

Adult diabetic ketoacidosis: Diagnosis, management and the importance of prevention

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Citation: Mills LS, Stamper JE (2014) Adult diabetic ketoacidosis: Diagnosis, management and the importance of prevention. *Journal of Diabetes Nursing* 18: 8–12

Article points

1. Diabetic ketoacidosis (DKA) is a life-threatening complication of type 1 diabetes.
2. DKA can progress rapidly and requires immediate medical attention. Readmission to hospital is common.
3. DKA is largely preventable with good self-management. People with diabetes require solid education to help them prevent occurrence and recurrence.

Key words

- Diabetic ketoacidosis
- DSN role
- Illness management
- Prevention

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Diabetic ketoacidosis (DKA) is a life-threatening complication of type 1 diabetes that progresses rapidly and requires immediate medical attention. This article discusses the prevalence of DKA and the implications, including repeated episodes of DKA and longer stays in hospital. It covers the diagnosis and management of the condition and also emphasises the importance of preventing its occurrence and recurrence by educating people with type 1 diabetes about self-management and recognition of the first signs of illness as soon as they have their initial diabetes diagnosis. The role of the DSN within the wider clinical team is discussed and suggestions are made for measures that can be put in place to aid education about self-management and prevention of this often avoidable complication.

Diabetic ketoacidosis (DKA) is a life-threatening complication of type 1 diabetes. It is the most common cause of mortality in people under the age of 40 with type 1 diabetes (Wilson, 2012). It is characterised by persistently high blood glucose levels and it occurs when there is not enough insulin for the body to function normally. The body reacts by breaking down body tissues to be used for energy as an alternative to glucose. The acidic ketones that build up as a result become poisonous.

Incidence

The annual incidence of admissions for people with DKA is high. Between April 2010 and March 2011, 8472 people who were included in the national diabetes audit were admitted to hospital for DKA at least once (Health and Social Care Information Centre, 2012). It has been found that people who have been admitted with DKA are 2.764 times more likely to die in the following 21 months than other people with

diabetes (Health and Social Care Information Centre, 2012). DKA can progress rapidly and requires immediate medical attention.

It is thought that some diabetes-related admission events could be undocumented due to poor discharge coding. Price et al (2013) showed that as many as one in three hospital admissions involving people with diabetes were not coded as such in hospital episode statistics. It is, therefore, difficult to establish the actual rate of DKA in the UK.

Readmission rates for DKA are also high, with statistics showing that an average of 31% of people are readmitted with DKA within a year of their initial admission (Joint British Diabetes Societies [JBDS] Inpatient Care Group, 2010).

The 2012 national inpatient audit showed that the prevalence of one or more hospital admission for DKA was 3.32% for people with type 1 diabetes (Health and Social Care Information Centre, 2013) and that for all inpatients admitted specifically for the

management of diabetes, 13.6% were for DKA (Health and Social Care Information Centre, 2013). This audit also highlighted that there were longer bed stays for diabetes emergencies compared with planned admissions.

DKA is possible to prevent. Laffel et al (2005) reported that an estimated 50% of all hospital admissions with DKA could be prevented with improved outpatient treatment and better self-care. The guidance from JBDS stresses the importance of prompt diagnosis and intensive management.

Diagnosis

DKA is characterised by insulin deficiency and increasing blood glucose production in the liver. Enhanced fat breakdown then increases levels of serum-free fatty acids, which are metabolised producing large quantities of ketones and metabolic acidosis (Savage and Hilton, 2010). It can present in someone with a new diagnosis or indeed be a predisposing illness in someone with an existing diagnosis of type 1 diabetes; DKA is rare in people with type 2 diabetes.

DKA usually occurs as a consequence of absolute or relative insulin deficiency that is accompanied by an increase in counter-regulatory hormones, such as glucagon, cortisol, growth hormone and catecholamines. A person with DKA may typically present with symptoms of dehydration, nausea and vomiting, hyperglycaemia and raised ketones. There may also be pyrexia or drowsiness. Medical conditions that may cause DKA are shown in *Box 1*. The clinical features that are key to early detection are shown in *Box 2*. These are the baseline criteria for diagnosis of DKA.

It is important to note that certain groups of people are at greater risk of developing DKA, such as those with eating disorders and/or mental health issues. DKA is also more common in young people (Saunders, 2013)

The survival of people with DKA can depend on the ability of the individual and the professional to recognise its signs and symptoms.

Management and care

Despite the publication of the JBDS Inpatient

Care Group guidance for the management of DKA, care is not always optimal and, as Savage and Hilton (2010) documented:

“Errors in its management are common and associated with significant morbidity and mortality.”

