Pak. j. life soc. Sci. (2024), 22(1): 2168-2174 E-ISSN: 2221-7630;P-ISSN: 1727-4915

Pakistan Journal of Life and Social Sciences
www.pjlss.edu.pk

https://doi.org/10.57239/PJLSS-2024-22.1.00159

RESEARCH ARTICLE

The Biochemical and Hematological Changes in Laparoscopic Cholecystectomy

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ARTICLE INFO

Received: May 22, 2024

Accepted: Jul 1, 2024

Keywords

Laparoscopic

Cholecystectomy

Liver Function Tests

Mean Platelet Volume

Cholelithiasis

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ABSTRACT

Hematological indicators, including neutrophils, leukocytes, neutrophil-lymphocyte ratio, platelet lymphocyte ratio, and mean platelet volume, have been observed to change following laparoscopic surgery. Blood parameter and liver enzyme level changes following laparoscopic cholecystectomy are the focus of this investigation. Participants in this study were those who had symptomatic cholelithiasis and had a laparoscopic cholecystectomy. Those patients who had other medical conditions, such as hepatitis and diabetes, and those who had to change from laparoscopic cholecystectomy to open cholecystectomy were not included in the study. The pre-operative and post-operative Hematological parameters and liver function tests were documented. The noted features included body mass index (BMI), gender, age, surgery indication, and duration, the pneumoperitoneum pressure, and duration of hospital stay. Various hematological parameters mean pre and postoperative values were compared using a paired sample t-test. HCT (hematocrite), hemoglobin (Hb), platelets, and alkaline phosphatase (ALP) levels all decreased after surgery. After the procedure, there was an increase in mean corpuscular volume (MCV), mean platelet volume (MPV), leukocytes, and alanine transaminase (ALT). The mean values of Hb, MCV, Hct, leukocytes, MPV, and ALT showed a statistically significant difference ($p<0.05$). Significant alterations in hematological parameters and liver enzymes occurred during LC.

INTRODUCTION

The gall bladder stone (Cholelithiasis) is a common disease widespread globally. It affects approximately 10%-15% of people in Western societies and The percentage ranges from 3% to 5% in Asian and African communities (1). In another study found that 10.2% of subjects who underwent ultrasonography were diagnosed with cholelithiasis [2]. Laparoscopic cholecystectomy (LC) has become the preferred surgical treatment for removing symptomatic gallbladder disease and cholelithiasis since the 1990s, replacing open cholecystectomy (OC). It is now regarded as one of the most commonly done operations for these conditions [3]. Although laparoscopic cholecystectomy has short hospitalization and rapid recovery period, surgery carries a risk of problems in cardiovascular at vulnerable groups due to its effects on blood flow and breathing. The elevated intra-abdominal pressure and increased levels of carbon dioxide in the blood during laparoscopic cholecystectomy operations, which are associated with changes in blood parameters (4-6).

The aorta, inferior vena cava, splanchnic arteries, hepatic artery, portal veins, and renal blood vessels were compressed, leading to the perioperative consequences of pneumoperitoneal pressure.

Reduced blood flow in the hepatic artery and portal vein leads to a temporary lack of oxygen in liver cells, causing damage to the cells. As a result, the level of ALT in the blood increases. Elevated intra-abdominal pressure is associated with increased hemodynamic Abnormalities and irregularities in liver function tests. The alterations in liver function tests, after laparoscopic cholecystectomy are associated with the presence of the pneumoperitoneum and the time it lasts (4,7-9). Several investigations have documented alterations in blood parameters following the laparoscopy surgeries (10-11). Leukocytes, neutrophils, the ratio of neutrophils to lymphocytes, the ratio of platelets to lymphocytes, and mean platelet volume (MPV) were all significantly different from one another, before and after insufflation. The mean platelet volume were increased when intraabdominal pressures rise can be used clinically to diagnose intraabdominal hypertension [10-11]. A study examined the impact of CO2 insufflation on the occurrence of more blood clotting events. This was caused by an increase in coagulation factors and a decrease in the fibrinolytic system activity. The rise in thromboembolic events was specifically linked to the pneumoperitoneum pressure and the length of the surgical procedure [12]. In various situations, it is important to establish the impact of these surgeries on the hematological parameters. This will enable appropriate actions to be made before, during, and after the surgery to reduce the occurrence of illness, death, hospitalization, and overall expenses for both the patient and the hospital. The main objective of this study was to compare the levels of various parameters, such as hemoglobin (Hb), MCHC, MCV, MCH, hematocrit(HCT), platelet,MPV, and liver function tests (LFTs), including ALT and ALP, before and after laparoscopic cholecystectomy.

