Light-responsive systems for ocular drug delivery

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Abstract

Among the various routes of administration, ophthalmic drug delivery is particularly challenging regardless of the relatively simple accessibility of the eyes. Drug delivery to the posterior segment of the eye through periocular and intravitreal injections involve a high risk of complications e.g. inflammation, infection, and haemorrhage. Consequently, researchers have developed a variety of delivery systems to overcome these limitations. Stimuli responsive polymers are the focus of increasing attention as they undergo physical or chemical change in response to external or internal stimuli. Light is an attractive trigger for drug release because it can offer both spatial and temporal control based on parameters that can be adjusted with ease e.g. irradiation intensity, wavelength, and exposure duration, potentially via non/minimally invasive methods. Photo-cleavage can be accomplished either by UV, visible or NIR light, resulting in fast degradation of molecule structures and allowing on demand release of payloads. Photocleavable moieties enhance drug targeting abilities as the drug will remain inactive until reaching the site of action and irradiation of the correct wavelength will release the free active form of it. However, exploiting these valuable materials in the ocular delivery field has still not been fully accomplished. Accordingly, the purpose of the current work is to develop a platform for controlled drug delivery to intraocular tissues using light triggered DDS that exploits drug conjugates with immobilized photocleavable linkages e.g. o-nitrobenzyl (o-NB) derivative to polymer matrix. Here we report the synthesis of both light-responsive conjugates and investigation of drug release profiles. Complementary DDSs were designed to immobilize drug conjugates to polymers that would enable preparation of materials capable of targeting the intraocular compartment and triggering drug release with suitable light sources.

Learning objective: Synthesis of Photocleavable moieties/drug moieties and light triggered release of payloads & application of in silico toxicity screening to polymer design.

References

[1] Abdelmohsen, H.A.M., Copeland, N.A. & Hardy, J.G. Light-responsive biomaterials for ocular drug delivery. *Drug Deliv. and Transl. Res.* (2022). https://doi.org/10.1007/s13346-022-01196-5

[2] Podder, S., Ghosh, C.K., Das, A. et al. Light-responsive nanomaterials with pro-oxidant and anti-oxidant activity. emergent mater. 5, 455–475 (2022). https://doi.org/10.1007/s42247-022-00361-3