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Original Article

MORPHOMETRIC STUDY OF FOURTH VENTRICLE BY COMPUTERISED TOMOGRAPHY

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ABSTRACT

Background: The two major changes that may occur in elderly individual without neurologic deficits is enlargement of ventricles and cortical atrophy. Aim of the study was to statistically analyse the dimensions of Fourth ventricle in humans and also to study the Changes that occur during ageing. Ventricular size of males and females was compared.

METHOD: The CT images of 112 adult individuals (Age Group 21-60) and 88 ageing individuals (Age above 61) was studied in both males and females. Measurements like vertical length, height, anterior-posterior diameter and transverse diameter of fourth ventricle was made by using dicomworks software.

RESULT: This study showed positive co-relation of age with dimensions of fourth ventricle and the dimensions of the fourth ventricle were enlarged with physiologic ageing. Also the dimensions of fourth ventricle were more in males as compared to females.

KEY WORDS: CT images, Fourth ventricle, Neurological deficits, Cortical atrophy.

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INTRODUCTION

The brain undergoes many gross and pathological changes with advancing age, and also in various dementias, with regression of brain tissues [1]. The mild to moderate enlargement of ventricles occurs with ageing [2,3,4,5]. Ventricular enlargement is also seen in dementia especially in Alzheimer's disease and Parkinson's disease this can be due to reduction in size of nerve cells [6,7,8,9] The analysis of these clinical conditions remains difficult, mainly due to the fact that anatomical evidence is very small. Regression of the brain with ageing is the normal process [10]. Thus the thorough knowledge of the normal changes that occur in the brain with age is critical before abnormal findings are analysed. The posterior fossa is a small region of skull cradled on all sides by bone and limited above by tentorium. The brain stem, cerebellum and fourth ventricle occupy this region. The dimensions of fourth ventricle enlarge in ageing and various types of hydrocephalus. CT scanning has unusual promise in the evaluation of patients with dementia since, besides excluding occult mass lesions; the amount of ventricular enlargement and sulcus atrophy can actually be seen [11]. The CT studies showed a positive correlation between ventricular enlargement and age with greater degree of ventricular enlargement and cortical atrophy in men as compared to women [12,13]. Therefore the aim of this morphometric study was to analyse the dimensions of fourth ventricle. The fourth ventricular size of males

and females was compared. The changes in normal fourth ventricular size during ageing were studied.

MATERIALS AND METHODS

This was the prospective study of 12 month duration in which CT images of 112 adult individuals (Age Group 21-60) and 88 ageing individuals (Age above 61) of either sex attending department of Radiodiagnosis of municipal corporation hospital for brain CT was studied. The CT scanner used in the study was "SIEMENS SOMATOM VOLUME ZOOM MULTI SLICE (4 SLICE) MULTI DETECTOR SPIRAL CT SCANNER" with a scan time of 1-10 sec and slice thickness of 4mm. Patients were given detailed information about the study and written informed consent was obtained from them for the use of their CT scan images for the purpose of this study before enrolling them into the study. The CT scan images which were reported normal by the individual radiologist were taken. Measurement of fourth ventricle was made by using dicomworks software. Ethics clearance was taken from the institutional ethics committee.

Individuals below 20 years of age and with any history of local mass lesion in brain, cerebral infarction, hydrocephalus, drug abuse and trauma or previous history of intracranial surgery was excluded from the study.

Measurement of the fourth ventricle, from upper margin of pons to lower limit of open part of medulla oblongata:

a) Greatest height in cms, it was measured as the greatest distance between the roof and the floor of the fourth ventricle (Fig 1).

b) Greatest vertical distance (length) of fourth ventricle, from upper margin of pons to lower limit of open part of medulla oblongata. It was calculated by multiplying the number of slices passing through the fourth ventricle with the thickness of each slice.

b) Greatest transverse diameter in cms, maximum transverse distance along the horizontal axis (Fig 2).

Statistical analysis was performed using SPSS software. For all the dimensions maximum, minimum, mean and standard deviation was calculated. The correlation coefficients for all the dimensions of fourth ventricle were calculated for age and gender. For calculation of significance the independent t test was used. The P value of <0.05 was deemed statistically significant.

Fig. 1: Measurement of Fourth ventricle: Height.

