Original Research Article

Musculoskeletal complications of diabetes post COVID-19

Vijay Krishna Kumar A. K.*, Ashwini Ganesan, Suruthi Raju

Department of Physiotherapy, Dr. B. R. Ambedkar Medical College and Hospital, Bangalore, Karnataka, India

*Correspondence:
Dr. Vijay Krishna Kumar A. K.,
E-mail: Vijaysubi14@gmail.com

ABSTRACT

Background: COVID-19 is an emerging disease caused by the severe respiratory syndrome. This affects the respiratory system but directly or indirectly affects the multiple organ system, including the musculoskeletal system. The patients with diabetes who get COVID are at risk of a severe disease course and mortality.

Methods: The study design is Observational study. The study will be conducted on 30patients who have recovered from covid-19 with diabetes mellitus. The samples of the study are selected randomly. The data will be collected in a non-homogenous way, especially regarding lifestyle habits, and severity of the illness. Myalgia was calculated by numerical rating scale, Arthralgia was calculated by visual analog scale, and fatigue was calculated by Chalder fatigue scale to assess the severity of fatigue.

Results: The severity of the complication was decreased in patients with second month COVID-19 recovery than in the first month.

Conclusions: This study concluded that there is decrease in the severity of musculoskeletal complications in diabetic patients from 1st month to 2nd month COVID-19 recoveries.

Keywords: COVID-19, Diabetes mellitus, Musculoskeletal complications, Myalgia, Arthralgia

INTRODUCTION

COVID-19

Coronavirus disease 2019 (COVID-19), the highly contagious infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) Coronaviruses are enveloped, positive single-stranded large RNA viruses that infect humans, and also a wide range of animals.[1-5] The novel coronavirus (severe acute respiratory syndrome; SARS-CoV-2) pandemic has spread rapidly throughout the planet. It is believed to have originated in the Wuhan province of China, but this highly contagious respiratory virus has spread to over 140 countries on 6 continents as of mid-March 2020, according to the world health organization.[2] India is also facing this very tough task for controlling the virus outbreak and has managed its growth rate through some strict measures.[3] Although COVID-19 predominantly affects the respiratory system, evidence indicates a multisystem disease which is frequently severe and often results in death.[4]

Virology

SARS-CoV-2 is strictly related to SARS-CoV-2.[6] It is believed to have a zoonotic origin. Coronavirus genetically clusters with the genus Beta coronavirus, in subgenus Sarbecovirus (lineage B), together with two bat-derived strains. At the whole genome level, it is 96% identical to other bat coronavirus samples (BatCov RaTG13).[6] Similar to other viruses, SARS-CoV-2 infects lung alveolar epithelial cells through receptor-mediated endocytosis via the angiotensin converting enzyme II (ACE2) as an entry receptor.[7] Also, the DPP4 receptor is implicated in viral entry.[8]

Transmission

The disease is believed to spread mainly with close contacts (within 1 to 2 meters), and through small droplets originating by people during sneeze, cough, or talk.[9] The contagion can also occur by first touching a contaminated surface and then touching eyes, nose, or mouth.[9] Virus spread may happen before the symptoms appear, however if the people are symptomatic the virus is most contagious.[10]

Symptoms

Within the subset of patients admitted to hospital, the most common symptoms at onset of illness were fever (90-98%), cough (70-80%), dyspnoea (60-50%) and myalgia or fatigue (4050%). Notably, 20-30% of patients had upper respiratory tract symptoms such as coryza, or gastrointestinal symptoms such as nausea, vomiting, and diarrhoea. Other clinical features included sputum production, headache (8%) and haemoptysis. The median time from onset of symptoms to first hospital admission was 4-8 days. About 20-30% required intensive treatment unit (ITU) admission for respiratory support: 70-80% of patients are male and 30-50% had preexisting comorbidities, such as hypertension (15-25%), diabetes (20-25%), obesity, and cardiovascular diseases (10-15%), or Chronic obstructive pulmonary disease (COPD). Laboratory features include leukopenia (20-40%), lymphopenia (20-45%) and raised aspartate aminotransferase (40%). Abnormalities on computed tomography (CT) of the chest were seen in all patients.[11]

