Ultrasound Mediated Non-invasive Drug and Vaccine Delivery Device

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Background and aims

Ultrasound has long been identified as a promising, means for non-invasive drug delivery, yet clinical translation remains limited[1]. A cross-platform, ultrasound based, non-invasive, agent delivery device has been developed to achieve biologic delivery to the eye without the need for, or risk of, injections for a range of blinding conditions as well as vaccine delivery to oral mucosal tissue in order to elicit mucosal immunity which is necessary to challenge pathogens at their portal of entry to prevent both disease and transmission.

Methods

The device comprises of a sterile, single-use, agent-holding tip coupled to a reusable ultrasound transducer. Tips are fabricated from a solid substrate made from biocompatible, non-reactive materials with micro or nanoscale features, to allow for a precise volume of drug or vaccine to be loaded. Ultrasound both releases a controlled dose of the agent from the tip and delivers it into ocular or mucosal tissue by temporarily increasing its permeability.

Results

Vaccines have safely been delivered to the lip mucosa in mouse models creating in addition to systemic immunity, mucosal immunity in a) gastrointestinal tissues (robust levels of CD8+ tissue resident memory cells in Payer's Patches using a pox-vector virus HIV vaccine); b) genitourinary tissue (vaginal levels of IgG and IgA created by device significantly higher than topical intranasal and sublingual route using a CpG based vaccine); and c) respiratory tissue (protective levels of CD8+ tissue resident memory cells in upper airways using a live attenuated influenza vaccine). As shown in Figure 1 (US=ultrasound, Cont=no ultrasound), the device safely delivered a significant amount of radiolabelled bevacizumab (149kDa) to rabbit ocular tissues including the choroid and retina as assessed by histology, photon emission tomography, magnetic resonance imaging and computerised tomography.

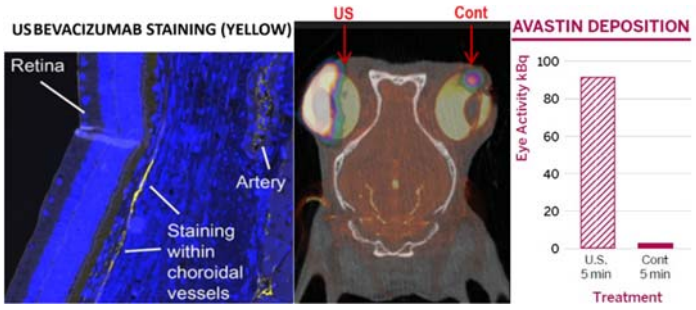

Figure 1 – Device delivery of radiolabelled Bevacizumab into ocular tissues.

Conclusion

The results demonstrate the remarkable ability of the device to potentially eliminate the risks and lack of patient compliance associated with intraocular biologic injections and other invasive ocular drug delivery means and to elicit safe and reliable protective mucosal and systemic immunity to pathogens addressing many urgent unmet vaccination needs.

References:[1] Isaac J Rad.; et all. *Theranostics 2023, 13(11): 3582-3638*