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Photo-responsive nanoparticles for diagnostic imaging and treatment of ectopic pregnancy

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Abstract

Ectopic pregnancy (EP) - the abnormal implantation of an embryo, often in the fallopian tube - remains the leading cause of maternal death in the first trimester of pregnancy. Current diagnostic modalities including human chorionic gonadotropin (hCG) quantification and ultrasonography are effective but may still misdiagnose EP in many cases. Depending on the gestational duration of the pregnancy, management strategies may include expectant management, chemotherapeutic treatment using methotrexate (MTX), or surgical intervenoin. While these strategies are largely successful, expectant management may result in tubal rupture if the pregnancy does not spontaneously resolve; MTX administraotin is not always successful and may induce significant side effects; and surgical intervention may result in loss of the fallopian tube or tubal function, further impacting subsequent fertility. We report a nanotheranostic strategy for EP management using polymeric photo-responsive nanoparticles which accumulate in the murine placenta following systemic administration in pregnant mice, enabling fluorescence and photoacoustic visualization of the placenta. Subsequent illumination of internalized nanoparctiles using focused near-infrared (NIR) light produces localized heat sufficient to disrupt placental function, resulting in the demise and complete resorption of targeted fetuses. Clinical translation of this approach may enhance the diagnostic confirmation of EP when current strategies are unsuccessful or inconclusive, and localized hyperthermia would result in impairment of placental function, safely eliminating the products of conception while sparing healthy surrounding issues.