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Case Report

A Case Reporting the Neuro-Rehabilitation of a Patient with Bilateral Multi-Level Lower Extremity Arterial Thrombosis Post COVID -19

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Abstract

Background: The novel coronavirus (COVID-19 or SARS CoV2) appears to be associated with the risk of thrombosis which is a common consequence of a variety of medical and surgical disorders. These sequelae suggest the presence of coagulopathy induced by COVID-19 infection. ***Case Report:*** We present the case of a 63-year-old woman who developed lower limb weakness after undergoing revascularization surgery for multi-level femoral artery thrombosis as a result of SARS-CoV2. After recovery from COVID-19 infection, the patient developed bilateral lower-extremity pain and paralysis. Doppler ultrasound revealed bilateral superficial femoral artery thrombosis, which was later confirmed by angiography. The patient further developed critical limb ischemia and underwent revascularization surgery. Post surgery, patient was unable to ambulate due to marked weakness and sensory deficits in lower extremities. An evidence-based physiotherapy exercise regime was planned for this patient and was followed up for a period of three months. The functional recovery of the patient was documented using two-minute walk test (2 MWT), berg balance scale (BBS) and manual muscle testing of hip, knee and ankle. ***Results and conclusion:*** Early tailor-made neuro-rehabilitation plays a significant role in improving the functional status of patients with bilateral lower limb arterial thrombosis post COVID-19.

Keywords: ***Neuro-rehabilitation, COVID-19, Physiotherapy, SARS-CoV2, Thrombosis.***

Introduction

The novel corona virus (COVID-19 or SARS-CoV2) originated in December 2019 and led to its spread across the globe and wreaked havoc in the healthcare system. In the initial cases of infection, the virus was primarily seen to affect the cardio-pulmonary system. Due to this reason, before the virus was identified, the initial infections were described as 'pneumonia of unknown cause'. The common presenting symptoms included low-grade fever, dry cough, sore throat and breathlessness. However, as time elapsed, COVID-19 has been linked to a variety of organ-specific and systemic phenotypes [1]. Extensive research is currently targeted on the understanding of the different mechanisms by which the virus affects the human body. The cardio-pulmonary, integumentary, gastro-intestinal and neurological manifestations of COVID-19 have been widely reported so far.

In the initial phases of the pandemic, not much was known about how COVID-19 is associated with haematological sequelae. However, as some similar cases were documented in different parts of the world, some insights can be drawn to understand the possible mechanisms behind this. The entry of SARS COV2 virus into the cell is mediated by ACE-2 receptors. Extensive viral load in the body disrupts the inflammatory and coagulation pathways [2]. This deregulation produces hyper-coagulable state in the host body characterised by mild thrombocytopenia, prolongation of pro-thrombin time, activated partial pro-thrombin time (APTT), elevated D-dimer levels and elevated clotting factors [2]. As a result, the individual is rendered more prone for developing arterial and venous thrombosis. Critical limb ischemia is another rare complication associated with arterial or venous thrombo-embolism in COVID-19 infection [3]. We represent a case of bilateral lower extremity arterial thrombosis post COVID -19 patient receiving physiotherapy.

Case Description

A 63-year old female presented with influenza-like symptoms of fever, cough and body-ache for three days and tested positive for COVID-19. The symptoms rapidly worsened and the patient got admitted to the ICU for respiratory distress. She was closely observed and treated with antiviral medications (lopinavir 400 mg by mouth every 12 hours), along with 5-day course of anti-malarial drug (hydroxyl-chloroquine two doses of 400 mg by mouth every 12 hours, followed by 200 mg by mouth every 12 hours). After 15-days of hospitalisation, the patient was discharged and sent home with medications. The patient was apparently well for a few days following discharge when the patient suddenly developed bilateral lower extremity weakness on the morning of 4th September 2021 at 10:30 a.m. The weakness rendered the patient unable to move the lower extremities. On initial evaluation, peripheral pulses of bilateral lower extremity were not palpable such as the dorsalis pedis artery, popliteal artery and the femoral artery. The preliminary investigations have been listed in Table 1.

