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ORIGINAL ARTICLE

Complete blood count: A simple prognostic indicator in patients with acute heart failure.

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ABSTRACT

Background: Heart failure (HF) is a global health problem associated with marked increase in mortality, morbidity and healthcare costs with frequent hospitalization. Patients at high risk for complications on hospital admission should be identified early for optimal care and better outcomes. This work aimed to assess the value of admission complete blood count (CBC) in predicting the occurrence of complications in patients admitted to hospital with acute heart failure (AHF).

Methods: This study was conducted on 210 patients hospitalized with AHF over one year, Patients were classified into two groups according to the presence of complications at admission or during their hospitalization: group 1 (Non-complicated group) including 191 patient and group 2 (complicated group) including 19 patients, the results of admission CBC were correlated with outcomes.

Results: A statistically significant correlation was found between poor outcomes in hospitalized AHF patients and the following hematological parameters; Decrease in Hemoglobin concentration (Hb), increase in Neutrophils percentage, decrease in Lymphocytes percentage, increase in the Neutrophils to lymphocytes ratio (NLR), an increase in the Red cell distribution width (RDW).

Conclusion: A simple CBC on admission can be used as a single test for the prediction of short-term outcomes in patients hospitalized with AHF.

Key Words: Hemoglobin, Hospitalization, Lymphocytes, Neutrophils, Red cell distribution

INTRODUCTION

Acute Heart Failure (AHF) is a clinical syndrome associated with specific symptoms and signs caused by a functional and/or structural abnormality in the heart, resulting in a decrease in cardiac output and/ or increase in intracardiac pressures [1]. AHF is associated with a significant economic burden with frequent patients hospitalizations. Despite the emerging therapies, AHF mortality rates are still high [2]**.** One year mortality rate ranges between 17- 45% in patients hospitalized with AHF and most of the patients die within 5 years, about 2-17% of individuals who were admitted to hospital with AHF die during hospital stay [1]. Many prognostic biomarkers in patients with AHF have been studied, unfortunately, their value in clinical practice remains limited**.** Hematological parameters like Hemoglobin (Hb) [3], red cell distribution width (RDW) [4], neutrophils to lymphocyte ratio [5], were studied in patients with AHF, but their role in predicting outcomes and complications remains unclear. Complete blood count (CBC) is a widely available, cheap test used in daily practice. Our study aimed to assess the value of CBC as a tool for predicting complications in patients hospitalized with AHF.

PATIENTS AND METHODS:

This Prospective cohort study was conducted on patients who were admitted with AHF to our cardiology department. Acute heart failure is broadly defined as a rapid onset of new or worsening signs and symptoms of HF[6]. Patients with the following conditions were excluded from

the study: active bleeding, primary hematological diseases, decompensated liver cell failure, severe chronic kidney disease GFR < 30 ml, malignant disease and collagen disease.

The study comprised 210 patients, with age ranging from 17- 94 years, 148 were males and 62 females, Patients were classified into two groups according to the presence of complications at admission or during their stay in the hospital into group 1 (Non-complicated group) including 191 patient and group 2 (complicated group) including 19 patients. Study outcomes entailed complications as cardiogenic shock, malignant Arrhythmia and sudden cardiac death.

After taking consent to participate in the study, all patients were subjected to the following: History taking of previous hospital admissions for heart failure, used medications, presence of co-morbidities. full clinical examination and investigations:12 lead electrocardiography (ECG), Echocardiography, chest x-ray and some laboratory investigations including CBC with comment on WBCs with the differential count (Lymphocytes, neutrophils, eosinophils, monocytes, and basophils), Hemoglobin (Hb), Red blood cells with different red blood cell indices as red cell distribution width(RDW), Platelets count and Mean platelet volume (MPV). Written informed consent was obtained from all participants, the study was approved by the research ethics committee of the Faculty of Medicine, Mansoura University. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis: All data collected were analyzed with the use of SPSS (Statistical Package for the Social Science). Continuous data were expressed in form of mean ± SD or median while nominal data were expressed in form of frequency. The nominal data of different groups in the study were compared using Chi^2-test. Student t-test used to compare mean of different two groups. ANOVA test was used for more than two groups. Pearson's correlation was used to determine the correlation between hematological parameters with other continuous variables. The diagnostic accuracy of using hematological parameters for the prediction of decompensated heart failure was determined using the receiver operating characteristic (ROC) curve. Morbidity and mortality prediction in patients with AHF were determined by multivariate regression analysis. *P*-value was considered significant if < 0.05, highly significant if <0.001.

