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Red Cell Distribution Width and Seveirity of Covid-19 Disease: A Case Series

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Abstract

Background: Hematological picture of COVID-19 transpires as lymphopenia, occasional thrombocytopenia, and overall leukopenia at the time of hospital admission. RDW appears to be a non-specific marker of illness, that has the potential to provide morbidity risk stratification which might be particularly useful for a new and unknown disease.

Aim: To investigate possible association existing between morbidity burden of COVID-19 disease and an elevated Red Cell distribution width (RDW)-CV percentage, at the time of hospital admission and during course of hospitalization in COVID-19 patients.

Materials and Methods: A Case Series was conducted on 23 patients, RT-PCR confirmed COVID-19 cases; admitted to and kept under observation in medicine ward, ICU or dedicated COVID-19 wards of RNT Medical College and Associated group of Hospitals for a duration of 30 days. Data was collected from records at the time of admission of these cases.

Statistical Analysis: Data coding and analysis was done using MS Excel 2013 (Office 365, Microsoft Company Ltd., USA). Applying descriptive statistics averages were calculated. Observations were stated accordingly.

Results: A very high RDW above 35% was observed alongside $SpO_2 \leq 94\%$ in 34.78% of patients on day 1 and 43.47% of patients on day 5. Highest therapeutic O_2 requirement on both the days of observation were seen with RDW levels greater than 45%. Maximum average RDW values on both days was observed for HFNO.

Conclusions: Elevated RDW at the time of hospital admission and during the course of treatment could be one of the markers for severity of COVID-19 disease and its morbidity burden.

Keywords: RDW, COVID-19, SpO_2, Mode of ventilation

Introduction

An acute respiratory illness caused by infection with Severe Acute Respiratory syndrome coronavirus 2 (SARS-CoV-2) created a global menace pertaining to a high rate of hospitalization, critical care requirement, alongside enhanced morbidity and mortality.[1]-[2] Identification of patients at high risk for severe disease is important to facilitate early, aggressive intervention and management of local hospital resources to mitigate the critical care crises that have impacted the hospital systems nationwide. In general, hematological picture of COVID-19 transpires as lymphopenia, occasional thrombocytopenia, and overall leukopenia at the time of hospital admission.[3] A dramatically varied range of clinical course for hospitalized patients is observed, with early evidence showing that ICU admission and mortality risk are associated with an elevated D-dimer (Dimerized Plasmin Fragment D) level and deteriorating lymphocyte count.[1],[4] For apt patient risk stratification, additional routine biomarkers are exigently required.

The Red Blood Cell Distribution Width (RDW) is a standard component of a routine Complete Blood Count (CBC) laboratory test. RDW quantifies the variation of individual red blood cell (RBC) volumes, which vary from one cell to the next and for the same cell as it circulates in the course of its approximately 115-day lifespan.[5-7] An elevated RDW is associated with an increased risk for all-cause mortality; mortality from heart disease, pulmonary disease, sepsis, influenza, and cancer; complications associated with heart failure, severity of coronary artery disease and viral hepatitis, advanced stage and grade for many cancers; and the development of diabetes, chronic obstructive pulmonary disease (COPD), stroke, anemia, and many other conditions.[8-18] RDW appears to be a non-specific marker of illness that has the potential to provide risk stratification that may be particularly useful for a new and unknown disease.

RDW is the coefficient of variation in RBC volume, or the SD divided by the mean. An increase in RDW must therefore correspond to a decrease in mean RBC volume (MCV), an increase in RBC volume variance, or both. Previous studies [6],[8],[17],[19] have found evidence in some specific conditions that RDW elevation is caused by delayed clearance of older RBCs. Because RBCs characteristically decrease in cellular volume across their lifespan, persistence of these older, smaller cells thus increases volume variance, and this clearance delay coincides with and offsets a net decrease in RBC production.[6],[8],[17] RDW-CV where CV is coefficient of variation is expressed in percentage. Normal RDW-CV ranges are 12.2%–16.1% for women and 11.8%–14.5% for men. [20-21] Above mentioned reports suggest the possibility that an elevated RDW in some circumstances may reflect a clinical state in which RBC production and turnover have slowed in the setting of increased production and turnover of leukocytes or platelets such as would occur in inflammation [8-18]. Although a definitive mechanism for RDW elevation has not yet been established, there is evidence that RDW can provide robust risk-stratification among patients diagnosed with the same acute illness. In this context present study, aims to investigate any possible association existing between morbidity and elevated RDW investigated at the time of hospital admission (day 1) and during further course of hospitalization (day 5 under observation) in patients with COVID-19.

