

# Early Intervention in Patients diagnosed with Hydrocephalus: A Literature Review

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**Abstract**—*Introduction: Hydrocephalus is defined by the increase in cerebrospinal fluid (CSF), the result of dilation of the cerebral ventricles resulting from this accumulation. Spasticity in the upper and lower limbs, postural deviations, irritability, changes in fine and thick motor coordination, personality changes and developmental retardation are some of the signs and symptoms. Physiotherapy plays an essential role in the neuropsychomotor development of these patients. Objective: Understand the performance and benefits of physiotherapy in the early treatment of patients diagnosed with hydrocephalus. Material and Method: The methodology used was an integrative bibliographic review of qualitative character, which aims to demonstrate the contribution of physiotherapy in early performance in patients with hydrocephalus. Conclusion: Physiotherapy plays an important role in the development of patients with hydrocephalus, softening motor sequelae and improving the quality of life of patients.*

**Keywords**— *Hydrocephalus, Cerebrospinal Fluid, Pathology Infant, Neuropediatric Physiotherapy.*

## I. INTRODUCTION

Hydrocephalus is defined by the increase in cerebrospinal fluid (CSF), the result of dilation of the cerebral ventricles resulting from this accumulation. It changes production, absorption, and circulation generating an obstruction in the drainage of the liquid into the bloodstream and may cause the increase or not of cranial pressure [1,2].

The main clinical consequences of this obstruction are intracranial hypertension, which, for a better prognosis, introduces a peritoneal ventricular shunt system (PVSS), for the deviation of CSF that accumulates in the cerebral ventricles [3]. It is believed that after surgery and implantation of PVSS leads to an improvement in the signs and symptoms caused by the pathology, although signs that tissue damage remains.

This pathology is more in the infant population, where it can happen in two aspects: congenital and acquired. Congenital when it is diagnosed shortly after birth or intrauterine, during prenatal consultations. It can be caused by any disorders during pregnancy, in the course of embryonic development. The acquired occurs after birth caused by trauma, meningitis, and or diseases such as meningitis, trauma, tumors [4].

According to [5], hydrocephalus can be classified as communicative, which results from interruption of cerebrospinal fluid circulation in the subarachnoid space or from the deficiency of the absorption mechanism of the spinal brain fluid. And the non-communicating one that indicates an obstruction of the cerebral fluid inside the ventricular system, near the foramen of the fourth ventricle.

The clinical signs that the patient may present are related to increased cranial circumference, spasticity in the upper and lower limbs, postural deviations, irritability, changes in fine and thick motor coordination, personality changes, and developmental retardation, [6].

Physiotherapy plays an essential role in the neuropsychomotor development of these patients, to soften motor and neurological sequelae and thus grant improvement in their quality of life [7]. It aims to create pathways for the anatomy functional pathways of the nervous system, through repetitive and specific movements replacing partially damaged pathways to improve the changes caused by disuse or little activity and lack of stimuli [8]. Physiotherapy in addition to exercising techniques that bring relief to patients can develop exercises that return physical and functional capacity according to the evolution

of each patient, it is also important that this provides a special moment of empathy and sensitivity, that understands the psychological state and that build a conscious relationship between therapist and patient understanding through performance, the need for competent enforcement [9].

Early physiotherapeutic intervention can help to improve the evolution of treatment and later in the progress of good prognosis of the disease aiming at improving functional and motor skills [10].

Given the theory presented, it can be seen that hydrocephalus is worthy of prominence due to its relative frequency and morbidity, as well as the large number of sequelae it can cause, especially if this patient is of premature birth. The suspicion of diagnosis and confirmation at the appropriate time will provide subsequently effective assistance and rehabilitation, by the appropriate monitoring protocol and conducts.

## II. JUSTIFICATION

The justification for this study is related to early diagnosis together with multi-professional treatment where physiotherapy is part and that will provide advances for patient development, resulting in functional independence and quality of life. the actions of family members and caregivers are also highlighted, as they directly contribute to the cognitive and motor development of these patients with hydrocephalus [11].

