

ORIGINAL RESEARCH

Normative Volumetric Measurements of Hippocampus in Kashmiri Adults using Magnetic Resonance Imaging

Majid Jehangir¹, Rahil yousuf Khanday², Seema Qayoom³

ABSTRACT

Introduction: Volumetric measurements of hippocampus using Magnetic Resonance Imaging (MRI) is commonly being used in diagnosis of various neurological and neuro-psychiatric disorders. Although normative data of hippocampal volume is available for western population, no such data is available for Kashmiri population. The aim of the study was to establish normal values of hippocampal volume in Kashmiri adults that would be pertinent to the management and follow up of the patients suffering from post-traumatic stress disorder (PTSD).

Materials and Methods: Hippocampal volume was measured in 50 (35 males and 15 females) healthy Kashmiri adults using 1.5 Tesla MRI. Subjects with history of epilepsy, previous head injury, any present or past neurologic abnormalities or chronic illness or any abnormal MRI brain finding were excluded from the study. Sagittal sequence was used to locate the plane of left Sylvian fissure. An oblique T2 turbo spin echo sequence was obtained perpendicular to the plane of left Sylvian fissure. Cross sectional area of both the hippocampus was measured in these oblique coronal images. Manual segmentation and volumetry was done using Siemens syngo software

Results: The hippocampal volume in Kashmiri population was found to be less when compared with the available data in western population.

Conclusion: The data obtained in our study can be used as reference in Kashmiri population in various disorders related to hippocampus

Keywords: Hippocampus, Volumetry, MRI, Normative Data, Kashmiri, population

How to cite this article: Majid Jehangir, Rahil yousuf Khanday, Seema Qayoom. Normative Volumetric measurements of hippocampus in Kashmiri adults using magnetic resonance imaging. *International Journal of Contemporary Medical Research* 2015;2(5):1345-1347.

¹Associate Professor, ²Senior Resident, Department of Radio-diagnosis, Government Medical College, ³Associate Professor, Department of Dermatology, SKIMS Medical College, Srinagar, India

Corresponding author: Rahil Yousuf Khanday, House No, N/10, Cooperative Colony, Peerbagh, Srinagar, J&K, India.

Source of Support: Nil

Conflict of Interest: None

INTRODUCTION

The hippocampus and amygdala are involved in a number of neurological and neuro-psychiatric disorders, including temporal lobe epilepsy, Alzheimer's disease, Schizophrenia, depression and post traumatic stress disorder (PTSD). Over the last decade, there have been several studies showing the utility of volumetric measurement of hippocampus using MRI in these disorders.¹⁻⁸ In Mesial Temporal Lobe Sclerosis, the most common cause of temporal lobe epilepsy, MRI volumetry not only shows hippocampal atrophy, but also provides information regarding seizure lateralization and expected post – operative outcome.⁹⁻¹⁰ Atrophic changes in hippocampus have also been detected in major depression, post- traumatic stress disorder (PTSD) and early stages of Alzheimer's disease and thus highlights the potential role of MRI hippocampal volumetry in early diagnosis and follow up of these patients.⁶⁻⁷ MR hippocampal volume measurements can be done by various techniques including manual, semi-automatic or fully automatic computer segmentation of sequential images. Manual tracing is the gold standard,¹¹ and has been used by the most researchers. Few studies have evaluated the normal hippocampal volume in various age groups. Comparing these studies show a wide range of normal hippocampal volume (1.99-3.91 cubic centimeters).¹²⁻¹⁶ This wide variation can be explained by the fact that various researchers have used different data acquisition techniques, analysis software and anatomical boundaries. Also the hippocampal volume varies with age and ethnicity.¹⁷⁻¹⁸ Thus, there is a need to have a local normative data in various ethnic groups. Hence, we undertook this study to measure and establish normal hippocampal volumes in adults of Kashmiri ethnicity, using manual method of segmentation. These normative data can be used in the evaluation of patients with a variety of disorders relating to hippocampus. However, the main aim of the study was to acquire normative data that would be pertinent to the management and follow up of patients suffering from post -traumatic stress disorder.

