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REVIEW

Effects of aquatic physical therapy on balance in post-cerebrovascular accident patients: an integrative review

Efeitos da fisioterapia aquática no equilíbrio de pacientes pós-acidente vascular encefálico: uma revisão integrativa

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Abstract

Introduction: Stroke can be characterized as ischemic or hemorrhagic, and in individuals with this condition there is a decrease in their functional independence, which reproduces a decrease in quality of life. Aquatic physical therapy is an approach that stands out in the rehabilitation of these patients, mainly due to the increase in treatment due to the environment. Subjects: Patients with stroke. *Objective*: To update the literature on the effects of aquatic therapy on the balance of post-stroke patients, verifying the most used evaluation methods. *Methods*: The literature search was performed in 6 Pubmed, Web of Science, Scopus, Medline, PEDro and Cochrane databases, using the association of descriptors, keywords and Boolean operators “Stroke” AND “Hydrotherapy” OR “Hydrokinesiotherapy” OR “Aquatic Physiotherapy” AND “Balance”, stipulating inclusion and exclusion criteria. *Results*: Of the 259 studies identified, 14 were selected for analysis and qualitative synthesis. Overall, the results showed significant differences in the balance of individuals with cerebral vascular accident after aquatic therapy. *Conclusion*: When compared to conventional neurofunctional physical therapy techniques, aquatic physiotherapy has superior efficacy. The most used evaluative means are the Berg Balance Scale and Timed Up and Go, as they are tools that are quick and easy to apply, in addition to being highly effective, demonstrating the relevance of the study in aspects of functional recovery in the midst of dysfunctions arising from neurological impairments.

Keywords: stroke; hydrotherapy; physical therapy modalities; postural balance; quality of life.

Resumo

Objetivo: Atualizar a literatura sobre os efeitos da terapia aquática no equilíbrio de pacientes pós-AVE e verificar os métodos avaliativos mais empregados. *Métodos*: A

busca na literatura foi realizada em 6 bases de dados Pubmed, Web of Science, Scopus, Medline, PEDro e Cochrane, utilizando a associação de descritores, palavras-chave e operadores booleanos “Stroke” AND “Hydrotherapy” OR “Hydrokinesiotherapy” OR “Aquatic Physiotherapy” AND “Balance”, estipulando critérios de inclusão e exclusão. *Resultados*: Dos 259 estudos identificados, foram selecionados 14 para análise e síntese qualitativa. No geral, os resultados evidenciaram diferenças significativas no equilíbrio de indivíduos com AVE após terapia aquática. *Conclusão*: Quando comparada às técnicas de fisioterapia neurofuncional convencionais, a fisioterapia aquática apresenta superioridade de eficácia. Os meios avaliativos mais utilizados são a Berg Balance Scale e a Timed Up and Go por se tratarem de ferramentas de rápida e fácil aplicação, além de alta eficácia, demonstrando a relevância do estudo em aspectos de reabilitação funcional em meio a disfunções advindas de comprometimentos neurológicos.

Palavras-chave: hidroterapia; acidente vascular encefálico; equilíbrio postural; fisioterapia; qualidade de vida.

Introduction

The cerebral vascular accident (CVA), more commonly known as "stroke", is widely classified as ischemic or hemorrhagic. In either category, the result is a loss of blood flow, nutrients, and oxygen to a region of the brain, resulting in neuronal damage and subsequent neurological deficits [1]. There are numerous etiologies that can cause a CVA and one of the most common causes is the formation of a plaque due to the accumulation of low-density lipoprotein (LDL) cholesterol. The most common risk factors are hypertension, diabetes mellitus and smoking [2].

The CVA harms the descending neural pathways due to injuries of the superior motor neurons, if it occurs in the middle cerebral artery, the most common site for this type of injury, corticospinal and corticocerebellar tract connections will be affected [3]. In post-CVA individuals, impairments in gait and balance will lead to decreased functional independence, limited mobility and social interaction, in addition to presenting weakness, spasticity, lack of coordination and deficiencies, which can lead to costly complications [4-7]. Through the exposed complications, physical therapy can contribute to reducing the limitations and quality of life of these individuals [8].