## III. PROBLEMATIC

Can early physical therapy contribute to a better functional prognosis about neuropsychomotor development in patients diagnosed with hydrocephalus? Can this early intervention increase the chances of this patient having a minimal motor and cognitive impairment?

## IV. GENERAL OBJECTIVE

This study aims to understand the performance and benefits of physiotherapy in the early treatment of patients diagnosed with hydrocephalus.

### 4.1 SPECIFIC OBJECTIVES

The specific objectives mention the need to cover how the physical therapy treatment of this pathology can decrease complications and delay in neuropsychomotor development (NPMD);

Present the advances and techniques that physiotherapy have to contribute to the development of

patients;

Understand the pathophysiology of the disease, taking into account the importance of family support during treatment.

## V. MATERIALS AND METHODS

The methodology used was a qualitative integrative bibliographic review, which aims to demonstrate the contribution of physiotherapy in early performance in patients with hydrocephalus, where a study with explanatory purpose was conducted from March to May 2020, in which literary authorship, scientific articles, and journals were chosen. A search had been carried out in the databases of Lilacs (Latin American Literature in Health Science), Medline (Medical Literature Analysis and Online System), Scielo (Scientific Electronic Library Online), and Google scholar (Google scholar) of the last ten years.

The research included only studies published between 2009 and 2020 and was limited to languages in Portuguese and English., using the keywords according to the classification of descriptors in Health Science (DeHS): physiotherapy in hydrocephalus and its core reports in the English language. Thirty articles were selected, where 20 were excluded because they were not following the proposed theme, or presented a date lower than the established. with the following references: effects of early physiotherapy in patients with hydrocephalus, hydrocephalus, physical therapy in hydrocephalus, and myelomeningocele.

## VI. EXPECTED RESULTS

New information regarding advances in treatment and therapy intervention can be found, such as new ways of diagnosing, as well as new methodologies in follow-up for the better advancement of PMD in patients with this pathology.

## VII. CONCEPTUAL THEORICH REFERENCE

### 7.1 PHYSIOLOGY AND PATHOPHYSIOLOGY OF HYDROCEPHALUS

Cerebrospinal fluid (CSF) known as CSF or fluid brain – spinal is found in the subarachnoid space in the brain and spinal cord between the arachnoid meninges and pia mater. This liquid produced by the choroid plexus of the lateral ventricles and subarachnoid spaces acts directly to supply nutrients and remove metabolic residues from nervous tissues and has as function the mechanical protection of the central nervous system (CNS). The balance between CSF

production and absorption is responsible for keeping liquid volume stable.

Hydrocephalus is characterized by increased CSF volume along with the dilation of the cerebral ventricles. A change in the flow, or consequence of an obstruction of the scandic circulation, which can occur in several sites, in the foramen

of Monro, in the Sylvius aqueduct, in the foramen of Magendie, in the foramen of Lucha, or the subarachnoid space.

The etiology may be linked to factors of environmental, genetic origin, or multifactorial inheritance.

