



InDependent Diabetes Trust

Hypoglycaemia

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Hypoglycaemia is not caused by diabetes but by the treatment of it.

What is hypoglycaemia?

In people without diabetes the level of glucose in the blood is controlled by insulin produced by the beta cells in the pancreas. This prevents the level of glucose in the blood from rising too high. In people with Type 1 diabetes, the body does not produce its own insulin and the blood glucose levels rise too high [called hyperglycaemia] and so injections of insulin are given to prevent this.

People with Type 1 and Type 2 diabetes are advised to keep their blood glucose levels as near to the normal blood glucose levels as possible. If the blood glucose levels drop below normal, whatever the cause, then this is called hypoglycaemia [a hypo]. 'Good' control of diabetes is avoidance of both high and low blood glucose levels.

Definitions

Normal blood glucose levels in non-diabetic people range between 4 and 7mmols/l. Hypoglycaemia is usually said to occur at 3.8mmols/l and so the recommended lower level is 4mmols/l – hence the recommendation to people with diabetes that “4 is the Floor”.

Note: Some publications say that hypoglycaemia does not occur until blood glucose levels are below 3.5 or even 3.0mmols/l. However, there is research that shows that the ability to function may be impaired by blood glucose levels of 3.8mmols/l and lower.

Useful definitions of hypoglycaemia

It is important that even mild hypos, or ‘lows’, are recognised as being hypoglycaemia and treated. This is also important so that all hypos can be reported to your doctor to provide a true picture of your diabetic control. Hypos are generally defined as follows:

Mild: a hypo that is easily treated by the patient by the intake of a sugary drink or food, often referred to as ‘being low’.

Moderate: one where someone else, spouse, friend or parent, has to intervene and give the sugary food/drink because the person with diabetes is confused or even losing consciousness

Severe: one that usually means unconsciousness and maybe accompanied by a convulsion/seizure.

Parent comment: I am sure that I under-reported my daughter’s hypos at our clinic visits because I was never sure how to answer the question about how many hypos she had since the last visit. I didn’t know whether to class the lows before meals as a hypo or not.

The causes of hypoglycaemia

The simplistic explanation is that hypoglycaemia is caused by too

much insulin hence the statement that hypoglycaemia is not caused by diabetes but by the treatment of it. The other way of looking at this is that there is not enough food for the exercise taken or the energy used.

Information packs and leaflets describe the causes of hypoglycaemia as follows:

- Missing or postponing a meal or eating less than the correct allowance of carbohydrate.
- Taking more exercise than usual
- Injecting the wrong dose of insulin
- The risk of severe hypoglycaemia is increased threefold with tight control of blood glucose levels, which is keeping blood glucose at near normal levels.
- Emotional upset or stress
- Alcohol consumption
- No apparent reason

From a patient/carer perspective this may seem like an underestimate of the complexities of hypoglycaemia in everyday life. Many leaflets for patients list these causes of hypos in a way that seems to place responsibility and blame on the patient and/or the family carer. All too often this can add to their feelings of guilt and failure for ‘not having managed their diabetes properly’! This is especially the case for parents of children with diabetes.

Treatment of hypoglycaemia

- Hypoglycaemia in its early stages [mild hypo] is treated with a sugary drink or sugary food. This should then be followed with some longer-acting carbohydrate to prevent another hypo.
- If the hypo is not treated at this stage then there may be confusion, behavioural changes, helplessness and an inability to function

properly occurs [moderate hypo].

- If not treated at this stage with glucose or GlucoGel then coma occurs and this may or may not be accompanied by seizures [severe hypo]. Severe hypos need treating with glucagon or intravenous glucose and this may mean admission to hospital.

Note: GlucoGel is a sugary gel that can be squeezed into the mouth around the cheeks and gums. It **MUST NOT** be given if the person is unconscious or unable to swallow because they could choke. It is available on a doctor's prescription in the UK.

