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Determination of red cell Indices importance in predicting trauma patients

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Abstract

Background: Red cell distribution width (RDW) is a hematologic marker widely requested in many different clinical contexts. RDW is not expansive and is available in many clinical laboratories. Recently, there has been speculation about the prognostic ability of this marker in different diseases and conditions. One filed gaining attention is the trauma patients. Data suggesting a clear relation in patients is lacking and most studies conducted are retrospective with limited ability in aiming to fill this gap.

Methods: The present prospective study was conducted between April and December 2016 in educational Medical Centers of Tabriz University of Medical Sciences. Information were gathered regarding the patient's age, sex, hematologic factors, route of trauma, GCS and the clinical outcome. Based on the value of RDW patients were distributed to 5 groups and statistical analysis was done.

Results: The most common route of trauma in patients was car accidents. Most patients had a Glasgow coma scare (GCS) of 15 during their first presentation. Hospitalization was the most common clinical outcome in patients. RDW was significantly related to the clinical outcome of the patient but was not significantly different between male or female patients, or in some specific trauma routes.

Conclusion: RDW can be used as a surrogate marker to assess the severity of one's trauma and clinical outcome. But there are still limitations on whether the results could be generalized to patients of trauma with different etiologies.

Introduction

Red cell distribution width (RDW) is a low costing and widely reachable measure, reporting the variability in red blood cell size. This test is routinely administered in a normal complete blood count (CBC) and does not burden the patient with ant incremental costs [1-3]. Diseases involving red blood cell (RBC) destruction or production have the ability to increase variability in RBC size and lead to RDW elevation thus this measure is commonly used in diagnosing anemias, especially those that are associated with iron, vitamin B12 (cobalamin), or folate deficiencies [4]. There is also evidence that RDW can be used as a surrogate marker of inflammation [5-7]. RDW has shown efficacy in the context of chronic inflammation, having a sustaining rise in patients with diseases such as chronic renal failure, tuberculosis and various types of cancers [8-10]. Recently studies have shown that RDW can act as a prognostic factor in some life-threatening situations such as sepsis [11]. The same observation was also demonstrated recently in an adult population of patients being admitted to the emergency wards [12]. In concordance to previous studies examining the beneficence of RDW in various clinical contexts, there is also a trend in utilizing this measure as a prognostic factor for patients being admitted because of trauma [13]. But there are contradicting information on the use of this surrogate in defining inflammation and disease activity in different patient groups with different comorbidities [14]. Furthermore, there are no studies pertaining specifically to common trauma patients. But there is data supporting the role of RDW as a prognostic factor in these patients [15]. Moreover, the relation between RDW and other blood markers are also largely left unknown. The present multi-center prospective study aims to fill in the above-mentioned gaps and determine whether RDW could be used as a prognostic marker of trauma patients.

Methods

Patients

During this prospective study, patients being admitted to the emergency wards of medical educational centers of Tabriz university of medical sciences (including 5 centers) between April 2016 and December 2016 were included in the study. Inclusion criteria were consisted of a chief complaint related to trauma, having vital signs in the

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first presentation, having personal satisfaction for participation in the study (or satisfaction of the legal representative of the patient), and not being in a state of hemodynamic shock. Patients with no identification or contradicting of medical records were excluded. Patients with hematologic diseases such as leukemia, thalassemia, myelofibrosis, agranulocytosis, and myelodysplastic syndromes were also excluded because of the effect of their background disease on the test result [16].

Questioner design

A questionnaire was used to obtain information from patients. The questionnaire had been designed under the guidance of Deputy of Research and the Regional Council of Ethics of Tabriz University of Medical Sciences. The questioner contained questions pertaining to the patient's sex, age and the route of trauma and the setting which the accident happened. The final fate of the patient (hospitalization, being admitted to the ICU, death, discharge and discharge with personal willing) was also recorded. Death was assessed by the attending emergency medicine specialists. Glasgow Coma Scale (GCS) of patients were also recorded on their first examination which was performed by the attending specialist.