MATERIAL AND METHODS

Fifty healthy volunteers from the hospital staff were studied. The subjects included 35 males and 15 females, aged 25 -47 years. All the subjects were of Kashmiri ethnic origin,

neurologically intact and did not have any systemic disease. All subjects were right handed. Subjects with history of epilepsy, previous head injury, any present or past neurologic abnormalities or chronic illness or any abnormal MRI brain finding were excluded from the study. A written consent was obtained from all the subjects and the study was approved by the institutional review board.

All MRI examinations were performed on a 1.5 Tesla system (Magnetom Avanto, Siemens) with a matrix head coil. Symmetric head positioning with respect to orthogonal axes was verified on scout sequences. Sagittal sequence was used to locate the plane of left Sylvian fissure. An oblique T2 turbo spin echo sequence (TSE) (T2W tse: TR 4440, TE 84, BW 260, matrix:349 x 448, slice thickness: 3mm, inter-slice gap: 0mm, Voxel size: 0.4x0.4x3mm) was obtained perpendicular to the plane of left sylvian fissure. Cross sectional area of both the hippocampus was measured in these oblique coronal images. Manual segmentation and volumetry was done using Siemens syngo software. The anterior hippocampus was taken from the point where the cerebro-spinal fluid (CSF), in the uncus recess of temporal lobe or alveus was seen. The posterior margin was taken on the MR image where the crus of fornix was seen in full profile. CSF in the lateral ventricle was taken as lateral border CSF in the cisterna ambiens was taken as medial border. The gray white junction between the subiculum white matter of parahippocampal gyrus was taken as inferior landmark. The alveus and the CSF within the lateral ventricle was used as superior landmark Figure 1.

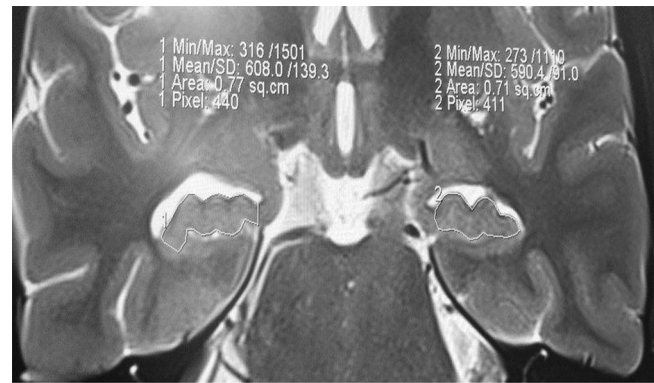
The right and left hippocampi were measured separately. The region of interest (ROI) was manually traced using a computer mouse. The total area was obtained by adding all the areas from each slice. The hippocampal area was obtained by adding up all the areas from each slice. The hippocampal volume was obtained by multiplying the total area with the slice thickness (in cms). To reduce inter observer variability, each ROI was traced by two radiologists independently and a mean of the two volumes on each side was obtained.

RESULTS

We recruited 50 healthy subjects of Kashmiri ethnicity (35 males and 15 females) aged 25- 47 years. The mean and standard deviation of age was 32.1 (6.9) years. The mean and standard deviation of the right, left and total hippocampal volumes are summarized in Table 1

DISCUSSION

The study was designed primarily to provide normative data of hippocampal volume in Kashmiri adults that would be pertinent to the management and follow up of the patients suffering from post- traumatic stress disorder. We found the mean right hippocampal volume as 2.61 cubic cm and mean left hippocampal volume as 2.41 cubic centimeter. The range of normal hippocampal volume in western population as re-



1 : right hippocampus and various measurements
2 : Left hippocampus and various measurements

Figure-1: Coronal T2WI Showing The Right And Left Hippocampus

	Range	Mean	SD
Right hippocampal volume (cubic centimeter)	2.14 – 3.01	2.61	0.48
Left hippocampal volume (cubic centimeter)	1.82 – 2.80	2.41	0.41

Table-1: MR Volumetric measurements of hippocampus in Kashmiri Adults (n=50)

ported in literature is from 2.78 to 3.91 cubic centimeter.¹²⁻¹⁶ Thus the hippocampal volume in Kashmiri population is smaller compared to the western population. The data can be used as a reference in Kashmiri population in various disorders related to hippocampus. However, as hippocampal volume varies with age, sex and handedness, further study is needed to establish the detailed normative data

