

# Insulin pump therapy and the management of alcohol intake

Gill Morrison, Philip Weston

## Article points

1. Evidence specifically tailored for insulin pump users and alcohol consumption is lacking.
2. The authors describe the strategies taught to individuals managed with continuous subcutaneous insulin infusion regarding the safe consumption of alcohol.
3. Given the complexity of the physiological impact of alcohol consumption on individuals with type 1 diabetes, strategies that can facilitate its safe use for people on insulin pump therapy are multifocal.
4. The patient and healthcare professional should work in partnership, personalising a strategy for the safe consumption of alcohol.
5. People with diabetes must be educated on how to drink alcohol safely.

## Key words

- Alcohol
- Education
- Insulin pump therapy
- Type 1 diabetes

Authors' details can be found at the end of this article.

Despite the increasing popularity of insulin pump therapy, specific information regarding the management of alcohol and continuous subcutaneous insulin infusion (CSII) is lacking. Given the negative effect of alcohol on glycaemic control, it is essential that CSII users are taught realistic strategies that will allow them to consume social levels of alcohol safely. In this article, these strategies are discussed.

For people with type 1 diabetes the social consumption of alcohol has the potential to have a negative impact on glycaemic control. Indeed, evidence suggests that one-fifth of severe episodes of hypoglycaemia can be attributed to the consumption of alcohol (Potter et al, 1982; Nilsson et al, 1988). Transient hyperglycaemia is also an issue of concern for this population owing to the co-ingestion of carbohydrate with alcohol (Bantle et al, 2006).

In this article, the authors describe the strategies taught to individuals managed with continuous subcutaneous insulin infusion (CSII) regarding the safe consumption of alcohol, at the UK's largest insulin pump centre (Royal Liverpool University Hospital).

## Health issues and alcohol

Current evidence from the Department of Health (2006) suggests that men should not regularly drink more than 3–4 units of alcohol per day (maximum weekly intake of 21 units) and women no more than 2–3 units per day (maximum weekly intake of 14 units). "Regularly" is defined as drinking every day or most days of the week (NHS Choices, 2011).

Drinking in excess of the recommended amount of alcohol can have a serious impact

on health, with the dangers increasing the longer excess quantities of alcohol are consumed (NHS Choices, 2011). Alcohol also contains "empty" calories and, therefore, can significantly contribute towards weight gain (NHS Choices, 2011).

For individuals with diabetes, it has also been demonstrated that alcohol consumption above the recommended limits can lead to long-term elevated blood glucose levels, which can cause deterioration in neuropathy, lipid profile and retinopathy (Emanuele et al, 1998; Howard et al, 2004; Bantle et al, 2006). However, ironically, the ingestion of 1–2 units of alcohol per day is associated with a reduced risk of cardiovascular disease (Howard et al, 2004; Bantle et al, 2006).

## Hypoglycaemia

It is well documented that alcohol has a hypoglycaemic effect in individuals with type 1 diabetes, particularly when in a fasting state (Meeking and Cavan, 1997; Emanuele et al, 1998; Turner et al, 2001). Indeed, some authors have indicated that following the consumption of alcohol, a person with type 1 diabetes can be at an increased risk of hypoglycaemia for up to 16 hours (Turner et al 2001; Diabetes UK, 2008).

Multiple factors are responsible for increasing the risk of hypoglycaemia following alcohol consumption in individuals with type 1 diabetes. These include inhibition of gluconeogenesis, alteration of carbohydrate absorption and changes in the levels of counter-regulatory hormones.

### Strategies to manage alcohol and CSII

Given the complexity of the physiological impact of alcohol consumption on individuals with type 1 diabetes, strategies that can facilitate its safe use for people on insulin pump therapy are multifocal.