Complete blood count

CBC was performed on the patients first presentation, using the IDEXX ProCyte Dx® Hematology Analyzer. White blood cell count (WBC), hemoglobin (Hb), RDW, platelet count (PLT), Mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) were determined.

Statistical analysis

Statistical analysis was done by STATA software version 14 (StataCorp LP Texas USA). For baseline characteristics, variables are summarized as mean (SD) for continuous variables (median with SE for non-normally distributed variables), and percentages for discrete variables. Because the distribution of data was not normal according to Kolmogorov–Smirnov test, data were represented in 5 percentiles (5, 25, 50, 75 and 95 percent). Inter-group comparisons were made using analysis of variance or chi square tests. For nonparametric variables, Mann–Whitney U test and Kruskal–Wallis one-way analysis of variance were used. For each of the variables studied a group was set as the reference for the comparison. Confidence interval was set at 90%. *P* value less than 10% was regarded as statistically significant. Power of the study was set at 80%.

Ethical consideration

All patients being included in the study had signed written informed consent forms themselves or their legal representatives had signed it. This study followed the Helsinki declaration. Personal information of patients was kept confidential and were not shared in any manner with any third party. The procedure of the present study was approved in the regional ethics committee of Tabriz University of Medical Sciences (TBZMED.REC.1394.573).

Results

A total of 890 patients were included in the study. The mean age of patients was 34.3 with a standard deviation of 19.5 years. 676 (75.96%) patients were males and 214 (24.04%) were females. The most common routes of trauma consisted of downfall in 194 (21.80%) cases, car accident in 600 (67.42%), bicycle accident in 1(0.11%), motorbike accident in 70 (7.87%) and having an accident as a pedestrian in 25 (2.81%). The outcome of patients consisted of 278(31.31%) cases of hospitalization, 22(3.78%) cases of admission in ICU, 263(29.62%) cases discharged from the emergency ward, 120(13.51%) cases referred to other medical centers,179(20.16%) cases discharged because of personal request and death for 26(2.93%) cases. The mean of hematologic factors is summarized in Table 1. Number of traumas happening in every month is summarized in Table 2. Relation between RDW and background variables is illustrated in Table 3. As it can be seen there was a significant relation between RDW an age in the 25th (P<0.001), 50th (P=0.038) and 75th (P=0.003) percentiles. There was also a significant relation between having a lower level of RDW and not having a comorbid disease (p=0.004 for the 5th percentile and P=0.049 for the 25th percentile). There was a significance relation between having a bicycle accident and the 5th and 25th and 50th and 75th percentiles of RDW (P values 0.056, 0.039, 0.051 and 0.044 respectively. RDW was significantly related to the outcome of the patients in different contexts. Results are summarized in Table 3.

Discussion

The present prospective study was conducted to assess the possible beneficence of RDW as a prognostic factor in trauma patients. It was found that RDW did indeed have prognostic ability in the context of the study. Lam et al. conducted a cohort study to determine the predictive ability of hematological parameters for the mortality rate of trauma patients. They found that age (P<0.001) was a significant factor in the rate of survival, in contrast to sex which was not a significant predictor (p =0.384). They found that there were significant differences in patients surviving trauma with the non-survivors in indices such as RBC count, Hb, Ht, MCH, RDW, PLT and PCT (p <0.001, p <0.001, p <0.001, P=0.004, p=0.041, p <0.001 and P< 0.001 respectively). But they cited that only RBC count, Hb, Ht, PCT, and PLT could be used as a

Table 1. Hematologic characteristics of included patients

Variables	Subjects	Mean	Std. Dev.	Min	Max
Age	884	34.3	19.5	0	35.9
WBC	889	12.9	5.3	2	22.1
HB	886	13.3	2.1	5	24.4
RDW	888	13.2	1.2	10.8	24.4
PLH	888	246.9	75.7	2.9	676
MCH	889	28.4	3.3	17	91
MCV	889	85.8	6.3	42.7	132

