

HISTOLOGICAL CHARACTERISTICS OF PLACENTA OF WOMEN UNDERGOING ACUTE AND CHRONIC PSYCHOEMOTIONAL STRESS

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Abstract

Delays in development and functioning of different systems of the fetus, related to processes taking place in the organism of a pregnant woman, are reflected, in the first place, on morphofunctional condition of placentae, which is the link in mother-fetus system. This has served as a ground to initiate study of structural changes, taking place in placentae of woman in labor who underwent acute and chronic psychoemotional stress.

Histological examination of placentae among 65 women in labor was conducted: 15 with normally developing pregnancy comprised the control group, 25 women who had undergone acute stress were composed another group, and the remaining 25 women with chronic psychoemotional stress composed the last group. The group of those undergoing acute stress involved women, to whom, on medical indications 12 mg. of dexamethasone was administered daily during 2 days within 26-34 weeks of pregnancy.

Women, undergoing chronic psychoemotional stress during the entire pregnancy were selected on the basis of history of long-term stress situations in their medical history, as well as by evaluating and identifying high level of state and trait anxiety per Spielberger test.

Paraffin sections consisting of fetal and maternal parts of placentae and stained with Hematoxylin and eosin were prepared for microscopic examinations. Specimens were viewed by trinocular light microscope with a digital camera. The software allowed magnifying microscopic objects with known optical method and digital zoom.

Comparative histologic pattern for placental barrier condition at acute and chronic stress is characterized by corresponding morphological changes. At acute stress these are indicated by presence of unexpressed stromal-vascular and haemodynamic changes with inflammation symptoms, hematoma pockets, dystrophy of epithelial covering of the villi and chorionic plates, as well as irregular branching of small villi, with their hypervascularization and absence in fetal erythrocytes therein. Immature diffuse sclerotic villi with prevailing fibroblasts and collagenic fiber are identified in placentae of women, who underwent chronic psychoemotional stress, as well as luminal occlusions, blood clots with foci of villus epithelia necrosis and bland infarctions. Such pattern of abnormalities in connective tissues and vessels serves as a basis for development of placental insufficiency.

On the grounds of the foregoing a conclusion has been made, that changes observed in acute stress cannot have substantial functionally significant impact on the fetus condition, whereas in chronic psychoemotional stress they are significant and may become a ground for blood flow disorders in mother-fetus system and pathological expressions of fetus and progeny development. At the same time, they allow to taking corresponding measures to prevent stress and its complications among pregnant women, undergoing chronic psychoemotional stress.

KEYWORDS: acute and chronic psychoemotional stress, placentae, dexamethasone.

INTRODUCTION

It is known that placenta of women serves as an indicator for uterine placental and fetal placental

blood flow in different pathologic states, including cases of acute and chronic stress, undergone by pregnant women [Teleshova OV, 1996; Pluess M et al., 2011; Glover V, 2015]. Human placentae is attributed to hemochorial type and is characterized by tertiary villi of chorion frondosum with proteolytic enzyme of trophoblast destroy the endometrial epi-

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thelia of the uterine, the connective tissue and, completely, the blood vessel wall. As a result, the tertiary villi are swept by maternal blood. Thus, arterial link of uterine placental blood flow provides rhythmic pulsation of maternal blood, enriched with oxygen and other nutrient substances into the villus fluid space of the placenta. [Milovanov AP et al., 1995; Kuznetsov SL, Mushkambarov NN, 2012].

On the basis of the foregoing, it is necessary to mention that in different pathological state cases [Glover VT et al., 2010; Harris A, Seckl J, 2011] of pregnant women (technological disasters, family crisis, death in the family) morphological markers of placental insufficiency are identified, the former being the key problem of obstetrics and neonatology, as the functional failure of this organ results in miscarriage, fetal growth restrictions or its death [O'Donnell K et al., 2012].

Psycho-emotional stress, most frequently occurring in obstetrical practice, reveals histological indicators of placental insufficiency. [Tatarchuk TF, 2006; Pluess M et al., 2011].

