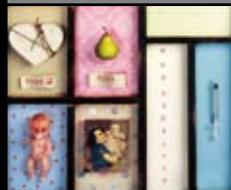




THEME

Diabetes



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Teenagers with diabetes

Management challenges

BACKGROUND

During adolescence major hormonal, neuro-maturational, emotional and psychosocial changes occur within a relatively short time interval. The additional burden of living with a chronic disease such as type 1 diabetes can further add to the potential for instability.

OBJECTIVE

This article discusses the specific management issues facing diabetic patients and their doctors in the teenage years.

DISCUSSION

Deteriorating metabolic control of diabetes during adolescence is a relatively common event. Increasing insulin resistance during adolescence is usual for both sexes. Adolescents may increasingly resent parental supervision of their diabetes care, and also rebel against the restrictive nature of diabetes treatment regimens with acceptance of medical advice and adherence to treatment regimens diminishing. Diabetes may interfere with conformity to a peer group and increase the likelihood of risk taking behaviours and fluctuating glycaemia may increase the likelihood of an adverse outcome. Physical risk taking, binge drinking, recreational drug use and unplanned sexual activity all present particular problems for adolescents with diabetes. Subthreshold eating disorders are more common in adolescent females with type 1 diabetes than in their nondiabetic peers. The most helpful thing for a health care professional to do is to maintain a mutually respectful relationship with an adolescent who is struggling to control their diabetes, encourage family support, and praise any improvements that the adolescent makes as he or she proceeds toward adulthood.

'Our adolescents now seem to love luxury. They have bad manners and contempt for authority. They show disrespect for adults and spend their time hanging around places gossiping with one another... they are ready to contradict their parents, monopolise the conversation in company, eat gluttonously and tyrannise their teachers'.

Socrates

The challenges of adolescence have been with us for some time. There may be some comfort in knowing that even ancient and great philosophers had no greater insight than contemporary parents and care givers. Adolescence can be seen as tectonic situation where psychological and physiological changes grind against each other, sometimes with no apparent consequence and at other times with cataclysmic

outcomes. During adolescence major hormonal, neuro-maturational, emotional and psychosocial changes occur within a relatively short time interval. These changes can have a major impact on the individual and their family. The extra burden of living with a chronic disease such as type 1 diabetes can further add to the potential for instability and turmoil. Longitudinal data indicates that by the time patients with type 1 diabetes reach adolescence, one in 3 will have a DSM-IV psychiatric disorder.¹

Diabetes outcomes through adolescence

Deteriorating metabolic control of diabetes during adolescence is unfortunately a relatively common event.²⁻⁵ Some of the reasons for worsening metabolic control include erratic meal and exercise patterns, poor adherence, deliberate risk taking behaviour, eating

disorders, maladaptive lifestyle practices acquired during adolescence, and endocrine changes associated with puberty, leading to greater insulin resistance.⁶⁻¹⁸ Studies^{5,19} have shown that females appear to be most likely to experience deterioration in metabolic control during this time.

Physiological changes that affect diabetes

Increasing insulin resistance during adolescence is usual for both sexes, accounting for the well recognised increasing total daily insulin requirement from less than 1 unit/kg/day to as high as 2 units/kg/day.²⁰⁻²² Central to the hormonal events of puberty is the growth hormone/insulin-like growth factor axis. Growth hormone (GH) is the counter regulatory hormone thought to be most responsible for increasing overnight insulin resistance, otherwise known as the 'dawn phenomenon'.²³ As overnight secretion of GH increases through puberty, increasing levels of morning hyperglycaemia are often the corollary. Some adolescent females may also experience cyclical fluctuations in glycaemia, often hyperglycaemia, immediately before menstruation.²⁴ Irregular menses and subsequent polycystic ovarian syndrome are sometimes seen in adolescent females with poor control and excessive weight gain.²⁵

Specific challenges for adolescents with diabetes

Risk taking behaviours

'If there would be no age between ten and three-and-twenty, or that youth would sleep out the rest; for there is nothing in the between but getting wenches with child, wronging the ancients, stealing (and) fighting'.

Shakespeare, A Winter's Tale

Neuro-maturation and impulse control are significant issues during adolescence. Adolescent actions can therefore at times be impulsive and seemingly without regard to consequence. Examples of this are physical risk taking, binge drinking, recreational drug use and unplanned sexual activity. The first of these (more often seen in males) may result in significant injury or, more tragically, deaths associated with distinctly adolescent activities such as 'train surfing', 'car joy riding' or graffiti writing in hazardous environments.^{26,27} Heavy alcohol intake, recreational drug use and sexual activity are also often impulsive. Physical morbidity, unwanted pregnancy, psychopathology and mortality may arise in this context through accidental overdose, ingestion of unknown and multiple agents, infection, and the combination of an altered sensorium with risk laden activity. Diabetes may

interfere with conformity to a peer group²⁸ and increase the risk and likelihood of risk taking behaviours.²⁹ In this context however, fluctuating glycaemia may increase the likelihood of an adverse outcome ensuing.