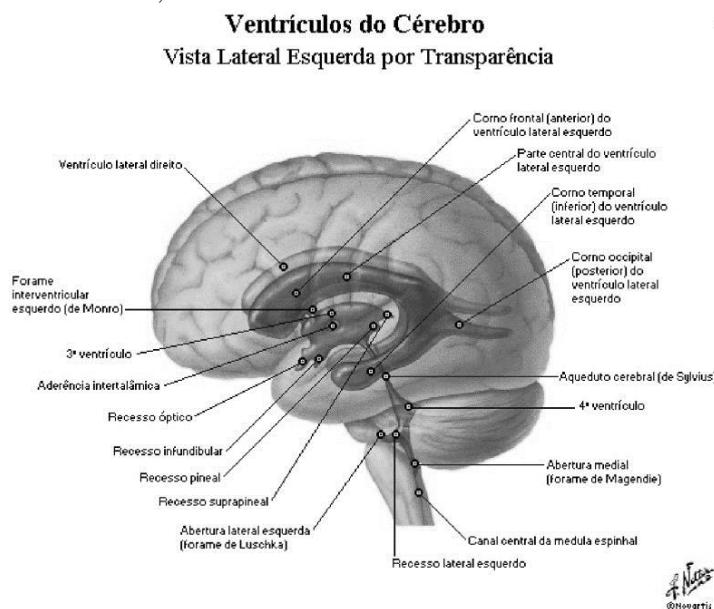


Fig.1: Sagittal section of the brain where it shows the CSF circulation at the beginning of its production passing through the choroid plexus and ventricles until its absorption in the arachnoid villi.

Source: Frank H. Netter (5 ed. 2011)

The pathophysiology is directly linked by an increase in the ventricular cavities due to an increase in the volume of the cerebrospinal fluid as a consequence of the imbalance between the production and absorption of the same, with

obstruction of the cerebrospinal fluid in the ventricular system or outside it, or there is an imbalance between the production and resorption of CSF.

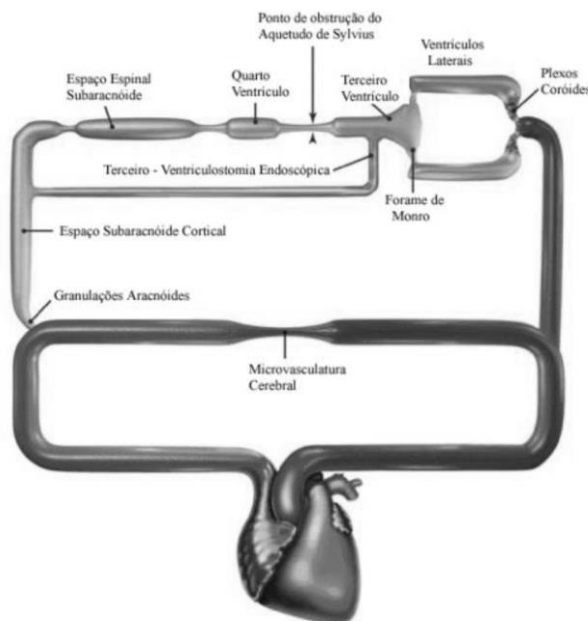


Fig.2: Circulation of the schematic CSF.

Source: Fabbro (2008, apud ReKate, 1994, p.37).

This pathology has become one of the easiest anomalies to be diagnosed during prenatal care, as it is given according to what is usually found in scans, such as ventricular dilation and the observation of a greater distance between the ventricles, extremities of the lateral ventricles, and cerebral hemispheres (this explanation is defined by the Evans Index). This diagnosis can already be found and visualized from the second trimester of pregnancy.

## 7.2 CLASSIFICATION OF HYDROCEPHALUS

Hydrocephalus is a pathological quality that has become known for developmentally, especially about treatment. It is the result of an imbalance resulting from the lack of bad distribution of this liquid [3]. Hydrocephalus is divided into Communicative - which is the obstruction or interruption of cerebrospinal fluid flow in the subarachnoid space shortly after leaving the fourth cerebral ventricle. Non-communicating – which results in obstruction of cerebral fluid in the ventricular system, that is, there is no communication of the system with the subarachnoid space. These manifestations are directly related to the patient's age, as well as speed [12].

This pathology can also be congenital or acquired, and in the congenital form, it is diagnosed at birth or even when it is still in the mother's belly. And in the acquired form that can present at any age by various circumstances such as infections, head trauma, brain tumors, stroke, or cerebral hemorrhages.

