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Linking CRP and D-dimer levels in hypertensive versus non-hypertensive COVID-19 patients at a tertiary hospital: A retrospective cross-sectional study

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Abstract:
COVID-19 pandemic has caused global disruption to the normal way of life and health conditions at the start of 2020, leaving a lasting and memorable impression on the world. Inflammatory biomarkers like C-reactive protein (CRP) and D-dimer are measured to asses inflammation and clotting risk in this severe disease and together they can help in predicting complications and guide treatment decisions. Patients were categorised as hypertensive (n=19) and non-hypertensive (n=131), out of total 150 COVID-19 positive individuals in our study, with a higher proportion of non-hypertensive patients experiencing milder symptoms. CRP and D-dimer levels were found to be significantly higher in hypertensive COVID-19 patients in comparison to non-hypertensive groups ($p< 0.05$). Thus, data shows the importance of monitoring inflammatory biomarkers in COVID-19 positive patients with comorbidities for early identification of disease progression and targeted therapeutic interventions.

Keywords: Coronavirus disease (COVID-19), C-reactive protein (CRP), hypertension, inflammation, coagulation, pathophysiology

Background:
The COVID-19 virus preferentially attacks the lower respiratory tract and tissues expressing ACE-2 (angiotensin converting enzyme-2) receptors leading to a spectrum of clinical manifestation from asymptomatic infection to severe respiratory failure **[1]**. Monitoring CRP and D-dimer levels in COVID-19 patients, especially those with hypertension, can provide valuable insights into the patient's condition and help guide treatment strategies. CRP biomarker is most closely associated with the progression of COVID-19 and is significantly elevated in the early stages of inflammation **[2, 3]**. By examining the correlations between these variables and COVID-19 severity in mild, moderate and severe cases, valuable insights can be gained regarding the potential role of these factors in influencing disease outcomes **[4]**. Therefore, it is of interest to assess the association between hypertension and the risk of SARS-CoV-2 infection and adverse COVID-19 outcomes.

Methodology:
A retrospective cross-sectional study was conducted on 150 individuals (cases) diagnosed with COVID-19 after nasopharyngeal swab testing and confirmed RT-PCR tests during the period of April 2021 to January 2022, utilizing data sourced from Dr. K.K.B.M. Subharti Hospital Dehradun (Uttarakhand), out of which 19 patients were hypertensives. The study specifically targeted COVID-19 positive patients below 70 years old. Medical records were scrutinized for laboratory findings regarding CRP levels and D-Dimer values at the mentioned hospital. CRP levels were determined using the Turbidimetric method, while D-Dimer test was performed by immunofluorescence technology, using STANDARD F D-Dimer FIA kit. The blood pressure of COVID-19 positive patients was measured by using a sphygmomanometer. Cases were classified as hypertensive and non-hypertensive based on 2024 European Society of Cardiology (ESC) guidelines for hypertension:

[1] Non-Hypertensive: Blood pressure (BP) ≤ 120/70 mmHg.
[2] Hypertensive: BP is ≥ 140/90 mmHg.
[3] Reference range for CRP: < 3 mg/L in normal population.
[4] Reference range for D-Dimer: < 0.5 microgram/ml

Data analysis was conducted using SPSS statistical software version 20.0 provided by IBM Corp.

Results:
Patients, with severe conditions of the disease had higher levels of CRP and D-dimer than those without severity. A direct correlation between CRP concentration as well as D-Dimer concentration as shown in **Figure 1** and the COVID-19 severity was observed ($p < 0.001$). Hypertension was found to be significantly related to the severity of COVID-19 infection in nearly all systematic review and meta-analysis studies. However, no systematic reviews or meta-analyses have been conducted to determine whether elevated blood pressure increases the likelihood of contracting SARS-CoV-2. D-dimer levels exhibited significant positive correlations with CRP levels ($r = 0.734^{**}$, $p < 0.01$). These associations highlight the interconnections between coagulation activity and inflammation. For individuals with hypertension, among the 150 respondents, 12.6% of COVID-19 cases were hypertensive while 87.3% were non-hypertensive in our study. This indicates that COVID-19 severity was observed in both hypertensive and non-hypertensive individuals, with a higher proportion of non-hypertensive individuals experiencing milder symptoms. The chi-square value was found 1.26, df = 2 and p-value was 0.53, found to be non-significant at $p < 0.05$. Our analysis focuses on the ANOVA table, which provides insights into the association between variables (CRP and D-Dimer) and co-morbidity (hypertension) which we have taken in our study. The table includes the degrees of freedom, F-value and P-value for the significance for each variable. The ANOVA results indicate a significant association between CRP level and hypertension (F =

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3.466, p = 0.000). The between-groups variation (5.770) is significantly larger than the within-groups variation (244.324), suggesting that CRP level shows a notable difference between the hypertensive and non-hypertensive group. The ANOVA results reveal a statistically significant association between D-Dimer level and hypertension (F = 4.281, p = 0.023). The between-groups variation (6.992) is significantly larger than the within-groups variation (204.281), indicating a noticeable distinction between the hypertensive and non-hypertensive groups.

