International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979; Impact Factor: RJIF 5.72
Received: 12-11-2018; Accepted: 14-12-2018
www.allsubjectjournal.com
Volume 6; Issue 1; January 2019; Page No. 81-84

Effect of shunt operations on cervical range of motion in patients with brain tumors

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Abstract
Objectives: This study aimed to investigate the effect of shunt operations on cervical range of motion in children with brain tumor.
Methods: This study conducted at Children's Cancer Hospital–Egypt (57357) to investigate the effect of ventriculoperitoneal shunt operation on cervical range of motion in patients with brain tumors. The inclusive criteria in this study includes, fifty patients with shunt operation, age from 6 to 16 years, 38 males and 12 females are included, cooperative patients, agreement of patient's family (parents will sign a consent) and fair orientation and awareness. While, the exclusive criteria included, severe infections, patients who receive high dose radiation therapy, mental disorders and open or incompletely healed wounds. The patients groups used in this study includes, fifty patients having brain tumors admitted to undergo shunt operation formed an experimental group (one group study). The cervical range of motion was measured three times. One week before, two weeks before and four weeks after the operation. Neck flexion, extension, bilateral side bending and bilateral rotation movements were measured. Cervical Goniometer (CROM) used for measurements. MANOVA was used to compare the tested variables.
Results: The cervical range of motion decreased slightly in side bending and rotation to both sides after two weeks from the operation. Measurements after four weeks from the operation showed significant increase in all movements.

Keywords: shunt, brain tumor, radiation therapy, CROM goniometer

Introduction

Brain tumors are the most common solid tumors that occur in children. Children of any age may be affected, about 400 children in the UK develop brain tumors each year. Boys are affected slightly more often than girls (Zuccaro, 1999 and Fohlen *et al.*, 2018 and Totapally *et al.*, 2018) [17, 8, 15].

A number of different tumors can lead to CSF blockage if they are located in certain areas. Some of these areas include the lateral or third ventricles, the posterior fossa, and intraspinal tumors. The tumors may be malignant or benign. The fluid is trapped inside the skull and spine and will increase intracranial pressure causing symptoms such as Headache, Sickness, Drowsiness and Unconsciousness. To drain this fluid, a shunt operation must be done (Zuccaro, 1999; Bognar *et al.*, 2003 and El Molla and Hamza (2016) [17, 3, 7].

Anti-seizure medication (to treat and prevent seizures associated with intracranial pressure) and ventriculoperitoneal shunt (VP shunt) are the typical treatment steps for brain tumors. A ventriculoperitoneal shunt may be placed in the head to drain excess fluid from inside the brain that helps to control the pressure inside the brain (Philip, 2005 and Eidsvaag *et al.*, 2018) [14].

A shunt is a long, thin tube that is placed in the brain and then threaded under the skin to another part of the body, usually into peritoneum. The tube allows excess fluid from the brain to drain into the abdominal cavity where the body reabsorbs it. The shunt has valves in place so that fluid can drain away from the brain but not back towards it. The shunt is not visible outside of the body (Ching-Lau, 2010 and Totapally *et al.*, 2018) [15].

Here are a number of complications associated with shunt placement. Many of these complications occur during childhood and cease once the patient has reached adulthood (Wong, 2011) [16].

Ventriculoperitoneal shunting (VPS) may rapidly normalize intracranial pressure (ICP) in the setting of hydrocephalus (Gonda *et al.*, 2012) [9]. However, despite the fact that it is considered a minor invasive procedure, it does involve certain risks, such as hemorrhage, shunt malfunction, or infection (Naftel *et al.*, 2011) [12]; in addition, it may rarely result in peritoneal carcinomatosis due to seeding from the central nervous system (CNS) tumors (Belongia *et al.*, 2012) [2].

The most important complications can be summarized in includes Infection (Inamasu *et al.*, 2003) [11], Shunt malfunction that includes, Obstruction (Belongia and Jogal, 2012) [2], Over drainage (Gonda *et al.*, 2012) [9], Intraventricular hemorrhage (El Molla, and Hamza, 2016) [17].

The VP shunt operation is one of the most common in neurosurgical practice for treatment of hydrocephalus. However, malfunction due to proximal obstruction of the ventricular catheter caused by improper placement of the ventricular catheter tip is still a common occurrence. (Conen, *et al.*, 2007 and Ananthanandorn, 2017) [5, 1].