Diagnosis

COVID-19 is currently diagnosed with RT-PCR and has been screened for with CT scans, but each technique has its own drawbacks. There are three issues that have arisen with RT-PCR.[12] First, the availability of PCR reagent kits has not kept up with demand. Second, community hospitals outside of urban cities lack the PCR infrastructure to accommodate high sample throughput. Lastly, RT-PCR relies on the presence of detectable SARS-CoV-2 in the sample collected. If an asymptomatic patient was infected with SARS-CoV-2 but has since recovered, PCR would not identify this prior infection, and control measures would not be enforced. Meanwhile, CT systems are expensive, require technical expertise, and cannot specifically diagnose COVID-19. Other technologies need to be adapted to SARS-CoV-2 to address this deficiencies.[12]

COVID-19 protective measures

COVID-19 spreads primarily from person to person. Fighting this disease is our joint responsibility. Protect yourself and others by making these 6 simple precautions your new habits: clean your hands often, cough or sneeze in your bent elbow-not your hands!, avoid touching your eyes, nose and mouth, limit social gatherings and time spent in crowded places, avoid close contact with someone who is sick and clean and disinfect frequently touched objects and surfaces.[13]
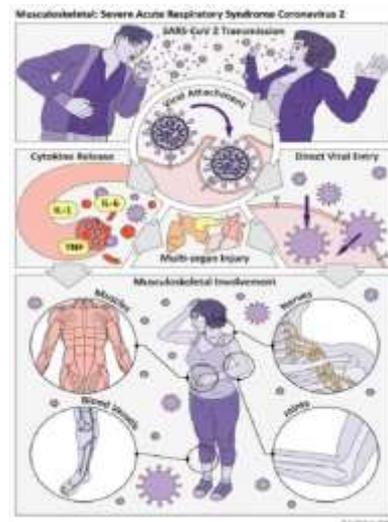

Figure 1: The effects of COVID-19 on the musculoskeletal systems may manifest as, Myalgia.[10]

Risk factors

Older age, cardiovascular disease, diabetes, chronic respiratory disease, hypertension, and cancer were all associated with an increased risk of death.[14]

Diabetes mellitus

Diabetes is a group of metabolic diseases characterized by hyperglycaemia resulting from defects in insulin secretion, insulin action, or both. The chronic hyperglycaemia of diabetes is associated with long-term damage, dysfunction, and failure of different organs, especially the eyes, kidneys, nerves, heart, and blood vessels.[15]

Classification

Diabetes mellitus is a heterogeneous metabolic disorder characterized by the presence of hyperglycaemia due to impairment of insulin secretion, defective insulin action or both. The chronic hyperglycaemia of diabetes is associated with relatively specific long-term microvascular complications affecting the eyes, kidneys and nerves, as well as an increased risk for cardiovascular disease (CVD). The diagnostic criteria for diabetes are based on thresholds of glycaemia that are associated with microvascular disease, especially retinopathy.[16] Type 1 diabetes: encompasses diabetes that is primarily a result of pancreatic beta cell destruction with consequent insulin deficiency, which is prone to ketoacidosis. This form includes cases due to an autoimmune process and those for which the etiology of beta cell destruction is unknown.[16] Type 2 diabetes may range from predominant insulin resistance with relative insulin deficiency to a

predominant secretory defect with insulin resistance. Ketosis is not as common.[16] Gestational diabetes mellitus refers to glucose intolerance with onset or first recognition during pregnancy.[16] Other specific types include a wide variety of relatively uncommon conditions, primarily specific genetically defined forms of diabetes or diabetes associated with other diseases or drug use.[17] The risk of hospitalization if a patient has diabetes and then contracts COVID-19 is three times higher compared with people without diabetes.[18] Furthermore, diabetes is associated with increased lung expression of angiotensin-converting enzyme 2 (ACE2; the receptor by which SARS-CoV-2 seems to infect cells) and increased circulating levels of proteases that facilitate SARS-CoV-2 fusion with host cells, indicating that it may be easier for the virus to infect the lung of a patient with diabetes compared with an individual without diabetes.[19]