The first 7-10 days after extreme situation shall be considered as the acute stage of stress, since within this period the anxiety stage of the general adaptation syndrome continues, and the highest number of miscarriages, acute neuro-psychic disorders and other critical conditions are being clinically recorded. Within the following period of time (a few months) psychoemotional tension slightly reduces, therefore there occurs a possibility to provide qualified medical assistance to the pregnant woman.

On the basis of the foregoing, histological characteristic of placenta in acute and chronic psychoemotional stress of pregnant women is of certain interest.

The purpose of this study is to describe the structural elements of "placental barrier" in pregnant women who underwent acute and chronic psychoemotional stress.

MATERIAL AND METHODS

The material for histological study was placenta of 15 women in labor with normal pregnancy course (control group), 25 women in labor, who

underwent acute stress, and 25 women with chronic psychoemotional stress.

Selection of women, who underwent acute stress, was carried out as follows. As it is known, one of the major stress markers is growth of corticosteroids concentration in blood. Considering this, parenteral administration of dexamethasone is reviewed in literature [Chitrit Y et al., 2000; Reynolds RM, 2013] as an artificially induced model of acute stress and is applied in obstetric practice, as a rule, within the period of 26-33 weeks of gestation, for accelerated development of respiratory system of premature fetuses among women with premature birth threat. According to this, 25 pregnant women, to whom, on medical indications 24 mg of dexamethasone were administered intramuscularly (12 mg daily during 2 days) within 26-34 weeks of pregnancy were involved in acute stress group. Another group was composed of twenty five more women, who, over the entire pregnancy, underwent chronic psychoemotional stress with high level of state and trait anxiety as per Spielberger test [Spielberger CD et al., 1970].

Microscopic method. Paraffin sections, consisting of fetal and maternal parts of placenta, were stained with hematoxylin and eosin. Specimens were viewed with trinocular light microscope Micros (Austria) with Canon digital camera. The software allowed magnifying microscopic objects using a conventional optical method and digital zoom.

RESULTS AND DISCUSSION

Histological pattern of placenta of expectant mothers, undergoing acute stress.

During histological examination of maternal and fetal parts of the placenta, sampled from women in labor after dexamethasone, weakly expressed indicators of pathological immaturity were identified. Furthermore, in particular, irregular branching of small villi without terminal branches, forming solid assemblies or meshwork. It should be specifically noted that these small villi in their structure do not comply with typical terminal branches. Another distinctive feature is hypovascularization of these villi, as only singular, thin capillary vessels are observed therein, often empty, without fetal erythrocytes.

They seem to be squeezed by excess connective tissue in the stroma. Consequently, under the influence of a severe stress, formation of small villi takes place due to domination of stromal component and delay of capillary bed development, as well as of epithelial covering of the villus (Fig. 1a,b).

Beside that, acute stress gives rise to signs of inflammation observed in the placentae, as a local reaction of the body to external irritation. Additionally, there are placental Kashchenko-Hofbauer macrophage cells, also identified in villus stroma, containing channels for placental macrophages circulation (Fig. 2a). These stromal channels are regarded to be some sort of an analogue of a lymphatic basin for villus tree. Alongside with this are revealed foci of hematomas, thrombosis and organization of maternal formed elements in arterial, capillary and venous links (Fig. 2b), which may be the cause of fetus hypoxia. The significant pathogenetic mechanism in these shifts is the disruption of villus tree epithelial covering integrity, with weakly expressed dystrophy of micro-villi (Fig. 2c), as well a blood clots of supporting villi arteries and chorionic plates (Fig. 2d).

Histological pattern of placentae of expectant mothers, who underwent chronic psychoemotional stress.

