MEDICAL SCIENCE

Utility of Hemogram based markers for predicting severity of acute pancreatitis

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ABSTRACT

Introduction: Acute pancreatitis is a serious and potentially life-endangering condition. Complete blood count (CBC) is basic laboratory investigation routinely conducted in most of acute pancreatitis patients and by use of simple calculation, CBC based marker could be utilized. *Material and methods:* Current prospective observational study performed at Medical Gastroenterology Department, JNMC, Wardha, Maharashtra, India during April 2022 to March 2023. After satisfying inclusion and exclusion criteria total 84 acute pancreatitis patients were enrolled and assessed for hemogram based markers and severity indices. Revised Atlanta classification was used for classifying acute pancreatitis severity. AUROC were utilized for calculating cut-off values of hemogram based markers (such as LMR, NLR etc.) APACHE-II score, BISAP score, SIRS and mCTSI for predicting organ failure, ICU admission and outcome. *Results:* In current study, mean age of patient was 41.1±12.7 years. Based on Revised Atlanta classification, 42.9% patients had mild, 15.5% patients had moderate and 41.7% patients had severe pancreatitis. WBC count, Neutrophils, NLR, PLR, mCTSI, SIRS, BISAP and APACHE II were significantly increasing while Lymphocyte and LMR was significantly decreasing with raising acute pancreatitis severity ($p<0.05$). By using AUROC NLR (Neutrophil lymphocyte ratio) had significantly predicted ICU admission (0.761; $p<0.05$) and organ failure (0.797; $p<0.05$). *Conclusion:* Evaluating severity based on hemogram based marker were early, easy and simple to calculate compared to complex severity indices which require multiple parameters for calculating severity index for prediction of organ failure, ICU admission conversely, severity indices were better compared to Hemogram based marker for predicting outcome of acute pancreatitis.

Keywords: Acute Pancreatitis, Hemogram based markers, Organ failure, ICU admission

1. INTRODUCTION

Acute pancreatitis is abrupt pancreas inflammation, which can arise because

of numerous causes; among them commonest are gallstones and chronic alcohol ingestion (Yadav and Lowenfels, 2013). It might differ in severity, from mild self-controlled pancreas inflammation to necrosis of pancreas tissues with dangerous complication (Singh et al., 2011). Majority of acute pancreatitis patients (80%) were mild and self-resolved without consequence, though disease severity advances in around 10% to 20% patients (Hagjer and Kumar, 2018) and around 15-20% such patients would suffer from severe acute pancreatitis (Forsmark and Baillie, 2007). Among severe acute pancreatitis patient average mortality rate ranges from 2% to 10% (Singh et al., 2011). It is accountable for higher rate of hospitalization related with higher financial burden; hence, stratification of pancreatitis severity was critical for gaining better final outcomes along with reducing financial cost (Silva-Vaz et al., 2020).

According to Revised Atlanta classification, Acute Pancreatitis was classified into mild, moderately severe and severe pancreatitis (Liu et al., 2018). For management according to severity of pancreatitis disease scoring system, numerous criteria and certain serum markers were utilized for recognizing severe disease patients and development of complications (Kokulu et al., 2018). There were numerous clinical and laboratory prognostic methods identified for assessing and forecasting acute pancreatitis severity with variable accuracy. Different scoring systems had been developed such as APACHE-II, modified computed tomography severity index (MCTSI), Ranson and Bedside Index for Severity in Acute Pancreatitis (BISAP) were in use whole-world, for forecasting episodes of acute pancreatitis severity, but all were related with numerous restrictions (Suppiah et al., 2018). Each of these scoring methods had their own shortcoming comprising lower sensitivity and specificity, lengthiness of scoring methods along with incapacity to get final score during 48 hours of admissions (Kumar and Griwan, 2018).

Numerous hematological markers had been in utilized such as PLR, NLR, Red cell distribution width (RDW) and Lymphocyte to monocyte ratio (LMR) for forecasting of Pancreatitis severity. NLR is fast and simple calculated marker for forecasting severity. Raising neutrophilic count shows acute inflammatory reaction, while lower lymphocyte count was indicative of worsening overall wellbeing and physiological stress (Gibson et al., 2010). Therefore, raising NLR offers supplementary benefit compared to either of two parameters separately. Increase of NLR during early two days of hospitalization was significantly related with pancreatitis severity, it was considered superior to total WBC (Azab et al., 2011). Additionally, repeatedly lower level of LMR could be helping for prediction of acute pancreatitis predicting during hospitalization (Mubder et al., 2020).