According to [12], hydrocephalus is caused by the mis adjustment between the production and drainage of the liquid into the bloodstream, and several possibilities cause this pathology to arise, such as:

Brain tumor – tumors cause swelling in brain tissues, becoming weak drainage causing then a buildup of fluid in the cerebral ventricles.

Prematurity – premature babies are more susceptible to the development of hydrocephalus because they are more vulnerable as many parts of the body are still maturing and thus more vulnerable to disease than those born at term.

Meningitis – is an infection of the meninges or membranes that protect and cover the brain. The expansion of this infection can prevent the drainage pathways of the cerebral fluid thus causing hydrocephalus [12].

The improvements that have expanded in the treatment of hydrocephalus have not only occurred in the techniques, but also the virtues of surgeries, imaging diagnosis, and physiotherapy. These contributions allow for a more accurate diagnosis and treatment [13].

## 7.3 SIGNS AND SYMPTOMS OF HYDROCEPHALUS

The symptoms of hydrocephalus diversify according to age and several factors can influence their appearance. The newborn may present rapid growth of the skull cap with changes in the shape of the skull due to the accumulation of fluid in the cerebral ventricles. The most common findings are: irritability, vomiting, lethargy, looking at the setting sun (looking face down), dilated fontanel (moleira), drowsiness, and delay in the deficit of motor and cervical control due to increased head circumference and weight, disfavoring motor development.

Older children may present with loss of motor coordination, balance, headache, nausea, vomiting, inattention. Neuropsychomotor deficits and developmental delay can occur in several forms as an example of functional limitations. Advances in patients with delayed neuropsychomotor development are directly related to the early diagnosis of hydrocephalus because the sooner it happens, the more likely the patient will be facing multidisciplinary treatment, thus reducing subsequent neurological alterations. The characteristic clinical symptoms are often identified from the second year of life because, in addition to the physical signs, they should take into account the neurological evaluation and the clinical history of the patient [13].

## 7.4 PHYSICAL THERAPY IN HYDROCEPHALUS

The most used intervention nowadays is surgical intervention, which boils down to the use of a device or valve (shunt), connected to a catheter, whose extremity is introduced into the peritoneal cavity (heart or intestine) to bypass the circulation of the liquor, where it will be absorbed into the bloodstream. On the other hand, physiotherapy can act in various ways to reduce or delay the signs, or symptoms caused by the pathology. Physiotherapy should be performed as early as possible for the stimulation of age-appropriate functional skills and synthesize secondary deficiencies [14].

Physiotherapy directly influences not only the neuropsychomotor development but also on the intrinsic development of the child improving their functional abilities [15].

*“The investigation of the evolutionary process of the child and the identification of problems related to its development allows early intervention in evolutionary delays and the implementation of simulation programs for children with developmental disorders. The formal objective of early intervention is to reduce the negative effects of a high-risk history, as many suffer the influence of impoverished experiences, in the family environment and environments such as daycare centers and schools” [16].*

Based on the context, physiotherapy has as one of the

objectives, the reduction of pathological reflex activity to thus normalize muscle tone, facilitating the movement considered normal making it an improvement in muscle strength, range of motion (ROM), flexibility, and improvement in movement patterns and basic motor capacity resulting in improved patient functionality [14].

Early stimulation, also known as essential stimulation for development, aims at the sensory-motor, affective development of preterm babies, and also with the integration of the family member with a newborn [17]. The child with hydrocephalus can often this associated with decreased adipose tissue, decreased muscle tone, the cranium is relatively larger compared to the body, distended abdomen, impaired respiratory function, deficient rib cage. When the therapist initiates early stimulation, it becomes possible for the child to experience normal movements and posture through normalization of muscle tone, favoring the development closer to the considered normal, through a thorough evaluation, identifying possible disorders and thus able to elaborate specific conducts for each patient and then perform an appropriate treatment [18].