Materials And Methods

It is a Case Series – an extempore exploratory survey of majorly descriptive in design conducted over a period

of 30 days in RNT Medical College and Associate Group of Hospitals, Udaipur.

The Study population comprised of 23 patients who were confirmed RT-PCR cases of COVID-19 admitted in dedicated COVID wards and ICU of RNT Medical College and Associated Groups of Hospitals. The patients were selected on the basis of purposive sampling (non-probability sampling). The cases shared similar clinical profile and were requiring oxygen therapy and assisted ventilation along with drug protocol for COVID -19. Required drug therapy for symptomatic relief was administered for the same.

Inclusion Criteria

- Patients and/or their attendants who willingly gave consent to participate in the study.
- Symptomatic patients with Real Time Polymerase Chain Reaction (RT-PCR) positive for SARS COV-2.
- Patients fulfilling criteria of case consideration mentioned above.

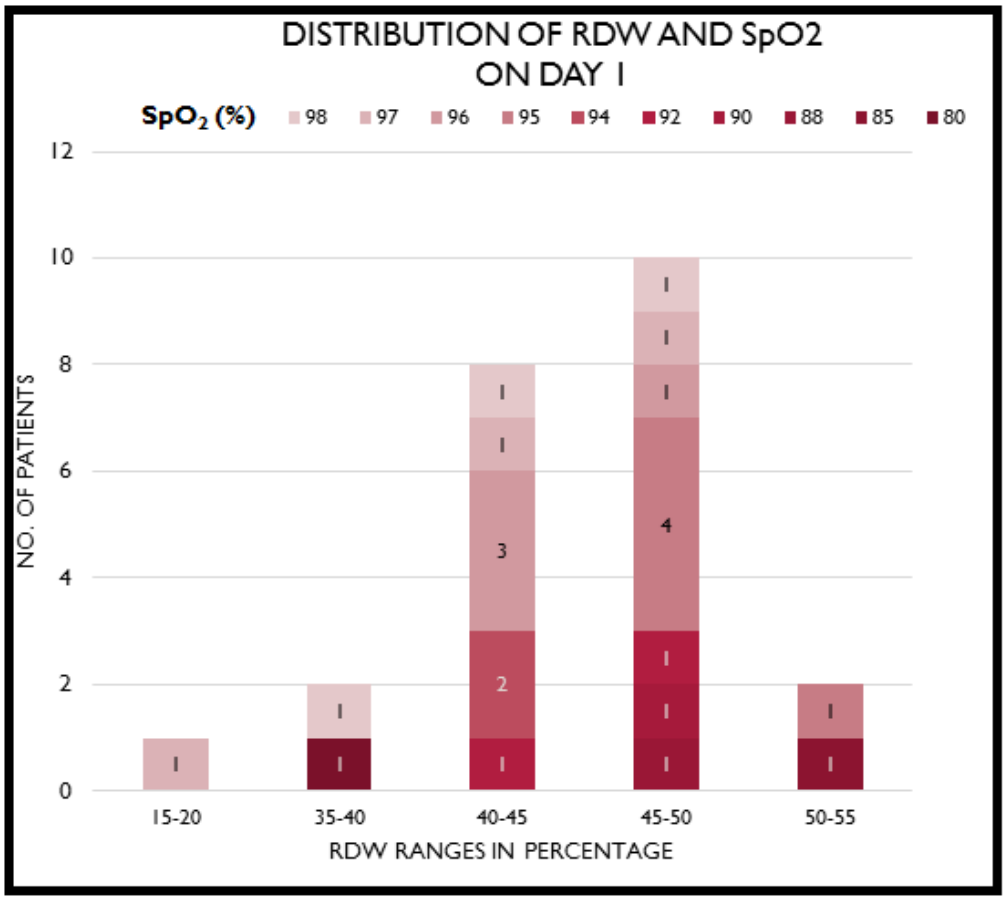
Exclusion Criteria

- Patients presenting with atypical pneumonia but RT-PCR negative for SARS COV-2.
- Patients admitted for the same in mid-course of the study.
- Patients home isolated during the study period.
- Loss to follow up patients – LAMA (Leave Against Medical Advice) or Absconded.