Table 2. Variables of patients being included

Variables	Freq (Percent)	Variables	Freq (Percent)
Sex		***Trauma***	
Male	676(75.96)	Downfall	194(21.80)
Female	214(24.04)	Auto car	600(67.42)
Month		Bicycle	1(0.11)
April	92(10.34)	Biker	70(7.87)
May	93(10.45)	Pedestrian	25(2.81)
June	106 (32.70)	***CO-morbidities***	
July	135(15.17)	Yes	26(3.67)
August	120(13.48)	No	682(96.33)
September	107(12.02)	***Outcome***	
October	94(10.56)	Hospitalization	278(31.31)
November	96(10.79)	Admission to ICU	22(3.78)
December	47(5.28)	Death	26 (2.93)
GCS		Discharge	263(29.62)
>14	411(56.30)	Referral	120(13.51)
8-14	272(37.26)	Discharge because of Personal satisfaction	179(20.16)
<8	47(6.44)		

Table 3. Relationship between background variables and RDW

Variables	Percentiles				
	5	**25**	**50**	**75**	**95**
	B (90% CI), P	B (90% CI), P	B (90% CI), P	B (90% CI), P	B (90% CI), P
Sex					
Male	Reference	Reference	Reference	Reference	Reference
Female	(-0.1 to 0.1), 1.000	(-0.15 to 0.02), 0.222	(-0.118 to 0.009), 0.160	(-0.13 to 0.04), 0.351	(-0.5 to 0.4), 0.900
Age	(-0.001 to 0.006), 0.163	(0.002 to 0.004), <0.001	(0.0005 to 0.0042), 0.038	(0.001 to 0.004), 0.003	(-0.004 to 0.008), 0.647
Comorbidity					
Yes	Reference	Reference	Reference	Reference	Reference
No	(-0.4 to -0.1), 0.004	(-0.34 to -0.03), 0.049	(-0.1 to 0.1), 1.000	(-0.3 to 0.4), 0.841	(-2.0 to 1.8), 0.905
Trauma					
Downfall	Reference	Reference	Reference	Reference	Reference
Auto car	(-0.2 to 0.1), 0.389	(-0.15 to 0.02), 0.222	(-0.1 to 0.1), 1.000	(-0.1 to 0.1), 1.000	(-0.5 to 0.4), 0.795
Bicycle	(0.1 to 1.8), 0.056	(0.1 to 1.1), 0.039	(0.1 to 0.7), 0.051	(0.02 to 0.34), 0.044	(-0.9710 to 0.0006), 0.100
Biker	(-0.5 to 0.4), 0.757	(-0.2 to 0.1), 0.432	(-0.1 to 0.1), 0.532	(-0.2 to 0.1), 0.504	(-0.9 to 0.3), 0.367
Pedestrian	(-0.2 to 0.3), 0.592	(-0.1 to 0.1), 1.000	(-0.2 to 0.1), 0.598	(-0.2 to 0.1), 0.669	(-0.7 to 0.3), 0.496
Outcome					
Hospitalize	Reference	Reference	Reference	Reference	Reference
ICU	(-0.2 to 0.2), 1.000	(-0.5 to -0.1), 0.039	(-0.3 to 0.3), 1.000	(-0.2 to 0.6), 0.355	(-0.3 to 0.8), 0.465
Death	(-0.2 to 0.5), 0.497	(-0.2 to 0.2), 1.000	(-0.3 to 0.2), 0.672	(-0.1 to 0.3), 0.516	(-0.5 to 0.7), 0.716
Release	(-0.21 to 0.04), 0.251	(-0.22 to -0.03), 0.023	(-0.18 to -0.04), 0.013	(-0.13 to 0.04), 0.398	(-0.6 to 0.2), 0.504
Refer	(-0.4 to 0.1), 0.247	(-0.26 to 0.01), 0.118	(-0.15 to 0.04), 0.355	(-0.2 to 0.1), 0.492	(-0.7 to -0.1), 0.057
Personal satisfaction	(-0.2 to 0.1), 0.363	(-0.23 to -0.02), 0.053	(-0.14 to 0.03), 0.303	(-0.17 to -0.01), 0.055	(-0.7 to 0.2), 0.354
GCS	(0.004 to 0.166), 0.085	(-0.005 to 0.133), 0.127	(-0.002 to 0.110), 0.112	(0.02 to 0.16), 0.026	(0.1 to 0.5), 0.025
>14	Reference	Reference	Reference	Reference	Reference
8-14	(-0.04 to 0.21), 0.257	(0.04 to 0.21), 0.015	(0.04 to 0.17), 0.009	(0.02 to 0.16), 0.042	(-0.1 to 0.6), 0.308
<8	(-0.2 to 0.4), 0.613	(-0.1 to 0.2), 0.523	(-0.1 to 0.2), 0.509	(0.01 to 0.43), 0.082	(0.1 to 0.9), 0.032
WBC	(-0.01 to 0.01), 1.000	(-0.012 to 0.003), 0.358	(-0.008 to 0.003), 0.400	(-0.01 to 0.01), 1.000	(-0.028 to 0.004), 0.207
HB	(-0.4 to 0.04), 1.000	(-0.02 to 0.02), 1.000	(-0.029 to 0.004), 0.202	(-0.05 to -0.02), <0.001	(-0.13 to -0.08), <0.001
PLT	(-0.0009 to 0.0009), 1.000	(-0.0004 to 0.0004), 1.000	(-0.0003 to 0.0003), 1.000	(0.00001 to 0.00086), 0.089	(0.0001 to 0.0032), 0.077
MCH	(-0.09 to -0.04), <0.001	(-0.08 to -0.04), <0.001	(-0.07 to -0.03), <0.001	(-0.09 to -0.04), <0.001	(-0.11 to -0.04), 0.001
MCV	(-0.04 to -0.01), 0.027	(-0.03 to -0.01), <0.001	(-0.03 to -0.02), <0.001	(-0.04 to -0.02), <0.001	(-0.05 to -0.02), <0.001

