DOI: https://doi.org/10.54393/pjhs.v6i5.2881

PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (E): 2790-9352, (P): 2790-9344
Volume 6, Issue 05 (May 2025)

Original Article

OPEN ACCESS

Hematological Ratios versus Disease Characteristics versus Surgeons' Experience and Expertise: What Stands Out as Predictor of Conversion to Open Cholecystectomy?

Maryam Afzal[1*], Mahmood Ul Haq Farooqi[2], Sobia Ashraf[3] and Muhammad Afzal[4]

[1]Department of Pathology, University College of Medicine and Dentistry, The University of Lahore, Lahore, Pakistan
[2]Department of Surgery, Surayya Azeem Hospital, Lahore, Pakistan
[3]Department of Hematology, University College of Medicine and Dentistry, The University of Lahore, Lahore, Pakistan
[4]Department of Surgery, University College of Medicine and Dentistry, The University of Lahore, Lahore, Pakistan

ARTICLE INFO

Keywords:
Laparoscopic Cholecystectomy, Systemic Inflammatory Ratios, Neutrophil to Lymphocyte Ratio, Monocyte to Lymphocyte Ratio, Platelet to Lymphocyte Count, Systemic Inflammatory Response Index, Systemic Immune Inflammation Index, Derived Neutrophil to Lymphocyte Ratio

How to Cite:
Afzal, M., Farooqi, M. U. H., Ashraf, S., & Afzal, M. (2025). Hematological Ratios versus Disease Characteristics versus Surgeons' Experience and Expertise: What Stands Out as Predictor of Conversion to Open Cholecystectomy? Hematological and Surgical Factors in Cholecystectomy.Pakistan Journal of Health Sciences, 6(5), 189-199. https://doi.org/10.54393/pjhs.v6i5.2881

Corresponding Author:
Maryam Afzal
Department of Pathology, University College of Medicine and Dentistry, The University of Lahore, Lahore, Pakistan
maryam.afzal99@hotmail.com

Received Date: 17th February, 2025
Revised Date: 29th April, 2025
Acceptance Date: 23rd May, 2025
Published Date: 31st May, 2025

ABSTRACT

Conversion of laparoscopic to open cholecystectomy is often a surprise for the surgeon. **Objective:** To evaluate predictors like inflammatory ratios, gallbladder wall thickness and surgeons' experience to see what predicts conversion best. **Methods:** Retrospective cohort study was done on adult patients diagnosed with acute cholecystitis (Tokyo guidelines) at Surayya Azeem Hospital from 2021 to 2024. Data collected included demographics, CBC findings, surgeons' experience, operation details and ultrasound findings. Patients with chronic cholecystitis, comorbidities and other gallbladder pathologies were excluded. Ratios like NLR, MLR, PLR, SIRI, SII, NLPR and d-NLR were calculated. Chi square, Mann Whitney U, binary logistic regression and ROC analysis were used as per requirement. P-value of less than 0.05 was considered significant. **Results:** 80% of 475 patients were females. 22 (4.8%) patients underwent conversion. Old age and male gender were associated with adverse outcome. WBC count, NLR, d-NLR, SIRI, SII and NLPR were higher in conversion group. Platelet count, PLR and MLR had no associations. Higher hemoglobin (>12.3 g/dL) and ALC (> 1.8x109/L) were predictive of successful laparoscopic procedure. Highest predictive value for conversion was found for NLR and d-NLR (AUC=0.84) followed SIRI (AUC=0.78) with cut-offs of 4.97, 3.76, and 1.69 respectively. Gallbladder wall thickness of >7mm (AUC=0.64) and inexperienced surgeons (AUC=0.69) also increase the probability of conversion. **Conclusion:** Systemic inflammatory indices predict conversion better than ultrasound findings and surgeons' experience. Experienced laparoscopic surgeons should operate on patients with thick gallbladder wall and high inflammatory ratios to minimize the risk of conversion.

INTRODUCTION

Laparoscopic cholecystectomy is gold standard procedure for gall bladder diseases [1]. It has replaced open cholecystectomy for most operations [2]. The reasons include early mobility of the patients, shorter hospital stay, less pain and cosmetic advantages. However, difficult cholecystectomy is commonly encountered by surgeons that necessitates conversion to open cholecystectomy [3]. Difficult cholecystectomy has been defined by a number of parameters that include Visual Analogue scale (VAS) for pain of 8 and above, surgery spanning more than 75 minutes and/or conversion to open cholecystectomy [4]. Many factors have been associated with increased risk of

