



Original Article



Preoperative Total Leukocyte Count: A Key Predictor for Better Optimization and Conversion Risk in Laparoscopic Cholecystectomy for Cholelithiasis

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ABSTRACT

Gallstone disease requires laparoscopic cholecystectomy (LC) as the standard of care. Sometimes, the surgeon decides to convert LC to open cholecystectomy (OC) for patient safety. Several factors help us predict preoperatively whether there is any chance of conversion of LC to OC. The role of elevated total leukocyte count (TLC) as a predictor for conversion is being proposed. This study investigates the association between pre-operative TLC levels and conversion rates from LC to OC. **Objective:** To determine the association between increased TLC and conversion from LC to OC. **Methods:** This study was conducted at Al-Tibri Medical College Hospital, Karachi, over eighteen months from 1st July 2023 to 31st December 2024. A total of 230 patients were included. We selected 115 patients with TLC above $11.0 \times 10^9/L$ and 115 patients with non-elevated TLC. All patients underwent LC, and conversions to OC were recorded. Data were analyzed using SPSS version 23.0. Mean and standard deviation were computed for numerical variables, and percentages for categorical variables. The chi-square test was applied to find the association between categorical variables. The relative risk (RR) was calculated to compare the risk of conversion of LC to OC among Elevated and Non-elevated TLC Groups. **Results:** The average age of patients was 31.82 ± 10.06 years. The conversion risk was 117% higher in the elevated TLC group compared to the non-elevated TLC group (RR=2.17, 95%CI: 1.32-3.56). **Conclusions:** It was concluded that elevated pre-operative TLC is significantly associated with a higher risk of conversion from LC to OC, indicating its potential as a predictive factor for surgical planning.

INTRODUCTION

Gallstone disease is a common condition requiring surgical intervention, with 6-8% of the global population affected by cholelithiasis [1, 2]. Laparoscopic cholecystectomy (LC) has become the gold standard due to its benefits in reducing hospital stay and promoting faster recovery [3, 4]. Despite its advantages, complications such as visceral injuries, hemorrhage, bile leaks, and strictures can necessitate conversion to open cholecystectomy (OC), increasing hospital stay, cost, and morbidity [4-6]. Conversion rates from LC to OC vary significantly, reported between 2% and 15% in various studies [7]. Factors

influencing conversion include patient anatomy, surgeon experience, and equipment quality [8, 9]. Identifying pre-operative predictive factors like TLC can aid in stratifying patients' risk for conversion [9, 10]. Several recent studies have explored the role of elevated pre-operative Total Leukocyte Count (TLC) in predicting conversion from laparoscopic to OC [9-11]. Elevated TLC is often considered a marker of systemic inflammation. Inflammation leads to increased tissue adhesions and distorted anatomy, which may complicate the laparoscopic procedure and necessitate conversion to open surgery. Amin et al.,

demonstrate that patients with elevated pre-operative TLC were significantly more likely to undergo conversion from LC to OC due to these complications [10]. A study by Dinçer *et al.*, also confirmed that elevated TLC is a significant predictor for conversion, suggesting that it could be integrated into pre-operative risk assessments [12]. However, conflicting evidence exists. While many studies have reported an association between elevated TLC and conversion rates, others have failed to establish a clear link [11]. This variability could be due to differences in patient populations, surgical expertise, and the degree of underlying inflammation. Some researchers argue that while TLC is useful in assessing the overall inflammatory status of the patient, it may not be a standalone factor in predicting conversion, and other factors such as patient anatomy and surgeon experience should also be considered [9-11]. This study aims to assess whether elevated pre-operative TLC is an independent risk factor for conversion from LC to OC. By identifying potential predictors such as TLC, surgical planning can be improved, and high-risk patients can be identified more accurately, thereby reducing the likelihood of complications and improving patient outcomes.

Although elevated pre-operative Total Leukocyte Count (TLC) has been proposed as a predictor for conversion from laparoscopic to open cholecystectomy, existing evidence remains inconsistent. Moreover, there is limited local data evaluating TLC as an independent predictor, highlighting the need for further investigation in this population. This study aims to determine the association between increased TLC and the conversion from laparoscopic cholecystectomy to open cholecystectomy.

METHODS

This analytical cross-sectional study was conducted at Al-Tibri Medical College Hospital, Karachi, after obtaining approval from the Institutional Ethical Review Committee (ref no. ATMC/IERC/13th/01-2023/04). It spanned over 18 months from 1st July 2023 to 31st December 2024. The sample size was calculated using the Open Epi online software for sample size calculation. Keeping the following values, with hypothesized frequency of cholelithiasis at 18.2 % as reported in a recent local study, the sample size was 230 at a 95% confidence level and a 5% margin of error. Therefore, 230 patients were included in the study [13]. Sample size $n = [DEFF * Np(1-p)] / [(d^2 / Z^2(1-\alpha/2)^2 * (N-1) + p*(1-p))]$.