Table 1: Investigations

Investigation	Interpretation
Haematological Reports	Moderate anaemia (Haemoglobin:8.1gm/dL) Leucocytosis (11.5 X 10^{9}L) Thrombocytopenia (26 X 10^{9}/L) Coagulopathy (elevated INR 1.43) C-reactive protein (57 U/L) Partial Thromboplastin Time with Kaolin (PTTK) (41.0 seconds)
High resolution CT Chest	Ground glass opacities
RT-PCR COVID-19 test	Positive
Doppler Ultrasound	bilateral lateral femoral artery thrombosis, superficial femoral artery and popliteal artery occlusion
Ultrasound abdomen and pelvis	Thrombosis involving the aorta
CT aortic angiography	Total infra-renal abdominal aorta thrombosis extending to bilateral common iliac arteries, bilateral internal iliac arteries and bilateral proximal external iliac arteries. Eccentric non-occlusive thrombus was seen along the right lateral wall of the distal part of ascending aorta
Echo-cardiograph	Mild left ventricular dysfunction, mild mitral regurgitation.

Surgical Treatment: After the diagnosis of multilevel arterial thrombosis (**Figure 1**), left and right femoral endovascular endarterectomy was performed as an emergency procedure for salvaging the lower extremity. In the follow-up surgery, thrombectomy and bilateral femoral artery stenting were done. The patient was put on intravenous anticoagulant therapy using the fondaparinux drug (500 mg OD) and other medication such as faropenem (200 mg BD), clindamycin (600 mg BD), aspirin (150 mg OD). After restoration of the blood flow to the lower extremities, the patient was discharged from the hospital after 8 days. The patient was advised a strict home quarantine for a period of 15 days after discharge from the hospital.

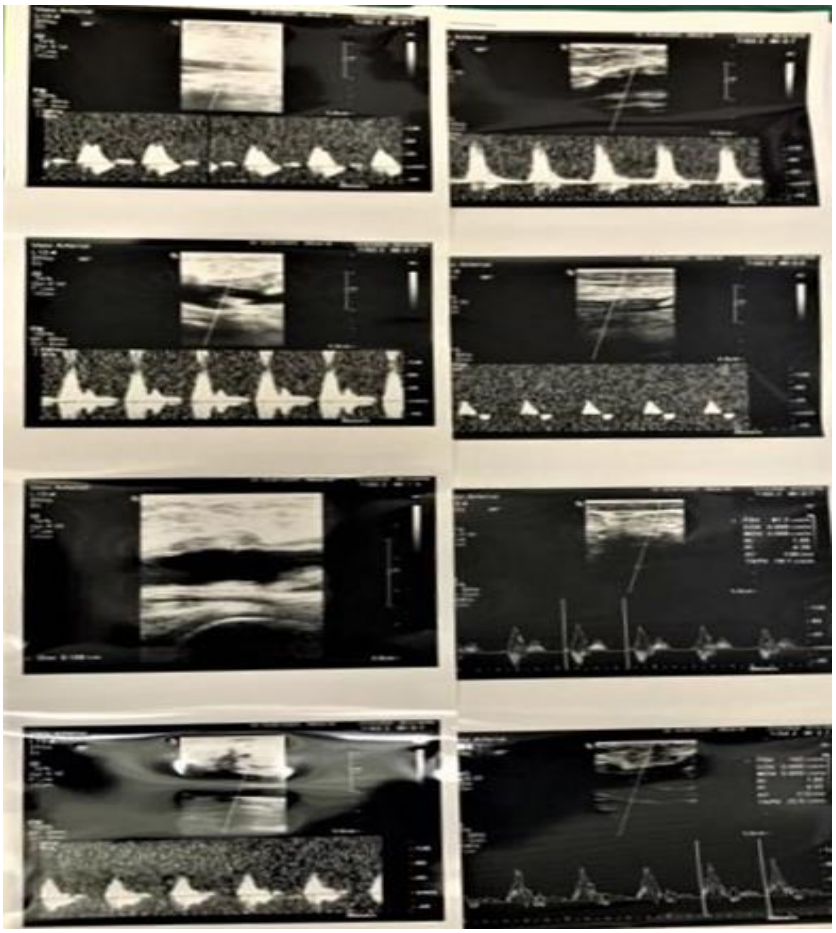

Figure 1: Doppler Ultrasound

Physiotherapy assessment and intervention

During physiotherapy examination, the built of the patient was mesomorphic, sitting posture was stooping forwards and the patient used cane for ambulation, which could be attributed to her posture. The pattern of movement was normal and no muscle wasting was seen. Muscle tone was grade 1 as per by Modified Ashworth Scale, pitting oedema was seen over the dorsum of foot and behind the medial malleolus in bilateral foot. The higher mental function was intact as measured by Mini mental state examination. Mild tightness was documented in iliopsoas, hamstrings and calf muscles. Evaluation of the cardiovascular system revealed MRC grade 3 dyspnoea (at rest). After the thorough assessment of the patient, a tailor-made treatment regime was designed for her who would cater to her specific needs (Table 2). The early rehabilitation planned for this patient was evidence based and formulated after extensive literature research on critical limb ischemia and peripheral arterial disease [4-8].

