Musculoskeletal Dysfunctions in IPD COVID Patients - A Prevalence Study and Clinical Perspectives

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ABSTRACT

Introduction: Studies have demonstrated the effectiveness of Prone lying for minimum of 6 hours improves the oxygen saturation of the COVID subjects. But, very few studies have demonstrated the occurring musculoskeletal dysfunctions in subjects with COVID who are admitted in COVID-ICU with regular Physiotherapy following CARP protocol and medical care.

Objective: The study intend to investigate the type, mechanism and pathogenesis of the musculoskeletal dysfunctions which have occurred in the subjects with COVID.

Methods: This was an analytical type of study conducted on 300 COVID positive subjects who were recruited after 7th day of admission in Krishna Hospital, and were divided into two groups. Group A with 3 hour prone lying and Group B with 6 hours prone lying depending on the Physiotherapy intervention given. Structured Orthopedic Manual Therapy Assessment Format was used to analyze the subjects among both the groups for any Musculoskeletal dysfunction they currently possess.

Results: The results of the study showed definite and significant difference in the occurrence of Musculoskeletal dysfunctions in both the groups of 3 hours and 6 hours with outcome measure Structured Orthopedic Manual Therapy Assessment Format; subparameters: pain, tender point and accessory glide: showed the more significant presence in group B (6 Hours) and between-group difference existed with p-value: 0.05. In sub-parameters like: type of pain, Combined movement pattern, Janda's movement pattern, spasm, fascia and muscle mobility and neural tension testing p-value showed: 0.005 and 0.05, 0.05 and 0.05, 0.112 and 0.05, 0.112 and 0.05, 0.05 and 0.05, 0.891 and 0.715 (for ULTT) and 0.815 and 0.521 for LLTT respectively.

Conclusion: Six hours of prone lying in subjects infected with Coronavirus have good outcome concerning Respiratory as well as Cardiac parameters, but, in the present study Group A showed very less amount of Musculoskeletal dysfunction occurrence when compared to Group B. But, further studies are needed to determine whether 3 hours of prone lying if given twice a day, can have any effect on musculoskeletal dysfunction in such subjects.

Key Words: Musculoskeletal, In-patients department, COVID, Mechanism, Pathogenesis, Prevalence

INTRODUCTION

A viral infection which is recently declared global pandemic disease caused by the virus named Corona primarily involves a respiratory system with its main manifestations being interstitial and alveolar pneumonia and thus gradually causing Severe acute respiratory syndrome (SARS).¹ The recent studies have demonstrated that IPD subjects with COVID, have improved concerning respiratory patterns with the help of respiratory Physiotherapy which includes: Chest expansion techniques, Breathing exercises and Positioning (CARP protocol).² Studies have specifically demonstrated that lying

prone for a minimum of 6 hours by COVID subjects have demonstrated maximum improvement in all the respiratory parameters including oxygen saturation.³ Few studies have demonstrated that high flow nasal cannula (High flow nasal oxygen therapy) along with Respiratory Physiotherapy have improved respiratory parameters: especially Oxygen Saturation and early weaning off from ventilator is highly unstable patients.⁴ Though improvement in oxygen saturation level is studied and demonstrated in various articles in subjects with COVID, few studies have also demonstrated the adverse effects of continuous mechanical ventilation of Mus-

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ISSN: 2231-2196 (Print)

ISSN: 0975-5241 (Online)

Received: 20.08.2020

Revised: 15.09.2020

Accepted: 22.10.2020

Published: 24.11.2020

culoskeletal system like Neck muscle weakness, diaphragm weakness, abdominal muscle weakness, gradually leading to Posture changes.⁵

Constant maintenance of a certain Posture leads to shortening of the agonist muscle and lengthening of the antagonist's muscle. If the same posture is maintained through-out the bed rest, then postural muscles may undergo tightness leading to an alteration in posture. Also, Constant posture may lead to the development of Bed-sore called as Pressure Ulcer, which occurs due to repeated bearing of the unvarying load on a certain area without changing in the amount of load borne by it for a certain duration frequently.⁶