Some Golden Rules for hypoglycaemia:

- Always have some form of quickly absorbed glucose with you.
- Never drive while hypo. If warning signs come on while driving, always stop the car and get into the passenger seat so that you are not seen to be in control of a car while hypoglycaemic.
- When driving always keep glucose or sweets in an accessible place – the glove compartment is not very accessible.
- If it is difficult to make the person eat or drink, then GlucoGel can be used, which is easier than the more old-fashioned method of rubbing jam around the cheeks and gums!
- People with diabetes are renowned for denying that they are hypo when they actually are. If you are suspicious that they are hypo, always treat with sugary food or drink.
- If you are a carer and are unable to treat an unconscious hypo, call emergency services or your GP.
- If the hypo is accompanied by vomiting, drowsiness and difficulty breathing, then a doctor is needed and admittance to hospital.

Warning symptoms of hypoglycaemia

- When the blood glucose levels start to drop at the stage of mild hypoglycaemia, then there are usually warnings signs/symptoms

of the impending hypo. These are usually:

- Sweating
- Trembling
- Pallor
- Weakness
- Hunger

These are called the **adrenergic effects of hypoglycaemia** because the body reacts to the low blood glucose level by the production of counter-regulatory hormones, mainly adrenalin and glucagon. These hormones are the 'fight and flight' hormones that the body releases when there is any danger. Hypoglycaemia is a danger and these hormones give the warning symptoms of an impending hypo and trigger the release glucose from the liver.

If the mild hypo is not treated for any reason, then the blood glucose drops further and the symptoms of this are less obvious to the person with diabetes when the signs are usually:

- Confusion
- Irritability
- Behavioural changes such as aggression, excitement or violence
- Sensory changes such as blurred vision

These symptoms are much harder to recognise and can be missed and so remain untreated. This can lead to a severe hypo and unconsciousness.

These are the neuroglycopenic effects of hypoglycaemia because the blood glucose level has dropped to lower levels and the brain is starved of glucose. This results in reduced cognitive function with confusion and behavioural changes. The person who is hypo may well say that they are "definitely not hypo" but in reality this may be part of the confusion caused by the neuroglycopenia. Research has shown that brain function can be impaired when the blood glucose falls below 3.5mmols.

Important to remember:

- The warning symptoms vary from person to person and can vary in the same person at different times. Many people have found that the warnings seem to vary with the rates at which the blood sugars fall. For example after exercise they drop quickly but at other times it may be a gradual, slow drop over a longer period with less obvious warning signs.
- Often the family carer or friend notices the signs of a hypo before the person with diabetes, especially the behavioural changes which can be difficult to handle, especially aggressive and/or violent hypos.
- It is very common for the person with diabetes to deny that they are hypo even though they are. Carers get used to this as one of the signs that their partner or child is actually hypo!
- If the person who is hypo carries out a blood test while hypo the results are not necessarily reliable because of their confused state while doing the blood test.
- The warning symptoms are the body's mechanism for WARNING of an impending DANGER and that danger is hypoglycaemia.

Loss of hypo warnings [or hypoglycaemia unawareness]

Hypoglycaemia itself, or the avoidance of it, is an acute daily problem for people with diabetes but when accompanied by loss or partial loss of warnings, it can have a dramatic effect on the lives of both the person with diabetes and their families. There can be a marked reduction in the quality of life for all concerned.

- **Total loss of warnings** - is a condition where the warning symptoms of an impending hypo are not present and so when the blood glucose levels drop there are no warning signs that the person must eat. This makes the likelihood of severe hypos much greater. People with loss of warnings have to rely on the help

of others.

- **Partial loss of hypo warnings** - this means that warning symptoms are present sometimes and not at other times. In some ways this is more difficult than total loss of warnings because the person may not even be aware that they have some loss of warnings and so have unexpected and unheralded moderate or severe hypos. This is particularly dangerous when driving.
- **Reduced warning symptoms** – is where the early warning signs of hypoglycaemia are reduced or missing [sweating, trembling etc] and the blood glucose drops to the stage where the symptoms are less obvious [confusion, behavioural changes etc]. This means that the person often then requires the help of others to treat the hypo.

