Use of Therapeutic Exercise, Functional Endurance and Gait Re-training in a Deconditioned Patient with Acute Respiratory Failure: A Case Report

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Background

Acute Respiratory Failure (ARF)

The human body requires oxygen-rich blood in order to work efficiently.[1] During respiration, air passes from the nose and mouth and into the alveoli of the lungs. When air reaches the alveoli, oxygen passes into the capillaries as carbon dioxide moves out of the capillaries, otherwise known as gas exchange.

Respiratory failure may occur when there is a lack of oxygen passing from the lungs into the blood (hypoxemic), or if the lungs cannot remove carbon dioxide from the blood (hypercapnic).

Chronic respiratory failure is caused by conditions such as muscular dystrophy, amyotrophic lateral sclerosis (ALS), spinal cord injuries, or stroke.

ARF is caused by a sudden and serious complication as a result of conditions such as pneumonia, adult respiratory distress syndrome (ARDS), and congestive heart failure (CHF).[1,2]

Initial Treatment

Supplemental oxygen is typically used. In severe cases, patients may require invasive mechanical ventilation (IMV) or noninvasive ventilation (NIV),[2] followed by physical therapy to restore various functional losses.

Purpose

The purpose of this case report was to document the outcomes of therapeutic exercise, functional endurance activities, balance and gait re-training in a deconditioned patient, following ARF.

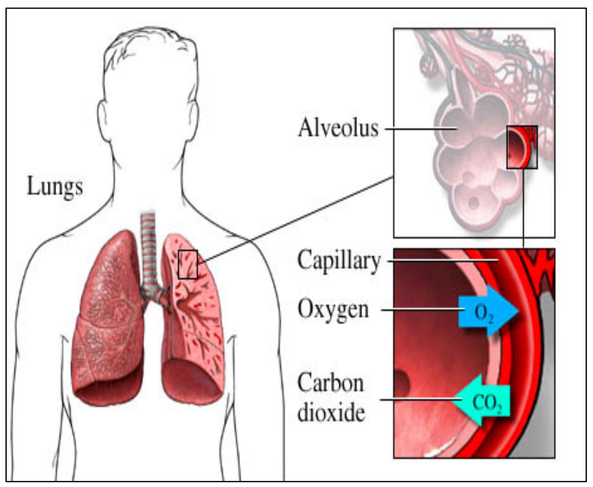


Figure 1. Anatomy/Physiology of Gas Exchange
http://img.webmd.com/dtmcms/live/webmd/consumer_assets/site_images/media/medical/hw/n5551117.jpg

Case Description

Middle-aged female who lived with her husband in a two-story, wheelchair accessible home. Wheelchair bound and independently used forearm crutches to ambulate short distances prior to hospital admission. Additional medical history included rheumatoid arthritis in bilateral knees, morbid obesity and sleep apnea.

Patient arrived to the Emergency Department with lower extremity (LE) swelling, and was taken to the operating room after vascular surgical consultation for a thrombectomy. An endo-tracheal tube was placed during surgery due to ARF.

After several days of recovery on the acute floor, patient was referred to physical therapy and admitted to the Rehabilitation Medicine Unit (RMU) due to significant functional decline.

Figure 2a. Power wheelchair used for long distance mobility

Figure 2b. Forearm crutches used for short distance ambulation

Examination

Tests & Measures	Initial Evaluation Results		Discharge Evaluation Results	
Manual Muscle Test (MMT)	Left	Right	Left	Right
Hip Flexion	2-/5	2-/5	4/5	4+/5
Hip Abduction	2+/5	2+/5	4-/5	4-/5
Hip Adduction	2+/5	2+/5	4-/5	4-/5
Knee Flexion	3-/5	3-/5	4/5	4+/5
Knee Extension	2+/5	2+/5	4-/5	4+/5
Ankle Dorsiflexion	4/5	4/5	4+/5	4+/5
Ankle Plantarflexion	4/5	4/5	4/5	5/5
Observational Gait Analysis				
Distance (feet)	Unable to perform		18 feet with forearm crutches, modified independent using a 4-point gait pattern	
Sitting Balance				
Static	Fair, able to sit at edge of bed with PT in front of patient, stabilizing LE		Normal, able to maintain steady balance without handheld support	
Dynamic	Poor, able to resist light perturbations to core while stabilizing self with bilateral UE		Fair+, able to maintain balance with reaching/perturbations, no handheld support	
Standing Balance				
Static	Unable to perform		Good, able to maintain steady balance with forearm crutches	
Dynamic	Unable to perform		Fair+, with forearm crutches, can accept moderate challenge	
Functional Independence Measure (FIM)				
Transfers	1 – Dependent		3 – Moderate assistance	
Stairs	0 – Not tested (unable)		1– Total assistance	
Locomotion	0 – Not tested (unable) Distance: 0 feet		1 – Helper (less than 50 feet) Distance: 1 (less than 50 feet)	
Aerobic Endurance				
Standing Tolerance (using stopwatch)	Unable to perform		100 seconds with bilateral upper extremity support on forearm crutches	

Interventions

The patient received PT for 30-150 minutes per day (split into 1-3 treatment sessions). The shortest treatment session lasted approximately 30 minutes, while the longest was 60 minutes. This patient received therapy 5-7 days per week for 24 days.