Result

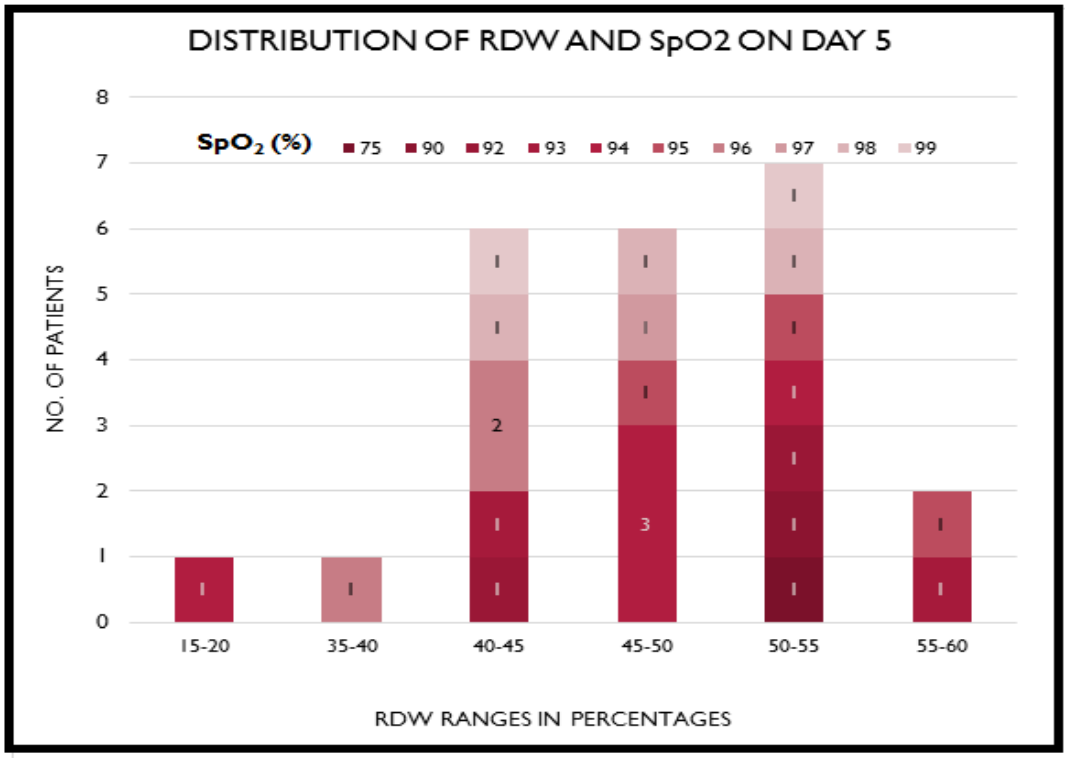
SpO_2 % age and Count of patients on DAY 5											
RDW RANGES in percentage	75%	90%	92%	93%	94%	95%	96%	97%	98%	99%	Total no of patients
15-20					1						1
35-40							1				1
40-45			1	1			2		1	1	6
45-50					3	1		1	1		6
50-55	1	1	1		1	1			1	1	7
55-60				1		1					2
Total no of patients	1	1	2	2	5	3	3	1	3	2	23

On Day 1; out of total 23 patients under study, 8 patients (i.e., 34.78%) had SpO_2 levels ≤ 94% and all of them had RDW levels above 35%; amongst them 50% i.e., 4 patients had considerably high RDW values above 45%.