Table 1: Sample Size for Frequency in a Population

Variables	Sample Size
Total population size, considered in statistical tests (N)	1000000
The expected % frequency of the outcome factor found in the population (p)	18.2% +/-5
Assume 100 as the starting amount; confidence limits are then represented as a percentage (d)	5%

The design effect (DEFF) is important for cluster surveys	1
95%	229
80%	98
90%	162
97%	281
99%	395
99.9%	645
99.99%	901

Results from Open Epi, Version 3, open source calculator—SS-Propor. An equal number of participants diagnosed with symptomatic cholelithiasis were included in the present study, falling in two categories, TLC >11.0 X 10⁹ and TLC < 11.0 X 10⁹, comprising a total count of 230 patients. Patients with TLC >11.0 X 10⁹ were labelled as Elevated TLC Group, and those with TLC <11.0 X 10⁹ as Non-elevated TLC Group. The sampling technique employed was stratified random sampling. Patients included in the study were aged 18 to 60 years. Informed consent was obtained, and confidentiality was maintained. Patients were diagnosed with cholelithiasis based on history (right hypochondrial and epigastric pain may or may not radiating to back, pain and indigestion followed by intake of fatty food), detailed physical examination (Tenderness in right hypochondrium, Heart rate, presence /absence of jaundice), laboratory investigations including Complete blood count and Liver function tests and ultrasound reports (size and number of stones in gallbladder, gall bladder wall thickness of 3mm or less, presence/absence of pericholecystic fluid, common bile duct diameter 0.4cm or less.). All ultrasound examinations were performed by an experienced sonologist with a minimum of five years of experience. Confounding variables were controlled by excluding high-risk patients, including acute cholecystitis, empyema, gangrene, or gallbladder perforation; patients requiring common bile duct exploration or experiencing perioperative complications were not included. Patients with known comorbidities, pregnant women, children, and those unable to provide informed consent were also excluded from the study. Each patient underwent a standard four-port laparoscopic cholecystectomy performed by a consultant general surgeon with a minimum of five years of post-fellowship experience. The primary outcome measured was the rate of conversion from laparoscopic to open cholecystectomy in patients with elevated versus non-elevated TLC, which was recorded along with the reasons for conversion (difficult anatomy and presence of dense adhesions). Data were analyzed using SPSS version 23.0 Numerical variables were summarized using mean and standard deviation, while categorical variables were summarized by their frequencies and percentages. Researchers carried out the Chi-square test. A Chi-square test is used to check if there is a strong link between two sets of categorical variables. It

was used here to find out if people in the control group had different conversion rates than people in the test group. The data was found to be significant, since the p-value was below 0.05, and this led to rejecting the null hypothesis. The relative risk (RR) was calculated using data from a 95% confidence interval. Relative Risk (RR) is used to measure how likely it is for LC to turn into OC in the Elevated and Non-elevated TLC Groups.

RESULTS

The average age of patients in the Elevated TLC Group was 31.82 ± 10.06 years, compared to 28.8 ± 8.62 years in the Non-elevated TLC Group. There were 144 male and 86 female patients. The gender distribution showed a higher proportion of males in both the Elevated TLC Group (73%) and Non-elevated TLC Group (52.2%)(Figure 1).

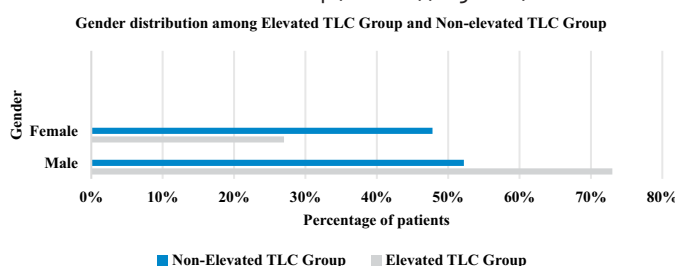


Figure 1: Gender Distribution of the Patients Concerning Groups

Table 3: Conversion Rates of Laparoscopic Cholecystectomy to Open Cholecystectomy in Elevated TLC Group and Non-Elevated TLC Groups

Conversion to Open Surgery	Elevated TLC Group (%)	Non-elevated TLC Group (%)	Total (%)	Relative Risk (RR)	95% CI	p-value
Yes	33.9%	15.7%	24.8%	2.17	1.32 - 3.56	*0.001
No	66%	84%	75.2%			

Statistical Significant at p-value<0.050

It examines how likely certain groups are to switch from a condition called LC to one called OC, comparing those with total leucocyte count (Elevated TLC Group) to those with normal total leucocyte count (Non-Elevated TLC Group). Males categorized in the Elevated TLC Group underwent conversion to OC more than twice as often (38%) than males in the Non-elevated TLC Group (19.4%). They were twice as likely to require conversion, with a relative risk (RR) of 2.03. The difference between the groups was found to be statistically significant (p=0.022). Those with higher TLC levels were more likely to be converted to surgery as female patients (30%) compared to male patients (14.3%). For patients aged ≤ 40 , more people in the Elevated TLC Group (35%) converted to OC compared with the Non-elevated TLC Group (14.1%). It is shown by RR=2.47 that the risk of conversion is nearly doubled. According to the statistical results, the finding was highly significant (p=0.001). For patients over 40, the change in conversion rates between the groups did not reach a statistically significant difference. Younger individuals (aged less than 40) and male patients in the Elevated TLC Group had a much higher chance of converting OC from LC. The findings suggest that age and gender might affect conversion risk in people exposed to what was studied (Table 4).

