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Age Related Changes in Lateral Ventricles of Brain in Normal Individuals by CT Method

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Abstract

Context: As human brain ages, characteristic structural changes occur that are considered to be normal. Knowledge of age related changes is important before analysing the abnormal findings. As age advances there is regression of brain tissue and thus ventricles size enlarges.

Aims: To analyse the morphometric measurements of lateral ventricles of the brain in different age group in both genders.

Material and Methods: The study was done from Feb 2009 to July 2010. Data was collected from the CT scans Dept of Radiology Mysore Medical College & Research Institute. 200 normal CT scans (100 male, 100 female) in the age group of 10–80 yrs were collected.

Results: Right frontal horn measures 28.8 ± 2.5 in youngest and 30.3 ± 2.5 in oldest group. Right body part measures 47.9 ± 2.9 in youngest and 49.0 ± 1.9 in oldest group. Posterior horn measures 26.2 ± 1.9 in youngest age group and 26.0 ± 1.4 in oldest age group. Inferior horns could not be visible in few scans and were taken wherever possible as transverse diameter (TD) and vertical diameter (VD). All the measurements were found to be more in age group > 60 yrs compared to younger age group.

Statistical methods: Data was analysed by using SPSS 2004 version, Standard Deviation and Independent 't' test, analysis of variant and P – value.

Conclusion: Advances in CT imaging helps us to understand the normal structure and function of brain. The present study has shown increase in ventricular measurements as age advances.

Keywords: CT brain; Lateral Ventricles of brain; brain atrophy.

Introduction

The cerebral ventricular system comprises of interconnecting cavities filled with cerebrospinal fluid and are derived from central lumen of the embryonic neural tube. The ventricular system of brain consists of two lateral ventricles, midline third and fourth ventricles which communicate via inter-ventricular foramen and aqueduct of Sylvius respectively. Detailed analysis of normal and abnormal morphology of cerebral ventricular system is essential for neurosurgeons and radiologists in routine clinical practice. Computed Tomography (CT) and Magnetic Resonance imaging (MRI) produce cross sectional images that allow real time assessment of ventricular dimensions. Though MRI is far superior to CT, CT scores in view of its easy availability, reduced cost and faster imaging. Assessment of ventricular morphology and dimensions play a critical role in a wide range of clinical conditions.[1]

Lateral ventricle size is an index of brain atrophy that can be measured noninvasively by computed tomography (CT). In cross sectional studies of healthy aging, lateral ventricle size increases, whereas memory and visuo-spatial performance decreases. Variance of lateral ventricle size

also increases with age suggesting substantial differences in age related atrophy.[2]

Thorough knowledge of the age related normal changes that occur in brain is required before any abnormal findings are analysed. Both imaging and autopsy studies revealed that there is correlation with increase in cerebrospinal fluid spaces and reduction in cerebral volume in normal human aging. There is regression of thalamic nuclei after 50 years of age which explains demonstration of early third ventricular enlargement. There is more shrinkage with age in the frontal cortex, brainstem and components of diencephalon. Ventricular enlargement is more sensitive indicator of cortical atrophy due to increasing age and dementias. To understand the changes, knowledge of normal ventricular system of brain is important.[3]

It is also important for knowing the normal upper and lower limits of brain ventricular size in different age groups and in both sexes so as to diagnose various brain pathologies.[4]

Ventricles of brain constitute about 2% of total brain volume. Lateral ventricles contribute about 82% of total ventricular system. A well defined reference system to represent and classify age related, gender related or developmental changes in anatomy of brain ventricles should facilitate.[5]

Expansion of CSF volume with age provides a good index of brain shrinkage although changes and growth of head with age tend to confound.[6]

Aim and Objective

To analyse the morphometric measurements of lateral ventricles of the brain in different age group in both genders CT method.

Material and Methods

The study was done for a period of 18 months from Feb 2009 to July 2010. Data was collected from the CT scans done in the Dept of Radiology K R Hospital attached to Mysore Medical College & Research Institute. CT scans were randomly selected which were reported by radiologists as normal. 200 CT scans in the age group of 10–80 yrs were collected. The study group includes 100 male and 100 female. Normal CT scans of both male and female subjects aged between 10– 80 yrs were included in the study. CT scans with head injuries, cerebral infarctions local mass lesions, previous intracranial surgeries were excluded from the study.

Ct scan machine used for the study was GE High Speed Dual Slice Version 2.0 having a fan beam scanner with a scan time of 1 to 10 seconds. The density of CSF was 10 Hounsfield Units (HU) that of white matter was 22–32 HU and grey a matter was 36–46 HU. The matrix was 256 × 256 with a slice thickness of 10 mm in supratentorial region and 4 mm in infratentorial region.

Measurements were taken in mm on both right and left sides of frontal horn, body, posterior horn & inferior horns of lateral ventricles.

1. At the level of interventricular foramen of Monro: Length of frontal horns
2. Above the level of interventricular foramen: Length of body and posterior horns.
3. Below the level of interventricular foramen: Transverse diameter and height of inferior horns.

Fig. 1: CT image showing the anterior horn, body and posterior horns of lateral ventricles.

