

Morphometric study of the fourth ventricle of brain by computed tomography in hydrocephalic children in tertiary hospital of Telangana

Radhakrishna Palla

Assistant Professor, Dept. of Anatomy, RVM Institute of Medical Sciences & Research Center, Siddipet, Hyderabad

Email: drradhaeradhae@gmail.com

Abstract

Introduction: Aim of the study was to determine the morphometric measurement of the fourth ventricle of brain by computed tomography in hydrocephalic children, and to assess its importance in different age groups.

Materials and Method: The study group included CT Scans of 50 normal and 50 hydrocephalic children between 0-12 yrs attending the Department of Radiology, Niloufer hospital Hyderabad Telangana between November 2013 to August 2014. Maximum height, width of the fourth ventricle were measured and statistically analyzed.

Results: Out of 50 Hydrocephalic cases 24 (48%) were males and 26 (52%) were females, 31 were below 3 years and 19 were above 3 years. Mean height of fourth ventricle (13.07 \pm 6.03 95% CI 11.88-14.25mm) is more than control (6.94 \pm 1.14, 95% CI 6.71-7.16mm). Mean width of fourth ventricle (14.9 \pm 6.24 95% CI 13.66-16.13mm) is more than control (11.1 \pm 1.88, 95% CI 10.72-11.47mm). Mean height of fourth ventricle in males (12.62 \pm 6.4 95% CI 10.11-15.13mm) is less than females (13.49 \pm 6.2, 95% CI 10.98-16.0mm). Mean width of fourth ventricle in males (15.70 \pm 7.9, 95% CI 12.84-18.56mm) is more than females (14.16 \pm 5.7, 95% CI 11.84-16.48mm). Mean height of fourth ventricle in children below 3 yrs (13.45 \pm 6.39, 95% CI 14.9-11.9mm) is more than in above 3 yrs (12.34 \pm 5.37, 95% CI 10.28-14.3mm). Mean width of fourth ventricle in children below 3 yrs (15.24 \pm 7.26, 95% CI 13.58-16.89mm) is more than in above 3 yrs (14.23 \pm 3.63, 95% CI 12.83- 15.62mm).

Conclusions: The study shows significant difference in height and width of fourth ventricle among cases and controls. It was not significant in gender and age.

Key words: Hydrocephalic children, Fourth ventricle.

Introduction

The outcome of pediatric hydrocephalus, including surgical complications, neurological sequel, academic achievement has been the matter of many studies. Mortality caused by hydrocephalus and its treatment is between 0-3% depending on the duration of follow up.⁽¹⁾ Obstruction in the circulation of CSF leads to accumulation of fluid with in the ventricular system which causes compression of brain. Within the brain critical points at which obstruction may occur correspond to the narrow foramina and passage of the ventricular system. Conventional view is that obstruction with in the subarachnoid space impair CSF circulation and lead to CSF malabsorption causing either obstruction or communicating hydrocephalus. Thus, obstruction or congenital absence of the apertures of the fourth ventricle leads to enlargement of the entire ventricular system.⁽²⁾ Morphometric analysis of cerebral ventricular system is important for evaluating changes due to growth, aging, intrinsic and extrinsic pathologies.⁽³⁾ Computerized axial tomography is a safe non-invasive technique which can be utilized for morphometrical evaluation of the ventricles.⁽⁴⁾ The present work was undertaken to analyse the morphometry of fourth ventricle of brain in hydrocephalic children by CT scan method.

Material and Method

On approval from ethical committee CT scans of 50 cases of hydrocephalic children of age group 0-12 yrs were studied for a period from November 2013 to

August 2014 attending department of Radiology, Niloufer Hospital for women and children, Hyderabad Telangana. 50 normal CT scans of same age children collected randomly were included as control group.

Exclusion Criteria:

- CT scans of teenagers and adults.
- CT scans of trauma, head injury.
- CT scans showing intracranial hemorrhage.
- CT scans of patients with previous head surgeries.