Nonadherence

'Children aren't happy with nothing to ignore,
And that's what parents were created for'.

Ogden Nash

'Parents are the bones upon which children
sharpen their teeth'.

Peter Ustinov

Adolescents may increasingly resent parental supervision of their diabetes care and also rebel against the restrictive nature of diabetes treatment regimens. Acceptance of medical advice and adherence to treatment regimens therefore tends to diminish during adolescence as teenagers become increasingly independent.⁸⁻¹¹ Reluctance to do more than a minimum of blood glucose tests, erratic meals and missed insulin doses are commonplace. There are a number of risk factors that are particularly associated with poor adherence including emotional disturbance, family dysfunction, poor school performance and difficult peer relationships.³⁰ While nonadherence during adolescence may appear entrenched and unlikely to improve, it is important for health care staff to remain dispassionate and nonjudgmental so as not to alienate their adolescent patients. Any improvement in metabolic control is to be lauded and a 'cup half full' rather than half empty perspective is often helpful.

Changing insulin regimens

Data from a state wide study in New South Wales showed that the majority of children with type 1 diabetes are prescribed twice daily insulin.³¹ The figures cited in this study are similar to our experience in Victoria. Most adolescents are encouraged to switch to basal:bolus (4 injection) regimens with an accompanying notion that this will increase flexibility of lifestyle. Unfortunately this change is often associated with deteriorating metabolic control and increasing weight gains, particularly in females.³² In particular, some adolescents struggle with having to self administer insulin in a school context and this may lead to deteriorating adherence. It would appear unlikely therefore, that the simple substitution of analogue insulins will lead to significant improvements in this area. Long term follow up data on the use of insulin pump therapy in this particular age group is still forthcoming. Our anecdotal experience in this age

group is similar to that of basal:bolus regimens, and that remembering to bolus dose appropriately remains the greatest challenge.

Sick day management

The principles of sick day management during adolescence are no different from those in other age groups. Intercurrent illness (most often infectious) may cause marked fluctuations in glycaemia with a vigorous immune or 'stress' response inducing insulin resistance and hyperglycaemia and vomiting/decreased oral intake potentially causing hypoglycaemia. The aim of sick day management is to prevent ketoacidosis and severe hypoglycaemia. There are numerous techniques that can be employed by families including 'mini dose glucagon rescue' and more frequent, extra doses of short acting insulin being given. A detailed description of these techniques is beyond the scope of this article, however useful information is available (see *Resources*). In the context of adolescence, sick day management protocols can also be used successfully during recovery phases of either alcohol or drug induced illness.

Sports

Participation in sporting activity for adolescents with diabetes is desirable for a number of reasons including positive impact upon self esteem and mental health, potential benefits to metabolic control, and prevention of excessive weight gain. Managing blood glucose levels during sporting activities however can be problematic. Short bursts of anaerobic activity may be associated with hyperglycaemia whereas long periods of aerobic activity may cause hypoglycaemia. Alternatively, swings in blood glucose levels may effect judgment and sporting prowess. While most sports are accessible to young people, some extreme sports where momentary loss of judgment could have dire consequences are best avoided (eg. scuba diving and solo hang-gliding). Other sports such as rock climbing, flying, motorbike/car racing, open water swimming and cross country skiing should be undertaken in company with someone who has a knowledge of hypoglycaemia therapy. There are several strategies to avoid hypoglycaemia during prolonged exercise including reducing the insulin dose before (this is a good strategy if the amount of exercise is predictable, eg. swimming) or having 'hypo' foods and drinks on hand (this is a good strategy if the degree of physical exertion is less predictable, eg. football). If patients are ketotic, sports are best avoided until the ketones have been cleared with increased insulin therapy. Patients must be reminded that the potential for hypoglycaemia exists for up to 12 hours after the activity if marked exertion has

occurred, as muscle glycogen stores are depleted. Therefore, if sporting activity occurs in the afternoon, special attention should be given to subsequent overnight glycaemia.

