Effects of High Intensity Stepping Training on Gait in Patients with Ataxia

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Protocol Title:	**Effects of High Intensity Stepping Training on Gait in Patients with Ataxia**
Principal Investigator:	**Kaitlin Benjamin, PT, DPT**
Co-Investigators:	With increased patient volumes, other therapists will be added to the study
Population:	15 patients of ages 18-65 years old with diagnoses of cerebellar ataxia
Number of Sites:	TIRR Memorial Hermann TMC and TIRR Kirby Glenn outpatient
Study Duration:	5 months spanning the months of January to May.
Subject Duration:	At least 3 weeks with patients receiving 1 hour and 30 minutes of non-consecutive stepping intervention per week.

General Information

- The study will be a quantitative, prospective case series and data will be collected for about four months. Patients from TIRR Memorial Hermann TMC and from TIRR Memorial Hermann Kirby Glenn with ataxia from a cerebellar disease, brain injury, or stroke will be recruited and will receive an intervention consisting of high intensity stepping training from a physical therapist. The patientâ€™s Six Minute Walk Test, 10 Meter Walk Test, Scale for Assessment and Rating of Ataxia (SARA), and Berg Balance Scale will be collected before and after intervention.

Background Information

- Ataxic gait is characterized by a disordered coordination between the head, trunk, and legs. This results in impairments in posture, balance, and coordination.[1] Motor training and potentially motor learning in these patients is limited due to involvement of the cerebellum, which is critical in motor adaptation and learning.[1]
- Cerebellar ataxia normally manifests itself as decreased coordination leasing to increased fall risk, decreased quality of life, and decreased independence. While disorders such as stroke, TBI, and SCI have a CPG that instructs best practices and interventions, patients with cerebellar involvement do not have the same interventional best practices. There is currently low to moderate grade evidence that supports the use of therapeutic exercises for improvement in objective measures such as the SARA and Berg Balance Scale (BBS) in patients with ataxia.[2] Additionally, there is some support for the use of robot assisted walking and treadmill training for patients with ataxia.[3,4] In terms of intensity, there is a study published from Barbuto et al that suggests that intensity may lead to improvements in SARA, walking speed, Timed up and Go Test, and Dynamic Gait Index. However, this study only looks at the feasibility of maintaining high heart rates in patients that receive stationary bicycle training, not walking interventions.[5] A survey of physical therapists found that while 81% of therapists were interested in ataxia, only 11% of physical therapists

considered themselves as having expertise in treating patients with ataxia. Additionally, two thirds of the physical therapists reported a need for guidelines for treatment of patients with ataxia.[3]

- More research needs to be done that specifically examines options for effective therapeutic interventions for patients with cerebellar involvement. The goal of this specific study is to examine the effects of high intensity stepping training on gait recovery, including walking speed and endurance in this population. The hypothesis of the study is that there will be a significant improvement in gait outcome measures (6 Minute Walk Test and 10 Meter Walk Test) in patients who received high-intensity stepping training during therapy. The secondary hypothesis is that the SARA score will not be correlated to improvement in functional outcome measures (such as gait and balance measures) in patients who received high-intensity stepping training during therapy.

Objectives

- Primary objective: To determine the effects of high intensity stepping training on gait outcome measures in patients with cerebellar ataxia.
- Secondary objectives:
    - Identify the correlations between gait outcome measures and measures of ataxia and balance in individuals with cerebellar ataxia.
    - Determine differences in response to high intensity stepping training based off of diagnosis.

Study Design

- The study will be a non-blinded prospective case series performed at TIRR Memorial Hermann and TIRR Kirby Glenn. Participants will be recruited if they have an ICD-10 code of ataxia or present with ataxia at initial evaluation. Either the director of the brain injury rehabilitation team or the evaluating therapist will contact the principal investigator in order to refer the patient to the study. The evaluating therapist will provide the PI with the referral through a secure e-mail utilizing their Memorial Hermann e-mail. The secure e-mail will include the patient diagnosis and their room number with no other personal identifiers listed until the patient consents to the research study.
- The study sample will be about 15 and the expected duration of the study will be at least 3-4 weeks.
- The primary outcomes measured include the 10 Meter Walk Test and the 6 Minute Walk Test. These outcome measures will be performed once at baseline and again at week 3.
- The secondary outcomes to be measured include the SARA and the Berg Balance Scale. These outcome measures will be performed once at baseline and again at week 3.