Regarding the therapeutic strategies for CVA, aquatic physical therapy is widely used in the treatment of these individuals. The aquatic environment is suggested as the ideal medium due to its physical properties, buoyancy, hydrostatic pressure, density, viscosity and thermodynamics, optimizing the effects of rehabilitation [9]. Hydrotherapy

cover traditional approaches, such as the Halliwick Method and Bad Ragaz, and complementary medicine techniques [10,11], which have shown promising effects on balance, strength and mobility after CVA [12,13]. There are several clinical studies addressing hydrotherapy in post-CVA rehabilitation, however, there is a shortage in the analysis of evaluative measures. Thus, the aim of this study is to update the literature on the effects of aquatic therapy on the balance of post-CVA patients and verify the most used evaluation methods.

Methods

A systematic search was performed in 6 databases: Pubmed, Web of Science, Scopus, Medline, PEDro and Cochrane. In this sense, an association of descriptors, keywords and Boolean operators was used: “Stroke” AND “Hydrotherapy” OR “Hydrokinesiotherapy” OR “Aquatic Physiotherapy” AND “Balance”. As inclusion criteria, only randomized clinics published in English in the period from 2016 to 2021 and available in full were delimited, which addressed aquatic physical therapy techniques in the balance of individuals with CVA with different therapies or no intervention as a comparison. In this study, studies on animals, systematic reviews or meta-analyses are excluded.

Five authors selected the articles, following the process of choosing the title, reading the abstracts and lastly the reading of the full text. The studies that met the inclusion criteria were analyzed and the following data extracted: author, year of publication, population design, evaluative measures, interventions and results (Table I). The PICOS strategy (P-Population; I-Intervention; C-Comparison; O-Outcomes; S-Study type) was used to search the databases and guide the research question (Chart 1). According to the established “PICOS” strategy, the guiding question of the research was: “What is the effect of aquatic physical therapy techniques on the balance of individuals with CVA?” The assessment of the methodological quality of the included studies was performed using the PEDro scale (Physiotherapy Evidence Database) (Table II), which qualifies clinical trials following 11 criteria with scores from 1 to 10, with the first criterion not being scored.

Table I - *Characteristics of the selected studies (ver anexo PDF)*

Chart 1 - *Elements of the PICOS strategy*

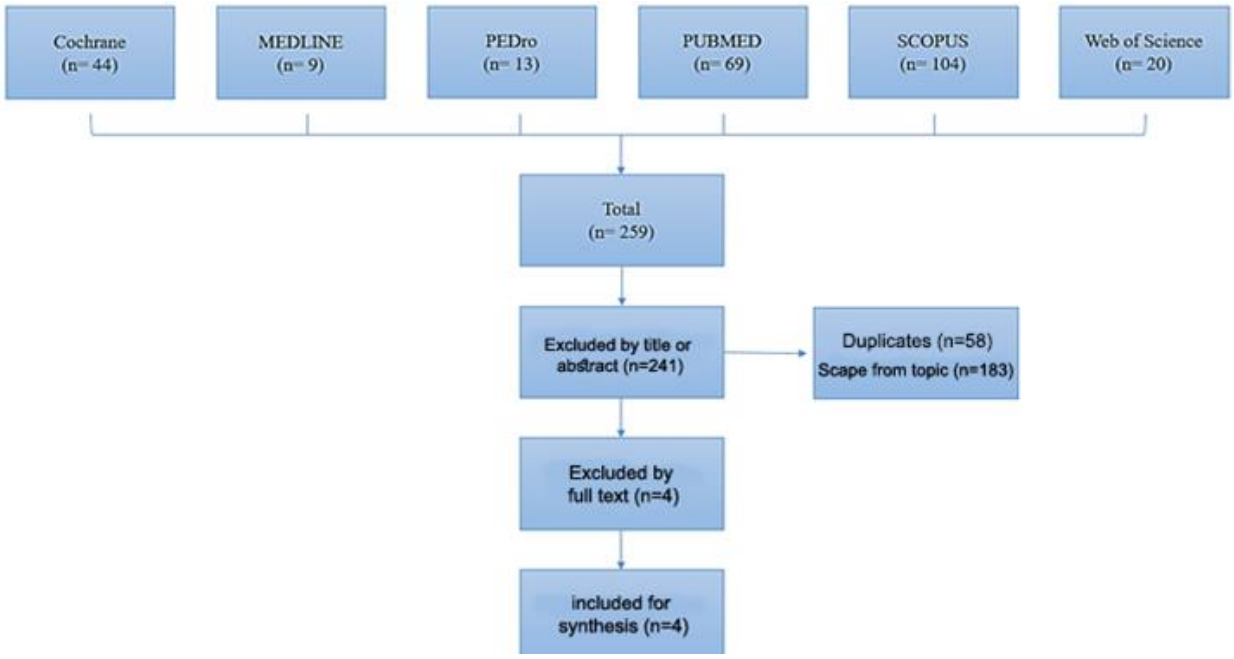
Description	Abbreviation	Question components
Population	P	Individuals with CVA
Intervention	I	aquatic physical therapy
Comparison	C	Groups without intervention or groups with other physical therapy resources and techniques
Outcome	O	Effectiveness of aquatic physiotherapy on balance
Kind of study	S	Randomized clinical trials

Source: Own Authorship (2021).