Neck soreness and stiffness was present in (45%) of a study sambles associated with ventriculoperitoneal shunt and ventriculoatrial shunt (Conen A. *et al.*, 2007) [5].

O'Neill *et al.* (2013) [13] reported that, the shunt operation is of high cost operation and its effects commonly on reducing the level of fluids inside of the brain and its effect is transient for limited period and it may associated with many complications that includes Obstruction, Over drainage and Intraventricular hemorrhage.

This study aimed to, investigate the effect of shunt operations on cervical range of motion in children with brain tumor.

Material, subjects and methods

This study conducted at Children's Cancer Hospital –Egypt (57357) to investigate the effect of ventriculoperitoneal shunt operation on cervical range of motion in patients with brain tumors.

Design of the study

Pre – post test design

Inclusive criteria

Fifty patients with shunt operation, Age from 6 to 16 years, 38 Males and 12 females are included, Cooperative patients, Agreement of patient's family (parents signed a consent) and Fair orientation and awareness.

Exclusive criteria

Severe infections, Patients who receive high dose Radiation therapy, Mental disorders and open or incompletely healed wounds.

Instrumentation: the instrument used includes, gravity-reference goniometer (Myrin goniometer) (Hazel, 2000).

Groups

Fifty patients having brain tumors admitted to undergo shunt operation will form an experimental group (one study group).The subjects underwent cervical range of motion measurement by CROM three times in the following schedule;

a. One week before the operation.
b. Two weeks after the operation.
c. Four weeks after the operation.

Statistical Analysis

Statistical analysis was conducted using SPSS for windows, version 22 (SPSS, Inc., Chicago, IL). The current test involved one independent variable was the (measuring periods); within subject factor which had three levels (pre operation, post 2 weeks of operation, and post 4 weeks of operation). In addition, this test involved six tested dependent variables (ROM of flexion, extension, left and right rotation and side bending). Accordingly, repeated measure MANOVA was used to compare the tested variables of interest at different tested measuring periods. Within subject MANOVA was performed on the examined sample with the alpha level 0.05.

Data collected will be analyzed statistically using

1. Mean and standard deviation.
2. Paired T-test will be used to compare pre-operative and post-operative results.

Results and Discussion

Results that obtained from repeated measure MANOVA for dependent variables in different measuring periods cleared that, the six tested dependent variables; (ROM of flexion, extension, left and right rotation and side bending) differ significantly ($P < 0.01$) among different periods of either pre-operation, post-2 weeks of operation and post 4-weeks of operation.

Results on ROM of flexion cleared that, the higher level of ROM flexion observed post-4 weeks of operation and the lower flexion ROM observed before operation and post-2 weeks of operation. (Table, 1 and Fig 1).

Table 1: Descriptive statistics and repeated measure MANOVA for the Rom of flexion at different measuring periods.

Mean ±SD	Pre operation	Post 2 weeks of operation	Post 4 weeks of operation
ROM of flexion	46.72±2.13	46.38±1.90	47.78±1.37
The univariate tests for the mean of ROM of flexion at different measuring periods			
	F-value	P-value	
ROM of flexion	20.493	0.0001*	
Multiple pairwise comparison tests (Post hoc tests) for the ROM of flexion at different measuring periods			
	Pre operation Vs. Post 2 weeks of operation	Pre operation Vs. Post 4 weeks of operation	Post 2 weeks of operation Vs. Post 4 weeks of operation
ROM of flexion	0.021*	0004*	0.0001*

*Significant at alpha level <0.05

Results on ROM of extension cleared that, the higher level of ROM extension observed post-4 weeks of operation and the lower Rom extension observed before operation and post-2 weeks of operation. (Table, 2 and Fig. 2)

Table 2: Descriptive statistics and repeated measure MANOVA for the ROM of extension at different measuring periods.

Mean ±SD	Pre operation	Post 2 weeks of operation	Post 4 weeks of operation
ROM of extension	56.16±2.30	56.30±2.13	58.02±1.26
The univariate tests for the mean of ROM of extension at different measuring periods			
	F-value	P-value	
ROM of extension	27.376	0.0001*	
Multiple pairwise comparison tests (Post hoc tests) for the ROM of extension at different measuring periods			
	Pre operation Vs. Post 2 weeks of operation	Pre operation Vs. Post 4 weeks of operation	Post 2 weeks of operation Vs. Post 4 weeks of operation
ROM of extension	0.999	0.0001*	0.0001*

*Significant at alpha level <0.05

While, results on ROM of left rotation cleared that the higher level was before operation and 4 weeks after and the lower level was after 2-weeks post-opeartion. (Table, 3 and Fig. 3)

Table 3: Descriptive statistics and repeated measure MANOVA for the ROM of left rotation at different measuring periods.