The infection per se varies the posture in subjects with COVID, due to pain and breathlessness. Individuals suffering from Corona infection, develop a slouched posture so that the energy consumed to breathe reduces and this position eventually leads to forward headed posture, protracted shoulder, humped upper-back and slouched thorax. Though, the therapies have improved the respiratory parameters, very less focus is given with perspective towards, Musculoskeletal dysfunction occurring in admitted subjects with COVID in IPD. The pain occurring in COVID subjects is assumed to be a multi-factorial disorder having several risk factors contributing to it.⁷

Usually, pain related to Musculoskeletal system in subjects with COVID admitted in ICU may arise due to continuous prone positioning, slouched posture, decreased ability to walk which may lead to hamstring tightness thus progressing towards piriformis tightness and may lead to piriformis syndrome. Though Prone positioning is shown very effective in subjects with Corona infection it may cause several musculoskeletal issues like; Low back pain, sacroiliac joint dysfunction, neck pain, piriformis syndrome. Anatomically speaking, prone positioning also causes compression of the spinal disc posteriorly which may have a compressive effect on the exiting nerve rootlet. If this position is maintained for hours together by geriatric subjects, it may lead to harmful musculoskeletal disadvantage.⁸

Many of the above-mentioned therapies have an indecisive effect on Musculoskeletal system of the IPD admitted subjects with COVID. Very few studies have mentioned or quantified the occurred musculoskeletal dysfunctions in IPD admitted subjects with COVID. Also, the analysis of these subjects on Musculoskeletal dysfunctions with perspective to type, mechanism and pathogenesis was the urge. Hence this study is been undertaken.

MATERIALS AND METHODS

Study Type and Ethical Approval

It is a cross-sectional analytical study conducted on 300 subjects (recruited through non-probability sampling) who were

diagnosed as COVID positive. The study was conducted at Krishna Institute Of Medical Sciences Deemed To Be University, Karad-Maharashtra and Approval of the study was taken by Institutional Ethical Committee with reference number: KIMS/IEC/03/2020.

Participants

All participants were informed about the procedures and the written informed consent form was taken to participate in the study. 300 subjects were recruited in this study comprising of Males and Females Diagnosed with COVID positive and have stayed in ICU setup minimum for 7 days. Inclusion criteria for recruitment were; COVID positive, 7th-day post-ICU admission, both 3-hour prone lying and 6-hour prone lying therapy subjects, both the genders, subjects willing to participate in study and age: above 18 years. Exclusion criteria were: fever, unconscious subjects, subjects with already diagnosed musculoskeletal dysfunction who consented either Physiotherapist or an Orthopedician, subjects with neurological or cardio-respiratory instability, subjects with surgical history, neoplasia, and known case of severe balance issues. Subjects were recruited by convenience sampling. Subjects were recruited based on inclusion and exclusion criteria. The assessment of the subjects was conducted with Structure Orthopedic Manual Therapy assessment format (L-91041/2020). Sample size calculation: was calculated to be 300.

Analytical Procedure

Demographic details like age, gender, height, weight, BMI, were noted. The assessment was done based on Structure Orthopedic Manual Therapy assessment format along with the X-ray taken on the first day of admission and 7th day of ICU admission.

Outcome measures of Structured Orthopedic Manual Therapy Assessment Format

The assessment format assesses the musculoskeletal dysfunctions and also makes an Orthopedic Manual Therapy based diagnosis which will be either secondary or primary to COVID. It provides an objective measure and evaluates the outcome of symptoms of bodily pain over time. The format is a 10 point version with 9 points for assessment and 10th point for diagnostic criteria. The assessment format includes almost all the schools of manual therapy relevant to the non-operated conditions with musculoskeletal problems. The scale was documented with high Cronbach's α coefficient, excellent interclass correlation and good concurrent validity and internal consistency.

Statistical analysis

Data analysis was carried out using SPSS version 16.0. Effect is considered significant when P is less than 0.05.

RESULTS

The study was divided into subjects subjected for 6 hours of prone lying and subjects subjected for 3 hours of prone lying. Demographic data showed no difference among groups hence, the parametric test was used for further analysis of the results with the quantitative and qualitative parameters and Non-parametric test was used to analyze the gender difference between the groups.

Demographic data

The result was analyzed for age and gender (Table no. 1). No significant difference was found between musculoskeletal dysfunction and age & gender showing homogeneity among the sample.

