

Gender Variation of Paracentral Lobule Among Bangladeshi Population: A Cross-Sectional Study

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Abstract

Background: The paracentral lobule is the area on medial surface of the cerebral cortex surrounds the indentation produced by the upper end of central sulcus on the superior border. Any trauma, tumor, or cerebral ischemia cause lesions of motor and sensory cortex of paracentral lobule. This study was carried out to observe the morphometric pattern of paracentral lobule in adult male and female Bangladeshi population for establishment of a baseline anatomical normative data of our own for future studies.

Materials and Methods: This cross-sectional study was conducted in the Department of Anatomy, Dhaka Medical College, Dhaka, during the period of January 2017 to December 2017. A total of 70 adult Bangladeshi (35 male and 35 female) age ranging from 20-65 yrs were selected. CT scan image of brain in mid sagittal view was used for this study. Data were analyzed by Unpaired Student's 't' test.

Results: The length of motor and sensory area and width of motor area of right and left paracentral lobule was significantly higher in male. Non-significant difference was found in width of sensory area between male and female.

Conclusion: The present study reveals significant difference in morphological measurements of right and left paracentral lobule between male and female of adult Bangladeshi population.

Key words: Paracentral lobule, central sulcus, motor cortex, sensory cortex, morphometric measurement.

Introduction

The cerebral cortex of paracentral lobule contain parts of primary motor and sensory area, are concerned with specific parts of the body with specific types of input and activities.¹ The anterior part of paracentral lobule is continuous with the precentral gyrus (motor cortex) and posterior part

is continuous with the postcentral gyrus (sensory cortex).² On the medial surface of cerebral hemisphere, the paracentral lobule is bounded anteriorly by the paracentral sulcus, an ascending branch of the cingulate sulcus which is anterior to precentral sulcus, separates the paracentral lobule from the medial frontal gyrus. Posteriorly the paracentral lobule is bounded by the pars marginalis, which is the ascending termination of the cingulate sulcus and separates the paracentral lobule from the precuneus. Inferiorly the paracentral lobule is bounded by the cingulate sulcus which separates it from the cingulate gyrus.³

Morphology and boundaries of the paracentral lobule are determined by its limiting sulci, while its superior boundary corresponds to the superior margin of the hemisphere. The paracentral sulcus which is anterior to the precentral sulcus containing

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the supplementary motor area did not consider as a potential anterior boundary of the paracentral lobule.⁴ In case of segmented cingulate sulcus there is a short transitional lobulo-limbic gyrus, which may complicate definition of the paracentral lobule boundaries.⁵ On the medial hemispheric surface, the paracentral lobule extends from the ascending and descending paracentral sulci anteriorly to the terminal up-swing of the cingulate sulcus posteriorly.⁶

The precentral gyrus control movements of lower limb below the knee and perineal region of the opposite side and is concerned with voluntary control over the defecation and micturition reflexes.^{2,7,8} Damage of paracentral lobule occurs from occlusion or lesion of anterior cerebral artery which causes contralateral lower limb muscle weakness or paralysis and urinary incontinence^{9,8}. Thickness of cortex (gray matter volume) of paracentral lobule decreases with age and also in many diseases such as in Alzheimer's disease,¹⁰ chronic Schizophrenia, multiple sclerosis.¹¹

So, anatomy of the paracentral lobule has a great importance in diagnosis and management of injury and diseases of paracentral lobule. Clinician depends on available data and findings found in this area and demands more studies. The present study was an effort in that issue using data collected as Computed Tomography (CT) scan images of brain through CD from Radiology and Imaging Department of Dhaka Medical College and Hospital. CT scan provided more detailed information about structure of brain than regular radiographs.¹²

Review of existing literature reveals that few studies have been done on this topic in different countries. We need to make our own baseline standard. So, the values of this study might be helpful for the clinicians as well as the researchers of our country.

Methods

This cross-sectional study was conducted in the Department of Anatomy, Dhaka Medical College, Dhaka, during the period from January 2017 to

December 2017. Seventy adult Bangladeshi people, 35 males and 35 females, age ranging from 20-65 years were included in this study. The subjects of this study were selected from the Radiology & Imaging Department of Dhaka Medical College & Hospital attending for CT scan of brain advised by their physicians. Subjects were selected purposively and informed consent was taken. The study subjects were assured of confidentiality of the study. Personal information of the subjects was recorded on questionnaire by the researcher. CT scan images of brain in mid sagittal view of both cerebral hemispheres were collected which were reported normal by the radiologists. For this study, reconstructed mid sagittal view of both cerebral hemispheres were taken since the paracentral lobule was visible in this way and these images were viewed on a computer monitor for editing and magnifying. It was magnified at 100%. These images were transferred to a CD. Different dimensions of paracentral lobule were measured from these images by using computer with image measuring software program named RadiAnt DICOM Viewer version 4.0.3. (64-bit).

