Age Related Changes Of Corpus Callosum By MRI In Females

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Citation

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Abstract

The morphologic characteristics of brain in humans appear to be sensitive to the effects of both age and sex, and data suggest that these 2 variables may interact over the life span to influence brain size. These morphometrical data can provide a useful context to interpret changes in regional brain structure associated with aging. The corpus callosum is the largest commissure of the brain. It is seen as thick, curved white band on medial surface of sagittaly bisected brain. It is 10 cm long and consist of the rostrum, genu, trunk and splenium. The present study was carried out on 120 females, between the age group of 20-85 years who visited the OPD of Department of radio-diagnosis of SVBP Hospital and NMC Sky Imaging Centre, LLRM Medical College, Meerut. They were studied for various parameters of corpus callosum in mid-sagittal plane by Magnetic Resonance Imaging .Different parts of corpus callosum were compared in adult and senile age groups. Progressive chronological decrease was found with age especially in the region of genu and rostrum, also the maximum width of corpus callosum significantly decreased with increasing age.

INTRODUCTION

There are disputed claims about the difference in the size of the human corpus callosum in men and women and the relationship of any such differences to gender differences in human behaviour and cognition. RB Bean, a Philadelphia anatomist, suggested in 1906 that the “exceptional size of the corpus callosum may mean exceptional intellectual activity” and claimed differences in size between males and females and between races, although these were refuted by Franklin Mall, the director of his own laboratory. Of much more substantial popular impact was a 1982 Science article claiming to be the first report of a reliable sex difference in human brain morphology, and arguing for relevance to cognitive gender differences.

The corpus callosum is a structure of the mammalian brain in the longitudinal fissure that connects the left and right cerebral hemispheres. It is the largest white matter structure in the brain, consisting of 200-250 million contra lateral axonal projections. It is a wide, flat bundle of axons beneath the cortex. Much of the inter-hemispheric communication in the brain is conducted across the corpus callosum. Monotremes and marsupials do not have a corpus callosum. It is 10 cm long and consist of the rostrum, genu, trunk and splenium. Rostrum is the narrowest part , Genu is the most anteriorly projecting part and lies about 4cm from frontal pole. Trunk (Body) is the main part of corpus callosum. Splenium is the thickened posterior end of corpus callosum and lies about 6 cm from occipital pole. (Standring et al, 2005)

MR imaging enables the in vivo study of cerebral structure and function. Several neuroimaging studies have used the midsagittal area of the corpus callosum to show differences in morphology related to sex, handedness , aging and pathologic states. The corpus callosum has been shown to be altered in conditions such as schizophrenia, dyslexia, even when visual assessment of the MR images reveals normal findings. In pathologic states such as multiple sclerosis and Alzheimer disease, quantitative measures of the corpus callosum have been proposed as useful indicators of disease progression. Several studies indicate that the size and shape of the corpus callosum (CC) in human brain are correlated to sex, age, brain growth and degeneration , handedness , and to various types of brain dysfunction .

MATERIAL AND METHOD

A total of 120 females of age ranging from 20 to 85 years , who attended OPD of Radio-diagnosis of Sardar Vallabh Bhai Patel Hospital, Meerut and visited NMC Sky Scanning centre, were studied by Magnetic Resonance Imaging (Mid-sagittal imaging) by 1.5 Tesla Machine of G. G. company

with LCD projector. Informed consent was taken from the patients. Subjects were divided into two groups – adult (20-60 years) & Senile group (> 60 years). The subjects of the MRI were normal volunteers or patients referred for suspected or known central nervous system diseases.

Exclusion Criteria: Patients were excluded only when the pathologic process affected, or theoretically could affect, the corpus callosum (e.g., hydrocephalus or tumor) and when the entire corpus callosum was not on a single slice as a consequence of an oblique imaging plane. Magnetic resonance images were eliminated if there was any visible evidence of deviation from the midsagittal plane.

In this study various parameters of corpus callosum measured in females in mid-sagittal plane of magnetic resonance imaging were-

1. Thickness of various parts of corpus callosum at its maximum level (genu, rostrum, body and splenium).

2. Maximum length and maximum width of corpus callosum.

3. Distance of corpus callosum from frontal pole and occipital pole of cerebral hemisphere.

Comparison of these parameters were done between adults (20-60 years) and senile (>60 years) age groups of females. The results were statistically analyzed by using unpaired student 't' test with Welch correction. Probability 'p' value ≤0.05 and 't' value ≥ 1.96 is considered significant. All parameters were measured in millimeter (mm).