Similarly, platelet count was also increase in acute inflammatory condition, so PLR was utilized to be one of the markers of disease severity and it had been also applied to pancreatitis as well (Feng et al., 2014). The PLR had been considered as tool that permits assessment of systemic inflammatory reaction. RDW had been monitored routinely as marker for ICU admitted patients and used for predicting type of anemia. RDW reported as part of CBC test and quantitative measure of changeability in circulating erythrocytes sizes and it also considered as predictive marker for early and delayed death among patients with severely illness (Ganji et al., 2017). All such markers NLR, LMR, RDW and PLR are easily available at any time for emergency patients; hence all these markers are very helpful for guessing acute pancreatitis severity. Prediction of disease severity was important goals in acute pancreatitis patients' treatment.

Past studies had found that first 48 hours after symptom onset in pancreatitis patients was very essential for recognizing at risk patients suffering from complication or death. Consequently, it was imperative to implement, as early as probable, close observing or hospitalization in ICU and to diagnose cases that might necessitates higher center transfer (Silva-Vaz et al., 2020). Complete hemogram was basic investigation regularly conducted every acute pancreatitis patient. By use of simple calculation, such analytical markers could be access and watched for from CBC count in emergency department. Hence, current study performed with the goal of assessing predictive role of hemogram-based marker in acute pancreatitis.

2. MATERIAL AND METHODOLOGY

Current hospital based prospective observational study performed at Medical Gastroenterology Department at JNMC, Sawangi (Meghe), Wardha, Maharashtra, India during April 2022 to March 2023. Once getting approval from DMIMS University ethical and research committee, information of acute pancreatitis patients was collected. Identification of acute pancreatitis patients were done depending on presence of two or more of subsequent standards:

1) Characterized pain in abdomen of acute pancreatitis,

2) Levels of S. lipase and/or amylase around 3 times higher than normal

3) Typical features of acute pancreatitis on abdominal radiology i.e., ultra-sonography (USG) and/or computerized tomography (CT)

Recurrent acute pancreatitis cases were included only in their primary episodes of acute pancreatitis. Patients were not included if they had

Age <18 years
Pregnant,
On steroids medication
History of blood transfusion
Infection of other organ systems
Cases suffering from hemoproliferative disease or
On chemotherapy medication
Chronic pancreatitis

Total 84 acute pancreatitis patients who had provided written and informed consent were enrolled and assessed for hemogram based markers and severity indices. Detailed history and physical examination of acute pancreatitis patients was conducted. Basic patient data, clinical findings, biochemical investigation findings and radiological findings were collected from patients included in research. Complete blood count samples and relevant biochemical tests were collected during first day of hospitalization. The LMR was calculated, by dividing absolute lymphocyte number by absolute monocyte number; PLR was calculated by dividing absolute platelet number by absolute lymphocyte number and NLR was calculated by dividing absolute neutrophil number by absolute lymphocyte number. Revised Atlanta classification was used for classifying acute pancreatitis severity. Calculation of SIRS score, BISAP score, mCTSI score and APACHE-II score was done in every case. Assessments of requirement of ICU treatment, Organ failure development, Interventions requirement (such as Surgical, Radiologic or Endoscopic), complications progress (Local or Systemic) and death within one month.

Statistical analysis

All collected data of present study was tabulated in Microsoft excel spread-sheets and studied by using version 20.0 IBM SPSS for Windows package software. Chi square test was performed for cross-tabulation statistical relation that made between two qualitative data and One-way ANOVA test was applied for checking the statistical association among three groups of acute pancreatitis. AUROC were utilized for calculating cut-off values of hemogram based markers, APACHE-II score, BISAP score, SIRS and mCTSI for predicting organ failure, ICU admission and outcome. Along with AUROC, Sensitivity, Specificity, Positive and Negative Likelihood ratio, Cut-off values of each parameter of RDW, NLR, LMR, PLR ratio, mCTSI, BISAP, SIRS and APACHE II were also calculated. Statistically significant was considered when P value was less than 0.05.

3. RESULTS

The mean age of patient was 41.1±12.7 years (range 18 – 82 years), where majority of patients were males (82%). The relationship of age, gender and BMI with pancreatitis severity was statistically not significant ($p>0.05$). Commonest etiological findings for acute pancreatitis were alcoholic (48.8%), idiopathic cause (31%), gall stone disease (16.7%) and others, while commonest clinical features were abdominal pain (100%), vomiting (82.1%) and decrease/loss of appetite (31%), abdominal distension (25%), breathlessness (21.4%), fever (16.7%) and others. Based on Revised Atlanta classification, 42.9% patients were suffering from mild pancreatitis, 15.5% were suffering from moderate and 41.7% were suffering from severe pancreatitis (Table 1).