DOI: https://doi.org/10.54393/pjhs.v6i5.2881

conversion. Male gender and obesity (BMI > 30 kg/m2) have higher conversion rates as compared to females and non-obese patients. Past history of acute inflammatory pathologies involving gallbladder (acute cholecystitis) and in the vicinity of gallbladder or bile duct (acute pancreatitis), as well as acute inflammation at the time of surgery have higher rate of conversion [5, 6]. Multiple long pain attacks (more than five pain attacks that last longer than four hours) predict difficult laparoscopy and subsequent conversion with high sensivity [7]. Among comorbidities, diabetes mellitus and its association with severity of infectious diseases has a positive predictive value for conversion [5]. Past history of abdominal surgery also demands extra vigilance from the surgeon and predicts higher possibility of conversion [6]. Preoperative ultrasonographic findings are also used for predicting the course of cholecystectomy [7]. These include increased thickness of gallbladder wall, fibrosis and presence of multiple large calculi [3-7]. Therefore, preoperative ultrasound has shown great utility in predicting the fate of cholecystectomy. Intraoperative findings and difficulties play the final part in difficult decision making. Anatomical factors like abnormal Callot's triangle anatomy and intrahepatic gallbladder are difficult to operate upon [3]. Finally, the single most important finding that alerts the surgeon towards possible unsuccessful laparoscopic procedure is the presence of extensive adhesions at the time of surgery [8]. Neutrophil to lymphocyte ratio (NLR), Platelet to lymphocyte count (PLR), monocyte to lymphocyte ratio (MLR), Systemic Inflammatory Response Index (SIRI), Systemic Immune Inflammation Index (SII), Neutrophil to platelet x lymphocyte ratio (NLPR) and derived neutrophil to lymphocyte ratio (d-NLR) are ratios derived from complete blood count through calculations. These, along with ESR, are hematological markers of inflammation [9]. Like other acute inflammatory conditions, they are raised in case of acute cholecystitis and correlate with the severity of disease [10, 11]. In daily practice, it has been observed that ultrasound findings sometimes do not correlate well with disease severity. In this study, the patients were addressed without any comorbidities and extensive previous abdominal surgeries. Since gallbladder wall thickness and comorbidities have been linked to increased probability of conversion and there is divided opinion about surgeons' expertise in this regard in the literature, it was aimed to find predictive value of CBC parameters and ratios like NLR, PLR, MLR, SIRI, SII, NLPR and d-NLR for conversion of laparoscopic cholecystectomy to open procedure. CBC is readily available and cost-effective investigation with reasonable turn-around time in the context of emergency setting. Predictors derived through this test will be both easily and timely available. The predictive value will be compared with gallbladder wall thickness and surgeons' expertise to establish which of these has highest predictive value. This, along with other adjuncts of diagnosis, will help the surgeon in anticipating clear picture of the severity of the disease, making more confident preoperative decisions and conveying clear information to the patients regarding the course of their operation. Precious time can be saved and difficulties as a result of unexpected intraoperative findings can be minimized if preoperative prediction can be strong enough to guide treatment decisions.

Although ultrasound findings and clinical factors are used to predict difficult laparoscopic cholecystectomy, their accuracy is often inconsistent. There is limited local evidence evaluating CBC-derived inflammatory markers as predictors of conversion to open cholecystectomy, highlighting a gap this study aims to address. The study aimed to determine cut-off values for these pre-operative CBC parameters along with gallbladder wall thickness on ultrasound that can guide surgeons to anticipate operative difficulty and decide what level of expertise of operating surgeon might be needed for the surgery.

METHODS

This retrospective cohort study was conducted at Surayya Azeem Hospital after obtaining ethical approval (Ref. No. 1316/25/MS/SATH). Data was collected over one week from hospital records of 457 adult patients who presented with acute cholecystitis between 2021 and 2024. Informed consent was not obtained as the study used retrospective data. Inclusion criteria were adult patients diagnosed with acute cholecystitis (Tokyo criteria) who underwent early laparoscopic cholecystectomy. Exclusion criteria included chronic cholecystitis, comorbidities, other gallbladder pathologies, and interval cholecystectomy. Data collected included demographics, clinical history, examination findings (e.g., Murphy's sign), ultrasound reports (e.g., gallbladder wall thickness), CBC (analyzed using Sysmex XN-1000), and surgeon expertise. Systemic inflammatory indices such as NLR, PLR, MLR, SIRI, SII, NLPR, and d-NLR were calculated and validated in SPSS version 27. Gallbladder wall thickness was stratified into four groups, and operative outcomes were categorized as successful laparoscopic or converted to open cholecystectomy. Well-experienced surgeons were defined as those with >200 laparoscopic cholecystectomies in the past 5 years. Statistical analysis included Chi-square for categorical variables, Kolmogorov-Smirnov for normality testing, Mann-Whitney U for comparing indices, and logistic regression for univariate and multivariate analysis. ROC analysis was performed for significant predictors, with AUC ≥0.7 considered acceptable. Findings were presented in tables and figures.

DOI: https://doi.org/10.54393/pjhs.v6i5.2881

RESULTS

A total of 457 patients were included in the study. The study cohort had 90 (19.7%) male patients and 367 (80.3%) females. Male to female ratio was 1:5. Age distribution in the study population as shown in Figure 1.

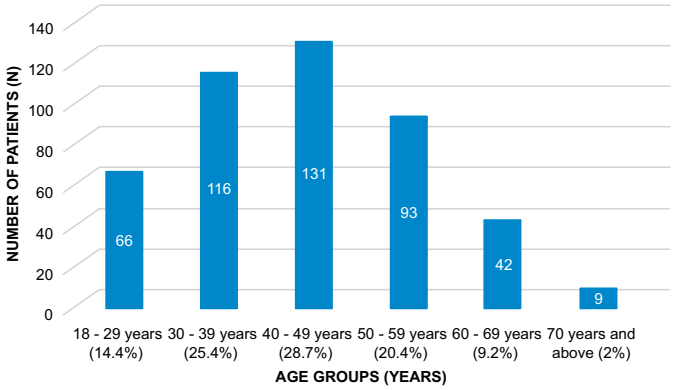

Figure 1: Patient Distribution According to Age Groups

The CBC characteristics, calculated and derived parameters are listed along with their statistics in table 1.

Table 1: CBC Parameters, Calculated and Derived Parameters

Variables	Median	Inter-Quartile Range	Minimum	Maximum	Mean ± SD
Hemoglobin (g/dL)	12.2	11.2 – 13.1	7.0	16.8	12.2 ± 1.63
WBC count (x109/L)	8.6	7.1 – 10.9	3.0	28	9.27 ± 3.33
Platelet count (x109/L)	285.0	224 – 349	33	835	297.14 ± 103.95
Absolute neutrophil count (x109/L)	5.39	4.21 – 7.30	1.65	25.48	6.24 ± 3.24
Absolute lymphocyte count (x109/L)	2.41	1.80 – 2.93	0.34	4.93	2.42 ± 0.85
Absolute monocyte count (x109/L)	0.34	0.24 – 0.48	0.05	6.44	0.41 ± 0.40
Neutrophil to lymphocyte ratio (NLR)	2.17	1.61 – 3.36	0.75	35.39	3.24 ± 3.35
Monocyte to lymphocyte ratio (MLR)	0.14	0.10 – 0.23	0.02	7.83	0.21 ± 0.40
Platelet to lymphocyte ratio (PLR)	120.90	88.98 – 163.83	10.55	1117.24	143.15 ± 97.72
Systemic immune inflammatory index (SIRI)	0.76	0.43 – 1.44	0.08	45.39	1.55 ± 3.29
Systemic inflammatory index (SII)	633.6	411.15 – 1012.50	58.24	11664.00	1001.81 ± 1286.47
Neutrophil to lymphocyte x platelet ratio (NLPR)	0.0081	0.0055 – 0.0124	0.0018	0.1883	0.0122 ± 0.0154
Derived neutrophil to lymphocyte ratio (d-NLR)	1.78	1.32 – 2.57	0.47	10.11	2.35 ± 1.75