predictor in the first week after the trauma. they concluded that patients undergoing trauma should go under routine hematological work up as a means of assessing treatment, however the value of prediction remains limited for many indices [17]. In a retrospective cohort study, Sekhon et al. evaluated the association between hemoglobin concentration and mortality in critically patients with severe traumatic brain injury. They acclaimed that 7-day average hemoglobin concentration of less than 90 g/L may be associated with poor outcome (3 fold in hospital mortality) but they were not able to define a threshold for anemia, on which the management of the patient could be based on [18]. Alike the previous study, other factors other than RDW were also used as prognostic factors and this makes RDW and even more acceptable option as it is usually assessed alongside other hematologic factors. Soo Hyun Kim et al. investigated the relation of RDW with in-hospital mortality rates of patients older than 65 years age admitted to the emergency department and found that there was a significant association between RDW and mortality rate. They concluded that for every percent increase in RDW values, hospital mortality rate increased by 21.8%. similar to the previous study mentioned, the authors of this study also failed to determine any threshold on which a clinical decision could be made [12]. The efficiency of RDW was also demonstrated in more specific settings, for example Garbharran et al. were able to show that the amount of RDW was an independent predictor of survival in hip fracture [19]. Jiang et al. were also capable of showing the same association among RDW and mortality of critically ill patients [20]. Noteworthy, as previously mentioned the relative effectiveness of RDW in predicting the outcome of patients is not limited to the cause of morbidity and as studies have illustrated, is not age specific. Ramby et al. disclosed that RDW was in fact a prognostic factor and the marker was the most efficient, when patients were divided to two groups of low or high DWR and a midline threshold did not yield any further beneficence [21]. One important factor in different studies aiming to demonstrate the clinical usefulness of RDW is that most of these studies are retrospective and are mostly based on test administered after patients are hospitalized and based on this, usually these studies fail to be relevant in patients not receiving care in a professional medical context. This limitation was reported in a previous study performed by Ozdemir et al. [22] in contrast to this study, the present study demonstrated the relation in both in-patients and patients discharged. One essential question about RDW is whether this marker can predict a grim outcome, not only because of etiologies related to the recent hospitalization, and that the marker could have a general prognostic characteristic. Large scale studies answering this question are still none existent, but there have been experiments. Ani et al studied a group of 450 patients who underwent stroke and recorded their final clinical outcome and concluded that RDW was a prognostic factor for not only specific causes of death but was able to predict the outcome independent of the etiology [23]. Amid many studies performed on the relation of RDW with many life threatening and possibly lethal conditions few have been able to suggest a cut-off point on which clinical decision making could be based on. These studies were performed by Tenekecioglu et al. [24] who advised that at a level of 14%, RDW had a sensitivity and specificity of 73% and 59% respectively. They also found that RDW values were positively correlated with cardiac troponin I (p=0.006).

