ORIGINAL RESEARCH PAPER

Anatomy

THIRD VENTRICLE OF BRAIN: A MORPHOMETRIC STUDY BY COMPUTERIZED TOMOGRAPHY.

KEY WORDS:

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ABSTRACT

Background: Cerebral ventricular enlargement has been associated with many neurological disorders. Whether this enlargement is primary or secondary to these pathological conditions remains controversial. Analysis of brain ventricles such as volume, shape and size recently has become a main focus of interest in studies of some neuropsychiatric diseases like schizophrenia and Alzheimer's disease1. Complete study of ventricular size of brain help neurosurgeons for localization and total removal of space occupying lesions around ventricular system like craniopharyngiomas and gliomas2. Analysis of ventricular system is also helpful in the diagnosis and classification of hydrocephalus and in assessment, follow-up of enlargement of ventricular system during therapy (ventricular shunts)3 .
Aims and objectives: Third ventricular measurement was taken to establish baseline reference values, linear dimension and its relationship with age and sex on Computed Tomography so that it can help in day to day clinical practice and can rule out changes due to intrinsic and extrinsic pathologies.
Materials and Methods: This study was conducted in the Postgraduate Department of Anatomy in collaboration with the Department of Radiodiagnosis and Imaging of Government Medical College and Associated Hospitals, Srinagar for a period of 18 months, on patients presenting for CT brain. Total of 300 cases were studied. Data obtained from the study was analyzed and results were calculated.
Observations and results:A total of 300 eligible subjects were included in the study, among them 156(52.0%) were males and 144(48.0%) were female subjects The overall mean age distribution of the study subjects was 47.7±17.88 yrs. There was a steady rise in mean third ventricular width across age groups in both males and females until the sixth and seventh decade, and was more in males as compared to females. So there is positive co-relation of age with dimensions of third ventricle and the volume of the third ventricle is enlarged with physiologic ageing.
Conclusion: Nomograms from this data can be used locally for Kashmiri ethnic population to allow clinicians to estimate more accurately the degree of atrophy or hypertrophy of organs in certain disorders and thus, avoid false positive and false negative diagnosis of pathological enlargement or reduction in brain ventricular size in clinical practice.

INTRODUCTION:

In the adult human brain there are four connected ventricles: two lateral ventricles within the cerebrum, a third ventricle within the diencephalon and a fourth ventricle lying between the cerebellum and the pons[4,5]. Third ventricle is a **slit-like cavity** between the right and the left halves of the diencephalon (between two halves of the thalami). It communicates with the lateral and fourth ventricles. The **choroid plexus**, which produces cerebrospinal fluid (CSF), lies in its **roof** [4,5]. The third ventricle **communicates** with the lateral ventricles anteriorly by the interventricular foramina (of Monro). It also **communicates** with the fourth ventricle posteriorly by the cerebral aqueduct (of Sylvius)[6]. Several studies have found evidence of ventricular enlargement to be associated with major depression, particularly enlargement of the third ventricle[7,8,9] . The maximum width of the ventricle has been widely used as a region of interest in various ventricular morphometric studies. Studies revealed that there is **gradual widening of the third ventricle** starting about the **fourth decade**, it was also found that mean values of the **width** of the third ventricle suggested a **smaller ventricular system** in the **female than in the males** in all **ages beyond the second decade**[10,11] .Comparisons of these values produce data that can be used for diagnosing specific diseases. These data allow the clinician to identify the grade of atrophy or hypertrophy of an organ. Any deviations from the normal have led to diagnosis or prediction of pathological conditions. Accurate assessment of brain ventricular size is used in the clinical treatment of patient[8].

MATERIALS AND METHODS:

This study was conducted in the **Postgraduate Department of Anatomy in collaboration with the Department of Radiodiagnosis and Imaging of Government Medical College and Associated Hospitals, Srinagar** for a period of **18 months**, on patients presenting for CT brain. It was a **cross-sectional observational type** of study. The subjects included in this study were of **Kashmiri ethnicity**. The size of the brain ventricles in **centimeters(cms)** were measured based on **age and sex**.