The patterns of sonographic wall thickness were shown in figure 2.

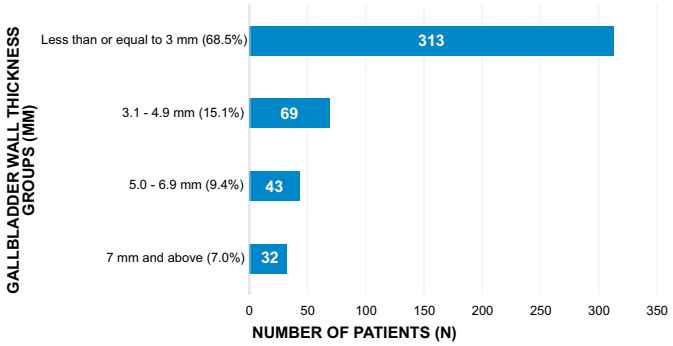

Figure 2: Gallbladder wall thickness distribution in the study population

Comparison of demographic details, CBC parameters and ratios, disease characteristics and operation details are summarized in table 2.

Table 2: Comparison of Successful Versus Converted Group

Variables	Successful Laparoscopic Cholecystectomy Frequency (%)	Conversion to Open Cholecystectomy Frequency (%)
Total patients (n=457)	435 (95.2%)	22 (4.8%)
Age (Years)		
18 – 29 Years	65 (14.9%)	1 (4.5%)
30 – 39 Years	114 (26.2%)	2 (9.1%)
40 – 49 Years	129 (29.7%)	2 (9.1%)
50 – 59 Years	81 (18.6%)	12 (54.5%)
60 – 69 Years	38 (8.7%)	4 (18.2%)
>70 Years	8 (1.8%)	1 (4.5%)
Gender		
Male	82 (18.9%)	8 (36.4%)
Female	353 (81.1%)	14 (63.6%)
CBC Parameters And Ratios (Median Values)		
Hemoglobin (g/dL)	12.3	11.6
Platelet count (x109/L)	285	284.5
WBC count (x109/L)	8.5	13.5
Absolute neutrophil count (x109/L)	5.31	11.8
Absolute lymphocyte count (x109/L)	2.46	1.47

DOI: https://doi.org/10.54393/pjhs.v6i5.2881

Absolute monocyte count (x109/L)	0.35	0.31
Neutrophil to lymphocyte ratio (NLR)	2.17	8.45
Monocyte to lymphocyte ratio (MLR)	0.14	0.27
Platelet to lymphocyte ratio (PLR)	118.17	210.56
Systemic Immune Inflammation Index (SII)	619.84	2357.70
Systemic Inflammatory Response Index (SIRI)	0.72	3.11
Neutrophil to Platelet x lymphocyte ratio (NLPR)	0.0077	0.0216
Derived neutrophil to lymphocyte ratio (d-NLR)	1.70	5.27
Operation Characteristics (Operating Surgeon)		
Senior Consultant (n=238)(52.1%)	234 (98.3%)	4 (1.7%)
Junior Consultant (n=219)(47.9%)	201 (91.8%)	18 (8.2%)
Disease Characteristics (Gallbladder Wall Thickness)		
< 3 mm (n=313)	302 (96.5%)	11 (3.5%)
3.1 – 4.9 mm (n=69)	67 (97.1%)	2 (2.9%)
5.0 – 6.9 mm (n=43)	40 (93.0%)	3 (7.0%)
>7 mm (n=32)	26 (81.2%)	6 (18.8%)

Chi Square test was used to see if there is statistically significant association between conversion and categorical variables. Mann-Whitney U test was used to compare median values for continuous variables between the two groups.

Table 3: Statistical Significance of Difference of Variables between the Study Groups

Variables	Chi-Square~ And Mann Whitney-U Test~~ Results (p-Value)
Age (Years)	
18 – 29 Years	<0.001*
30 – 39 Years	
40 – 49 Years	
50 – 59 Years	
60 – 69 Years	
> 70 Years	
Gender	0.040*
Hemoglobin (g/dL)	0.030*
Platelet count (x10^9/L)	0.350
WBC count (x10^9/L)	<0.001*
Absolute neutrophil count (x10^9/L)	<0.001*
Absolute lymphocyte count (x10^9/L)	<0.001*
Absolute monocyte count (x10^9/L)	0.610
Neutrophil to lymphocyte ratio (NLR)	<0.001*
Monocyte to lymphocyte ratio (MLR)	<0.001*
Platelet to lymphocyte ratio (PLR)	<0.001*
Systemic Immune Inflammation Index (SII)	<0.001*
Systemic Inflammatory Response Index (SIRI)	<0.001*
Neutrophil to Platelet x lymphocyte ratio (NLPR)	<0.001*
Derived neutrophil to lymphocyte ratio (d-NLR)	<0.001*
Operating surgeon	0.001*
Gallbladder Wall Thickness	< 3mm, 3.1 – 4.9 mm, 5.1 – 6.9 mm, > 7 mm: 0.001*

~ Chi-square test was used for categorical variables. ~~ Mann-Whitney U test was used for continuous variables

Univariate and multivariate analyses were done through logistic regression are given in table 4.

