



A STUDY ON HISTOGENESIS OF HUMAN FETAL CEREBRUM

Anatomy

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ABSTRACT

Human cerebral cortex is thinnest at 8wks of intra-uterine life and becomes thicker progressively along the supero-lateral and infero-lateral walls from frontal to occipital poles. brains of 50 still born human foetuses of both sexes were procured and 5mm tissues bits of frontal, temporal, parietal and occipital cortices were processed for histological examination using crystal violet stained. the neurons were granular until 18wks of gestation and showed few pyramidal cells at 24 weeks and than sesquilaminar pattern with predominance of Betz cells in frontal and temporal cortex and predominance of granule cells in parietal and occipital cortex. Cell migration and genesis is important in disorders like epilepsy or dyslepsy.

KEYWORDS

Betz, cerebrum, ependymal, granule, koniocortex, migration

Introduction

The histogenesis of the cortical wall of cerebral hemispheres has generated an impressive literature since 1930. The immense complexity and multiplicity of cell types and structural heterogeneity in different locations, generated wide study by different authors in the past. Pioneering studies into cell migration in the developing neocortex were made by tilney(1933)¹. He professed trilaminar sequential structure of cerebral cortex. Economo and koskinas(1929)² corroborated 5 fundamental types in neocortex and further professed sesquilaminar pattern. The present study has been undertaken to notify the changes in the cortex of foetal cerebral hemispheres.

Materials and method:

- 50 human still born foetuses of various gestational ages ranging from 12 weeks to 40 weeks were taken for present study.
- Tissues of different regions of cerebral hemispheres (18, 24, 33, and 40 weeks) have been collected.
- They were processed and stained with crystal violet, to view the cytoarchitecture of cerebral cortex.

Observation

- At 18wks gestation, the neuronal cells showed a closely packed stratification with migration of all the cells from the ependymal zone(ventricular zone) to the pial surface(fig.1). This being very prominent in all the regions of cerebral cortex. vertical migration is predominant over the collateral migration. The cells are rounded with deep stained nuclei (fig.2).

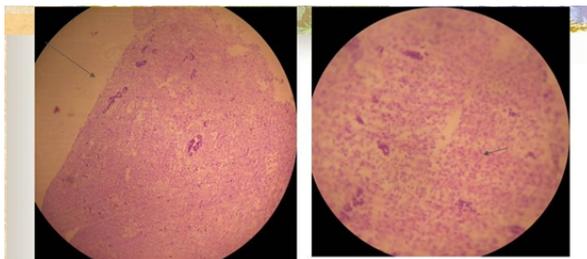


FIG.1

FIG.2

FIG.1 SHOWING CLOSELY PACKED STRATIFICATION OF CELLS IN 18WKS FETAL CEREBRUM, 10X MAG. CRESYL VIOLET STAIN

FIG.2 SHOWING ROUNDED CELLS AT 18 WKS GESTATIONS

- At 24 wks the process of migration is still on. However the typical laminar pattern is not seen. The cells look like rounded granule cells with deeply stained nuclei.
- At 33 wks, the cells are assuming the laminar pattern. Predominance of granule cells is seen along with few pyramidal cells.

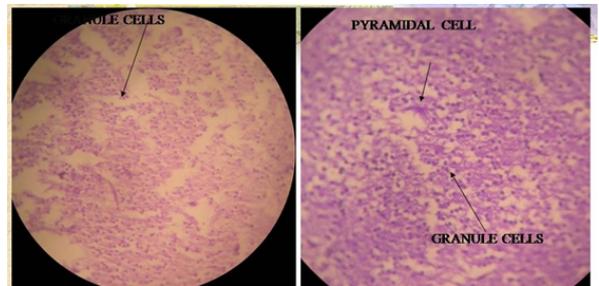


FIG.3

FIG.4

FIG.3 SHOWING GRANULE CELLS AT 24 WKS GESTATION

FIG.4 SHOWING A PYRAMIDAL CELL AND NUMEROUS GRANULE CELLS AT 33 WKS GESTATION

- At 40 wks, the laminar pattern is clearly demarcated. Large pyramidal cells (Betz) are seen in the pre-central gyrus in the frontal lobe. In post-central gyrus, granule cells are predominant with few pyramidal cells.
- At 40 wks, the granule cells and predominantly pyramidal cells are seen which is a feature of temporal cortex. The occipital cortex showing very small, rounded granules with deeply stained nuclei, absence of pyramidal cells completely, a feature of koniocortex.