RESULTS

Our study showed that the mean age of patients was 60.12 ± 11.5 years, no significant difference was found between both groups regarding their age and sex (P = 0.445 and 0.207; respectively) [Table 1]. Regarding the first CBC done for these patients after admission: A statistically highly significant decrease in Hb concentration was found in group 2 compared to group 1 (P <0.001). A statistically highly significant increase was found in neutrophils percentage in group 2 compared to group 1 (P-value < 0.001). Regarding Lymphocytes percentage, A statistically highly significant decrease in lymphocytes was found in a group compared to group 1 (P < 0.001). RDW was a statistically highly significant increase in group 2 compared to group 1 (P < 0.001). Other statistically significant data were found between the two groups as NLR which increased in group 2(P = 0.042). No statistically significant difference between the two groups regarding Total leucocytic count (WBCs), Platelets count, and Mean platelet volume [Table 2]. The whole group of 1 patient (191 patients) got better and discharged safely from the hospital and were assigned to the outpatient clinic follow-up visits. On the other hand 7 patients of group 2 got better and discharged while 12 patients, unfortunately, died at the hospital despite optimum medical care. Of the complicated group, 1 patient had SCD, 2 patients developed ventricular tachycardia that was terminated by direct current cardioversion, and 16 patients had cardiogenic shock. Logistic regression analysis showed that Hb concentration and RDW as the most predictive values for the occurrence of complications and poor outcomes in heart failure patients [table 3]. The ROC curve used to detect the cut points to detect complications in these patients revealed that; for Hb concentration, the cutoff point was 9.45 with a sensitivity of 81.2% and a specificity of 73.7% [Figure 1]. Neutrophils percentage had a cutoff point of 74.25% with a sensitivity of 89.5% and a specificity of 65.4%. Lymphocytes percentage had a cut-off point of 18.55 % with 54.5% sensitivity and 94.7% specificity. NLR had a cut-off value of 4.64 %, with an area under the curve of 0.8 with a sensitivity of 84% and specificity of 63.9%. Finally, RDW had a cut-off value of 50 fl with Area under the curve 0.76 and sensitivity of 68.4% and specificity of 82.7 %

Table 1: Patient's characteristics of the studied group:

		Range	Mean ± SD
Age (years)		17 – 94	60.12 ± 11.5
Sex	male	n = 148	70.47 %
	female	n = 62	29.52 %
Hb (g/dl)		6.4 – 15.3	10.97 ± 1.89
WBC (×10^3/uL)		2.2 – 68	9.43 ± 5.62
Neutrophils %		33.1 – 92.1	69.54 ± 12.52
Lymphocytes %		1.3 – 62.1	19.84 ± 10.81
NLR		0.53 – 64.23	5.54 ± 5.98
PLT (×10^3/uL)		34 – 728	238.22 ± 111.26
MPV (fL)		4.4 – 14.2	10.42 ± 1.69
RCD (fL)		31 – 66.2	46.84 ± 5.97

Hb: hemoglobin**, WBC:** white blood cells**, NLR:** neutrophil/lymphocyte ratio,
PLT: platelet count, **MPV:** mean platelet volume, **RDW**: red cell distribution width.

