'Artificial pancreas' a step nearer for children with type 1 diabetes

February 4 2010

Use of 'artificial pancreas' closed-loop insulin delivery systems, in which insulin is delivered in response to changing blood sugar levels, can improve blood sugar control in patients with type 1 diabetes. This is the conclusion of an Article published Online First and in an upcoming edition of The *Lancet*, written by Dr Roman Hovorka, Institute of Metabolic Science, University of Cambridge and Addenbrooke's Hospital, Cambridge, and colleagues.

Type 1 diabetes is one of the most common chronic childhood diseases and incidence has doubled during the past 10 years. Children and adolescents need lifelong insulin treatment to achieve glucose control that is sufficient to prevent long-term complications.

Continuous glucose monitoring devices and insulin pumps can be combined to form closed-loop systems. Insulin is then delivered according to real-time sensor glucose data, as directed by a control algorithm, rather than at preprogrammed rates. Few closed-loop prototypes have been developed and progress has been hindered by suboptimum accuracy and reliability of monitoring devices, slow absorption of subcutaneously administered rapid-acting insulin analogues, and inadequate control algorithms. In this study, the authors aimed to establish whether closed-loop systems reduce risk of nocturnal hypoglycaemia and achieve good glucose control in children and adolescents, even after variable evening meal intake and differing exercise patterns.

The researchers studied 17 children and teenagers aged between 5 and 18 years with type 1 diabetes during 54 nights in hospital. The team measured how well the artificial pancreas system controlled glucose levels compared with the children's regular continuous subcutaneous insulin infusion (CSII) pump, which delivers insulin at preselected rates.

The study included nights when the children went to bed after eating a large evening meal or having done early evening exercise. Both are challenging to manage, a large evening meal because it can lead to so-called "insulin stacking" and, as a result, a potentially dangerous drop in blood glucose levels later in the night, and late afternoon or early evening exercise because it increases the body's need for glucose in the early morning and can therefore increase the risk of night time hypoglycaemia.

The data showed that children with the artificial pancreas maintained blood glucose levels in the normal range for 60% of the time, compared with 40% for the CSII. The artificial pancreas halved the time that blood glucose levels fell below 3.9mmol/l - the level considered as mild hypoglycaemia. It also prevented blood glucose falling below 3.0mmol/l, which is defined as significant hypoglycaemia, compared with nine hypoglycaemia events in the control studies.

The authors say: "Our results show that overnight manual closed-loop insulin delivery can improve glucose control and reduce risk of hypoglycaemia in young patients with type 1 diabetes."

They add: "Closed-loop systems could transform management of type 1 diabetes, but their introduction is likely to be gradual, starting from straightforward applications such as shutting off of the pump at low glucose concentrations or overnight closed-loop delivery, proceeding to more complex applications providing 24-h control. Overnight closed-loop delivery is appealing because it addresses the issue of nocturnal

hypoglycaemia."

They conclude: "Advancements in glucose-sensing technologies could further improve performance of closed-loop systems. Fully automated closed-loop delivery will need wireless data transmission to replace manual control of the pump by nurses. These technological steps are important but routine and should not affect closed-loop performance."

In an accompanying Comment, Dr Eric Renard, Centre Hospitalier Universitaire de Montpellier, France, discusses the various technological issues surrounding the closed-loop insulin delivery. He says: "Starting with overnight control before addressing control at meal times and during various activities is the most rational way forward. This seems to be the track to follow towards progressive implementation of automated insulin delivery at home."

More information: www.thelancet.com

Provided by Lancet