The effects of loss of warnings

Information gathered from the experiences of people with diabetes and their carers says that loss of warnings may result in the following:

- A feeling of insecurity and loss of independence.
- Embarrassment.
- A fear of leaving the home.
- Being a danger to oneself and others.
- Aggressive or violent behaviour.
- Family conflict, breakdown of relationships.
- Loss of driving licence – it is illegal to drive with loss of warnings.
- Loss of job
- A deliberate raising of blood glucose levels to avoid such situations.

There are several causes of loss of warnings or hypo unawareness:

- Duration of diabetes – long-term diabetes can result in loss of warnings.
- Hypoglycaemia itself can cause loss of warnings and therefore the risk of more hypos. This then becomes a vicious circle of hypos leading to loss of warnings and more hypos!
- Intensive therapy with multi-daily insulin injections and aiming

for near normal blood glucose levels, has been shown to cause a threefold increase in the risk of severe hypoglycaemia. This increased hypoglycaemia can therefore increase the risk of loss of warnings.

- Neuropathy – damage to the autonomic nervous system is a complication of diabetes and this can cause loss of warning symptoms.
- Changing insulin species can cause a loss or change in warning symptoms.
- ‘Human’ and analogue insulins can cause loss of warnings of hypos - from the early 1990s, Patient Information Leaflets in ‘human’ insulin packs had to include this warning.

Living with the daily risk of hypos

Here are just a few quotes from people with diabetes:

- “Hypoglycaemia is one of the worst parts of having diabetes”
- “Hypoglycaemia screws up your life.”
- “For some of us it is a constant battle that we go through everyday and every night to try to obtain some sort of normality in our blood glucose levels. The fears and experiences, especially of hypoglycaemia comas and seizures that many of us and our carers suffer, are ever present.”

Practical information from people with diabetes for people with diabetes

- One hypo can easily lead to another within the next 72 hours. The first hypo used up much of the body’s emergency store of glucose so leaving the body vulnerable to another hypo.
- Strenuous exercise can lead to low the blood sugars the next day.
- Exercise sufficient to lower blood sugars and cause a hypo is not always the strenuous sporty-type exercise. For example, for

- people with a sedentary job or the elderly, a trip around the busy supermarket is exercise and can be sufficient to cause a hypo.
- Sexual intercourse is exercise and can cause hypos in both men and women.
- Alcohol lowers the blood sugars and can cause hypoglycaemia both at the time and up to 48 hours later. Alcohol also masks the warning signs of a hypo. Hypos can be misinterpreted by others as ‘ you being drunk’.
- Good diabetic control means avoiding hypoglycaemia just as much as avoiding hyperglycaemia [high blood sugars].
- Hypoglycaemia itself can lead to loss of warnings.
- Being able to function and walk around with low blood sugars does not mean that you are not hypo – it probably means that you have missed or not had the early warning signs.
- Emotional upset, stress and excitement, which may not always be apparent, can cause hypos.
- Some drugs taken for other conditions may cause hypoglycaemia eg beta-blockers.
- With illness and especially vomiting, it is OK to eat or drink anything that will keep the blood sugars up to avoid hypoglycaemia.
- All long and intermediate acting insulins that are cloudy contain crystals and they settle to the bottom of the vial. They must be re-suspended before drawing up and injecting the insulin. Research has shown that the vial must be rolled or tipped 20 times [NOT shaken] to achieve a satisfactory mixture. Failure to do this can result in unexpected hypos because there will be less crystals in the insulin and it is the crystals that slow down the action of the insulin.
- A change of insulin type, species and even batch can affect diabetic control and cause hypos.
- Genetically produced synthetic ‘human’ and analogue insulins in some people cause more severe hypos, more frequent hypos and reduced or loss of warning symptoms.
- Hypos can occur for no apparent reason and in people who blood test frequently as well as those who don’t.

Hypoglycaemia and Type 2 diabetes

It is well recognised that hypoglycaemia is the biggest daily fear of people with Type 1 diabetes and those with Type 2 diabetes who are taking insulin or drugs that can cause hypoglycaemia. The only drug for Type 2 diabetes that does not cause hypoglycaemia is metformin because it increases the body's sensitivity to insulin but does not increase insulin production, as do other drugs. If people with Type 2 diabetes are treated with insulin, then they are also at risk of hypos.