Musculoskeletal involvement

The effects of COVID-19 on the musculoskeletal systems may manifest as, Myalgia, muscle weakness, and Arthralgia and fatigue.[20] The total prevalence of fatigue symptoms was 25.6% while, the prevalence of Arthralgia and Myalgia was 15.5%. Interestingly, eight studies have reported a higher prevalence of fatigue in more than 50% of patients.[21] Soft tissue abnormalities such as limb gangrene, COVID-19 toes, hematoma and pressure sores have been described primarily in patients with associated comorbidities such as diabetes.[22]

Objectives

Objectives of current study were to classify the musculoskeletal complications in post COVID-19 patients with diabetes mellitus. It also intended to investigate the severity of Arthralgia, Myalgia and fatigue.

METHODS

Study type, place and duration

Current investigation was a comparative study performed at Dr. Br. Ambedkar medical college and hospital Banglore, Karnataka, India from April 2021 to September 2021.

Inclusion criteria

Inclusion criteria for current study were; age: 30-60 years, gender: male and female and COVID recovered diabetic patients.

Exclusion criteria

Exclusion criteria for current study were; infants and children, comorbidity diseases associated with COVID-19.

Procedure

This was a comparative study carried out at Dr. B. R. Ambedkar medical college and hospital, Bangalore. The main objective was to find the musculoskeletal complications in COVID-19 recovered diabetes patients. The sample size of 40 was taken between age group of 30 to 60 years on the basis of inclusion and exclusion criteria and further divided into A and B consisting of 15 patients each. All patients were concerned prior assessing. Patients data was collected using data collection form in which the myalgia, arthalgia and fatigue were assessed using numerical pain rating scale, visual analogue scale, Chalder fatigue scale respectively. The comparison from 1st to 2nd month was done for post COVID patients with diabetes mellitus. Consent was taken from all participants by sending along the questionnaire through web link and to get response as agree or disagree.

Need of the study

The relationship between COVID-19 and diabetes mellitus is complicated and bidirectional. On the one hand, diabetes mellitus is considered one of the most important risk factors for a severe course of COVID-19. So the need of the study is to find if there are any long term and permanent effect on musculoskeletal system after Covid-19 recovery in diabetes patients.

Data collection tools, data collection and data analysis

Data collection tools used were data collection forms, questionnaire, pen, paper. The collection has been carried out by data collection form and by using various scales: numerical pain rating scale, visual analog scale and Chalder fatigue scale. The questionnaire was designed to collect information whether if there is any musculoskeletal complication in post COVID diabetic patients during the past 2 months of their recovery. Information on individual characteristics demographic data, history of illness, drug history, systemic complications, blood glucose investigations, severity of pain, physical and mental fatigue was collected. These observations have been obtained to identify musculoskeletal complications of diabetes in post COVID patients. Data were analysed using SPSS 24 version.

RESULTS

The aim of the study was to identify the "musculoskeletal complications of diabetes in post COVID patients". Data were numerically coded and analysed the data SSPS 24 version. The investigator collected descriptive data from hospital and calculated as percentages and presented by using bar graph and tabulated in the table, for this study 30 individuals were taken as sample. Descriptive statistics is found using Mean, Standard deviation and frequency percentage. Comparison between 1 month and 2 months was done by unpaired t test. Significant level was set at 5%.

