Medical Studies Department
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Neuropsychological and Genetic Studies of Corpus Callosum Abnormalities

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List of Abbreviations

Abbr.	Full-term
ACC	Agenesis of the corpus callosum
ACLS	Acrocallosal syndrome
BAEP	Brain stem auditory evoked potential
CBA	Cerebellar atrophy
CBCL	Child Behavior Check List
CBH	Cerebellar hypoplasia
CC	Corpus callosum
CCA	Corpus callosum abnormality
CGH	Comparative Genomic Hyberdization
CK	Creatine phosphokinase
CNV	Copy number variant
CVH	Cerebellar vermian hypoplasia
DWM	Dandy-Walker malformation
EEG	Electroencephalogram
EMG	Electromyography
ERG	Electro-retinogram
FAS	Fetal alcohol syndrome
FH	Family history
FISH	Fluorescence In Situ Hybridization
HC	Head Circumference
Ht	Height
MR	Mental retardation
MRI	Magnetic resonance imaging
NCV	Nerve conduction velocity
PCH	Pontocerebellar hypoplasia
SMTM	Sulcus medianus telencephali medii
TORCH	Toxoplasmosis, Rubella, Cytomegalovirus & Herpes viruses
UBO	Unidentified bright objects
UNO	Neurofibromatosis bright objects
VEP	Visual evoked potential
WPSSI	Wechsler Primary Preschool Scale of Intelligence
Wt	Weight
X-ALD	X-linked Adrenoleukodystrophy

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ABSTRACT

Background: Corpus callosum CC connects the left and right cerebral hemispheres. It is the largest white matter structure in the brain connecting mainly homotopic, but also heterotopic brain areas of both hemi-sphere. It has a major role in everyday behavior. Abnormalities of corpus callosum can occur as an isolated finding on Magnetic resonance Imaging (MRI), or more commonly, it is associated with large number of brain anomalies.

Aim of the study: Identification of various developmental abnormalities of CC and detection of associating genetic syndromes and chromosomal aberrations among studied patients. Associating the morphological abnormalities of CC to the intellectual function, behavioral and social skills of patients.

Patients and methods: Neuropsychological and genetic assessment of 64 cases with corpus callosum abnormalities was done from January 2012 till December 2014. Interpretation of all MRIs were reviewed by radio-diagnosis consultant with particular attention to the degree of callosal abnormality.

Results: 12.5% of cases had chromosomal aberrations, 14% of cases had identified genetic syndrome and 73% of cases were non-syndromic/ unclassified. Variable degrees of mental retardation were encountered among 92.2% of studied patients.

Conclusion: Abnormalities of the corpus callosum is often associated with cognitive deficits, autism, and epilepsy

Key words: Corpus callosum- Agenesis- Abnormalities- Chromosomal- MRI, Psychological evaluation

Introduction

Corpus callosum (CC) is the main fiber tract connecting the left and right cerebral hemispheres. Histological researches show that the fibers in different parts of corpus callosum link with the different regions of cerebral hemispheres. The fibers in the anterior segment of corpus callosum connect with frontal region (the genu and the anterior third with prefrontal cortices), the ones in the middle third with motor, auditory, and somatosensory cortices, and the ones in posterior third with temporal, parietal, occipital regions and with the isthmus which is a region between the mid-body and the splenium. But it is now still in debate about the exact functions of corpus callosum and its various parts ***(Junle et al., 2008).***

The corpus callosum is the main inter-hemispheric commissure of the brain consisting of approximately 180 million fibers, most of which connect with homologous cortical areas. Studies of the acallosal subjects, subjects with brain lesions or commisurotomies and animal research indicates an integral role of the C.C in unifying sensory fields, organizing bimanual motor output, aiding memory storage and retrieval, allocating attention and arousal, facilitating language and auditory functions and perhaps also in consciousness itself. In general, the C.C is thought to integrate the activities of the two

hemispheres by transferring sensory and higher processed information. As task difficulty increases, the integrated activity of both hemispheres becomes more important, and both creativity and intelligence have been linked to interhemispheric integration ***(Giedd et al., 1996).***

Magnetic Resonance Imaging (MRI) studies reveal that C.C. development in humans begins approximately 8 weeks after conception with the formation of the anterior curve, or genu, followed by the body and then posterior bulb, or splenium. The rostrum is the exception to this general anterior to posterior trend, forming last at about 20 weeks ***(Barkovich, 1990).***

The size of the C.C. is determined by the number and size of its constituent axons, degree of myelination, packing density, vasculature and extra-vascular fluid. The most likely candidate for age related increase in size is myelination.

Agenesis of the corpus callosum (ACC) encompasses a broad range of diagnoses. A synthesis of recent neonatal and prenatal imaging studies suggested that ACC occurs in at least 1:4000 live births ***(Guillem et al., 2003; Wang et al., 2004)*** and other imaging studies ***(Jeret et al., 1985, Bodensteiner et al., 1994)*** demonstrated that 3–5% of individuals assessed for neuro-developmental disorders have ACC. It is one of the most frequent malformations in brain

with a reported incidence ranging between 0.5 and 70 in 10,000 births. ACC is a clinically and genetically heterogeneous condition, which can be observed either as isolated condition or as a manifestation in the context of a congenital syndrome ***(Dobyns, 1996).***

Diagnosis of agenesis of the corpus callosum requires MRI imaging analysis. Such imaging studies are typically undertaken in the context of an evaluation for either developmental delay or epilepsy. MRI, with its lack of ionizing radiation and excellent anatomical resolution provides unprecedented opportunity to obtain in vivo neuro-anatomical information of children ***(Giedd et al., 1996).***

Measuring the widths of different parts of corpus callosum on MRI sagittal plane can indirectly reflect (1) the dimensions of different parts and the situations of atrophy, (2) the normal reference value in different age phrases and in different genders, (3) the difference between the normal and the various abnormal corpus callosum. Save its linking functions in brain, other functions are also evoking more and more interests ***(Junle et al., 2008).***

Agenesis of the corpus callosum is not a single malformation. On the basis of embryology, Dobyns 1996 described two primary or “true” types and two secondary types of callosal abnormalities. The two types of primary