3	0.838	-0.50%
AlkP	251.1±295.8	248.2±278.2	0.603	-1.15%
Direct bilirubin	6.2±28.5	2.6±5.4	0.028*	-58.06%
Amylase	303±1374.7	367.3±817.9	0.589	21.22%
Lipase	214.6±513.8	500.1±1324.5	0.014*	133.04%
CRP	9.5±54	5.8±6.8	0.237	-38.95%
WBC	8.9±5.6	8.8±5.1	0.677	-1.12%
Neutrophils	67.7±18.8	90.2±337.4	0.218	33.23%
Lymphocytes	20.8±13.2	17.2±9.9	0.000*	-17.31%
Monocytes	9±15.6	8.1±11.2	0.014*	-10.00%
Eosinophils	2.6±2.2	2.3±1.9	0.064	-11.54%
Basophils	0.9±0.8	1.5±13.7	0.393	66.67%
Platelets	250.2±107.1	245.9±97.9	0.145	-1.72%
Creatinine	5.3±32.3	2.1±21.2	0.148	-60.38%

* Significance level at < 0.05

Table 3: Comparison between the indicators Pre and Post, ERCP finding = Stone

	Pre ERCP	Post ECRP	p-value	% of variation
	(mean ± SD)	(mean ± SD)	(Paired t-test)	
ALT	138.6±167.3	129.3±137.7	0.294	-6.71%
AST	120.1±134.3	87.3±80.7	0.001*	-27.31%
GGT	356.2±377.8	350.7±342.3	0.688	-1.54%
AlkP	228.9±218.6	229.4±230.4	0.956	0.22%
Direct bilirubin	7.6±28.3	3±6.9	0.094	-60.53%
Amylase	188.8±437.5	486.2±1161.1	0.121	157.52%
Lipase	204.3±584.2	613.5±1618	0.121	200.29%
CRP	14.4±86.6	5.7±7.3	0.307	-60.42%
WBC	9.3±7.7	9±6.6	0.324	-3.23%
Neutrophils	69.4±24	74.7±18.5	0.000*	7.64%
Lymphocytes	21±14.8	16.5±9.9	0.000*	-21.43%
Monocytes	10±25.2	8.6±18.6	0.042*	-14.00%
Eosinophils	2.3±1.7	2±1.5	0.082	-13.04%
Basophils	0.8±0.8	0.7±0.4	0.021*	-12.50%
Platelets	235.2±92.4	237.9±88.2	0.633	1.15%
Creatinine	8.4±46.2	0.9±0.4	0.085	-89.29%

* Significance level at < 0.05

Table 4: Comparison between the indicators Pre and Post, ERCP finding = Stricture

	Pre ERCP	Post ECRP	p-value	% of variation
	(mean ± SD)	(mean ± SD)	(Paired t-test)	
ALT	124.4±145.5	117.5±117.6	0.708	-5.55%
AST	112.1±150.1	91.8±118.5	0.042*	-18.11%
GGT	581.7±637.7	570.7±579.9	0.749	-1.89%
AlkP	348.4±307.5	320.6±275.9	0.268	-7.98%
Direct bilirubin	11.8±46.7	4±6.3	0.298	-66.10%
Amylase	330.4±371.9	515.3±882.3	0.396	55.96%
Lipase	423.2±521.2	983.5±1546.8	0.256	132.40%
CRP	4.2±4	5.4±5.3	0.072	28.57%
WBC	8.1±3.1	8.5±3.5	0.241	4.94%
Neutrophils	66.9±15.1	72.2±12.2	0.007*	7.92%
Lymphocytes	21.7±13	16.9±8.9	0.007*	-22.12%
Monocytes	7.7±3.3	7.6±2.7	0.738	-1.30%
Eosinophils	3.2±3.5	2.5±2.2	0.111	-21.88%
Basophils	1±0.6	0.9±0.8	0.449	-10.00%
Platelets	275.8±118.2	265.7±106.7	0.171	-3.66%
Creatinine	6.3±33.8	1.1±1.4	0.321	-82.54%

* Significance level at < 0.05

Table 5: Comparison between the indicators Pre and Post, ERCP finding = Sludge + Stone