Table II - *Analysis of the methodological quality of the included studies (ver anexo PDF)*

Results

Based on the search strategies, 259 articles were identified in the databases, of which 58 were excluded because they were duplicates. After the reading, 14 studies were selected for the specific analysis of methodological quality and for the qualitative synthesis, this to compose the structural framework of this study, but other articles were selected. These were intended to support stages of the study such as introduction and discussion. This new selection of studies was blindly performed by 3 other authors and a fourth author selected what was in common among the first 3 authors. Thus, we ended up with 36 articles in total, with the 14 specific articles selected by the criteria established for quality analysis already in these. The selection process is shown in figure 1.



Source: Own Authorship (2021)

Figure 1 - *Study selection process*

The study investigated 430 participants aged 20 to 85 years who were diagnosed with CVA. All surveys included had balance as one of the outcomes, using several

evaluative scales, such as the Berg Balance Scale (BBS), Sit Up Test (TSL), Timed Up and Go (TUG), Tinetti Test, Test of Stability Limit, Functional Range Test (TAF) and Barthel Index.

Discussion

The present study aimed to update the literature on the effects of aquatic therapy on the balance of post-CVA patients, verifying the most used evaluative methods. In this sense, it was observed in the literature that post-CVA individuals have decreased functional independence, limited mobility, resulting from deficits in gait and postural balance, generating difficulties in the process of functional recovery [4,5]. Functional recovery after CVA has been shown to be very important in function recovery and there are many tools that can be used [14]. The popularity of aquatic physical therapy has increased among neurological physiotherapists and researchers due to the benefits that water provides [15]. The aquatic environment acts as a partial support to the body, allowing the mobilization of joints and, in addition, provides motor and sensory stimuli that can induce plasticity [16] and presents itself as an alternative for training in balance, gait and weight transfer, due to its physical characteristics [5]. Therefore, it is essential to carry out a more focused assessment of such impairments in post-CVA patients.

A water exercise technique that has been growing among neurological patients is Ai Chi, which is composed of movements that address characteristics of postural stability training. Some studies demonstrate the effectiveness of Ai Chi, as can be seen in Ku *et al.* [19], who showed positive effects during excursion speed and movement in the stability limit test in the group treated with the Ai Chi technique. Similar to the previous study [19], Pérez-De la Cruz [17], in two studies, evaluated the effects of Ai Chi compared to two other interventions over a 12-week period: dry land therapy and associated aquatic therapy with dry land therapy [28]. In Pérez-De la Cruz [28], Ai Chi was associated with calming activity, in which significant differences were observed for the combined therapy group in BBS, TSL, Tandem Posture Test and TUG. In Pérez-De la Cruz [17] the technique was associated with a cooling program, in which the group of therapy on land and aquatic therapy obtained significant results in EVA, total Tinetti, 360-degree rotation and TSC -30.

Temperoni *et al.* [18] performed two therapeutic approaches in their study that lasted 4 weeks, comparing a sequential postural change training with a standard aquatic therapy plus warm-up, stretching, recruiting and walking exercises, noting benefits in both groups, but with superiority in the combined therapy group in the BBS and EQVE-AVE scales. This study was characterized as the first to use sequential training.

Babaeipour *et al.* [22] programmed two aquatic interventions to compare with a control group without intervention. The first program included supervised exercises in shallow water; the second applied supervised exercises in deep water, both with load progression, with a significant difference in the two interventional groups in the BBS scores compared to the control group, which demonstrates the effectiveness of aquatic training whatever the depth.

Saleh *et al.* [31] compared terrestrial training with aquatic training, showing significant effects in patients treated in the aquatic environment compared to terrestrial, with superiority in the OASI, APSI and MLSI parameters [31]. Corroborating these results, Noh [33] and Montagna [34] demonstrated in their studies that when compared to the conventional therapy group, the aquatic therapy group had significant changes in BBS scores, forward and backward weight bearing skills, limbs and knee flexor strength, with positive effects on postural balance [33,34] as well as Berger [35]. Cha *et al.* [24] compared rehabilitation on conventional soil with aquatic therapy associated with rehabilitation on conventional soil, obtaining significance in the TUG balance index [29], similar to the findings of Chan *et al.* [26] and Eyvaz *et al.* [23] who also obtained significant values in the balance parameters assessed in the combination therapy group.