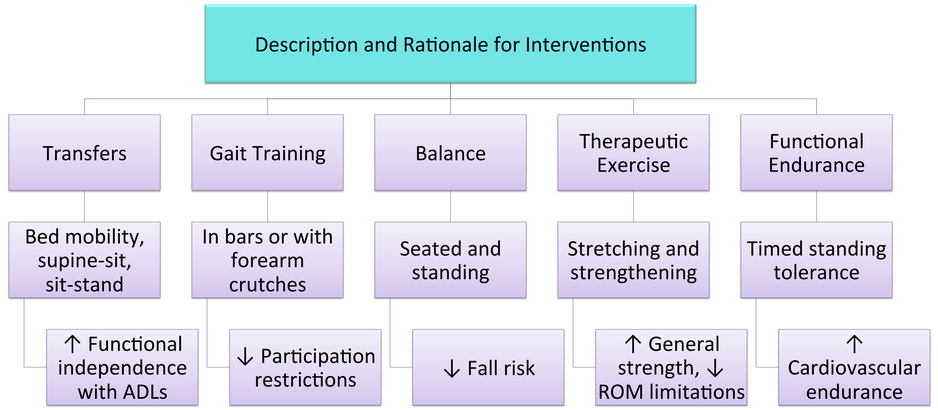


Figure 3. Description and Rationale for Interventions

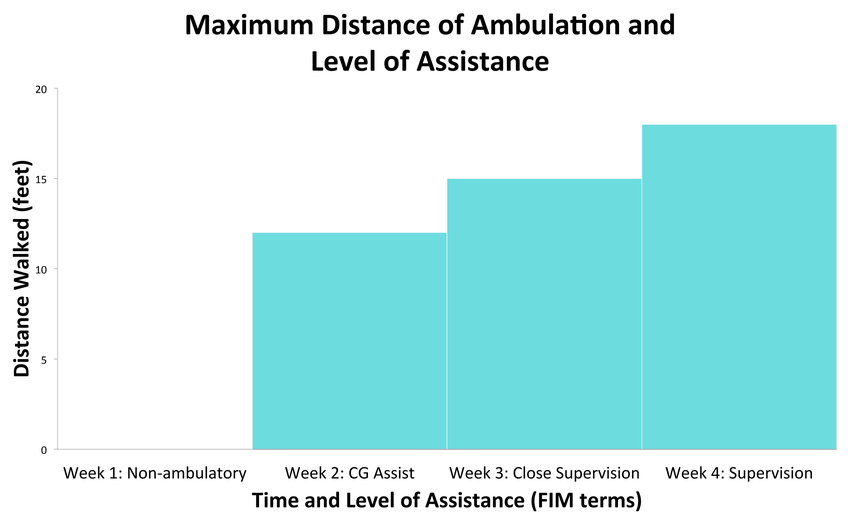
Outcomes

Patient demonstrated a general improvement in MMT of bilateral LE strength and significantly improved gait function, exceeding her baseline distance. Functional balance grades, FIMs and timed standing tolerance improved. She was able to complete most transfers with modified independence and mobility with supervision and use of forearm crutches.

Knee flexion contractures limited her progress in ambulation due to pain and fatigue. Overall, the patient was content with her progress and planned to continue home exercises to improve functional endurance and independence.

Discussion

This case report demonstrated that therapeutic exercise, functional endurance and gait training improved functional outcome measures for a patient following ARF in the RMU. These findings suggest future research is needed to make any causal inferences on this therapeutic approach.



Acknowledgments

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References

1. MedlinePlus Staff. Respiratory Failure. *National Institutes of Health*. https://www.nlm.nih.gov/medlineplus/respiratoryfailure.html. Published August 26 2015. Accessed September 20, 2015.
2. Stefan, M et al. Epidemiology and Outcomes of Acute Respiratory Failure in the United States, 2001 – 2009: A National Survey. *J Hosp Med.* 2013 February: 8(2): 76-82. Accessed September 28, 2015.