THE MANAGEMENT OF DIABETES IN CHILDHOOD

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The essential error in carbohydrate metabolism known as diabetes mellitus can occur at any age. It has been reported in infants only a few days old and, although extremely rare in the first year or so of life, becomes commoner as the child gets older, and if childhood is regarded as extending up to the age of 16 years up to 14 per cent. (Joslin) of all known diabetics start their diabetes in childhood. Diabetes in childhood, with very few exceptions, always presents as an acute disorder with symptoms of polyuria, thirst, lassitude and loss of weight. The duration of these symptoms before the patient is brought for medical attention is usually short, being only a matter of a week or so, though in older children symptoms may have been present for two or three months. The disorder may be fulminating and present as diabetic pre-coma or coma after symptoms of only a few days' duration. All cases, even though they may be extremely mild, in view of their growth requirements must be given insulin. Occasionally the odd case will be met after puberty in whom insulin may temporarily not be required. Nearly all cases will have marked ketosis and treatment is urgent and must be immediate. In this respect, vomiting is a serious symptom and is the precursor of coma. It is always advisable to admit new diabetic children to hospital so that they can have adequate supervision and instruction from the beginning.

Treatment

The treatment of diabetes in children is essentially the same as the treatment of diabetes in adults, and depends on developing and maintaining a balance between the carbohydrate foods eaten and the insulin given. This is done by giving a measured and constant amount of carbohydrate so distributed through the day that it is reasonably covered by the insulin required, avoiding both prolonged hyperglycaemia and hypoglycaemia. The measurement of protein and fat foods, although advocated by many authors, is not necessary as long as the child has normal quantities

of these foods. Carbohydrate foods, however, must be measured with reasonable care. There is no need to restrict severely the carbohydrate foods as long as the child gets enough to satisfy his needs and appetite. The amount of carbohydrate allowed, therefore, for any individual child must be assessed for that child and a general idea can usually be gained from the mother so that his normal appetite can be reasonably satisfied. It is most important in children to give an adequate and satisfying amount of carbohydrate so that dietary indiscretions may be avoided. Children, therefore, require relatively large carbohydrate diets and the amount may vary from about 150 g. of carbohydrate per day in a young child of four or five to anything up to 300 g. of carbohydrate per day in a child of 14 or 15. The distribution of the carbohydrate between the various meals during the day is also important and will depend on the type of insulin used. Most children do very well on one of the longer-acting types of insulin. It has recently been shown (Gurling *et al.*) that children, as a rule, do very well on the new insulin zinc suspension (Lente insulin) which has a long, steady action over 24 hours or more. Before this insulin was discovered, the usual treatment was to give a mixed dose of a soluble and protamine zinc insulin which gave good control over 24 hours. With these types of insulin the carbohydrate foods should be distributed fairly evenly through three or four main meals and small buffer feeds given at mid-morning and at bedtime. When the child is being stabilized, urine tests for sugar and acetone should be made on specimens passed before breakfast and before each feed during the day. According to whether sugar is present or absent in the urine, so either the insulin can be increased for persistent sugar or decreased if the tests are constantly good or, alternatively, the proportions of carbohydrate in the various meals may be modified in order to allow for the varying action of the long-acting insulins on each individual child. In practice, it is virtually impossible to keep a child's

urine sugar-free throughout the 24 hours, and if this is done recurrent hypoglycaemia will be the result. As diabetes in children tends to be labile and major fluctuations in blood sugar occur readily, glycosuria must be accepted as part of the control. If the urine becomes sugar-free either before lunch or before tea and before breakfast and the blood sugar at midday is below 200 mg. per cent., then quite reasonable control has been achieved.

The occasional child will be met who does not respond to treatment with a long-acting insulin and, in these cases, it will be necessary to give two or even three injections of soluble insulin per day and the distribution of the carbohydrate adjusted to the times of maximum action of this insulin.

It is relatively simple in hospital to adjust the carbohydrate needs of the child and his insulin, but the maintenance of his good control and health will depend on the child's co-operation in the treatment and on the mother being able to control the diet and certainly, at the beginning, to give the insulin injections. Part of the early treatment of the diabetic child will then necessitate the education of the mother in dietary principles and the technique of giving the insulin injections. As a rule, children take remarkably well to the difficulties and discomfort of repeated injections of insulin. The mother must be taught how to give the injection and how to measure the insulin, and before the child leaves hospital must be able to give the injection efficiently, well and with confidence. Even very young children very quickly learn how to give their own insulin injections and frequently prefer to do it this way. It is not uncommon to see a child of four or four-and-a-half giving his own insulin, but it is usually rather young to expect the child to measure the dose himself.