Study Population

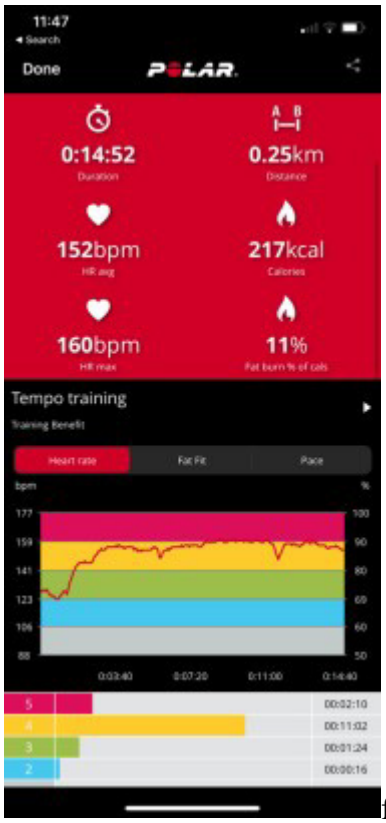
- The sample will consist of all patients with a diagnosis of ataxia who were admitted to TIRR TMC Inpatient or TIRR Kirby Glenn Outpatient. Diagnoses of inclusion will include any pathology that primarily affects the brain/ cerebellum including degenerative diseases, stroke, TBI, posterior fossa tumor, and MS. Additionally patients will be ambulatory at initial evaluation or will have functional ambulation goals at initial evaluation (as noted by 10 meter walk test and 6 minute walk test measures documented as 0). The ages that will be included

in this study are patients ages 18-65 years old and the chronicity of injury will be of at least 1 month or greater.

- The exclusion criteria include diagnoses that may have cerebellar involvement but without cerebellar ataxia as a principal impairment such as autism, down syndrome, schizophrenia, etc. Additionally, patients who are nonambulatory or who are not able to participate in high intensity stepping training due to cardiac involvement (such as cardiac rehabilitation parameters) or due to orthopedic limitations (such as weight bearing parameters) will be excluded from the study.
- The subjects will not be directly recruited. Subjects will be referred to do this study before or after their initial evaluation if they have an ICD 10 code indicating ataxia, are found to have gait ataxia, or have a neurologic injury to some part of their cerebellum based off imaging.

Study Procedures

- Potential subjects will be referred to the primary investigator upon arrival to TIRR Memorial Hermann Inpatient or TIRR Memorial Hermann Kirby Glenn outpatient, or after their initial evaluation is performed. The evaluating physical therapist will contact the primary investigator if a patient is presenting with physical symptoms of cerebellar ataxia. The evaluating physical therapist will contact the primary investigator through a secure email and will email Kaitlin.Benjamin@memorialhermann.org. The e-mail will include secure in the heading, protecting patient information and data.
- Informed consent will be obtained prior to participation in this study. The principal investigator will introduce the study to potential participants at initial evaluation or during their first physical therapy treatment session. Patients will be given the informed consent document and will be allowed to ask questions regarding the purposes, confidentiality, and procedures of the study.
    - If consent is obtained, all consent forms will be collected in a locked cabinet at the primary investigatorâ€™s desk.
- The Six Minute Walk Test, 10 Meter Walk Test, SARA, and BBS will be recorded at initial evaluation and will also be collected by the primary investigator.
- Each individual patient will receive 30 minutes of the high intensity stepping intervention 3 times a week for 3 weeks. Therefore, each participant will receive 9 sessions of high intensity stepping training, for a total of 4 hours and 30 minutes by the studyâ€™s conclusion.
- Each intervention will occur with either the primary investigator as the physical therapist or as another Doctor of Physical Therapy providing care for that patient. If another Doctor of Physical Therapy is providing care for that patient, they will be instructed by the primary investigator on where to put interventions, heart rate monitoring, and blood pressure monitoring in the note. As the intervention is not extremely specific and since it is considered standard of care for patients with stroke, brain injury, and spinal cord injury, the primary investigator will not be required to be the only therapist providing the intervention for this study.
- The intervention will require heart rate monitoring utilizing a â€œPolar H10â€ heart rate monitor, with the goal of reaching moderate to high intensity for 30 minutes during the one hour long therapy intervention. A screenshot of the Polar heart rate data will be taken after each session of monitoring and sent to the PI where it will be collected and kept in a private folder on a locked computer, with all patient information such as patient name transcribed to

a number 

for confidentiality. The screenshots themselves will be off of the Polar heart rate app on the primary therapistâ€™s phone but will contain no patient identifiers. Once the screenshots are taken, they will immediately be sent to the researcher and then within 24 hours they will be uploaded to a folder as mentioned above in order to ensure no data is lost. To the right is an example of what a screenshot would look like (note no patient identifiers). In order to send this information to the primary investigator, this photo will be sent via a Secure e-mail with the picture of the heart rate data in addition to the date this data was collected and the patient that this data was collected for. Once the e-mail is sent, the screenshot will be deleted from the therapistâ€™s phone. The PI will then store this information on a locked computer as noted above.

