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Measurements of Hippocampal Volume Using Magnetic Resonance Imaging in Sudanese Population

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ABSTRACT: This study concern to measure of hippocampus volume among Sudanese population for normal and abnormal patients using MR Toshiba 1.5 tesla, information was available for 300 patients (200 abnormal patients and 100 normal), and measure the right and left side of hippocampus for all patients. The average of right hippocampus volume for normal patients (2.207 mm) and for abnormal patients (2.134 mm), and the average of left hippocampus volume for normal (3.071 mm) and for abnormal patients (2 mm). the correlate the pathology with age show that the patients with 51-75 years more frequently with atrophy, infract and tumors.
Volume measurements for hippocampus to normal and abnormal patients shows that the volume for normal was bigger than the volume of abnormal patients for both left and right side of hippocampus, and the atrophy most pathology in Sudanese population aged from 51-75 years.

Keywords:hippocampus, volume measurements, MRI

I. INTRODUCTION

The morphology and size of the human brain and its major anatomically defined subdivisions are very important for understanding neurological diseases and also for neurosurgery. The widespread use of high-resolution neuroimaging techniques began in the early 1990s, and since then, numerous studies have been undertaken that apply these techniques to the volume measurement of various brain structures.

Hippocampal volume (HCV) is well preserved throughout adulthood in men and women, with no significant correlation with age. HCV is affected by several neurodegenerative and psychiatric diseases. Alzheimer disease (AD) is the most common disorder associated with reduced hippocampal volume [1-3].

The volume of the hippocampus is a commonly used structural MRI measurement in brain research. Many studies focus on a decrease in hippocampal volume associated with a wide variety of neurological and psychiatric conditions including depression [4] , posttraumatic stress disorder (PTSD) [5,6] , borderline personality disorder (BPD) [7] , schizophrenia [8,9] , alcohol abuse [10] and Alzheimer's [11] , Parkinson's and Huntington's diseases [12] .

It is as yet unclear what mechanisms underlie the decrease in hippocampal volume associated with major depressive disorder (MDD) [12].

Hippocampal volume is frequently used in the study of Alzheimer's disease (AD) and as such may be developed into a standardized biomarker for dementia and AD [13,14] . The volume of the hippocampus, adjusted for age and gender, has been found to best discriminate controls from early-onset AD cases in comparison to other medial temporal lobe structures [15]. However, a stronger correlation was found between change in hemispheric volume measurements (whole brain and ventricle) and cognitive performance compared to the correlation between medial temporal lobe volume decrease and cognitive performance [16].

MRI-based hippocampal volume measurement may become a useful diagnostic tool in cases of memory impairment which may indicate early-onset AD [14], and measurement of whole brain atrophy rates may be preferable for some clinical trials, especially considering that it can more easily be automated [15].Magnetic resonance (MR) imaging has been used in studies of the hippocampal formation and in amygdala biometric studies for several years. The biometric data are useful for evaluating selective hippocampal atrophy in patients with intractable partial seizures (17-22), Alzheimer-type dementia (23), amnesic syndromes (24), or schizophrenia (25,26). Obvious hippocampal atrophy seen on MR images corresponds to severe neuronal loss (27-29). Thus, early diagnosis depends on the ability to detect small variations in hippocampal volume. Different MR sequences have been used to evaluate the volume of the hippocampal formation, and technical progress has allowed reduction of section thickness.

Hippocampal sclerosis (HS) can be reliably detected on MRI [30], and quantitative analysis of hippocampal formation improves the sensitivity for detecting this pathology [31,32]. With advances in the MR

imaging field in the past decades, the current contributions of these postprocessing MR imaging tools for the detection of hippocampal pathology, especially in tertiary epilepsy centers, are not clear.
Quantification of hippocampal volume has advantages over visual analysis for the detection of subtle and bilateral hippocampal abnormalities. [30,33], Hippocampal volumetry is also becoming recognized as an important biomarker for detecting AD treatment effects in clinical trials [34].

II. MATERIAL AND METHODS

This Study was carried out in the Department of Diagnostic Radiology, Royal Care International Hospital, Sudan, with Toshiba VANTAGE ELAN, SHORT BORE 1.5T MRI system.

Protocol and procedure of patient imaging in MRI: Position for MRI brain Head first supine. Position the head in the head coil and immobilize with cushions. Give cushions under the leg for extra comfort. Center laser beam localizer over the glabella. MRI Brain should be done first axial T1, T2, FLAIR and sagittal images; it is use as screening for presence of mass lesion or other abnormalities. Sagittal image will use as a guide to obtain perpendicular plane to temporal lobe. T2 of coronal 3mm slice thickness, images perpendicular to the long axis of the temporal lobe should be taken.