Lim [32] in their study applied a conventional physical therapy program in two groups, both of which performed gait training on an underwater treadmill with different resistances, in which group 1 performed with jet resistance against the anterior region of the leg, and in group 2, an anklet weighing 5% of the participant's body weight was applied. Both groups showed benefits, however, the jet resistance group had significance in static and dynamic balance skill scores, which can be explained, according to the authors, as resistance at the ankle level limiting other areas, preventing buoyancy in all areas below the knee.

Franciulli [21] applied an intervention lasting 9 weeks, divided into a group that performed aerobic training (walking on the ground, treadmill and relaxation) and the other aerobic training in water, in which both interventions positively affected the TUG scores and BBS. A recent meta-analysis by Veldema and Jansen [36] demonstrated that aquatic therapy has superior efficacy in balance, walking, muscle strength, proprioception, health-related quality of life, physiological indicators, and cardiorespiratory fitness. However, they concluded that methods such as Halliwick, Ai Chi, Watsu or Bad Ragaz Ring are the most effective in the variables mentioned and that walking on a treadmill is less effective than them, thus outlining a more effective treatment.

In the study by Zhu [24] they compared two interventions in their study: the first consisted of water therapy with stretching of joints and major muscle groups, strengthening and balance exercises for upper limbs, lower limbs and training on a water

treadmill, while the second therapy land with stretching, exercises for strengthening and mobility of the trunk, training on a treadmill. The results were positive in both groups, due to trunk mobility movements and lower limb strengthening exercises, however, the aquatic therapy group obtained significance in the TAF and 2-min walk test due to water buoyancy and buoyancy training challenging the balance even more.

Bobath's approach is a method that involves the regulation of muscle tone and allows the restoration of functional movement through motor learning principles, characterized as a neurodevelopmental treatment. Kim *et al.* [25] compared the neurodevelopment intervention associated with dual-task aquatic training with individuals who underwent only the neurodevelopmental treatment, in which they demonstrated effects that are more significant after treatment in all balance and gait tests in the group of combination therapy. Park *et al.* [20] also presented differences in the scale of trunk impairment, postural assessment and functionality.

Regarding the evaluative tools, most of the studies included for synthesis more than one instrument to assess balance and functional capacity. The BBS was present in 10 of the 14 articles [17-26], as it is an easy and quick scale to apply, in addition to having high reliability [27], followed by the TUG which was present in 8 of the 14 articles [21-26,28,29], as it is a reliable, valid and easy-to-administer clinical tool to assess advanced functional mobility after a CVA [30].

This integrative review has relevant points, some limitations found may be related to the heterogeneity of objectives, the duration of the protocols, effects found in each study, and despite these limitations, the evidence found suggests that aquatic physical therapy is an effective treatment for balance in post-CVA patients. A strong point found is that most studies according to the PEDro methodological quality scale (Physiotherapy Evidence Database) have grades with quality ranging from moderate to high.

Conclusion

As for the facts described, we can conclude that aquatic physical therapy produces significant effects in the treatment of balance disorders in post-CVA patients, showing greater effectiveness when compared to conventional neurofunctional physical therapy techniques. Regarding the evaluative measures of balance, the BBS and the TUG proved to be the gold standard, given that they were the most used scales for being easy and quick to apply. With regard to the most suitable techniques, there was heterogeneity between the studies, which made our comparison difficult. Thus, it is necessary research that seeks results more accurate to define a linear and standardized therapeutic approach.

Conflict of interest
The authors do not have any conflicts of interest.

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Authors' contribution
Conception and design of the research: Santos ACS, Pratti BB, Lima DP; *Data collection*: Carvalho LT, Santos TES, Albuquerque A, Nader S; *Data analysis and interpretation*: Montelo ES, Filgueiras JR, Nascimento JF; *Writing the manuscript:* Santos ACS, Pratti BB, Lima DP, Carvalho LT, Santos TES; *Critical review of the manuscript for important intellectual content*: Pereira TMA, Siqueira JIB, Nascimento LS; Silva JM, Orsini M, Souza NL, Teles AS, Teixeira S, Bastos VHV

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