Table 1: Distribution of male and female patients according to age groups

Age group	Male	%	Female	%	Total	%
20-30	5	3.64	3	2.16	8	3.2
30-40	29	18.248	27	18.58	56	18.4
40-50	36	21.89	28	22.12	64	22.00
50-60	37	19.70	35	21.23	72	20.4
60+	50	36.49	50	35.39	100	36.00
Total	157	100	143	100	300	100
Mean Age	60.17		58.81		65.12	
SD Age	5.49		3.02		2.18	

Duration of Prone Lying

A non-parametric test was used for assessment of the association between duration of prone lying and gender. Chi-square test was used to statistically analyze the data (Table 2). Calculated p-value was greater than 0.05, hence no association was found between the groups.

Table 2: Comparison of male and female patients with duration of prone lying (hrs)

Duration of the prone lying position	Male	Female	Total	p-value
3 hours (Group A)	71	79	150	0.150
6 hours (Group B)	75	75	150	0.164
p-value	0.187	0.122	0.514	

Comparison of duration of prone lying in COVID subjects concerning quantitative parameters of structured orthopedic manual therapy assessment format by t-test. Within-group analysis of the subjects in Group A showed statistical significant with p-value 0.05*, but Group B did not show any

significance (Table 3). Also, the between-group analysis showed there existed a difference between both the groups with p-value 0.05* concerning Accessory glides, pain as well as the number of tender points.

Table 3: Comparison of Duration of Prone lying in COVID subjects

Parameter	3 hours	6 hours	p-value
Pain	46.18	10.52	0.001*
Number of Tender points	7.26	5.08	0.05*
Accessory glide assessment			
Temperomandibular joint	2.11	2.18	0.852
Cervical joint	2.12	1.25	0.05
Thoracic joint	3.18	2.54	0.05
Lumbar joint	1.98	1.27	0.05
Sacral joint	1.00	1.08	0.05
Shoulder joint	4.18	4.12	0.741
Elbow joint	4.41	3.18	0.842
Wrist joint	5.12	3.52	0.911
Hip joint	6.00	3.46	0.647
Knee joint	5.21	3.79	0.654
Ankle joint	4.87	4.82	0.236
p-value	0.121	0.05*	

Comparison of duration of prone lying in COVID subjects concerning qualitative parameters of structured orthopedic manual therapy assessment format was done by employing t-test. Within-group, analysis varied with the parameter to which it was assessed concerning the subjects in the group (Table 4). Discussing parameter wise, Group A with 3 hours showed a significant effect on the type of pain, combined movement pattern for cervical and Fascia and muscle mobility were 0.05. Group B with 6-hour prone lying showed a significant effect on the type of pain, combined movement pattern for lumbar, Janda's movement pattern, Spasm and Fascia and muscle mobility with p-value 0.05. Between the group, the analysis showed there existed a difference between both the groups with p-value 0.05* concerning the type of pain, combined movement pattern, Janda's movement pattern assessment, Spasm and Fascia and muscle mobility. But the p-value varied for the sub-parameters as given in the table. In both the analysis that is within and between-group analysis, showed no significant changes in neural tensioning of either upper or lower extremity.

