The Value of Monocyte-Lymphocyte Ratio, Neutrophil-Lymphocyte Ratio and Platelet-Lymphocyte Ratio in Predicting COVID-19 Mortality: A Single-Center Retrospective Study

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BACKGROUND

- The quest for an easy yet effective and affordable tool in predicting mortality among COVID 19 patients is one of the major health concerns that should be addressed
- In this study, we investigated the role of these hemogram derived ratios- Monocyte-Lymphocyte Ratio, Neutrophil-Lymphocyte Ratio and Platelet-Lymphocyte-Ratio in predicting in-hospital COVID 19 mortality

OBJECTIVES

- To determine the optimal cut-off value of each ratio
- To compare the values of each ratio in predicting mortality

METHODS

- **STUDY DESIGN :** Cross sectional retrospective study utilizing chart review of adult, COVID 19 confirmed patients admitted at Dr. Paulino J. Garcia Memorial Research and Medical Center from July 2020 to July 2021
- **INCLUSION CRITERIA:** Adult patients (19 years old and above), diagnosed to have COVID 19 confirmed by specific detection of the SARS-CoV-2 in nasopharyngeal and/or oropharyngeal swab using quantitative polymerase chain reaction
- **EXCLUSION CRITERIA:** diagnosed with hematological diseases, active malignancies, or rheumatic diseases, human immunodeficiency virus (HIV), hepatitis C virus (HCV), and hepatitis B virus (HBV)-seropositive individuals, on long-term immunomodulatory medications such as non-steroidal anti-inflammatory drugs or any corticosteroids, underwent surgical procedures and who has incomplete medical records
- Complete blood count taken within 24 hours of admission were recorded. The primary outcome was in-hospital mortality. The NLR, MLR and PLR values were computed and were stratified into two groups after determining the optimal cut-off from the receiver operating characteristic curve (ROC) curve

RESULTS

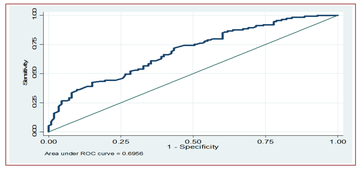
Table 1 Clinico-demographic profile of participants

Characteristic	Overall (n = 226)	Survivors (n = 113)	Non Survivors (n = 113)	p-value
Age (mean, SD)	58.62 (13.34)	56.10 (13.35)	61.13 (12.91)	0.004
Sex (n, %)				
Female	110 (48.67)	52 (46.02)	58 (51.33)	0.425
Male	116 (51.33)	61 (53.98)	55 (48.67)	
Body Mass Index (mean, SD)	26.31 (4.28)	26.19 (4.19)	26.42 (4.38)	0.693
Body Mass Index group (n, %)				
Underweight	4 (1.77)	3 (2.65)	1 (0.88)	0.066
Normal	84 (37.17)	37 (32.74)	47 (41.59)	
Overweight	99 (43.81)	58 (51.33)	41 (36.28)	
Obese	39 (17.26)	15 (13.27)	24 (21.24)	
Hospital days (mean, SD)	10.00 (6.99)	13.59 (6.21)	6.42 (5.79)	<0.001
Smoking history (n, %)				
Current smoker	3 (1.33)	1 (0.88)	2 (1.77)	0.761
Former smoker	24 (10.62)	11 (9.73)	13 (11.50)	
Non-smoker	199 (88.05)	101 (89.38)	98 (86.73)	
Comorbidities (n, %)				
Hypertension	121 (53.54)	56 (49.56)	65 (57.52)	0.230
Diabetes	82 (36.28)	33 (29.20)	49 (43.36)	0.027
Chronic kidney disease	46 (20.35)	18 (15.93)	28 (24.78)	0.099
Hypertensive cardiovascular disease	26 (11.50)	12 (10.62)	14 (12.39)	0.677
Coronary artery disease	12 (5.31)	6 (5.31)	6 (5.31)	1.000
Ischemic heart disease	6 (2.65)	4 (3.54)	2 (1.77)	0.408
Bronchial asthma	6 (2.65)	4 (3.54)	2 (1.77)	0.408
Chronic glomerulonephritis	4 (1.77)	3 (2.65)	1 (0.88)	0.313
Chronic obstructive pulmonary disease	3 (1.33)	1 (0.88)	2 (1.77)	0.561
Prior cerebrovascular disease	3 (1.33)	1 (0.88)	2 (1.77)	0.561
Pulmonary tuberculosis	3 (1.33)	2 (1.77)	1 (0.88)	0.561
Gouty arthritis	2 (0.88)	2 (1.77)	0 (0.00)	0.155
Dyslipidemia	2 (0.88)	2 (1.77)	0 (0.00)	0.155
Dementia	1 (0.44)	1 (0.88)	0 (0.00)	0.316
No comorbidities	38 (16.81)	26 (23.01)	12 (10.62)	0.013
Investigational Drugs received (n, %)				
Remdesivir	160 (70.80)	62 (54.87)	98 (86.73)	<0.001
Tocilizumab	11 (4.87)	1 (0.88)	10 (8.85)	0.005
Favipiravir	2 (0.88)	2 (1.77)	0 (0.00)	0.155
Baricitinib	2 (0.88)	0 (0.00)	2 (1.77)	0.155
Dexamethasone	209 (92.48)	99 (87.61)	110 (97.35)	0.006

