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CASE REPORT

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Effect of multimodal physiotherapy intervention on cardiopulmonary parameters, CD4 cell count, functional aerobic capacity, fatigue severity and quality of life in person living with HIV: A case report

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ABSTRACT

Human Immunodeficiency Virus (HIV) is associated with reduced cardiopulmonary fitness, fatigue, and compromised quality of life. Physiotherapy-based exercise intervention may help address these functional impairments. The case report describes changes following a multimodal physiotherapy intervention in a 21-year-old male with a 4-year history of HIV infection. The patient participated in a structured intervention for 16 weeks, consisting of 60-80 minutes session, 5 days per week. The program included aerobic exercises, resistance training using TheraBand, breathing exercises, and stretching. Cardiopulmonary parameters including Heart Rate (HR), Respiratory Rate (RR), peripheral oxygen saturation (SpO_2), along with the 6-Minute Walk Test (6MWT), Fatigue Severity Scale (FSS), SF-36 questionnaire, and CD4 cell count, were assessed before and after intervention. Following 16 weeks of intervention, 6MWD increased from 330 m to 420 m, while estimated VO_2max increased from 10.58 to 12.38 ml/kg/min. Resting heart rate decreased from 108 to 98 beats/min, whereas respiratory rate changed from 15 to 16 breaths/min and SpO_2 remained at 99%. FSS score decreased from 48/63 to 32/63. Improvements were also observed across multiple SF-36 domains. CD4 cell count increased from 412 to 478 cells/mm^3. The observed changes following the multimodal physiotherapy intervention suggest potential benefits for functional capacity, fatigue, cardiopulmonary status, and quality of life in this individual.

KEYWORDS

CD4 Cell Count, HIV, Multimodal rehabilitation, Cardiopulmonary parameters, Physiotherapy

ARTICLE HISTORY

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Introduction

HIV is a chronic infectious disease characterized by progressive immune suppression, primarily reflected by a decline in CD4+ T-lymphocyte count [1]. Despite significant advancements in Antiretroviral Therapy (ART), individuals living with HIV continue to experience systemic complications such as reduced cardiopulmonary fitness, muscle weakness, fatigue, and impaired quality of life [2,3].

Chronic inflammation, physical inactivity, and long-term disease burden contribute to decreased functional capacity and exercise intolerance in this population [4]. These factors further limit participation in daily activities and increase the risk of secondary health complications [5].

Exercise-based rehabilitation has been widely recognized as an effective adjunct therapy in the management of HIV [6]. Aerobic exercise improves cardiovascular efficiency and oxygen utilization, whereas resistance training enhances muscular strength and endurance [7,8]. Additionally, breathing exercises contribute to improved respiratory function and autonomic regulation, thereby reducing fatigue and improving overall well-being [9].

Multimodal physiotherapy interventions, combining aerobic, resistance, flexibility, and breathing exercises, provide a comprehensive approach to address multiple impairments associated with HIV [10]. Although existing literature supports the role of exercise in improving functional outcomes, limited evidence is available regarding its impact on immunological parameters such as CD4 cell count [11].

Therefore, this case report aims to evaluate the effect of a structured multimodal physiotherapy intervention on cardiopulmonary parameters, CD4 cell count, functional aerobic capacity, fatigue severity, and quality of life in a young adult with HIV.

Case Presentation

Study design, setting, and ethical considerations

The present study report was conducted in a physiotherapy rehabilitation setting over a period of 16 weeks. Written informed consent was obtained from the participant.

A 21-year-old male with a 4-year history of HIV infection was referred for physiotherapy rehabilitation. The patient was receiving ART TLD drugs in OD for 4 years and continued at the time of intervention. His primary complaints were reduced exercise tolerance, generalized fatigue, and decreased functional capacity. A baseline clinical assessment was performed before commencement of the physiotherapy intervention. The patient had no identified contraindications to exercise. Baseline cardiopulmonary and functional assessments included resting heart rate, respiratory rate, peripheral oxygen saturation, 6-minute walk distance, fatigue severity, quality of life, and CD4 cell count. Relevant baseline outcome values are presented in Table 1.

