Shuttle service through the placenta

Barely a few decades ago, the placenta was regarded as an impermeable barrier between mother and child. Ever since the sleeping pill Contergan caused deformities, however, we know better. Nicotine, heroin and various environmental toxins also get through to the fetus. Does the same hold true for nanoparticles?

The placenta is a complex organ that is responsible for the exchange of oxygen and carbon dioxide between the mother and child, as well as the transport of nutrients and metabolic products. But it also keeps the mother's bloodstream separate from her unborn child's. Anyone who wants to study how the human placenta works can use data from animal experiments only to a limited extent as the placenta functions very differently from one species of mammal to the next. One alternative is to conduct research on an *ex vivo* model, i.e. on placentas that mothers donate for research purposes after a C-section. Thanks to nutrient solutions, the organs can remain intact for several hours and document the transport of substances through the tissue. This ex vivo study method was first applied in the early 1970s and has been honed continually ever since.

Peter Wick and his team joined forces with MDs from the University Hospital Zurich and Kantonsspital St. Gall to investigate whether tiny polystyrene particles are able to pass through the placenta. The result: particles up to 80 nanometers in diameter passed through the barrier and would have reached the fetus. 500-nanometer particles, however, were stopped in their tracks. What's more, the team also discovered that the nanoparticle shuttling is not passive diffusion. In other words, the particles don't simply seep through the tissue, but are actively transported through the placenta via a mechanism that is yet to be elucidated. A considerable proportion of the particles accumulates in the so-called syncytium, the first cellular barrier layer.

Besides experiments using polystyrene particles, which remain chemically unchanged in the body, the researchers are now looking to study the transport of metal oxide particles or other chemically active substances. The goal is not merely to understand the exchange mechanism of the human placenta, but also to recognize rules with a view to using nanoparticles diagnostically or therapeutically in future. If the mother falls ill, for instance, the drugs could thus be prepared in such a way that the active substances are only administered to the pregnant woman and not to the unborn child. //

The placenta isn't a completely impenetrable wall. Alcohol and drugs can get past the barrier between the mother's and child's bloodstreams and damage the fetus. Nanoparticles of a certain size also pass through the placenta while others are stopped in their tracks. Might this effect be used to encapsulate medication so that only the mother actually receives the drug?