As it is known, [Milovanov AP, 1999; Kuznetsov SL, Pugachev MK, 2009] the condition of placentae villi, as well as the primary substance of connective tissue or extracellular matrix – a macromolec-

ular complex, surrounding stroma cells and forming basal layers of vessels and all types of epithelia play an important role in normal growth of the fetus. The extracellular matrix provides interaction of structural elements at all levels – from the molecular to tissue one. As noted by Milovanov A.P. (1999), intercellular substance is, in its essence, an information system, genetically programmed to form a certain molecular structure of extracellular matrix components and their peculiar, sequential transformation in ontogenesis. According to this, chronic stress of pregnant women required our special attention in regard to extracellular matrix structures condition.

Thus, sclerotic processes in placental villi with excess enlargement of dense connective tissue due to proliferation of fibroblasts and intensified biosynthesis of different types of collagen and glycosaminoglycans were found in placentae of expectant mothers, who had underwent chronic stress. Sclerosis of terminal villus stroma in chronic stress was most extensively observed in the presence of pathologic dismaturity of placentae – variants of chaotic, sclerotic villi, when fibrosis results in oppression of fetal capillary vessels and abrupt reduction of gases and nutrient substances surface of diffusion between mother and the fetus. Stroma sclerosis in certain observations is accompanied by focal thickening of basal layer of the epithelia. Small foci of necrosis, immature villus, villus stroma diffusive sclerosis are also visible. In such a morphological pattern, as

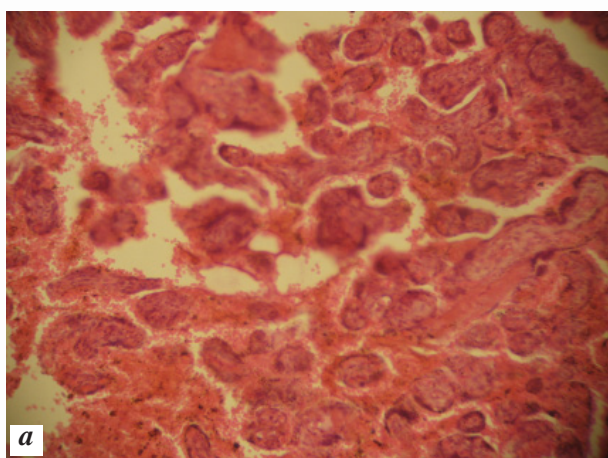


FIGURE 1. Histological patterns of maternal and fetal parts of placentae after dexamethasone administration. Staining with hematoxylin and eosin.

a) solid accumulation of small villi. X200;

b) capillary occlusion, X400.

was mentioned before, depending on the extent of affection, the blood circulation in mother-fetus system can also be impaired, along with fetus hypoxia, delay in its development etc. (Fig. 3a,b) [Khudaverdyan AD et al., 2011].

A particular role in acute and chronic psychoemotional stress is attributed to the status of

mother-placentae and fetus-placentae blood circulation, impairment of which can be manifested in the form of placental insufficiency. The latter, in chronic psychoemotional stress, elapses for a long time (months) during antenatal period and, as it is known, is diagnosed by dopplerometry as blood flow failure in arteria uterina of pregnant women and fetal ves-

