Advanced diabetes care: Making optimum use of technology

A report from the Insulin Pump Association Conference, which took place on 5 December 2008 at the Freemason's Hall, London. The principal sponsors of the event were Animas, Medtronic and Roche Diagnostics. This meeting report was generated independently by the publisher and conference speakers, with whom editorial control rests.

Introduction

The Insulin Pump Association hosted this conference to offer education for healthcare professionals with an interest in technology for the treatment of diabetes. As well as examining the clinical evidence for the usefulness of technologies in diabetes care, the speakers also offered advice and guidance on the practical issues relating to their use. Now that technology is a major part of diabetes care, the aim is to optimise the use of technologies to deliver meaningful clinical benefits. This document is a summary of the talks and discussions that took place.

The conference was introduced by Gill Morrison (Co-Chair of the Insulin Pump Association [IPA], and Diabetes and CSII Specialist Nurse, Liverpool), who reflected on the increased availability of insulin pumps since the publication of the NICE (2008) technology appraisal, and raised the question of the use of insulin pumps for the treatment of type 2 diabetes.

As well as continuing to support ease of access to pump therapy, the IPA aims to champion education and support for people using insulin pumps.

Glucose sensing: Uses and abuses

David Kerr (Consultant Physician and Co-Chair of IPA, Bournemouth).

Dr Kerr highlighted how glucose variability can affect quality of life, with hypoglycaemia and fear of hypoglycaemia leading to a reluctance to intensify treatment, which can result in a high HbA_{1c} and ultimately, a higher risk of complications (Reach, 2008).

Dr Kerr explained that, in his experience, when an individual with diabetes can associate their feelings with the trace produced by the glucose monitor, and make adjustments, it helps them better understand their diabetes, improving their quality of life.

Although continuous glucose monitoring (CGM) is clearly helpful, there are a number of drawbacks. There is a lag of about 10 minutes between a rise in blood glucose levels and the detection of this rise in subcutaneous glucose levels. This can result in the hypoglycaemia alarm on a continuous glucose monitor continuing to sound even after blood glucose levels have returned to a healthy range. Because of these "false alarms" people may begin to ignore all alarms.

Results from the Juvenile Diabetes Research Foundation (JDRF) CGM study (2008) showed, in a group of participants over the age of 25 years, an improvement in HbA_{1c} if they used CGM with continuous subcutaneous insulin infusion (CSII). There was a correlation between more time spent using the sensor and an improvement in HbA_{1c} levels.

Other outcomes, apart from HbA_{1c}, are important to people with diabetes, such as the impact of an improvement in quality of life on family members, and a feeling of being "normal" and not preoccupied with diabetes. CGM along with good education can improve on the outcomes that are important to those living with the condition.

Downloading of patients' glucose meters: should we make it routine?

Colin Dayan (Consultant Senior Lecturer in Medicine, and Head of Clinical Research, Bristol).

Dr Dayan began his talk by asking how many of the delegates already routinely download data from glucose meters, and a show of hands revealed that most of them do.

But what are the advantages of downloading data from glucose monitors? For people with diabetes, the downloaded data is orgnanised to show patterns and variations in blood glucose. This is also an advantage for healthcare professionals as well as being able to see the whole record, and not just highlights, edited by the user. The downloaded data also shows the frequency of fingerprick blood glucose testing.

The data produced by the glucose meter can be difficult to interpret, with many different types of charts and tables.

Dr Dayan explained which format he prefers to view the

data, by asking the following questions. Does the chart clearly show: the frequency of testing; the frequency of hypoglycaemia; the blood glucose variability; and any visible patterns? A daily overview chart, tracking blood glucose levels against time (often called a "daily overview scattergram"), showed all of these elements. However, more detailed data, tracking the effect of food and exercise on blood glucose levels, would need to be collected using a food diary or entered into a real-time CGM device.

The data from glucose monitors provides the healthcare professional with a lot of information so that the decisions about the treatment of a person presenting with a complex problem with their glycaemic control become much simpler. The day-to-day blood glucose variations are clearly visible, as well as the treatment regimen, and any behavioural patterns.

Routinely downloading data from glucose monitors does present some technical problems. There are lots of different monitors and all of them have their own cables, and software. This could be simplified by only issuing one type of monitor. Software such as CareLink® (Medtronic) could overcome some IT problems. It allows the uploading of data from the individual's own personal CareLink records as well as from the monitor, and generates reports as PDFs. CareLink can also save and manage uploaded data from many different people.

Clinical uses of technology

Pump downloads are de rigueur

Laila King (Senior Diabetes Nurse Consultant, Buckinghamshire).

Data downloaded from insulin pumps can provide a helpful insight into an individual's self-management of their diabetes, explained Laila. People using an insulin pump can often download the data on to their personal computer and then email it to their diabetes team prior to their appointment, which is useful. The diabetes team can then spend more time discussing optimal therapy with the individual.

The information from 24-hour trend graphs can facilitate decision-making for basal insulin doses, and show the user when the action of their bolus dose is complete. It can also help to identify patterns overnight and the effects of exercise, stress and high-fat foods on glycaemia.