METHODOLOGY

The research was conducted prospectively at the AL-IMAM ALI Hospital/baghdad from June to November 2022. There were 60 patients, fifteen males, and fifteen females, all with gallbladder stones. Confirmation was obtained using liver function tests and ultrasounds of the abdomen. The Criteria for inclusion were comprised of patients undergoing laparoscopic surgeries, those with symptomatic gallbladder disease, and those with a physical status of I or II as determined by the American Society of Anaesthesiologists (ASA). This study excluded those patients with related diseases (such as diabetes and stroke), those who had undergone a conversion from laparoscopic cholecystectomy to open cholecystectomy, and those with postoperative infections or coagulation issues. Aseptically, 2 ml of blood was extracted from the antecubital vein. The blood samples, collected a 12-hour after the procedure, were analysed to establish the patient's initial levels of leukocytes,Hb,MCV,MCHC,MCH,MPV,HCT,the blood sugar, and platelets, serum ALT, and ALP. These parameters were determined before and after the operation. The blood was centrifuged for three to five minutes using the Rotofix-32 apparatus (Hettich, Massachusetts). The (Beckman Coulter automated device, USA) was utilized to assess alanine aminotransferase (ALT) levels.

The patient's vital signs were kept within the normal range in the preoperative rooms and were closely observed for 24 hours. A laparoscopic cholecystectomy was carried out using general anaesthesia and four standard ports. The pneumoperitoneum was created using a closed approach and a veress needle. The documented variables included the utilization of intra-abdominal pressure and the duration of the surgical procedure. After twelve hours, two ML of blood was extracted from the antecubital vein using the identical approach. This was done to measure the postoperative levels of the variables being investigated. Additional factors, such as age, gender, body mass index, and length of stay in the hospital, were also recorded. We compared the average values of several blood parameters and liver enzymes before and after the operation using the sample t-test. A comparative analysis using an independent sample t-test assessed the differences in factors that vary between males and females. To assess the differences in these parameters among the various groups, an

analysis of variance (ANOVA) was run. The tailed two P-value of less than 0.05 was deemed to be statistically significant. The analysis employed the Statistical Package for Social Sciences (SPSS) (IBM Corp, Armonk, NY).

RESULTS

For the study, a total of sixty patients were chosen. There were thirty individuals, with 50% being male and 50% female. The average age of the patients was 40.3, with a standard deviation of 15.6. The average time of the surgery was 60.02 minutes, with a standard deviation of 18.1 minutes and a range of 35 to 95 minutes. Simultaneously, the average pressure of the peritoneum was 13.5 mmHg with a standard deviation of 1.8 mmHg and a range of 12-17 mmHg. All of the individuals exhibited symptomatic cholelithiasis. Forty-five patients required fewer than twenty-four hours to recover after their surgeries. By comparison, a total of fifteen patients remained hospitalised for a duration of two days, while just one patient stayed for a duration of three days.

Table 1: Displays the distribution of different age groups based on gender

Age groups	Male(30)		Female (30)	
	No.	%	No.	%
20-39 yrs.	16	53.3	17	56.5
40-59 yrs.	7	23.3	10	33.3
60+ yrs.	7	23.3	3	10

Analysis of haematological results before and after surgery

The levels of haematological variables were compared between the preoperative and postoperative situations using a sample t-test. The average ALT level increased from 35.1 to 57.6 and the standard deviation from 40.6 to 64.9 after the procedure, indicating a statistically significant increase. Similarly, there was a significant rise in leukocytes, MPV, and MCV levels after surgery compared to levels before. There was a significant reduction in haemoglobin levels following the operation, with the mean decreasing from 13.8 (SD=1.5) before the surgery to 10.1 (SD=1.6) after the surgery. Furthermore, there was a significant reduction in hematocrit levels seen following the operation. Prior to the surgery, the average hematocrit level was 38.5 with a standard deviation of 5.3. However, after the surgery, the average hematocrit level decreased to 34.6 with a standard deviation of 4.9.

Table 2: Comparative analysis of the variations in levels among several groups

Hematological parameter	Preoperative		Postoperative		t	df	p-value
	mean	SD	mean	SD			
Hb (g/dl)	13.8	1.5	10.1	1.6	4.1	52	0.000*

MCV (fL)	80.4	8.6	82.5	6.7	-2.3	52	0.023*
MCHC(g/dL)	34.6	2.1	34.8	2.5	-0.3	52	0.700
MCH (pg)	27.8	3.0	28.1	3.3	-0.7	52	0.436
Leukocytes (*10^3/IU)	8.4	2.4	12.5	3.7	-7.7	52	0.00*
Platelets (*10^3/uL)	303.2	79.3	286	80.5	1.9	52	0.063
Hct	38.5	5.3	34.6	4.9	3.6	52	0.001*
MPV(fL)	9.9	0.9	10.2	0.8	-2.9	52	0.004*
ALT(U/L)	35.1	40.6	57.6	64.9	-2.7	52	0.008*
ALP (U/L)	152.7	120	143.7	117.2	0.8	52	0.416

The calculation involved finding the difference between the pre- and post-operation levels of all variables. To measure the differences between the two gender, a two-sample independent t-test was used. On the other hand, the study found no statistically significant difference in the genders for any of the characteristics that were considered. This study were using an analysis of variance (ANOVA) to investigate the differences in haematological variable levels after surgery across various BMI groups. Nevertheless, there were no detected alterations that were statistically significant.