Table 4: Univariate Analysis and Multivariate Analysis for Conversion to Open Cholecystectomy Summary

Variables		Univariate Analysis~			
		p-Value	Odds Ratio (OR)	Confidence Intervals	
				Lower Limit	Upper Limit
18 – 29 Years	18 – 29 Years	0.005* (combined)	Reference~~		
	30 – 39 Years	0.910	1.14	0.10	12.82
	40 – 49 Years	0.990	1.008	0.09	11.32
	50 – 59 Years	0.030*	9.63	1.22	76.00
	60 – 69 Years	0.090	6.84	0.74	63.47
	>70 Years	0.150	8.10	0.46	142.93
Gender		Reference~~ - Male			
		0.050	0.41	0.16	1.00
Hemoglobin (g/dL)		0.030*	0.75	0.58	0.96
Platelet count (x10^9/L)		0.090	1.00	0.99	1.01
WBC count (x10^9/L)		<0.001*	1.30	1.18	1.44
Absolute neutrophil count (x10^9/L)		<0.001*	1.35	1.22	1.49
Absolute lymphocyte count (x10^9/L)		< 0.001*	0.20	0.10	0.40
Absolute monocyte count (x10^9/L)		0.390	1.34	0.69	2.61

DOI: https://doi.org/10.54393/pjhs.v6i5.2881

Neutrophil to lymphocyte ratio (NLR)		< 0.001*	1.26	1.15	1.38
Monocyte to lymphocyte ratio (MLR)		0.160	1.43	0.86	2.38
Platelet to lymphocyte ratio (PLR)		0.001*	1.004	1.002	1.007
Systemic Immune Inflammation Index (SII)		<0.001*	1.00	1.000	1.001
Systemic Inflammatory Response Index (SIRI)		0.002*	1.15	1.05	1.25
Neutrophil to Platelet x lymphocyte ratio (NLPR)		<0.001*	2.49 x 1015	2.64 x 10^{-7}	2.34 x 1023
Derived neutrophil to lymphocyte ratio (d-NLR)		<0.001*	1.73	1.47	2.01
Operating surgeon's experience		Reference~~ – experienced surgeons			
		0.003*	5.24	1.74	15.73
Gallbladder wall thickness	<3mm	0.006* (combined)	Reference~~		
	3.1 – 4.9 mm	0.790	0.82	0.18	3.78
	5.1 – 6.9 mm	0.280	2.06	0.55	7.70
	>7 mm	<0.001*	6.34	2.17	18.51
Variables		**Multivariate Analysis~**			
		p-Value	**Odds Ratio (OR)**	**Confidence Intervals**	
Age (Years)	18 – 29 Years	0.006* (combined)	Reference~~	**Lower Limit**	**Upper Limit**
	30 – 39 Years	0.790	1.40	0.11	17.51
	40 – 49 Years	0.970	0.96	0.07	12.29
	50 – 59 Years	0.020	11.61	1.31	102.66
	60 – 69 Years	0.050	10.11	0.96	106.82
	> 70 Years	0.120	12.90	0.53	313.76
Gender		Reference~~ - Males			
		0.070	0.35	0.11	1.11
Hemoglobin (g/dL)		0.004*	0.61	0.44	0.85
Platelet count (x10^9/L)		0.830	1.00	0.99	1.00
WBC count (x10^9/L)		<0.001*	1.35	1.13	1.61
Absolute neutrophil count (x10^9/L)		<0.001*	1.52	1.24	1.85
Absolute lymphocyte count (x10^9/L)		<0.001*	0.19	0.07	0.49
Absolute monocyte count (x10^9/L)		0.330	1.66	0.60	4.58
Neutrophil to lymphocyte ratio (NLR)		<0.001*	1.31	1.14	1.50
Monocyte to lymphocyte ratio (MLR)		0.080	1.18	0.92	3.52
Platelet to lymphocyte ratio (PLR)		0.060	1.004	1.000	1.009
Systemic Immune Inflammation Index (SII)		<0.001*	1.001	1.000	1.001
Systemic Inflammatory Response Index (SIRI)		0.003*	1.15	1.04	1.26
Neutrophil to Platelet x lymphocyte ratio (NLPR)		<0.001*	>1.05 x 1021	1.51 x 10-8	7.29 x 1033
Derived neutrophil to lymphocyte ratio (d-NLR)		<0.001*	2.18	1.56	3.04
Operating surgeon's experience		Reference~~ – experienced surgeons			
		<0.001*	9.695	2.55	36.92
Gallbladder wall thickness	<3mm	0.04* (combined)	Reference~~		
	3.1 – 4.9 mm	0.520	0.58	0.11	3.00
	5.1 – 6.9 mm	0.390	2.01	0.41	9.81
	>7 mm	0.010*	5.77	1.52	21.88

~ Univariate analysis and Multivariate analysis was done using logistic regression
~~ Reference categories are mentioned for categorical variables only

ROC curves were made for the variables found to be significant in logistic regression. ROC curves are given in Figure 3 – 7 and results are summarized in table 5.

Table 5: ROC Analysis for Factors Analyzed

Variables	Area Under Curve (AUC)	Sensitivity (%)	Specificity (%)	Cut-off value (equal and above)
Variables and Cut Offs Predictive of Conversion				
WBC count (x10^9/L)	0.75	68.0%	83.5%	11.65
ANC (x10^9/L)	0.79	68.2%	89.9%	9.79
NLR	0.84	72.7%	89%	4.97

DOI: https://doi.org/10.54393/pjhs.v6i5.2881

SIRI	0.78	72.7%	82.1%	1.69
SII	0.83	64%	93%	1913.08
NLPR	0.81	81.8%	79%	0.013
d-NLR	0.84	72.7%	89.9%	3.76
Wall thickness (mm)	0.64	40.9%	84.8%	5.0
Variables and Cut Offs Predictive Of Successful Laparoscopic Procedure				
Hemoglobin (g/dL)	0.64	47.6%	77.3%	12.3
ALC ($x10^9$/L)	0.83	78.4%	86.4%	1.8

Figure 3 illustrated the ROC (Receiver Operating Characteristic) curves for CBC parameters in predicting conversion to open cholecystectomy.