Computed tomography of these patients was performed on Toshiba, Aquilion, TSX-101A, Multi slice Detector CT scanner with a scan time of 0.5sec and slice thickness of 5mm. A constant 120kvp station was used. Routine scanning was done on 360 degree standard scan with the following scan parameters.

CT machine specifications:

- Scan protocol: Axial
- patient position: supine
- direction: cranial to caudal
- slice thickness: 5 mm
- scan time: 0.5sec
- rotation time: 0.5sec
- voltage: 120kvp
- resolution: standard
- slice increment: 0.5mm
- rotation: 12.5mm
- Table position: 50mm
- m As: 150 m As/slice

The patient was placed on CT table in supine position. The table was adjusted in required position

using the push button to manipulate the table position; the patient was centralized and supported for correct alignment and to reduce blurring images. Head was centered to the criss cross point of the light beam at external auditory meatus. The vertical light beam was made to coincide with the orbitomeatal line. This position represents the table zero position. The gauze pads were kept on either side of the head and the head band was placed across the forehead to immobilize the head.

The following CT scan parameters were used in the study:

- Maximum height of fourth ventricle.
- Maximum width of fourth ventricle.



Fig. 1: CT scan of 18 months old female showing grossly dilated fourth ventricles

A-B Maximum height of the fourth ventricle



Fig. 2: CT scan of 18 months old female showing grossly dilated fourth ventricle
A-B Maximum width of the fourth ventricle

Results

Table 1: Measurements of fourth ventricle

Name of the parameter	Cases				Control			
	Mean	SD	SD		Mean	SD	95%CI	
			UL	LL			UL	LL
Fourth ventricle Height (mm)	13.07	6.03	14.25	11.88	6.94	1.14	7.16	6.71
Fourth ventricle Width (mm)	14.9	6.24	16.13	13.66	11.1	1.88	11.47	10.72

a. Mean height of fourth ventricle of cases (13.07+/-6.03 95%CI 11.88-14.25mm) is more than control (6.94+/-1.14,95%CI 6.71-7.16mm) ; Z = 7.063 ; p = <0.001 ; 95% CI upper = 7.831; Lower = 4.429

Z test =7.063 shows significant difference in two groups in terms of mean; p <0.001

b. Mean width of fourth ventricle (14.9+/- 6.24 95% 13.66-16.13mm) is more than in control (11.1+/-1.88,95%CI 10.72-11.47mm) ; Z = 4.123 ; p= <0.0001 ; 95% CI upper = 5.606; Lower = 1.993

Z test =4.123 shows significant difference in two groups in terms of mean; p <0.0001

