

Prevention of hypoglycaemia in children

Intensive therapy in type 1 diabetes has often been associated with an increased risk of severe hypoglycaemia, and nocturnal hypoglycaemia (recognised and unrecognised) is common in adults and children. Many clinicians have perhaps accepted this situation too easily, in part, because they are often unaware how frequently their patients experience hypoglycaemic episodes, but also because prevention strategies have far too often been based on anecdote.

Paediatricians have perhaps been more conscious of the risks of severe hypoglycaemia, especially in the very young, because of the potential for causing long-term cognitive impairment, though the literature on this topic is sparse. In the study by Hannonen and colleagues, children with type 1 diabetes and a past history of severe hypoglycaemia were compared with children with diabetes but no history of severe hypoglycaemic episodes and a control group who did not have diabetes. Children who had experienced severe hypoglycaemia had more learning difficulties and were more likely to need special education compared with the other two groups. Children with diabetes, but no history of severe hypoglycaemia had slightly poorer auditory-verbal skills than the children without diabetes.

This study is still relatively small but the results are in keeping with past clinical findings, that severe hypoglycaemia can be associated with learning difficulties. Previous studies have suggested that children under 5 years are more susceptible to hypoglycaemia but the present study was too small to determine whether the neurocognitive differences are due to hypoglycaemia or the age of onset of diabetes on the developing brain.

These findings could well result in making clinicians even more suspicious of tight glycaemic control in children but the study by Norfeldt and colleagues shows that with an appropriate intervention (in this case written educational material and videotapes) the incidence of severe hypoglycaemia could be reduced without a deterioration in HbA_{1c} levels.

Closed loop systems, in which continuous glucose sensors are linked to insulin infusion pumps are some way off and their widespread use is unlikely for years to come. People with diabetes, and children in particular, will therefore remain vulnerable to the effects of severe hypoglycaemia. Whilst these may be devastating to the developing brain, so too are the microvascular and macrovascular complications that occur in young adulthood if glycaemic control is poor. These two studies remind us both of the risks of hypoglycaemia but also offer a strategy for prevention.

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DEVELOPMENTAL MEDICINE AND CHILD NEUROLOGY



Cognitive impairment in children with severe hypoglycaemia

Readability	✓✓✓✓
Applicability to practice	✓✓✓✓
WOW! factor	✓✓✓✓

- 1 Much of the evidence for a long-term effect of hypoglycaemia on neurocognitive performance is based on adults with long-standing diabetes.
- 2 The aim of this study was to assess the effects of diabetes and severe hypoglycaemia on the neurocognitive functioning of children.
- 3 Eleven children with diabetes and a history of severe hypoglycaemia, 10 children with diabetes and without a history of severe hypoglycaemia, and 10 healthy controls were studied using the Wechsler Intelligence Scale for Children-Revised (WISC-R) and a Developmental Neuropsychological Assessment (NEPSY).
- 4 The WISC-R was used to assess general intelligence, whilst the NEPSY assessed development in attention and executive functions, language, sensorimotor functions, visuospatial processing, and learning and memory.

- 5 Children with diabetes who had experienced severe hypoglycaemia had significantly more neuropsychological deficits and learning difficulty, and they needed more special education than the other two groups of children.
- 6 Severe hypoglycaemia is a risk factor for learning due to deficits in auditory-verbal functioning.
- 7 Neuropsychological assessments should be done in children with diabetes to identify possible deficits in neurocognitive functioning.

Hannonen R, Tupola S, Ahonen T, Riiikonen R (2003) Neurocognitive functioning in children with type-1 diabetes with and without episodes of severe hypoglycaemia. *Developmental Medicine & Child Neurology* **45**: 262–68

ARCHIVES OF DISEASE IN CHILDHOOD



Self-study material could reduce hypoglycaemia

Readability	✓✓✓✓
Applicability to practice	✓✓✓✓
WOW! factor	✓✓✓✓

- 1 Patient education and active self control are essential in order to prevent severe hypoglycaemia in young people.
- 2 This study tested the hypothesis that self-study material for home use would reduce severe hypoglycaemia without worsening metabolic control as measured by HbA_{1c}.

- 3 A total of 333 children with type 1 diabetes were assigned to: intervention (videotapes and a brochure designed to review skills for self-control and treatment); control (videotape and brochure with general information about diabetes); and control (traditional treatment).

- 4 Yearly incidence of severe hypoglycaemia decreased from 42% to 27% in the intervention group but not in the controls. HbA_{1c} levels remained unchanged.

- 5 Mass distribution of self-study materials may contribute to the prevention of severe hypoglycaemia.

Norfeldt S, Johansson C, Carlsson E, Hammarsjo J-A (2003) Prevention of severe hypoglycaemia in type 1 diabetes: a randomised controlled population study. *Archives of Disease in Childhood* **88**: 240–45

‘The elevated rate of severe hypoglycaemia in patients with higher ACE levels suggests the existence of a genetic determinant for severe hypoglycaemia.’



