A Scoping Review of the Unique Role of Physical Therapy in Cardiovascular COVID-19 Management

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INTRODUCTION

Long-standing research has shown positive outcomes associated with physical therapy (PT) intervention and the cardiovascular (CV) system. Through patient (pt) education, aerobic and resistance training, and early mobilization, pts demonstrate decreased hospital readmission and secondary complications.

In December 2019, COVID-19 spread rapidly around the world. Despite many published studies outlining the major effects of COVID-19 on the CV system, there are no studies pertaining specifically to PT treatment (tx) aimed at the CV system.

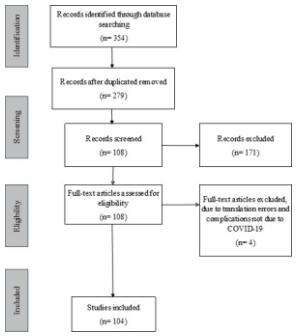
AIM

This scoping review aimed to identify gaps in research related to COVID-19 complications and the CV system in order to make recommendations for the treating PT and interdisciplinary team.

METHODS

Two electronic database searches were conducted to gather the studies for this scoping review between October 2019 and February 2021. The databases included LitCovid, PubMed, and Google Scholar. Inclusion criteria were limited to studies that specifically discussed how COVID-19 may affect the CV system. Publications following the year 2019 were included to ensure accuracy of research specific to COVID-19 strain. Given the novelty of the virus and research associated, all publications were included. Publications evaluating PT modalities for CV complications were limited to original research that specifically discussed sequelae similar to complications seen thus far due to COVID-19. Articles following the year 2015 were included to ensure up-to-date research. The PRISMA chart for the COVID-19 article search can be found in Figure 1.

Figure 1



RESULTS

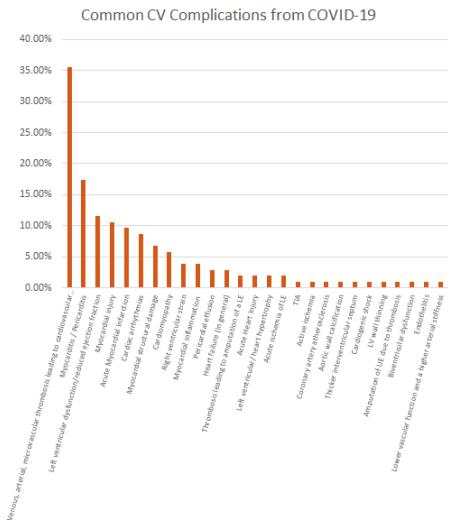
COVID-19 Effects on the Cardiovascular System

SARS-CoV-2, the virus causing COVID-19 in humans, enters the body through droplet transmission and affects host cells through the angiotensin-converting enzyme 2 (ACE2) receptors. This method of infection is well established and was mentioned in 38% of articles pertaining to COVID-19. 18% of articles highlight how COVID-19 can create a severe inflammatory cascade and cytokine storm, as noted by increased troponin, ferritin, and C-reactive protein levels. This can lead to acute respiratory distress syndrome (ARDS), as noted in 11% of the articles. COVID-19 can also result in venous, arterial, or microvascular thrombosis, with elevated D-dimer levels, mentioned in 10% of searched articles. 6% of articles in this literature search noted abnormal ECG findings, expression of the TMPRSS2 enzyme, and endothelial inflammation. Finally, approximately 2% of articles mentioned cardiogenic shock, cytokine release syndrome, and direct injury to endothelial cells from the virus resulting in vascular damage.