Table 4: Conversion Rates from LC to OC Stratified by Gender and Age Group

Variables	Group	Elevated TLC Group (%)	Non-elevated TLC Group (%)	Relative Risk (RR)	95% CI	p-value
Gender	Male	38	(19.4)	2.03	1.09	*0.022
	Female	30	(14.3)			
Age	≤ 40	35	(14.1)	2.47	1.40	*0.001
	> 40	26.7	(21.7)			

There is a statistically significant difference in age between the Elevated and Non-elevated TLC Groups. On average, the Elevated TLC Group is older by about 3 years, and this difference is significant (p=0.027)(Table 2).

Table 2: Demographic Characteristics of Patients in Each Group (n=115)

Variables	Elevated TLC Group (TLC $> 11.0 \times 10^9/L$)	Non-elevated TLC Group (TLC $11.0 \times 10^9/L$)	p-Value
Number of Patients	115	115	*0.027
Age (mean \pm SD)(Years)	31.82 ± 10.06	28.8 ± 8.62	

*Statistically Significant at p-value<0.050

LC was converted to OC at a conversion rate of 24.8%. More patients in the Elevated TLC Group (33.9%) had their LC progress to OC, in comparison to the Non-elevated TLC Group (15.7%). It was found that LC may sometimes become OC. Subjects in the Elevated TLC Group were twice as likely (RR=2.17) to require surgery after an attempted laparoscopic procedure, compared to subjects in the Normal TLC Group who did not need surgery. The result shows that the association is statistically significant, with a small p-value of 0.001 and a confidence interval (CI) that prevents the estimate from being greater than 1. Our study indicates that there is very little chance that our result came about by chance (Table 3).

DISCUSSION

On average, 24.8% of LC patients are converted to OC in our series, whereas studies from other countries show that usually between 2% and 15% of LC patients are switched to OC [4, 5]. A report from Pakistan reports that 3.7% of LC cases are diagnosed as OC [4], but another report cites a higher conversion rate of 7.78% [11]. Because we are studying how LC converts to OC in patients with increased TLC, and since the conversion rate of LC to OC in that group is high, standing at 33.8%. High TLC levels in patients before surgery are strongly linked to an increased risk of converting from LC to OC. Greater TLC in the blood points to silent cholecystitis or ongoing inflammation, which complicates surgery and leads to converting the procedure to open surgery. Oymaci *et al.*, reported that patients with higher TLC were more likely to undergo conversion because of stronger adhesions and difficulties during surgery, which is similar to what we observed [14]. Multiple studies agree that TLC can be used to forecast the chance of conversion in surgery. Dinçer *et al.*, found that a higher TLC is a major risk for developing PC [12], whereas Amin *et al.*, reported that elevated TLC before LC greatly increased the chances of a conversion operation [10]. We found that male patients were more often converted during surgery, which is in agreement with various other studies [15, 16]. This may be due to more severe disease at the time of presentation or more complex anatomy in males, which complicates laparoscopic dissection, however, few studies contradict these findings [17]. Additionally, younger patients (≤ 40 years) with elevated TLC had a significantly higher risk of conversion in our study, which contrasts with the general assumption that older age is a stronger predictor of conversion due to the presence of more fibrosis and more comorbidity [18]. Preoperative assessment of TLC can serve as an important tool in surgical planning. Patients with elevated TLC should be considered at higher risk for conversion, allowing for more informed surgical decisions and resource allocation. Furthermore, preoperative counselling can be tailored to better prepare patients for the possibility of conversion and the associated risks [19-21].

The study was limited by its single-center design and relatively small sample size, which may affect the generalizability of the findings. Additionally, potential confounding factors such as surgeon experience, intraoperative findings, and comorbid conditions were not fully adjusted for in the analysis. Future large-scale, multicenter studies incorporating comprehensive clinical and intraoperative variables are recommended to develop more accurate predictive models for conversion from LC to OC.

CONCLUSIONS

It was concluded that there was an association between raised total leucocyte counts (TLC) and the conversion from LC to OC because patients with raised TLC undergo conversion from LC to OC more frequently. This makes Increased TLC an important predictive marker for the risk of conversion from LC to OC. Preoperative identification of patients with elevated TLC will help the surgeon in better surgical planning, improving preoperative counseling and resource allocation, and potentially enhancing patient outcomes by reducing the incidence of complications associated with delayed conversion.

Authors' Contribution

Conceptualization: HWA

Methodology: HWA, RK, TMG

Formal analysis: RK, TMG, SK, JB

Writing and Drafting: RN

Review and Editing: HWA, RK, TMG, SK, RN, JB

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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