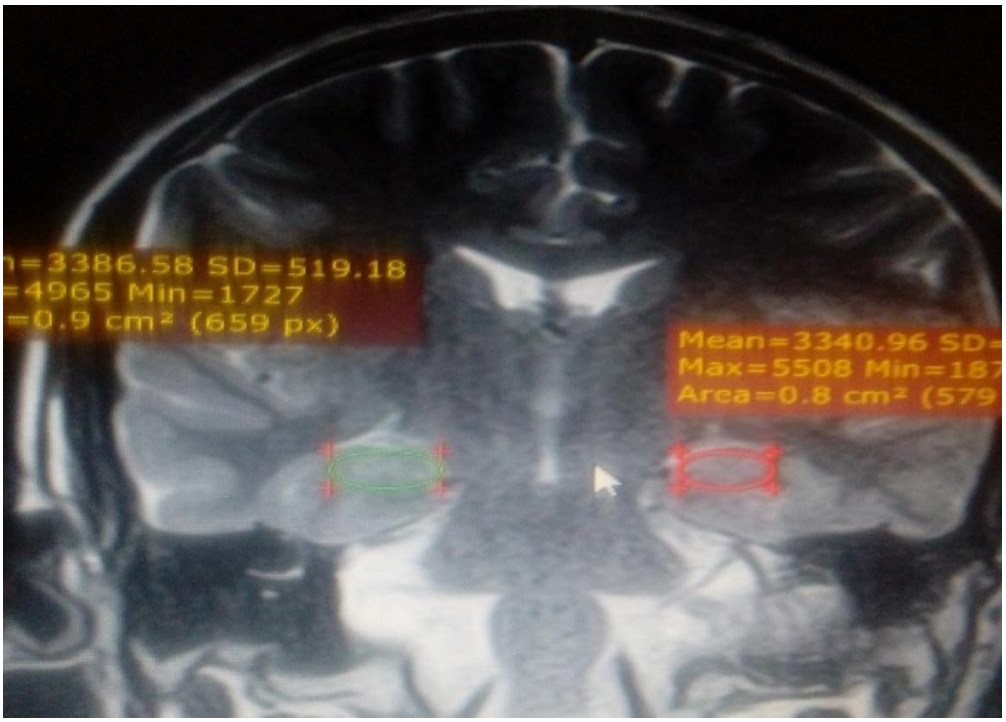

Fig 1. Show measurement method

Volume measurement:

The whole hippocampal volume was measured. Measurement hippocampal body and tail included subicular complex, the hippocampus proper, the dentate gyrus, the alveus and hippocampal fimbria. ROI-manually traced with computer mouse, right and left sides were measured individually. The measures were done three times for each ROI and the average was taken. Summation of the average of each slice = the total area of hippocampus for each side. Volume of the hippocampal complex, (cm3) = total area of the hippocampal complex (cm2) X The slice thickness (cm).

III. RESULTS:

Table 1. Show statistical parameters for all patients:

	Mean	Median	STD	Min	Max
Age	41.04	40	23.01	1	89
Lt hipp vol	2.07	2	0.366	1.1	4
Rt hipp vol	2.196	2.2	0.388	1.3	4.1

Table 2. Show paired sample statistics of normal and abnormal patients

		Mean	Std. Deviation	Std. Error Mean
Pair 1	Nor Rt hipp volume	2.207	.4930	.0535
	Ab Nor Rt hipp volume	2.134	.2136	.0232
Pair 2	Nor Lt hipp volume	2.071	.4522	.0490
	Ab Nor Lt hipp volume	2.000	.2177	.0236

Table 3. Show paired sample correlation of normal and abnormal patients

		Correlation	p.value
Pair 1	RT hipp fir normal and abnormal	.241	.026
Pair 2	LT hipp fir normal and abnormal	.244	.024

Table 4. Show MRI finding with age group

MRI finding	Age					Total
	1-18	19-35	36-50	51-75	76-90	
Atrophy	2	0	1	23	8	34
Age related	0	0	0	8	3	11
Vasculitis	4	7	5	6	0	22
Infarct	2	2	3	17	1	25
Ischemic	5	0	1	4	1	11
Epilepsy	11	3	3	1	0	18
Sinusitis	6	11	1	0	0	18
Tumor	18	10	14	16	2	60
Total	48	33	28	75	15	199