As it is understood various studies have been performed and the role of RDW in the upcoming para-clinical tests of patients undergoing traumatic or inflammatory is established. But there are some vague aspects that should be further studied. first is the prognostic ability in different group of patients which have the same etiologic factor but have different comorbidities. Second is determining cut off points on which clinical decision making could be based on. Third is conducting large scale studies in patients with different etiologies of morbidity and understanding whether RDW could be used as a general surrogate marker. These studies should include patients with wide racial groups and performed in multiple centers and on national bases so that their results could be further generalized.

Limitation

The limitation of the present study is that it was only performed in one city, though the results could be generalized to wider populations, larger studies would definitely be of great merit, also the study did not assess different patients of specific traumas on the severity of trauma, a factor that could be important in interpreting the results of RDW.

Conclusion

RDW proved to be a beneficial surrogate marker of trauma severity and outcome, making possiblilty that the test be performed as a routine assessment in trauma patients. Although exact cut off points are lacking at the time, the tests show potential for the upcoming future.

Conflicts of interest

The authors declare that they have no conflict of interest.

Ethic approval

The procedure of the present study was approved in the regional ethics committee of Tabriz University of Medical Sciences (TBZMED. REC.1394.573).

Park SH, Chi HS, Cho YU, Jang SS, Park CJ. The allele burden of JAK2 V617F can aid in differential diagnosis of Philadelphia chromosomenegative myeloproliferative neoplasm. Blood Res 2013; 48:128-32.