REFERENCES

- Ashtari M, Barr WB, Schaul N, Rogerts B. Three dimensional fast low angle shot imaging and computerized volume measurement of the hippocampus in patients with chronic epilepsy of temporal lobe. *AJNR Am j Neuroradiol* 1991;12:941-947
- Bogerts B, Lieberman JA, Ashtari M. Hippocampus –amygdala volumes in psychopathology and chronic schizophrenia. *Biol Psychiatry* 1993;33:236-246
- Cendes F, Leproux F, Melanson D. MRI of amygdala and hippocampus in temporal lobe epilepsy. *J Comput Assist Tomogr* 1993;17:206-210
- Golomb J, Kluger A, de leon MJ, et al. Hippocampal formation size in normal human aging: a correlate of delayed secondary memory performance. *Learning memory* 1994;1:45-54
- Gilmore RL, Childress MD, Leonard C, et al. Hippocampal volumetrics differentiate patients with temporal lobe epilepsy and extra temporal lobe epilepsy. *Arch Neurol* 1995;52:819-824
- Jack CR, Bently MD, Tworney CK, Zinsmeister AR. MR based hippocampal volumetry in the diagnosis of Alzheimer’s disease. *Neurology* 1992;42:183-188
- Bremmer JD, Rendall P, Scott TM, et al. MRI based

- measurement of hippocampal volume in patients with combat-related post-traumatic stress disorder. *Am J Psychiatry* 1995;152:973-981
8. Mushtaq A, Margoob, Yasir A, Malik, Wiqar Bashir, Majid Jehangir. A Preliminary MRI Study Of Hippocampal Volume In Chronic Post Traumatic Stress Disorder. *JK Prac* 2006;13:s69-71.
 9. Coan AC, Kubota B, Bergo FP, Campos BM, Cendes F. 3T MRI Quantification of Hippocampal Volume and Signal in Mesial Temporal Lobe Epilepsy Improves Detection of Hippocampal Sclerosis. *AJNR Am J Neuroradiol*. 2014;35:77-83.
 10. Jack CR, Jr, Sharbrough FW, Casino GD, Hirschorn KA, O'Brien PC, Marsh WR. Magnetic resonance image based hippocampal volumetry: Correlation with outcome after temporal lobectomy. *Ann Neurol*. 1992;31:138-46
 11. Hsu Y Y, Schuff N, Du AT, Mark K, Zhu X, Hardin D, et al. Comparison of Automated and Manual MRI Volumetry of hippocampus in Normal Aging and Dementia. *J Magn Reson Imaging*. 2002;16:305-310.
 12. Honeycut NA, Smith CD. Hippocampal volume measurements using magnetic resonance imaging in normal young adults. *J Neuroimaging*. 1995;5:95-100
 13. Pruessner JC, Li LM, Serles W, Pruessner M, Collins DL, Kabani N, et al. Volumetry of hippocampus and amygdala with high-resolution MRI and three-dimensional analysis software: Minimizing the discrepancies between laboratories. *Cereb Cortex*. 2000;10:433-42
 14. Szabo CA, Xiong J, Lancaster JL, Rainey L, Fox P. Amygdalar and hippocampal volumetry in control participants: Differences regarding handedness. *AJNR Am J Neuroradiol*. 2001;22:1342-5
 15. Bhatia S, Bookheimer SY, Gaillard WD, Theodore WH. Measurement of whole temporal lobe and hippocampus for MR volumetry: Normative data. *Neurology*. 1993;43:2006-10
 16. Hasboun D, Chantome M, Zouaoui A, Sahel M, Deladoue M, Sourour N, et al. MR determination of hippocampal volume: Comparison of three methods. *AJNR Am J Neuroradiol*. 1996;17:1091-8
 17. Horvath K, Kover F, Kovacs N, Kallai J, Nagy F. Volumetric measurements of the hippocampus and amygdala with MRI in healthy adults.
 18. Aravind Narayan Mohandas, Rose Dawn Bharath, Parthipulli Vasuki Prathyusha, Arun K Gupta. Hippocampal volumetry: Normative data in the Indian population
 19. Salmah Jalaudin, Norhasiza Mat Jusoh, Izzat Abdulla Ali Bsahai, Mohd Shafie Abdullah, Ahmad Helmy Abdul Karim, Anis Kausar Gazali. Normalised MRI Volumetry of the Hippocampus among Normal Malay Children and Adolescents.