	Pre ERCP	Post ECRP	p-value	% of variation
	(mean ± SD)	(mean ± SD)	(Paired t-test)	
ALT	98.6±98.2	79.8±64.3	0.057	-19.07%
AST	79.9±96.4	59.3±45.1	0.136	-25.78%
GGT	184±175.1	167.9±119.1	0.390	-8.75%
AlkP	263±332.9	243.2±296.8	0.075	-7.53%
Direct bilirubin	2.4±3.3	1.7±2.4	0.056	-29.17%
Amylase	169.3±391.5	279.9±708.2	0.583	65.33%
Lipase	173.1±380.4	440.6±1333.6	0.474	154.53%
CRP	5±6.7	5.6±7.2	0.595	12.00%
WBC	9.9±6.3	9.2±5.4	0.364	-7.07%
Neutrophils	67.4±13.4	272.2±1119.9	0.317	303.86%
Lymphocytes	20.4±12	17.8±9	0.057	-12.75%
Monocytes	8.4±3	7.6±2.7	0.136	-9.52%
Eosinophils	2.8±2.2	2.9±2.4	0.765	3.57%
Basophils	0.7±0.5	0.7±0.6	0.800	0.00%
Platelets	239.8±107.6	228±96.4	0.092	-4.92%
Creatinine	1.4±1.3	1.2±1	0.059	-14.29%

* Significance level at < 0.05

Table 6: Comparison between the indicators Pre and Post, ERCP finding = Sludge

	Pre ERCP	Post ECRP	p-value	% of variation
	(mean ± SD)	(mean ± SD)	(Paired t-test)	
ALT	138.4±123.9	131.5±142.6	0.774	-4.99%
AST	94.6±86.3	65.9±51.7	0.096	-30.34%
GGT	283.8±265.2	297.9±267.1	0.649	4.97%
AlkP	215.9±224.4	221.4±185.7	0.734	2.55%
Direct bilirubin	1.7±2.1	1.8±2.5	0.892	5.88%
Amylase	182±403.4	330.7±736	0.418	81.70%
Lipase	98.8±136	609.5±1814	0.177	516.90%
CRP	4.9±6.2	5.4±6	0.568	10.20%
WBC	8±3.4	8.5±4.5	0.437	6.25%
Neutrophils	67.1±14.8	68.4±14.5	0.483	1.94%
Lymphocytes	19.7±10.3	19±8.8	0.644	-3.55%
Monocytes	7.7±2.6	7±2.5	0.175	-9.09%
Eosinophils	2.2±2	2.3±1.5	0.878	4.55%
Basophils	0.8±0.6	0.7±0.5	0.258	-12.50%
Platelets	258.3±95.8	243.6±98.2	0.027*	-5.69%
Creatinine	1±0.7	0.9±0.7	0.126	-10.00%

* Significance level at < 0.05

Table 7: Comparison between the indicators Pre and Post, ERCP finding = Tumor

	Pre ERCP	Post ECRP	p-value	% of variation
	(mean ± SD)	(mean ± SD)	(Paired t-test)	
ALT	224.5±207.3	185.6±167.8	0.006*	-17.33%
AST	200.7±135	145.9±101.4	0.015*	-27.30%
GGT	1003.4±714.7	886.5±614.3	0.002*	-11.65%
AlkP	739.7±727	669.1±638.1	0.018*	-9.54%
Direct bilirubin	6.9±7.4	5.6±6.5	0.024*	-18.84%
Amylase	90±44.5	132.3±116.5	0.507	47.00%
Lipase	50.3±29.4	99±87.4	0.284	96.82%
CRP	5.4±6.4	6.4±7.9	0.135	18.52%
WBC	8.5±3.8	8.4±3.4	0.876	-1.18%
Neutrophils	64±15.8	67±17.9	0.283	4.69%
Lymphocytes	18.6±13.1	13.3±9.1	0.075	-28.49%
Monocytes	8.9±3.1	9.6±4.4	0.606	7.87%
Eosinophils	2.6±2.2	2.4±1.7	0.707	-7.69%
Basophils	0.9±0.5	0.9±0.7	0.670	0.00%
Platelets	248.3±86.4	239.9±71.8	0.504	-3.38%
Creatinine	1±0.3	1±0.2	0.425	0.00%