Pregnancy and sexual health

Counselling regarding sexual health for adolescents with diabetes varies little compared with their nondiabetic peers. Adolescents and young adults should be aware that hypoglycaemia can affect sexual performance (particularly by males) and that chronic hyperglycaemia can be associated with recurrent candidiasis (particularly in females). Contraception is a critical issue for all sexually active adolescents, but particularly so in the context of diabetes. It should be emphasised that great care needs to be undertaken to ensure optimal diabetes control in females before becoming pregnant in order to maximise the wellbeing of the fetus. Given that most adolescent females neither desire pregnancy nor have optimal diabetes control, contraception should be actively discussed. Low dose oestrogen containing oral contraceptive (OCP) agents are not contraindicated in type 1 diabetes, however, they should be used with caution as some recent long term data has suggested that sustained use of the OCP may be associated with a greater risk of nephropathy.³³

Eating disorders/body image

Increases in body mass index (BMI) frequently occur during adolescence, particularly in females. This often causes marked distress and may be coincident with the appearance of an eating disorder.^{13,14} Subthreshold eating disorders have been found to be almost twice as common in adolescent females with type 1 diabetes than in their nondiabetic peers.¹⁶ Many female adolescents with diabetes rapidly learn how to manipulate weight gains by altering insulin dosage.¹⁸ The combination of either anorexia nervosa or bulimia and diabetes can result in marked deterioration in metabolic control, multiple hospital re-admissions for either ketoacidosis or hypoglycaemia, early appearance of diabetes related complications, and considerable familial disruption. Increasing BMI in the absence of an eating disorder is also problematic. Recent longitudinal Finnish data showed that 33% of patients aged 18–33 years with type 1 diabetes were significantly overweight and that this was an independent risk factor for subsequent diabetic nephropathy.³⁴

Alcohol and recreational drug use

The adverse effects of recreational drug use in adolescents with diabetes are the same of those for their nondiabetic peers. In the context of type 1 diabetes however, there are four additional dimensions of illicit drug use that need

to be considered. These include: interaction between drug effects and body metabolism; effects of drugs upon motivation to maintain diabetes control; confusion between hypoglycaemia and intoxication; and added risk factors from smoking in respect to micro- or macrovascular disease. The context of recreational drug taking will also have a significant impact (eg. increased caloric intake with cannabis, associated rave dancing/frenzied activity with ecstasy or methamphetamine, vomiting with alcohol binging). Therefore the effects upon glycaemia are not only drug but context dependent and it is hard to be dogmatic when counselling adolescents about generic harm minimisation strategies. At a basic level we recommend having a decent meal before going out and checking blood glucose levels as often as possible during the night, but particularly before going to bed. The credibility of any advice from medical experts will depend upon an up-to-date knowledge of recreational drug taking mores/activities and a nonjudgmental, realistic approach (see *Resources*).

Microvascular complications

The incidence of microvascular diabetic complications is fortunately low in the adolescent age group. Recent studies from both the Royal Children's Hospital in Melbourne and Westmead Children's Hospital in Sydney have shown incidence rates of 0.7–2.0% for mild, nonproliferative retinopathy and 2.0–3.0% for persistent microalbuminuria.^{35,36} There were no adolescent patients showing evidence of either macroalbuminuria or proliferative retinopathy in either group. Notwithstanding this, it is often during adolescence that patients commence routine diabetes related complication screening and hence increasingly start to think about this aspect of their overall health. Some patients will use this as a motivational tool while others may become depressed about their long term outlook. Many patients may show little outward interest, regarding diabetes related complications as irrelevant to them and something that 'only happens to old people'.

Transition

Transition of adolescent to adult diabetes care services should coincide with a major degree of autonomy in self care by the young adult in question. Unfortunately the process of successful transition from a paediatric or adolescent clinic to an adult program often remains suboptimal. Anecdotally we experience significant drop out rates during the process of transition despite transition workshops and active collaboration with other adult diabetes services. Adolescents should be made aware of the different adult clinics available to them and the

practice style of those clinics. In some centres, specific young adult clinics are provided. These clinics are often staffed by a combination of both paediatric and adult diabetes specialists. Unfortunately, if transition is not made successfully and patients are lost to ongoing specialist care, diabetes control usually deteriorates markedly, maladaptive lifestyle practices become further entrenched, and the early appearance of diabetes related complications frequently results. It is during this period that the greatest risk for sudden death exists³⁷ and therefore the time at which the greatest efforts should be made in ensuring that patients are not lost to follow up.

'The denunciation of the young is a necessary part of the hygiene of older people, and greatly assists in the circulation of the blood'.

Logan Smith, Oxford Scholar 1865–1946

'I have found the best way to give advice to your children is to find out what they want and advise them to do it'.

