Light-activated RNA interference in human embryonic stem cells.

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Public Summary:
We describe a near infrared (NIR) light-activated gene silencing method in undifferentiated human embryonic stem cell (hESC) using a plasmonic hollow gold nanoshell (HGN) as the siRNA carrier. Our modular biotin-streptavidin coupling strategy enables positively charged TAT-peptide to coat oligonucleotides-saturated nanoparticles as a stable colloid formation. TAT-peptide coated nanoparticles with dense siRNA loading show efficient penetration into a wide variety of hESC cell lines. The siRNA is freed from the nanoparticles and delivered to the cytosol by femtosecond pulses of NIR light with potentially exquisite spatial and temporal control. The effectiveness of this approach is shown by targeting GFP and Oct4 genes in undifferentiated hESC (H9). The accelerated expression of differentiation markers for all three germ layers resulting from Oct4 knockdown confirms that this method has no detectable adverse effects that limit the range of differentiation. This biocompatible and NIR laser-activated patterning method makes possible single cell resolution of siRNA delivery for diverse studies in stem cell biology, tissue engineering and regenerative medicine.

Scientific Abstract:
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