Table 2: Intervention Plan

Intervention Program	Dosage
Week 1-2	
1. Counselling of the patient regarding her disease and the outcomes to expect after physiotherapy	
2. Active knee extensions and curls in supine and in sitting,	20 eps 2 sets
3. Isometrics for quadriceps, hamstrings, adductor and abductors	20 eps each, 2 sets, 45 sec hold.
4. Ankle toe movements	40 reps 2 sets each side
5. Compression bandaging was applied at the beginning of and after therapy session, where it was re-applied for 7 days	
Week 3-4	
6. Active knee extensions and curls in sitting with 0.5 kg weight Active knee extensions and curls in sitting without weight Ankle toe movements	20 reps 2 sets 20 reps 2 sets 40 eps 2 sets each side
7. Lower limb ergometer	7-10 inutes at minimum resistance
8 TENS on the triceps surae	10-Hz frequency, pulses (200 μs), intensity as tolerated by the patient X 10 minutes
Week 4-6	
9 Same protocol as for week 3-4 in addition with the following	
10 Electrical stimulation of tibialis anterior with active dorsiflexion	90 contracts 5 sets
11 Task-oriented activities for lower limb- Reach outs, Stepping, Kicking, Sit to stand,	20 reps 2 sets 10 reps 1 set 10 reps 2 sets 5 reps 2 sets
Week 6-8	
12 For trunk control PNF alternating isometrics Bridging Rolling activities on plinth Diagonal trunk curl	20 reps 3 sets 10 reps 3 sets 10 reps 5 sets 20 reps 1 set
13 Walking with ball catching, waling on a ramp with ball catching, Stair climbing with ball catching.	20 reps 2 sets 10 reps 2 set 10 reps 1 set
14 Tandem Walking with one hand support Side walking Standing on Bosu Ball Single leg standing Walking on toes and heels	20 metres 3 sets 20 metres 3 sets 40 secs 5 reps 20 secs 20 metres 3 sets x 2
15 Rood's Approach for sensory rehab: Brushing, Hot-and-cold alternate stroking, Distal Joint compressions	
Week 8-12	
16 Home protocol given to the patient including the above mentioned exercises to be done under supervision. 17 Stair climbing	5 steps up and down- 5 sets.

Results

In this study, we present a patient-centered exercise programme that is supervised by rehabilitation professionals. In the post-acute phase of limb ischemia, after COVID-19 infection, physical rehabilitation plays a crucial role. We intend to bring this subject to the reader's attention.

We evaluated the patient's mobility, balance, and strength before beginning the exercise programme (baseline) and three months after starting the programme to determine the efficacy of the exercise regimen. Table 3 of the publication includes a specific presentation of the results. Due to the dearth of studies on the best types and intensities of exercise for individuals with limb ischemia, choosing the right rehabilitation programme for the patients might be challenging. The fact that we present specific information regarding the dosage of the workouts, including the total number of repetitions, sets, and duration, is a major strength of this case study.

It is significant to remember that the patient's specific needs and physical capabilities required that the intensity, frequency, and dosage of the exercises performed in this situation be adjusted periodically. These changes were made in response to the patient's progressive improvements. Overall, by providing a patient-centered exercise programme for those with limb ischemia after COVID-19, our study advances the field. Although further research is needed to establish standardized guidelines, this case study offers valuable insights into the potential benefits of supervised exercise in this context.

Table 3: Outcome Measures (*Berg balance Scale, †Timed up & go, ‡2 Minute walk test, §Manual muscle testing)

	Outcome Measures				
	BBS*	**TUG† test**	**2 MWT‡**	**MMT § (Hip)**	**MMT§ (Knee)**
Pre-intervention	39.0	28 sec	4.0 meter	3-(L) 3 (R)	3- (L) 3 (R)
Post-intervention	49.0	17 sec	5.5 meter	4+(L) 4+(R)	4+(L) 4+(R)

Discussion

Coagulopathies associated with COVID-19 is a very severe sequelae of the disease and is associated with poor prognosis of the patient. This may manifest in the form of arterial or venous thrombosis [3]. The exact mechanism behind the coagulopathy associated with COVID-19 is not very clearly understood. One of the possible mechanisms suggests the exaggerated inflammatory responses that lead to cytokine storm, complement activation and endothelial damage to be the culprit [3,9]. Prolonged immobilization, mechanical ventilation, and nutritional deficiencies also contribute to hypercoagulable states in the patient [9].