References

1. Qurtom HA, al-Saleh QA, Lubani MM, Hassanein A, Kaddoorah N, et al. (1989) The value of red cell distribution width in the diagnosis of anaemia in children. *Eur J Pediatr* 148: 745-748. [Crossref]
2. Sultana GS, Haque SA, Sultana T, Ahmed AN (2013) Value of red cell distribution width (RDW) and RBC indices in the detection of iron deficiency anemia. *Mymensingh Med J* 22: 370-376. [Crossref]
3. Isik T, Ayhan E, Kurt M, Tanboga IH, Kaya A, et al. (2012) Is red cell distribution width a marker for the presence and poor prognosis of cardiovascular disease? *Eurasian J Med* 44: 169-171. [Crossref]
4. Romero AJ, Carbia C, Ceballo M, Diaz N (1998) Red cell distribution width (RDW): its use in the characterization of microcytic and hypochromic anemias. *Medicina* 59: 17-22. [Crossref]
5. Lippi G, Targher G, Montagnana M, Salvagno GL, Zoppini G, et al. (2009) Relation between red blood cell distribution width and inflammatory biomarkers in a large cohort of unselected outpatients. *Arch Pathol Lab Med* 133: 628-632. [Crossref]
6. Demirkol S, Balta S, Cakar M, Unlu M, Arslan Z, et al. (2013) Red cell distribution width: a novel inflammatory marker in clinical practice. *Cardiol J* 20: 209. [Crossref]
7. Wen Y (2010) High red blood cell distribution width is closely associated with risk of carotid artery atherosclerosis in patients with hypertension. *Exp Clin Cardiol* 15: 37-40. [Crossref]
8. Oliveira MG, Delogo KN, Oliveira HMdMG, Ruffino-Netto A, Kritski AL, et al. (2014) Anemia in hospitalized patients with pulmonary tuberculosis. *J Bras Pneumol* 40: 403-410. [Crossref]
9. Tekce H, Kin Tekce B, Aktas G, Tanrisev M, Sit M (2014) The evaluation of red cell distribution width in chronic hemodialysis patients. *Int J Nephrol* 2014: 754370. [Crossref]
10. Auezova R, Ryskeldiev N, Doskaliyev A, Kuanyshev Y, Zhetpisbaev B, et al. (2016) Association of preoperative levels of selected blood inflammatory markers with prognosis in gliomas. *Onco Targets Ther* 9: 6111-6117. [Crossref]
11. Mahmood NA, Mathew J, Kang B, DeBari VA, Khan MA (2014) Broadening of the red blood cell distribution width is associated with increased severity of illness in patients with sepsis. *Int J Crit Illn Inj Sci* 4: 278-282. [Crossref]
12. Kim SH, Yeon JH, Park KN, Oh SH, Choi SP, et al. (2016) The association of Red cell distribution width and in-hospital mortality in older adults admitted to the emergency department. *Scand J Trauma Resusc Emerg Med* 24: 81. [Crossref]
13. Zhang B, Zhao J (2015) Red blood cell distribution width as a prognostic biomarker for mortality in traumatic brain injury. *Int J Clin Exp Med* 8: 19172-19175. [Crossref]
14. Ipek S, Cekic C, Alper E, Coban E, Eliacik E, et al. (2015) Can red cell distribution width be a marker of disease activity in ulcerative colitis? *Int J Clin Exp Med* 8: 13848-13853. [Crossref]
15. Majercik S, Fox J, Knight S, Horne BD (2013) Red cell distribution width is predictive of mortality in trauma patients. *J Trauma Acute Care Surg* 74: 1021-1026. [Crossref]
16. Roberts GT, El Badawi SB (1985) Red blood cell distribution width index in some hematologic diseases. *Am J Clin Pathol* 83: 222-226. [Crossref]
17. Lam SW, Leenen LP, van Solinge WW, Hietbrink F, Huisman A (2011) Evaluation of hematological parameters on admission for the prediction of 7-day in-hospital mortality in a large trauma cohort. *Clin Chem Lab Med* 49: 493-499.
18. Sekhon MS, McLean N, Henderson WR, Chittock DR, Griesdale DE (2012) Association of hemoglobin concentration and mortality in critically ill patients with severe traumatic brain injury. *Crit Care* 16: R128. [Crossref]
19. Garbharran U, Chinthapalli S, Hopper I, George M, Back DL, et al. (2013) Red cell distribution width is an independent predictor of mortality in hip fracture. *Age Ageing* 42: 258-261. [Crossref]
20. Jiang L, Feng X, Ma Y, Zhang M (2014) Red cell distribution width: a novel predictor of mortality in critically ill patients. *J Thorac Dis* 6: E194-195. [Crossref]
21. Ramby AL, Goodman DM, Wald EL, Weiss SL (2015) Red blood cell distribution width as a pragmatic marker for outcome in pediatric critical illness. *PloS one* 10: e0129258. [Crossref]
22. Isik B, Yilmaz MS, Yel C, Kavalci C, Solakoglu GA, et al. (2016) Importance of red blood cell distribution width (RDW) in patients with upper gastrointestinal haemorrhage. *J Pak Med Assoc* 66: 151-154. [Crossref]
23. Ani C, Ovbiagele B (2009) Elevated red blood cell distribution width predicts mortality in persons with known stroke. *J Neurol Sci* 277: 103-108. [Crossref]
24. Tenekecioglu E, Yilmaz M, Yontar OC, Bekler A, Peker T, et al. (2015) Red blood cell distribution width is associated with myocardial injury in non-ST-elevation acute coronary syndrome. *Clinics* 70: 18-23. [Crossref]