

How to improve the management of people with hyperosmolar hyperglycaemic state

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Article points

1. Hyperosmolar hyperglycaemic state (HHS) is an under-recognised form of hyperglycaemia that occurs in people with type 2 diabetes.
2. More needs to be done to raise awareness of the condition and to encourage a more widespread implementation of the national guidelines.
3. HHS onset occurs over a long period of time, culminating in dehydration and metabolic disturbances with hyperglycaemia.

Key words

- Diagnosis and management
- Hyperosmolar hyperglycaemic state
- Type 2 diabetes

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This article discusses hyperosmolar hyperglycaemic state (HHS), which is an under-recognised form of hyperglycaemia that occurs in people with type 2 diabetes. It can be mistaken for hyperglycaemia, which means insulin is often given as the first-line treatment; this often causes more harm than good. The article gives an overview of its precipitating factors, its prevalence and how to diagnose and manage it in the acute stage and during follow up. It also discusses the barriers to implementing the national guidelines for its management that were outlined by the Joint British Diabetes Societies in 2012. The aim is to increase awareness of the condition and improve patient care by encouraging more widespread use of the national guidelines.

Hyperosmolar hyperglycaemic state (HHS) is a form of hyperglycaemia that occurs as a medical emergency in people with type 2 diabetes. It is under-recognised even among diabetes inpatient specialist nurses (DISNs) and, as a result, it is often poorly managed. At the DISN national conference in October 2013, the Joint British Diabetes Societies (JBDS) guidelines for the management of HHS in adults with diabetes (JBDS, 2012) were discussed. Interestingly, many of the delegates were unaware of the guidelines and in a recent survey undertaken by the JBDS, 50.6% of the respondents had not adopted the guidelines for local use (Dhatariya, 2013).

The danger is that if guidelines are not followed, HHS will often be mismanaged and mistaken for normal hyperglycaemia and treated with intravenous insulin, which can prove to be disastrous. It is clear that more needs to be done to raise awareness of the condition and to encourage a more widespread implementation of the guidelines.

HHS: An overview

HHS is a medical emergency that only occurs in people with type 2 diabetes. It requires urgent, specialised management and care to reduce its morbidity and mortality. A precise definition of HHS does not exist, although there are characteristic features that set it apart from other hyperglycaemic states. These are:

- Marked hyperglycaemia (30 mmol/L, sometimes exceeding 60 mmol/L), without significant hyperketonaemia (<3 mmol/L) or acidosis (pH >7.3, bicarbonate >15 mmol/L).
- Hypovolaemia.
- Osmolality, usually 320 mOsmol/kg or more (JBDS, 2012).

Its onset occurs over many days or weeks, culminating in extreme dehydration and metabolic disturbances, with hyperglycaemia. Unlike diabetic ketoacidosis (DKA), the person with HHS is not usually ketotic or acidotic (JBDS, 2012). In some individuals, a mild acidosis (pH greater than 7.3) may be secondary to acute renal failure. People with

HHS are nearly always dehydrated and uraemic, which leads to drowsiness and confusion, or even unconsciousness. The confusion is often transient, but it can make it difficult to ascertain the sequence of events that has led to hospital admission. It has been suggested that cognitive impairment will correlate with the degree of hyperosmolality (Daugiradis et al, 1989).

HHS may occur due to precipitating factors such as infection, steroid therapy or omission of prescribed diabetes medication. The typical individual affected is an older person or middle-aged and they will have felt generally unwell over the previous couple of weeks. These individuals often suffer from malnutrition, as they may have felt too ill to eat. Dehydration is noticeable by dry mucosa, sunken eyes and tenting of the skin. Tachycardia may develop due to hypovolaemia and the individual is usually hypotensive. HHS may be the first presentation of type 2 diabetes.

Mortality associated with HHS is estimated to be about 15–20%. Although there are no recent figures published in the UK, it is thought there are higher rates in older people with comorbidities (Chung, 2006). With the increase in the numbers of people developing type 2 diabetes at a younger age, we will inevitably see more episodes of HHS in younger people.

The longer a person has had diabetes the more likely they are to have the chronic complications. Older people who live alone may be socially isolated and morbidity may go unnoticed. The frail older person requires regular review of their well-being, glycaemic control, renal function, liver function and cognitive assessment, as their condition can change rapidly. In older age, the thirst and appetite response is reduced so this group of people may not be eating regular meals and they may also give an unreliable history of their food intake (Sinclair, 2009). In addition to this, it has been reported that 30–50% of people with long-term conditions do not take their medications as prescribed (WHO, 2003) and people who are in a confused state can easily forget to take medication.