Pleural effusion was found in 45.2% patients, while 53.8% moderate pancreatitis and 88.6% severe pancreatitis patients had pleural effusion. Ascites was found in 28.6% patients, while 7.7% moderate pancreatitis and 65.7% severe pancreatitis patients had Ascites. ICU admission required in 40.5% patients, while 2.8% mild, 30.8% Moderate and 82.9% Severe pancreatitis patients had required ICU admission. Organ failure was found in 52.4% patients where 20.2% had renal failure, 26.2% had respiratory failure and 6% had both Renal and Respiratory failure. Around 4.8% patients were expired and all were suffering from severe pancreatitis. Relationship of pleural effusion, ascites, Requirement of ICU admission, organ failure with revised Atlanta classification was statistically significant. ANOVA test (one-way) had found that WBC count, Neutrophils and NLR, PLR, mCTSI, SIRS, BISAP and APACHE II were significantly increasing with high severity, while Lymphocyte and LMR was significantly decreasing with higher severity. However, no statistically significant relation for hemoglobin, hematocrit, RDW, Monocyte, Eosinophils and Platelets count with severity was found (Table 1).

Table 1 Comparison of variables with revised Atlanta classification

Variables		*Pancreatitis*			*Total (n=84)*	*P value*
		Mild (n=36)	*Moderate (n=13)*	*Severe (n=35)*		
Age (years)		41.3 ± 14.2	39.2 ± 8.9	41.7 ± 12.5	41.1 ± 12.7	0.841
Gender	*Male*	29 (80.6%)	12 (92.3%)	28 (80%)	69 (82.1%)	0.581
	Female	7 (19.4%)	1 (7.7%)	7 (20%)	15 (17.9%)	
BMI (kg/m²)		23.2 ± 2.48	23.6 ± 1.95	23.61 ± 1.95	23.4 ± 2.2	0.738
Pleural effusion		0	7 (53.8)	31 (88.6)	38 (45.2)	*<0.001**
Ascities		0	1 (7.7)	23 (65.7)	24 (28.6)	*<0.001**
Hemoglobin (gm/dl)		11.3 ± 2.6	12.5 ± 2.2	11.8 ± 3.4	11.7 ± 2.9	0.471
Hematocrit (%)		33.8 ± 7.0	37.3 ± 6.0	35.0 ± 9.3	34.9 ± 7.9	0.406
RDW		16.5 ± 2.9	16.3 ± 2.0	17.1 ± 2.9	16.7 ± 2.8	0.558
WBC		10306 ± 5404	12185 ± 5700	13888 ± 5806	12089 ± 5793	*0.032**
Neutrophils (%)		70.9 ± 7.7	76.9 ± 5.8	80.7 ± 5.1	75.9 ± 7.8	*<0.001**
Lymphocyte (%)		23.9 ± 7.6	18.1 ± 6.0	14.0 ± 5.1	18.9 ± 7.8	*<0.001**
NLR		3.37 ± 1.48	4.68 ± 1.58	6.80 ± 3.37	5.0 ± 2.91	*<0.001**
Monocyte (%)		3.33 ± 0.63	3.31 ± 0.95	3.37 ± 0.94	3.35 ± 022.81	0.966
LMR		7.43 ± 3.05	7.08 ± 8.45	4.29 ± 1.45	6.07 ± 4.17	*0.003**
Eosinophils (%)		1.81 ± 0.58	1.77 ± 0.73	2.0 ± 0.87	1.88 ± 0.74	0.455
Platelets (Lakhs/ml)		2.48 ± 1.56	3.07 ± 1.66	2.68 ± 1.50	2.65 ± 1.55	0.507
PLR		109.3 ± 64.2	160.7 ± 104.6	161.9 ± 101.1	139.2 ± 90.5	*0.031**
mCTSI		3.17 ± 1.34	5.0 ± 1.47	7.26 ± 1.63	5.15 ± 2.40	*<0.001**
SIRS		1.47 ± 0.81	2.31 ± 0.48	2.57 ± 0.66	2.06 ± 0.87	*<0.001**
BISAP		0.69 ± 0.62	2.0 ± 0.58	2.51 ± 0.85	1.65 ± 1.11	*<0.001**
APACHE II		4.36 ± 3.16	6.15 ± 3.05	8.49 ± 3.94	6.36 ± 3.94	*<0.001**
ICU admission		1 (2.8%)	4 (30.8%)	29 (82.9%)	34 (40.5%)	*<0.001**
Organ Failure		0	13 (100%)	31 (88.6%)	44 (52.4%)	*<0.001**
Outcome: expired		0	0	4 (11.4%)	4 (4.8%)	0.053