INCLUSION CRITERIA

The in and out-patients, of either sex, between age groups **(20-40)** years, **(41-60)** years, **(61-75)** years, **(76 years and above)** who after the routine clinical evaluation, were to undergo **CT examination** in the **Department of Radiodiagnosis**, due to various indications for the brain CT. Only those patients were included in the study whose brain CT was labeled as normal by an experienced radiologist

Method: Non Contrast CT examination of brain was done using **Siemens Emotion 16 Slice Multi-detector Spiral CT scan** and **256-slice SOMATOM Definition Flash CT scan** at SMHS hospital Srinagar.

Measurement of third ventricle.

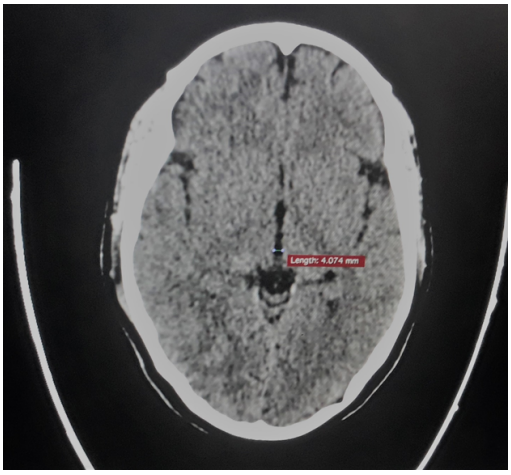


Fig 1: Width at the level of thalamus in cms (measured as the greatest distance between each lateral margin of the third ventricle at the level of thalamus) in axial plane.

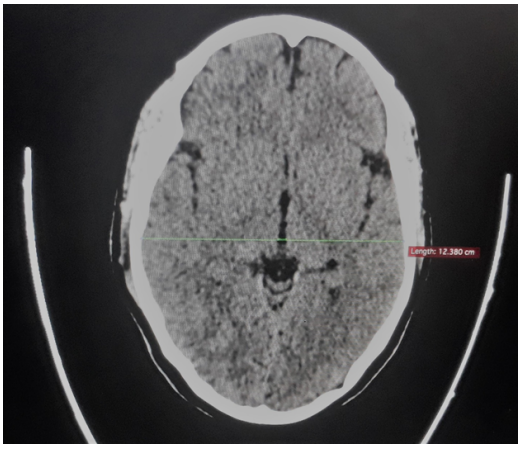


Fig 2: The second transverse diameter of the brain (brain width) in cms is measured as the distance along the line of thalamus extending from left to the right cortical surfaces in axial plane.

All measurements were taken in axial plane.

A total of **300 subjects of either sex and aged above 20 years**, were scanned and all the parameters were recorded in proformas and excel sheet of Microsoft Office. The data was divided into male and female groups and age groups **(20-40)** years, **(41-60)** years, **(61-75)** years, **(76 years and above)**.The recorded data was compiled and entered in a spreadsheet **(Microsoft Excel)** and then exported to data editor of **SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA).**

RESULTS AND DISCUSSIONS:

Table 1: Showing baseline reference values for third ventric le width on brain CT as per age

Age (years)	N	Mean	SD	95% CI for Mean		Min	Max
20-40	116	0.33	0.192	0.30	0.37	0.13	2.11
41-60	108	0.40	0.120	0.37	0.42	0.22	0.75
61-75	61	0.51	0.183	0.47	0.56	0.18	0.98
≥ 76	15	0.42	0.038	0.40	0.44	0.4	0.5
Total	**300**	**0.40**	**0.175**	**0.01**	**0.38**	**0.13**	**2.11**

The mean baseline refrence values for third ventricular width at the level of thalamus in (20-40)yrs of age group was 0.33±0.192cms, in (41-60)yrs of age group was 0.40±0.120cms, in (61-75)yrs of age group was 0.51±0.183cms and ≥76 yrs of age group mean was 0.42±0.038cms. **The overall mean baseline refrence value in all age groups for third ventricular width was 0.40±0.175cms.**