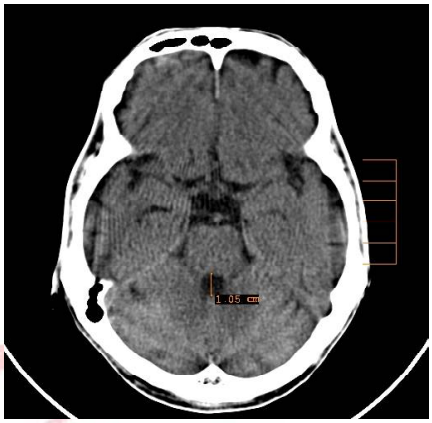
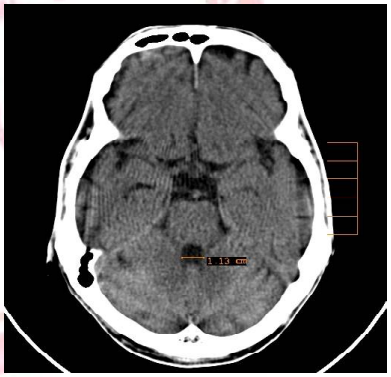


Fig. 2: Measurement of Fourth ventricle: Transverse diameter.



RESULTS

The various measurements of fourth ventricle are shown in table 1 & 2.The greatest height of the fourth ventricle showed low positive correlation with age of males (mean=1.06cm, SD=± 0.146) and of females (mean=0.94, SD= ± 0.217) which was statistically significant in both. The trendline shows increase in height of the fourth ventricle with age in both males and females (Fig.3). The greatest transverse diameter of the fourth ventricle showed low positive correlation with age of males (mean= 1.32cm, SD=± 0.201) and females (mean= 1.19cm, SD=± 0.171) which was statistically significant in both. The trendline shows increase in transverse diameter of the fourth ventricle with age in both males and females (Fig.4). Thus it was seen that the dimension of fourth ventricle increases with age. This change was more in individuals with age above 60 years than in individuals with age 20-60 years and more in

males than in females (table 1, 2).

Fig. 3: Correlation of age with greatest height of fourth ventricle for all male and female samples.

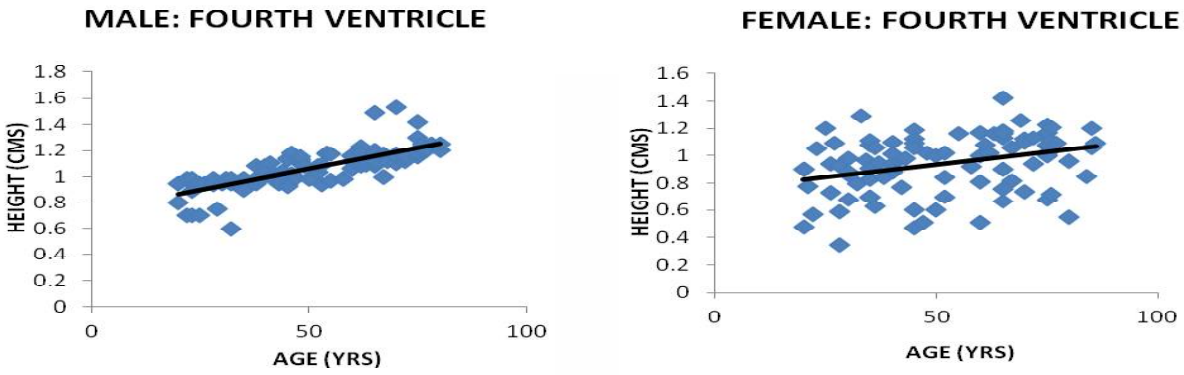


Fig. 4: Correlation of age with transverse diameter of fourth ventricle for all male and female samples.

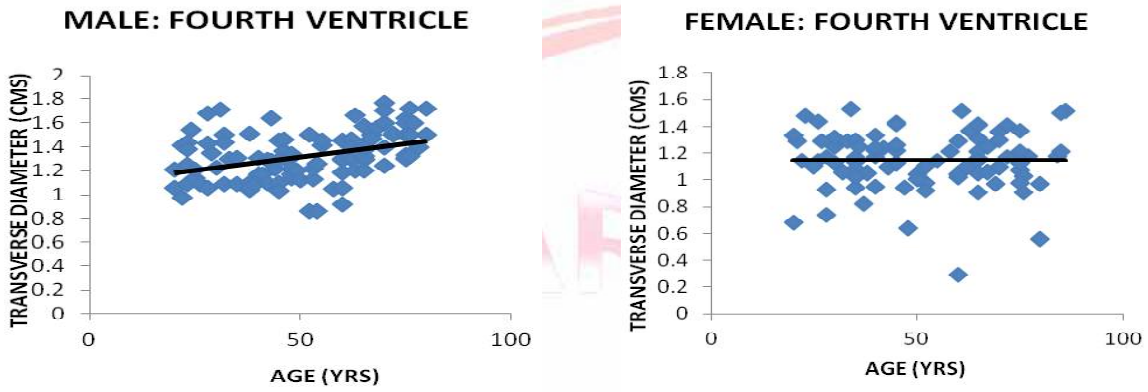


Table 1: Comparison of morphometry of ventricles and brain in males and females age 20-60 years.