Through physical therapy, changes in neuropsychomotor development can be diagnosed, improve posture quality, avoiding abnormal patterns, prevent deformities and contractures, increase hospitalization time, attenuate respiratory changes caused by pathology and hospitalization, normalize and stabilize motor patterns, such as muscle tone and tropism, stimulate and monitor neuropsychomotor development. Parents need to accompany their children during treatment because they will continue treatment according to the guidance passed on by the therapist, the resources used should lead to the same final goal, such as the need to maintain the best positioning for the patient, to improve functional performance and motor behavior, sensorimotor stimulation, among others [13].

Among the many physiotherapy therapy techniques that can be applied in the treatment of the disease, both respiratory and motor, hydrotherapy resources can also be used, because this technique can add a lot to the treatment due to the physical properties of heated water, such as buoyancy, the relief of irritability, hydrostatic pressure of water and the density of water that allows the body to fluctuate. A resource for enriching the patient's treatment, to promote greater functional capacity and consequently a better quality of life for the patient [14].

Another technique that is available and that can be well used to the development of the patient with hydrocephalus is Bobath. The Bobath concept assumes the principle of facilitation of movement through the application of "key

control points". The use of adequate and functional movement aims to inhibit abnormal patterns of spastic synergism through the least possible effort, this consequently influenced postural control and the performance of functional activities. The facilitation and inhibition techniques are performed by a physiotherapist through key points, in this technique can also be used the weight discharge, because the same causes pressure and, at the same time, the recruitment of motor units, also has an extremely important role for the release of the other segments that are sustaining so that the other movements are performed [17].

Thorough evaluation and therapeutic diagnosis should be performed to evaluate the general motor status of the patient, elaborating short- and long-term objectives and goals with appropriate treatment plans, to meet the individual needs of each patient. If physical therapy is established early the prognosis of the disease will reach a good evolution, since the hydrocephalus when undergoing physical therapy treatment appropriated when they reach progress in their functional abilities. The physiotherapist's follow-up in the motor learning process is of paramount importance as well as the guidance to caregivers and family members for an evolution in the functional independence of the patient with hydrocephalus [10].

As is known, hydrocephalus is a chronic disease that affects the functionality of patients without their activities of daily living (ADLs). The quality of the domestic stimulus can influence the cognitive development of the patient, as well as in the environment in which he/she is inserted, as well as in the family structure. Therefore, the physiotherapist should be attentive and transmit guidance and information to caregivers regarding the care and stimulation of the patient at home [19].

The advancement of the patient depends on a set of circumstances that were part of the beginning of physical therapy treatment, the impairment of the central nervous system to the action, and the understanding of the caregivers of the patients.

## VIII. CONCLUSION

Patients diagnosed with hydrocephalus may present physical and motor restrictions, such as the deficit in cervical and trunk control due to increased head circumference and consequently their weight, due to increased intracranial pressure and may cause neural lesions that will result in motor development. Physiotherapy plays an important role in the development of patients with hydrocephalus, softening motor sequelae and improving the quality of life of patients, using techniques that are available

such as hydrotherapy, the Bobath concept, in addition to passive joint mobilizations, physical-motor stimulation, muscle stretching, muscle strengthening, training of fine motricity, myofascial massage, diaphragmatic release, gait training and guidance to family members.

The physical therapist's action seeks to promote in a preventive manner and the harmony of neuropsychomotor development of patients with hydrocephalus, through techniques that gradually promote functional improvement and develop psychomotricity and motor control, stimulating the relationship between patient and family, making it necessary also a multidisciplinary team that works and treats each aspect in its particularity, respecting the limit and age of patients, especially during treatment.

It is concluded that the physiotherapist should observe during the treatment which techniques fit and become effective to each patient, observing it in its entirety and not only in their motor impairment. Guide family members and caregivers about the stimuli the patient needs to have a better quality of life. Given the facts addressed, it is clear the importance of physiotherapy for the treatment of patients with hydrocephalus, always requiring scientific studies that develop and bring new techniques to the professional environment.

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