Procedure

Medical history related to HIV was obtained from the patient's clinical records. Demographic details and baseline characteristics were recorded.

Outcome measures were assessed at two-time frames: Baseline (pre-intervention) and after completion of 16 weeks of intervention (post-intervention).

Outcome Measures

All outcome measures were assessed at the baseline and following completion of 16 week intervention.

Cardiopulmonary parameters: HR and RR were measured at rest,

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SpO_2 was measured using a pulse oximeter.

Functional aerobic capacity was assessed using the 6MWT according to the American Thoracic Society (ATS) guidelines [12]. The total distance covered during the six-minute period was recorded as the 6MWD. The test was conducted according to standard ATS guidelines. The 6MWT is a reliable and valid submaximal test used to assess functional capacity.

Fatigue was assessed using the FSS. The scale evaluates the impact of fatigue on daily functioning

Quality of life was assessed using a standardized SF-36 QOL questionnaire. The questionnaire was used to assess multiple domains of health-related quality of life.

CD4 cell count was recorded using laboratory investigation reports. It was used as a marker of immune status.

Intervention

The participant underwent a structured multimodal physiotherapy program for 16 weeks, with five supervised sessions per week. Each session lasted approximately 60–80 minutes.

Exercise training programme

Each session commenced with a 5–10-minute warm-up, consisting of slow walking and active range-of-motion exercises for the upper and lower limbs.

Aerobic exercise was performed for approximately 20-25 minutes per session and consisted of cycling and step-up/step-down exercises. Exercise intensity was maintained at approximately 50-70% of maximum heart rate (was calculated using formula 220-age) corresponding to moderate-intensity exercise [13]. The duration and intensity of aerobic exercise were progressively increased according to the participant's tolerance.

Resistance training was performed using TheraBand elastic resistance bands for approximately 15–20 minutes per session. Exercises included elbow flexion and extension, shoulder flexion, extension and abduction, scapular retraction, chest fly, hip flexion, extension and abduction, and knee flexion and extension. According to APTA guidelines, The TheraBand resistance level was selected according to the participant's ability to perform approximately 8–12 repetitions comfortably with appropriate technique and full prescribed elongation of the band. The exercise dosage consisted of 2-3 sets of 10-15 repetitions. Resistance was progressively increased by advancing to the next TheraBand colour as the participant's tolerance improved and the prescribed repetitions became easier [14].

Box breathing was performed for approximately 10 minutes per session using a 4:4:4:4 breathing pattern, consisting of equal-duration inhalation, breath holding, exhalation, and breath holding.

Flexibility exercises were performed for approximately 10 minutes and included stretching of the hamstrings, quadriceps, calf muscles, pectoral muscles, and back muscles. Each stretch was maintained for 20–30 seconds and repeated twice.

Cool Down (5 minutes)

Slow walking.

Result

Following completion of the 16-week multimodal physiotherapy program, the participant underwent a repeat assessment using the same outcome measures that were performed at baseline. Changes were observed in functional capacity, selected cardiopulmonary parameters, fatigue severity, quality of life, and CD4 cell count.

Functional performance showed a noticeable improvement following the intervention. The participant's 6-minute walk distance increased from 330 m at baseline to 420 m after the intervention, representing an increase of 90 m. Correspondingly, the participant completed 11 laps during the baseline assessment compared with 14 laps at the post-intervention assessment.

The estimated VO_2max also increased from 10.58 to 12.38 mL/kg/min, indicating an increase in the estimated aerobic capacity following the intervention.

Among the resting cardiopulmonary parameters, heart rate decreased from 108 to 98 beats/min. Respiratory rate showed a small change from 15 to 16 breaths/min, while peripheral oxygen saturation remained unchanged at 99% at both assessments.

A reduction in perceived fatigue was observed after the intervention. The FSS score decreased from 48/63 at baseline to 32/63 post-intervention, representing a 16-point reduction in the reported severity of fatigue.

