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Anatomy

MORPHOMETRIC STUDY OF HUMAN FOURTH VENTRICLE OF HUMAN BRAIN BY COMPUTED TOMOGRAPHY

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ABSTRACT

Background: The structure and the function of the brain are so intricate and complex, yet not fully understood. The Cerebral ventricular system is a series of interconnecting spaces and channels within the brain, which are derived from the central lumen of the embryonic neural tube and the cerebral vesicles to which it gives rise[1]. The brain undergoes many gross and pathological changes with advancing age, and also in various dementias with regression of the brain tissue[2,3,4,5]. CSF spaces increase in dementia especially in Alzheimer's disease and Parkinson's disease[2,6,7]. Fourth ventricle was found to be significantly larger in the Autistic group compared to control group[2,8]. The knowledge of normal neuroanatomical changes that occur in brain is important for understanding pathological changes[4].

Methods: For the present study, computerized tomographic scans for 100 patients (50 males and 50 females) in the age group of 25 to 50 years, were studied for the measurements of fourth ventricle of human brain and it was observed that the height of the fourth ventricle were 1.4556 ± 0.25 SD cm in males and 1.309 ± 0.15 SD cm in females and width of the fourth ventricle were 1.5858 ± 0.24 SD cm in males 1.474 ± 0.18 SD cm in females.

Results: Morphometric parameters Height of the fourth ventricle, width of the fourth ventricle found to be greater in male than in female.

Conclusion: The present study was undertaken to find out the size of the fourth ventricle of human brain in normal individuals; the variations between male and female. The present study has defined the morphometric measurements of fourth ventricle, which has clinical correlation in diagnosis, treatment and surgical intervention.

KEYWORDS : Computed tomography, Morphometry, Cerebral ventricular system, Fourth ventricle.

INTRODUCTION

The brain of the human beings, with its tremendous intellectual functions made him to reach the supreme position in the Universe. The Cerebral ventricular system is a series of interconnecting spaces and channels within the brain, which are derived from the central lumen of the embryonic neural tube and the cerebral vesicles to which it gives rise[1]. The brain ventricular function is a brain development marker and also a predictor of the outcome of neurodevelopment[9,10]. In cases of CNS disorders, ventriculomegaly is commonly considered the ' iceberg tip'[9,11]. Malformations such as corpus callosum agenesis, spina bifida, and heart defects are associated with ventriculomegaly. Fetuses with ventriculomegaly with other defects have a higher risk of chromosomal abnormality, like Down's syndrome[9,12].

Knowledge of anatomy of cerebral ventricular system is important for neurosurgery[13]. It helps the neurosurgeons for accurate localization and complete removal of space occupying lesions around ventricular system. The study of shape and size of ventricular system recently has become a main focus of interest in studies of some neuropsychiatric diseases like schizophrenia and Alzheimer's disease and chronic alcoholism[13,14]. Before the Computed Tomography (CT) has become available, encephalography or ventriculography were the only means of demonstrating the ventricular system and subarachnoid space clearly during the life[15]. Computed Tomography helps in dramatic expansion of our understanding of the normal structure of brain[16]. Symmetry is a poor marker of normality in brain imaging[17], but the cerebral ventricular enlargement is a more sensitive indicator of cortical atrophy due to increasing age and dementias[3].

The range of changes in ventricular size of the brain encountered in clinical practice can lead most people to believe that a decision taken without an exact measure of ventricular size, however, there is likely to be an increasing number of circumstances in which precise measurements will be of value[5]. It should be noted that there is a continuous debate in the literature of neuro anatomy, psychiatry, neuroradiology and neurology over the best method of accessing the various parts of the cerebral ventricular system[18,19].

The aim of this morphometric study is to examine the range in size of the ventricular system of brain in humans and to find any relationship of this with gender and clinical correlation, in their diagnosis, treatment, and the need to intervene surgically (in particular by ventricular shunting procedures) and in judging the efficacy of treatment to deal with hydrocephalus.

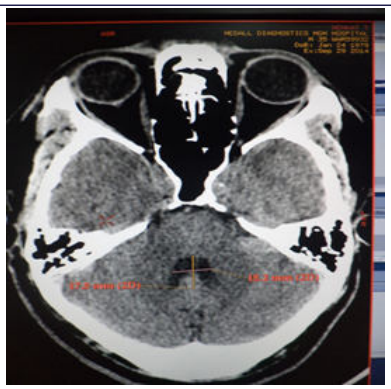
MATERIALS & METHODS

This study was carried out on 100 patients (50 males and 50 females) in the age group of 25 to 50 years, attending the department of Radio diagnosis, Kakatiya Medical College/Mahatma Gandhi Memorial Hospital, Warangal. These patients were selected randomly and had no history of cerebral infarction, local mass lesions, probable communicating hydrocephalus, alcoholism, drug abuse, trauma or previous intra-cranial surgery and other hereditary diseases and were not on medication at the time of study. Photographs of computed tomography in monitor of control panel with measurements of length of fourth ventricle and width of fourth ventricle are taken with Sony digital camera.

The measurements taken at the level of fourth ventricle were, the greatest height of fourth ventricle in cm and greatest width of the fourth ventricle in cm. Statistical analysis of the data was performed by using Microsoft excel Software Package 2007. The Mean and standard deviation (SD) of all measurements were estimated. The data was also analyzed by using Z test for significance of difference of the measurements between males and females.

