Surgery

Demographic and Clinical Characteristics in Patients with Elevated Neutrophil-Lymphocyte Ratio Undergoing Cholecystectomy

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Abstract	Original Research Article

Introduction: Cholecystectomy, the surgical removal of the gallbladder, is a common procedure performed to address gallbladder-related conditions, primarily gallstones and cholecystitis. This study aimed to evaluate the demographic and clinical characteristics of patients with elevated neutrophil-lymphocyte ratio undergoing cholecystectomy. *Methods:* This prospective observational study was conducted at the various surgical units of the inpatient Department of Surgery, Dhaka Medical College Hospital, Dhaka, from July 2018 to June 2019. Patients with cholecystitis attending in the outdoor or emergency, admitted with cholecystitis in Dhaka Medical College Hospital, Dhaka were considered as the study population. A total of 50 patients were selected as study subjects by purposive sampling technique. Statistical Package for Social Science (SPSS) version 21 for Windows was used to analyze the data. A p-value < 0.05 was considered to be significant. *Result:* Among 50 cholecystectomy patients, 68% were admitted as outpatients, and 32% via the emergency department. The predominant symptom was abdominal pain (92%), and the mean serum leukocyte count was significantly higher in the elevated NLR ($\geq$3) group (13500/mm³ vs. 6200/mm³, p <0.004). Eighty percent had gallbladder calculus, with 82% diagnosed with simple cholecystitis. Most procedures (78%) were laparoscopic, and 72% did not require drains. The mean postoperative hospital stay was 4 days, longer for the elevated NLR group (median 6 days vs. 4 days, p <0.002). Complications occurred in 30% of patients, with a higher incidence in the elevated NLR group. *Conclusion:* The findings suggest that an elevated neutrophil-lymphocyte ratio (NLR) is linked to important clinical characteristics and outcomes, especially in older adults and males. Patients with higher NLR exhibited increased rates of laparoscopic conversion, longer operative times, and extended postoperative hospital stays. Additionally, they were more likely to need surgical drainage and experienced a higher incidence of postoperative complications, though this was not statistically significant.
Keywords: Demography, Clinical Characteristics, Neutrophil-Lymphocyte Ratio, Cholecystectomy.

INTRODUCTION

Cholecystectomy, the surgical removal of the gallbladder, is a widely performed procedure, especially for patients presenting with symptomatic gallbladder diseases like cholelithiasis and cholecystitis. The procedure is frequently carried out via laparoscopic techniques, which have reduced patient recovery times and overall hospital stays compared to open cholecystectomy. Despite these advances, certain patient factors still significantly affect postoperative outcomes, including the length of stay (LOS), risk of complications, and overall recovery trajectory [1,2]. Among these, the neutrophil-lymphocyte ratio (NLR), a systemic inflammatory marker, has garnered interest for its potential role in predicting postoperative outcomes across various types of surgeries, including cholecystectomy. Elevated NLR levels have been linked to increased inflammation and are associated with poorer surgical outcomes, prolonged recovery periods, and higher rates of complications [3]. The NLR is derived from routine complete blood counts and reflects the relative levels of neutrophils and lymphocytes, with

higher values indicating a predominance of neutrophils, a key inflammatory cell type [4]. It has been extensively studied as an indicator of the body's inflammatory response, particularly in acute conditions and among surgical patients. For patients undergoing cholecystectomy, an elevated NLR is thought to correlate with an increased inflammatory state, possibly due to the presence of more severe disease at presentation, such as acute cholecystitis or gangrenous cholecystitis [5]. Additional clinical characteristics, such as the route of hospital admission and leukocyte count, have further implications for understanding the role of NLR in cholecystectomy outcomes. For instance, patients admitted through the emergency department (ED) for acute cholecystitis or gallstone pancreatitis often present with higher NLR levels, indicating a more severe disease state that could predict prolonged hospitalization and postoperative challenges [6]. High leukocyte counts, often accompanying elevated NLR, suggest an active inflammatory process that may complicate surgical intervention and extend recovery time. Therefore, evaluating preoperative NLR, alongside other clinical variables, provides a framework for predicting surgical risk, particularly in emergency versus elective admissions, where the severity of presentation tends to differ [7]. Considering the significant impact of NLR on postoperative outcomes, it is essential to investigate the demographic and clinical profiles of patients with elevated NLR to better understand the underlying factors that contribute to poorer outcomes in cholecystectomy. By identifying these characteristics, clinicians can make informed preoperative assessments, manage patient expectations, and implement tailored perioperative care plans to mitigate risks associated with elevated NLR levels. Additionally, understanding the role of NLR and its association with demographic and clinical characteristics could support the development of standardized risk stratification tools that allow for more precise prediction of postoperative recovery needs, especially in high-risk populations [8].

