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Cardiovascular Autonomic Dysfunction in Post Covid Patients Evaluated by Sustain Handgrip Test

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Abstract

Background: *This study was performed to evaluate the cardiovascular autonomic function in Covid and non-Covid patients by using sustained hand grip test. Covid 19 primarily involves lungs by causing pneumonia but may also involve other organs. Pneumonia is interstitial pneumonia as it is viral origin. The patient commonly presents with fever, dry cough, fatigue. SARS-COV 19 virus in pandemic of Covid -19 not only shows ill effect in acute phase but symptoms may persist or delayed symptom beyond 4 weeks of acute infection called as "long Covid or post Covid syndrome". The symptoms of Persistent Long Covid syndrome consist of cough, dyspnea, fatigue, palpitation, headache, insomnia, etc. Along with neurological abnormalities involvement of ANS is not uncommon.* ***Methods:*** *27 RT-PCR confirmed COVID-19 recovered patients and 27 healthy subjects in the age group between 18 to 60 were enrolled in the study. This is a type of cross-sectional study. Sustained hand grip test was performed on the subjects. The subject is asked to sit comfortably, and ECG and sphygmomanometer are connected. Baseline heart rate and B.P. are recorded. Ask the subject to maintain pressure of 30% of maximum activity for 5 minutes. Record heart rate and B.P. change. The diastolic blood pressure response to isometric exercise was calculated as the difference between diastolic blood pressure after a 4-min hand grip at 30% of maximal effort and diastolic blood pressure at rest.* ***Results:*** *In Sustain hand grip test (HGBP) in cases 66.7 % (18) were in normal range (>or = 16), 3.7% (1) was borderline (11-15) whereas 29.6% (8) were abnormal (< or = 10). For control 96.3% (26) were in normal range while 3.7% (1) was abnormal. The mean Sustain hand grip test (HGBP) of cases was 15.4 ± 5.4 and that of control was 19.2 ± 5.1. When unpaired t-test was applied, statistically there was significant difference between the two groups.* ***Conclusion:*** *The present study thereby shows that Covid 19 infection may present with cardiovascular autonomic dysfunction. The CVS autonomic dysfunction leads to changes in heart rate and blood pressure. Blood pressure and heart rate study are important to identify cardiovascular autonomic dysfunction. Sustain hand grip test may be used to evaluate cardiovascular autonomic dysfunction with fair accuracy.*
Keywords*: COVID-19, cardiovascular autonomic dysfunction, Sustain hand grip test*

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Introduction

COVID-19 disease leads to mild or moderate or severe infection in humans due to a virus called SARS COV 2 (Severe acute respiratory syndrome COV -19 virus). This disease started from China in December 2019 and declared as pandemic in March 2020 by WHO. SARS-COV 19 virus in pandemic of covid -19 not only shows ill effect in acute phase but symptoms may persist or delayed symptom beyond 4 weeks of acute infection called as "Persistent

long covid or post covid syndrome" [1] Long covid syndrome consists of symptom like fatigue, dyspnoea, cough, headache, insomnia, palpitation etc. Also, neurological, and Autonomic nervous system (ANS) abnormalities are not uncommon. [2,3,4]

ANS regulates homeostasis of cardiovascular system, thermoregulatory, gastrointestinal, genitourinary, pupillary function. [5,6] Sustain handgrip test is a type of isometric exercise for evaluating sympathetic autonomic reflex in the form of proportionately increase in diastolic B.P. in response to this isometric exercise. Isometric exercise is useful to diagnose sympathetic dysfunction. A subnormal increase in diastolic B.P. is an indicator of impaired sympathetic function. [7]

Aim and Objective

To assess the proportion of sympathetic cardiovascular autonomic system dysfunction in post Covid patients with Non Covid subjects.

Materials and Methods

27 RT-PCR confirmed COVID-19 recovered patients (12 to 18 months after Covid infection) and 27 healthy subjects in age group between 18 to 60 have been enrolled in the study. This is a type of cross-sectional study. Consent was taken from all the patients for the study. Different cardiovascular autonomic function tests are follows.

Different cardiovascular autonomic function tests are-

Tests for **sympathetic nervous system** include blood pressure changes on immediate standing, blood pressure changes on Valsalva maneuver, cold pressor test, sustained handgrip test. [8,9,10,11,12] Test for **parasympathetic nervous system** includes heart rate changes in deep breathing and immediate standing, Valsalva maneuvers [8,9,10,11]. Autonomic disturbance is difficult to establish as clinical symptoms appear late in course of disease and nonspecific) [8,9,11]. Here we have evaluated the patients by sustain hand grip test.

Inclusion criterion

RT-PCR confirmed Covid 19 recovered cases from medicine OPD of age group between 18 - 60 years who have given written consent are included in the study.

Patients suffering from Neurodegenerative disease, Polyneuropathy, long term Diabetes, Obesity, Hypertension, Heart diseases (Angina, coronary artery diseases), Autonomic dysfunction and patient on drugs like Antidepressants, Beta blockers, Alpha 1 blockers, Calcium channel blockers, Angiotensin converting enzyme (ACE) inhibitors, Anticholinesterase are excluded from the study.

Before starting the investigation, the experimental protocol was properly, and carefully explained and informed consent is obtained from each subject.

The subject was asked to sit comfortably, and ECG and sphygmomanometer are connected. Baseline heart rate and B.P. are recorded. The subject was asked to maintain pressure of 30% of maximum activity for 5 minutes. Record heart rate and B.P. change. [13,7]

The diastolic blood pressure response to isometric exercise was calculated as the difference between diastolic blood pressure after a 4-min hand grip at 30% of maximal effort and diastolic blood pressure at rest [14]. Results were entered in excel sheet and t test and p value was calculated.