Figure 1

Showing position of corpus callosum in mid-sagittal view of MRI (arrow), thickness of its different parts (1-Rostrum, 2-Genu, 3-Body, 4-Splenium)

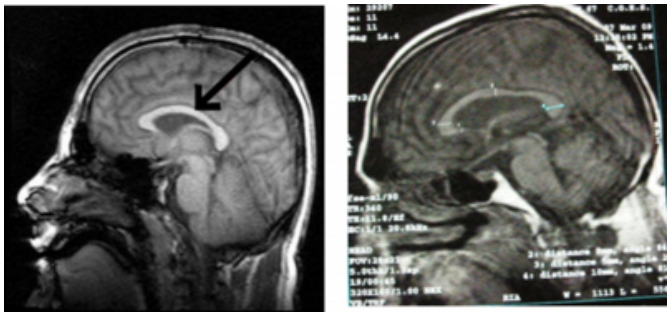
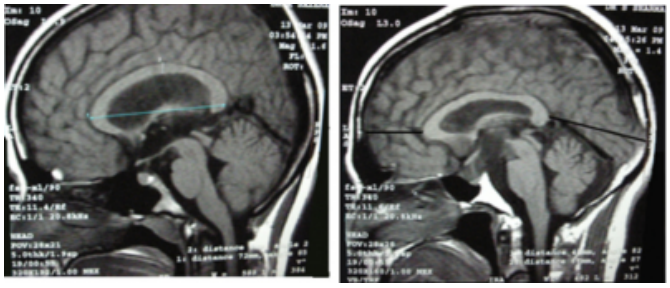


Figure 2

Showing maximum length (1)and maximum width (2) of Corpus callosum in mid-sgittal view, Distance of corpus callosum from frontal and occipital pole.



OBSERVATION

The various observations of this study are shown in following tables

S-Significant, NS- Non significant, VS- Very significant, ES- Extremely significant, ( ) – No of cases of females in adult and senile age groups.

Figure 3

Table -1showing comparison of thickness of different parts of Corpus callosum in adult & senile age groups with its significance.

Parts of CC	20-60 yrs (75)	>60 yrs (45)	P- value	t-value	Result
Rostrum	3.92 ± 0.95	3.10 ±0.74	0.0205	2.4346	S
Genu	11.04 ±1.67	8.80 ± 2.10	0.00201	3.3315	VS
Body	5.88 ± 1.09	5.10 ± 1.20	0.0721	1.8580	NS
Splenium	10.68 ± 1.44	8.60 ± 1.35	0.0004	3.9356	ES

NS- Non significant, S- significant, ( ) – No of cases of females in adult and senile age groups.

Figure 4

Table -2showing comparison of maximum length and maximum width of Corpus callosum in adult & senile age group with its significance.

Corpus callosa	20-60 yrs (75)	>60 yrs (45)	P value	t-value	Result
Max. Length	70.0 ± 4.58	70.50 ± 6.40	0.7966	0.2599	NS
Max. Width	5.88 ±1.13	4.90 ± 1.10	0.0258	2.3345	S

Figure 5

Table -3 showing comparison of distance of corpus callosum from frontal and occipital pole in adult & senile age group of females with its significance

Corpus callosum	20-60 yrs (75)	>60 yrs (45)	P value	t-value	Result
Distance from Frontal pole	44.32 ± 3.00	43.80 ± 2.86	0.6417	0.4696	NS
Distance from Occipital pole	59.60 ± 3.50	60.0 ± 4.55	0.7810	0.2803	NS

NS- Non significant, ( ) – No of cases of females in adult and senile age groups.

RESULT

The present study shows a significant difference in thickness of rostrum and genu parts of Corpus callosum in adult & senile age groups of Females and the thickness decreases with age also significant difference is seen in maximum width between the above two groups again thickness decreases with age.

DISCUSSION

Corpus callosum has been the focus of fair amount of research and debate, especially its morphology in relation to various aspects of cerebral function. In recent years, most of the available studies have been carried out on MRI scans, and few studies are based on formalin- fixed autopsy brain specimens. Most of the studies of CC measurements have been performed on Caucasian samples, and there are very few studies on normative data of CC in Indian population. We could come across only three Indian studies on CC measurements: one on preserved brain (Banka et al, 1996), and the second on MRI scans (Suganthy et al 2003) and the third including both methods (Gupta et al, 2009).

Changes in callosal size in aging adults are controversial. Doraiswamy et al (1991) and Weis et al (1986) have shown senescent effects over 3rd-8 th decades. Salat et al (1997) and Davatzikos et al (1998) found aging effects in elderly subjects especially those exceeding 55 years. Studies by Weis et al (1986) and Salat et al(1997) have shown greater vulnerability to aging in anterior than posterior regions of CC. This is particularly marked in women (Salat et al,1997) while Johnosn et al(1994) found greater vulnerability of men compared to women in older decades.

Salat et al (1997) reported that among elderly subjects (age range
65-95 years) age related atrophy of the anterior and middle sectors of the CC occurred in women but not in men. These findings correlate with the present study as the thickness of rostrum and genu has decreased wih age.

Witelson (1989) observed that the callosal size decreased with chronological age in males. Cowell et al (1992) have also documented that men exhibit maximum callosal width in their early 20's with a relatively rapid decline thereafter. The present study reveals ht in females also the thickness of different parts of corpus callosum decreased significantly with chronological age especially after 60 yrs.

Corpus callosum, being the major structure connecting both the hemispheres, is likely to be affected by the physiologic as well as pathological changes occurring in the cortical and sub cortical regions of brain. Therefore different sub regions of the CC may be affected depending upon the region of the brain involved, as fiber systems connecting corresponding hemispheric regions pass through specific callosal sub regions. Therefore, alteration in CC morphology may give a clue towards diagnosis of specific disease processes. A knowledge of CC morphology and the gender as well as age related changes, thus is likely to be helpful in providing baseline data for the diagnosis of presence and progression of disease.

This is a random prospective study and further work is still required to assess the more specific age as well as gender related differences.

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