Due to a total absence of clear morphological landmarks, measurement was standardized by using intercommissural or CA-CP line (CA- anterior commissure, CP- posterior commissure) line system in order to increase precision of data.⁴ Unpaired student's 't' test was done for statistical analysis of the results. P value <0.05 was taken as level of significance.

Ethical clearance

The study was approved by Ethical Review committee of Dhaka Medical College.

Results

The maximum length of motor area of the right & left paracentral lobule was significantly higher in male than female and the result was statistically significant (p<0.01) (Table I).

Table I

Maximum length of motor area of right and left paracentral lobule between male and female

Variables	Side	Male (n=35)	Female (n=35)	p value
Maximum length of motor area (mm)	Right (Mean±SD)	25.91±1.84	24.56±1.98	0.004**
	Left (Mean±SD)	26.52±1.68	25.55±1.80	0.023*

It was found that length of sensory area of right and left paracentral lobule was significantly higher in male than female and the result was statistically significant ($p < 0.05$) (Table II).

Table II

Maximum length of sensory area of right and left paracentral lobule between male and female

Variables	Side	Male (n=35)	Female (n=35)	p value
Maximum length of sensory area (mm)	Right (Mean±SD)	20.79±2.54	19.33±2.66	0.022*
	Left (Mean±SD)	21.32±2.41	20.06±2.47	0.034*

The maximum width of right and left paracentral lobule was significantly higher in male than female and the result was statistically significant ($p < 0.05$) (Table III).

Table III

Maximum width of motor area of right and left paracentral lobule between male and female

Variables	Side	Male (n=35)	Female (n=35)	p value
Maximum width of motor area (mm)	Right (Mean±SD)	23.78±2.30	22.43±2.00	0.011*
	Left (Mean±SD)	24.39±2.0	23.34±1.81	0.025*

There was no significant difference ($p = 0.109$) in right & left paracentral lobule between male and female (Table IV).

Table IV

Maximum width of sensory area of right and left paracentral lobule between male and female

Variables	Side	Male (n=35)	Female (n=35)	p value
Maximum width of sensory area (mm)	Right (Mean±SD)	0.62±1.47	10.06±1.43	0.109 ^{ns}
	Left (Mean±SD)	9.73±1.14	9.33±1.38	0.189 ^{ns}

Discussion:

In this study, the length of motor area of right and left paracentral lobule was higher in male than female and statistically significant difference was also observed. Neto et al³ did not find any significant difference in length of motor area of right and left paracentral lobule between male & female. It may be due to nutritional, environmental

variation and life style difference in their study population.

In the present study, the length of sensory area of right and left paracentral lobule was higher in male than female. Statistically significant difference was also observed between male and female. Neto et al³ recorded the length of paracentral lobule in the sagittal axis. But they did not publish any data

regarding the length of sensory area. They stated that the motor area showed larger length in relation to the sensory area in the analysis of two hemispheres.

In this study, the width of motor area of right and left paracentral lobule was higher in male than female and statistically significant difference was observed of right and left paracentral lobule between male and female. On the contrary, Neto et al.³ also measured the width of paracentral lobule in transverse axis and significant difference was not found in their study subjects. They found that average width of motor area was larger in left than right paracentral lobule but did not publish separate data regarding male and female.

In this study, no significant difference was observed in width of sensory area of the right and left paracentral lobule between male and female. On the other hand, similar observation were found by Neto et al.³ By reviewing literature it is observed that few studies have been carried out on morphometric measurements of the paracentral lobule in other countries that evaluated the measurements of distances between sulci that demarcated the paracentral lobule. There is no available published work on measurements of the paracentral lobule in Bangladesh. So, the result of the present study was compared with the findings of other researchers of abroad. The studies were done by different researchers, recorded the data on morphometry of paracentral lobule in various ways. The researchers carried out their study on living subject or postmortem brain or people of different countries. Some researchers used MRI study, some also used digital calipers, Auto CAD software, calibrated scale for measurements of various parameters of the paracentral lobule and for surrounding other areas. Some dissimilarities were also noticed among the findings of present study and the studies conducted by other researchers. These dissimilarities may be due to mixture of different age and races, use of cadaveric brain instead of CT scan image from living subject, variation in the radiograph and taking the measurement in different technique. Some of the researchers conducted study on paracentral lobule

but they did not show separate data for male and female but in the present study, the data was collected separately from right and left cerebral hemisphere of both male and female.

The human paracentral lobule is an important center for micturition and defecation and control lower limb muscular activity below the knee. Size of the paracentral lobule varies from person to person. So the adult paracentral lobule study is very important to the radiologist and clinicians for the diagnosis and treatment of related diseases. Its variable morphology requires exact morphological and quantitative data.

Conclusion

The maximum length of motor and sensory area and maximum width of motor area has been found significantly higher in male than female. Maximum width of sensory area have shown non-significant difference between male and female. The study findings suggest that morphological measurements of the paracentral lobule dimensions reveal significant difference in adult Bangladeshi male and female people that may have anatomical and clinical importance.

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