Age distribution

Among the 30 respondent participants, who were all diabetic, 15 participants were selected from 1 month (group A) after recovery and 15 participants were selected from 2 months (group B) after recovery from COVID-19. In group A average age is 47.4±8.304 years and in group B average age is 47.6±6.695 years.

Table 1: Mean and standard deviation of age.

	Group	N	Mean	SD
Age (years)	1 month (group A)	15	47.4	8.3049
	2 months (group B)	15	47.6	6.69541

Gender distribution

Among 30 respondent participants who were all diabetic, in group A (1 month) there were 10 female and 5 male participants and in group B (2 months) there were 5 female and 10 male participants. In group A (1 month) Female percentage is 66.7% and male percentage was 33.3%. In group B (1 month) female percentage is 33.3% and male percentage was 66.7%.

Table 2: Gender distribution.

Gender	Group A N (%)	Group B N (%)	Total N (%)
Female	10 (66.7)	5 (33.3)	15 (100)
Male	5 (33.3)	10 (66.7)	15 (100)
Total	15	15	30

Numerical pain rating scale interpretation

Comparison in NPRS between 1 month and 2 months group was done. In 1 month, group average NPRS is 5.266±1.279 and 2 months is 3.2±0. 941. between group comparison shows $p<0.05$.

Table 3: NPRS mean and standard deviation.

Group		Mean	SD	t value	P value	Result
NPRS	1 month	5.266	1.279	5.038	0	p<0.005
	2 months	3.2	0.941			

Table 4: NPRS interpretation.

Numerical pain rating scale					
		Mild	Moderate	Severe	Total
Group	1 month	0 (0)	13 (86.7)	2 (13.3)	15 (100)
	2 months	10 (66.7)	5 (33.3)	0 (0)	15 (100)
Total		10 (33.3)	18 (60)	2 (6.7)	30 (100)

Table 5: VAS mean and standard deviation.

	Group	Mean	SD	t value	P value	Results
VAS	1 month	5.00	1.414	4.403	0	p<0.05
	2 months	3.00	1.000			

Table 6: VAS interpretation.

Pattern of VAS						
		Mild	Moderate	Severe	Very severe	Total
Group	1 month	0 (0)	6 (40)	7 (46.7)	2 (13.3)	15 (100)
	2 months	10 (66.7)	5 (33.3)	0 (0)	0 (0)	15 (100)
Total		10 (33.3)	11 (36.7)	7 (23.3)	2 (6.7)	30 (100)

Therefore, there is statistically significant difference in NPRS between the groups. In group A (1 month) the patients assessed by numerical pain rating scale and the severity is mild in 0 patient, moderate in 13 patients and severe in 2 patients with the frequency percentage of 0.0%, 86.7% and 13.3% respectively.

In group B (2 months) the patients assessed by numerical pain rating scale and the severity is mild in 10 patients, moderate in 5 patients and severe in 0 patient with the frequency percentage of 66.7%, 33.3% and 0.0% respectively.

Table 7: CFS mean and standard deviation.

	Group	Mean	SD	t value	P value	Results
CFS	1 month	16.200	1.612	8.247	0	p<0.05
	2 months	12.333	0.816			

Table 8: CFS interpretation.

Pattern of CFS				
		More than usual	Much more than usual	Total
Group	1 month	14 (93.3)	1 (6.7)	15 (100)
	2 months	15 (100)	0 (0)	15 (100)
Total		29 (96.7)	1 (3.3)	30 (100)

Visual analog scale interpretation

Comparison in VAS between 1 month and 2 months group was done. In 1 month, group average VAS is 5±1.414 and 2 months is 3±1.0 between group comparison shows p<0.05. Therefore there is statistically significant difference in VAS between the groups. In group A (1 month) the patients assessed by VAS and the severity is mild in 0 patients, moderate in 6 patients, severe in 7 patients and very severe in 2 patients with the frequency percentage of 0.0%, 40.0%, 46.7% and 13.3% respectively. In group B (2 months) the patients assessed by VAS and the severity is mild in 10 patients, moderate in 5 patients, 0 in severe and very severe patients with the frequency percentage of 66.7%, 33.3%, 0.0%, 0.0% respectively.