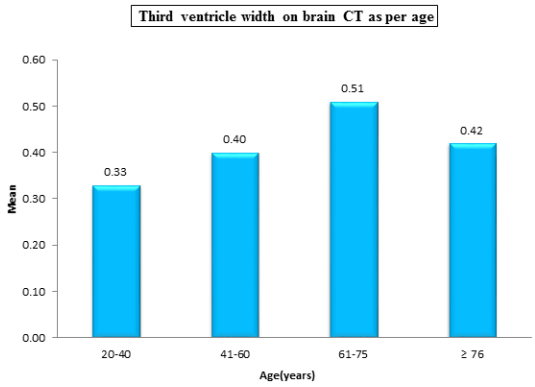
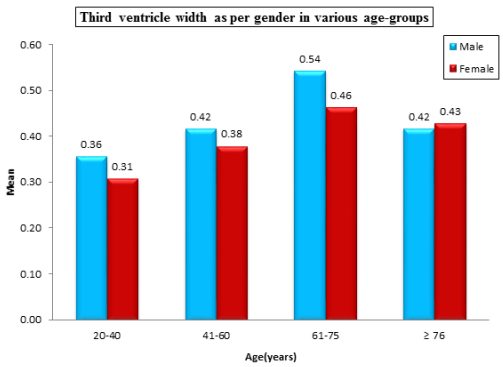


Table 2: Comparison of third ventricle width as per gender in various age-groups

Age (years)	Male			Female			P-value
	N	Mean	SD	N	Mean	SD	
20-40	58	0.36	0.257	58	0.31	0.085	0.182
41-60	53	0.42	0.122	55	0.38	0.117	0.113
61-75	38	0.54	0.208	23	0.46	0.120	0.105
≥ 76	7	0.42	0.029	8	0.43	0.045	0.612
Total	**156**	**0.42**	**0.212**	**144**	**0.37**	**0.116**	**0.074**

Mean width of the third ventricle at the level of thalamus was higher in males than in females in our study population and was highest in (61-75)yrs of age group in both males and females however the results were not significant statistically (P>0.05).



CONCLUSION:

There was a steady rise in **mean third ventricular width** across age groups in both males and females until the sixth and seventh decade, and was more in males as compared to females. The range of the third ventricular width in the current study was between 0.13cm to 0.98 cms with mean of 0.40±0.175cms and 95%CI for mean was 0.01 to 0.38 cms . **There was a steady rise in mean third ventricular width across age groups in both males and females until the sixth and seventh decade.** Mean ventricular width at the level of thalamus in present study in males was 0.42±0.212cms and in females it was 0.37±0.116cms**, thus more in males as compared to females**.

DISCUSSION:

The mean ventricular diameter of the current study is slightly more than that previously reported by **Haug et al**[12] in which he found an average third ventricle size of 0.33cms. He used a smaller sample size compared to the current study, however, the general trend that third ventricle sizes in males were

larger than those in females was confirmed. The current findings were also in agreement with studies by **Celik et al**[13] in which compared to women, the size of the third ventricle was larger in men. **Gawler et al**[14] studied 11 normal subjects and he found mean third ventricle size of 0.46cms which was slightly larger than the mean of our current study, this may be due to a small sample in their study and the age range difference as they used patients aged between 18 to 30 years. **Brinkmann et al**[15] and **Soininen et al**[16] also reported that the maximum width of the third ventricle had a mean of 0.59cm and 0.92cm respectively with higher figure in males and mean larger than the mean of our present study. All these researchers used elderly people above the ages of sixty years and as such their findings can only be compared with the sixth and seventh age groups of the current study. Study by **Soininen et al**[16] probably reflect the relatively higher age ranges used (mean age 77 + 6 years) which is beyond the subjects sample in the current study. Such high value findings for the sizes of the third ventricle width could be a result of the fact that value of CT in evaluating brain morphology in elderly people is diminished: this is because in normal aging ventricles undergo compensatory dilatation with increasing age due to factors such as cortical atrophy, a common feature at this age range (**Le May et al**[17]).

D'Souza and Natekar[18] found a 0.42cm average, still with a higher male average of 0.45cm which is comparable to our study. In general males have big heads and big brain sizes as compared to females of the same age (**Mathalon et al**[19]) and as such is expected that the cerebral ventricles of males are larger. Third ventricles were also found to increase in size with age in this study, a result which was in line with **Haug**[12] **and celik et al**[13] **.**

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Conflicts of interests: none.

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