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**Is Hippotherapy Effective in Reducing the Fall Risk in Patients
Diagnosed with a Stroke?**

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A SELECTIVE EVIDENCE BASED MEDICINE REVIEW

In Partial Fulfillment of the Requirements for

The Degree of Master of Science

In

Health Sciences-Physician Assistant

Department of Physician Assistant Studies
Philadelphia College of Osteopathic Medicine
Philadelphia, Pennsylvania

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ABSTRACT

OBJECTIVE: The objective of this selective EBM review is to determine whether or not hippotherapy is effective in reducing fall risk in patients diagnosed with a stroke.

STUDY DESIGN: Review of three English language randomized controlled trials (RCTs) between 2006-recent.

DATA SOURCES: Three non-blind RCTs published and obtained from PubMed.

OUTCOMES MEASURED: Each RCT measured balance by either using the Berg Balance Scale or the Bio Rescue (an analysis system with biofeedback).

RESULTS: All three articles found that hippotherapy significantly improved the balance of patients diagnosed with a stroke, when compared to the traditional physical therapy treatments of treadmill walking, performing trunk exercises with a swiss ball, and utilizing neurodevelopmental techniques.

CONCLUSION: Based on the articles included in this EBM, hippotherapy is an effective treatment in reducing the fall risk in patients diagnosed with a stroke.

KEY WORDS: hippotherapy, stroke balance

INTRODUCTION

A stroke is a cardiovascular disease that causes sudden focal neurological deficits due to cerebral ischemia or hemorrhage.¹ It is the 5th leading cause of death and mortality in the United States.² More than 795,000 people suffer a stroke annually, and more than 140,000 individuals die from it each year.² The risk of having a stroke doubles every year after the age of 55.³

Stroke is also a leading cause of significant, long term disability in the United States.² The National Stroke Association states that 80% of stroke survivors suffer from some degree of hemiparesis.⁴ Hemiparesis is having weakness or the inability to move one side of the body. Hemiparesis causes increased fatigue, lack of coordination, inability to perform everyday ADLs, and most importantly, increases fall risk.

In one study which surveyed stroke survivors, up to 37% reported at least one fall in the preceding 6 months before enrolling in the study.⁵ Falls account for over 800,000 hospitalizations and more than 27,000 deaths annually.⁶ It has been reported that a fall with injury added 6.3 days to the hospital stay.⁷ The average cost for a fall with injury is about \$14,000.⁸ In 2014, the total cost of fall injury was \$31 billion.⁶ The expense for falls in the elderly population is expected to increase as the population continues to age, and may reach \$67.7 billion by 2020.⁶

For many years, physical therapy has been the first line of treatment in reducing the fall risk in stroke survivors. Depending on the clinician, many different methods have been used, such as generalized fitness and muscle strengthening, over-ground walking and balance training, body weight-supported treadmill training, robotic gait assist devices, and function electrical stimulation.

Hippotherapy, also known as horseback riding therapy, is a physical therapy intervention that utilizes the horse's gait to correct motor impairments by using rhythmic and repetitive movements similar to human gait mechanics.^{1,9} It has been used in the last several years to treat motor disabilities in children suffering from cerebral palsy (CP), which has shown to significantly decrease the fall risk within the CP population.^{9,10} Hippotherapy has also shown to increase compliance and motivation throughout treatment with the CP population when compared to other physical therapy interventions.¹ Unfortunately, in the adult population, hippotherapy has not been frequently used, particularly with the stroke population.⁹ This paper evaluates three randomized controlled trials (RCTs) comparing the efficacy of hippotherapy to other proven physical therapy balance regimens, and the effect they have on reducing fall risk in stroke survivors.

OBJECTIVE

The objective of this selective EBM review is to determine whether or not hippotherapy is effective in reducing fall risk in patients diagnosed with a stroke.

METHODS

The studies used in this systematic review included three randomized controlled trials, which were selected based on specific criteria. The population studied in this review only included adults with a diagnosis of stroke who were at fall risk. The intervention used in all three RCTs was hippotherapy.

In the study by Kim et al., hippotherapy (mechanical simulator) was compared to neurodevelopmental exercises (NDT) for 6 weeks. In the study by Lee et al., hippotherapy was compared to treadmill exercise for 8 weeks. In the study by Baek et al., hippotherapy

(mechanical simulator) was compared to performing trunk exercises on a swiss ball for 8 weeks. The measured outcome in all three articles was balance.

Each article was published in a peer-reviewed journal and written in the English language. Articles were selected by the author via PubMed using keywords “hippotherapy” and “stroke balance”. The inclusion criteria for all three articles included RCTs in which the outcomes measured were patient-oriented evidence that matter (POEM), published between 2006-present, and utilized hippotherapy as an intervention for reducing fall risk in patients diagnosed with a stroke. Exclusion criteria included patients who were unable to ambulate and any outcomes that were disease oriented evidence (DOE). A summary of the statistics used in the 3 RCTs included the paired t-test, independent t-test (utilized to demonstrate between-group differences), and p-value. The demographics and characteristics of the included studies are found in Table 1.