Newer insulin pumps can now be paired up with a blood glucose meter that wirelessly transmits the result to the pump.

Laila emphasised how helpful it is to focus on the percentage of time spent within the target range, and a number of graphs can help to illustrate this to insulin pump users.

Teaching technology

Elisabeth Jones (Diabetes Specialist Nurse, Bristol).

Technology has changed diabetes management over the past 30 years in terms of glucose measurement, insulin delivery devices and types of insulin.

Teaching people how to use new technology involves assessment of their skills and enthusiasm, teaching basic features of the insulin pump, before moving on to using more "advanced" features.

It can be difficult to assess which people are suitable for CSII. A study by Deeb et al (2008) states that "knowledge of individuals and their medical and psychosocial situation are crucial variables for successful pump use". Elisabeth presented the case of one woman who had erratic control, frequent hypoglycaemia, high anxiety and an HbA_{1c} of 8.5%. She initiated CSII but struggled with calculating the correct doses. It soon became clear that she had numeracy difficulties and needed to learn about decimal points, fractions and percentages, as well as new terminology such as, basal rate, insulin to carbohydrate ratio and correction bolus.

Once the basics have been mastered, the advanced features can be introduced and tailored to each individual. For example, for someone who forgets they have already administered a bolus dose, they can use the "bolus history" feature to check, so they do not administer an extra bolus dose.

Keynote lecture: Exercise and technology

Peter Adolfsson (Consultant Physician, Sweden).

Exercise for a person with diabetes can be difficult, as people often experience overnight hypoglycaemia after exercising in the afternoon. These effects can be complicated to counteract.

In a study by Grimm et al (2004), post-exercise hypoglycaemia could be avoided by eating carbohydrate. Supplementation with carbohydrate during exercise was found to be more important than adjusting insulin doses (Grimm et al, 2004).

Glucose monitoring, together with an analysis of the amount of additional carbohydrate and the reduction of insulin doses, is essential when trying to achieve normoglycaemia throughout exercise. As an exemplified model, Dr Adolfsson suggested eating half a banana before exercising, sipping lucozade during exercise and eating the other half of the banana after finishing the exercise, followed by a meal up to 2 hours afterwards. The analysis is easier to do and more qualitative if glucose meters and insulin pumps are downloaded using software such as CareLink (Medtronic) or Diasend® (Aidera).

A study by Admon et al (2005) showed that there was no difference in hypoglycaemia after and during exercise with the insulin pump turned on compared with the insulin pump turned off. Hypoglycaemia after exercise was found to be more common than during exercise (Admon et al, 2005).

The authors recommend suspending basal dose, or not wearing the pump during exercise, but making sure an adequate amount of carbohydrate is consumed.

Special groups and technology:

Children

Fiona Campbell (Consultant Paediatrician/ Diabetologist, Leeds).

The UK has the highest number of children with type 1 diabetes, but also the lowest number achieving adequate glycaemic control (Department of Health, 2007).

The data from the University of Leeds insulin pump database shows that the 93 children using pumps who took part in an audit have improved their glycaemic control from an average HbA_{1c} of 9.4% to 8.9%. The number of hospital admissions due to hypoglycaemia also reduced by around 4%, but this is not statistically significant (Feltblower et al, 2008).

The Leeds diabetes clinic now cares for over 140 children using insulin pumps, who all fulfill the criteria detailed in the NICE guidelines (NICE, 2008).

Insulin pump therapy is particularly helpful for children, for example in toddlers who have unpredictable eating habits, and babies requiring small amounts of insulin.

Dr Campbell emphasised that insulin pumps should be seen as a first-line therapy for children under 12 years of age, rather than a "last ditch attempt".

Pregnancy and lactation

Julie Abayomi (Senior Dietitian, Liverpool).

NICE guidelines recommend the use of insulin pumps for pregnant women with type 1 diabetes, but does not consider the use of insulin pumps while breastfeeding (NICE, 2008). Julie recalled a situation where an insulin pump was taken away from a woman with type 1 diabetes in the delivery room, due to a lack of funding.

It is important for women with type 1 diabetes to keep a pump after their baby is born because diabetes can make breastfeeding difficult.

Particular problems include delayed lactogenesis, prolonged separation of mother and child and increased hypoglycaemia.

Women with type 1 diabetes have low serum prolactin concentrations during the first postnatal week, which can result in reduced milk volume. In a study by Ostrom and Ferris (1993), early breastfeeding

Technology updates. 15-minute presentations delivered by a representative from a device company to inform delegates about the progression of technology.

Technology update 1: The benefits of personal continuous glucose monitoring

Adam Macdonald (Therapy Development Specialist, Medtronic, Hertfordshire)

Personal continuous glucose monitoring (CGM) allows the user to see the changes in glucose plotted on a graph (glucose concentration against time) and displayed on the monitor. Personal CGM has been shown to improve HbA_{1c}. In a study by Deiss et al (2006) 50% of participants using Personal CGM experienced a reduction of HbA_{1c} levels ≥1% compared with baseline. HbA_{1c} levels further improve when Personal CGM is used in combination with CSII therapy for more than 60% of the time, compared with using CGM alone (Hirsch et al, 2008). Medtronic are the only company that integrates Personal CGM functionality with CSII therapy in Paradigm® REAL-Time.