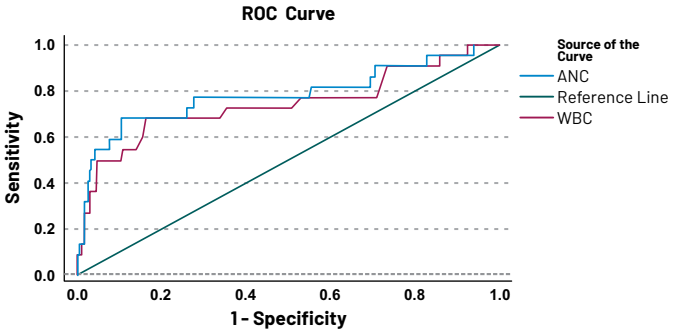

Figure 3: ROC curves for CBC parameters that predict conversion. AUC for ANC = 0.79. AUC for WBC count = 0.75

Figure 4 displayed ROC (Receiver Operating Characteristic) curves for various CBC-derived inflammatory ratios predicting the probability of conversion to open cholecystectomy.

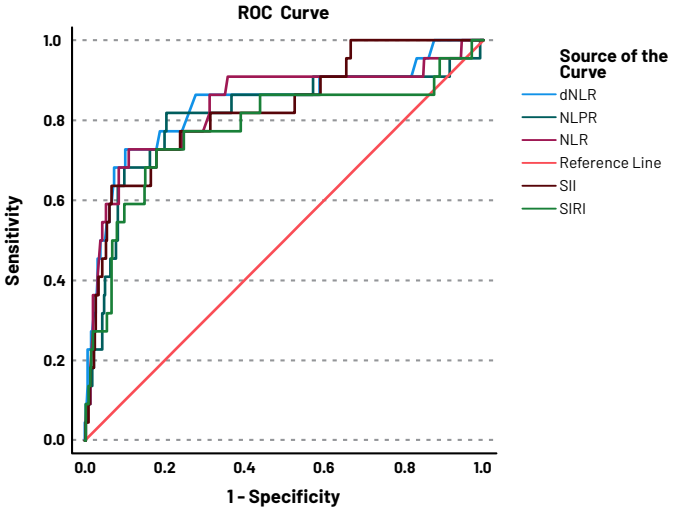

Figure 4: ROC curves for ratios derived from CBC that predict probability of conversion. AUC for NLR = 0.84. AUC for SIRI = 0.78. AUC for SII = 0.83. AUC for NLPR = 0.81. AUC for d-NLR = 0.84

Figure 5 showed the ROC (Receiver Operating Characteristic) curve for gallbladder wall thickness as a predictor of conversion to open cholecystectomy. The area under the curve (AUC) is 0.64, indicating a modest discriminatory ability.

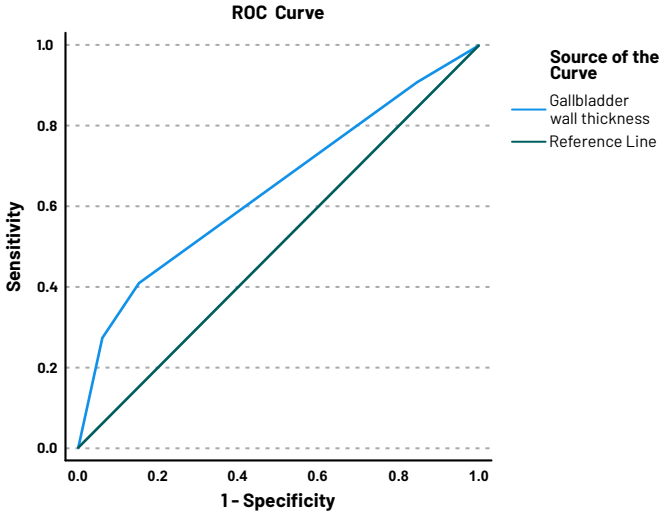

Figure 5: ROC curve for gallbladder wall thickness. AUC = 0.64.

Figure 6 illustrated the ROC (Receiver Operating Characteristic) curve evaluating surgeons' experience as a predictor for conversion to open cholecystectomy. The area under the curve (AUC) is 0.69, suggesting a fair predictive value, indicating that lower surgical experience may modestly increase the risk of conversion.

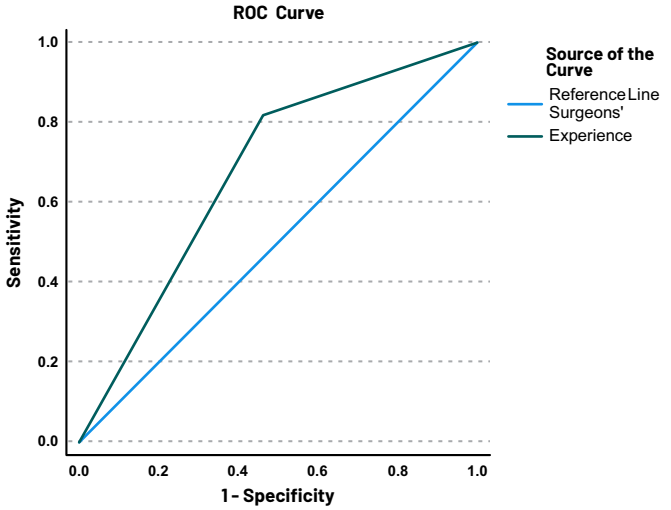

Figure 6: ROC curve for surgeons' experience as predictor for conversion. AUC = 0.69.