*P-value <0.05 i.e., statistically significant

Table 2 AUROC analysis of CBC and pancreatitis severity index for predicting ICU admission, Organ failure and Outcome

	ICU Admission								
	Indices	*Sn*	*Sp*	*LR+*	*LR–*	*Cut-off*	*AUROC*	*SE*	*P value*
CBC	RDW	73.5%	42%	1.27	0.63	>15.55	0.554	0.064	0.399
	NLR	73.5%	64%	2.04	0.41	>3.98	0.761	0.054	*<0.001**
	LMR	61.8%	18%	0.75	2.12	<3.88	0.267	0.055	*<0.001**
	PLR	67.6%	34%	1.02	0.95	>93.35	0.581	0.068	0.209
Pancreatitis Severity Index	mCTSI	94.1%	76%	3.92	0.08	>4.5	0.932	0.025	*<0.001**
	SIRS	100%	32%	1.47	0.00	>1.5	0.756	0.052	*<0.001**
	BISAP	94.1%	70%	3.14	0.08	>1.5	0.887	0.035	*<0.001**
	APACHE-II	88.2%	66%	2.59	0.18	>4.5	0.778	0.050	*<0.001**
Organ Failure									
		Sn	*Sp*	*LR+*	*LR–*	*Cut-off*	*AUROC*	*SE*	*P value*
CBC	RDW	68.2%	40%	1.14	0.80	>15.55	0.496	0.065	0.954
	NLR	72.7%	72.5%	2.64	0.38	>3.98	0.797	0.048	*<0.001**
	LMR	77.3%	7.5%	0.84	3.03	<3.32	0.216	0.051	*<0.001**
	PLR	75%	42.5%	1.30	0.59	>93.35	0.663	0.060	*0.010**
Pancreatitis	mCTSI	81.8%	80%	4.09	0.23	>4.5	0.893	0.033	*<0.001**

severity index	SIRS	100%	40%	1.67	0.00	>1.5	0.801	0.047	*<0.001**
	BISAP	95.5%	87.5%	7.64	0.05	>1.5	0.945	0.024	*<0.001**
	APACHE II	84.1%	62.5%	2.24	0.25	>4.5	0.822	0.045	*<0.001**
Outcome									
		Sn	*Sp*	*LR+*	*LR–*	*Cut-off*	*AUROC*	*SE*	*P value*
CBC	RDW	100%	50%	2.00	0.00	>15.95	0.725	0.080	0.130
	NLR	75%	85%	5.00	0.29	>7.65	0.734	0.147	0.115
	LMR	75%	15%	0.88	1.67	<3.32	0.233	0.084	0.073
	PLR	50%	48.7%	0.97	1.03	>113.7	0.344	0.139	0.294
Pancreatitis severity index	Mctsi	100%	80%	5.00	0.00	>7.5	0.963	0.029	*0.002**
	SIRS	75%	75%	3.00	0.33	>2.5	0.797	0.111	*0.046**
	BISAP	100%	85%	6.67	0.00	>2.5	0.962	0.025	*0.002**
	APACHE II	100%	82.3%	5.65	0.00	>9.5	0.958	0.028	*0.002**

*P-value<0.05 is statistically significant. Sn=Sensitivity, Sp=Specificity, LR= Likelihood ratio.

AUROC value for significantly ($p<0.05$) predicting ICU admission for NLR was 0.761 (Cut-off >3.98), for LMR was 0.267 (Cut-off <3.88), for mCTSI was 0.932 (Cut-off >4.5), for SIRS was 0.756 (Cut-off >1.5), for BISAP was 0.887 (Cut-off >1.5) and for APACHE II was 0.778 (Cut-off >4.5). While AUROC value for significantly predicting ($p<0.05$) organ failure for NLR was 0.797 (Cut-off >3.98), for LMR was 0.216 (Cut-off <3.32), for mCTSI was 0.893 (Cut-off >4.5), for SIRS was 0.801 (Cut-off >1.5), for BISAP was 0.945 (Cut-off >1.5) and for APACHE II was 0.822 (Cut-off >4.5). However, AUROC values of RDW and PLR had non-significant value for ICU admission and Organ failures. Further, AUROC value for significantly ($p<0.05$) predicting outcome for mCTSI was 0.963 (Cut-off >7.5), for SIRS was 0.797 (Cut-off >2.5), for BISAP was 0.962 (Cut-off >2.5) and APACHE II was 0.958 (Cut-off >9.5), while all hemogram markers RDW, NLR, LMR and PLR had non-significant values of AUROC for predicting outcomes (Table 2) (Figure 1, 2, 3, 4, 5, 6).