Samples	Female Aged 20-60 yrs			Male Aged 20-60 yrs		
Type	Minimum	Maximum	Mean	Minimum	Maximum	Mean
F1	0.35	1.29	0.87	0.44	2.5	0.928
F2	1	2	1.548	1	2.5	1.651
F3	0.64	1.53	1.141*	0.86	1.71	1.250*

Table 2: Comparison of morphometry of ventricles and brain in males and females age above 60 years.

Samples	Female Aged Above 60 yrs			Male Aged Above 60 yrs		
Type	Minimum	Maximum	Mean	Minimum	Maximum	Mean
F1	0.51	1.42	1.017	0.44	1.53	0.958
F2	1	2	1.523	1	2.5	1.608
F3	0.29	1.52	1.149	0.71	1.77	1.286

*** P Value Significant (P < 0.05)**
Fourth ventricle:
F1 – Height,
F2 – Vertical distance,
F3 – Transverse Diameter

Table 3: Measurement of Fourth Ventricle.

Parameters	Gawler et al [11]	D'souza & Natekar [13]		Present Study		F.Duffner et al.[12]
Height		Males	Females	Males	Females	
Mean	1.08	1.18	1.11	1.06	0.94	3.83
SD	--	± 0.27	± 0.24	± 0.146	± 0.217	0.3
Vertical distance						
Mean	--	--	--	1.63	1.53	
SD	--	--	--	± 0.338	± 0.286	
Transverse Diameter						
Mean	--	1.31	1.21	1.32	1.19	1.25
SD	--	± 0.23	± 0.24	± 0.201	± 0.171	0.17

DISCUSSION

The knowledge of normal neuroanatomic changes that occur in brain is important for understanding pathologic changes. Very less number of morphometric studies of the posterior fossa structures was done so there was a need for normative data. In our prospective study, we examined two potential sources of normal variability in Fourth ventricle: age and sex. The results of this investigation provide a valuable addition to the normative database of the fourth ventricle anatomy.

Studies by Gawler [14] et al in 1976 revealed that the greatest distance between the roof and the floor of the fourth ventricle was 1.08 cms (table 3). F.Duffner et al [15] found the height of the fourth ventricle to be 3.83 (SD: 0.30) cms and the width to be 1.25 (SD: 0.17) as seen in table 3. D'souza and Natekar [16] et al studied 1000 patients by CT scan for the various morphometric measurements of the ventricles of the brain. It was observed that the height of fourth ventricle was significantly larger in males (1.18 ± 0.27 cms) than females (1.11 ± 0.24 cms) (table3). The width of the fourth ventricle was found to be greater than the height in both gender and was more in males (1.31 ± 0.23) than in females (1.21 ± 0.22) (table 3).

IN the present study the greatest height in males (1.06cm, SD=± 0.146) was more than in females (0.94, SD= ± 0.217) .The transverse diameter was more than the height and was more in males (1.32cm, SD=± 0.201) than in females (1.19cm, SD=± 0.171).thus the findings were consistent with the past studies (Table 3).

CONCLUSION

Regression of brain tissue with enlargement of the ventricles as the age progresses is the common phenomenon [17]. Haaga [18] reported ventricular enlargement to be a more sensitive indicator of cortical atrophy due to increasing age and dementias. Morphometric analysis of ventricular system is also helpful in the diagnosis and classification of hydrocephalus and in assessment during therapy. Knowledge of anatomy of cerebral ventricular system is important for endoscopic neurosurgery [15]. Many radiological methods especially CT scan has been used to show that with advancing age fourth ventricle enlarges. Thus the present study has defined the morphometric measurements of the fourth ventricle which is not only of academic interest, but also important to help radiologists on the correct interpretation of image examinations and for clinicians to diagnose conditions like Alzheimer's and Parkinson's disease.

Conflicts of Interests: None

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