Figure 7 presented the ROC (Receiver Operating Characteristic) curves for parameters associated with successful laparoscopic cholecystectomy. The area under the curve (AUC) for absolute lymphocyte count (ALC) is 0.83, indicating good predictive accuracy. Hemoglobin

DOI: https://doi.org/10.54393/pjhs.v6i5.2881

shows a lower AUC of 0.64, suggesting modest discriminatory ability.

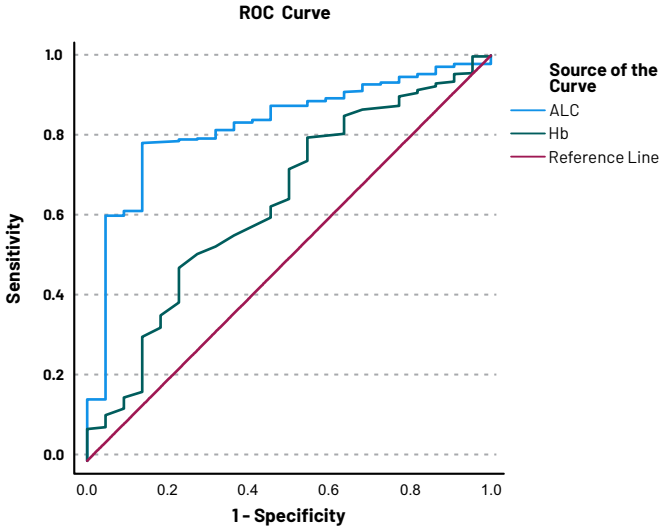

Figure 7: ROC curves for Parameters Associated with Successful Laparoscopic Cholecystectomy. AUC for ALC = 0.83. AUC for Hemoglobin = 0.64.

DISCUSSION

NLR and PLR have been widely studied in relation to complications in laparoscopic cholecystectomy. Serban *et al.*, found NLR > 4.19 predictive of advanced inflammation and conversion risk, with 85.5% sensitivity and 66.9% specificity. They concluded NLR was also superior to PLR and SII in predicting postoperative complications [12]. A Turkish study found a positive association between NLR and conversion in emergency cholecystectomy, but not in elective cases, and no independent predictive value in multivariate analysis [13]. Kartal M also found no predictive power for NLR or PLR in surgical complications [14]. In contrast, Moloney B.M *et al.*, proposed an NLR cut-off of 3.5 as predictive of conversion [15]. SIRI and SII, known inflammatory markers, were also evaluated. Efgan *et al.*, showed SII > 4631.293 to be 100% sensitive and 86% specific for systemic inflammation post-cholecystectomy. SIRI > 5.924 was 61.75% sensitive and 65.71% specific for gallstones in acute cholecystitis [16]. MLR has limited literature in this context, though Durak D *et al.*, reported a cut-off of 0.2693 for predicting procedural difficulty [17]. Ultrasound findings such as gallbladder wall thickness, pericholecystic fluid, fibrosed gallbladder, and sonographic Murphy's sign are helpful in assessing disease severity. Morales-Maza *et al.*, found wall thickness ≥ 4 mm associated with higher conversion rates and another study reported a 5.75 mm cut-off [18, 19]. In this study, most patients with acute cholecystitis were females (around three-fourths of the population), with highest numbers in the 40–49 age group, followed by 30–39. These demographics match existing literature [20]. Over half of the converted cases were in the 50–59 age group, a statistically significant finding in both univariate (p = 0.04) and multivariate analysis (p = 0.006). Conversion risk increased >10-fold above age 50 and >12-fold above 70. Due to a small number of patients above 70, conclusions in this age bracket are limited. Some studies associate age > 60 with increased conversion risk [21]. Patients with comorbidities were excluded, so the effect of chronic illnesses like diabetes could not be analyzed. More than 80% of successful cases were females, who showed 65% lower conversion risk, though this was not statistically significant. Some studies report worse outcomes in males, but no such association was found here [5, 6, 18]. Surgeons with fewer than 200 laparoscopic cholecystectomies were considered inexperienced. The senior to junior consultant ratio was 1.1:1. Conversion rate was 4.8%, with 82% of conversions performed by junior consultants—a statistically significant result. These findings align with studies reporting higher complication rates among less experienced surgeons, though not all evaluate conversion as a complication [22, 23]. Surgeon expertise was an independent predictor of conversion, with junior surgeons showing a 9-fold increased risk. Gallbladder wall thickness on ultrasound was categorized: ≤ 3 mm (about two-thirds), 3.1–4.9 mm (15%), 5.1–6.9 mm (9.2%), and ≥ 7 mm (6%). Normal wall thickness in acute cholecystitis contrasts with some literature though others state thickening isn't exclusive to the condition [24, 25]. Thickened, inflamed gallbladder was noted intraoperatively. Wall thickness was significant in both univariate and multivariate analysis. Conversion rates were lower in patients with normal or minimally thickened walls, with no significant difference between these two groups. Wall thickness ≥ 5 mm carried 2-fold increased risk; ≥ 7 mm carried >5-fold increased risk. ROC analysis showed >5 mm as the cut-off for predicting conversion. Logistic regression confirmed the 7 mm group had significant p-values and confidence intervals. CBC trends showed significantly higher hemoglobin in successful cases. Platelet count was comparable. WBC was significantly higher in converted cases, consistent with prior research [19]. Median ANC, NLR, MLR, PLR, SIRI, SII, NLPR, and d-NLR were higher in converted cases. ALC and AMC were lower in successful laparoscopies. Univariate and multivariate analyses were used to assess independent predictors. Hemoglobin >12.3 g/dL reduced conversion risk by 47% (p = 0.004). Platelet count was not significant. Each unit increase in WBC and ANC was associated with 35% and 52% increased risk of conversion, respectively (p < 0.001). Higher ALC was protective, with 81% lower risk per unit rise. AMC showed 66% increased risk but was not statistically significant (p = 0.44). NLR cut-off was 4.97, with 31% increased conversion risk per unit rise.