Table 2: Comparative analysis of non-complicated and complicated groups of patients regarding complete blood count :

	non complicated (n = 191)	Complicated (n = 19)	T	P
Hb (g/dl)	11.13 ± 1.8	9.34 ± 2.04	4.091	<0.001*
WBC(×10^3/uL)	9.44 ± 5.79	9.33 ± 3.58	0.081	0.935
Neutrophils %	68.46 ± 12.44	80.35 ± 7.12	6.374	<0.001*
Lymphocytes%	20.73 ± 10.78	10.89 ± 6.11	6.139	<0.001*
NLR	4.93 ± 4.31	11.64 ± 13.3	2.189	0.042*
PLT (×10^3/uL)	241.49 ± 112.42	205.37 ± 95.21	1.352	0.178
MPV (fL)	10.42 ± 1.7	10.45 ± 1.59	0.088	0.930
RDW (fL)	46.31 ± 5.61	52.17 ± 7.03	4.244	<0.001*

Hb: hemoglobin**, WBC:** white blood cells**, NLR**: neutrophils/lymphocytes ratio**, PLT**: platelet count, **MPV:** mean platelet volume, **RDW**: red cell distribution width.

Table 3: Logistic regression analysis of complete blood count:

	B	S.E.	Sig.	Odds ratio	95.0% CI
HB (g/dl)	-0.429	0.15	0.004	0.651	0.486 – 0.873
Neutrophils %	0.035	0.029	0.223	1.036	0.979 – 1.097
Lymphocytes %	-0.094	0.059	0.109	0.91	0.811 – 1.021
NLR	0.002	0.051	0.97	1.002	0.906 – 1.108
RDW (fL)	0.091	0.041	0.025	1.096	1.012 – 1.187

Hb : hemoglobin , **NLR**: neutrophils/lymphocytes ratio**, RDW** : Red cell distribution width.

Table: Comparative analysis between complicated and non-complicated groups of heart failure patients regarding electrocardiographic data:

	non complicated (n = 191)		Complicated (n = 19)		Total (n = 210)		χ2	P
	No	%	No	%	No	%		
ECG								
sinus	88	46.1%	11	57.9%	99	47.1%	1.730	0.785
AF	68	35.6%	5	26.3%	73	34.8%		
flutter	5	2.6%	0	0%	5	2.4%		
LBBB	24	12.6%	2	10.5%	26	12.4%		
RBBB	6	3.1%	1	5.3%	7	3.3%		
AF								
No	123	64.4%	14	73.7%	137	65.2%	0.657	0.418

	non complicated (n = 191)		Complicated (n = 19)		Total (n = 210)		χ2	P
	No	%	No	%	No	%		
Yes	68	35.6%	5	26.3%	73	34.8%		
LVH								
Negative	78	40.8%	5	26.3%	83	39.5%	1.525	0.217
Positive	113	59.2%	14	73.7%	127	60.5%		
IHD								
No	71	37.2%	7	36.8%	78	37.1%	0.001	0.977
Yes	120	62.8%	12	63.2%	132	62.9%		

ECG: electrocardiography**, AF**: atrial fibrillation, **LVH**: left ventricular hypertrophy**, IHD**: ischemic heart disease

Table: Comparative analysis between complicated and non-complicated groups of heart failure patients regarding demographic and echo data

		non complicated (n = 191)	Complicated (n = 19)	t	P
AGE (years)		59.93 ± 11.05	62.05 ± 15.61	0.766	0.445
sex	**Male**	137	11	χ2=1.589	0.207
	female	54	8		
EF %		34.24 ± 7.2	30.11 ± 7.6	2.373	0.019*
FS %		17.13 ± 3.89	15.63 ± 4.99	1.553	0.122
LAD (cm)		5.19 ± 2.16	5.17 ± 0.53	0.039	0.969

EF: ejection fraction, **FS:** fractional shortening, **LAD:** left atrial diameter.