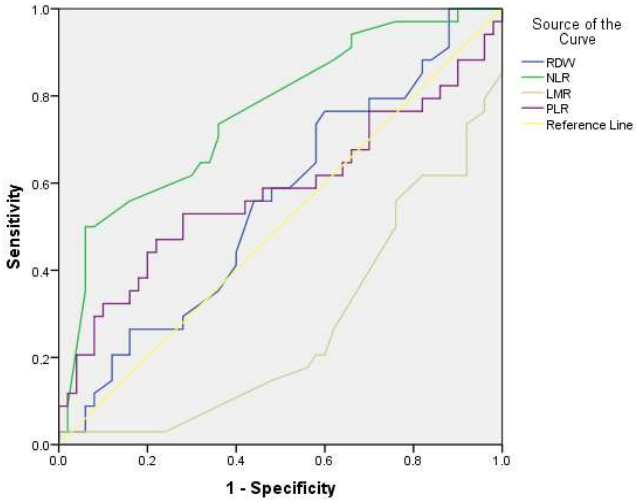

Figure 1 AUROC analysis of CBC indices for predicting ICU Admission

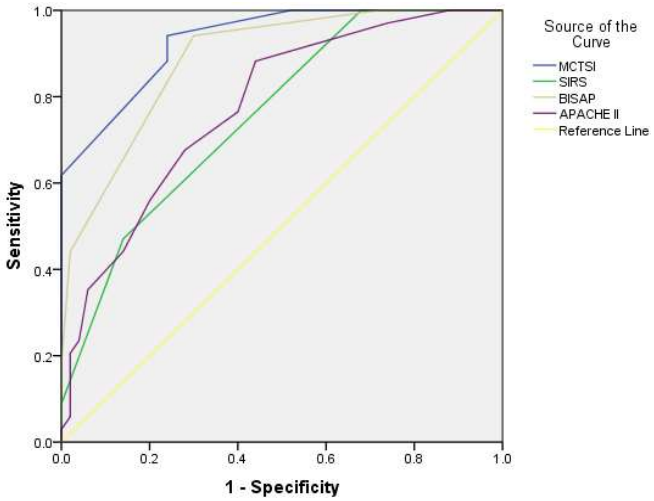

Figure 2 AUROC analysis of pancreatitis severity index for predicting ICU Admission

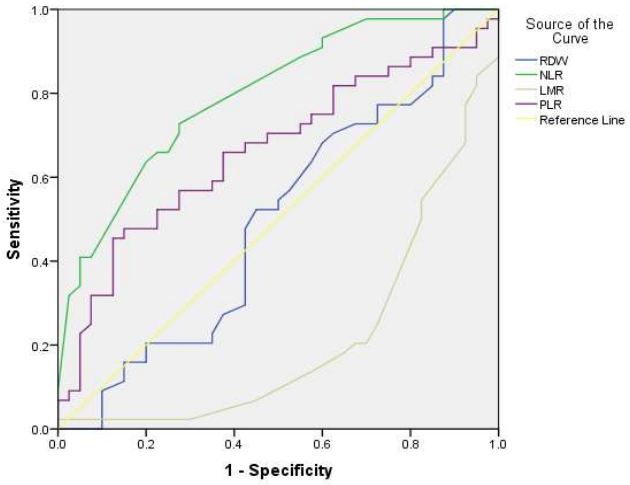

Figure 3 AUROC analysis of CBC indices for predicting Organ Failure

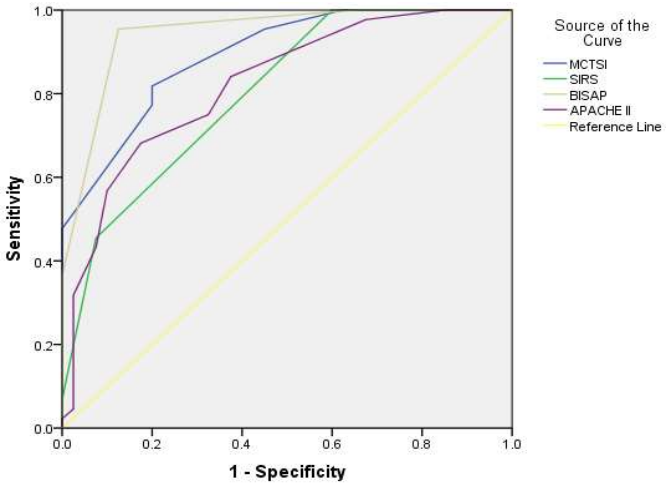

Figure 4 AUROC analysis of pancreatitis severity index for predicting Organ Failure