DOI: https://doi.org/10.54393/pjhs.v6i5.2881

MLR and PLR were not significant in multivariate analysis, with 18% and 0.4% increased risk per unit, respectively. PLR was significant in univariate analysis but lost significance after adjusting for confounders. MLR was not significant in univariate analysis. SIRI was significant with a cut-off of 1.69 and a 15% risk increase per unit. SII was also an independent predictor with a cut-off of 1913.08 and 0.1% risk increase per unit. d-NLR had a cut-off of 3.76, with a 2-fold increased conversion risk per unit rise. NLPR showed an exponential odds ratio (1.15×10^{8} to 7.29×10^{23}), suggesting high risk, though the wide confidence interval calls for caution. These wide intervals may stem from the low conversion rate in the sample (457 patients), not small sample size itself. Multivariate analysis found the best predictors were NLR and d-NLR, followed by SIRI. Though SII and NLPR had significant p-values, they were excluded due to insignificant or excessively wide confidence intervals. These were followed by surgeon experience and gallbladder wall thickness. Given the shift toward minimally invasive surgery, the study recommends targeted training in laparoscopic techniques. In resource-constrained settings, rotations or collaborative workshops with well-equipped centers should be arranged. Most patients had normal gallbladder wall thickness, raising questions about ultrasound's role in acute cholecystitis diagnosis. Previous studies have shown diabetes and past abdominal surgeries increase conversion risk, but these factors could not be assessed here due to patient exclusion. Only two patients had past surgeries. Wider confidence intervals in some variables suggest that larger cohort studies are needed to better define effect sizes and improve predictive accuracy. This study excluded patients with comorbidities such as diabetes and prior abdominal surgeries, limiting the ability to assess their impact on conversion risk. Additionally, the relatively low conversion rate resulted in wide confidence intervals for some variables, affecting the precision of risk estimates. Future large-scale prospective studies including diverse patient populations are recommended to validate inflammatory markers and improve predictive models for conversion in laparoscopic cholecystectomy.

CONCLUSIONS

Among the factors compared, systemic inflammatory indices specially NLR, d-NLR and SII were found to have highest predictive value for conversion followed by surgeons' experience with laparoscopic cholecystectomy and gallbladder wall thickness. However, interpretation of these indices should be cautious and in conjunction with clinical context. Therefore, it was concluded that patients with acute cholecystitis who have high systemic inflammatory indices at presentation and thickened gallbladder wall should be operated upon by experienced laparoscopic surgeons to minimize chances of conversion. Caution should also be exercised in old aged patients and in those with low hemoglobin.

Authors' Contribution

Conceptualization: MA[1]
Methodology: SA, MA[1]
Formal analysis: MA[1]
Writing and Drafting: MA[1], MUHF, SA, MA[2]
Review and Editing: MA[1], MUHF, SA, MA[2]

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.

Source of Funding

The author received no financial support for the research, authorship and/or publication of this article.

REFERENCES

[1] Delgado LM, Pompeu BF, Pasqualotto E, Magalhães CM, Oliveira AF, Kato BK *et al.* Robotic-assisted cholecystectomy versus conventional laparoscopic cholecystectomy for benign gallbladder disease: a systematic review and meta-analysis. Journal of Robotic Surgery. 2024 Jun; 18(1): 242. doi: 10.1007/s11701-024-01989-5.

[2] Mannam R, Narayanan RS, Bansal A, Yanamaladoddi VR, Sarvepalli SS, Vemula SL *et al.* Laparoscopic cholecystectomy versus open cholecystectomy in acute cholecystitis: a literature review. Cureus. 2023 Sep; 15(9). doi: 10.7759/cureus.45704.

[3] Zhao JJ, Syn NL, Chong C, Tan HL, Ng JY, Yap A *et al.* Comparative outcomes of needlescopic, single-incision laparoscopic, standard laparoscopic, mini-laparotomy, and open cholecystectomy: A systematic review and network meta-analysis of 96 randomized controlled trials with 11,083 patients. Surgery. 2021 Oct; 170(4): 994-1003. doi: 10.1016/j.surg.2021.04.004.

[4] Da Costa DW, Schepers NJ, Bouwense SA, Hollemans RA, van Santvoort HC, Bollen TL *et al.* Predicting a 'difficult cholecystectomy'after mild gallstone pancreatitis. Hpb. 2019 Jul; 21(7): 827-33. doi: 10.1016/j.hpb.2018.10.015.

[5] Bhandari TR, Khan SA, Jha JL. Prediction of difficult laparoscopic cholecystectomy: An observational study. Annals of Medicine and Surgery. 2021 Dec; 72: 103060. doi: 10.1016/j.amsu.2021.103060.

[6] Magnano San Lio R, Barchitta M, Maugeri A, Quartarone S, Basile G, Agodi A. Preoperative risk factors for conversion from laparoscopic to open cholecystectomy: a systematic review and meta-analysis. International Journal of Environmental

DOI: https://doi.org/10.54393/pjhs.v6i5.2881

Research and Public Health. 2022 Dec; 20(1): 408. doi: 10.3390/ijerph20010408.

[7] Stanisic V, Milicevic M, Kocev N, Stanisic B. A prospective cohort study for prediction of difficult laparoscopic cholecystectomy. Annals of Medicine and Surgery. 2020 Dec; 60: 728-33. doi: 10.1016/j.amsu.2020.11.082.

[8] Kapoor A, Sidhu BS, Singh J, Brar N, Singh P, Kapur A. Adhesions detection and staging classification for preoperative assessment of difficult laparoscopic cholecystectomies: A prospective case-control study. Journal of Medical Ultrasound. 2023 Apr; 31(2): 137-43. doi: 10.4103/jmu.jmu_36_22.