DISCUSSION

Laparoscopy has become a fundamental component of contemporary surgical practice. Therefore, it is crucial to closely evaluate both the advantages and disadvantages of it to sustain its positive impact on society. Our investigation has yielded intriguing findings that will enhance our understanding of the effects of this surgical procedure. There were notable disparities in the number of factors being examined. This implies that even while laparoscopy may seem harmless, it nevertheless necessitates proper caution and preventive measures to ensure the patient's safety and well-being. Multiple studies examining the frequency of the condition or focusing on surgical techniques for cholelithiasis have documented comparable results (13). A study conducted in China revealed a greater prevalence of cholelithiasis in females (14). The development of gallstones is thought to be more common in females. according to a number of research (15).

The main objective of this study was to elucidate the alterations in the blood composition resulting from laparoscopic cholecystectomy. Initially, we saw a substantial decrease in the levels of Hb and hematocrit. Lindberg et al. provide support for the results (16). The dilutional effect of intravenous (I/V) fluids utilized in treatment explains this phenomenon. Furthermore, these increases in mean corpuscular volume (MCV) is also understandable. Intravenous fluids are provided continuously during the procedure to prevent the occurrence of shock and after the surgery to prevent the

development of dehydration. Prolonged use of laparoscopic operations with minimal bleeding results in hemodilution and decreased plasma osmolality.

Consequently, this causes water to move into cells, potentially increasing Mean Corpuscular Volume (MCV). Leukocytes exhibited an increase in levels after the surgery. The Turkish study by Bitkin et al. [11] lends credence to this. An increase in white blood cell (WBC) numbers is inevitable after surgery because the stress triggers immune pathways.

An important indicator of elevated intra-abdominal pressure is the MPV [11]. In line with the results of Bitkin et al. (11) and our own observations, it is evident that the mean platelet volume (MPV) increased significantly following the operation. Research conducted by Celep et al. () provides more evidence of this expansion.(10). However, Marakis et al. conducted a research that found a decrease in the mean size of platelets among the people they analyzed (17). Possible explanations for this occurrence include the elevated thrombolytic activity and coagulation activation noted in these people, as described in many investigations (16, 18). It follows that the platelet count drops, which is in agreement with what (Marakis *et al.*) found: a significant drop in platelet count. Nevertheless, our investigation (17) revealed no significant difference in platelet count.

Several studies have identified these individuals as having higher thrombolytic activity and coagulation activation, which may explain this incidence (16, 18). The result is a decrease in platelet count, which is consistent with the findings of (19) however, there was an observed rise in the average size of platelets. This phenomenon can be elucidated by prior studies indicating that only platelets with a larger volume are initially discharged during stressful circumstances, such as surgical interventions. The total number of circulating cells increases within a minimum time frame of one to two days (20-21). The variable ALT had a significant surge during the process, rendering it the ultimate variable of interest. Consistent and statistically significant findings are presented by many investigations (7, 22–23). After three to ten days, the enzyme levels will be back to their original state, indicating that the changes are temporary (24). An intra-abdominal pressure of 8 mmHg is considered normal. A pneumoperitoneum, created during laparoscopy, causes a pressure rise of about 13–14 mmHg. Several clinical and experimental studies have shown that pneumoperitoneum can cause hepatic hypoperfusion. As an example, it has been shown by Jakimowicz et al. that portal venous flow is reduced during laparoscopic insufflation (25). As a result, this leads to liver damage, which in turn causes an elevation in ALT levels. Nevertheless, the levels of ALP exhibited no substantial alterations, aligning with the results of previous studies, including the one undertaken. As stated by Hasukic et al. (23).

This study has some drawbacks. Initially, data was gathered exclusively from a solitary institution. Furthermore, this study, which involved observing subjects over time, required a significant amount of time and, as a result, had a limited number of participants. Therefore, conducting a study with a more extensive sample size is advisable to achieve more reliable and transferable outcomes.

CONCLUSION

Notable alterations were observed in the hematological parameters and liver enzymes. It is important to exercise caution to prevent these parameters from reaching harmful levels, therefore minimizing the risk of additional problems and morbidity. Moreover, this study can work as a catalyst for individuals to explore further the alterations of these parameters in response to other controllable elements during the operation and identify strategies to mitigate these changes.

Acknowledgment

A great thank you was submitted to the staff of the anesthesia department in the Bagdad Teaching Hospital and the anesthesia technique department at the College of Health and Medical Technique/ Iraq/ Baghdad.

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