The Study of Placental Vascularization Using Type AGO II Plastic Substances

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Placental blood circulation has certain features that allow the exchange of nutrients between the maternal and fetus blood, respectively allow exchanges of nutrients between the mother and the fetus. We studied 50 human placentas. The method used in the case of our study is a standardized method of the Laboratory of Anatomy and Embryology, Victor Babes University of Medicine and Pharmacy, Timisoara, for over 50 years. The making of corrosion concoction followed the recipe of the laboratory using type AGO II plastic substances, differently coloured and then subjected to the corrosive action of hydrochloric acid. The model of corrosion preparations showed the distributions known as dichotomic and magisterial distribution. The normal development of placenta remains a major factor in the growth and development of the fetus, and maternal-fetal vasculature in the placenta is essential in this regard.

Keywords: AGO II plastic substances, uteroplacental circulation, pregnancy-induced hypertension, thrombophilia

The process of formation of the placenta, respectively the formation of complex structural and functional connection between the endometrium which is properly prepared for implantation and the fertilized egg, starts from the time when the egg has completely embedded itself into the endometrium.

In the years that followed, the arguments concerning the pure fetal or maternal-fetal origin continued, as well as the ones on the momentum of the connection between the two systems. The question posed by Ramsey when exactly is established the real uteroplacental circulation or how maternal blood enters the intervillous space, as well as the theories issued by Borell, Panigel or Ramsey, are still debated today [1-2].

Fetal circulation: is provided by the two umbilical arteries, branches of the common iliac arteries and umbilical vein carrying venous blood from the fetus to the placenta. Umbilical arteries penetrate the placenta by the umbilical insertion. Before entering the placenta between the two umbilical arteries there is an anastomosis (Hyrtl) equalizing the pressure between the two arteries. They penetrate the chorionic plate and irrigate half of placental territory. In the chorionic plate, they branch creating villous cytyledons and villous arteries -of the primary, secondary and tertiary order leading to capillary networks in the villi. These capillaries are arranged in two networks: a central one and a superficial one forming a perivascular plexus [3].

Venous circulation is represented by a number of branches which converge in a single umbilical vein. The total length of villous capillaries is estimated at some 50 Km. Umbilical venous blood flow is 250 mL / min. The blood-pressure in the capillaries of the villi is about 10 mmHg, increasing to 30 mmHg [4]. Maternal circulation (uteroplacental) is supplied by the spiral arteries, branches of the uterine artery. The spiral arteries are opened into the basal plate and the blood flows through finer vessels that cross through the chorionic plate to the capillaries in the villi [5].

Experimental part

Material and methods

The database was gathered using the Microsoft Excel program. In the first part beside the figures obtained from the chirurgical procedure we described and classified our patients / cases using frequency tables. Based on this tables and figures we could build some guideline idea which will get us a better characterisation for this pathology. For the statistical significance we applied a Mann - Whitney test.

Study of the corrosion concoction

We studied 50 human placentas collected immediately after naturally performed births in the Bega Clinic of Obstetrics and Gynecology, Emergency County Hospital, Timisoara, Romania, from 2012 to 2013; 25 placentas from births that are not associated with maternal pathology and 25 placentas from births that are associated with maternal pathology (pregnancy-induced hypertension, thrombophilia, intrauterine growth restriction).

The method used in the case of our study is a standardized method of the Laboratory of Anatomy and Embryology, Victor Babes University of Medicine and Pharmacy, Timisoara, for over 50 years. The making of corrosion concoction followed the recipe of the laboratory using type AGO II plastic substances, differently coloured and then subjected to the corrosive action of hydrochloric acid. This technique has been published and reported in

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the national and international anatomical press, under the signature of Professor Gheorghe Corondan and Lecturer Leonida Bejan in 1956, and was later improved by Ciobanu (1960), Diaconescu (1962), Radu (1968), Kuhn (1961), Rottenberg (1969). The results of this technique are the corrosion preparates to get a clearer picture of allantochorion vessels from the placenta and the umbilical cord.These preparates provide a 3D image that is very close to real, thus allowing the study of vascular arborisation.

Results and discussions

All our 50 cases were hospitalised in Bega Clinic. The patients were split in two equal groups: patients with or without maternal pathology (25 patients in each group). We grouped the data in frequency tables in order to have a general characterization of the gestational period, the placentas weight in different scenarios (tables 1,2). In order to see if there are statistical differences between the gestational periods we applied a Mann - Whitney test. We obtained that there are extremely significant differences ($p<0.001$) within the two groups, more exactly the patients with maternal pathology are more likely to give birth much sooner. As well we measured the placentas weight in the two groups. After applying the Mann - Whitney test, again we obtained extremely significant differences ($p<0.001$).

Macroscopic aspects of the placenta

Regarding *the placental weight* - shown in table 2 - we obtained a rise that indicated that the placenta weight/ birth weight ratio is 1/5, not 1/6, as it is mentioned in some studies in the literature [6-7]. Therefore, the term placentas present large weight variations. In the third trimester of pregnancy, the placenta grows more than the fetus. The placenta development is directly dependent on blood flow through the umbilical artery [8-10].