SpO_2 % age and Count of patients on DAY 5											
RDW RANGES in percentage	75%	90%	92%	93%	94%	95%	96%	97%	98%	99%	Total no of patients
15-20					1						1
35-40							1				1
40-45			1	1			2		1	1	6
45-50					3	1		1	1		6
50-55	1	1	1		1	1			1	1	7
55-60				1		1					2
Total no of patients	1	1	2	2	5	3	3	1	3	2	23

On 5th day post admission, it was observed that number of patients with $SpO_2 \leq 94\%$ with RDW above 35 were 10 i.e., 43.47% of total patients under study. 3 (13.04%) patients who had very low oxygen saturation, SpO_2 of 75%, 90% and 92% respectively had RDW ranging between 50-55%.

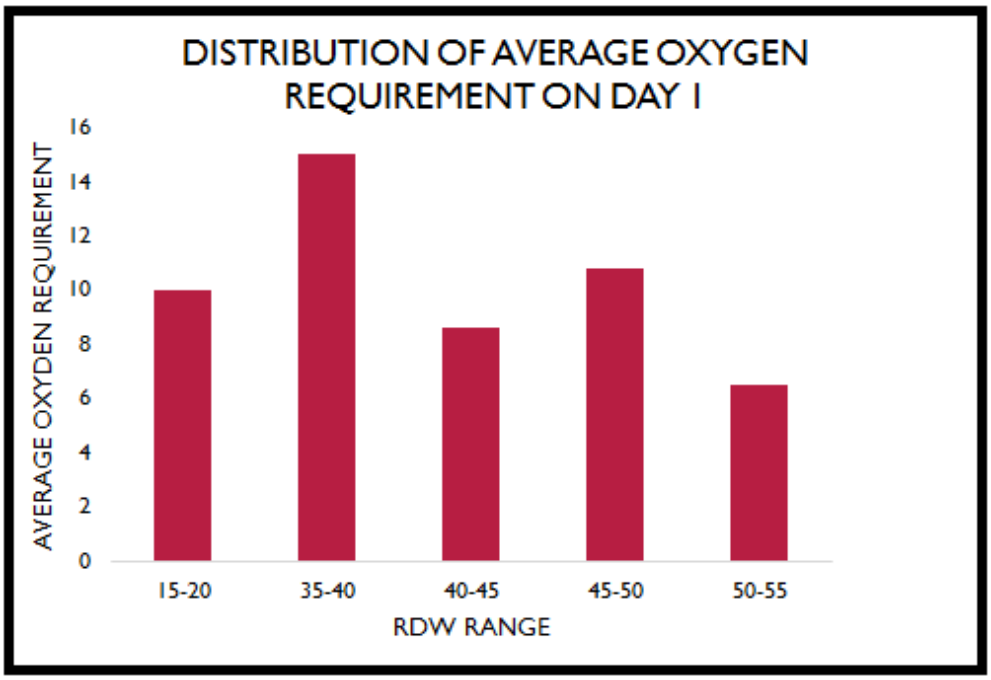


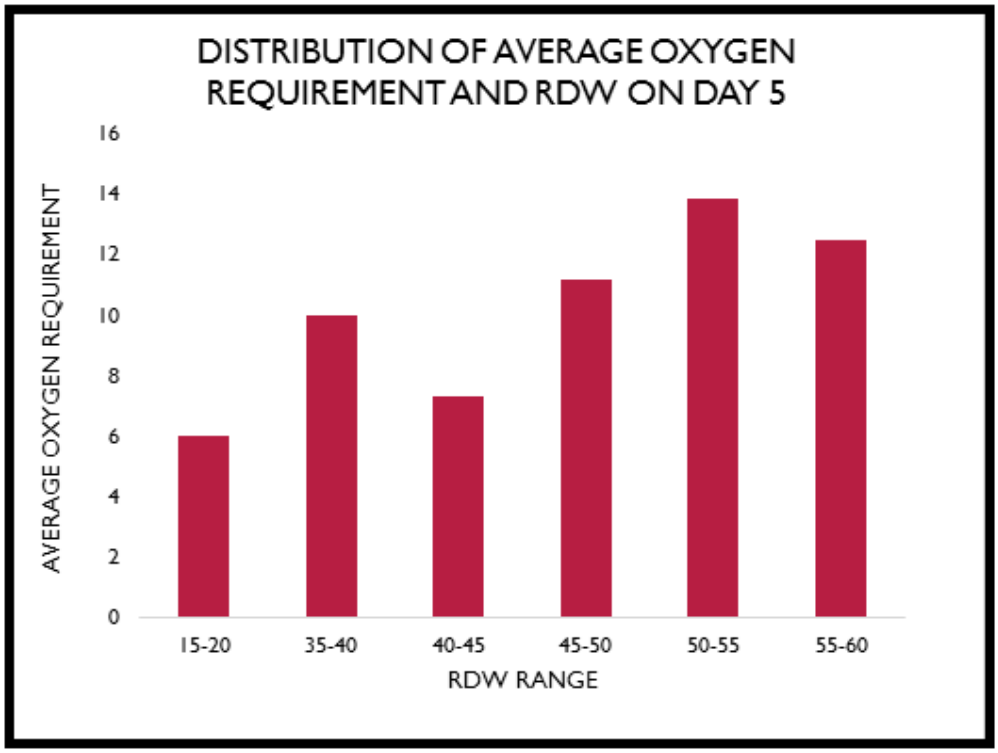
RDW Range	Average 0_2 Requirement Day 1
15-20	10
35-40	15
40-45	8.625
45-50	10.8
50-55	6.5
Total	10