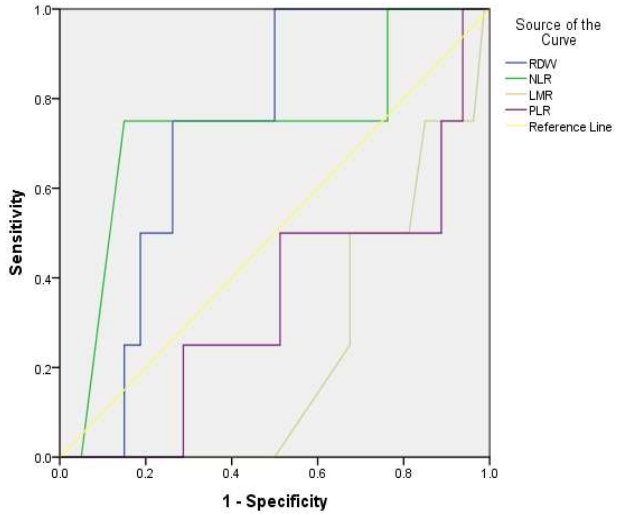

Figure 5 AUROC analysis of RDW, NLR, LMR and PLR for predicting outcome

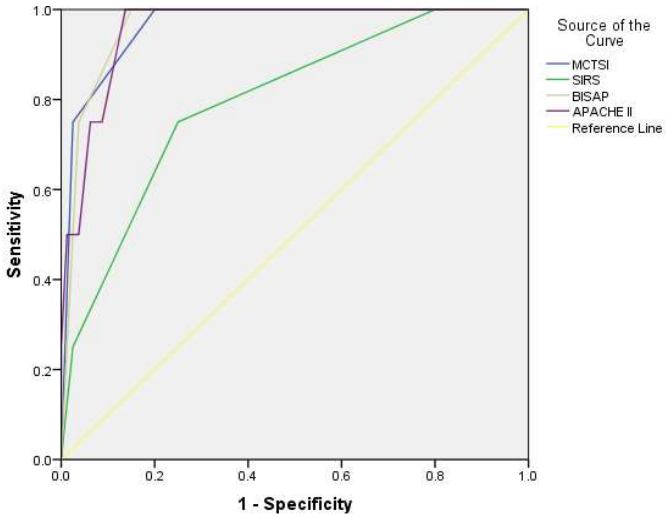

Figure 6 AUROC analysis of pancreatitis severity index for predicting Outcome

4. DISCUSSION

Acute pancreatitis was the common gastrointestinal emergency and it was fast growing inflammation of pancreas, which differs in severity from mild disease to fast progressing multi-organ failure. Pancreatitis incidence and mortality was mostly anticipated by combined utilize of medical data, imaging and biochemical analysis. Conversely, around 20% to 30% severe pancreatitis patients were not diagnosed properly. There was requirement for cheap, non-invasive, sensitive, specific, repeatable, objective and easy laboratory investigation, which did not need further examination for diagnosing acute pancreatitis in early stages and diagnose severe cases (Wang et al., 2015). Current hospital based prospective observational study conducted in 84 acute pancreatitis patients for evaluating relationship of hemogram and severity indexes with severity index of acute pancreatitis. By using Revised Atlanta Classification in current study, 42.9% patients were suffering from mild, 15.5% from moderate and 41.7% from severe pancreatitis (Table 1). Similarly, Kumar and Griwan, (2018) had found 38% patients of mild, 34% patients of moderately severe and 28% of severe pancreatitis. In Junare et al., (2021) study, they noted that 47.5% cases with mild, 36.3% with moderate and 16.3% with severe pancreatitis. Though, Kakulu et al., (2018) found different findings with 81% cases were mild, 19% cases were moderate to severe pancreatitis and Liu et al., (2018) also had found 46.6% mild cases, 47% cases with moderate-severe and 6.5% cases with severe pancreatitis.

In current study, mean age of patient was 41.1±12.7 years, where majority of patients were males (82%). Compared to current study, higher mean age was found by Kumar and Griwan, (2018) (48.4 years), Khan et al., (2021) (48.5 years) and Kakulu et al., (2018) (55.6±18.4 years), while lower mean age was found by Junare et al., (2021) (37.3±10.03 years). Higher male predominance was found in current study, due to higher ratio of alcohol addiction in male population. Similarly male predominance was found in

study conducted under Khan et al., (2021) (61%) and Junare et al., (2021) (57.5%), while female predominance was found by Kumar and Griwan, (2018) (66%) and Kakulu et al., (2018) (60%) in their studies. Additionally, in current study relationship of age, gender and BMI with pancreatitis severity was statistically non-significant (p>0.05). Similarly, Li et al., (2017) had found non-significant relationship of age, gender and etiology with severity of pancreatitis. Junare et al., (2021) had found non-significant relationship of mean age and BMI but significant relationship of gender with severity of pancreatitis. Study by Liu et al., (2018) had found non-significant relationship of age and sex with severity of acute pancreatitis.