Changes were also observed in the participant's health-related quality of life as assessed using the SF-36 questionnaire. Improvements were noted across multiple domains, with the individual domain scores presented in Table 2.

The CD4 cell count increased from 412 cells/mm^3 at baseline to 478 cells/mm^3 following the 16-week intervention, representing an observed increase of 66 cells/mm^3. No adverse effects or exercise-related complications were reported during the intervention period.

Table 1. Outcome Measures: Baseline and post-intervention

Outcome measure	Baseline	Post-intervention
Heart rate (beats/min)	108	98
Respiratory rate (breaths/min)	15	16
SpO_2 (%)	99	99
6-minute walk distance (m)	330	420
Estimated VO_2max (mL/kg/min)	10.58	12.38
Fatigue severity scale (/63)	48	32
CD4 cell count (cells/mm^3)	412	478

Table 2. SF-36 domain scores

SF-36 domain	Baseline (%)	Post-intervention (%)
Physical functioning	85	95
Role limitations due to physical health	50	100
Role limitations due to emotional problems	66.7	100
Energy/fatigue	60	90
Emotional well-being	72	96
Social functioning	62.5	100
Pain	67.5	77.5
General health	40	60

Discussion

The participant completed the 16-week multimodal physiotherapy programme without any reported adverse effects, and the intervention was well tolerated. Changes were observed across functional, cardiopulmonary, fatigue, quality-of-life, and immunological outcomes. However, as this is a single-case report without a comparison group, these findings represent individual

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clinical observations and cannot establish treatment effectiveness [15].

Functional aerobic capacity showed a noticeable change, with the 6-minute walk distance increasing from 330 m at baseline to 420 m following the intervention. The participant also progressed from 11 to 14 laps. The programme combined aerobic and resistance training with flexibility and breathing exercises, providing a comprehensive approach to physical rehabilitation. The observed increase in walking distance may reflect improved exercise tolerance; however, familiarisation with the test and other individual factors may also have contributed [16].

Resting heart rate decreased from 108 to 98 beats/min, while respiratory rate changed minimally from 15 to 16 breaths/min and SpO_2 remained stable at 99%. The reduction in resting heart rate may be consistent with improved cardiovascular conditioning, although a direct relationship with the intervention cannot be established. Stable oxygen saturation indicates that no deterioration in resting oxygenation was observed [17].

Fatigue severity decreased from 48/63 to 32/63 following the intervention. This reduction indicates a lower reported fatigue burden at reassessment. The combination of aerobic and resistance training may have supported improved physical conditioning and activity tolerance, although fatigue can be influenced by several factors.

Conclusion

A 16-week multimodal physiotherapy programme was well tolerated and was associated with improvements in functional capacity, fatigue, and health-related quality of life in this individual living with HIV. An increase in CD4 cell count was also observed following the intervention. These findings suggest that multimodal physiotherapy may be a useful adjunct to routine HIV care; however, larger controlled studies are needed to confirm these observations.

Data Availability Statement

The data supporting the findings of this case report are available from the corresponding author upon reasonable request, while ensuring patient confidentiality.

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The authors received no financial support for the research, authorship, or publication of this case report.

Ethics Declaration

Written informed consent was obtained from the patient for participation and publication of this case report. The patient's identity has been kept confidential. As this manuscript describes a single case report, formal approval from the Institutional Ethics Committee was not required according to institutional policy.

AI Disclosure

Artificial Intelligence was used only for language editing and grammar improvement. The scientific content, interpretation, and conclusions were developed, verified, and approved by the authors.

Author Contribution Statement

Dr. Rachana Murkute (PT) was responsible for the literature review, participant recruitment, data collection, administration of the intervention, data analysis, interpretation of the findings, and preparation of the initial manuscript.

Dr. Vishvnath Pawadshetty (PT) conceived and supervised the study, guided the study design and methodology, provided continuous academic support throughout the research, critically reviewed the manuscript, and approved the final version for publication

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