Nano-TiO_2 Translocation and Deposition After Maternal Inhalation Exposure

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Air pollution and consumer goods (e.g., sunscreen, toothpaste, food, paint, etc.) are primary sources of nanoparticle exposure that occur every day. These inevitable exposures pose a threat to delicate populations, such as cancer patients, pregnancy, and children. In our lab, we have found that both intrauterine position and maternal full-body inhalation of nanosized titanium dioxide particles (nano-TiO_2) independently play a role in the development of fetal growth restriction (FGR). Prior research has concluded that nano-sized particles can translocate from the maternal lungs to the uterus, placenta, and fetal tissues. This study seeks to determine if a relationship exists between nano-TiO_2 translocation, uterine horn position, and fetal size. Sprague Dawley rats were exposed to nano-TiO_2 via full-body inhalation on gestation days (GD) 4 through 19 and sacrificed on GD 20. Placenta and fetal tissues from the Ovarian, Middle, and Cervical positions of the left and right uterine horns were collected. Tissues were digested and ICP-MS analysis was used to measure Ti in the tissues. As expected, the lungs of exposed dams contain significantly higher amounts of titanium than control counterparts ($p<0.05$). Interestingly, the maternal uterus and fetal livers also contained significantly more titanium than controls. Furthermore, maternal heart, ovary, placenta (maternal side), and fetal blood demonstrated elevated titanium concentrations, but these values were not to significance ($p<0.13$). These results reveal that translocation of nano-TiO2 from the maternal lungs to the fetal compartment is possible in our maternal fetal model. Titanium may not be the only metal that can translocate; however, other metals may pose greater risks when their chemical properties are taken into consideration. Although, significance was not identified, it was interesting to see how the metal did not accumulate one area, but it spread throughout the body demonstrating how inconsistent material translocation within a biological system can be. This is alarming as particle translocation to and deposition within the fetus may act to initiate local oxidative or inflammatory responses within fetal tissue, predisposing offspring to disease. Supported by R01ES031285, T32ES007148, P30ES005022, R25ES020721, SOT Intern Program and ASPET SURF Program.