Mean ±SD	Pre operation	Post 2 weeks of operation	Post 4 weeks of operation
ROM of left rotation	75.82±4.67	75.24±3.59	76.52±2.27
The univariate tests for the mean ofROM of left rotation at different measuring periods			
		F-value	P-value
ROM of left rotation		16.457	0.0001*
Multiple pairwise comparison tests (Post hoc tests) for the ROM of left rotation at different measuring periods			
	Pre operation Vs. Post 2 weeks of operation	Pre operation Vs. Post 4 weeks of operation	Post 2 weeks of operationVs. Post 4 weeks of operation
ROM of left rotation	0.999	0.002*	0.0001*

*Significant at alpha level <0.05

While, results on ROM of right rotation cleared that, the ROM right rotation of a higher level post 4-weeks of operation than its level before operation and after 2-weeks of operation. (Table, 4 and Fig, 4).

Table 4: Descriptive statistics and repeated measure MANOVA for the ROM of right rotation at different measuring periods.

Mean ±SD	Pre operation	Post 2 weeks of operation	Post 4 weeks of operation
ROM of right rotation	76.12±4.66	75.60±2.50	78.06±1.43
The univariate tests for the mean ofROM of right rotation at different measuring periods			
	F-value	P-value	
ROM of right rotation	10.061	0.0001*	
Multiple pairwise comparison tests (Post hoc tests) for the ROM of right rotation at different measuring periods			
	Pre operation Vs. Post 2 weeks of operation	Pre operation Vs. Post 4 weeks of operation	Post 2 weeks of operationVs. Post 4 weeks of operation
ROM of right rotation	0776	0.0001*	0.006*

*Significant at alpha level <0.05

While, results on ROM of left side bending cleared that, the ROM of left bending left side bending of a higher level post-4 weeks of operations, than pre-operations and it was in its lower level 2 weeks pre-operation. (Table, 5 and Fig. 5)

Table 5: Descriptive statistics and repeated measure MANOVA for the ROM of left side bending at different measuring periods.

Mean ±SD	Pre operation	Post 2 weeks of operation	Post 4 weeks of operation
ROM of left side bending	43.32±1.37	42.66±1.73	44.42±0.92
The univariate tests for the mean of ROM of left side bending at different measuring periods			
	F-value	P-value	
ROM of left side bending	13.761	0.0001*	
Multiple pairwise comparison tests (Post hoc tests) for the ROM of left side bending at different measuring periods			
	Pre operation Vs. Post 2 weeks of operation	Pre operation Vs. Post 4 weeks of operation	Post 2 weeks of operationVs. Post 4 weeks of operation
ROM of left side bending	0.302	0.0001*	0.005*

*Significant at alpha level <0.05

The results of ROM of right side bending cleared that, its level improved after operations by 4-weeks post-operations, than its level 2-weeks post-operations and pre-operations. (Table, 6 and Fig. 6).

Table 6: Descriptive statistics and repeated measure MANOVA for the ROM of right side bending at different measuring periods.

Mean ±SD	Pre operation	Post 2 weeks of operation	Post 4 weeks of operation
ROM of right side bending	43.42±1.60	42.8±1.53	44.52±0.97
The univariate tests for the mean ofROM of right side bending at different measuring periods			
	F-value	P-value	
ROM of right side bending	10.812	0.0001*	
Multiple pairwise comparison tests (Post hoc tests) for the ROM of right side bending at different measuring periods			
	Pre operation Vs. Post 2 weeks of operation	Pre operation Vs. Post 4 weeks of operation	Post 2 weeks of operationVs. Post 4 weeks of operation
ROM of right side bending	0.415	0.0001*	0.004*

*Significant at alpha level <0.05

Discussion

Results that obtained from repeated measure MANOVA for dependent variables in different measuring periods cleared that, the six tested dependent variables; (ROM of flexion, extension, left and right rotation and side bending) differ significantly ($P < 0.01$) among different periods of either pre-operation, post-2 weeks of operation and post 4-weeks of shunt operation.

The measurements of the cervical range of motion showed that shunt operations has very mild effect which appears just after 2 weeks on certain motions (side bending and rotation to both sides) and it improved and was in its highest level after 4 weeks from the operation.

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