Even when local hospital guidelines are available, the adherence to and the use of these can vary among the admitting team. The guidance clearly states that there is substantial evidence to support care models that aim to reduce the incidence of hospital admissions, excess length of stay and acute metabolic complications. The authors of the guidance also suggest that these models have been “low cost and value for money”. The JBDS state that

“The specialist diabetes team should always be involved as soon as possible and ideally within 24 hours because this has been demonstrated to be associated with a better patient experience and reduced length of stay.”

The JBDS guidance also encourages audit against defined standards.

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Box 1. Illnesses that may cause diabetic ketoacidosis.

- The common cold/virus
- Influenza or bacterial infections
- Stomach upset/gastroenteritis
- Urinary infection
- Chest infection
- Abscesses
- Injury

Box 2. Clinical features for diagnosis of diabetic ketoacidosis.

- Ketonaemia (3 mmol/L and over), or significant ketonuria (more than 2+ on standard urine sticks).
- Blood glucose over 11 mmol/L or known diabetes mellitus.
- Bicarbonate below 15 mmol/L and/or venous pH less than 7.3.

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1. Any individual who becomes unwell should be advised to seek prompt medical treatment. The general rule is that any child or pregnant woman, or any person who is unable to keep fluids down, should be admitted to hospital as a priority.
2. Blood glucose and ketone monitoring should be carried out more frequently; this may require testing glucose levels pre- and post-meals, and ketone levels if glucose levels are above 13 mmol/L.
3. Prevention of DKA relies on the individual understanding the physiology and treatment of “red flag” symptoms. Commonly termed as “sick day rules” or illness management, this is a set of guidance and instructions fundamental to the education of any person with type 1 diabetes.

Any individual who becomes unwell should be advised to seek prompt medical treatment. The general rule is that any child or pregnant woman, or any person who is unable to keep fluids down, should be admitted to hospital as a priority (James, 2013). If they are unable to eat normally, carbohydrates should be replaced with soups or liquid carbohydrates. Withholding carbohydrates due to high glucose levels may worsen blood ketone levels. Plenty of sugar-free liquids should be encouraged and, if the person is vomiting and unable to tolerate liquid carbohydrates, medical attention should be sought immediately. As a rough guide, the person should try and take 2–3 servings of carbohydrates approximately 4–5 times a day. They should also be encouraged to drink at least 2.5–3.5L of sugar-free fluid in 24 hours in order to avoid dehydration (TREND-UK, 2013).

Insulin should continue to be taken even if the individual is not able to eat normal amounts of food. The dose may even need to be increased during the episode of DKA.

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Caring for people after an episode of DKA

Once the cause of the DKA episode is identified, it is important to consider if this illness could have been managed in a different way. This could be discussed with the individual in an open and non-judgemental way. It may have been many years since the person has seen a member of the diabetes team and they may have forgotten what they learnt then, hence the need to re-enforce this education at each review with a healthcare professional.

The specialist team need to establish if the person who has repeated admissions with DKA has any underlying issues. It is well documented that at least one-third of people with DKA has additional health needs, such as eating disorders, or they may have compliance issues

and social, domestic or psychiatric problems (Hurel et al, 1997). Where possible, the underlying cause of DKA should be investigated and education and support should be provided (Jerreat, 2010). NICE (2011) states clearly that there should be local arrangements to ensure that people admitted to hospital with DKA receive educational and psychological support prior to discharge and are followed up by a specialist diabetes team.

Preventing DKA

Prevention of complications and empowerment of the individual with diabetes remains the cornerstone of any self-management plan. Prevention of DKA relies on the individual understanding the physiology and treatment of “red flag” symptoms. Commonly termed as “sick day rules” or illness management, this is a set of guidance and instructions fundamental to the education of any person with type 1 diabetes.

This education should begin at the initial diagnosis. When a person is diagnosed with diabetes, consistency and agreement by the specialist team is key to providing a solid knowledge base. As the importance of sound education and advice can never be underestimated, the diabetes team should evaluate the structure followed in any new person’s education, with particular regard to illness management. At the same time, regular review should be undertaken regarding the adherence to the locally agreed DKA guidelines used within the hospital.

Education about self-managing diabetes in order to prevent DKA is essential to reduce the risk of developing this acute illness. Good self-monitoring and regular insulin doses according to need are the primary preventive measures for the condition.