Complications

Cardiovascular complications, such as stroke, thrombosis or myocardial infarction, are the

more common complications of HHS and more research is required to ascertain whether thrombolytic prophylaxis can reduce this risk. Less common complications of HHS include seizures, cerebral oedema and central pontine myelinolysis (JBDS, 2012).

People with HHS have an increased risk of arterial and venous thromboembolism (Keller, 1975). The risk of venous thromboembolism is greater than in DKA, as people affected are generally older and less mobile (Petrauskiene et al, 2005). All patients should receive prophylactic low molecular weight heparin throughout their admission and care should be taken as people with HHS are often at increased risk of haemorrhage. Full anti-coagulation is not usually necessary (JBDS, 2012).

Managing HHS

Senior medical staff should be involved in managing people with HHS. It is recommended that the condition is managed in an intensive care unit or in a well-staffed monitored ward because people with HHS require a high level of care (JBDS, 2012). The diabetes team should be involved at the earliest opportunity to avoid misdiagnosis and potentially harmful treatment with fluids and insulin.

Immediate care should focus on normalising the osmolality brought about by extreme dehydration and electrolyte loss (see *Figure 1* overleaf). Rehydrating the individual will reduce the blood glucose level without the need to give insulin, as insulin can lead to hypoglycaemia. Insulin is not given initially to avoid rapid shifts in fluids/solutes between the extracellular and intracellular compartments, which can lead to cardiovascular shock and cerebral oedema.

People with severe dehydration may present with tachycardia and hypotension due to hypovolaemia (Kavouras, 2002). They may also be hypoxic and hypothermic. A rapid change in osmolality is dangerous; it is advised to use 0.9% sodium chloride as the principle fluid to restore circulating volume and reverse dehydration (JBDS, 2012). Calculation should be undertaken every hour initially to aid adjustment of the rate of fluid replacement necessary to bring about a gradual decline in osmolality (JBDS, 2012). The

Page points

1. People with hyperosmolar hyperglycaemic state (HHS) are nearly always dehydrated and uraemic, which leads to drowsiness and confusion, or even unconsciousness. The confusion is often transient but it can make it difficult to ascertain the sequence of events that has led to hospital admission.
2. HHS may occur due to precipitating factors such as infection, steroid therapy or omission of prescribed diabetes medication.
3. Cardiovascular complications, such as stroke, thrombosis or myocardial infarction, are the more common complications of HHS and more research is required to ascertain whether thrombolytic prophylaxis can reduce this risk. Less common complications of HHS include seizures, cerebral oedema and central pontine myelinolysis.

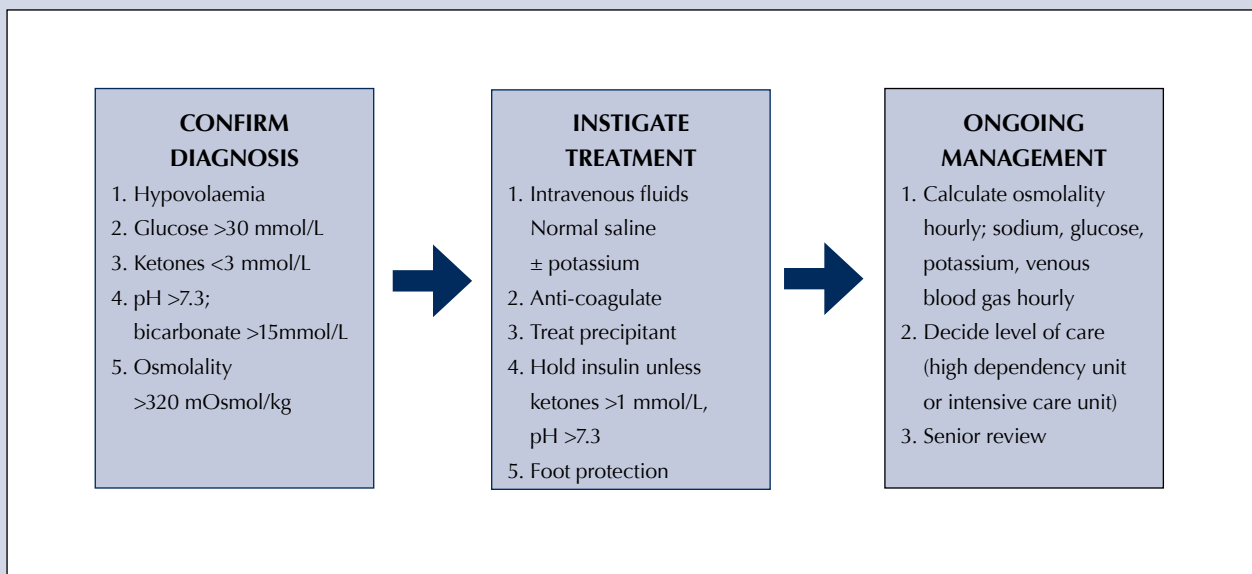


Figure 1. Initial management of hyperosmolar hyperglycaemic state (within first two hours).

process of reducing the osmolality may take up to 72 hours and the goal should be a reduction in blood glucose of 5 mmol/L per hour. Only when rehydration has been achieved and the blood glucose level is no longer dropping should insulin be considered.