METHODS

This prospective observational study was conducted at the various surgical units of the inpatient Department of Surgery, Dhaka Medical College Hospital, Dhaka, from July 2018 to June 2019. Data were collected through a pre-designed data sheet. Patients with cholecystitis attending in the outdoor or emergency, admitted with cholecystitis in Dhaka Medical College Hospital, Dhaka were considered as the study population. A total of 50 patients were selected as study subjects by purposive sampling technique. Eligible participants were explained the study procedures in detail and written informed consent was obtained from all patients. Data analysis was conducted by descriptive and analytical techniques including mean, SD, frequency distribution, computation of percentage, etc. The continuous variables were compared using independent t-tests while the categorical variables were compared using the chi-square test. The logistic regression model was used for multivariate analyses. Statistical Package for Social Science (SPSS) version 21 for Windows was used to analyze the data. A p-value < 0.05 was considered to be significant. Before starting this study, the research protocol was submitted and approved by the Institutional Review Board of Dhaka Medical College and Hospital, Dhaka.

Inclusion criteria:
- Patients with symptomatic cholecystitis.
- Patients above the age of 18 years

Exclusion criteria
- Minor patient (Below 18 years)
- Patients with associated other conditions e.g. acute pancreatitis and patients with malignancy confirmed on histopathology.

RESULTS

Table 1: Distribution of the patients by age (N=50)

Age in years	Simple Cholecystitis	Severe Cholecystitis	Total
<18	0	0 (0%)	0 (0%)
18-28	6 (12%)	0 (0%)	6 (12%)
28-38	13 (26%)	2 (4%)	15 (30%)
38-48	9 (18%)	1 (2%)	10 (20%)
48-58	8 (16%)	3 (6%)	11 (22%)
>58	5 (10%)	3 (6%)	8 (16%)
Total	41 (82%)	9 (18%)	50 (100%)

Out of 50 respondents, near about one-third (30%) of the patients were in the age group of 28-38 years of age, 22% were in the age group of 48-58 years and 20% of the patients were in the age group of 38-48 years (Table 1). The age of the patients ranged from 18 years to 67 years with a mean of 53.45±16.073 years.

Table 2: Category of the respondents according to demographic characteristics (N=50)

Attributes	Total (n=50)	NLR <3 (n=41)	NLR ≥3 (n=9)	p-value
Age (years)	18-67	18-62	21-67	0.002
Sex				
Male	19 (38%)	13 (31.7%)	6 (66.7%)	0.003
Female	31 (62%)	28 (68.3%)	3 (33.3%)	
Total	50 (100%)	41 (82%)	9 (18%)	-

Among the 50 respondents, the higher NLR (NLR ≥3) group included more patients who had advanced age (p = 0.002), and were male (p =0.003) (Table 2).

Table 3: Category of the respondents according to preoperative characteristics (N=50)

Attributes	Total (N=50)	NLR<3 (n=41)	NLR ≥3 (n=9)	p-value
Admission route				
ED	16 (32%)	8 (19.5%)	8 (88.9%)	<0.002
OPD	34 (68%)	33 (80.5%)	1 (11.1%)	
Symptoms				
Abdominal Pain	46 (92%)	37 (90.2%)	9 (100%)	
Discomfort	8 (16%)	6 (14.6%)	2 (22.2%)	
Nausea/ Vomiting	19 (38%)	13 (31.7%)	6 (66.7%)	0.004
Fever	31 (62%)	28 (68.3%)	3 (33.3%)	
Others	20 (40%)	11 (26.8%)	9 (100%)	
Serum Leukocyte	7700 (1800039300)	6200 (270016500)	13500 (160039300)	<0.004