It has been thought by many people, including health professionals, that severe hypoglycaemia was primarily a problem for people with Type 1 diabetes and rarely, if ever, occurs in Type 2 diabetes. However, research presented at the American Association of Clinical Endocrinologists Congress, May 2013, confirmed that severe hypoglycaemia can occur in both Type 1 and Type 2 diabetes. (Severe hypoglycaemia was defined as hypos that required the assistance of another person.) This study also showed:

- During the time studied, 11.9% of people with Type 1 diabetes had a severe hypo compared with 1.7% of people with Type 2 diabetes,
- Quality of life was considerably worse in people who experienced severe hypos.
- Social functioning scores were lower in people with Type 1 and Type 2 who experienced severe hypoglycaemia compared with those who did not.
- Severe hypoglycaemia appeared to be linked to lower physical health problems in people with Type 1 diabetes but this association was only borderline in Type 2 diabetes. However, there were mental and general health problems in people with Type 2 diabetes who experienced severe hypoglycaemia.

The researchers concluded that their research highlights the need to minimise hypoglycaemia and particularly severe hypoglycaemia in both Type 1 and Type 2 diabetes.

A further report, 'Hypoglycaemia and Diabetes' issued by the American

Diabetes Association [ADA] and The Endocrine Society in 2013 reviews the impact of hypoglycaemia on people with diabetes and highlights that certain populations are especially vulnerable to hypoglycaemia – children and teenagers with Type 1 diabetes, the elderly, hospital patients and pregnant women. One of its recommendations is that blood glucose level targets should be individualised based on the patient's age, life expectancy, other conditions present, patient preferences and how hypoglycaemia might affect the person's life.

Hypoglycaemia and family carers

Group discussions conducted by IDDT with people with diabetes and unrelated family carers - both partners and parents - highlighted that the whole issue of carers and their role in diabetes was a source of conflict and there were some marked disagreements between some of those with diabetes and some family carers.

It was generally accepted by those with diabetes and by the carers that where long-term complications of diabetes were present, the carer would fit into the 'normal' caring role. The conflicts seemed to be present when the adult/child/teenager with diabetes is healthy and leading an independent life.

Below is a summary of the discussions which are important because they perhaps represent views, experiences and conflicts of many families who live with diabetes.

People with diabetes:

- Some fiercely defended their independence and could not see a need for the involvement of their family carer while others seemed quite happy to accept their partners as carers both in the provision of meals and the early recognition of hypos.
- Some expressed resentment that a carer should even consider being included in a hospital visit and could not understand that

their partners may have their own fears and needs for information and support.

- Some expressed concerns that an involved partner might be judgmental.
- There was general acceptance that a carer is needed for moderate or severe hypos.

Carers, partners and parents expressed the following:

- Feelings of being excluded and uninformed.
- Fears of hypos especially severe ones and those occurring during the night. Fears of the responsibilities and making decisions eg when to call the doctor in emergency.
- Parents expressed many of the same feelings, especially during the teenage years but they also had additional fears about the psychological impact of hypoglycaemia on their child with diabetes and any other children in the family.
- Parents also said that diabetes caused marital and family conflicts and that the worry about hypos, especially at night, was a major problem.

Quote from a carer: "It's as if it is OK for me to sort out the hypo but all the rest has nothing to do with me. I feel used and trapped."

Quote from a sibling: "My memories of my sister's hypos are of us arguing and getting angry – she was given sugar and was fine in 10 minutes while I was left still feeling angry."

Is hypoglycaemia dangerous?

Hypoglycaemia can affect people's work, relationships, ability to drive and their whole quality of life but there are two main aspects to the question of whether it is actually dangerous:

- Severe untreated hypoglycaemia leads to coma with or without an accompanying seizure and this can occasionally lead to death. Studies in both the UK and the US have shown the estimated deaths from hypoglycaemia to be between 4 and 13% of the total number of deaths in insulin treated people.
- There is growing evidence that repeated moderate/severe hypoglycaemia can cause a reduction in cognitive function. This is of special concern in children where the brain is still developing. Some research has suggested that repeated hypoglycaemia in children can reduce the IQ by 5 or 6 points which does not sound very much but one researcher suggested that this could mean the difference between getting a university place and not. [See Useful Research item 8 of contents]
- Loss of warnings of an impending hypo can be classed as dangerous because it can result in more episodes of hypoglycaemia with all the consequent risks.

