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Erythrocyte-derived Optical Nano-constructs as Photo-theranostic Agents

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Extended Abstract

The use of biological materials such as erythrocytes, lymphocytes, and macrophages as platforms for the delivery of therapeutic or imaging agents has been gaining increased attention by various investigators (Yoo et al.). For example, erythrocytes have been utilized in experimental studies to deliver therapeutic agents such as L-asparaginase to treat patients with acute lymphoblastic leukaemia (Domenech et al.). In relation to cell-based platforms for imaging, hemoglobin-depleted red blood cells (erythrocyte ghosts (EGs)) have been used to encapsulate iron oxide for magnetic resonance imaging (Antonelli et al.). Herein, we present results to demonstrate the utility of nano-vesicles derived from EGs and loaded with the near infrared (NIR) chromophore, indocyanine green (ICG), as photo-theranostic agents with fluorescence imaging and photothermal destructive capabilities (Bahmani et al.). We refer to these nano-vesicles as NIR erythrocyte-mimicking transducers (NETs) since once photo-activated by NIR excitation, they can transduce the light energy to emit fluorescence, or generate heat. We can fabricate NETs by hypotonic treatment of erythrocytes to remove the hemoglobin, followed by extrusion of the EGs through nano-sized porous membranes, and finally incubating the resulting nano-vesicles with ICG in a hypotonic solution. The nano-scale dimensions of NETs is relevant to imaging capability at sub-cellular and molecular levels, and the delivery of the constructs to abnormal sites such as tumours. As constructs that can be engineered autologously, they may potentially serve as biocompatible, non-immunogenic, and non-toxic photo-theranostic platforms for use in personalized nanomedicine.

References

Antonelli A., Sfara C., Manuali E., Bruce I. J., Magnani M. (2011). Encapsulation of superparamagnetic nanoparticles into red blood cells as new carriers of MRI contrast agents. *Nanomedicine (Lond)* 6, 211-223.

Bahmani B., Bacon D., Anvari B. (2013). Erythrocyte-derived photo-theranostic agents: hybrid nano-vesicles containing indocyanine green for near infrared imaging and therapeutic applications. *Sci. Rep.* 3, 2180. doi: 10.1038/srep02180.

Domenech C., Thomas X., Gueyffier F., Mazingue F., Auvrignon A., Corm S., Dombret H., Chevallier P., Galambrun C., Huguet F., Legrand F., Mechinaud F., Vey N., Philip, I., Liens D., Godfrin, Y., Rigal D., Bertrand Y. (2010). L-asparaginase loaded red blood cells in refractory or relapsing acute lymphoblastic leukaemia in children and adults: results of the GRASPALL 2005-01 randomized trial. *Br. J. Haematol.*, 153, 58-65.

Yoo J. W., Irvine D. J., Discher, D. E., Mitragotri S., (2011). Bio-inspired, bioengineered and biomimetic drug delivery carriers. *Nat. Rev. Drug Discov.* 10, 531-535.