Among the 50 respondents, the majority (34, 68%) of the respondents got admitted through the outpatient department, and the rest 16 (32%) were admitted through the emergency department. The majority (46, 92%) of the respondents had abdominal pain, 19 (38%) had nausea/ vomiting, 8 (16%) had discomfort,31 had fever (62%) 20 (40%) had others. The serum leukocyte count ranged from 18000-39300 and the mean serum leukocyte count was 7700/mm^3 with a significant difference between the mean serum leukocyte count of the two groups of respondents (P <0.004). The mean serum leukocyte count was higher among the group of respondents with NLR ≥3 (13500/mm^3) than the group of respondents with NLR<3 (6200/mm^3) (Table 3).

Table 4: Category of the respondents according to histopathologic analysis and presence of stones (N=50)

Attributes	Total (N=50)	NLR<3 (n=41)	NLR ≥3 (n=9)	p-value
Contents of gallbladder				
A calculus	10 (20%)	6 (14.6%)	4 (44.4%)	-
Calculus	40 (80%)	35 (85.4%)	5 (55.6%)	
Histopathology				
Simple	41 (82%)	36 (87.8%)	5 (55.6%)	<0.005
Severe	9 (18%)	5 (12.2%)	4 (44.4%)	

Among the 50 respondents, the majority (40, 80%) of the respondents had calculus and only 10 (20%) did not. The majority (41, 82%) of the respondents had simple cholecystitis and only 9 (18%) had severe cholecystitis (Table 4).

Table 5: Category of the respondents according to intraoperative and post-operative characteristics (N=50)

Attributes	Total (N=50)	NLR<3 (n=41)	NLR ≥3 (n=9)	p-value
Operative Procedure				
Open	11 (22%)	6 (14.6%)	5 (55.6%)	-
Laparoscopic	39 (78%)	35 (85.4%)	4 (44.4%)	
Insertion of Drain				0.006
No	36 (72%)	33 (80.5%)	3 (33.3%)	
Yes	14 (28%)	8 (57.1%)	6 (66.7%)	
Open Conversion	4 (8%)	1 (2.4%)	3 (33.3%)	0.12
Operative Time				0.003
<60 min	31 (62%)	29 (70.7%)	2 (22.2%)	
≥60 min	19 (38%)	12 (29.3%)	7 (77.8%)	

Attributes	Total (N=50)	NLR<3 (n=41)	NLR ≥3 (n=9)	p-value
Post-Operative Hospital Stay (Days)				0.002
Mean ± SD	4 ± 2	3.8 ± 2	5.2 ± 3	-
Median	5	4	6	
Post Operative Complications	15 (30%)	6 (14.6%)	9 (100%)	
Voiding Difficulty	3 (6%)	1 (2.4%)	2 (22.2%)	
Pleural Effusion	2 (4%)	0 (0%)	2 (22.2%)	0.054
Wound Infection	7 (14%)	2 (4.9%)	5 (55.6%)	
Atelectasis	3 (6%)	1 (2.4%)	2 (22.2%)	

Among the 50 respondents, the majority (39, 78%) of the respondents had a laparoscopic cholecystectomy and the rest 11 (22%) had an open cholecystectomy. The majority (36, 72%) did not need insertion of the drain, and the rest 14 (28%) needed insertion of the drain. The majority (31, 62%) had their surgery done within 60 minutes while the rest 19 (38%) needed 60 minutes or more to complete the surgery. The mean operative time was 75 ± 3.7 minutes. The mean postoperative hospital stay was 4 ± 2 days. The higher NLR group had a longer LOS (median values; 6.0 days vs. 4.0 days, p <0.002). Among the 50 respondents, 15 (30%) had post-operative complications. Among them, 7 (14%) had wound infection, 3 (6%) had voiding difficulty, another 3 (6%) had atelectasis, and 2 (4%) had pleural effusion (Table 5).