Table 1: Association between degree of severity and variables

Variables	Total no of Counts N = 150	COVID-19 Severity		
		N = 56	N = 51	N = 43
		Mild	Moderate	Severe
CRP	Mean Score	9.67	40.04	101.68
	SD ±	3.46	20.27	34.35
D-dimer	Mean Score	0.32	0.42	1.72
	SD ±	0.109	0.11	0.539

Table 2: Association of variables and co-morbidity (hypertension)

Co-morbidities	Variables					
	CRP			D-dimer		
	df	F	P value	df	F value	P value
Hypertensive	149	3.46	0	149	4.28	0.023

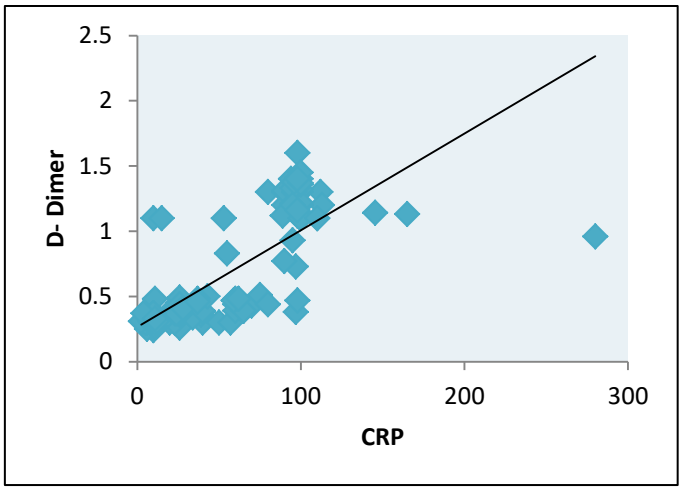

Figure 1: Correlation between CRP and D-dimer

Discussion:

Our findings indicate that the variables show substantial differences between the hypertensive and non-hypertensive groups. Previous research has showed that persons who are already sick are more susceptible to the disease's extremes **[5]. Table 1** of our study shows the association between the degree of severity (mild, moderate and severe) and variables (CRP and D-dimer). The correlation between COVID-19 severity and several clinical variables, including CRP level, D-Dimer were investigated. These variables were chosen based on their known association with inflammation and coagulation, which are key mechanisms underlying COVID-19 pathophysiology. Previous studies have consistently showed a direct correlation between CRP concentrations and the severity level as well as mortality rates linked with the disease **[6-8]**. The similarity in findings aligns with our research as shown in **Table 1**. Additionally, another study (similar to our work mentioned in **Table 1**) revealed a positive association between elevated CRP levels, heightened inflammation rates and disease severity **[9, 10]**. Findings from a separate systemic review **[11]** indicated that the levels of CRP in patients with COVID-19 were significantly higher in those with severe disease than in those without the disease. The scientific evidence showed that the patients who passed away due to COVID-19 were more likely to have high levels of D-dimer **[8, 12]**. D-dimer levels in patients with severe Coronavirus infection are higher than those in patients with non-severe (mild to moderate) disease and levels above 0.5µg/ml are associated with severe disease in patients with COVID-19 infection. Similar to our work, mentioned in **Table 1**, in 11 different clinical researches, severe patients had higher serum concentrations (D-dimer) than patients with mild forms (average difference range 0.6 to 6.21 mg/mL) **[13-15].** Researchers have also indicated that an increased incidence of D-dimer levels at the time of admission was observed in patients with more severe cases of COVID-19 **[12, 16-18]**. The analysis of our observation as shown in **Table 2** also reveals significant associations between hypertension comorbidity) and the variables (CRP and D-dimer) **[19]**. However, a very few systematic reviews or meta-analyses have been conducted to determine whether elevated blood pressure increases the likelihood of contracting SARS-CoV-2. Similar to our study, as shown in **Table 2**, in another research, no significant correlation was observed between CRP levels and COVID-19 positive hypertensive patients **[20].** As depicted in **Figure 1**, the correlation between CRP and D-Dimer also reveals that, the frequent evaluation of CRP and D-dimer in COVID-19 patients can help with early risk assessment and timely therapeutic decision-making, which may improve clinical outcomes and decrease mortality **[21].**

Conclusion:

Elevated CRP and D-dimer levels are key biomarkers of inflammation and hypercoagulability in COVID-19, with higher levels in hypertensive patients indicating greater disease severity and poorer outcomes. Hypertension amplifies inflammatory and thrombotic responses in COVID-19, emphasizing its role as a major comorbidity. These findings highlight the interplay between inflammation, coagulation and hypertension, providing a basis for targeted therapy and improved clinical management of COVID-19.

Author's note:

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