Table 1 - Demographics & Characteristics of included studies

Study	Type	#Pts	Age	Inclusion Criteria	Exclusion Criteria	W/D	Interventions
Kim (2015)	RCT	20	66-74 y/o.	Mini-Mental State Examination (MMSE) score > 24 points, ability to walk > 10 meters independently, and Brunnström approach stage of four or greater.	Visual disability or orthopedic disease of the lower extremities	0	Horse-riding exercise (mechanical simulator) for 6 weeks. Control group: Only utilized NDT exercise for 6 weeks.
Baek (2014)	RCT	30	49-63 y/o.	Patients with hemiplegia, no previous experience with hippotherapy, able to verbalize instructions, sit/walk independently, and no ROM deficits.	None Mentioned.	0	Horse Riding Simulator for 8 weeks Control group: Performed trunk exercises using a swiss ball for 8 weeks.

Lee (2014)	RCT	30	57-70 y/o.	Diagnosed with CVA, able to ambulate independently, Korean Mini-Mental State Examination score > 24, Modified Ashworth Scale <2, no orthopedic issues, and able to train >30 min.	None Mentioned	0	Hippotherapy (live horse) for 8 weeks Control group: Treadmill exercise for 8 weeks
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OUTCOMES MEASURED

In the studies Lee et al. and Kim et al., balance was measured using the Berg Balance Scale (BBS). BBS is a 14-item scale designed to measure balance of the elderly in a clinical setting. A maximum score of 56 can be achieved in this exam: 41-56=low fall risk, 20-40=medium fall risk, and 0-20=high fall risk. A difference of 8 points is required to demonstrate a significant change in balance between two assessments.¹¹ In the third study Baek et al., balance was measured using the BioRescue (an analysis system with biofeedback). While using the BioRescue in this study, subjects stood in a specialized platform with their eyes covered to prevent any visual feedback, while their center of pressure (COP) displacement was measured during static standing.¹

RESULTS

All three RCTs in this systematic review compared treatment with hippotherapy to control groups that received the following traditional physical therapy regimes to increase balance post stroke: neurodevelopmental exercise, treadmill exercise, and trunk strengthening over a swiss ball. Each experimental and control group in the trials received a total of 30 minutes of their specific therapy program over a total of 6-8 weeks. There were no adverse events mentioned in any of these studies.

The data from all three RCTs included in this review only contained continuous data which was not able to be converted to dichotomous data. As a result, numbers needed to treat (NNT), numbers needed to harm (NNH), absolute risk reduction (ARR), and relative risk reduction (RRR) were not able to be calculated.

In the RCT by Kim et al., the effects of hippotherapy (mechanical simulator) on balance were compared to those of the control group receiving only NDT. The patients included in this study had been diagnosed with a stroke on MRI at least 6 months prior to participation.¹⁰ Patients with any visual disability or orthopedic disease of the lower extremities were excluded from this study, as it could hinder progress and the ability for these patients to ride the horse simulator efficiently. Among the 20 patients in this study, 10 were each randomly assigned to either an experimental group, or the control group.¹⁰ Both groups received their individualized treatment for 30 minutes per day, 5 days a week for a total of 6 weeks at an undisclosed facility.¹⁰

Balance was measured utilizing the BBS at baseline and at the end of the 6 weeks. Upon completion, the experimental group demonstrated significant decrease in fall risk for all pre- and post-experiment variables ($p < 0.05$).¹⁰ The control group exhibited no significant difference in fall risk pre- and post-experiment ($p > 0.05$).¹⁰ In the between-group comparison, the BBS outcomes for the experimental group were significantly different from those of the control group ($p < 0.05$).¹⁰ There was 100% patient adherence throughout this study, and none of the patients withdrew from participation. Table 2 summarizes the results.

Table 2. Changes in balance following intervention

Group	Baseline BBS	Final BBS	Paired t-test	Ind. t-test
Experimental	42.4 +/- 1.3*	44.1 +/- 1.2	$p < 0.05$	$p < 0.05$
Control	41.6 +/- 1.3	42.2 +/- 1.6	$p > 0.05$	$p > 0.05$

*Mean+/-SD.

In the RCT Baek et al., the effects of hippotherapy (mechanical simulator) on balance were compared to those of the control group only performing trunk exercises using a swiss ball. The patients included in this study were diagnosed with a stroke at D General Hospital in Busan, South Korea.¹ No specific exclusion criteria were mentioned in this study. Among the 30 patients in this study, 15 were each randomly assigned to either an experimental group, or the control group.¹ Both groups trained for 30 minutes per session, 3 sessions per week for a total of 8 weeks at an undisclosed facility.¹

Static standing balance was measured utilizing the BioRescue at baseline and at the end of the 8 weeks. Upon completion, only the hippotherapy group exhibited statistically significant balance improvement, as demonstrated by the decrease in COP path length ($p < 0.01$) and travel speed ($p < 0.05$).¹ In the between-group comparison, COP path length and travel speed were not statistically significant before the intervention ($p > 0.05$), but were significant ($p < 0.05$) after the intervention was performed.¹ There was 100% patient adherence throughout this study, and none of the patients withdrew from participation. Table 3 summarizes the results.