There are many factors that can lead to placental hypotrophy, such as: genetic variation, the length of the umbilical cord, preeclampsia, thrombophilia, obesity, maternal hypertension, most fetal malformations, smoking during pregnancy, etc. [11-15]. We found 5 cases of pregnancy-induced hypertension, with placental hypotrophy directly related to fetal hypotrophy.

The examination of the corrosion preparations led to several aspects regarding the distribution of the allantoic vessels:

- Whe did not reveal any anastomosis in placental venous territory (fig 1, fig 2).

- the three types of ramifications existing at the placental level are divided as follows: the first order branches give the second order branches, so that the later branches of the third order penetrate into the corium plate (fig 3, fig 4)

Table 1

THE DISTRIBUTION OF GESTATIONAL AGE OF PREGNANCY AND NUMBER OF PLACENTAS IN PREGNANCIES WITH OR WITHOUT BEING ASSOCIATED WITH MATERNAL PATHOLOGY

Groups	Gestational age of pregnancy	Number of placentas	%
Group 1 (patients with maternal pathology. Gestational age and the number of placentas in high-risk pregnancy)	32 weeks	1	4%
	33 weeks	1	4%
	34 weeks	2	8%
	35 weeks	2	8%
	36 weeks	1	4%
	37 weeks	7	28%
	38 weeks	11	44%
Total group 1		25	100%
Group 2 (patients without maternal pathology)	38 weeks	8	32%
	39 weeks	13	52%
	40 weeks	4	16%
Total group 2		25	100%

Table 2

WEIGHT OF STUDIED PLACENTAS CORRELATED WITH GESTATIONAL AGE OF PREGNANCIES WITH OR WITHOUT BEING ASSOCIATED WITH MATERNAL PATHOLOGY

Groups	Gestational age of pregnancy	Placental weight
Group 1 (patients with maternal pathology. Gestational age and the number of placentas in high-risk pregnancy)	32-34 weeks	310g
	34-36 weeks	360g
	36-38 weeks	440g
Total group 1		25 patients
Group 2 (patients without maternal pathology)	38 weeks	480g
	39 weeks	510g
	40 weeks	540g
Total group 2		25 patients

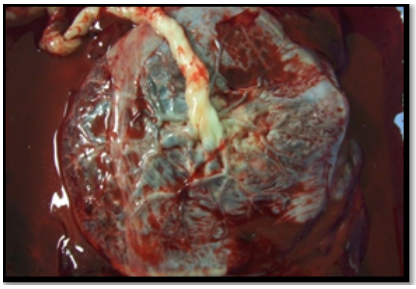

Fig. 1.Placenta at 38 weeks, with a central insertion of the umbilical cord (fetal face)

Fig. 2. Placenta - fetal face - corrosive agent

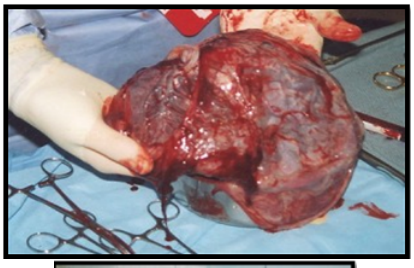

Fig. 3. Term placenta - fetal face

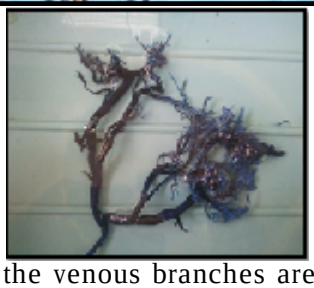

Fig. 4. Placenta - fetal face - corrosion preparation. There is an umbilical vein that branches into two primary trunks, which then follows the branches of a venous stem

- the venous branches are then disposed after a dichotomic or magistral division pattern (from which branches of much smaller diameter start) (fig 5, fig 6).

- the arterial division differs from the vein;

- in the vast majority of cases, most anastomoses have been encountered at the cord insertion level (in 43 cases out of 50, which is 86%).

Fig. 5. Placenta at 40 weeks ; the cotyledons are separated by grooves (maternal surface)

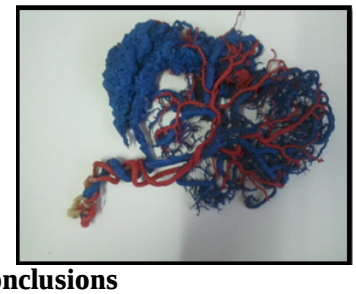

Fig. 6. Term placenta, fetal face - corrosive agent. The umbilical vein branches dichotomously, while the umbilical arteries branch into two trunks of almost equal calibers

Conclusions

The examination of the placental parameters - shape (the size of placentas clinically examined after birth was variable, the majority having a disc shape) and weight - is important, as a preliminary stage for the study of the placental architecture.

The examination of the placental surfaces provided data on the possible placental pathologies. We have not demonstrated the presence of shape placental abnormalities in our study. Placental angiogenesis has a local component different from angiogenesis found in other anatomical regions. Placental development is a complex process; villosis vascularisation complicates and a dysfunction of this may lead to placental insufficiency.

Placentas that were examined, showed some abnormalities of shape, weight or umbilical cord due to pregnancy-induced hypertension.

Also, we obtained a significant lower weight in the case where we have maternal pathologies present ($p<0.001$).

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