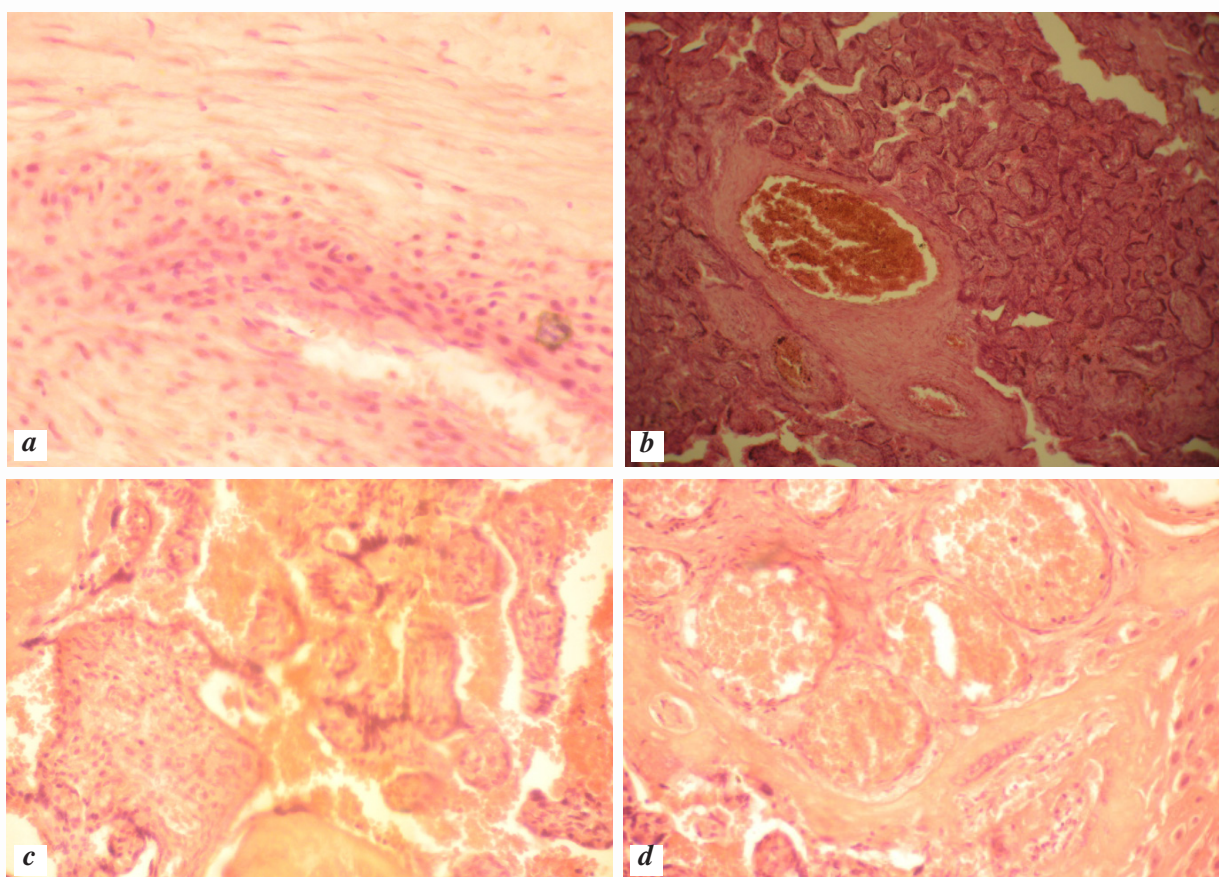


FIGURE 2. Signs of inflammation in placentae in acute stress. Staining with hematoxylin and eosin. **a)** placental macrophages, stromal channel, X200; **b)** capillary thrombosis, X200; **c)** microvillus epithelia dystrophy, X400; **d)** arterial blood clots of supporting villi, X400.