Technology update 2: New technology to enhance postprandial glucose management

Lars Krinelke (Head of Medical Affairs of Disetronic Systems AG, Switzerland)

Roche has developed a new bolus calculator algorithm that focuses the user's attention on blood glucose levels rather than on insulin on board. It also considers the different impact of correction and meal bolus doses on reducing actual blood glucose levels. Therefore, this new bolus calculator has the flexibility to normalise postprandial glucose levels more quickly and thus maintain blood glucose levels within the target range without increasing the risk of hypoglycaemia.

Technology update 3: Animas 2020 – performance pumping case studies

David McMahon (Business Unit Director, Animas, UK and Ireland)

The Animas 2020 insulin pump provides the lowest basal setting and lowest bolus increments available, providing more dosing options. David used a case study of a baby being treated with the Animas 2020 insulin pump to illustrate the applications of the small increments in insulin dose that the pump provides. The pump also features a built-in food database, a colour screen, and is waterproof to 12 feet for 24 hours.

The in-built food database may have important applications in the school setting, uncomplicating bolus doses for those administering them to children. A man with type 1 diabetes is planning to swim the channel later this year, while using an Animas 2020 insulin pump.

activity, increased breastfeeding frequency and good glycaemic control were associated with increased prolactin secretion.

Newborn babies are often taken straight to a special care unit if their mother has diabetes, so mother and child are separated for a longer than usual. The baby is also more likely to be offered supplementary feeds, which may further impair breastfeeding efforts.

Hypoglycaemia is increased after delivery because hormone levels reduce dramatically (Ferris et al, 1988) and carbohydrate is lost during breastfeeding. An insulin pump would help to alert the user to these changes so they can adjust their therapy more easily.

For successful breastfeeding in women with diabetes, Julie said, glycaemia needs to be well controlled, the mother needs an adequate diet with enough calories, appropriate counselling and support; strategies for dealing with initial problems; and mastitis monitoring and breast care.

Julie explained that at Liverpool Women's Hospital, women with diabetes set their pump with a conservative basal rate that is reduced by 20% following delivery. Regular blood glucose testing and adjustment of any low blood glucose levels before feeding helps to manage hypoglycaemia.

The inaugural IPA lecture: Harnessing technology – an international initiative to optimise control

Sarah Johnson (Director of Policy and Communications, JDRF, London).

The JDRF is a global charity that exists to find a cure for type 1 diabetes. One major area of research is aiming to "close the loop" between CSII and CGM, resulting in an artificial pancreas.

One trial randomised 322 people with type 1 diabetes into two groups: one used a CGM device to manage their diabetes and those in the other continued to use self-monitoring of blood glucose. After 26 weeks a significant improvement in HbA_{1c} was observed, without an increase in hypoglycaemia (a reduction of 0.53%; $P<0.001$; JDRF CGM Study Group, 2008).

A team led by Roman Hovorka in Cambridge is researching the artificial pancreas (as well as another seven centres around the world). Under Dr Hovorka, the focus is on testing the closed-loop technology overnight.

Sarah expressed her excitement about another aspect of research: SmartInsulin. Although it has only been tested in animals so far, SmartInsulin would be a major breakthrough in diabetes treatment. SmartInsulin involves the use of a multivalent glucose-binding molecule (GBM) that is bound to an insulin polymer conjugate (IPC). The GBM reacts to increasing levels of glucose in the blood by releasing the IPC, which lowers blood glucose levels in the usual way. This also works in the opposite way, when there is excess circulating insulin.

As well as research, the JDRF also provide resources to help families understand diabetes, including a teddy bear called Rufus, who has patches on his arms and legs as insulin injection sites.

Panel discussion

The panel discussion centred on the issues of obtaining funding for insulin pumps. Delegates asked how to secure funding for an insulin pump for a woman with diabetes post-delivery. Julie Abayomi responded by explaining how a consultant at the Royal Liverpool Hospital wrote a letter to demonstrate how insulin pumps actually save money because of the reduced risk of hospitalisation as a result of hypoglycaemia associated with using an insulin pump.

Another significant question discussed was how a clinical lead or commissioner can decide which people need an insulin pump. Peter Adolfsson answered using teenagers as an example. He said that, if a teenager has tried using an insulin pump and is not motivated to use it effectively, depending on the indication for using the insulin pump, he sometimes recommends multiple daily injection therapy as an alternative option after consulting with them. Fiona Campbell disagreed and said that she would recommend an unmotivated teenager keep using an insulin pump because it may keep them from experiencing severe hypoglycaemia and subsequent hospitalisation.

The panel identified that the most relevant commissioning problem is the lack of staff to run clinics and provide training. On hearing this, the delegates applauded. ■

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