Table 4: Comparison of Duration of Prone lying in COVID

Parameter	Nature	Number of subjects with a positive response		P-value
		3 hours	6 hours	
Type of pain	Sharp stabbing	58	15	0.001*
	Burning pain	45	17	0.001*
	Radiating	10	10	0.124
	Throbbing	20	20	0.001*
	Deep aching	25	80	0.001*
p value		0.05*	0.05*	-----
Combined movement pattern (Spine)	Cervical			
	Arthritic pain	48	75	0.001*
	Muscular pain	25	80	0.001*
	Ligament pain	04	18	0.812
	Nerve pain	00	50	0.541
p value		0.05*	0.178	-----
	Lumbar			
	Arthritic pain	18	70	0.0001*
	Muscular pain	22	85	0.0001*
	Ligament pain	5	30	0.05*
	Nerve pain	5	65	0.001*
p value		0.891	0.05*	-----
Janda's movement pattern	Hip extension	0	80	0.05*
	Hip abduction	0	41	0.05*
	Trunk curl-up	8	38	0.05*
	Cervical flexion	58	15	0.05*
	Push up	12	26	0.912
	Shoulder abduction	22	0	0.05*
p value		0.112	0.05*	-----
Spasm	Neck muscles	43	08	0.05*
	Trapezius	38	12	0.05*
	Thoracic muscles	34	03	0.05*
	Back muscles	07	44	0.001*
	Gluteal muscles	04	32	0.05*
	Piriformis	03	55	0.05*
	Hamstring	01	12	0.754
	Calf	00	4	0.945
p value		0.112	0.05*	-----
Fascia and muscle mobility (Painful is considered 1 and painless 0)	Cervical region	70	37	0.05*
	Thoracic region	31	12	0.0001*
	Lumbar region	05	68	0.0001*
	Gluteal region	02	50	0.05*
	Calf region	00	25	0.05*
p value		0.05*	0.05*	-----
Neural tensioning (Positive=1 and Negative=0)	ULTT			
	Median	55	25	0.874
	Radial	36	20	0.174
	Ulnar	24	20	0.891
	p-value	0.189	0.745	
	LLTT			
	Sciatic	20	55	0.845
	Obturator	12	12	0.975
	Common peroneal	10	18	0.842
	Femoral	08	57	0.789
	p-value	0.815	0.527	-----

DISCUSSION

Theories and studies so far, have focused on improvement in respiratory and cardiac parameters in subjects with COVID post their admission in Intensive Care Unit along with Regular Chest Physiotherapy, followed by CARP protocol and Medical Care. The medical care consisted of Drug therapy along with either High Flow Nasal Cannula or Mechanical Ventilation. Studies have demonstrated that Continuous Mechanical Ventilation therapy causes weakness of Diaphragm, neck muscles especially the flexors (muscles used for breathing), thus causing ventilatory dependency.⁵ The biomechanical theory suggests that the weakness of one group of muscles leads to overactivity of others. Considering this point noted in the Biomechanical concepts, weakness of flexor aspect of the neck may have activated the extensor muscles overly such that it led to the development of Myofascial trigger points and spasm of neck extensors as seen in the present study.⁹ Hence the present study follows the principle of the biomechanical concept of weakening and tightening of the opposite group of muscles. Also, due to this kind of changes in the muscular chain of agonist as well as antagonist, there occurs irregular or abnormal Janda's movement Pattern as well as Muscle spasm in longer Prone positioning as seen in the present study.

The present study divided the subjects into two groups for the assessment of the Musculoskeletal dysfunction occurring in COVID subjects concerning CARP protocol followed in ICU setup. The groups were divided concerning 3 hours and 6 hours prone lying positioning under CARP protocol. According to various prevalence study related to low back pain and neck pain, provide the data suggesting monotonous work, constant maintenance of the same posture, repeated similar movements are the causative factors for the dysfunction in Spine¹⁰. Taking a similar concept into consideration, lying for 3 hours and 6 hours in the respective groups may have caused intervertebral mobility restriction. Also, according to the principle of Mackenzie diagnosis, the faulty position maintenance caused, the subjects to develop positional faults of the vertebrae. Also, the theory suggests that longer the duration of faulty position, more the dysfunctions seen.¹¹ On similar grounds, in the present study, subjects with 6 hours of prone lying have reduced intervertebral mobility rather than 3 hours.

Studies suggest that, as age increases, the musculoskeletal system gets weakened concerning bone density and muscular weakness.¹² In the present study, maximum recruited subjects were above 60 + who are generally more prone to COVID attack. Also, 60+ adults have maximum degeneration in the joints leading to arthritic changes with the cause being occupation-related or sedentary lifestyle. If such asymptomatic subjects with degeneration are placed in the prone position for a prolonged period, it will cause symptom-related pain

in the spine. Hence in correlation to this in the present study, the subjects showed similar pain in arthritic condition as well as deep ache which is due to a muscular cause occurring as a fact of bony changes in geriatric. In the present study, Group A showed more significance towards Cervical arthritic pain and Group B showed more significance towards Lumbar arthritic pain.