Insulin may be started using a fixed-rate intravenous insulin infusion (FRIII) given at a rate of 0.05 units per kilogram per hour (JBDS, 2012). Once the individual is eating and drinking, subcutaneous insulin should be initiated. This can be reviewed following a period of stability and it may be possible for the person to be controlled on oral anti-diabetic agents (JBDS, 2012).

The aim of treatment is to replace approximately 50% of fluid loss within the first 12 hours and the remainder in the following 12 hours, although this will depend on the whole clinical picture (for example, the replacement will be slower if the person has heart failure). Heart failure is not an indication to stop hydration. The person may need inotropic support in a high dependency unit in order to continue hydration.

The importance of clearly and accurately documenting the person's fluid balance at this stage of their management cannot be overestimated. People with HHS are potassium deplete; however potassium shifts are less pronounced than with DKA.

The JBDS guidelines state the following

recommendations for fluid balance:

- More than 5.5 mmol/L: Administer no potassium
- 3.5 mmol/L to 5.5 mmol/L: Administer 40 mmol/L potassium
- Below 3.5 mmol/L: Senior review is necessary as further potassium is needed (JBDS, 2012).

People with HHS are at high risk of foot pressure ulceration, as many will have neuropathy or peripheral vascular disease. An initial foot assessment should be undertaken and heel protectors should be provided after which feet should be examined daily (JBDS, 2012).

Discharge and follow-up

As the individual recovers, it is important to discuss the sequence of events leading to the episode of HHS in order to educate them how to avoid the situation in the future. The aim of care is to promote independence and self-management, and self-administration of insulin using an appropriate regimen. Use of an insulin pen device should be encouraged. They will also need to monitor their blood glucose levels using a suitable device. If the individual is not able to administer the insulin safely then they will need support from their district nurse. Written information should be provided to reinforce the message and for the person to refer to after discharge. A busy ward is not the ideal learning environment so it may be necessary to arrange for frail or older

people to have initial support from the diabetes nursing team in an outpatient setting to provide structured education at a pace suited to their individual needs.

With the constant pressure on hospital beds and the push to discharge patients, initiatives such as a discharge phone call to the person, their carer or district nurse – instead of a ward visit – can promote a safer discharge and help to prevent readmission. There should be good communication between the DSN and the GP to advise on treatment changes, education and follow-up plans.

Barriers to implementing guidelines

When attendees at the DISN national conference in 2013 discussed the barriers to implementing the HHS guidelines in hospitals, they identified several themes. Time was identified as a reason for the non-implementation of the guidelines locally. Although the guidelines are national, there can be administrative barriers to local introduction as they have to be converted to local formats and be accepted by clinicians before they can be implemented. In the current climate this can be complicated particularly in Trusts where hospitals have amalgamated and more than one group of diabetes specialists are involved. The HHS guidelines (JBDS, 2012) are not evidence based but reflect the expertise and experience of a wide range of experienced clinicians from diabetes nursing and medical disciplines. It is possible that the lack of gold-standard evidence is a reason why clinicians do not always use the guidelines and this may also encourage more local interpretation of the guidelines.

HHS is under-recognised and therefore under-treated and mismanaged. If the condition is considered rare then preparing protocols and adopting guidelines may not be prioritised. There is a lack of evidence-based literature identifying optimal treatment plans, so the current guidelines should be welcomed.

Staff must be trained in HHS management if we are to improve care for this group of people. Using a simulation suite is particularly useful as the doctors and nurses can be filmed managing a person with HHS and their performance can subsequently be analysed.

Conclusion

The key to demystifying and improving the management of this condition lies in the education of both people with diabetes and hospital staff. The majority of people admitted with HHS are older. We need to find time to talk to these individuals despite the pressure to discharge people quickly. Too much information while in hospital can be confusing and it may be better to talk with these people with their carers or relatives at an outpatient clinic, where more time can be taken.

Awareness of HHS needs to be improved and it needs to be diagnosed and managed correctly. The easiest way to do this is through training professionals and encouraging the implementation of the guidelines. ■

Page points

1. It is important to educate the individual when they are discharged to help them prevent a repeat episode of hyperosmolar hyperglycaemic state (HHS).
2. Barriers need to be overcome in order to implement the national guidelines at a local level.
3. Staff need to be educated about HHS so that it is not misdiagnosed or mismanaged.

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