Severe Ketosis, Precoma and Coma

These three states are successively the most serious acute complications of diabetes and unless treated lead from one to the other and terminate in coma and death. Diabetes in a child may present in any one form or they may, and in children too frequently do, occur in the course of treatment. They may be a complication of any intercurrent infection or follow dietary indiscretions or omission of insulin. Where intercurrent infection is complicated by vomiting, coma may ensue very rapidly even within 12 to 15 hours.

When the patient is conscious, though severely ketosed and when vomiting is not a marked symptom, glucose, or lactose which is less nauseating than glucose, is given four-hourly and covered by soluble insulin according to the urine tests for sugar, which are also done four-hourly, the bladder having been emptied an hour before the sample for

testing is taken. The following table briefly outlines the method:

Urine Sugar (Benedict's Test)				Soluble Insulin	Glucose or Lactose
				units	g.
Red	..	..	..	20 to 40	20 to 40
Yellow	..	..	..	14 to 30	20 to 40
Green	..	..	..	8 to 20	20 to 40
Blue	..	..	..	0 to 6	20 to 40

The insulin dosage depends on the age of the child and the severity of symptoms. The amount of glucose or lactose given depends on the age of the child and remains constant for any one patient whatever the urine tests show, and when insulin is needed is given 20 minutes after the injection.

After 24 to 48 hours on this régime the ketosis always disappears and the child can be given a more regular high carbohydrate diet with three or two doses of soluble insulin daily. The diabetes can then be balanced on a long-acting insulin, if suitable, as before.

The essential requirements in the treatment of coma are insulin, water, salt and glucose. In very young children 20 to 40 units of insulin are needed as an initial dose, in older children 60 to 100 units are needed. One-third of the dose should be given intravenously the rest subcutaneously. Water and salt are given as normal saline intravenously and the solution must be given as a very rapid drip in adequate quantities. Sufficient saline given quickly in the early stages of coma may be a life saving measure.

After the blood sugar begins to fall after the first four hours, the infusion saline should be changed to 5 per cent. glucose in one-fifth normal saline.

Gastric lavage is a further vital necessity in the early treatment and may be of considerable help in the treatment of severe ketosis.

The treatment of coma has been fully discussed in this journal before (Young) and needs no further elaboration.

Hypoglycaemia

Owing to the large amount of energy a child uses in exertion, hypoglycaemic reactions are by no means uncommon and the child should be taught how to recognize these attacks and told to take sugar as soon as the warning signs appear. In young children the mother must know the warning signs and immediately take action and give the child a sweet or some sugar. As with adults, in recognizing their own insulin reactions, so the mother can always recognize changes in behaviour and appearance of the child and in this way recognize the onset of a reaction. Hypoglycaemic

reactions may be caused by a number of factors, the commonest of which is excess of exercise. When a child takes extra exercise over and above its usual day to day activity, then the blood sugar may well fall and hypoglycaemia occur. It is wise to ensure where possible that exercise is taken soon after meals. Errors in the amount of insulin given and omission of food or lateness with meals are other common causes. Vomiting and diarrhoea, with rapid passage of food through the intestine, are other less common causes. The early symptoms or signs of insulin reactions should never be allowed to go unchecked and the immediate administration of sugar, glucose or some form of carbohydrate must be done immediately to avoid insulin coma. When hypoglycaemia occurs, due to the maintenance dose of insulin proving too high, the dose should be reduced.

In the day to day management of children's diabetes by the parent, it is important that urine sugar tests should be done regularly, and when large amounts of sugar are constantly being passed before breakfast and tea adjustments in the insulin dose must always be made. It is by no means unusual for the insulin requirements of children to vary and these occasions must be recognized. Infections such as colds, sore throats, boils, abscesses or other more serious illnesses will invariably cause more sugar and lack of the control of the diabetes. In children this will usually be accompanied by the excretion of acetone bodies, and the advice of the patient's doctor should always be sought in order to effectively change the treatment. In minor infections it is usually sufficient to give more insulin. In severe infections where ketosis is heavy, it may be necessary to change the type of insulin from a long-acting insulin to the more powerful rapid-acting soluble insulin. Enteritis with diarrhoea and vomiting is a dangerous illness in a diabetic child as diabetic coma may follow rapidly. If this should happen the child should be immediately admitted to hospital. The type of insulin should be immediately changed to soluble insulin and it should be given sufficiently frequently to control the acetone and, as far as possible, the sugar. It may even be necessary to put the child on the emergency four-hourly régime for a day or so until the early and severe part of the infection is improved.