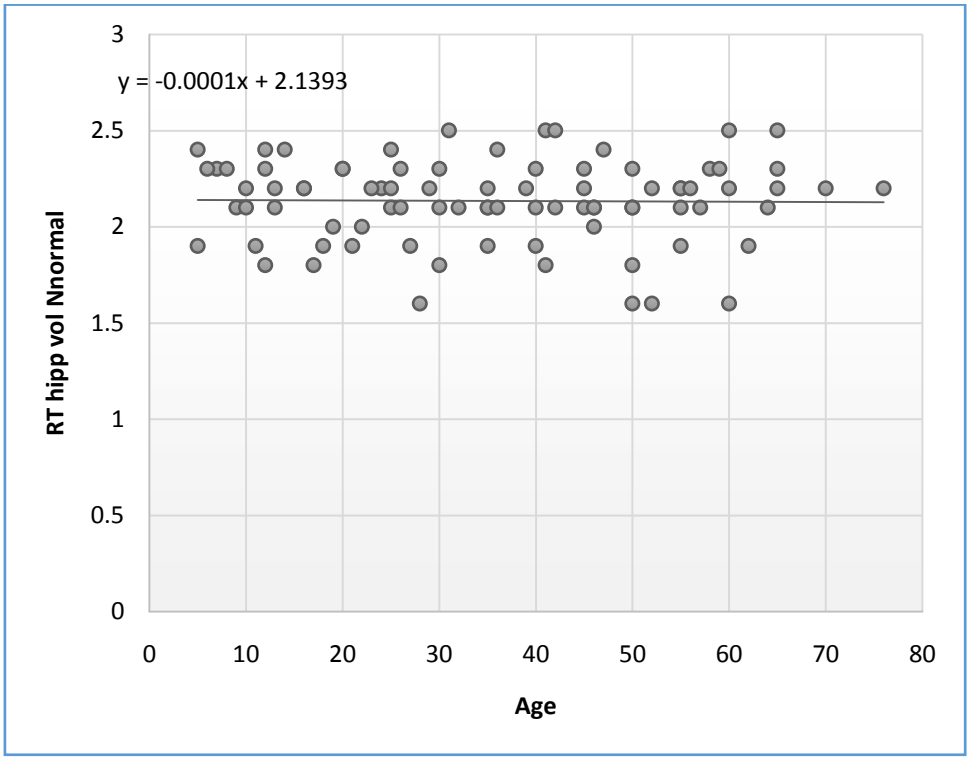

Fig 2. Show correlation between right hippocampus volume for normal

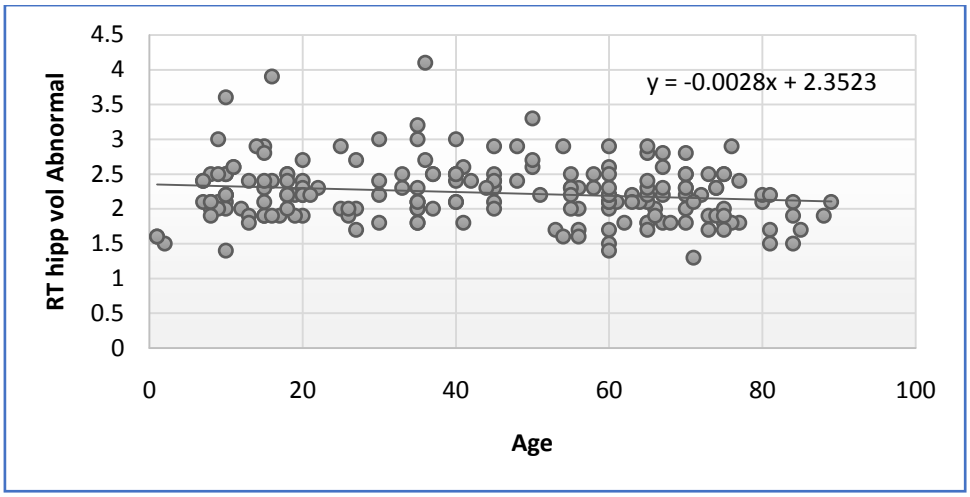

Fig 3. Show correlation between right hippocampus volume for abnormal

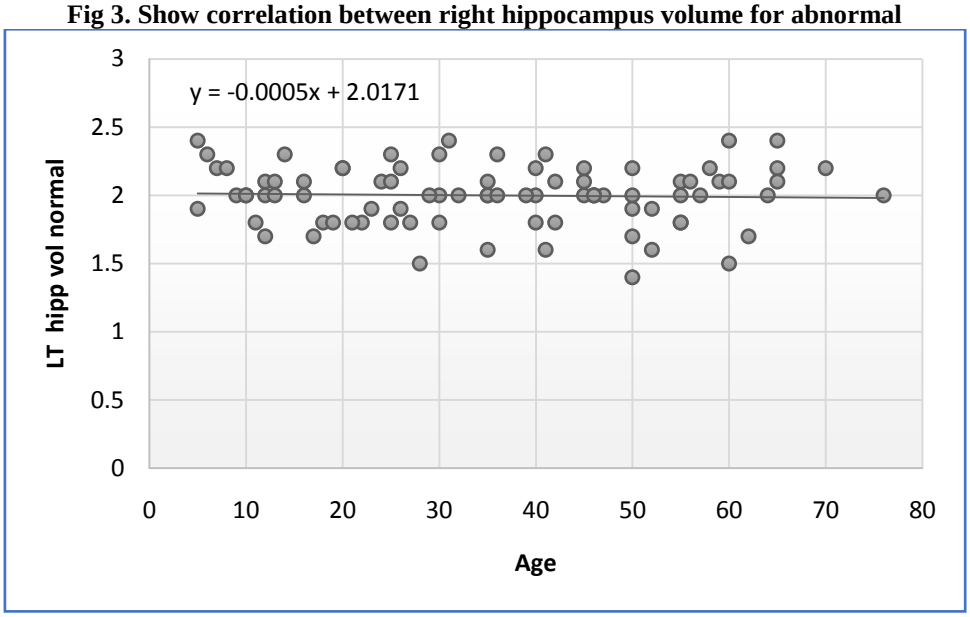

Fig 4. Show correlation between left hippocampus volume for normal

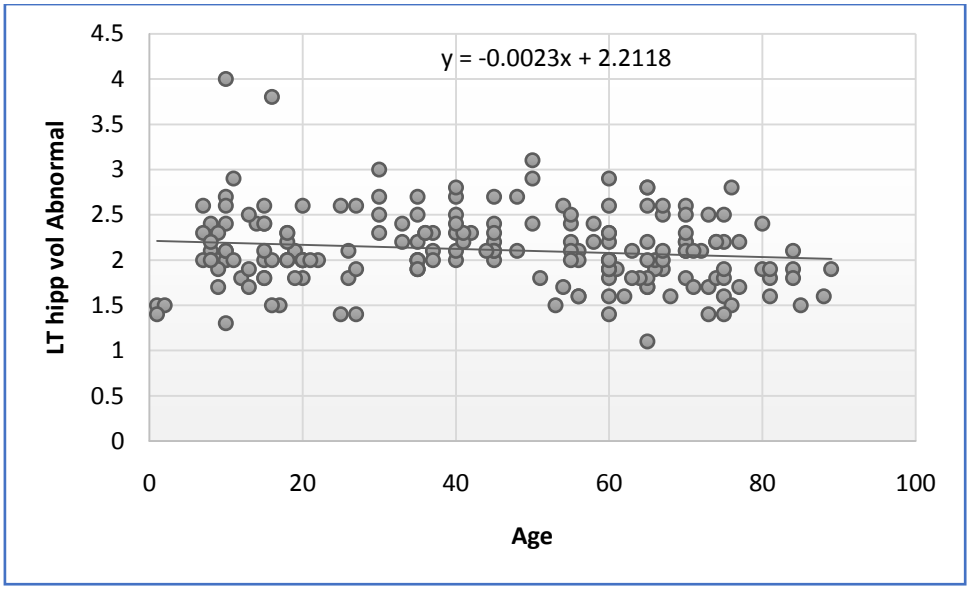

Fig 5. Show correlation between left hippocampus volume for abnormal

IV. DISCUSSION

Statistical parameters for all data showed as mean, median, standard deviation, minimum and maximum, for the age 41.04 ± 23.01, the left hippocampus volume 2.07± 0.366 and the right hippocampus 2.196 ± 0.388 table 1.

Table 2. show Paired sample for hippocampus to normal and abnormal patients for right hippocampus volume for normal patients 2.207 ± 0.493 and for abnormal patients 2.134 ± 0.2136.
For lift hippocampus volume for normal patients 2.071 ± 0.4522 and for abnormal patients 2 ± 0.2177.
this result showed that there are no significant differences between the right hippocampus for normal and up normal and same to left hippocampus for normal and up normal patients concerning left femoral artery. This difference was significant using t-test at p =0.05 in table 3.

For a relation between the disease and the patients age in age period from 1-18 years was epilepsy and tumor, for range from 19-35 years was sinusitis, and age rangers from 36-50, 51-75 and 76-90 was tumor, infract and atrophy respectively table 4.

Linear regression results showed that the rate of change in left hippocampus volume for abnormal patients decreases by 0.0.0023 for each year (fig 2). Linear regression results showed that the rate of change in right hippocampus volume for abnormal patients decreases by 0.0028 for each year (fig 3). Linear regression results showed that the rate of change in right hippocampus volume for normal patients decreases by 0.0.0001 for each year (fig 4). Linear regression results showed that the rate of change in left hippocampus volume for normal patients decreases by 0.0.0005 for each year (fig 5)

V. CONCLUSION

Measurement the volume of hippocampus volume for Sudanese population tonormal and abnormal patients as right and left side using MR 1.5 tesla, information was available for 300 patients (200 abnormal patients and 100 normal). volume measurements for hippocampus to normal and abnormal patients shows that the volume for normal was bigger than the volume of abnormal patients for both left and right side of hippocampus. And the correlate between patients age with different pathologies shows that the patients from 51-75 years with higher number of pathology atrophy, infract and tumors.

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