RDW Range	Average O_2 Requirement Day 5
15-20	6
35-40	10
40-45	7.33
45-50	11.16
50-55	13.85
55-60	12.5
Total	10.82

On first day, the total mean oxygen requirement was 10 liters while on day 5th of observation it was 10.82 liters. On day 1, maximum average oxygen requirement, 10.8 liters was observed with RDW range between 45-50%. On day 5th of observation, it was deciphered that maximum average oxygen requirement of 13.85 liters was amongst RDW ranges of 50-55% followed by 12.5 liters for 55-60% of RDW values.

A rise in average therapeutic O_2 requirement was observed with elevating RDW values.

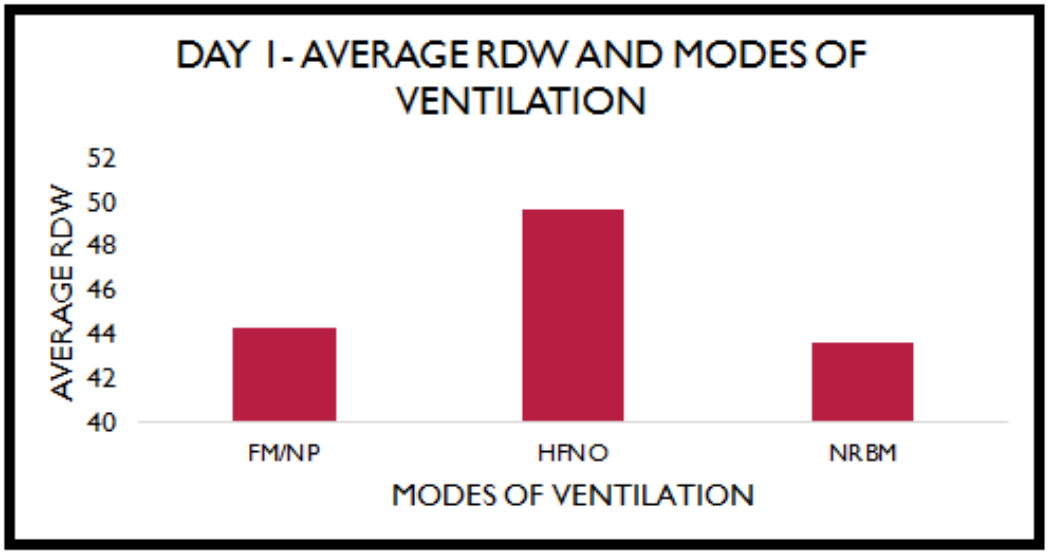


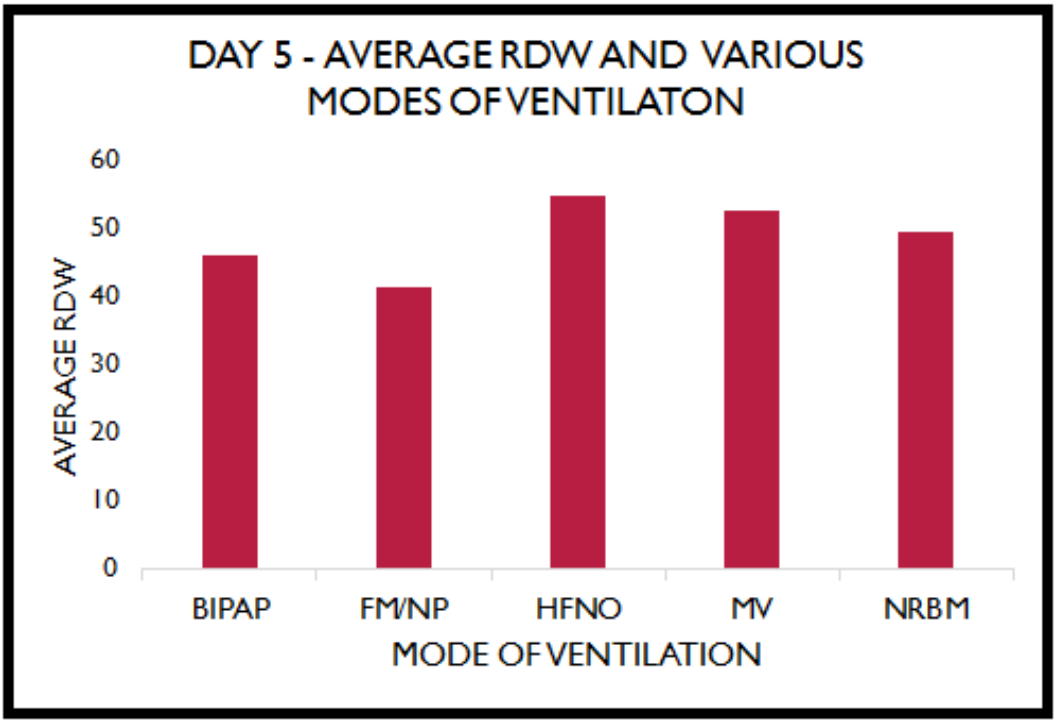


Mode Of Ventilation	Average RDW On Day 1
FM/NP	44.28
HFNO	49.7
NRBM	43.63
Total	44.34

Mode of Ventilation	Average RDW On Day 5
BiPAP	45.83
FM/NP	41.26
HFNO	54.55
MV	52.50
NRBM	49.32
Total	46.65

The average values of elevated RDW ranges for different modes of ventilation observed on day 1 of admission, were 44.28% for face mask (FM) or nasal prongs (NP), 49.7% for High Flow Nasal Oxygen (HFNO) delivered by cannula and 43.63% for Non-Rebreather Mask (NRBM) while on day 5 for BiPAP (Bilevel Positive Airway Pressure) average RDW was 45.83%, 41.26% for FM/NP, 54.55% by HFNO, 52.50% average RDW for Mechanical Ventilation (MV), 49.32% by NRBM 49.32. The total mean of RDW on day 1 and day 5 were 44.34% and 46.65% respectively.





Discussion

A very high RDW above 35% was observed along with $SpO_2 \leq 94\%$ in 34.78% patients on day 1 and 43.47% patients on day 5. Highest therapeutic O_2 requirement on both days of observation, was seen with a RDW values greater than 45%. Maximum average RDW of 49.7% and 54.55% on day 1 and day 5 respectively, were for HFNO mode of assisted ventilation.

This study falls short due to its small sample size and limited geographical representation. Due to its descriptive nature, inferential statistics could not be used to derive a statistically significant correlation. It is recommended that along with other inflammatory markers, RDW should be evaluated for COVID-19 disease severity and its role in morbidity should be analyzed in future research.

Conclusion

An elevated Red Cell Distribution Width (RDW) in absence of other common causes (like nutrient deficiency) indicates infective etiology. The investigators have tried to evaluate a possible relationship between morbidity burden of covid-19 infection and an elevated RDW. This study suggests that a considerably high RDW of 40% and above might have possible association with low SpO2 levels below 94% and in patients requiring higher therapeutic oxygen with invasive modes of ventilation.

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