Harry S Truman 1884–1972

Positive therapeutic approaches

Education about diabetes and its management had been widely advocated as the answer to some of the maladaptive lifestyle practices adopted by adolescents. Unfortunately there is little evidence to suggest a link between knowledge and health behaviour in adolescents.³⁸ Alternatively positive role modelling, diabetes camps, buddy systems and peer counselling are approaches gaining increasing usage within paediatric diabetes clinics. Techniques that encourage resiliency life skills are also gaining interest from some clinicians who deal with adolescents and chronic disease, although specific diabetes research in this field is lacking.

Perhaps the most helpful thing for a health care professional to do is to maintain a mutually respectful relationship with an adolescent who is struggling to control their diabetes, encourage family support, and praise any improvements that the adolescent makes as he or she proceeds toward adulthood.

Resources

- Caring for diabetes in children and adolescents. A parents manual. 2nd ed. Ambler G, Ambler E, Barron V, Cameron F, May C, editors. Joint project of The Children's Hospital at Westmead and the Royal Children's Hospital. Open Training and Education Network – Distance Education (OTEN-DE). Available at www.rch.org.au/diabetesmanual/index.cfm?doc_id=2352
- NHMRC clinical practice guidelines for type 1 diabetes in children and adolescents. Available at www.chw.edu.au/prof/services/

endocrinology/apeg/apeg_handbook_final.pdf

- Useful tools on alcohol and recreational drug use (DVD/video) are available at 'Keep your life online' (www.theinjectors.org/pages/video.html) and a wallet insert 'Going out/staying out' (available through RCH, Melbourne).