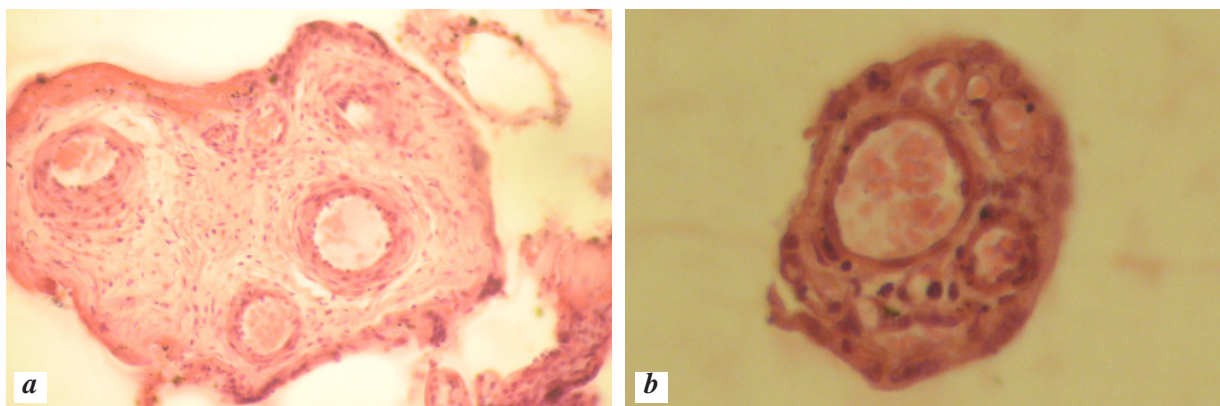


FIGURE 3. Sclerotic changes in placenta villi: Staining with hematoxylin and eosin. **a)** villus stroma sclerosis, thickening of arterial walls, X400; **b)** thickening of basal layer of the epithelia, X400

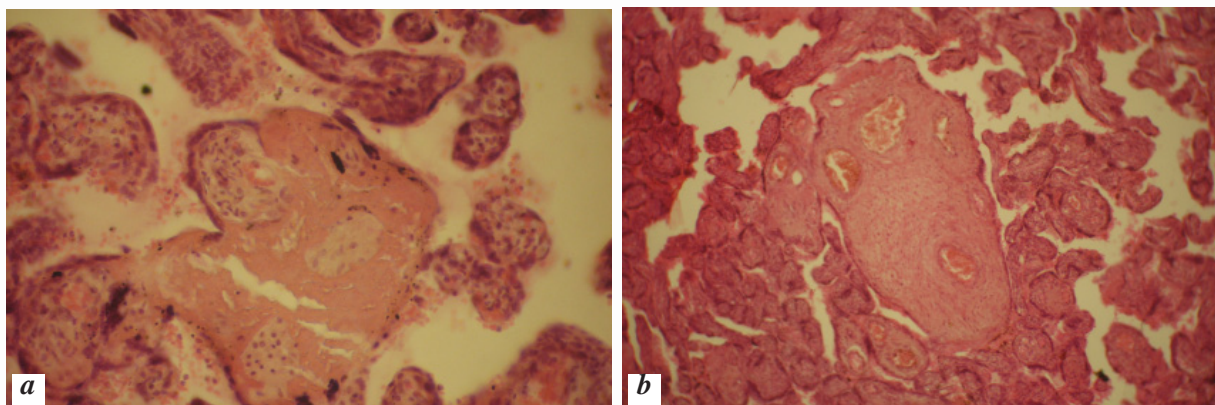


FIGURE 4. Histological indicators of placental insufficiency. Staining with hematoxylin and eosin. *a) villus epithelia necrosis, X200; b) approximated villi, vascular congestion, X200.*

sels. In histological examination the structure of villus tree in general either corresponded to a gestation term, or complied with pathological placental immaturity. The most expressed histological indicators were foci of bland infarction – fresh necrosis of epithelia villi with hemorrhage into the intervillous space. Approximated villi have rather distinctive view, reminding of clusters of grapes along the supporting villi. (Fig. 4a,b).

In terms of histological condition, in chronic stress failure of synchronous development of connective tissue and capillary bed was identified in placentae. At the same time, stromal channels with Kashcenko cells and primitive narrow capillary vessels in the center were preserved in the villi. Fibroblasts and multiple collagen fibers were prevalent in sclerotic villi. Areas of fresh and old blood clots were observed in the intervillous space. The main, most often identified structural feature in chronic type of placental insufficiency is the ex-

pressed tendency for luminal occlusion and media hypertrophy, which was observed in arteries and arterioles of the supporting villus. Obliteration of arteries and arterioles was observed in certain supporting villi (Fig. 5a,b).

Thus, in chronic psychoemotional stress, the dominating feature of placental insufficiency is blood flow failure in chorionic plate and supporting villi, which is confirmed by obliterating angiopathy. The major causes for maternal blood circulation failures in intervillous space and changes in uteroplacental system, as described above, are the combination of local shifts of hemostasis over the villus tree surface and progressive obliterative pathology of spiral artery of the uterus.