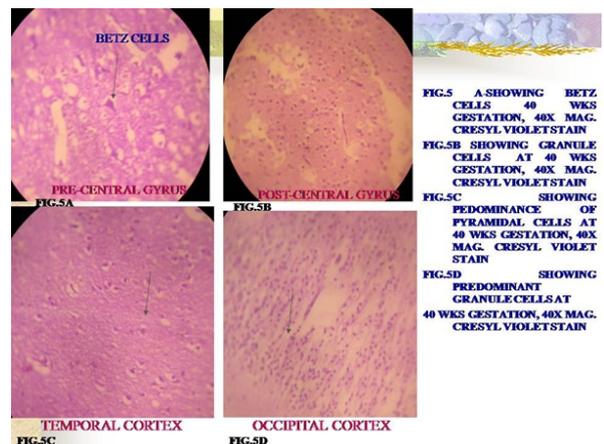


FIG.5A

FIG.5B

FIG.5C

FIG.5D

FIG.5 A SHOWING BETZ CELLS AT 40 WKS GESTATION, 40X MAG. CRESYL VIOLET STAIN
FIG.5B SHOWING GRANULE CELLS AT 40 WKS GESTATION, 40X MAG. CRESYL VIOLET STAIN
FIG.5C SHOWING PREDOMINANCE OF PYRAMIDAL CELLS AT 40 WKS GESTATION, 40X MAG. CRESYL VIOLET STAIN
FIG.5D SHOWING PREDOMINANT GRANULE CELLS AT 40 WKS GESTATION, 40X MAG. CRESYL VIOLET STAIN

Discussion:

- Human cerebral cortex is thinnest at 8wks of intra-uterine life and becomes thicker progressively along the supero-lateral and infero-lateral walls from frontal to occipital poles (Sanides1970)³. Outer molecular layer is thin with sparse cells adjacent to pia mater named as Cajal-Retzius cells (Bryan Kolb, Ian Q. Whishaw 2003)

4. The neurons that are migrating accomplish a vertical and lateral migration from that of the first matured neurons which settled down as layer 6 neurons. Later more superficial layers of cortex are formed from inside out.
- The transformation into the adult neocortical pattern starts between weeks 25 and 34 as the migration and proliferation of proneurons diminishes. Dendrites begin to differentiate and synapses begin to develop in the deepest cortical layers, progressing to the most superficial layer. (Huttenlocher, p.r.1987)⁵
 - The topographic changes in pre-central, post-central, temporal, and occipital cortices do take place between 5-8 months due to unequal growth and heterogeneous differentiation of cortical regions. It has been recognized that the young neurons are guided in their migrations by following the surfaces of radial glial cells, a bipolar cell form of astroglial lineage (Rakic, 1972⁶, 1978⁷)
 - This areal differentiation occurs concomitantly with the arrival of thalamocortical fibres (Marin – Padilla, 1970⁸; Sidman and Rakic, 1973⁹) but not necessarily as a consequence of it (Seil et al., 1974¹⁰). The embryonic central nervous system consists of five fundamental zones from which the adult organization is derived, though none of the five corresponds directly to any adult component. The geographical names are ventricular zone, subventricular zone, intermediate zone, cortical zone and marginal zone (the Boulder Committee, 1970¹¹).
 - Chong et al., (1996)¹² had provided a template of the normal appearance and the temporal pattern of neuronal migration in the human foetal brain early in the II Trimester as seen with MRI and correlated with histological sections. The presence of germinal matrix and layers of migrating neurons diminished considerably in size by 21 weeks. In the present study, the six layered pattern of cortex was clearly appeared at first in the precentral gyrus from 30 weeks onwards. Conclusion:
 - At present, disorders of cell migration can be identified by magnetic resonance imaging, most common disorder is dysleptia or epilepsy. (Bryan Kolb, Ian Q. Whishaw 2003) 4. Clark (2002)¹³, made identification of lissencephaly, cerebral hypoplasia, polymicrogyria and heterotopias which are sexlinked inherited disorders.

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