Table 3: Changes in static balance following intervention

	Group	Baseline	Final	Paired t-test	Ind. t-test
COP length (cm)	Experimental	15.9 +/- 5.1*	12.2 +/- 4.3	$p < 0.01$	$p > 0.05$ (pre) $p < 0.05$ (post)
	Control	14.5 +/- 5.9	14.4 +/- 5.8	$p > 0.05$	$p > 0.05$ (pre) $p > 0.05$ (post)
COP speed (mm/s)	Experimental	0.7 +/- 0.3	0.6 +/- 0.2	$p < 0.05$	$p > 0.05$ (pre) $p < 0.05$ (post)
	Control	0.7 +/- 0.3	0.7 +/- 0.2	$p > 0.05$	$p > 0.05$ (pre) $p > 0.05$ (post)

*Mean +/- SD.

In the final study Lee et al., the effects of hippotherapy (live horse riding) on balance were compared to those of the control group only performing treadmill exercise. The patients included in this study had been diagnosed with a stroke, and had no impairment significant enough that would affect their ability to perform training for 30 minutes.⁹ No specific exclusion criteria were mentioned in the study. Among the 30 patients in this study, 15 were each randomly assigned to either an experimental group, or the control group.⁹ Both groups trained for 30 minutes per session, 3 days per week for a total of 8 weeks at H horse riding place, K hospital and T hospital located in Gyeonggi Providence, South Korea.⁹

Balance was measured utilizing the BBS at baseline and at the end of the 8 weeks. Upon completion, only the experimental group demonstrated significant decrease in fall risk pre- and post-experiment ($p < 0.05$).⁹ In the between-group comparison, the scores for the BBS of the experimental group were not significantly different pre- and post-experiment from those of the control group ($p > 0.05$).⁹ There was 100% patient adherence throughout this study, and none of the patients withdrew from participation. Table 4 summarizes the results.

Table 4: Changes in balance following intervention

Group	Baseline BBS	Final BBS	Paired t-test	Ind. t-test
Experimental	40.4 +/- 1.5*	42.7 +/- 3.2	$p < 0.05$	$p > 0.05$
Control	40.5 +/- 1.5	41.7 +/- 5.1	$p > 0.05$	$p > 0.05$

*Mean +/- SD.

DISCUSSION

As the incidence of stroke continues to increase as a result of longer life expectancy, the number of falls among stroke survivors will only continue to rise. In order to decrease the negative medical sequela that result from a fall, providers and physical therapists are constantly collaborating to implement new techniques to further improve balance in patients diagnosed with

a stroke. Despite being around for several years, hippotherapy has seldom been implemented in the adult population, particularly with the stroke population. This systematic review evaluated the effectiveness of hippotherapy in patients diagnosed with a stroke, in comparison to other common physical therapy techniques to decrease fall risk.

In the study Kim et al., hippotherapy was found to significantly decrease the fall risk in patients diagnosed with a stroke at 6 weeks, as compared to only implementing NDT, demonstrating that hippotherapy is superior to NDT in preventing falls in stroke survivors. In addition to balance, this study also found that hippotherapy improved gait and the ability to perform ADLs.

Baek et al. also found hippotherapy to be superior to performing trunk stability exercises on a swiss ball. This study demonstrated that hippotherapy significantly improved static standing balance at 8 weeks, as compared to performing only trunk exercises. In addition to decreasing fall risk, this study also demonstrated that hippotherapy improved the asymmetry in abdominal muscles found in stroke survivors.

Lee et al. as well found that hippotherapy was significantly more effective than only performing treadmill exercises in decreasing the fall risk in patients diagnosed with a stroke. In addition to decreasing fall risk, gait mechanics were also significantly improved. This further demonstrates that hippotherapy reduces fall risk through multiple factors.

All three studies had similar limitations. The first being that each study had a small sample size. Thus, the results from each study limits generalizability. The second limitation to all three studies was the inclusion criteria utilized, as these results were attained from higher functioning stroke patients. The results from these studies may not be consistent with lower functioning stroke patients. The third and final limitation in each study was that follow up at a

later date was not performed. Therefore, it is unknown if the benefits of hippotherapy were reproducible long term.

Unfortunately, hippotherapy can be very costly and many insurances consider it investigational because the literature on its effectiveness is lacking, particularly when applied to the stroke population.¹² Contraindications to utilizing hippotherapy are uncontrolled seizures, fear of animals, atlantoaxial instability, osteogenesis imperfecta, severe osteoporosis, and complete spinal cord injury above T6.¹³

CONCLUSION

Based on the articles selected for this EBM review, hippotherapy has shown to be effective in decreasing the fall risk in patients diagnosed with a stroke. Future studies should consider long term follow up, include lower functioning stroke patients, and increasing the sample size.

Further studies like the three RCTs used in this systematic review are needed to increase the awareness of hippotherapy not only with providers and patients, but most importantly with insurance companies. This would enable stroke survivors, despite their income, to receive the most effective treatment to improve their overall quality of life.

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