Replacing pumps with light controlled insulin delivery (#IS083)

Authors
Friedman S.H. [1]

Affiliations
1 - University of Missouri-Kansas City (United States of America)

Abstract Body
We have developed a new way of delivering insulin that uses light to stimulate insulin release from a patient-injectable depot. We call this approach the Photoactivated Depot (PAD) approach. This allows for the continuous variability of an insulin pump, without the numerous problems associated with the physical connection that a pump requires. These problems include infection, cannula crimping, bio-fouling and occlusion. We designed and synthesized a range of materials that are injectable into the skin using a standard insulin syringe and have shown that these release insulin both in-vitro and in-vivo. The amount of insulin released is proportional to the amount of light applied to the skin using a compact LED light source. In addition, we have demonstrated that these materials release fully bioactive insulin which results in blood glucose reductions that are also proportional to the amount of irradiation. In this presentation we will discuss the strategies that we have used to achieve multiple design aims. One of these design aims is Efficiency. This refers to the proportion of the material that is insulin, as opposed to carrier or polymer. First generation materials were based on polymers to achieve depot insolubility. This resulted in materials that contained <10% insulin by dry weight. Our second generation design strategies allow materials that are ~90% dry weight insulin, allowing for greater duration of action and ease of release. In addition, we will describe potential therapeutic advantages of photoactivated insulin over pump delivered insulin. The principal of these advantages is speed. We observe insulin in the blood 5 minutes after irradiation of a PAD, which makes photoactivated insulin as fast or faster than the fastest insulins commercially available. This begins to rival the performance of the pancreas itself, and can lead to better control of post-prandial blood glucose excursions, with attendant health benefits. Finally we will discuss some of the operational issues associated with the PAD approach. The skin based light source used to stimulate insulin release is entirely solid state with significantly lower energy requirements compared to a pump. This can lead to a smaller, lighter form factor. In addition, the lack of moving parts compared to an insulin pump should lead to greater physical robustness, and lower costs to manufacture and purchase. This latter factor can potentially expand the range of patients who are able to access and use an artificial pancreas.