The SARS COV2 virus is known to directly attack the endothelial cells causing endothelial damage [9]. This damage to the endothelium renders it prone to lodgement of the thrombus which is formed as a result of inflammatory and pro-thrombotic events in the bloodstream of the patient [9,10]. Venous thrombo-embolism related to COVID-19 is more frequently reported whereas multi-level arterial thrombo-embolism is not a very common occurrence [3]. The case we reported is that of a patient who presented with acute limb ischemia in bilateral lower extremity as a sequelae of COVID-19 with an extensive multi-level thrombosis at the level of infra-renal abdominal aorta extending to the arteries of bilateral lower extremity.

The patient presented to the emergency department with the classical symptoms of pain, paralysis and paraesthesia over bilateral lower extremity. Pallor and absent pulse were noted by doctors on duty [11]. Immediate endovascular thrombectomy was performed which was followed up by surgical revascularization procedure by bilateral femoral artery stenting. Even after revascularization, due to the ischemic injury, the weakness tends to persist and may or may not be accompanied by claudication [12]. Therefore, for rehabilitation of this patient, a tailor-made physiotherapy exercise program was warranted. The core of this protocol was evidence-based from the literature available on Peripheral artery disease and critical limb ischemia [4-8]. However, this case was one of its kinds since this was sequelae to COVID-19.

According to Emma Kate Zadow, et al (2021), mild to moderate intensity of exercise has positive effects on the biochemical markers of coagulopathy in patients with COVID-19 [13]. Moderate intensity exercise is associated with an increase in the ability to activate the fibrinolytic system by augmenting the tissue plasminogen activator (tPA). It is also correlated with von Willebrand's factor's activity and concentration in the blood. Insufficient physical activity is in fact considered as a risk factor for comorbidities such as coagulopathies post COVID-19.

According to Dhamija RK, 2021, neuro-rehabilitation plays a key role in the functional recovery of patients recovering from COVID-19 [14]. According to Ani Nalbandian, et al (2021), physical activity should be prescribed to COVID-19 patient as soon as they can tolerate it. The findings of our study coincide with the findings of Emma Kate Zadow, et al (2021) and Ani Nalbandian, et al (2021) wherein tailor made physiotherapy protocol including mild to moderate intensity exercises improved the prognosis of the patient [15]. Thus, it is recommended that physiotherapy should be incorporated in the treatment of post COVID- 19 patients with lower limb thrombosis. However, further studies are needed to understand the efficacy of rehabilitation in this context.

Conclusion

COVID-19 associated coagulopathy may present as venous or arterial thrombo-embolism.. In case of an extensive arterial thrombosis, surgical revascularization is warranted. However, physiotherapy plays a key role in rehabilitating the patients after surgical revascularization and gets them back to their normal lives. This case report brings forth the importance of tailor-made physiotherapy rehabilitation protocol for patients with critical limb ischemia. This case report also intends to highlight the role of physiotherapists in the time of COVID-19 pandemic along with additional psychological, medical and emotional support as part of a multidisciplinary approach.

Ethics Statement

The ethical standards and recommendations provided by the Declaration of Helsinki are followed in this case study. The rights, dignity, and welfare of the subject have all been given the utmost care during the study's conduct. Informed consent was sought from the participant, ensuring that they were completely aware of the nature, purpose, and potential risks or advantages of being a part of this case study. The participant's sensitive and private information has been handled with the utmost discretion. No personally identifiable information will be disclosed without explicit permission from the participants.

Data Access Statement

Access to the data in this case report is restricted to authorized personnel in compliance with our institution's privacy and confidentiality policies. Requests for data access should be directed to the corresponding author and will be subject to approval by the relevant ethics committee. De-identified data may be made available for scientific or academic purposes, ensuring adherence to research integrity and ethical guidelines. For further information, please contact the corresponding author.

Conflicts of Interest

The authors of no conflicts of interest.

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