

## MORPHOMETRIC STUDY OF LATERAL VENTRICLES OF BRAIN BY COMPUTERISED TOMOGRAPHY

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### ABSTRACT

**Introduction:** Morphometric study of lateral ventricles of brain is important for evaluating changes due to growth, ageing, intrinsic and extrinsic pathologies. The aims of this study were to examine the range in size of normal lateral ventricles of brain, and to compare the dimensions of with reference to gender and side by CT Scans.

**Materials and Methods:** The study was done from Feb 2009 to July 2010. Materials for the study were collected from K.R.Hospital attached to M.M.C & R.I. Mysore. 200 normal CT scans of patients were collected (100 male and 100 females). Measurements were taken as follows, 1) at the level of interventricular foramen (IVF) - IVF to tip of frontal horn, 2) from IVF – from IVF to collateral trigone and Posterior horn from collateral trigone to tip of posterior horn, 3) below the level of IVF - Transverse diameter and Height of inferior horn.

**Results:** All the measurements except inferior horn were more in males compared to females and more on left side than right side. Measurements of inferior horn transverse diameter (TD) the right side were slightly (0.2 mm) more than left side in males and equal in females. Height (HT) of inferior horn was 0.3 mm more on right side in males and 0.1 mm in females.

**Conclusion:** The study shows the normal range of measurements of different parts of lateral ventricles in male and female patients. Left ventricles are larger than right side in males compared to females.

**KEY WORDS:** lateral ventricles, Computerised Tomography (CT), interventricular foramen (IVF).

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### INTRODUCTION

The evaluation of the normal measurements of the cerebral ventricles in the living human has great importance in the diagnosis and monitoring of several pathologies. Accurate measurements of the ventricles provide available and safe means of diagnosis of some neurological disorders such as early detection of hydroceph-

alus, cerebral atrophy etc and provide important follow up information in affected patients [1].

According to Schochet (1998) the brain undergoes many gross and histo pathological changes in advancing age and also in various dementias with regression of brain tissue leading to ballooning of 3<sup>rd</sup> ventricle and rounding of angles of lateral ventricles. Enlargement of the ventricles

are the more sensitive indicator of cortical atrophy due to increasing age and dementias [2].

As the human brain ages, characteristic structural changes occur that are considered to be normal and are expected. Thus the thorough knowledge of the age related normal changes that occur in the brain is required before analysing the abnormal findings [3].

Morphometric studies of human brain ventricles have been under focus by many scholars due to the relation with pathologies evidences such as hydrocephalus, schizophrenia, tumor, trauma, etc., as well as gender and aging which could lead to dementia and or brain geriatrics. The advent of CT scanning resolved the problem of volumetric measurements performed on normal subjects [4].

Knowledge of normal variations in ventricular morphological features is important in endoscopic neurosurgery.

**Aims and objectives:** The aim of the morphometric study is to examine the range in size of the normal ventricular system on right and left side and find any relationship with gender.

## MATERIALS AND METHODS

The study was done for the period of 18 months from Feb 2009 to July 2010. Data for the present study was collected from CT scans done in the Dept of Radiology K. R. Hospital attached to MMC & RI Mysore. CT scans for various indications from other departments were taken. The CT Scans were randomly selected, which were reported as normal by the radiologist. 200 CT scans in the age group of 10-80 years were taken. The study group patients include 100 male & 100 females. CT scans with H/O head injuries, cerebral infarctions, local mass lesions and previous intracranial surgeries were excluded.

CT scan machine used for this 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 matter was 36-46 HU. The matrix was 256 X 256 with a slice thickness of 10 mm in supratentorial region and 4 mm in infratentorial region.

Data were analysed by using SPSS 2004, Standard

deviation and Independent 't' test, analysis of variant and P- value, done by SPSS 2004 version.

The following parameters were taken at 3 levels

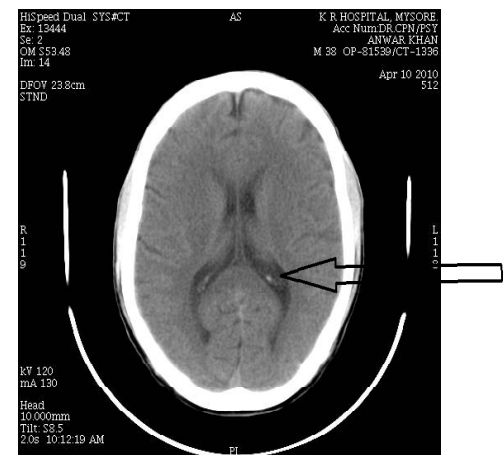
- 1) At the level of interventricular foramen of Monro, frontal horn was measured from interventricular foramen to tip of frontal horn on both sides
- 2) Body of lateral ventricle measured from interventricular foramen to collateral trigone on both sides and Posterior horn from collateral trigone to tip of posterior horn.
- 3) Below the level of interventricular foramen, inferior horn measurements were taken on both sides, Transverse diameter (TD) and Height.