With the availability of blood ketone meters, there is now compelling evidence to support the use of this technology for diagnosis and management of DKA (Klocker et al, 2013). Frequent repeated measurement of blood ketone levels is also a practical option for people to use to assist with early detection of rising ketone levels and developing DKA. Evidence seems to

point towards insulin management behaviour as the most common causal factor. A study by Morris et al (1997) involved an objective assessment of insulin management behaviour and indicated that 28% of young adults (15–25 year olds) with type 1 diabetes did not collect sufficient amounts of prescribed insulin to follow their treatment regimens. This behaviour also predicted admission for DKA.

Open discussions about the causation and associated problems is of paramount importance in the prevention of recurrent DKA and should be high on the healthcare professional's agenda. Steps that can be easily incorporated into routine care can prevent the emergence of DKA and people in the diabetes team must learn to identify psychopathologies as soon as possible (Skinner, 2002).

Illness management should be discussed at diagnosis and then at least annually, and there should be the opportunity to discuss, advise and assess the individual's understanding of how to prevent the risks of developing DKA. Those younger people who are at a higher risk of DKA should be carefully monitored, particularly if they have had a previous admission with DKA, are known to have an eating disorder or have been treated for depression.

All healthcare professionals involved in diabetes management should consider the following measures to prevent and manage DKA:

- Review of education, including a post-DKA assessment.
- Maintenance of skills and knowledge in the professional team.
- Standard agreement of all information and resources given to the person with DKA.
- Regular audit of care and adherence to agreed protocols.

Heller et al (2012) suggest that the increased mortality among those aged 15–30 years with diabetes – which was nine times higher in young men with diabetes than without diabetes – is alarming and reflects ineffective self-management among younger people with diabetes. Therefore, it is important that healthcare professionals are able to deliver complex interventions to ensure that these

vitaly important messages reach younger people. This can be done in a variety of ways:

- Structured education.
- One-to-one consultations.
- DKA review methods (pre-discharge), for example, ensuring individuals understand illness management and are competent self-managing and administering insulin.
- Out-of-hours advice.

All people with type 1 diabetes should be educated about self-management. A greater challenge is making sure that educational messages are understood. Saunders (2013) has commented on how inadequate education and the lack of understanding increases the risk for developing DKA.

The role of the DSN

The DSN is crucial in supporting independence and in helping people self manage their diabetes more effectively. DSNs are in a position where they have direct regular access to the person with diabetes. They can apply specialist and specific knowledge and skills to manage physical and psychological morbidity, and help to alleviate physical and psychological problems inherent in a long-term condition. They can help coordinate complex care and refer on to other professionals as part of the multidisciplinary team, particularly within the community services. They can provide people with diabetes with approachable, knowledgeable, accessible and professional support (Royal College of Nursing, 2010).

Adequate and appropriate skill mix is important to the dynamics of any team. In this instance, this will include the DSN, diabetologist and the specialist registrar. The JBDS Inpatient Care Group (2013) recommends that the specialist team must always be involved in the care of those admitted with DKA and in the assessment of precipitating factors, DKA management, discharge and follow up. The role of the DSN is multifactorial. In the TREND-UK publication *An Integrated Career and Competency Framework for Diabetes Nursing* (2011) it is suggested that experienced and senior nurses will be expected to provide expert advice to people with DKA and participate

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3. The DSN is crucial in supporting independence and in helping people self-manage their diabetes more effectively. They can apply specialist and specific knowledge and skills to manage physical and psychological morbidity.

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in the formulation of local guidelines and protocols. Through clinical practice, the DSN can demonstrate knowledge and skills to both promote the safety and wellbeing of people with diabetes, and acknowledge any potential gaps in service provision. TREND-UK also advocate active participation in peer review of one’s own practice (2011).

Specialist teams have the evidence that robust protocols can treat DKA successfully. The role of the DSNs is such that they can influence care and potentially prevent re-admissions. Local incident reporting will, in part, assist in the review of the effectiveness of national guidance. Using skills, knowledge and dedication to the promotion of health and wellbeing, the DSN can be instrumental in the treatment and prevention of DKA.

Conclusion

DKA is an acute complication of diabetes, which can require hospital admission and requires prompt action and treatment. The healthcare professional should ensure that they have the ability to provide support and education to people at risk of developing DKA and those that have had an episode of DKA; it is important to re-enforce the ongoing education to help reduce both the initial occurrence and recurrence of this often preventable life-threatening condition. ■

Acknowledgements

With thanks to Alex Williams, Librarian, Knowledge and Evidence Service, Warrington and Halton Hospitals NHS Foundation Trust

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