Diabetes and ‘The Happiest Place on Earth’: safely attending an amusement park and riding roller coasters

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Abstract
People with type 1 diabetes need to be aware of the potential impact of rapidly changing physical forces that occur during a roller coaster ride and other environmental factors that can impact on an individual’s efforts to maintain optimal glycaemic control during a visit to an amusement park. An individual’s tolerance to accelerations experienced during a roller coaster ride can be influenced by many factors including age, outside temperature, anxiety, hypoxia, infections and also hypoglycaemia. Before visiting a park it would make sense to speak to the specialist team about riding roller coasters and to be prepared to check glucose levels frequently. Individuals using an insulin pump should disconnect if they go on a roller coaster ride with electromagnets as these can affect insulin delivery from a pump. Elsewhere, visitors should account for extensive physical activity and temperature extremes which can cause glycaemic disturbances if not monitored. However, with thought and preparation, anyone with type 1 diabetes should be able to go to an amusement park and have fun. Copyright © 2015 John Wiley & Sons.

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Key words
diabetes; insulin pump; amusement park; Disney; roller coaster

Case study. Emily, a 12-year-old girl with type 1 diabetes, is being taken by her parents to Disneyland Park in California as a birthday treat. Emily and her family have never been to Disneyland before. They are apprehensive as they are not quite sure whether they need to make changes to her insulin pump settings and continuous glucose monitor when going on the rides, especially as Emily has recently had a number of severe hypoglycaemic events. What should she do?

‘All our dreams can come true if we have the courage to pursue them.’
Walt Disney

Theme park attendance
On 17 July 2015, Disneyland Park in Anaheim, California, celebrated its 60th Anniversary. Since its opening in 1955, the park continues to attract people from all over the world. Covering 85 acres of land, Disneyland now features 58 attractions including roller coaster rides, shows, and exhibits. Furthermore, Anaheim is host to temperatures that range from the low-40s to mid-90s degrees Fahrenheit with the highs coinciding with crowded summer months. During a day out at Disneyland, visitors usually average about nine rides over the course of a whole day, many of which have a duration of 1–10 minutes. With approximately 44 000 guests a day and given the known prevalence of type 1 diabetes in adults and children in the United States, it can be estimated that around 150 daily visitors under 20 years of age to Disneyland will be arriving with type 1 diabetes and, additionally, a significant number of persons of all ages will also have insulin-treated type 2 diabetes.

General guidelines
For Emily, there exist general guidelines regarding amusement parks with diabetes. For example, the American Diabetes Association cautions of the danger of riding roller coasters and for parents to check that their children meet the height requirements before they go on a ride as well as making sure that pumps and meters are safely stowed. The Juvenile Diabetes Research Foundation urges people to check their glucose levels more often while at an amusement park and the Disney organisation itself provides online information recognising the potential impact of the
‘adrenaline rush’ from roller coaster rides as well as the prevailing environmental temperature (www.t1everydaymagic.com/friends-for-life-guide-to-disney-world-with-type-1-diabetes/).

Additional guidance can be found at www.diabetes.co.uk/blog/2015/08/can-people-with-diabetes-get-special-access-to-theme-parks/.

**Impact of rapidly changing physical forces**

According to the most recently available information from the International Association of Amusement Parks and Attractions, there are approximately 340 million visitors to the 400 theme parks in the United States each year.9 Many of these visitors will ride roller coasters. Tolerance to acceleration depends on its magnitude, direction, rate of onset, and duration, as well as differences in individual physiology and psychology (fear factor). On a roller coaster a rider may experience three types of acceleration – linear, radial and angular – which induce different gravitational or ‘G’ forces on the body. From a physiological perspective during fluctuations in these different types of acceleration the aim is to maintain blood flow to the brain. This requires rapidly adaptive cardiovascular changes controlled by the autonomic nervous system.7

An individual’s tolerance to accelerations experienced during a roller coaster ride can be influenced by age, temperature, anxiety, alcohol, hypoxia, infections and also hypoglycaemia. Research on the effects of acceleration in humans has been restricted to healthy adults; there are no studies to guide ride designers in determining safe levels of acceleration and other forces experienced during a roller coaster ride in addition to the fluctuations in blood glucose occurring on a roller coaster have not been studied.9