In current study, 45.2% patients had pleural effusion and 28.6% patients had ascites and such relationship of pleural effusion and ascites with severity of pancreatitis was significant (p<0.01). In Kumar and Griwan, (2018) study, 54% patients were suffering from pleural effusion and 48% patients had ascites. Study by Kakulu et al., (2018) had found pleural effusion in 7% patients, pancreatic ascites in 7% patients and metabolic acidosis in 4% patients.

In present study, among severe pancreatitis patients significantly higher values were found for WBC count, Neutrophils, NLR, PLR, mCTSI, SIRS, BISAP and APACHE II compared to moderate to mild pancreatitis (p<0.05), while Lymphocyte and LMR was significantly lower among severely acute pancreatitis compared to mild (p<0.05) (Table 1). In Liu et al., (2018) study, there was significantly raised NLR, PLR, albumin-corrected calcium, BUN and BISAP score (p<0.05) and significantly lower calcium and LMR (p<0.05) among severe acute pancreatitis. Similarly, study done by Junare et al., (2021) had found that hematocrit, BUN, CRP, PLR, NLR, APACHE II and mCTSI, BISAP score were significantly higher in severe pancreatitis compared to moderate pancreatitis than mild pancreatitis (p<0.05), though LMR number was significantly decrease with severe pancreatitis compared to moderate than mild pancreatitis (p<0.05). Study done by Khan et al., (2021) had found significantly higher mean values of WBC count, neutrophils, monocytes, NLR and PLR and significantly lower mean values of LMR in severe pancreatitis (p<0.05) compared to mild to moderate pancreatitis, while there was non-significant relationship of mean RBC, hemoglobin, MCV, PCV, lymphocytes, MCH, platelet and MCHC. On multivariate regression analysis, they found WBC count and LMR both were independent forecasters for severe pancreatitis with aOR of 12.8 and 5.47, respectively. On comparing NLR with revised Atlanta classification in Tahir et al., (2021), they noted that NLR was outstanding forecaster of severity for mild patients, better forecaster for severe conditions and reasonable forecaster for moderate patients. AUC curve analysis. Kaplan et al., (2018) study, had found that PLR & NLR combine use and scoring systems had good identifying importance compared to CRP values in for predicting acute pancreatitis.

In current study, 40.5% patients had required ICU admission and this relationship of requirement of ICU admission with revised Atlanta classification was statistically highly significant (p<0.01). Additionally, AUROC analysis for predicting ICU admission of RDW was 0.554 (Cut-off >15.55, p>0.05), for NLR was 0.761 (Cut-off >3.98, p<0.05), for LMR was 0.267 (Cut-off <3.88; p<0.05) and for PLR was 0.581 (Cut-off >93.35; p>0.05). Though AUROC of severity index such as mCTSI was 0.932 (Cut-off >4.5; p<0.05), for SIRS was 0.756 (Cut-off >1.5; p<0.05), for BISAP was 0.887 (Cut-off >1.5; p<0.05) and for APACHE II was 0.778 (Cut-off >4.5; p<0.05). ICU admission was required in 21.9% acute pancreatitis patients in Junare et al., (2021) study, where 15.5% moderate and 100% severe pancreatitis had required ICU admission and this relationship ICU admission with severity of pancreatitis was statistically highly-significant (p<0.05). Further, AUROC for predicting ICU admission of RDW was 0.918 (>17), NLR was 0.943 (>16.3), LMR was 0.863 (<1.67), PLR was 0.883 (>208.7), APACHE II was 0.843 (>4) and BISAP was 0.943 (>1.0) with significant relationship for ICU admission for all parameters (p<0.05). In Kumar and Griwan, (2018) study, ICU admission was required in 28% patients and they used various cut-off values of severity scores for ICU admission such as Ranson's score (≥3), BISAP (≥3), mCTSI (>4) and APACHE II (≥8).