Chalder fatigue scale

Comparison in CFS between 1 month and 2 months group was done. In 1 month, group average CFS is 16.2±1.612 and 2 months is 12.33±0.816 between group comparison shows p<0.05. Therefore there is statistically significant difference in CFS between the groups. In group A (1 month) the patients assessed by Chalder fatigue scale and the severity is more than usual in 14 patients and much more than usual in 1 patient with the frequency of 93.3% and 6.7% respectively In the group B (2 months) the patients assessed by Chalder fatigue scale and the severity is more than usual in 15 patients and much more than usual in 0 patient with the frequency of 96.7% and 3.3% respectively.

DISSCUSSION

Myalgia reflects generalized inflammation and cytokine response and can be the onset symptom of 36% of patients with COVID-19.[20] Arthralgia is a novel clinical manifestation of COVID-19, and untypical of a viral prodrome or a reactive arthropathy. While musculoskeletal symptoms were not associated with developing a pneumonia.[21] Many recovered patients face persistent physical, cognitive, and psychological symptoms well past the acute phase. Of these symptoms, fatigue is one of the most persistent and debilitatine.[22] All the participants were evaluated with data collection form, NPRS, VAS and Chalder fatigue scale. The assessment is made for patients with 1 month and 2 months of recovery from COVID-19. In this researcher explains the respondent participants about the musculoskeletal complications of diabetes in post COVID-19 patients. Among that the according to age distributions of the sample says mean of age was 47.4 and standard deviation was 8.30490 in 1 month of recovery and the mean of 47.6 and standard distribution was 6.69541 in 2-months of recovery. According to gender distribution, 66.7% were female and 33.3% were male in 1 month of recovery and 33.3% were female and 66.7% were male in 2 months of recovery. IN NPRS interpretation, 0.0% was mild, 86.7% was moderate, 13.3% was severe in 1 month of recovery and 66.7% was mild, 33.3% was moderate, 0.0% in 2 months of recovery. IN VAS interpretation, 0.0% was mild, 40.0% was moderate, 46.7% was severe and 13.3% is very severe in patients with 1 month of recovery, 66.7% is mild, 33.3% was moderate, 0.0% was severe and 0.0% is very severe in patients with 2 months of recovery. IN Chalder fatigue scale, 93.3% was more than usual and 6.7% much more than usual in patients with 1 month of recovery, 100.0% more than usual and 0.0% in much more than usual in patients 2 months of recovery. IN all the above interpretation score is said to be statistically significant if the p-value is less than 0.05If p-value more than 0.05 then it is not statistically significant. So, the conclusion is that there is much complication in the first month of recovery and less in second month of recovery.

Limitations

Limitations of current study were; the study included moderate number of participants and did not include pediatric age group with juvenile diabetes.

CONCLUSION

As per the data analysis and interpretation null hypothesis is rejected and the alternative hypothesis is accepted which states that "there are some musculoskeletal

complications in COVID-19 recovered diabetic patients". The above table shows, the severity of Myalgia, Arthralgia and fatigue in diabetic patient from first month to second month. Hence, the study concluded that there is a significant decrease in the severity of musculoskeletal complications in post COVID-19 diabetic patients from first month to second month.