Hypoglycaemia and alcohol

Alcohol can cause delayed hypos in people with Type 1 diabetes - low blood sugars the day after drinking even modest amounts of alcohol the previous evening. Research carried out at the Royal Bournemouth Hospital [Diabetes Care, July 2005] has shown that alcohol has been implicated in up to one fifth of hospital visits for hypoglycaemia, low blood sugars. The researchers investigated the effect of evening alcohol in 16 people with Type 1 diabetes who had normal hypo warnings and who drank alcohol on a regular basis. The participants were evaluated with continuous blood glucose monitoring on two occasions - after taking orange juice and vodka or just orange juice followed by the same meal and same dose of insulin. They experienced 1.3 episodes of hypoglycaemia per day during the 24 hours after the alcoholic drink compared to 0.6 episodes after a non-alcoholic drink. The researchers suggest that this research may

encourage people to be more 'proactive' in adjusting their insulin appropriately if they are drinking alcohol.

Just a few words of warning:

- Try to learn how alcohol affects you and learn the best ways to cope with it.
- It is always best to drink with a meal and to tell someone you are with that you have diabetes.
- You should not assume that because some drinks contain carbohydrate that this will counteract the hypo risk because it doesn't.
- Low carb alcoholic drinks such as Pils contain more alcohol - so not a good idea!
- The warning signs of hypos can be missed with too many drinks and other people may mistakenly think that you are drunk rather than you are hypo.
- Carry out more blood glucose tests to check for hypos for at least the next 24hours

Useful findings from research

- It is possible to maintain near normal blood glucose levels with HbA1cs of less than 7% [52mmol/mol] without increasing the frequency of severe hypoglycaemia providing patients have an understanding of the way insulin works and they receive education to be able to make appropriate decisions about insulin dose based on blood glucose monitoring and eating patterns.
- Patients with hypo unawareness should be treated with short-term meticulous avoidance of hypos. This can reverse the abnormalities of responses to symptoms hormonal counter-regulation and brain cognitive function, therefore decreasing the risk of severe hypoglycaemia.
- The only reliable predictors of severe hypoglycaemia are a history

of previous severe hypoglycaemia, a history of hypoglycaemia-related injury or convulsion and the duration of insulin treatment.

- People that reported at least one hypoglycaemia episode a month had a poorer quality of life. With the emphasis on reducing blood glucose levels, the impact that hypoglycaemia may have on quality of life may be overlooked.
- Spouses/partners of people with Type 1 diabetes showed no differences in depression, anxiety and general marital conflict when there had not been a recent episode of severe hypoglycaemia. However, when there had been a recent history of a severe hypo, both male and female spouses/partners showed significantly more fear of it, marital conflict about diabetes management and sleep disturbances.

Useful findings from research in children

- In children with Type 1 diabetes a significant reduction in attention was found at mild hypoglycaemia but also at low normal blood glucose levels, so attention deficits may occur in children with diabetes before they are aware of any hypo symptoms.
- There are no effects the next day on children after a night hypo but there may be a decrease in wellbeing and low mood.
- Studies show no association between neurocognitive test scores and severe hypoglycaemia but that the children with a history of seizures had lower scores on tests assessing memory skills including short term memory and memory for words. Medical management should be directed at the prevention of frequent recurring, mild and severe hypoglycaemia.

It is for all these reasons, and more, that IDDT believes that natural pork and beef insulin must remain available indefinitely. The most common reported adverse reaction to 'human' insulin is loss of warnings of hypoglycaemia, which in many people regresses with a change to natural pork or beef insulin. For this

sub-group of people it is essential that the choice of animal insulins remains available to ensure that they do not suffer unnecessary and avoidable hypoglycaemia.

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