

# Characteristic Intracortical Vascular Networks in the Transient Cellular Compartments of the Human Fetal Cerebral Wall

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### Introduction

Major neurogenetic events (proliferation, migration, molecular specification, neural aggregation, dendritic differentiation, axonal growth, synaptogenesis and cell death) occur in transient cerebral compartments which show prolonged differentiation from late embryonic to late preterm period(ventricular zone VZ, subventricular zone SVZ, intermediate zone IZ, subplate SP, cortical plate CP, marginal zone MZ).

In this study we analyzed general patterns of vascularization in relation to the development of cellular compartments in the human fetal cerebrum.

#### **Materials and methods**

Development of vascular patterns was analyzed in Histological sections from fetal brains ranging from 7,5 PCW until 36 PCW (Zagreb Neuroembryological Collection, http://www.zagrebbraincollection .hr/). Histological sections were

processed with Stensas modification of Rio del Hortega method, with additional immunohistochemical methods, GFAP and vimentin.

# Results

In the earliest specimen studied cerebral wall was composed of three embryonic zones; VZ, SVZ and preplate, mantle layer. The blood vessels of arteriolar size and larger were found in all of the embryonic zones (Fig.1). In addition, new primitive blood vessels were found penetrating basal membrane from pial side and ending in T shape mode. After the formation of the CP there are two basic patterns of blood vessels: deep network (VZ, SVZ) shows mesh-like pattern, while cell dense CP shows predominant radial pattern. Parallel with formation of SP, new intermediate network is formed. During mid gestation (15-24 PCW) the cerebral wall shows typical lamination (VZ, SVZ, IZ, SP, CP, MZ).

Here, the blood vessels network showed the following pattern: VZ is composed from enlarged, venula type vessels, with big diameter of mesh units. In fiber rich SVZ, vessels run within the septa of the callosum. Deep SP zone exhibited radially oriented large vessels with side oblique, evenly spaced side branches. Superficial SP shows plexiform mesh like pattern similar as deep CP, while radially oriented vessels characterize superficial CP and MZ (Fig.2.). Thus, fetal cerebral wall of shows alternating mesh like – radial pattern across the cerebral wall. After 34 weeks, there is gradual transformation of SP vascularization and diminishment of the ventricular network parallel with thinning of VZ and SVZ.

Figure 1. Histological sections processed with Stensas modification of Rio del Hortega method and plastic, 10 PCW. The blood vessels of arteriolar size and larger were found in all of the embryonic zones (VZ, SVZ, PP).



Figure 2. Histological sections processed with Stensas modification of Rio del Hortega method, GFAP and vimentin, 20-23 PCW. The cerebral wall shows typical lamination and alternating mesh like – radial



### Conclusions

Rich vascularization and characteristic laminar patterns of vascular network are present in the cerebral wall from embryonic to the end of fetal period. The pattern of vascularization follows strictly the sequential development of transient cerebral compartments (zones) at all zones from the ventricle to the pia. Transient patterns (in the SP, SVZ, VZ) gradually transform and disappear during transformation of these layers parallel to the formation of gyri. Based on data from our studies of cortical histogenesis we propose that the process of change of transient vascular patterns is accompanied with transformation of radial glia, astrogliogenesis, diminishment of the amount of extracellular matrix as well as changes in axonal and dendritic growth. Identifying spatio-temporal patterns of angiogenesis in telencephalon could shed a new light on pathophysiology of vascular malformations in the brain.

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#### References

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