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References

1. Northam EA, Matthews LK, Anderson PJ, Cameron FJ, Werther GA. Psychiatric morbidity and health outcome in type 1 diabetes: perspectives from a prospective longitudinal study. *Diabet Med* 2005;22:152–7.
2. Anderson B, Ho J, Brackett J, et al. Parental involvement in diabetes management tasks: relationships to blood glucose monitoring adherence and metabolic control in young adolescents with insulin dependent diabetes mellitus. *J Pediatr* 1997;130:257–65.
3. Mortensen HB, Robertson KJ, Aanstoot HJ, et al. Insulin management and metabolic control of type 1 diabetes mellitus in childhood and adolescence in 18 countries. Hvidore Study Group on Childhood Diabetes. *Diabet Med* 1998;15:752–9.
4. Vanelli M, Chiarelli F, Chiari G, et al. Metabolic control in children and adolescents with diabetes: experience of two Italian regional centers. *J Pediatr Endocrinol Metab* 1999;12:403–9.
5. Dabadghao P, Vidmar S, Cameron FJ. Deteriorating diabetic control through adolescence: do the origins lie in childhood? *Diabet Med* 2001;18:889–94.
6. Loman DG, Galgani CA. Physical activity in adolescents with diabetes. *Diabetes Educ* 1996;22:121–5.
7. Webb KL, Dobson AJ, O'Connell DL, et al. Dietary compliance among insulin dependent diabetics. *J Chronic Dis* 1984;37:633–43.
8. Cerkoney KA, Hart LK. The relationship between the health belief model and compliance of persons with diabetes mellitus. *Diabetes Care* 1980;3:594–8.
9. LaGreca A, Auslander W, Greco P, et al. I get by with a little help from my family and friends: adolescents' support for diabetes care. *J Pediatr Psych* 1995;20:449–76.
10. Bryden KS, Neil A, Mayou RA, et al. Eating habits, body weight, and insulin misuse. A longitudinal study of teenagers and young adults with type 1 diabetes. *Diabetes Care* 1999;22:1956–60.
11. Du Pasquier-Fediaevsky L, Tubiana-Rufi N. Discordance between physician and adolescent assessments of adherence to treatment: influence of HbA1c level. The PEDIAB Collaborative Group. *Diabetes Care* 1999;22:1445–9.
12. Peveler R, Fairburn C, Boller I, et al. Eating disorders in adolescents with IDDM. *Diabetes Care* 1992;15:1356–60.
13. Rodin G, Johnson L, Garfinkel P, et al. Eating disorders in female adolescents with insulin dependent diabetes mellitus. *Int J Psychiatr Med* 1986;16:49–57.
14. Rosmark B, Berne C, Holmgren S, et al. Eating disorders in patients with insulin dependent diabetes mellitus. *J Clin Psychiatry* 1996;47:547–50.
15. Nielsen S, Borner H, Kabel M. Anorexia nervosa/bulimia in diabetes mellitus: a review and presentation of five cases. *Acta Psychiatr Scand* 1987;75:464–73.
16. Jones JM, Lawson ML, Daneman D, et al. Eating disorders in adolescent females with and without type 1 diabetes: cross sectional study. *BMJ* 2000;320:1563–6.
17. Daneman D, Olmsted M, Rydall A, et al. Eating disorders in young women with type 1 diabetes. Prevalence, problems and prevention. *Horm Res* 1998;50(Suppl)1:79–86.
18. Bryden KS, Neil A, Mayou RA, et al. Eating habits, body weight, and insulin misuse. A longitudinal study of teenagers and young adults with type 1 diabetes. *Diabetes Care* 1999;22:1956–60.
19. Domargard A, Sarnblad S, Kroon M, et al. Increased prevalence of overweight in adolescent girls with type 1 diabetes mellitus. *Acta Paediatr* 1999;88:1223–8.
20. Amiel S, Sherwin R, Simonson D, et al. Impaired insulin action in puberty. A contributing factor to poor glycaemic control in adolescents with diabetes. *N Engl J Med* 1986;315:215–9.
21. Arslanian SA, Heil BV, Becker DJ, et al. Sexual dimorphism in insulin sensitivity in adolescents with insulin dependent diabetes mellitus. *J Clin Endocrinol Metab* 1991;72:920–6.
22. Bloch CA, Clemons P, Sperling MA. Puberty decreases insulin sensitivity. *J Pediatr* 1987;110:481–7.
23. Carroll MF, Schade DS. The dawn phenomenon revisited: implications for diabetes therapy. *Endocr Prac* 2005;11:55–64.
24. Brown KG, Darby CW, Ng SH. Cyclical disturbance of diabetic control in girls before the menarche. *Arch Dis Child* 1991;66:1279–81.
25. Adcock CJ, Perry LA, Lindsell DR, et al. Menstrual irregularities are more common in adolescents with type 1 diabetes: association with poor glycaemic control and weight gain. *Diabet Med* 1994;11:465–70.
26. Strauch H, Wirth I, Geserick G. Fatal accidents due to train surfing in Berlin. *Forensic Sci Int* 1998;94:119–27.
27. Marshall C, Boyd KT, Moran CG. Injuries related to car crime: the joy riding epidemic. *Injury* 1996;27:79–80.
28. Jacobsen A, Hauser S, Wertlieb D, et al. Psychological adjustment of children with recently diagnosed diabetes mellitus. *Diabetes Care* 1986;9:323–9.
29. Patterson JM, Garwick AW. Coping with chronic illness: a family systems perspective on living with diabetes. In: Werther GA, Court JM, editors. *Diabetes and the adolescent*. Melbourne: Miranova Publishers, 1998;3–34.
30. Hauser ST, Jacobson AM, Lavori P, et al. Adherence among children and adolescents with insulin dependent diabetes mellitus over a four year longitudinal follow up. II. Immediate and long term linkages with the family milieu. *Pediatr Psychol* 1990;15:527–42.
31. Craig ME, Handelsman P, Donaghue KC, et al. Predictors of glycaemic control and hypoglycaemia in children and adolescents with type 1 diabetes from NSW and the ACT. *Med J Aust* 2002;177:235–8.
32. Holl RW, Swift PG, Mortensen HB, et al. Insulin injection regimens and metabolic control in an international survey of adolescents with type 1 diabetes over 3 years: results from the Hvidore study group. *Eur J Pediatr* 2003;162:22–9.
33. Ahmed SB, Hovind P, Parving HH, et al. Oral contraceptives, angiotensin dependent renal vasoconstriction, and risk of diabetic nephropathy. *Diabetes Care* 2005;28:1988–94.
34. Thorn LM, Forsblom C, Fagerudd J, et al. Metabolic syndrome in type 1 diabetes: association with diabetic nephropathy and glycaemic control (the FinnDiane study). *Diabetes Care* 2005;28:2019–24.
35. Kong A, Donath S, Harper CA, et al. Rates of diabetes mellitus related complications in a contemporary adolescent cohort. *J Pediatr Endocrinol Metab* 2005;18:247–55.
36. Mohsin F, Craig ME, Cusumano J, et al. Discordant trends in microvascular complications in adolescents with type 1 diabetes from 1990 to 2002. *Diabetes Care* 2005;28:1974–80.
37. Warner DP, McKinney PA, Law GR, et al. Mortality and diabetes from a population based register in Yorkshire 1978–93. *Arch Dis Child* 1998;78:435–8.
38. Ingersoll GM, Orr DP, Herrold AJ, et al. Cognitive maturity and self management among adolescents with insulin dependent diabetes mellitus. *J Pediatr* 1986;108:620–3.