Table: Comparative analysis of complicated and non-complicated groups of heart failure patients regarding sex, comorbidity, complications and outcome:

	non complicated (n = 191)		Complicated (n = 19)		Total (n = 210)		χ2	P
	No	%	No	%	No	%		
SEX								
M	137	71.7%	11	57.9%	148	70.5%	1.589	0.207
F	54	28.3%	8	42.1%	62	29.5%		
DM								
No	104	54.5%	10	52.6%	114	54.3%	0.023	0.879
YES	87	45.5%	9	47.4%	96	45.7%		
HTN								
No	84	44%	9	47.4%	93	44.3%	0.080	0.777
Yes	107	56%	10	52.6%	117	55.7%		
Stroke								
No	167	87.4%	16	84.2%	183	87.1%	0.160	0.689
Yes	24	12.6%	3	15.8%	27	12.9%		
COPD								
No	162	84.8%	17	89.5%	179	85.2%	0.298	0.585
Yes	29	15.2%	2	10.5%	31	14.8%		
Outcome								
Alive	191	100%	7	36.8%	198	94.3%	127.943	<0.001*
died	0	0%	12	63.2%	12	5.7%		

DM: diabetes mellitus**, HTN**: hypertension**, COPD**: chronic obstructive pulmonary disease

DISCUSSION

Heart failure (HF) is a clinical condition in which the heart cannot pump adequate oxygenated blood to cope with the tissues' metabolic needs [7]. Although HF is a chronic disorder, most patients experience acute decompensation with frequent hospitalization [8]. Many prognostic biomarkers for patients hospitalized with HF have been identified and studied but research aiming to a better understanding of the disease or predicting

the complications for those patients with simple blood tests is growing [9]**.** This work aimed to assess the value of admission CBC in predicting the short-term outcomes in patients hospitalized with AHF. In our study, there was a highly significant decrease in Hb concentration in the complicated group which is similar to many studies that found that the presence of anemia had its impact on survival, rehospitalization, and loss of functional capacity in patients with HF [10,11,12]. This effect was explained by the reduced oxygen delivery to tissues in anemic patients triggers detrimental hemodynamic, neurohormonal, and renal alterations[13]. Many mechanisms for anemia were found in HF patients including decreased intestinal absorption of iron, decreased production of erythropoietin, and hemodilution [14]. A highly significant increase in neutrophils percentage was found in the complicated group, this result goes with Arruda-Olson et al**.** [15] who found that increased neutrophils was associated with an increased incidence of AHF in patients with acute myocardial infarction. Our study showed a highly significant decrease in lymphocytes in the complicated group which goes with other studies that showed lymphopenia as an independent predictor for all-cause mortality in HF patients [16]. NLR, which is a simple, available, inexpensive marker, has emerged as a prognostic marker in patients with AHF [17]**.** In our study NLR showed a significant increase in the complicated group which agrees with a study by Wang et al. [18] in which NLR was a powerful predictor of mortality and the author concluded that each 1% increase in the baseline NLR is associated with 28% increase in all-cause mortality Also, in 31 publications, including about 12000 patients; NLR was correlated to the severity of HF as well as to short and long-term prognosis [19]**.** RDW is a simple, available parameter that increases inflammation, altered iron metabolism, and reduced hemoglobin level [20]**.** RDW, thus, integrates different pathophysiological mechanisms associated with the progression of HF, and elevated RDW is a marker of poor prognosis in patients with AHF [21,.22]**.** Many studies showed that in patients with AHF, a higher RDW has a poor prognosis compared with lower RDW [23, 24, 25]**.** This typically goes with the results of our study that found RDW showed a significant statistical increase in the complicated group of patients. In our study, platelet count had no significant statistical difference between complicated and non-complicated groups of patients that is different from other studies that showed thrombocytopenia may be a marker of bad prognosis in patients with AHF [26, 27, 28]**.**

CONCLUSION

A simple CBC on admission can be used as a single test for predicting short-term outcomes in patients hospitalized with AHF.

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