Both the 3 hours and 6 hours of Prone lying position were taken into consideration in the present study which is already demonstrated to be significant in improving respiratory and cardiac parameters in subjects with COVID. Musculoskeletal changes occurred in subjects with COVID Specifically concerning prone lying position for 3 hours and 6 hours was dealt with in the study by using Structured Orthopedic Manual Therapy Assessment Pro-forma to both the groups. Thus, the study showed, 6 hours of prone lying was more significant in both qualitative and Quantitative parameters suggesting disadvantageous to the subjects. Rather, 3 hours showed lesser symptoms concerning the assessment format. However, bone densitometry should have been considered in the study to deal with the changes in Bone density in subjects with COVID.

CONCLUSION

Detailed History of the subjects while initial examination and before enforcing them into CARP protocol is mandatory. Geriatric subjects are more targeted in COVID attack as well as to the age-related Musculoskeletal changes, hence they should be examined in more detail for musculoskeletal changes that have already occurred through asymptomatic. The present study demonstrated that maximum pain and reduction in intervertebral mobility, as well as muscular changes, is majorly due to age-related changes. This was more evidently seen in Group B with 6 hours of prone lying. Some symptoms were seen in 3 hours of prone lying as well, but 6 hours of prone lying was more significant. Thus, the present study concludes that, before imposing the CARP protocol, Physiotherapist must assess and examine the subjects with COVID for any musculoskeletal changes that have already occurred through asymptomatic, as Prone lying a part of CARP protocol may induce or aggravate more changes leading to the biomechanical disadvantage of the subjects which may cause future disability in performing activities of daily life. Future study can be performed to analyze the musculoskeletal changes occurring in subjects with COVID and treat them accordingly. Also, the study can be used to analyze the bone density changes in subjects with COVID.

ACKNOWLEDGEMENT

I would like to thank all the people who have directly or indirectly contributed and helped me to conduct this research.

I would also thank Krishna institute of medical sciences who funded this project and helped me by all possible means.

Conflict of Interest: None

Funding: Self-funding

REFERENCES

1. Rothan H and Byrareddy S. The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. *J Autoimmun* 2020;109:1-4.
2. Lazzeri M, Lanza A, Bellinin R, Bellfiore A, Cecchetto S, Colombo A, et al. Respiratory Physiotherapy in Patients with COVID-19 Infection in Acute setting: A position paper of the Italian association of respiratory physiotherapists (ARIR). *Monaldi Arch Chest Dis* 2020 26;90(1):2185.
3. Thompson A, Ranard B, Wei Y, Jelic S. Prone position in awake, Nonintubated patients with COVID-19 Hypoxaemic Respiratory failure. *JAMA Intern Med* 2020; 180(11): 1537–1539.
4. Li J, Fink JB, Ehrmann S. High flow nasal cannula for COVID-19 patients: low risk of bio-aerosol dispersion. *Eur Respir J*. 2020;55(5):2000892.
5. Tobin M, Laghi F, Jurban A. Ventilator-induced muscle weakness. *Ann Intern Med* 2010;153(4):240-245.
6. Kilroy N, Dockrell S. Ergonomic intervention: its effects on working posture and musculoskeletal symptoms in female biomedical scientists. *Br J Biomed Sci* 2000;57(3):199-206.
7. Ariens GA, van Mechelen W, Bongers PM, Bouter LM, van der Wal G. Physical risk factors for neck pain. *Scand J Work Environ Health* 2000;26(1):7-19.
8. Arab A, Talimkhani A, Karimi N, Ehsani F. Changes in Lumbar lordosis during prone lying knee flexion test in subjects with and without low back pain. *Chiropr Man Therap* 2015;23(18):1-5.
9. Newell KM, Emmerik R. Biomechanical constraints and action theory. *Human Move Sci* 1989;8:403-409.
10. Metgud S, Chintamani R, Heggannavr A. Effect of Work-Related and Non-Work Related, Individual, and Psychosocial, Risk Factors on Neck Pain Among Office Computer Workers: A Cross-Sectional Study. *AJMR* 2017;2(6): 8-21.
11. Nowonty J, Nowonty-Czupryna O, Brzek A, Kowalczyk A, Czupryna K. Body posture and Syndromes of Back Pain. *Ortop Traumatol Rehabil* 2011;13(1):59-71.
12. Nolan M, Nitz J, Choy N, Illing S. Age-related changes in musculoskeletal function, sbalance and mobility measures in men aged 30-80 years. *Aging Male* 2010;1-8. DOI:10.3109/13685531003657818.