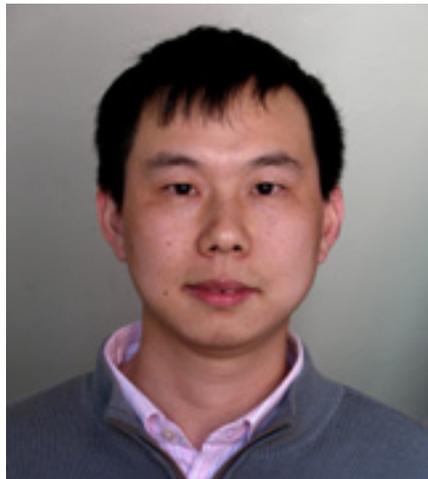


Congratulations to Xinyuan Chen, Ph.D., the 2010 recipient of the Bullock-Wellman Fellowship!



Project Title:

Needle- and Additive-Free Vaccine Delivery and Adjuvantation by Cutaneous Laser Illumination

Project Abstract:

The main goal of this proposal is to provide proof of concept evidence that an ablative fractional laser technology is effective both for transcutaneous vaccine delivery and adjuvanticity. Skin is an attractive site for vaccine delivery due to its rich in specialized antigen presenting cells (APCs). Vaccine delivery into the skin can be tracked back to the first smallpox vaccine that was delivered by skin scarification. Very recently, flu vaccine was found to induce a much stronger immune response by intradermal (ID) injection than by intramuscular (IM) injection and one such ID vaccine (Intanza, Sanofi Pasteur) was approved for clinical use last year in Europe. Needle-free vaccine delivery is desired to increase vaccination safety, patient compliance, and get rid of biohazardous waste. Though ID injection devices and microneedle patches were invented to overcome the technical difficulty for ID injection and increase compliance, these approaches generate biohazardous waste and are relatively expensive. Ablative fractional laser resurfacing creates vertical micro-channels in the skin. These channels bypass impermeable stratum corneum and are very promising for transcutaneous vaccine delivery. Model antigen ovalbumin (OVA) and 2010-2011 seasonal flu vaccine will be used to evaluate AFL-assisted temporal and dose dependent cutaneous vaccine delivery in mouse. In addition to vaccine delivery, enhancing vaccine immunogenicity is equally important, especially for recombinant protein or subunit vaccines as these vaccines are poor immunogens. Traditional ways to enhance immunogenicity is to add chemical or macromolecular adjuvants to vaccine preparations. However, these vaccine additives are foreigners to the body and have the potential to cause self-destructive immune cross-reaction if routinely used. They also cause local inflammation and reactogenicity. We recently developed laser vaccine adjuvant (LVA) for ID immunization⁹. This technology is based on a brief laser illumination of a small area of the skin to enhance function of local APCs. This physical type LVA is totally safe without causing any short-term or long-term side effects. We further found that laser at a broad range of wavelengths shares the similar adjuvant effects. Likewise, a non-ablative fractional laser was found to similarly enhance immune responses elicited by ID administration of ovalbumin (OVA). Considering the similarity between ablative and non-ablative fractional laser technology, we assume that AFL may also functions as laser vaccine adjuvant similar to the

one we developed recently. Compared with ID injection devices and microneedle patches, laser-based approach for vaccine delivery saves needle fabrication process, eliminates biohazardous waste, reduces costs for it can be used repeatedly and unlimitedly, and generates vaccine adjuvant effects. Thus, AFL will result in a novel strategy for needle- and additive-free vaccine delivery and adjuvantation. We will validate this novel strategy by using model antigen ovalbumin (OVA) and a clinical flu vaccine in the most convenient mouse model.

Internal Mentor: Mei X. Wu, M.D., Ph.D
R. Rox Anderson, MD