Implantable Insulin Nano-Pump for Treatment of Type I Diabetes

Diabetes mellitus is responsible for billions in annual healthcare costs, is a leading cause of premature death in the US, and is a driving factor of end-stage renal disease, heart disease, blindness, and amputations in the industrialized world. Managing diabetes is complex and can have significant impacts on quality of life. Traditional insulin pumps, whether subdermal, transdermal, or wearable have their limitations and can constrain the patient in terms of physical activity and lifestyle[1].

Scientists at UC San Francisco are developing an implantable insulin pump[2] that uses islet beta cells to create insulin in the body and deliver it as needed. The pump is composed of nanoetched silicon[3] membranes with mesopores that would allow insulin proteins out, but would be too small to allow in cells that would attack the implanted beta cells. This would allow the pump to continuously produce insulin, negating the need for finger pricks and blood glucose monitoring[2].

Implantable pumps allow patients to participate in activities, such as swimming and contact sports, that other insulin pump[2] devices would not allow. A nanoinsulin pump would be much smaller than existing implantable insulin pumps and would be much longer lasting and easier to insert into the patient. These attributes would reduce the need for and number of invasive procedures such is the case with other implantable nanopumps. The pumps could be easily installed and replaced in an outpatient setting, creating little inconvenience or risk for the patient. Additionally, this translational therapy has the potential to be applied to other cell-based diseases such as Parkinson's, Alzheimer's and hormone deficiencies.

References

Author:
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Development Stage:
- Engineering

Key Words:
- Insulin Pump
- Nanomembrane
- Artificial Pancreas
- Nanoetching
- Diabetes Melitus

Mechanism:
- Molecular Nanosystems

Summary:
The pump functions as an artificial pancreas rather than a traditional insulin pump, creating the insulin from beta cells encapsulated in the nanoporous membrane of the pump while the pump itself protects the membrane from the body’s immune response.

Function:
- Artificial Organ/Biological Enhancement

Source:
Two UCSF Scientists Put Their Discoveries to Work.

Material:
Benefit Summary:

There are a number of potential benefits to treatment with implantable insulin pumps, including better management of diabetes mellitus, reduced healthcare costs for diabetes complications and increased user comfort for diabetics.

Benefit:

- **Health**

Risk Summary:

The technological risks of this product are analogous to those of silicon semiconductor manufacturing. The fabrication process poses simple and well understood risks to human health and ecological systems; risks that can be mitigated with proper laboratory and clean room controls. The risk uncertainties of this technology would primarily be related to the human condition, particularly the social and ethical questions raised by replacing an organ with an improved, synthetic system.

Risk Characterization:

- **Simple**

Risk Assessment:

- **Human Condition Risks**

Facility:

- **Medicine**
Activity:

- Diabetes [26]

Substitute:

- Existing Therapy [27]

Challenge Area:

- Healthcare Costs [28]
- Health [29]

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