- Link to product: https://www.polar.com/us-en/sensors/h10-heart-rate-sensor?sku=92075957
- Instructions for use: https://www.youtube.com/watch?v=oN-RchX1UEQ

- The treatment intervention will consist of overground walking, treadmill walking (with or without bodyweight support), stairs, resisted walking, and all other stepping/ gait training. The goal of treatment will be to increase the intensity of the exercise safely and to patient tolerance.
- For safety, patient blood pressure will be monitored before and after each session at the very least. In patients with history of hypertension, stroke, or orthostatic hypotension, it may be taken several times throughout the intervention. Additionally, the following will all merit the intervention to be stopped:
  - A drop in systolic blood pressure >20 mmHg with the increasing workload
  - An increase in systolic and/or diastolic blood pressure >180 mmHg or 110 mmHg, respectively.
  - Reported chest or arm pain (angina)

- Severe shortness of breath, cyanosis, pallor, lightheadedness, dizziness or confusion

- The primary physical therapist will record all stepping interventions they performed in the â€œtreatmentâ€ section of the note. The heart rate monitoring and heart rate data will be added in the â€œtreatmentâ€ section of the note, below the actual treatment. Screen shots of the polar heart rate data for each patient will also be collected and stored in a coded file. Lastly, vitals before and after intervention will be recorded in the â€œtreatmentâ€ section of the note under â€œvitals.â€
- The 6 Minute Walk Test, 10Meter Walk Test, SARA, and Berg Balance Scale will all be recorded again at discharge. There may also be additional walking measures weekly, depending on therapist preference, but physical performance measures will not count as a high intensity stepping intervention.

Data and Safety Monitoring

- For subjects who were not physically active prior to their neurologic injury, with intense exercise there is a possibility for increase in cardiovascular events such as stroke or heart attack.
- Patients with premorbid conditions will have close blood pressure and heart rate monitoring throughout the session by a skilled Doctor of Physical Therapy. There are physicians on site at TIRR Memorial Hermann in addition to skilled therapists that understand signs of poor exercise tolerance such as pallor, profuse sweating, headache, and lightheadedness. Patients with chest pain at any point during the study will have exercise immediately discontinued and will have all of their vitals signs including blood pressure, heart rate, and oxygen saturation checked on the spot. There are blood pressure cuffs and oxygen saturation monitors throughout all of the gyms and in all of the units at TIRR Memorial Hermann and TIRR Kirby Glenn.
- However, in the neurologic population that will be receiving the intervention, there is greater risk associated with remaining sedentary. Patients who do not receive intensive rehabilitation are at greater risk for pressure injury, deep vein thrombosis, Type 2 Diabetes, and obesity. Additionally, sedentary individuals are more likely to have low cardiorespiratory fitness, which is a well-known risk factor for chronic diseases.[6]
- Additionally, literature published by the American Heart Association and the Neurologic Physical Therapy Association supports the implementation of high-intensity stepping training. Hornby et al has provided extensive research of high intensity stepping training on patients with stroke[7]. Even though these patients have already had a cardiovascular-related event, even with interventions in which they are required to maintain their heart rate at 75-85% of HR Maximum, there were no increases in adverse events.[7]
- Since this population will also be engaging in stepping training and locomotor training, there could be potential for increased risk of falls during interventions. However, therapists at the Memorial Hermann facility (which is where the study will be conducted) are highly experienced in walking interventions for these patients and in the prevention of falls. Additionally, most high intensity training stepping in patients with stroke, TBI, and SCI is proven to improve balance and thereby decrease risk of falls.
- For the more medically complex patients at TIRR inpatient (ie multiple comorbidities), a thorough chart review will be performed to ensure patient is not at increased risk of cardiovascular events (previous heart attacks, uncontrolled hypertension, etc). The Physical

Medicine and Rehabilitation Physician will also be asked to clear the patient for participation in high intensity training. For patients at Kirby Glenn outpatient, a chart review and medication review will be performed. If patient is at additional risk for cardiovascular event as determined by previous cardiac event or by uncontrolled hypertension as demonstrated by systolic blood pressure over 180 or diastolic blood pressure over 100 consistently, then the patient primary physician will be contacted to ensure the safety of high intensity training. Additionally, blood pressure and heart rate will be obtained before and after the intervention for every session. If patient has any signs of headache, nausea, vomiting, dizziness, blurred vision, double vision, or dysarthria during the treatment intervention, the treatment will be stopped immediately and vitals including blood pressure and heart rate will be taken.