**Effects on insulin pumps**

From a practical perspective, most insulin pump manufacturers recommend that these devices are disconnected (not just suspended) on rides in order to avoid malfunction, especially if the rides use electromagnets similar to the risks associated with magnetic resonance imaging.12 If leaving the pump outside the ride or with another person, it is important to ensure another member of the party has an alternative source of insulin with them in the event the pump is lost or stolen. Purchasing insurance for the insulin pump may also be of value. At Disneyland, California, rides that do use electromagnets include Big Thunder Mountain, California Screamin’, Hollywood Tower of Terror, and Snow White.13 Changes in pressure experienced during a ride in addition to the fluctuations in acceleration and other forces could potentially lead to bubble formation affecting insulin delivery similar to that seen on an aircraft during take-off and landing.14

**Planning for physical activity and environmental temperature**

For Emily, other potential hazards might include unaccustomed physical activity and also the effect of the environmental temperature.

Planning for physical activity can be challenging but there are free online sources for practical information (www.Excarbs.com) in addition to seeking advice from diabetes professionals.15

The outside temperature can also adversely affect people living with diabetes, with higher numbers of emergency department visits, hospitalisations and mortality during hot weather.16 In real life, people often store their medicines in areas exposed to extreme temperatures such as in a motor car during the summer. In such situations this can induce conformational changes to the insulin, promoting precipitation, chemical degradation and fibrillation impairing insulin action.17

The performance of blood glucose monitoring systems can also be affected by environmental conditions especially the prevailing temperature and humidity as well as rapid shifts in ambient temperature. Currently, most manufacturers of blood glucose monitoring systems recommend operating temperature ranges between 4 and 40°C. Modern meters usually have lock-out systems which prevent an inaccurate blood glucose value being obtained if the surrounding temperature is outside the manufacturer’s recommended range.17 Individuals with diabetes do not always appreciate the potential impact of heat on themselves or their diabetes equipment.18

**Other key considerations**

At any large gathering of people there is also the potential for communicable disease transmission, including measles.19 As a preventative measure, visitors are encouraged to remain up-to-date with their vaccines. At mass gatherings of people such as Disneyland, visitors with diabetes need to also consider the potential for long lines at food vendors in case of an urgent need for carbohydrates, and also to be prepared for the security checks on arrival. Disneyland does allow guests with allergies/special dietary needs
to bring food into the park and provides first-aid stations that have a facility for syringe disposal, or to get some help in the case of an emergency. For visitors with diabetes, there is also the Disability Access Service (DAS), which allows an option to schedule a time to ride an attraction.

Reducing the potential for mishap

Disneyland describes itself as ‘the happiest place on earth’. Each day a large number of visitors to the park will have diabetes. Although there are potential risks involved as outlined above, there is no compelling reason why children and adults with diabetes should not visit.

As with many aspects of living with diabetes, thought and preparation beforehand make sense and should markedly reduce the potential for mishap.

Declaration of interests

There are no conflicts of interest declared.

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References


POEMS

Liraglutide produces modest weight loss and lots of side effects

Clinical question

Is liraglutide effective for weight loss in obese adults without diabetes?

Reference


Synopsis

In this trial, the researchers identified adults with a body mass index higher than 30kg/m² (or >27kg/m² if they had dyslipidaemia or hypertension). A total of 2487 patients were randomised to receive liraglutide 3.0mg once-daily injection, and 1244 patients were given placebo injections; both groups received lifestyle counselling. Only 72% in the liraglutide group and 64% in the placebo group completed the trial. At the end of the year of follow-up, weight loss was greater in the liraglutide group (8.4kg versus 2.8kg; p<0.001). Blood pressure and lipid levels also improved a bit more in the active treatment group. In addition, several validated quality of life measures showed greater improvements in the active treatment group. Adverse events were much more common in the liraglutide group, including nausea (40% versus 15%), diarrhoea (21% versus 9%), constipation (20% versus 9%), and vomiting (16% versus 4%). The risk of gallbladder events (NNTH = 67) and pancreatitis (NNTH = 313) was also more common with the drug.