



HISTOMORPHOLOGICAL AND MORPHOMETRIC CHARACTERISTICS OF THE PLACENTA UNDER THE INFLUENCE OF MICROPLASTICS

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Abstract. Abstract. This article analyses the effect of microplastics on the placenta from histological, morphological, and morphometric perspectives. The accumulation of MNP particles in the placenta, a vital organ connecting the mother and foetus, and their impact on tissue structure, The results of modern studies on the accumulation of MNP particles in the placenta, and their impact on tissue structure, cell morphology, and the organ's functional state, are detailed.

Key words: Placenta, barrier, MNP, substance exchange, trophoblasts

Introduction



Today, microplastics are widespread in our environment, especially in water and air. However, their presence is not limited to these two media. Microplastics are being detected in soil, fruit and vegetables, seafood and even breast milk. This situation lays the groundwork for the ecological problem to become increasingly deeply linked with human health. Microplastics have previously been found in the human lungs, intestines, although microplastics have previously been detected in the human lungs, intestines, liver, blood and ovaries, it has long been believed that the body's blood-brain barrier prevents the particles from reaching the brain. It has also been observed in the placenta, an organ considered vital for both the mother and her foetus. The placenta is a product of all foetal layers and ensures the general development of the foetus, that is, it supplies the foetus with nutrients and oxygen, It also removes the waste products generated during life processes, thereby performing trophic, excretory and respiratory functions. The placenta also fulfils protective functions by forming a cellular barrier (barrier). However, the placenta cannot act as a barrier against alcohol and nicotine, certain medicinal substances, foreign proteins, antibodies and toxic substances. Moreover, microplastics can also easily pass from mother to child via the placenta. For this reason, studying the placenta's barrier function is of significant importance in medicine.

Methods

This paper is based on a review of the latest scientific articles, clinical guidelines, and medical textbooks published between 2024 and 2026. Sources were obtained from databases such as PubMed and Google Scholar using the search term "Presence of micro- and nano-plastics (MNP) in the placenta" and "Human health effects of microplastics".



Results

The ever-increasing production of plastic materials has led to widespread pollution of the environment with micro- and nanoplastics (MNP). As with airborne particulate matter (PM), inhalation has been identified as one of the main routes of human exposure to MNP. The small size of MNPs facilitates their entry into the systemic circulation and their passage across selective biological barriers, including the human placenta. The placenta is an organ that develops from the uterine mucosa and the foetal vascular layer, ensuring the exchange of substances between the mother and the foetus. Moreover, because the maternal and foetal circulatory systems are separate, the blood never mixes. However, because the membrane between the villous capillaries and the epithelium covering them is extremely thin, the two circulatory systems come into contact. Such a connection ensures the exchange of substances and air between mother and child. Through the placenta, oxygen, carbohydrates, hormones, vitamins, proteins and other substances pass from the mother to the foetus. From the foetus to the mother, carbon dioxide and the foetus's metabolic waste products pass. In this respect, the placenta is an organ that ensures the foetus's nutrition, respiration, and the excretion of metabolic waste products.

Humans and rodents have a hemochorial placenta, in which the maternal and foetal circulatory systems are separated by a thin barrier of syncytiotrophoblasts. The primary function of the placenta is to act as a bridge, facilitating the exchange of nutrients and waste products between the mother and the foetus. The efficiency of this exchange is directly proportional to the morphological surface area. Therefore, the aim of this study was to describe the effect of inhaling microplastics during pregnancy on the remodelling of uterine arteries and the development of placental morphology in a rat model. The scientists hypothesised that the effect of MNP would reduce spiral artery remodelling and decrease the volume of maternal and foetal blood spaces in the placenta. Furthermore, as trophoblasts are a cell type originating from the embryo, the sex of the foetus plays an important role in placental outcomes. Accordingly, we assessed the vascular morphology of the placentas of male and female rats at gestational days 16 and 20 following maternal exposure to sequential microplastics during pregnancy. Trophoblasts, as key cells of the placenta, have been highlighted in studies as playing a central role in mediating the effects of microplastics on the placenta. In particular, because microplastics have been detected in the human placenta, in breast milk and in meconium (the first faecal matter of a newborn baby), It is clear that they interact with maternal and foetal tissues during foetal and neonatal development. Furthermore, the placental parenchymal cells, which are responsible for the exchange of nutrients and waste products between the maternal and foetal circulations – trophoblasts have been shown to ingest and transport microplastics. Another study showed that the presence of microplastics was indicated by assessing birth outcomes by measuring foetal and placental weight. They found a statistically significant reduction in foetal weight between the groups exposed to the highest and lowest levels of exposure, but no such difference was observed in placental weight. The proportion of effects indicating that microplastics are harmful was estimated at



0.50 (95% confidence interval: 0.09–0.91) ($n = \frac{1}{2}$). The scientists concluded that the effects of microplastics on foetal and placental weight at birth could not be classified on the basis of the observed outcomes.

Conclusion

The results of the conducted research show that, The placenta performs vital functions, ensuring the exchange of substances between the maternal and foetal organisms; at the same time, it has been found that microplastic particles can cross the placental barrier and enter the foetal organism. The placenta's metabolic processes and morphofunctional characteristics were analysed in detail.

Histomorphological and morphometric studies of the placenta revealed certain changes in its tissue structure and cellular parameters. Furthermore, based on the research conducted, it is important to note that the trophoblast serves as the primary placental cell responsible for regulating the exchange of nutrients and waste products between the maternal and foetal circulations. It has been noted that trophoblasts accumulate microplastics, and the association between foetal and placental weight and birth outcomes cannot be described in a definitive or conclusive manner, as numerous factors influence this process. This article highlights the need for a more in-depth, complex study of the impact of microplastics on the health of the placenta and foetus.

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