[9] Targońska-Stępniak B, Zwolak R, Piotrowski M, Grzechnik K, Majdan M. The relationship between hematological markers of systemic inflammation (neutrophil-to-lymphocyte, platelet-to-lymphocyte, lymphocyte-to-monocyte ratios) and ultrasound disease activity parameters in patients with rheumatoid arthritis. Journal of Clinical Medicine. 2020 Aug; 9(9): 2760. doi: 10.3390/jcm9092760.

[10] Xia Z, Liu Y, Sun S, Shan E, Liu Y. The value of preoperative neutrophil/lymphocyte ratio in predicting the severity of cholecystolithiasis with cholecystitis in elderly patients. BioMed Central Surgery. 2023 Nov; 23(1): 360. doi: 10.1186/s12893-023-02267-1.

[11] Şener K, Çakır A, Kılavuz H, Doğan S, Güven R, Korkut S. Diagnostic Value of the Systemic Immune-Inflammation Index in Diagnosing Acute Cholecystitis. Comprehensive Medicine. 2023 May; 15(2): 125-31. doi: 10.14744/cm.2023.18209.

[12] Serban D, Stoica PL, Dascalu AM, Bratu DG, Cristea BM, Alius C *et al.* The significance of preoperative neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), and systemic inflammatory index (SII) in predicting severity and adverse outcomes in acute calculous cholecystitis. Journal of Clinical Medicine. 2023 Nov; 12(21): 6946. doi: 10.3390/jcm12216946.

[13] Avci MA, Akgün C, Buk O, Karadan D, Karadan II D. Can Hemogram Parameters and Derived Ratios Predict Conversion From Laparoscopic to Open Cholecystectomy?. Cureus. 2024 Aug; 16(8). doi: 10.7759/cureus.68290.

[14] Kartal M and Kalaycı T. Can neutrophil-lymphocyte ratio, platelet-lymphocyte ratio, prognostic nutrition index, and albumin be used to predict cholecystectomy morbidity in super-elderly patients?. Turkish Journal of Trauma & Emergency Surgery. 2023 Aug; 29(8): 890. doi: 10.14744/tjtes.2023.31462.

[15] Moloney BM, Waldron RM, O'Halloran N, Kelly ME, Myers E, Garvin JT *et al.* The clinical utility of pre-operative neutrophil-to-lymphocyte ratio as a predictor of outcomes in patients undergoing elective laparoscopic cholecystectomy. Irish Journal of Medical Science (1971-). 2018 Aug; 187: 755-60. doi: 10.1007/s11845-018-1749-6.

[16] Efgan MG, Bora ES, Coşkun SM, Kırık S, Kayalı A. Predictive value of inflammatory indices in acute cholecystitis: a retrospective study of gallstone detection and outcome assessment. Signa Vitae. 2024 Aug; 1: 10. doi: 10.22514/sv.2024.134.

[17] Durak D, Alkurt EG, Tutan MB. CRP, WBC and monocyte/lymphocyte ratio relation as a preoperative predictive factor for adhesions observed during laparoscopic cholecystectomy. Journal of Health Sciences and Medicine. 2021 Apr; 4(5): 686-91. doi: 10.32322/jhsm.952507.

[18] Morales-Maza J, Rodríguez-Quintero JH, Santes O, Aguilar-Frasco JL, Romero-Vélez G, García-Ramos ES *et al.* Conversion from laparoscopic to open cholecystectomy: Risk factor analysis based on clinical, laboratory, and ultrasound parameters. Revista de Gastroenterología de México (English Edition). 2021 Oct; 86(4): 363-9. doi: 10.1016/j.rgmxen.2021.08.001.

[19] Altıner S, Ergüder E, Altınok SH, Aydın SM, Barlas AM, Tuncal S. The role of preoperative ultrasound in predicting conversion from laparoscopic cholecystectomy to open surgery in acute cholecystitis. Turkish Journal of Trauma & Emergency Surgery. 2023 Sep; 29(10): 1109. doi: 10.14744/tjtes.2023.45469.

[20] Kulkarni SV and Kumar SS. Preoperative predictors of a difficult laparoscopic cholecystectomy. International Journal of Surgery. 2018 Feb; 5(2): 608-13. doi: 10.18203/2349-2902.isj20180362.

[21] Lee CE, Lee SJ, Moon JI, Choi IS, Yoon DS, Choi WJ *et al.* Acute cholecystitis in old adults: the impact of advanced age on the clinical characteristics of the disease and on the surgical outcomes of laparoscopic cholecystectomy. BioMed Central Gastroenterology. 2023 Sep; 23(1): 328. doi: 10.1186/s 12876-023-02954-6.

[22] Hobbs MS, Mai Q, Knuiman MW, Fletcher DR, Ridout SC. Surgeon experience and trends in intraoperative complications in laparoscopic cholecystectomy. Journal of British Surgery. 2006 Jul; 93(7): 844-53. doi: 10.1002/bjs.5333.

[23] Riccardi M, Dughayli M, Baidoun F. Open Cholecystectomy for the New Learner-Obstacles and Challenges. JSLS: Journal of the Society of Laparoscopic & Robotic Surgeons. 2021 Apr; 25(2):

DOI: https://doi.org/10.54393/pjhs.v6i5.2881

e2021-00026. doi: 10.4293/JSLS.2021.00026.

[24] Patel MD, Sill AP, Dahiya N, Chen F, Eversman WG, Kriegshauser JS *et al.* Performance of an algorithm for diagnosing acute cholecystitis using clinical and sonographic parameters. Abdominal Radiology. 2022 Feb; 47(2): 576-85. doi: 10.1007/s00261-021-03384-2.

[25] Patel R, Tse JR, Shen L, Bingham DB, Kamaya A. Improving Diagnosis of Acute Cholecystitis with US: New Paradigms. RadioGraphics. 2024 Nov; 44(12): e240032. doi: 10.1148/rg.240032.