DIABETES CARE

ACE levels predict hypoglycaemia

Readability	✓✓✓✓
Applicability to practice	✓✓✓
WOW! factor	✓✓✓✓

- 1 Prediction and prevention of severe hypoglycaemia have become increasingly important.
- 2 This study investigated whether risk of severe hypoglycaemia is related to serum angiotensin converting enzyme (ACE) levels during intensive treatment in children with type 1 diabetes.
- 3 HbA_{1c} levels, insulin doses, and events of severe hypoglycaemia were determined in 86 children with type 1 diabetes over a year. Serum ACE levels were measured once.
- 4 Serum hypoglycaemia correlated to serum ACE levels. Patients with serum ACE levels at the median level or above reported a mean of 3.0 yearly events of severe hypoglycaemia compared with 0.5 events in patients with serum ACE lower than the median.
- 5 The elevated rate of severe hypoglycaemia in patients with higher ACE levels suggests the existence of a genetic determinant for severe hypoglycaemia.

Nordfelt S & Samuelsson U (2003) Serum ACE predicts severe hypoglycaemia in children and adolescents with type 1 diabetes. *Diabetes Care* **26**: 274–78

‘Sleep may inhibit sympathetic and arousal response to hypoglycaemia. Rapid changes in glucose levels may result in awakening from sleep.’



THE JOURNAL OF PEDIATRICS

Interactions between sleep and hypoglycaemia

Readability	✓✓✓
Applicability to practice	✓✓✓
WOW! factor	✓✓✓

- 1 It is known that children with type 1 diabetes are at increased risk of hypoglycaemia during sleep, however, the mechanisms behind this are unclear.
- 2 Fifteen children with diabetes and 15 matched controls underwent full night polysomnographic recording.



DIABETES CARE

Safety of pump therapy in children

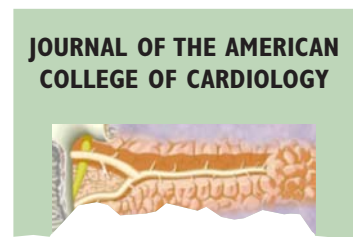
Readability	✓✓✓✓
Applicability to practice	✓✓✓✓
WOW! factor	✓✓✓

- 1 Insulin pump therapy has been used to treat diabetes since the late 1970s, but reports regarding safety and effectiveness are inconsistent.
- 2 HbA_{1c} levels, number of medical complications, and episodes of severe hypoglycaemia were assessed in 95 patients who had begun insulin pump therapy.
- 3 HbA_{1c} levels were slightly decreased 3–6 months after the start of pump therapy. Levels then gradually increased and remained elevated after 1 year of follow-up.
- 4 However, after adjusting for duration and age, mean HbA_{1c} was significantly lower than before the start of pump therapy.
- 5 There were fewer episodes of severe hypoglycaemia and no increase in diabetic ketoacidosis with pump use.
- 6 Pump therapy is safe and effective in selected children and adolescents with type 1 diabetes.

Plotnick LP, Clark LM, Brancati FL & Erlinger T (2003) Safety and effectiveness of insulin pump therapy in children and adolescents with type 1 diabetes. *Diabetes Care* **26**: 1142–46

- 3 Blood glucose levels were measured in all the children with diabetes, and six were also studied by peripheral arterial tonometry to assess sympathetic responses.
- 4 Five children with diabetes had hypoglycaemia during the night. Hypoglycaemia was associated with an increased sleep efficiency and slow wave sleep.
- 5 Sleep may inhibit sympathetic and arousal response to hypoglycaemia. Rapid changes in glucose levels, independent of absolute glucose levels, may result in awakening from sleep.

Pillar G, Schuschheim G, Weiss R et al (2003) Interactions between hypoglycemia and sleep architecture in children with type 1 diabetes mellitus. *The Journal of Pediatrics* **142**: 163–68



JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY

Hyperglycaemia has a key role in vascular dysfunction

Readability	✓✓
Applicability to practice	✓✓✓
WOW! factor	✓✓✓

- 1 This study examined if the type and severity of coronary vascular function associated with diabetes is similar in people with type 1 and type 2 diabetes.
- 2 The study group comprised 35 people with diabetes (18 type 1 and 17 type 2) who were free from overt cardiovascular complications, and 11 age-matched healthy controls.
- 3 Positron emission tomography imaging was used to measure myocardial blood flow at rest, during adenosine-induced hyperemia, and in response to cold pressor test.
- 4 The increase in myocardial blood flow with adenosine was similar in patients with type 1 and type 2 diabetes, but lower than in the controls.
- 5 Similarly, the increase in myocardial blood flow with adenosine and during the cold pressor test was similar in people with type 1 and type 2 diabetes, but lower than in the control group.
- 6 The reduced endothelium-dependent and independent coronary vasodilator function in people with type 1 and type 2 diabetes suggests a key role of chronic hyperglycaemia in the pathogenesis of vascular dysfunction in diabetes.

Di Carli MF, Janisse J, Grunberger G, Ager J (2003) Role of chronic hyperglycemia in the pathogenesis of coronary microvascular dysfunction in diabetes. *Journal of the American College of Cardiology* **41**: 1387–93