Results

Table No. 1: Sustain hand grip test for Diastolic BP difference (HGBP)

	Cases		Control	
	Frequency	Percent	Frequency	Percent
Normal	18	66.7	26	96.3
Borderline	1	3.7	0	0
Abnormal	8	29.6	1	3.7
Total	27	100.0	27	100.0
Mean	**15.4**		**19.2**	
SD	5.4		5.1	
T test	2.33			
P Value	0.027			
Significance	Significant			

In Sustain hand grip test (HGBP) in cases 66.7 % (18) were in normal range (>or = 16), 3.7% [1] was borderline (11-15) whereas 29.6% (8) were abnormal (< or = 10). For control 96.3% (26) were in normal range while 3.7% [1] was abnormal.

The mean Sustain hand grip test (HGBP) of cases was 15.4 ± 5.4 and that of control was

19.2 ± 5.1. When unpaired t-test was applied, statistically there was significant difference between the two groups.

Table No. 2: Comparison of sustain hand grip test between cases and control.

Sr. No	Cardiovascular autonomic function test	Cases		Control		t test	p value	Significance
		Mean	SD	Mean	SD			
1	Sustain handgrip test for diastolic B. P. difference	15.4	5.4	19.2	5.1	2.33	0.02	Significant

Bar diagram for sustain hand grip test.
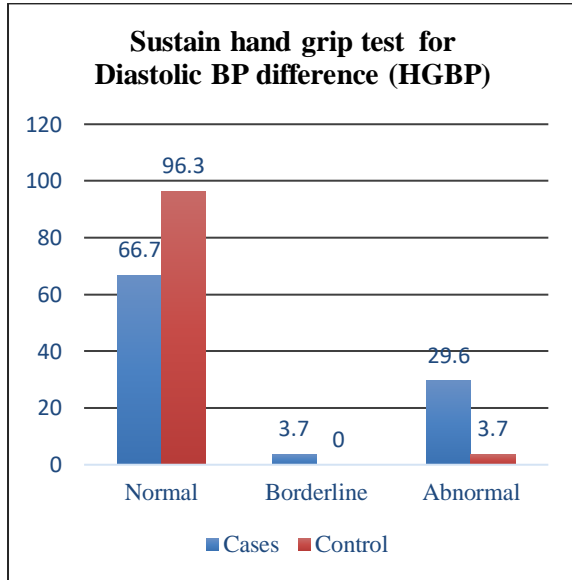
Cardiovascular sympathetic autonomic dysfunction is significantly more in post covid patients than non-covid subjects by evaluating with sustain hand grip cardiovascular autonomic function test.

Discussion

Sustain hand grip test for Diastolic BP difference (HGBP)
We have categorised the result of sustain hand grip test as normal, borderline and abnormal.
According to Ewing and Clark criteria of 1982, in sustain hand grip test Diastolic B.P. difference between isometric contraction state and resting state is measured. The difference is considered normal if difference is ≥16mmHg; borderline if between 15 to 11mmHg and labelled as abnormal if this difference is ≤10 mmHg. [15]
In this study out of 27 cases 18 were normal, (66.7%), while one case was borderline with 3.7% and 8 out of 27 (29.6%) were abnormal having diastolic B.P. difference ≤ 10 mmHg.
The mean of the Cases is 15.4 with standard deviation of 5.4 and that of control is 19.2 with std. deviation of 5.1. Unpaired t- test is applied which gives value of 2.33 and the p -value is

0.027, which is less than 0.05, which shows statistically significant difference between cases and control group.
Ewing et al observed significant correlation between Isometric handgrip test (IHG) and diastolic B.P.(DBP). Ziegles et al evaluate increase plasma Norepinephrine (NE) level with IHG test. In ANS dysfunction this NE level doesn't increase that much. [13]

Pathophysiology of sustain hand grip test.
In this isometric type of exercise, the subject is asked to hold handgrip dynamometer 30% of person's maximum voluntary contraction by dominant hand. B.P. is measured in non-dominant hand. Increase sympathetic outflow and via alpha adrenergic receptors of peripheral ANS there is peripheral vasoconstriction which leads to increase diastolic B.P. as a response to sympathetic reflex.
Any damage to ANS leads to diminish cardiovascular response to sustain handgrip. Such diminished response is seen in our study which is statistically significant in post Covid patient, suggestive of ANS dysfunction in most of the cases. [7]

Limitations of This Test
1. This test requires efforts which is unpleasant to some patients.
2. Encouragement i.e., external mental stimulation requires in case of some subjects to hold dynamometer at fixed value for 5mins.
3. If subject is unable to perform true maximum voluntary contraction false value of diastolic B.P. difference will obtain.

Complications
1. Pain or Paraesthesia in exercising forearm
2. As this test produce increase in heart rate and systemic B.P., it can produce angina or arrhythmias in ischemic heart disease patients.

This test is contraindicated in severe systemic Hypertension, Cardiovascular malformation, Angina, Myocardial Infarction, Arrhythmias.

Conclusion

The present study thereby shows that Covid 19 infection may present with cardiovascular autonomic dysfunction. The CVS autonomic dysfunction leads to reduced changes in heart rate and blood pressure variability in response to isometric exercise in post Covid patients as compared to non-Covid subjects. Blood pressure and heart rate study are important to identify cardiovascular autonomic dysfunction. Sustain hand grip test may be used to evaluate the cardiovascular sympathetic autonomic dysfunction with fair accuracy.

Conflict of Interest: **None**
Source of support: **Nil**
Ethical Clearance: **Obtained**

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