Chart 1: Shows the measurements of Fourth ventricle

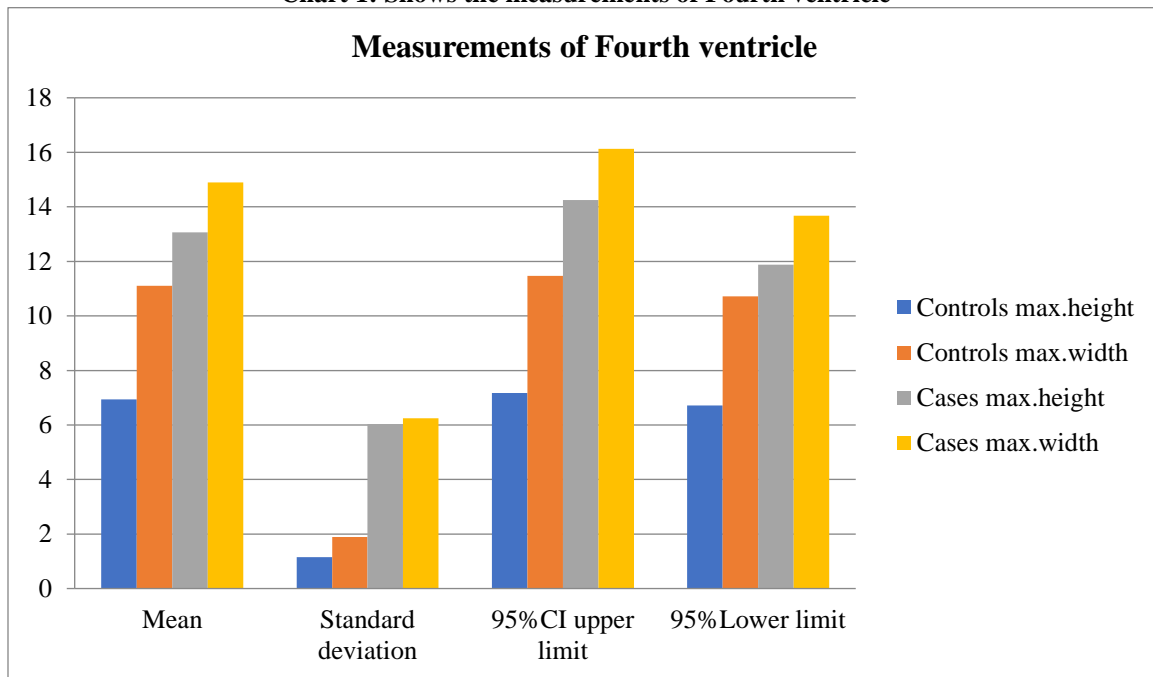


Table 2: Measurements of fourth ventricle in Hydrocephalic children according to gender

Name of the parameter	Males				Females			
	Cases				Cases			
	Mean	SD	CI		Mean	SD	CI	
ul			ll	ul			ll	
Fourth ventricle Height(mm)	12.62	6.4	15.13	10.11	13.49	6.2	16.0	10.98
Fourth ventricle Width(mm)	15.70	7.9	18.56	12.84	14.16	5.7	16.48	11.84

a. The mean fourth ventricle Height (mm) of males (12.62+/-6.4 95%CI 10.11-15.13mm) is less than the mean fourth ventricle Height (mm) of females (13.49+/-6.2, 95%CI 10.98-16.0mm).

Ztest = - 0.488; p = 0.625; 95% CI upper = 2.628; Lower = - 4.368

Z test = -0.48 shows no significant difference in terms of mean; p =0.625

b. The mean fourth ventricle width (mm) of males (15.70+/-7.9,95%CI 12.84-18.56mm) is more than the mean fourth ventricle width (mm) of females (14.16+/-5.7, 95% CI 11.84-16.48mm).

Ztest = 0.785; p = 0.432; 95 % CI upper = 5.386; Lower = - 2.306

Z test =0.78 shows no significant difference in terms of mean; p =0.432

Table 3: Measurements of fourth ventricle in Hydrocephalic children according to age

Name of the parameter	Below 3 yrs				Above 3 yrs			
	Cases				Cases			
	Mean	SD	CI		Mean	SD	CI	
ul			ll	ul			ll	
Fourth ventricle Height(mm)	13.45	6.39	14.9	11.99	12.34	5.37	14.39	10.28
Fourth ventricle Width(mm)	15.24	7.26	16.89	13.58	14.23	3.63	15.62	12.83

- a. The mean Fourth Ventricle Height (mm) in children below 3 yrs (13.45 \pm 6.39, 95% CI 14.9-11.9mm) is more than the mean Fourth Ventricle Height (mm) in children above 3 yrs (12.34 \pm 5.37, 95% CI 10.28-14.3mm).

Z-test = 0.660; p = 0.509; 95% CI upper = 4.41; Lower = - 2.19

Z test =0.66 shows no significant difference in terms of mean p=0.509

- a. The mean Fourth Ventricle Width (mm) in children below 3 yrs (15.24 \pm 7.26, 95% CI 13.58-16.89mm) is more than the mean Fourth Ventricle Width (mm) in children above 3 yrs (14.23 \pm 3.63, 95% CI 12.83- 15.62mm).