REFERENCES

1. Gupta R, Hussain A, Misra A. Diabetes and COVID-19: evidence, current status and unanswered research questions. Eur J Clin Nutr. 2020;74(6):864-70.
2. Cron RQ, Chatham WW. The rheumatologist's role in COVID-19. Clin Med. 2020;20(2):124.
3. Gupta R, Pal SK, Pandey G. A comprehensive analysis of COVID-19 outbreak situation in India. MedRxiv. 2020.
4. Barker-Davies RM, O'Sullivan O, Senaratne KP, Baker P, Cranley M, Dharm-Datta S, et al. The Stanford Hall consensus statement for post-COVID-19 rehabilitation. Br J Sports Med. 2020;54(16):949-59.
5. Casella M, Rajnik M, Aleem A, Dulebohn S, Di Napoli R. Features, evaluation, and treatment of coronavirus (COVID-19). Stat Pearls. 2021.
6. Ramani SL, Samet J, Franz CK, Hsieh C, Nguyen CV, Horbinski C, Deshmukh S. Musculoskeletal involvement of COVID-19: review of imaging. Skeletal Radiol. 2021;5:1.
7. Zhou P, Yang XL, Wang XG, Hu B, Zhang L, Zhang W, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature. 2020;579(7798):270-3.
8. Iacobellis G. COVID-19 and diabetes: can DPP4 inhibition play a role?. Diabetes Res Clin Prac. 2020;162.
9. Antonelli A, Elia G, Ferrari SM, Foddis R, De Marco S, Cristaudo A, et al. The COVID-19, epidemiology, clinic and prevention. Curr Genom. 2020;21(3):157.
10. Velavan TP, Meyer CG. The COVID-19 epidemic. Trop Med Int Health. 2020;25(3):278.
11. Lake MA. What we know so far: COVID-19 current clinical knowledge and research. Clin Med. 2020;20(2):124.
12. Udugama B, Kadhiresan P, Kozlowski HN, Malekjahani A, Osborne M, Li VY, et al. Diagnosing COVID-19: the disease and tools for detection. ACS Nano. 2020;14(4):3822-35.
13. Repici A, Aragona G, Cengia G, Cantù P, Spadaccini M, Maselli R, et al. Low risk of covid-19 transmission in GI endoscopy. Gut. 2020;69(11):1925-7.
14. Jordan RE, Adab P, Cheng K. Covid-19: risk factors for severe disease and death. Curr Genom. 2020;12(5):110.
15. American diabetes association. Diagnosis and classification of diabetes mellitus. Diab Care. 2014;37(1):S81-90.
16. Punthakee Z, Goldenberg R, Katz P. Definition, classification and diagnosis of diabetes, prediabetes and metabolic syndrome. Canad J Diab. 2018;42:S10-5.
17. Ramani SL, Samet J, Franz CK, Hsieh C, Nguyen CV, Horbinski C, et al. Musculoskeletal involvement of COVID-19: review of imaging. Skeletal Radiol. 2021;18:1.
18. Giorgino F, Bhana S, Czupryniak L, Dagdelen S, Galstyan GR, Janež A, et al. Management of patients with diabetes and obesity in the COVID-19 era: Experiences and learnings from South and East Europe, the Middle East, and Africa. Diab Res Clin Pract. 2021;5:172.
19. Abdullahi A, Candan SA, Abba MA, Bello AH, Alshehri MA, Afamefuna VE, et al. Neurological and musculoskeletal features of COVID-19: a systematic review and meta-analysis. Front Neurol. 2020;11:687.
20. Vaishya R, Jain VK, Iyengar KP. Musculoskeletal manifestations of COVID-19. J Clin Orthopaed Trauma. 2021.
21. Kucuk A, Cumhur Cure M, Cure E. Can COVID-19 cause myalgia with a completely different mechanism? A hypothesis. Clin Rheumatol. 2020;39:2103-4.
22. Hoong CW, Amin MN, Tan TC, Lee JE. Viral arthralgia a new manifestation of COVID19 infection? A cohort study of COVID-19-associated musculoskeletal symptoms. Int J Infect Dis. 2021;104:363-9.
23. Rudroff T, Fietsam AC, Deters JR, Bryant AD, Kamholz J. Post-covid-19 fatigue: Potential contributing factors. Brain Sci. 2020;10(12):1012.