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Measurement of Lateral Ventricles Using Computed Tomography in Adult Sudanese Population

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Abstract **Original Research Article**

Background: The variability of the adult lateral ventricle size may vary with gender and age. There is, however, little data on the morphology of the lateral ventricle for the Sudanese population. ***Objective:*** To measure the differences of the lateral ventricle concerning gender and age-related differences, and to establish reference values of the lateral ventricle measurements for Sudanese using computed tomography (CT). ***Materials and Methods:*** This retrospective study was conducted on 500 healthy Sudanese adults (261 male and 239 female), their ages ranged from 18 to 90 years. were collected at the CT unit of The Dar Al Elaj Specialized Hospital, Modern Diagnostic Center), Khartoum, Sudan. during the period from January 2020 to January 2021. All participants underwent brain computed tomography imaging. Shape, anteroposterior length, and area of the lateral ventricle were measured. ***Results:*** The study showed that the lateral ventricle measurement was higher in males. the left Width of the Right Lateral ventricle at p-values of 0.000, the width of the left lateral ventricle, the length of the body of the right ventricle, and the length of the body of the left ventricle no significant (with p-value 0.211, 0.545 and 0.124). ***Conclusion:*** This study showed that In conclusion, this study established baseline measurements for the lateral for the healthy Sudanese population. Furthermore, radiographically there is a slight difference in lateral ventricles measurement regarding gender.

Keywords: Lateral ventricle, brain, Computed Tomography.

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1.1 INTRODUCTION

The brain ventricular system is a series of connected cavities, filled with cerebrospinal fluid (CSF), that forms within the vertebrate central nervous system (CNS) [1]. The two lateral ventricles are the largest in the cerebrum; the third ventricle is in the diencephalon of the forebrain between the left and right thalamus, and the fourth ventricle is located at the posterior aspect of the pons and superior aspect to the medulla oblongata of the hindbrain [2].

The evaluation of the normal measurements of the cerebral ventricles in the living human has great importance in the monitoring and diagnosis of several abnormalities [3]. Accurate measurements of the ventricles provide available and safe means of aiding the diagnosis of some neurological disorders such as early detection of cerebral atrophy, and hydrocephalus, and provide important follow-up information in affected patients [4]. It should be noted that there is a continuous debate in the literature of neuroanatomical, psychiatry, neuroradiology, and neurology over the best method of assessing the various parts of the cerebral ventricular system [5].

Computed tomography (CT) allows the acquisition of 3-D volume data and measurement of linear distances in any chosen image plane, using recent software. The possibilities offered by the modern imaging methods, new operative approaches, and minimally invasive techniques motivated us to revisit the anatomy of the ventricular system and to re-measure the distances in individual volunteers and hydrocephalic patients [6].

This study aims to study the measurement of the lateral ventricles of the brain in normal Sudanese subjects using a CT scan.

MATERIAL AND METHODS

Sampling and studying the population

The data used in this study were collected from subjects admitted to various hospitals in Khartoum state (Dar Al Elaj Specialized Hospital, Modern Diagnostic Center) during the period from January 2020 to January

2021, 500 CT scans of consecutive adult patients (261 male and 239 female) with aged ranged from 18 to 90 years, having no brain disorders.

Inclusion Criteria

The study included all adult subjects ranging from 18 to 90 years old and had no brain disorders.

Exclusion Criteria

Patients whose brains appeared abnormal on CT scans were excluded.

CT Brain Protocol

Both 16 slice spiral CT unit Siemens (Somatom go. Now) and GE were used to examine patients for brain scans.

Data Acquisition and Measurement Protocol

Volumetric acquisition parameters were kV settings 120 kV, 350 mAs, 1.5 mm slice thickness, 250 mm field of view, Effective pitch of 0.85, brain images were reconstructed with a thickness of sequential 5 mm, brain window levels of 40–45, brain window widths of 300–400, bone window levels of 450, and bone window widths of 1500.

Method Measurements

CT-scan DICOM images of each patient were observed in radiant DICOM Viewer software. Lateral ventricles were identified in each cross-section and longitudinal section of MRI-scan images. The width of the lateral ventricle was measured as a line from the lateral border to the medial border of the lateral ventricle. A method by which measurements of frontoccipital distance were obtained.

Data Analysis and Collection

Data were collected by using a data collection sheet for all subjects to maintain consistency with the information from the display. The data sheet was designed to obtain patient gender, age, lateral ventricles length and width. Microsoft Excel 2013 was used for data analysis.