**Fig. 1:** Showing the methods used for the measurements of lateral ventricle.

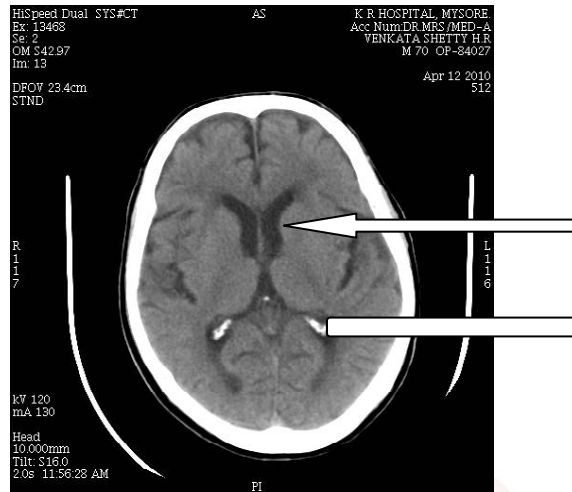


1-Tip of frontal horn, 2-level of inter ventricular foramen, 3-collateral trigone, 4-post horn A - L of frontal horn 1-2, B - L of body of lateral ventricle 2-3, C - L of post horn 3-4

**Fig. 2:** CT showing normal lateral ventricles, choroid plexus seen in inferior horn.



Arrow showing choroid plexus in post horn

**Fig. 3:** CT showing dilated lateral ventricles, inferior horn with choroid plexus.

Pointed arrow showing dilated frontal horn  
Plain arrow showing dilated inferior horn with choroid plexus

## RESULTS

**Table 1:** Length of frontal horn.

|       |     | MALE      |     |         |  | FEMALE    |     |         | TOTAL |      |
|-------|-----|-----------|-----|---------|--|-----------|-----|---------|-------|------|
|       |     | MEAN (mm) | SD  | P value |  | MEAN (mm) | SD  | P value | NO.   | MEAN |
| RIGHT | 100 | 29.8      | 2.6 | <0.0001 |  | 28.9      | 2.3 | <0.0002 | 200   | 29.3 |
| LEFT  | 100 | 31.1      | 2.5 |         |  | 29.9      | 2.3 |         | 200   | 30.5 |

Lt > Rt by 1.3 mm in males and 1 mm in females. When comparing between both sex, males it is more by 1.2 mm on left and 0.9 on right side.

**Table 2:** Length of body of lateral ventricle.

|       |     | male      |     |         |  | female    |     |         | Total |      |
|-------|-----|-----------|-----|---------|--|-----------|-----|---------|-------|------|
|       |     | MEAN (mm) | SD  | P value |  | MEAN (mm) | SD  | P value | NO.   | MEAN |
| RIGHT | 100 | 49.5      | 2.6 | <0.0001 |  | 47.3      | 2.5 | <0.0001 | 200   | 48.4 |
| LEFT  | 100 | 50.7      | 2.7 |         |  | 48.8      | 2.7 |         | 200   | 49.7 |

Lt > Rt by 1 mm in males, 1.5 mm in females. On comparison between male and female M > F by 2.2 mm on Rt side & 1.9 mm on Left side.

**Table 3:** Length of posterior horn.

|       |     | male      |     |         |  | female    |     |         | Total |      |
|-------|-----|-----------|-----|---------|--|-----------|-----|---------|-------|------|
|       |     | MEAN (mm) | SD  | P value |  | MEAN (mm) | SD  | P value | NO.   | MEAN |
| RIGHT | 100 | 26.9      | 2.1 | <0.002  |  | 26.3      | 2   | <0.002  | 200   | 26.6 |
| LEFT  | 100 | 28.4      | 2.5 |         |  | 27.3      | 2.5 |         | 200   | 27.8 |

Lt > Rt by 1.5 mm in males and 1 mm in females. When comparing between male & female, M > F by 1.1 mm on left and 0.6 mm on right side.