Results

Data was analysed by using SPSS 2004 version, Standard Deviation and Independent 't' test, analysis of variant and P – value.

Analysis of data was done by making 7 groups according to age.

Table 1: Showing the number of subjects according to age groups in male and female subjects.

Table 2: Showing the length (mm) of frontal horn, body and posterior horn on right and left side.

Table 3: Showing the transverse (TD) and vertical diameters (VD) of inferior horn of lateral ventricles on right and left side.

Table 1: Showing the distribution of number of CT scans of male and female subjects and age group.

Age (yrs)	Male	female	Total
10-19	20	12	32
20-29	21	26	47
30-39	13	17	30
40-49	15	15	30
50-59	:20	15	35
60-69	08	09	17
70-79	03	06	09
Total	100	100	200

Discussions

The two most important conditions that produce ventricular enlargement are hydrocephalus and atrophy. Atrophy can either be due to aging, or due to neuro-degenerative disease. Hydrocephalus on the other hand results from impaired circulation of CSF or in certain rare circumstances, due to the increased production of CSF, such as what occurs in choroidplexus tumors. The other features which suggest a ventricular enlargement due to increased CSF pressure include effacement of the cortical sulci, elevation and thinning of the corpus callosum, dilatation of the optic and infundibular recess of the third ventricle and pineal recess

Table 2: showing the measurements of frontal horn, body and posterior horn on right and left side.

Age (yrs)	Frontal horn				Body				Post horn			
	Right P > 0.05		Left P > 0.05		Right P > 0.05		Left P > 0.05		Right P > 0.05		LEFT P> 0.05	
	mean	SD	mean	SD	mean	SD	Mean	SD	mean	SD	mean	SD
10-19	28.8	2.5	30.1	2.4	47.9	2.9	49.3	3.0	26.2	1.9	27.8	2.4
20-29	29.0	2.6	30.1	2.9	48.2	2.9	49.8	3.0	26.3	2.1	27.7	2.5
30-39	29.1	2.1	30.3	2.0	48.6	2.8	49.8	3.0	26.3	1.9	27.3	2.1
40-49	29.2	2.7	30.6	2.5	48.9	2.7	49.9	2.6	26.5	2.1	27.9	2.7
50-59	29.9	2.7	30.7	2.5	48.6	3.0	49.9	3.1	26.8	2.8	28.2	2.9
60-69	30.6	1.5	31.6	1.7	47.6	2.1	48.9	2.3	27.1	2.7	28.5	2.9
70-79	30.3	2.5	31.4	2.4	49.0	1.9	50.3	2.1	26.0	1.4	27.0	1.6
Total 200	29.34	2.5	30.5	2.5	48.4	2.8	49.7	2.9	26.5	2.1	27.8	2.6

Table 3: Shows transverse (TD) and vertical diameters (VD) of inferior horn on right and left side and number of subjects in the age group.

Age (yrs)	Right side					Left side				
	No	TD P>0.05		VD P>0.05		No	TD P>0.05		VD P>0.05	
		mean	SD	mean	SD		mean	SD	mean	SD
10-19	28	7.7	2.4	3.1	0.9	27	7.9	2.8	3.0	0.9
20-29	44	9.5	3.1	3.2	1.4	42	8.9	3.4	3.0	1.1
30-39	29	7.3	2.4	2.9	1.1	28	7.1	2.4	2.9	1.1
40-49	24	8.4	2.2	3.4	1.3	22	8.7	2.1	3.0	1.2
50-59	33	7.6	2.4	3.3	1.0	33	7.4	2.0	3.0	1.0
60-69	16	7.1	2.8	3.1	1.1	16	7.5	2.9	3.2	1.0
70-79	08	8.6	2.6	3.4	0.7	08	8.8	2.1	3.1	0.6
	182	8.1	2.7	3.3	1.9	176	8.0	2.7	3.0	1.0

Table 4: Following table shows comparing the measurements of frontal horn on both sides with study reported by Shaikh Shamama et al[7].

Age (yrs)	Present study		Shaikh Shamama et al[7]	
	Right	Left	Right	Left
10-19	28.8 ± 2.5	30.1 ±2.4	–	–
20-29	29.0 ± 2.6	30.1±2.9	27.2 ±1.92	29.7 ±30.1
30-39	29.1 ±2.1	30.3±2.0	27.3 ±1.79	30.1 ±1.27
40-49	29.2 ±2.7	30.6±2.5	27.3 ±1.79	30.2 ±1.52
50-59	29.9 ± 2.7	30.7±2.5	27.4 ±1,89	29.7 ±1.34
60-69	30.6 ±1.5	**31.6±1.7**	27.6 ±1.36	29.9 ±1.03
70-79	30.3 ± 1.5	**31.4±2.4**	28.1 ±1.56	30.3 ±1.74

posteriorly.[4]Table Shaikh Shamama et al[7] reported a study of 500 CT scans between age group of 20–79 in 250 male and 250 female cases. There is gradual increase in length of frontal horn with increase in age, more so between 70– 79 yrs and on left side. In the present study there is gradual increase in length of frontal horn more so in age group between 60–79 yrs and on left side.