#### Managing gluconeogenesis

Analysis of the physiological phenomenon of gluconeogenesis suggests that if drinking in the evening, the CSII user should eat a meal containing carbohydrates. Manipulating the insulin–carbohydrate ratio for the meal can be used to successfully manage the reduction of gluconeogenesis. The authors advise that if a person normally uses 1 unit of insulin for every 10 g of carbohydrate, then a dose of 1 unit for every 15 g of carbohydrate would be appropriate when drinking in the evening. For individuals who inject insulin, Diabetes UK (2008) also advocates the consumption of a carbohydrate-containing meal as a means of preventing hypoglycaemia following the evening ingestion of alcohol.

#### Managing the hormonal effect

For individuals who drink a moderate-to-high amount of alcohol, a basal insulin rate reduction should also be considered. In the authors' experience, if alcohol has been consumed in the evening, then an overnight reduction of 20% is usually sufficient to overcome the effect of growth hormone suppression following the consumption of alcohol, as described by Howard et al (2004).

#### Managing hypoglycaemia

In addition to the glycaemic disruption caused by alcohol consumption, exercise in its own right (e.g. dancing at a night club) will also lower blood glucose levels. The authors recommend that if alcohol and physical activity are combined in the evening, the basal insulin rate should be reduced up to 50% until the next morning.

Drinking moderate amounts of alcohol in the evening can predispose an individual to hypoglycaemia until mid-morning the following day (Turner et al, 2001; Diabetes UK, 2008). The authors recommend that for people affected by this phenomenon, a successful strategy is the reduction of the pump user's insulin–carbohydrate ratio at breakfast time.

#### Hyperglycaemia

Alcohol can cause blood glucose levels to rise, particularly if carbohydrate is co-ingested (Bantle et al, 2006). As alcohol appears to

affect insulin sensitivity, this can contribute to hyperglycaemia (Wan et al, 2005).

If a blood glucose value requires correction during a period of alcohol consumption, caution should be applied owing to the risk of hypoglycaemia (Turner et al, 2001; Diabetes UK, 2008). In the authors' practice, the patient's usual correction dose for any given glucose value is a reduction of 50%.

It is prudent to follow the current Diabetes UK (2008) recommendation of using low-calorie mixers in alcoholic drinks as a means of reducing the risk of hyperglycaemia, as observed by Flanagan et al (1998). Implementation of this strategy also helps to reduce the overall caloric intake associated with alcohol consumption, which can help to minimise weight gain.

### Carbohydrates and alcohol

Despite some conflicting information regarding the absorption of carbohydrate following alcohol consumption, the most recent studies suggest that blood glucose levels are more likely to drop following a period of fasting (Horowitz et al, 1989; Turner et al 2001; Paton, 2005). Taking this evidence into consideration, pump users should be advised not to drink alcohol on an empty stomach. This strategy concurs with the Diabetes UK (2008) advice for individuals injecting insulin.

Many alcoholic drinks, such as dry white wine or spirits, have a very small amount of carbohydrate; given this, a bolus dose of insulin is not required when these drinks are consumed. Should the individual be particularly physically active, the small amount of carbohydrate contained in the alcoholic beverages will be offset by additional exercise.

Some alcoholic drinks, such as beer, lager, "alcopops" and ciders, contain levels of carbohydrate that will cause hyperglycaemia (Bantle et al, 2006). For CSII users, this phenomenon will occur immediately after drinking these types of alcoholic beverages.

If the blood glucose level rises above the target range 1–2 hours following alcohol consumption then a small bolus of insulin

to cover the carbohydrate content of the alcoholic drink should be delivered. Enough insulin should be given to cover half of the carbohydrate content of the drink for the first two bottles of alcopops, or the first two pints of beer, lager or cider. Should the bolus dose be inadequate and the blood glucose value rises above the individual's target range, slightly more insulin may be given next time these beverages are consumed. Owing to the risk of hypoglycaemia associated with increasing a bolus dose to counteract glycaemic rise during alcohol consumption, the authors take a conservative approach and only recommend an increase in small increments such as 0.1–0.5 units.

As information is key, CSII users need to know the carbohydrate content of common alcoholic drinks so that they can make an informed decision regarding any bolus doses. Legislation that improves the quality of nutritional information on the labels of bottles and cans of alcoholic beverages would undoubtedly help individuals with the decision-making process.