- In order to minimize fall risk, there will be a Doctor of Physical Therapy supervising the patient throughout the entire intervention. If the Doctor of Physical Therapy needs to leave even to get a blood pressure machine or a towel, the patient will take a seated rest break. -If any unplanned adverse events occur, or if protocol deviations occur, the PI of the study (Kaitlin Benjamin) will report these via the iRIS portal.
- The PI of this study (Kaitlin Benjamin) will be responsible for reporting Serious Adverse Events and Unanticipated Problems to the IRB. The PI will also be responsible for maintaining the confidentiality of data, data collection, management, and analyses. The Primary Investigator will perform reviews of all data once every two weeks in order to ensure safety for all patients and to ensure all data is being tracked accurately.

Statistics

- Statistics will be utilized to compare outcome measures before and after the intervention. A dependent sample t-test will be used for comparison of pre- and post-intervention outcomes. MANOVAs will be utilized in order to determine potential differences in outcomes in patients with different diagnoses (ie grouping patients based on chronicity, nature of cerebellar disease) and to compare the four outcome measures that I will utilize. I may also consider doing multiple t-tests or multiple ANOVAâ€™s if the data does not meet statistical assumptions. However, I would just need to account for increased possibility of type 1 error[2].
- Sample size will be 15 patients.

Ethics

- The PI is seeking IRB approval from both UTHealth Houston and Memorial Hermann.
- An informed consent process will occur for all patients participating in this study (with the document attached). The consent process will inform the participants about the study, identify the risks and benefits, stress that participation is voluntary, and that the patient may choose to partake or stop at any time. The subjects will be informed that the intervention that they are getting focuses on intensity, and is already best clinical practice for many neurologic conditions.
- In order to protect patient privacy, a linking log will be utilized instead of patient names linking them to a random number under which their data will be collected and stored securely, as per the â€œData handling and record keeping.â€
    - The only person with access to this log will be the primary investigator as the PI will be the only one collecting and organizing data.

Data handling and record keeping

- Names and data from participants will be transcribed to an identification number and kept on a master list that is kept by the principal investigator on a password protected computer or in a locked file cabinet at the PIâ€™s desk.
- The identification number will be used to protect patient privacy while collecting their outcome measure data.

Quality control and assurance

- In an effort to assure that data is collected accurately, a Polar Heart Rate monitor will be used for heart rate monitoring during each session.
- Additionally, only the PI or another Doctor of Physical Therapy will be permitted to implement the intervention that is documented for research.
- There will be no third-party monitoring.
- In order to be sure that data is accurate and consistent, the PI will be the only person performing the initial outcome measures and the final outcome measures. Due to the extremely high levels of inter-rater reliability of the Six Minute Walk Test, 10 Meter Walk Test, SARA, and Berg Balance Scale, there will be high validity with data being collected by only one person.
- Self-assessment will be performed by the primary investigator and the primary investigator will be the primary physical therapist documenting the interventions. Therefore, the PI will perform audits of the data after every week the study is being performed.
- Due to the high objectivity of the outcome measures being utilized and heart rate monitoring during the intervention, third party monitoring is not currently necessary for this project.

Publication Plan

- The PI will present the data from this study at TIRR Memorial Hermannâ€™s Residency graduation at the end of the TIRR Memorial Hermann Physical Therapy Neurologic Residency Program in July 2024.
- The PI will determine if there were enough patient encounters obtained to submit for publication. If so, the PI will likely submit in a physical therapy or neurologic physical therapy journal.
- Also depending on the amount of patients that were enrolled in the study, the PI may submit a poster abstract for presentation at local physical therapy conferences.
- The results will not be returned to patients but may be returned to individual Memorial Hermann facilities at their request for potential for quality improvement or for interventional purposes. Identifiable patients and therapist data will not be provided.

ATTACHMENTS

1. Schematic of Study Design
2. Study Schedule
3. Consent Document

4. Case Report Form
5. Linking Log

References:

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