Table 4 Following shows comparing the measurements of frontal horn on both sides with study reported by Shaikh Shamama et al[7].

Mitsunori Matsumaf et al[6] reported a MRI study of age related changes in Brain from 49 volunteers between 24–80 yrs. There was no change in ventricular volume of men and women. There was no ventricular enlargement between youngest and middle age, but between middle and oldest age group there was significant enlargement in ventricular volume. Expansion of CSF volume with age provides a good index of brain shrinkage. In the present study also enlargement of ventricular size is significant among age group of > 60 yrs in length of frontal horn and body more so on left side.

Bijayalakhmi Parija et al[8] reported a study of 150 randomly selected CT scans between age group of 15–70 yrs. The data is divided in to 3 groups. Group one between 15–30 yrs where brain fully developed and no degeneration, group two 31–50 yrs degeneration process may get initiated, as with aging brain start degeneration. Group three 51–70 yrs, degeneration would be evident in majority of people. P value of length of frontal horn on right and left side was not significant in group one and $P \leq 0.0001$ in group two. In group three $P \leq 0.002$ on right side and $P \leq 0.001$ on left side. There was no remarkable difference with respect to gender in younger age group however in subsequent higher age group males had higher ventricular size than females. Ventricular size was more evident in lateral ventricles in group three. The findings are comparable with our study. In the present study ventricular enlargement is evident in age group > 60 yrs in males on left side.

Dr Arun Kumar S et al[1] reported a study of 100 CT scans of male and female subjects between age group of 5–90 yrs. Frontal Horn Ratio (FHR) was calculated there was steady rise in mean FHR in all age groups in males as well as females which was statistically significant. The mean FHR was in the range of 0.3 to 0.32 across the age group from 21 to > 60 yrs. The mean FHR was slightly lower at 0.23 ± 0.03 in ≤ 20 yrs age group among females. The highest mean FHR was seen in the ≥ 60 yrs in both genders. Although we have not calculated FHR in our study, length of frontal horn shows increasing values after 60 yrs age.

Brij Raj Singh et al[3] reported a study of 358 CT scans of both male and female between age group of 20–60 yrs, 270 were between 20–60 yrs and 88 were more than 60 yrs. The length of the left frontal horn was more than the right. The mean length of right frontal horn with body between 20–40 yrs age group was 52.23 ± 4.80, between 41–60 yrs, 55.80 ± 6.18 and > 60 yrs age was 57.73 ±6.92. The measurements show increasing ventricular size as age increases. In the present study mean length of frontal horn was 29.34 ± 2.5 on right side and 30.5 ± 2.5 on left side.

Conclusion

As the human brain ages the normal structural changes are better understood by studying morphometric measurements of CT images of different age groups. The present study has made an attempt to analyse the changes in relation to age, gender, and side of lateral ventricles.

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References

1. Dr Arun kumar S, Dr S Meenakumari, Dr A Pavitra, Dr R Saraswathy.CT Based study of Frontal Horn Ratio And Ventricular Index in South Indian Population. IOSR J of Dental and Medical Sciences July 2017; vol 16 (9) ver V1: 55–59.
2. Rathod Pranjali U, Bhoir Mehera. Morphometric Study of Anterior Horn of Lateral Ventricle of Brain and Its Correlation with Age, Gender and Side: A CT Study. Indian Journal of Anatomy Jan- March 2017; Vol 6 (1): page 21–25. http://dx.doi.org/10.210088/ija.2320.0022.6117.4
3. Brij Raj Singh, Ujwal Gajbe, Amit Agarwal, Anilkumar Reddy Y, Sunita Bhartia. Ventricles of Brain: A Morphometric Study by Computerised Tomography; International J of Medical research & Health Sciences 2014; Vol 3 (2):381– 387.
4. Vinoo Jacob, A.S Krishna Kumar. "C T ASSESSMENT OF BRAIN VENTRICULAR SIZE BASED ON AGE AND SEX". Journal of Evolution of Medical And Dental Sciences Dec 2013; Vol 2 (50): Page 9842–9855.

5. Poonam Patnaik, Vishram Singh,Dalvinder Singh, Sathir Singh. Age and gender related Variations in lateral ventricle brain ratios. IJHSR May 2016; Vol 6 (5):page 78 – 84.
6. Mitsunori Matsumaf, Ron Kikinis Istvan A Morocz, Antonio V Lorenzo, Tamas Sandor, MariLyn S Albert et al. Age related changes in intracranial compartment Volumes in normal adults assessed magnetic resonance imaging. J. Neurosurg.1996; 84: 982–991.
7. Shaikh Shamama, Farheen, S. B. Sukre. Morphometric study of frontal horn of lateral Ventricle by Computerised Tomography.IJAR 2017; vol 5(3.1):4063 – 66.
8. Bijayalakhmi Parija, Niranjan Sahu, Siksha O, Shakti Rath, Rabindra N Pandhy. Age related changes in ventricular system of brain in normal individuals by Computed Tomography Scans; Siriraj Med J Nov – Dec 2014, Vol 66 (6):225.