### Self-care behaviours

It goes without saying that as alcohol consumption can have such a negative impact on cognitive function, an individual's ability to self-care can be impaired (Meeking and Cavan, 1997). If factors such as the ability to calculate insulin doses accurately or operate an insulin pump safely are impaired, then there is an indirect detrimental effect on both glycaemic control and the individual's safety. As a means of minimising the decision-making process and the need to operate insulin pumps, many of the CSII users at the authors' institution have adopted the practice of having an alternative basal rate that is preset to accommodate alcohol consumption.

People with type 1 diabetes who have consumed alcohol may not be aware of any symptoms associated with hypoglycaemia (Kerr et al, 1990). Just as the dangers associated with a low blood glucose level can be overlooked by the person with type 1 diabetes, onlookers can also misconstrue the

### Page points

1. Many alcoholic drinks, such as dry white wine or spirits, have a very small amount of carbohydrate; given this, a bolus dose of insulin is not required when these drinks are consumed.
2. As information is key, continuous subcutaneous insulin infusion (CSII) users need to know the carbohydrate content of common alcoholic drinks so that they can make an informed decision regarding any bolus doses.
3. If factors such as the ability to calculate insulin doses accurately or operate an insulin pump safely are impaired, then there is an indirect detrimental effect on both glycaemic control and the individual's safety.

### Page points

1. Given the cognitive risks associated with alcohol consumption, continuous subcutaneous insulin infusion (CSII) users need education and pragmatic strategies that they can use to minimise any risks.
2. CSII users should be encouraged to maintain a detailed diary that includes information such as carbohydrate intake, administration of bolus doses, the type and amount of any alcohol consumed, temporary basal rate changes, blood test results and physical activity levels.

### Box 1. Summary of advice given to insulin pump users in Liverpool.

- Do not drink alcohol on an empty stomach.
- Carry identification at all times.
- Tell the people that you are drinking alcohol with:
  - That you have diabetes managed with an insulin pump.
  - How to recognise a hypoglycaemic episode and how to treat it if necessary.
- If drinking beer, lager, sweet cider or “alcopops”, take enough insulin to cover half of the carbohydrate content for the first two pints or bottles of alcopops. Thereafter, no bolus should be given.
- If blood glucose levels are high after drinking beer, lager, sweet cider or alcopops despite a small carbohydrate bolus, increase the bolus conservatively (in increments of 0.1–0.5 units).
- No insulin bolus is generally required for wines and spirits.
- Use low-calorie mixers.
- For blood glucose values that require correction, reduce the usual calculated dose by 50%.
- Have a starchy supper and reduce the bolus dose for the carbohydrate content of it.
- A basal rate reduction before going to bed is required if drinking a significant amount of alcohol in the evening. Usually, a 20% reduction is adequate. If physical activity has taken place then a reduction of 50% will be necessary.
- Some individuals will need to alter the insulin–carbohydrate ratio for the breakfast bolus the following morning after alcohol consumption.
- Initially, frequent blood glucose testing may be needed to assess the impact of alcohol on blood glucose values and to modify strategies.
- Keep a diary of strategies used to manage alcohol and reflect on outcomes and modify them accordingly, with the assistance of your healthcare professional.

symptoms of hypoglycaemia as intoxication and so react inappropriately to the situation (Richardson et al, 2005).

Given the cognitive risks associated with alcohol consumption, CSII users need education and pragmatic strategies that they can use to minimise any risks. These strategies could include having a preset, “night out” basal rate that is in keeping with Diabetes UK (2008) recommendations, and carrying appropriate identification. In addition, the CSII user should be encouraged to tell their friends and relatives that they have type 1 diabetes and how to recognise and treat hypoglycaemia.

### Testing the chosen strategy

Although there are general management principles, individuals with diabetes have slightly different responses to alcohol

consumption. CSII users should be encouraged to maintain a detailed diary that includes information such as carbohydrate intake, administration of bolus doses, the type and amount of any alcohol consumed, temporary basal rate changes, blood test results and physical activity levels. This approach will enable the patient and healthcare professional to work in partnership, personalising a strategy for the safe consumption of alcohol.

