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Understanding transplacental mechanisms of nanoparticle transfer as a novel fetal and maternal therapy option during pregnancy.

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Background:

More than 70% of medications possess unknown teratogenic effects and can readily cross the placenta. They contribute to 2-3% of congenital malformations, which prompts the need for safer delivery methods. Nanosized particles, nanoparticles, modified with antibodies provide targeted delivery of reduced drug doses to meet this need. Furthermore, the modified nanoparticles can employ the maternal transfer of antibodies across the placenta to deliver medication to the fetus. We hypothesize that the crossing of antibody modified nanoparticles through the placenta can be regulated for maternal and fetal therapy.

Objective:

We will gauge the viability of the placenta exposed to nanoparticles and define factors controlling nanoparticle transfer across the placenta.

Methods:

Nanoparticles synthesized from chitosan (75-85% deacetylated) under different conditions were characterized. Anti-human IgG antibodies were chemically modified onto the nanoparticle surface. Placental integrity after treatment with nanoparticles (10, 50, 100 µg/mL) for 24 hours was assessed in the human BeWo placental cell line. Viability was measured with the colorimetric MTT Assay (n=3). Statistical significance was determined with a two-way ANOVA at the 95% confidence interval.

Results:

The MTT assay suggests size, IgG modification, and concentrations up to 100 µg/mL does not affect BeWo cellular viability ($p = 0.6076$). Changes in nanoparticle size are attributed to both synthesis conditions and modifications with IgG, which the latter significantly increased the size of nanoparticles ($p = 0.0015$) by more than 1.2 times. Increasing concentrations of nanoparticles modified with IgG correlated with a decrease in viability.

Conclusion:

A delicate balance between size and concentration contribute to the effectiveness of nanoparticles for therapy. Here we present nanoparticles as a viable candidate for safe drug delivery during pregnancy. Future investigation into the nanoparticle and placenta interactions will elude factors that can localize nanoparticles within the pregnant mother or cross the placenta to reach the fetus.