The aim of this morphometric study was to examine the range in size of the fourth ventricle in normal humans, both in males and females, and to find out if there existed any relationship with gender and other clinical relations.

Photograph 1: Showing Height & Width of 4th ventricle of a Female.



Photograph 2: Showing Height & Width of 4th ventricle of a Male.

OBSERVATIONS & RESULTS

Height of the 4th Ventricle: The measurements of height of the fourth ventricle were taken and analyzed. It was observed that the mean height of the fourth ventricle was larger in males (1.4556 ± 0.25 SD cm) as compared to females (1.309 ± 0.15 SD cm), which was statistically insignificant (Z 1.9599) (Table no.1).

Table No. 1. Mean gender difference of Height of fourth ventricle.

	Female (50)	Male (50)
Height (mean)	1.309	1.4556
Standard Deviation	0.1565	0.2593

P(Z<=z) two-tail 0.463558429
z Critical two-tail 1.959963985

Z =>1.96 significant

Width of the 4th Ventricle: The measurements of width of the fourth ventricle were taken and analyzed. It was observed that the mean width of the fourth ventricle was also greater in males (1.5858 ± 0.24 SD cm) as compared to females (1.474 ± 0.18 SD cm), which was also statistically insignificant (Z1.9599) (Table no.2).

Table No. 2. Mean gender difference of Width of fourth ventricle.

	Female (50)	Male (50)
Width (mean)	1.474	1.5858
Standard Deviation	0.1896	0.2405

P(Z<=z) two-tail 0.398669
z Critical two-tail 1.959964

Z =>1.96 significant

DISCUSSION

The human nervous system is most complex, widely investigated and yet poorly understood physical system known to mankind (Williams et al). The brain undergoes many gross and pathological changes with advancing age, and also in various dementias, with regression of brain tissues (Schochet et al).

The range of changes in the ventricular size of the brain encountered in clinical practice can lead most people to believe that a decision taken without an exact measure of ventricular size, however, there is likely to be an increasing number of circumstances in which precise measurements will be of value (D'Souza et al). According to Roberts and Caird (1976), LeMay (1984), modern computerized x-ray tomography allows easy and safe noninvasive study of the ventricular system, without complications, so unlike the pneumoencephalogram and it can be used as a screening procedure for many illnesses.

Studies by Gawler et all (1976), D'Souza et al (2007), revealed that the greatest distance between the roof and the floor of the fourth ventricle was less than 1.2 cms with a mean of 1.08 cms, 1.18+0.27,95% CI 0.65-1.71 cms in males and 1.11+0.24, 95% CI 0.65-1.58 cms in female respectively.

In our present study, it was observed that the mean height of the fourth ventricle was fond to be greater in males (1.4556 ± 0.25 SD cm) as compared to females (1.309 ± 0.15 SD cm), and the mean width of the fourth ventricle was also greater in males (1.5858 ± 0.24 SD cm) as compared to females (1.474 ± 0.18 SD), (Table No. 1) and (Table No. 2).

Height of the fourth ventricle.

The findings of the present study were compared with those of D'Souza DM et al, Usman JD et al, Musa MA et al and Brij Raj Singh et al, the measurements of various studies are shown in table no. 3.

Table No: 3

Comparative values of height of fourth ventricle between various studies

Study	Year	Sample size	Total	Female	Male
D' Souza DM et al	2007	1000	-	1.11	1.18
Usman JD et al	2012	652	-	0.83	1.01
Musa MA et al	2013	112	-	1.12	1.13
Brij Raj Singh et al	2014	358	-	1.21	1.21
Present Study	2014	100	-	1.30	1.45

The present study correlated with the study of D'Souza DM et al, Usman JD et al and Musa MA et al.

Width of the fourth ventricle.

The findings of the present study were compared with those of D'Souza DM et al, Usman JD et al, Musa MA et al and Brij Raj Singh et al, the measurements of various studies are shown in table no. 4.

Table No: 4

Comparative values of width of fourth ventricle between various studies

Study	Year	Sample size	Total	Female	Male
D' Souza DM et al	2007	1000	-	1.21	1.31
Usman JD et al	2012	652	-	1.21	1.32
Musa MA et al	2013	112	-	1.24	1.25
Brij Raj Singh et al	2014	358	-	1.10	1.10
Present Study	2014	100	-	1.47	1.58

The present study correlated with the study of D'Souza DM et al, Usman JD et al and Musa MA et al.

CONCLUSION

The present study was undertaken to find out the size of the fourth ventricle of human brain in normal individuals; the variations between male and female.

The present study found the mean height of fourth ventricle (Males 1.4556, Females 1.309) and width of fourth ventricle (Males 1.5858, Females 1.474), the Z value was 1.959964, which was not significant (Z Critical =>1.96 significant).

The findings of this study are in agree with previous studies in the size (Hight and Width) of the fourth ventricles of male are larger than that of female.

The present study has defined the morphometric measurements of fourth ventricle, which has clinical correlation in diagnosis, treatment and surgical intervention.

This study provided useful morphometric data about fourth ventricle while diagnosing, treating the patients, surgical interventions and judging the efficacy of treatment to deal with neuropsychiatric diseases like schizophrenia, Alzheimer's disease, Parkinson's disease, Chronic alcoholism, hydrocephalus in the fields of Psychiatry, Neurology, Neuroradiology and Neurosurgery.

Abbreviations: -

CSF – Cerebrospinal Fluid, CT – Computerized Tomography, SD – Standard Deviation, CNS – Central Nervous System, CI – Confidence Intervals.

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