Ztest = 0.653; p = 0.514; 95 % CI upper = 4.042; Lower = - 2.022

Z test =0.653 shows no significant difference in terms of mean p=0.514

Discussion

In the present study,

- a. Mean height of fourth ventricle (13.07 \pm 6.03 95%CI 11.88-14.25mm) is more than control (6.94 \pm 1.14,95%CI 6.71-7.16mm). Z test =7.063 shows significant difference in height of fourth ventricle between two groups in terms of mean p <0.001. Mean width of fourth ventricle (14.9 \pm 6.24 95% 13.66-16.13mm) is more than in control (11.1 \pm 1.88,95%CI 10.72-11.47mm) Z test =4.123 shows significant difference in width of fourth ventricle between two groups in terms of mean p <0.0001.
- b. The mean fourth ventricle Height (mm) of males (12.62 \pm 6.4 95%CI 10.11-15.13mm) is less than The mean fourth ventricle Height (mm) of females (13.49 \pm 6.2,95% CI 10.98-16.0mm). Z-test = - 0.488; p = 0.625; among the hydrocephalic children there is no significant difference in height of fourth ventricle between males and females.
- c. The mean fourth ventricle width (mm) of males (15.70 \pm 7.9,95%CI 12.84-18.56mm) is more than the mean fourth ventricle width (mm) of females (14.16 \pm 5.7,95% CI 11.84-16.48mm). Z-test = 0.785; p = 0.432; among the hydrocephalic children there is no significant difference in width of fourth ventricle between males and females
- d. The mean Fourth Ventricle Height (mm) in children below 3 yrs (13.45 \pm 6.39, 95% CI 14.9-11.9mm) is more than the mean Fourth Ventricle Height (mm) in children above 3 yrs (12.34 \pm 5.37, 95% CI 10.28-14.3mm). Z = 0.660; p = 0.509; among the hydrocephalic children there is no significant difference in height of fourth ventricle between two age groups.
- e. The mean Fourth Ventricle Width (mm) in children below 3 yrs (15.24 \pm 7.26, 95% CI 13.58-16.89mm) is more than the mean Fourth Ventricle Width (mm) in children above 3 yrs (14.23 \pm 3.63,

95% CI 12.83- 15.62mm). Z = 0.653; p = 0.514; among the hydrocephalic children there is no significant difference in width of fourth ventricle between two age groups.

Medora DC and Natekar PE(2007)⁽⁵⁾ in their study reported that the height of the fourth ventricle to be greater in males than in females and the width of the fourth ventricle was greater than the height in both genders and was more in males than in females. Usman et al; 2012⁽⁶⁾ in their study stated that the height of the fourth ventricle was larger in males (10.15mm) as compared to females (8.38mm) and the width of the fourth ventricle was also observed to be greater in males (13.23mm) than in females(12.17mm).

Conclusion

There is significant difference in height and width of fourth ventricle between hydrocephalic cases and controls of age 0-12yrs. But there is no significant difference in height and width of fourth ventricle among hydrocephalic children of age 0-12 yrs.

References

1. Vinchon et al. Fluids and Barriers of the CNS 2012;9:18.
2. Standring S, Gray's Anatomy The Anatomical Basis of Clinical Practice 40th edition, Churchill Livingstone Elsevier:2008.
3. Aziz, Aamer , Hu, Qing M, Nowinski, Wieslaw L, Morphometric analysis of cerebral ventricular system from MR images. Med Imag 2004;5369:574-82.
4. Torkildsen A. The gross anatomy of lateral ventricles. J Anatomy 1934;68:480-91.
5. D'Souza DM, Natekar PE. Morphometric study of the ventricular system of brain by computerized tomography. J. Anat. Soc. India 2007;56(1):19-24.
6. Usman JD, Yunusa GH, Saidu SA, Zagga AD, Bello A, Abdulhameed A, Bello SS, Tadros AA, Bello SM. Cephalometric assessment of the fourth ventricle using computerized tomography. Nigerian Journal of basic and applied science 2012;20(3):208-212.