DISCUSSION

In this study of 50 patients undergoing cholecystectomy, close to one-third (30%) were within the 28-38 age group, 22% fell between 48-58 years, and 20% were in the 38-48 age range. Patient ages ranged from 18 to 67 years, consistent with findings from previous retrospective cohort studies where ages spanned 17 to 91 years and 13 to 91 years, respectively [9,10]. The mean age in this study was 53.45 ± 16.07 years, which aligns with findings from a hospital-based observational study [11], a prospective study [12], and another retrospective cohort study [9] where the mean ages reported were 38.85 years [11], 53.41 ± 14.14 years [12], and 55.18 years [9]. In terms of gender distribution, females made up nearly two-thirds (62%) of the patient population, while males represented one-third (38%), mirroring findings from other studies with varying male-to-female ratios. For instance, the gender ratios reported were 8.5:91.5 [11], 58.2:41.8 [10], 58.1:41.9 [12], and 47:53 [9]. Most patients (80%) had cholecystitis with gallstones (calculus), while 20% had non-calculous cholecystitis, reflecting findings from another retrospective cohort study, which indicated an 80.9% prevalence of calculous cholecystitis [9]. Additionally, 82% had simple cholecystitis, while 18% experienced severe cholecystitis, aligning with previous studies showing simple cholecystitis rates of 79.6% [9] and 83.1% [12], and severe cholecystitis rates of 20.4% [9] and 16.9% [12]. The vast majority of procedures (78%) were performed laparoscopically, with four ports used, while the remaining 22% underwent open cholecystectomy. This is consistent with other retrospective studies, such as one reporting a 99.1% rate for laparoscopic and 0.9% for open cholecystectomy [9]. No significant differences in surgical approach or conversion rates were observed between the patient groups. Operative time varied, with 62% of surgeries completed in under 60 minutes, while the remaining 38% exceeded 60 minutes. The mean operative time was 75 ± 3.7 minutes, closely aligning with a prior study reporting a mean time of 76.5 ± 32.7 minutes [9]. Patients with higher NLR values, however, tended to have longer operative times, with 77.8% of the high NLR group requiring over 60 minutes, compared to only 22.2% in the low NLR group (p < 0.003). This trend is supported by another study that found longer operative times in patients with higher NLR values (median 77.5 vs. 65 minutes, p < 0.001) [9]. The mean postoperative hospital stay was 4 ± 2 days, which matches a previous study reporting a 4.4 ± 2.8-day stay [9]. Notably, patients with elevated NLR also had extended hospitalizations (median 6.0 vs. 4.0 days, p < 0.002), similar to findings from other studies where high NLR was associated with longer stays (median 5.0 vs. 3.0 days, p < 0.001) [9]. The use of Jackson-Pratt drains was more frequent in patients with higher NLR (66.7% vs. 57.1%, p = 0.006), supporting findings from another retrospective cohort study where drain insertion was required in 48.4% of high-NLR patients versus 35.9% of low-NLR patients (p = 0.002) [9]. Overall, 72% of patients in this study did not require drainage, while 28% did, closely matching prior studies showing rates of 59% without drainage and 41% with [9]. Postoperative complications occurred in 15 patients (30%). Complications included wound infections (14%), voiding difficulty (6%), atelectasis (6%), and pleural effusion (4%). These rates are consistent with another cohort study, which reported 0.79% for wound infections, 1.3% for voiding difficulty, and 1.3% for pleural effusion [9]. Although the high NLR group exhibited a higher incidence of postoperative complications, this difference was not statistically significant (14.6% vs. 100%, p = 0.054), corroborating findings from other research, which also found higher complications in the high-NLR group (4.3% vs. 8.2%, p = 0.056) [9].

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

The findings indicate that elevated NLR is associated with significant clinical features and outcomes, particularly among older adults and males, with higher rates of laparoscopic conversion, extended operative times, and longer postoperative hospital stays. Patients with elevated NLR were also more likely to require surgical drainage, and they experienced a higher incidence of postoperative complications, although not reaching statistical significance. These results emphasize that a high preoperative NLR could serve as a useful marker for identifying patients at higher risk for complex cholecystectomy courses and potentially prolonged recovery.

RECOMMENDATION

It is recommended that clinicians consider preoperative NLR as an important risk marker when planning cholecystectomy. Patients with elevated NLR may benefit from more intensive preoperative assessment and preparation, as well as close postoperative monitoring, given their higher likelihood of longer operative times, increased need for drainage, and prolonged hospital stays. Utilizing NLR as a predictive tool could improve surgical outcomes, guide resource allocation, and enhance individualized patient care in cholecystectomy management.

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