In present study, 52.4% patients had organ failure due to acute pancreatitis, where 20.2% had renal failure, 26.2% had respiratory failure and 6% had both Renal and Respiratory failure and this relationship of Organ failure with revised Atlanta classification was statistically highly significant (p<0.01). Moreover, AUROC value for predicting organ failure of RDW was 0.496 (Cut-off >15.55; p>0.05), for NLR was 0.797 (Cut-off >3.98; p<0.05), for LMR was 0.216 (Cut-off <3.32; p<0.05), for PLR was 0.663 (Cut-off >93.35; p>0.05), mCTSI was 0.893 (Cut-off >4.5; p<0.05), for SIRS was 0.801 (Cut-off >1.5; p<0.05), for BISAP was 0.945 (Cut-off >1.5; p<0.05) and for APACHE II was 0.822 (Cut-off >4.5; p<0.05). By using AUC for predicting organ failure in study done by Kumar and Griwan, (2018) had noted that mCTSI was most accurate score (0.893), followed by APACHE II (0.831), BISAP (0.762) and Ranson (0.762). A study by Junare et al., (2021) had found organ failure in 16.9% patients, while most of severe pancreatitis (80.8%) had organ failure and relationship of severity of pancreatitis with organ failure was statistically significant (p<0.05). Additionally, AUROC to predict organ failure for RDW was 0.870 (>17), NLR was 0.940 (>16.3), LMR was 0.829 (<2.1), PLR was 0.874 (>208.7), APACHE II was 0.845 (>7) and BISAP was 0.932 (>1.0) with significant relationship for predicting organ failure for all parameters (p<0.05). Study by Liu et al., (2018) had found that persistent organ failure cases were significantly older and with significantly raised NLR, PLR and albumin-corrected calcium, BUN, creatinine, RDW and BISAP score (P<0.05) but significantly

lower LMR and total calcium at baseline as compared with patients with no organ failure (p<0.05). Moreover, by using AUROC curve for predicting origin of persistent organ failure for total calcium (AUC=0.784, p<0.05, cut-off 2.2), PLR (AUC=0.731, *p*<0.05, cut-off 173.1), BISAP score (AUC=0.708).

In current study, 4.8% patients were expired and all were suffering from severe pancreatitis though this relationship of outcome with revised Atlanta classification was statistically non-significant (p>0.05). Additionally, AUROC value for predicting outcome was non-significant for RDW was 0.725 (Cut-off>15.95), for NLR was 0.730 (Cut-off>7.65), for LMR was 0.233 (Cut-off<3.32), for PLR was 0.344 (Cut-off>113.7), however, it was significant for mCTSI was 0.963 (Cut-off>7.5), for SIRS was 0.797 (Cut-off>2.5), for BISAP was 0.962 (Cut-off>2.5) and APACHE II was 0.958 (Cut-off>9.5). In Junare et al., (2021) study, 7.5% cases were non-survivor and relationship of pancreatitis severity with outcome was statistically significant (p<0.05). Moreover, AUROC for predicting mortality for RDW was 0.828 (>17.2), NLR was 0.910 (>16.5), LMR was 0.805 (<1.5), PLR was 0.867 (>208.7), APACHE II was 0.961 (>7) and BISAP was 0.892 (>1.0) with significant relationship for mortality for all parameters (p<0.05). Though in Kaplan et al., (2018) study, 10.6% patients were non-survivor and most of patients were suffering from severe pancreatitis and relationship of acute pancreatitis with outcome was statistically significant (p<0.05). Retrospective study done by Gülen et al., (2015) had noted that NLR was significantly higher in pancreatitis patients who expired on 1 day of admission (p<0.05). Harmless acute pancreatitis score and RDW had non-significant relationship with mortality (p>0.05). Study by Li et al., (2017) had noted that, non-survivors pancreatitis patients were significantly older and with raised CRP, amylase, RDW and NLR compared to acute pancreatitis survivors (p<0.05). However, lymphocyte count, platelets, albumin and LMR were significantly inferior among non-survivors comparison of survivors (p<0.05). Moreover, they found that NLR, cut-off level for predicting mortality was 16.6 (Sn 82.4% and Sp 75.6%), while RDW had maximum sensitivity (94.1%) and lower –LR (0.11) as predictive index without mortality in acute pancreatitis patients.

5. CONCLUSIONS

Current hospital noted that WBC count, Neutrophils, NLR, PLR, mCTSI, SIRS, BISAP and APACHE II were significantly increasing with increasing severity of acute pancreatitis. Additionally, AUROC curve analysis had shown that NLR and LMR had significant cut-off values for predicting ICU admission and organ failure. While AUROC curve analysis of all severity indexes such as mCTSI, SIRS, BISAP and APACHE II had significant cut-off values for predicting ICU admission, organ failure and outcome.

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Author's Contribution

All authors have contributed substantially for the concept, assessment and evaluation, data acquisition and development of this work. All authors read and approved the final version of the manuscript.

Ethical approval

This study was approved by the Institutional ethical committee of DMIMS (DU) (Ethical approval number: DMIMS (DU)/IEC/2022/714).

Informed consent

Written & Oral informed consent was obtained from all individual participants included in the study.

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Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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