Cardiovascular Complications Associated with COVID-19

COVID-19 can lead to numerous CV complications. Figure 2 illustrates the prevalence, in percentage, of specific CV complications that were discussed in the literature search to gain insight into what has been commonly seen. First, 36% of the articles described venous, arterial, or microvascular thrombosis as a CV complication associated with COVID-19. This was the most common CV sequelae in the literature search. 17% of the articles mentioned COVID-19 can lead to myocarditis or pericarditis. 12% of the articles described left ventricular dysfunction and associated reduced ejection fraction. Myocardial injury was cited in 11% of the articles. Acute myocardial infarction was mentioned in 10% of the articles. The complication of cardiac arrhythmias associated with a COVID-19 diagnosis was mentioned in 9% of articles. Some common arrhythmias included atrial fibrillation, bradyarrhythmia, non-sustained ventricular tachycardias and ultimately cardiac arrest due to ventricular fibrillation. Similarly, myocardial structural damage was cited in about 7% of the articles and cardiomyopathy in 6% of articles. Right ventricular strain and myocardial inflammation were each cited in 4% of the articles. Pericardial effusion and heart failure in general, were mentioned in 3% of the articles. Next, acute ischemia of a lower extremity, thrombosis leading to amputation of a lower extremity, acute heart injury, and left ventricular or heart hypertrophy were mentioned in 2% of literature search.

Figure 2



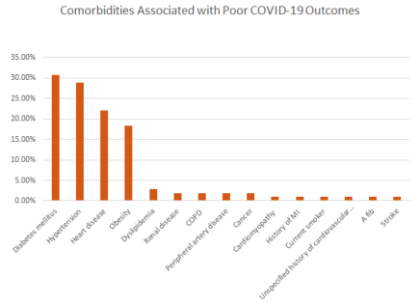
Comorbidities and COVID-19 Outcomes

This scoping review revealed four primary comorbidities related to poor COVID-19 outcomes: diabetes mellitus, hypertension (defined as systolic ≥ 130 and/or diastolic ≥ 85 mmHg), heart disease (defined as history of ischemic heart disease, at least moderate heart valve disease, or left ventricular dysfunction), and obesity (defined as BMI of 30 or greater).

Comorbidities such as dyslipidemia, renal disease, COPD, peripheral artery disease, and many others were also mentioned in the articles as being linked to an overall poor prognosis after being diagnosed with COVID-19.

The full list and prevalence of mentioned comorbidities can be found in Figure 3.

Figure 3



CONCLUSION

Physical Therapy and COVID-19 Treatment

The specific pathophysiology of COVID-19 lends to distinct considerations that must be taken into account by rehabilitation professionals. SARS-CoV-2 enters lung cells via the ACE2 receptor; this receptor is also found in many organs, thus creating an inflammatory cascade and cytokine storm causing multi-system involvement. Increased troponin, ferritin, C-reactive protein levels coupled with a suppressed immune response creates an ideal environment for severe oxygen supply-demand imbalance. It is well established that physical activity is beneficial for pts with CV complications not related to COVID-19. In fact, physical activity after CV events can promote protection against future complications. Research has found that pt education, aerobic exercise, resistance training, inspiratory muscle training, and airway clearance techniques are all supported as interventions to be implemented across the continuum of care. However, conventional tx techniques and timeline may not be applicable in COVID-19 populations based on the known hyperinflammatory, fluctuating state of the illness. Intermittent, low intensity, and carefully graded tx may benefit pts throughout their early rehabilitation journey. Further, formal exercise testing, spirometry, specific outcome measure assessment (6-minute walk, 2-minute step test, 30 second chair rise) may benefit PT assessment in outpatient settings to delineate long-term effects on the CV system.

The Role of Physical Therapy and Prevention of Comorbidities

The specific comorbidities associated with poor COVID-19 outcomes and death are largely preventable or managed conservatively with physical activity. Therefore, PTs can and should intervene prophylactically through exercise prescription, pt education, health and wellness promotion, and interdisciplinary care with other professionals such as occupational and speech therapy, nursing, dietitians, athletic trainers, psychology, etc.

Conclusion

COVID-19 can cause CV complications which significantly affects pt morbidity and mortality. PTs play a vital role in management of pts with COVID-19 from the intensive care unit to outpatient environments and must take the viral pathophysiology into consideration to avoid exacerbation of symptoms and promote safe mobility. PT also plays a direct role in prevention of mentioned comorbidities through skilled exercise progression and health promotion. Further research is warranted to guide clinical practice for better outcomes.

References

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*For exhaustive list of references please contact: andc2847@uwm.edu