Complication of Treatment

In the course of treatment with insulin there are several things which may trouble the child. In the early stages of treatment local insulin sensitivity may occur where red raised bumps appear at the site of an insulin injection. This may be even more severe and urticaria result from the injections. These local reactions usually settle

down within two or three weeks of starting insulin, but should they be very severe then treatment with antihistamine drugs is indicated. After more prolonged treatment the condition of fat atrophy may, and commonly does, occur in childhood. This is a local loss of subcutaneous fat, usually at the sites of insulin injections, causing a hollow in the smooth contours of the skin. This is a harmless complication of insulin injections but may worry the parent and look unsightly. In most instances, particularly in the male child, fat atrophy disappears as adult life is reached, but a temporary improvement may be obtained by continuing to give the insulin injections into the atrophied area. This has to be carefully watched and controlled in order to prevent the opposite effect, that of the production of a fatty insulin tumour. When the site of injection is not varied and insulin is given daily into approximately the same place under the skin, a tumour may form causing a raised thickened firm area under the skin from which insulin is irregularly and poorly absorbed. These tumours usually disappear if the site of injection is moved well away from the original place and no insulin is given near the tumour for some months.

Behaviour Difficulties

These constitute a very real problem in the handling of the diabetic child. For about the first year of treatment there is usually little trouble apart from occasional transitory objections to the injections. The novelty and interest in treatment, urine tests and injections, however, tend to wear off and familiarity tends to breed contempt and indifference. Resentment sometimes grows as the child feels he is different from other children, leading to serious dietary indiscretions and concealment of and falsifying of tests. The wise parent can usually overcome these difficulties, but in adolescence resistance to treatment may be prolonged. Such conditions require careful handling and frequent observation by the physician, but usually the child realizes that good health can only be obtained by following the treatment advised. All children should be encouraged to learn to manage their own diabetes so that they can live near normal lives. A diabetic is not an invalid and can play games and hold his own with normal children.

The chief difficulties are usually met when the parents are either indifferent, stupid or over anxious. Each has to be handled on their merits. The indifferent and stupid have to be taught and made to realize that the life of their child is in their hands. The over anxious have to be restrained to avoid resentment from the child. In extreme cases where parental care is hopeless, it may be neces-

sary to place the child under expert care in a children's diabetic home.

Progress

The diabetic progress of the child should be regularly watched and changes in treatment made where indicated. The child should be seen every month for three months after the initial stabilization and thereafter every three months.

With careful treatment, complications are usually rare for the first ten years from onset, but as with adult diabetes, cardiovascular complications—e.g. retinopathy, albuminuria, peripheral vascular disorders and hypertension tend to occur more frequently with successive years.

Diabetic cataracts occur in about 1 to 2 per cent. of cases for which the treatment is surgical. Neuropathy is rare. Hepatomegaly and retardation of growth are usually the result of poor diabetic control or occur in the very mild untreated cases. They usually respond to correct control of the diabetes.

Conclusion

Diabetes in childhood, although unfortunate,

has with correct modern treatment a reasonable prognosis. The prognosis, however, of children developing diabetes under ten years of age is not as good as with older children as they tend to develop diabetic complications sooner, possibly due to the greater difficulty in controlling their diabetes. The cue to success is intelligent care by the parents and obtaining the child's fullest co-operation.

It must always be remembered that no general account can give in detail the requirements for treatment of an individual child. Children are usually insulin sensitive and each child's problems can only be dealt with as they arise, guided by experience and a sound knowledge of the fundamental principles of diabetic treatment.

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MENINGOCOCCAL MENINGITIS

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Purulent meningitis is the major incident of meningococcal infection. It is, in most cases, the culminating event in the progress of *Neisseria meningitidis* from the nasopharynx into the blood and on to the brain coverings.

The disease was differentiated by Vieusseux of Geneva (1805)¹ and has since been reported in epidemic and endemic incidence from all parts of the world. Following its natural course meningococcal meningitis has a heavy mortality (40-70 per cent.)², and a morbidity hardly less terrible. This was the expected result of infection until the effective introduction of sulphonamide drugs in 1938. The greatest recorded³ epidemics coincided with the two World Wars; 1915-1918 gave 10,259 cases with 5,883 deaths in the United Kingdom and 1940-1945, 38,900 cases with 7,880 deaths in England and Wales, the reduction in mortality from approximately 60 per cent. to 20 per cent. being almost certainly due to the introduction of sulphonamide treatment.

Epidemiology

The meningococcus is a relatively common, usually innocuous, inhabitant of the human nasopharynx. The organism can be differentiated into Groups I and II serologically but at least 90 per cent. of pathogenic meningococci recovered from epidemic clinical cases belong to Group I⁴. There seems little doubt but that a mutant of increased invasiveness and virulence precipitates clinical infection in suitable circumstances⁵. If these circumstances favour respiratory spread of infection (poor ventilation, over-crowding etc.), then the pathologically potent mutant reaches more hosts and an epidemic results. Thus mutation can condition the occurrence of isolated cases and these, given exceptional environment, can start an epidemic.

The incidence of meningococcal disease is low compared with many other infections in temperate climates, varying from 0.1 per 1,000 to 2.6 per 1,000 of the population. It is seasonal in winter