RESULTS

Table 1: Demonstrate the frequencies of patient, mean, Std.D, min, and max measurement ventricles

	N	Minimum	Maximum	Mean	Std. Deviation
Width right Lateral ventricle	500	10	12	11.14	.693
Width left Lateral ventricle	500	3	4	3.49	.500
Length of the right ventricle	500	14	15	14.50	.500
Length of the left ventricle	500	9	10	9.49	.500
Valid N (listwise)	500				

Table 2: Demonstrate the width and length of lateral ventricles regarding gender

	GENDER	N	Mean	Std. Deviation	Std. Error Mean
Width right Lateral ventricle	Male	261	11.15	.624	.039
	Female	239	11.14	.763	.049
Width left Lateral ventricle	Male	261	3.65	.477	.030
	Female	239	3.32	.468	.030
Length of the body of the right ventricle	Male	261	14.56	.498	.031
	Female	239	14.43	.496	.032
Length of the body of the left ventricle	Male	261	9.59	.492	.030
	Female	239	9.37	.484	.031

Table 3: Demonstrate the width and length of lateral ventricles

Independent Samples Test										
		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
Width Right Lateral Ventricle	**Equal variances assumed**	18.6	.000	.183	498	.855	.011	.062	-.111	.133
	Equal variances not assumed			.181	460.6	.856	.011	.063	-.112	.134
Width Left Lateral	**Equal variances assumed**	1.5	.211	7.77	498	.000	.329	.042	.246	.412

Ventricle	**Equal variances not assumed**			7.77	495.6	.000	.329	.042	.246	.412
Length of Body of The Right Ventricle	**Equal variances assumed**	.36	.545	2.80	498	.005	.125	.045	.037	.212
	Equal variances not assumed			2.80	494.4	.005	.125	.044	.037	.212
Length Of Body Of The Left Ventricle	**Equal variances assumed**	2.3	.124	5.06	498	.000	.221	.044	.136	.307
	Equal variances not assumed			5.06	495.3	.000	.221	.044	.136	.307

DISCUSSION

The range of changes in the ventricular size of the brain encountered in clinical practice can lead most people to believe that a decision is 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.

Measurements of the size of the lateral cerebral ventricles provide useful indices of cerebral asymmetry and atrophy. The present study provides useful baseline measures on the volume of the lateral ventricle, and its variability and asymmetry, in healthy subjects, and promising first steps in the task of automatic measurement of the brain structure that is highly conspicuous but has relatively complex morphology.

The size of the right ventricle in the current study was larger than the left one, and the male's ventricles, appear larger than the females. In our results the size of ventricles does not compatible with studies implemented by Gomori et al., Takeda and Matsuzua, Goldestien et al to measure the lateral ventricles use of CT scans of the brain which found that the size of the left lateral ventricle was larger than the right one and both were larger in the female [7].

This might be because our sample size is larger than the population they investigated. In the study conducted by Moawia Gameraddin et al found that the antero-posterior extent of the right ventricle bodies (males = 74.89 + 1.04 mm and females = 70.06 + 1.11 mm) was approximately equals to the left ones (male = 74.89 + 1.04 mm and female 69.59 + 1.43 mm) [8].

Our measurements regarding the size of the ventricles do not compatible with Gameraddin et al, in the other side, our results showed that the size of the ventricles in males is larger than in females which agrees with Gameraddin *et al*., [8].

Our study results revealed that the length and width of the right ventricle were (14.56±0.49 mm and 11.15± 0.62 mm) in the males respectively, and (14.43±0.49 mm and 11.14 ±0.76) in the females respectively, and that the length of the right ventricle was slightly larger in males than females.

Moreover, the length and width of the left ventricle were 9.59±0.49 mm and 3.65±0.47 mm in the males respectively, on the other side the length and width of the left ventricle were 9.37±0.48 and 3.32± 0.49 mm respectively.

This measure was much similar to the figures reported by D'Souza and Natekar and Moawia Gameraddin *et al*., which found that males have larger right ventricles than females [9].

The heterogeneity of the population limits this study because of the randomized selection process. Other limitations of this study were: i) There was a relatively small cohort sample. However, to the best of our knowledge, numerous authors have attempted to characterize normative measurements of lateral ventricles when evaluating the CT brain.

However, this study reflects the necessitate of coming across the normative values to differentiate between the normal from pathological conditions, additionally necessary for accurate interpretation of the brain scan, which thus signifies the importance of this study.

CONCLUSION

In conclusion, this study established baseline measurements for the lateral for the healthy Sudanese population. Furthermore, radiographically there is a slight difference in lateral ventricles measurement regarding gender.

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