* Significance level at < 0.05

Table 8: Comparison between the indicators Pre and Post, ERCP finding = Normal

	Pre ERCP	Post ECRP	p-value	% of variation
	(mean ± SD)	(mean ± SD)	(Paired t-test)	
ALT	90.9±123.2	107.2±173.6	0.431	17.93%
AST	89.6±164.1	91.1±142.1	0.961	1.67%
GGT	167.5±175.7	210±208.7	0.114	25.37%
AlkP	123.9±75.2	144.1±95	0.104	16.30%
Direct bilirubin	1.1±3.5	1.4±4.2	0.085	27.27%
Amylase	951±3351.5	430.8±658.7	0.409	-54.70%
Lipase	381.7±813.2	296±452.8	0.578	-22.45%
CRP	5.8±8	4.9±6.4	0.116	-15.52%
WBC	7.9±2.8	7.7±2.6	0.668	-2.53%
Neutrophils	67.6±14	69±13.4	0.526	2.07%
Lymphocytes	21.9±12.7	19.7±10.9	0.212	-10.05%
Monocytes	7±3.1	7.5±2.5	0.287	7.14%
Eosinophils	2.5±1.7	2.4±1.4	0.762	-4.00%
Basophils	0.9±0.5	1.1±1.4	0.453	22.22%
Platelets	256.6±100.4	248.9±81.5	0.387	-3.00%
Creatinine	1±0.9	0.9±0.8	0.434	-10.00%

* Significance level at < 0.05

Table 9: Comparison between the indicators Pre and Post, by gender = Male

	Pre ERCP	Post ECRP	p-value	% of variation
	(mean ± SD)	(mean ± SD)	(Paired t-test)	
ALT	119.8±142.5	106.8±115.7	0.012*	-10.85%
AST	95.2±109.1	73.3±69.2	0.000*	-23.00%
GGT	405.7±437	396.7±391.8	0.430	-2.22%
AlkP	226.4±201.2	234.4±218.3	0.264	3.53%
Direct bilirubin	7.1±29.1	3.3±6.6	0.092	-53.52%
Amylase	364.8±1787.4	421.1±944.8	0.785	15.43%
Lipase	221.6±514.9	554.7±1383.9	0.048	150.32%
CRP	11.8±70.1	6.1±7	0.313	-48.31%
WBC	9±4.9	8.7±3.9	0.278	-3.33%
Neutrophils	68.6±20.5	104.8±449	0.263	52.77%
Lymphocytes	20.4±13.6	17±9.7	0.000*	-16.67%
Monocytes	9.7±19.7	8.8±14.6	0.053	-9.28%
Eosinophils	2.7±2.4	2.4±2	0.095	-11.11%
Basophils	0.8±0.5	0.8±0.8	0.520	0.00%
Platelets	239.8±112	236.3±100.1	0.358	-1.46%
Creatinine	5.1±31.5	1.1±0.8	0.088	-78.43%

* Significance level at < 0.05

Table 10: Comparison between the indicators Pre and Post, by gender = Female

	Pre ERCP	Post ECRP	p-value	% of variation
	(mean ± SD)	(mean ± SD)	(Paired t-test)	
ALT	128.5±149.6	133.1±153.7	0.668	3.58%
AST	118.2±143.5	91.5±108.6	0.007*	-22.59%
GGT	304.2±409.8	312±379.7	0.553	2.56%
AlkP	283.2±384.1	266.1±340.7	0.059	-6.04%
Direct bilirubin	5.1±27.8	1.7±3.1	0.164	-66.67%
Amylase	227.2±549.5	301.2±629.3	0.369	32.57%
Lipase	206.8±516.2	440.2±1263	0.143	112.86%
CRP	6.8±20.7	5.3±6.7	0.424	-22.06%
WBC	8.7±6.5	8.9±6.3	0.610	2.30%
Neutrophils	66.5±16.5	71.3±12.9	0.000*	7.22%
Lymphocytes	21.3±12.8	17.3±10.2	0.000*	-18.78%
Monocytes	8.1±7.5	7.1±2.9	0.119	-12.35%
Eosinophils	2.3±1.7	2.2±1.7	0.406	-4.35%
Basophils	0.9±1	2.5±20.7	0.378	177.78%
Platelets	263.6±99.3	258.3±93.8	0.252	-2.01%
Creatinine	5.5±33.4	3.5±32.2	0.614	-36.36%

* Significance level at < 0.05