Table 2 Complete blood count of participants taken within 24 hours of admission

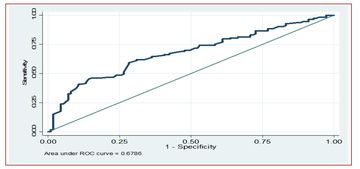
CBC profile	Overall (n = 226)	Survivors (n = 113)	Non Survivors (n = 113)	p-value
Neutrophils (mean, SD)	7.85 (1.14)	7.49 (1.27)	8.21 (0.87)	<0.001
Lymphocytes (mean, SD)	1.47 (0.91)	1.78 (1.00)	1.16 (0.69)	<0.001
Monocytes (mean, SD)	0.71 (0.90)	0.76 (1.09)	0.65 (0.66)	0.345
Platelets (mean, SD)	252.31 (95.25)	260.20 (90.75)	244.41 (99.33)	0.213
NLR (mean, SD)	8.79 (8.29)	6.12 (4.63)	11.47 (10.10)	<0.001
MLR (mean, SD)	0.59 (0.57)	0.47 (0.54)	0.70 (0.58)	0.002
PLR (mean, SD)	270.70 (285.56)	202.75 (150.63)	338.65 (363.06)	<0.001

Figure 1A Optimal cut-off point of NLR to predict Covid-19 mortality



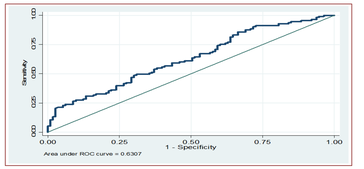
Optimal cut-off point: ≥5.846
Area under ROC curve: 0.6956; SE 0.0345; 95% CI 0.6281 to. 0.7631

Figure 1B Optimal cut-off point of MLR to predict Covid-19 mortality



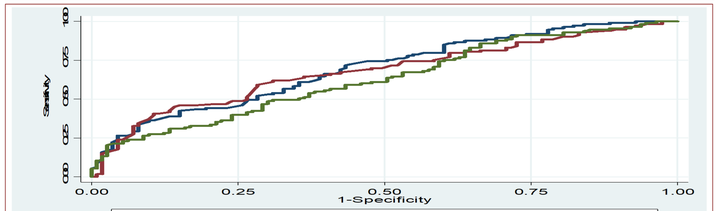
Optimal cut-off point: ≥0.4444
Area under ROC curve: 0.6786; SE 0.0357; 95% CI 0.6085 to 0.7486

Figure 1C Optimal cut-off point of PLR to predict Covid-19 mortality



Optimal cut-off point: ≥190
Area under ROC curve: 0.6307; SE 0.0368; 95% CI 0.5586 to 0.7028

Figure 2 Comparison of AuROC of NLR, MLR and PLR in predicting Covid-19 mortality



	Obs	AuROC	Std. Err.	[95% Conf. Interval]	
Neutrophil-lymphocyte ratio (nlr)	226	0.6956	0.0345	0.62805	0.76314
Monocyte-Lymphocyte ratio (mlr)	226	0.6786	0.0357	0.60854	0.74857
Platelet-lymphocyte ration (plr)	226	0.6307	0.0368	0.55862	0.70279

Ho: Comparison as defined by contrast matrix: C
chi2(1) = 12.06 Prob > chi2 = 0.0005

Table 3 Diagnostic value of NLR, MLR and PLR in predicting Covid-19 mortality

Parameters	NLR (≥5.846)	MLR (≥0.4444)	PLR (≥190)
Sensitivity	66.37%	64.60%	59.29%
Specificity	60.18%	63.72%	56.64%
PPV	62.50%	64.04%	57.76%
NPV	64.15%	64.29%	58.18%

Table 4 Ratio-wise distribution of cases and their significance

Test parameter	Cut-off value	Survivors (n = 113)	Non Survivors (n = 113)	Odds ratio (95% CI)	p-value
NLR	≥5.846	45 (39.82)	75 (66.37)	2.98 (1.73-5.13)	<0.001
	<5.846	68 (60.18)	38 (33.63)		
MLR	≥0.444	41 (36.28)	73 (64.60)	3.20 (1.86-5.52)	<0.001
	<0.444	72 (63.72)	40 (35.40)		
PLR	≥190.0	49 (43.36)	67 (59.29)	1.90 (1.12-3.23)	0.017
	<190.0	64 (56.64)	46 (40.71)		

CONCLUSIONS

- Neutrophil-lymphocyte ratio (NLR), Monocyte-lymphocyte ratio (MLR) and Platelet-lymphocyte ratio (PLR) were noted to be consistently high among non-survivors of COVID 19 infection
- These are helpful markers in predicting in-hospital mortality
- Neutrophil-lymphocyte ratio (NLR) appears to be the best predictor of COVID-19 mortality of the three markers. However, its overall diagnostic accuracy is only considered acceptable at best

LIMITATIONS

- The study only assessed the three hemogram ratios specified and its value in predicting COVID 19 in-hospital mortality
- It represented a single center experience in a tertiary government hospital
- The study did not take into account the severity and classification of COVID 19 including the duration of illness prior to patients' hospital admission

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