**Table 4:** Transverse diameter of inferior horn (TD).

|       |    | MALE      |     |         |  | FEMALE    |     |         | TOTAL |      |
|-------|----|-----------|-----|---------|--|-----------|-----|---------|-------|------|
|       |    | MEAN (mm) | SD  | P value |  | MEAN (mm) | SD  | P value | NO.   | MEAN |
| RIGHT | 92 | 7.9       | 2.7 | <0.05   |  | 8.4       | 2.7 | <0.05   | 182   | 3.2  |
| LEFT  | 89 | 7.7       | 2.6 |         |  | 8.4       | 2.8 |         | 176   | 3    |

Inferior horn was visible only in 92 scans on right side and 89 scans on left side. Rt > Lt by 0.2 mm in males and both sides were equal in females. Comparing between males and females, interestingly values were more in females by 0.5 on Rt and 0.3 on left side.

**Table 5:** Height of inferior horn (HT).

|       |    | MALE      |     |         |  | FEMALE    |     |         | TOTAL |      |
|-------|----|-----------|-----|---------|--|-----------|-----|---------|-------|------|
|       |    | MEAN (mm) | SD  | P value |  | MEAN (mm) | SD  | P value | NO.   | MEAN |
| RIGHT | 92 | 3.3       | 1.1 | <0.05   |  | 3.1       | 1.2 | <0.05   | 182   | 3.2  |
| LEFT  | 89 | 3         | 1.1 |         |  | 3         | 0.9 |         | 176   | 3    |

Height was more on right side in both sexes, by 0.2 mm in males and 0.1 mm in females. When compared between male and females, 0.2 mm more in on right side in males and equal in both.

## DISCUSSION

**Table 6:** Comparison of measurements of frontal horn with other studies.

| AUTHOR             | MALE       |            | FEMALE    |            |
|--------------------|------------|------------|-----------|------------|
|                    | RIGHT      | LEFT       | RIGHT     | LEFT       |
| Brij Raj Singh [3] | 25+3.18    | 26.16+2.96 | 25.34+3.5 | 26.53+3.58 |
| D Souza [2]        | 27.4+0.36  | 27.8+0.37  | 25.5+0.33 | 25.8+0.35  |
| Moawia [4]         | 28.53+3.88 | 28.53+3.88 | 26.16+4.2 | 26.17+4.23 |
| Present study      | 29.8+2.6   | 31.1+2.5   | 28.9+2.3  | 29.9+2.3   |

Left frontal horn is longer than right in the present study and the study reported by of Brij Raj Singh et al [3]. Right and left side measurements are equal in the other 2 studies shown in the table 5.

Comparing between male and female, M > F by 2 mm in study reported by D'Souza e dias Madora et al [2] and Moawia Gameraddin et al [4], 0.9 mm in present study and equal in study by Brij Raj Singh et al [3].

**Table 7:** Comparison of measurements of frontal horn + body of lateral ventricle with other studies.

| AUTHOR             | MALE       |            | FEMALE     |             |
|--------------------|------------|------------|------------|-------------|
|                    | RIGHT      | LEFT       | RIGHT      | LEFT        |
| Brij Raj Singh [3] | 55.78+6.15 | 56.70+6.61 | 55.1+6.91  | 56.28+7.59  |
| D Souza [2]        | 69.6+0.78  | 70.9+0.78  | 65.7+0.75  | 67.3+0.77   |
| Moawia [4]         | 74.89+9.86 | 74.89+9.86 | 70.06+8.83 | 68.89+11.42 |
| Present study      | 79.3+2.6   | 81.3+2.7   | 76.2+2.5   | 78.7+2.7    |

Values are more on left than right in all studies, except study by Maowia Gameraddin et al [4]. According to their study values are equal in males and 1 mm more on left side in females.

Comparing between male and female, values are equal in study by Brij Raj Singh et al [3] and more in males than females in other studies.

Both right and left lateral ventricles were larger in males compared to females, because males have heavier and bigger skull. The capacity of skull is 10% more compared to female skull and also brain size [5].

The degree of asymmetry of lateral ventricular

contour is common either because of anatomical difference or obliquity of the head in CT scans [6].

In a study by Edogan AR et al, in right handers the volume of the lateral ventricle was higher in the right side than left side but in left handers, it was higher on the left side than on the right side [7].

## CONCLUSION

Measurements of the lateral ventricles the frontal horn, body and posterior horn are more on left side when compared to right side in both male and female patients. Whereas measurements of inferior horn transverse diameter (TD) on the right side are slightly (0.2 mm) more than left side in males and equal in females. Height (HT) of inferior horn is 0.3 mm more on right side in males and 0.1 mm in females.

Measurements of lateral ventricles of brain by using CT, gives correct dimensions and helps clinicians to diagnose the neurological lesions. The dilated ventricles suggest atrophy of brain in degenerative and aging process.

**Conflicts of Interests: None**

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