As Diabetes UK (2008) has highlighted the prolonged risk of hypoglycaemia after heavy drinking, blood glucose levels should be tested on a regular basis. Initially, this may mean testing from 2 hours after the consumption of alcohol and then every 2–3 hourly for the next 12 hours. The frequency of blood glucose testing can be reduced once a successful strategy has been determined.

### Conclusion

Alcohol has general health implications, without even considering its potential negative impact on glycaemic control and the management of diabetes. Given the popularity and enjoyment of alcohol, it is unrealistic to follow a policy of prohibition or restriction for CSII users. Rather, the challenge facing healthcare professionals is to provide individualised, realistic, pragmatic advice in a non-judgmental manner, taking into consideration the metabolic and cognitive affects of alcohol.

People with diabetes must be educated on how to drink alcohol safely. *Box 1* summarises some of the advice that is given to CSII users at the authors' institution regarding alcohol use. However, as evidence specifically tailored for CSII users is lacking, it is essential that further research that confirms the specific strategies that these individuals should use when consuming alcohol is undertaken. ■

### Authors

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- Bantle JP, Wylie-Rosett J, Albright AL et al (2006) Nutrition recommendations and interventions for diabetes – 2006: a position statement of the American Diabetes Association. *Diabetes Care* **29**: 2140–57
- Department of Health (2006) *Drinking, You and Your Mates: How much is Too Much?* DH, London
- Diabetes UK (2008) *Alcohol and Diabetes*. Diabetes UK, London
- Emanuele NV, Swade TF, Emanuele MA (1998) Consequences of alcohol use in diabetics. *Alcohol Health Res World* **22**: 211–19
- Flanagan D, Wood P, Sherwin R et al (1998) *J Clin Endocrinol Metab* **83**: 796–800
- Horowitz M, Maddox A, Bochner M et al (1989) Gin and tonic and reactive hypoglycemia: what is important—the gin, the tonic, or both? *Am J Physiol* **257**: G291–8
- Howard AA, Arnsten JH, Gourevitch MN (2004) Effect of alcohol consumption on diabetes mellitus: a systematic review. *Ann Intern Med* **140**: 211–19
- Kerr D, Macdonald IA, Heller SR, Tattersall RB (1990) Alcohol causes hypoglycaemic unawareness in healthy volunteers and patients with type 1 (insulin-dependent) diabetes. *Diabetologia* **33**: 216–21
- Meeking DR, Cavan DA (1997) Alcohol ingestion and glycaemic control in patients with insulin-dependent diabetes mellitus. *Diabet Med* **14**: 279–83
- NHS Choices (2011) *The Risks of Drinking Too Much*. NHS Choices, London
- Nilsson A, Tideholm B, Kalen J, Katzman P (1988) Incidence of severe hypoglycemia and its causes in insulin-treated diabetics. *Acta Med Scand* **224**: 257–62
- Paton A (2005) Alcohol in the body. *BMJ* **330**: 85–7
- Potter J, Clarke P, Gale EA (1982) Insulin-induced hypoglycaemia in an accident and emergency department: the tip of an iceberg? *Br Med J (Clin Res Ed)* **285**: 1180–2
- Richardson T, Weiss M, Thomas P, Kerr D (2005) Day after the night before: influence of evening alcohol on risk of hypoglycemia in patients with type 1 diabetes. *Diabetes Care* **28**: 1801–2
- Turner BC, Jenkins E, Kerr D et al (2001) The effect of evening alcohol consumption on next-morning glucose control in type 1 diabetes. *Diabetes Care* **24**: 1888–93
- Wan Q, Liu Y, Guan Q et al (2005) Ethanol feeding impairs insulin-stimulated glucose uptake in isolated rat skeletal muscle: role of Gs alpha and cAMP. *Alcohol Clin Exp Res* **29**: 1450–6