In general, the results of histological examination of pregnant women, who received small doses of dexamethasone for treatment purposes (clinical model of acute stress), indicate insignificant vascular-stromal and hemodynamic changes, and, in

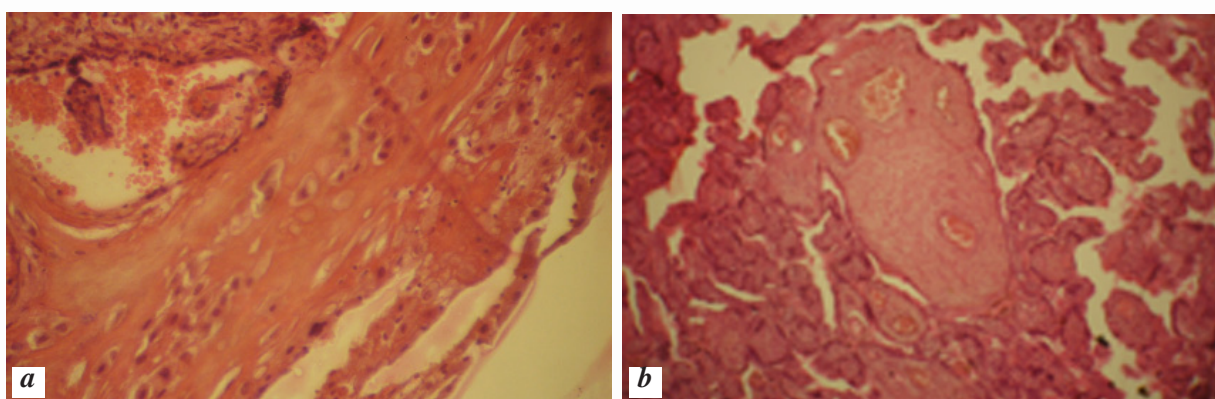


FIGURE 5. Impairment of synchronous development of connective tissue and capillary bed. Staining with hematoxylin and eosin. *a) sclerotic villi, concentration of fibroblasts and hyalinosis of collagen fibers, X400; b) luminal occlusion of arterioles and capillary vessels, X200.*

chronic psychoemotional stress those are characterized by structural changes in villi, up to necrosis thereof, as well as by gross changes in vessels: luminal occlusion, thrombosis and infarctions.

An important practical conclusion can be made on the basis of the foregoing: drug-induced therapy in such cases should be aimed at arteriospasm and blood clot formation.

Taking into consideration certain structural and functional disorders of expectant mothers' placentae detected post dexamethasone administration, as well as the data in regard to negative influence of excess corticoids to the developing fetus [Harris A, Seckl J, 2011; Reynolds RM, 2013], prescribing a medication to prevent the risk of complications related to fetus prematurity [Roberts D, Dalzell SR, 2006] should be done carefully and in case of strict indications, which is also attested by other researchers [Painter RC et al., 2012; Peffer ME et al., 2015].

Conclusion

Thus, comparative histological pattern of the placental barrier in acute and chronic stress has

corresponding morphological indicators. In acute stress such changes are characterized by presence of focal hematomas, reactive hyperemia of fetal vessels, and dystrophy of villus epithelia, which cannot have a functionally significant impact on the state of the fetus.

In chronic stress foci of necrosis, immature villi, as well as diffused sclerosis of villus stromas are identified in the placentae. The most expressive features of placental insufficiency in chronic stress were foci of bland infarctions, fresh necrosis of villus epithelia in the presence of fresh and old blood clots in the intervillous space. An important indicator of chronic placenta insufficiency is an expressed tendency for luminal occlusion in arteries and arterioles of the supporting villi.

The changes described may become the cause for blood flow failure in mother-fetus system and pathological manifestations of fetus development in women, undergoing chronic psychoemotional stress, which shall be taken into consideration in administering relevant medical and preventive measures.

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