TYPE 1 DIABETES MELLITUS IN CHILDREN AND ADOLESCENTS IN INDIA

CLINICAL PRACTICE GUIDELINES 2011

INDIAN SOCIETY FOR PEDIATRIC AND ADOLESCENT ENDOCRINOLOGY
TYPE 1 DIABETES MELLITUS IN CHILDREN AND ADOLESCENTS IN INDIA

CLINICAL PRACTICE GUIDELINES 2011

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PREFACE

The burden of childhood diabetes is increasing year by year in India, as it is in Western countries. However, our basic pediatric training, due to competing claims of issues of greater public health impact on the limited training time available, does not provide the skills for ambulatory chronic care of the child with diabetes. Yet, here is an example of a disease which, if well looked after, can allow a long and productive life for our patient. In recognition of a felt need, the Indian Society for Pediatric and Adolescent Endocrinology (ISPAE) has prepared this practical “guidelines” for the benefit of pediatricians, physicians, diabetes educators and medical students in India.

These guidelines aim to provide clear practical instructions on how best to look after a patient of pediatric diabetes in the Indian setting.

It is proven beyond doubt that the closer one comes to perfect blood glucose control, the lower the risk of developing the long term complications that contribute to diabetes morbidity and mortality. Even with the best available treatment, however, it may not be possible to achieve normal metabolic milieu; hence certain arbitrary criteria are laid down to indicate good control. These criteria must be individualized based on patient characteristics as the day to day management of diabetes is largely dependent on the patient. Thus patient education forms a constant theme in the background of this book. The market is flooded with a variety of insulins and insulin administration devices. The latest and the most expensive insulin or device is not necessarily the best for every case. The treating doctor must be equipped with the knowledge to make the right choice on a case to case basis. Nutritional management, physical exercise, assessment of long term control and tests to screen for microvascular and macrovascular complications and comorbidities associated with type 1 diabetes, the two acute complications of hypoglycemia and diabetic ketoacidosis, and management during sick days, are some of the other chapters which all will find useful. Special attention has been paid to psychosocial aspects, keeping in mind the tender age of our patients and the fact that diabetes management is a task for the whole family.

The preparation of these guidelines was entrusted to a team of pediatric endocrinologists and diabetologists from different parts of our vast and diverse country. The team includes those who manage the poor, less literate patients in public hospitals as well as those who deal with the well to do, highly educated patients in the private sector. Each chapter has been written by a single author but incorporates inputs from all members of the writing and editorial group.

The guidelines are divided in 23 chapters, each dealing with a specific aspect of type 1 diabetes. Each chapter is complete in itself and the reader can read the chapters in any sequence. We hope that the ISPAE guidelines will be read by all those who care for children; that reading the guidelines will result in earlier diagnosis of diabetes and scientific approach to its management, thus ensuring a longer, healthier life for children afflicted with this disease.

Aspi J Irani
P S N Menon
Vijayalakshmi Bhatia
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INTRODUCTION

Aspi J. Irani
SUMMARY

Diabetes mellitus should be suspected in a variety of clinical situations including failure to gain weight, weight loss despite good appetite, and recurrent infections, in addition to classical features of diabetes and ketoacidosis.

The revised criteria proposed for diagnosis of diabetes include HbA1c ≥6.5% as a criterion, in addition to plasma glucose levels.

Even though type 1 diabetes accounts for most cases in childhood, other types of diabetes are being increasingly diagnosed now.

Type 2 or other etiologies of diabetes should be suspected in presence of autosomal dominant history, presence of syndromic features, deafness, optic atrophy, abdominal pain, or acanthosis nigricans.

Insulin-requiring hyperglycemia in the first three months of life is known as neonatal diabetes mellitus. Approximately half of the cases are transient, which resolve spontaneously. The most common form of permanent neonatal diabetes is activating mutations of Kir6.2 (KCNJ11) and SUR1 (ABCC 8) subunits of KATP channel or mutations of Insulin Promoter Factor-1 or FOXP3 gene.
**TABLE 2. Differentiation of T1DM, T2DM and Monogenic Diabetes**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Type 1</th>
<th>Type 2</th>
<th>Monogenic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genetics</td>
<td>Polygenic</td>
<td>Polygenic</td>
<td>Monogenic</td>
</tr>
<tr>
<td>Age of onset</td>
<td>6 months to adolescence</td>
<td>Usually pubertal</td>
<td>Often post pubertal except glucokinase and neonatal</td>
</tr>
<tr>
<td>Clinical presentation</td>
<td>Most often acute, rapid</td>
<td>Variable</td>
<td>Variable</td>
</tr>
<tr>
<td>Autoimmunity</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Ketosis</td>
<td>Common</td>
<td>Uncommon</td>
<td>Common in neonatal forms, otherwise uncommon</td>
</tr>
<tr>
<td>Insulin secretion</td>
<td>Decreased/absent</td>
<td>Variable</td>
<td>Variably decreased</td>
</tr>
<tr>
<td>Insulin sensitivity</td>
<td>Normal</td>
<td>Decreased</td>
<td>Normal</td>
</tr>
<tr>
<td>Insulin dependency</td>
<td>Permanent</td>
<td>Episodic</td>
<td>Variable</td>
</tr>
<tr>
<td>Obesity</td>
<td>Population Frequency</td>
<td>Increased frequency</td>
<td>Population frequency</td>
</tr>
<tr>
<td>Acanthosis nigricans</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
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</table>
PRINCIPLES AND GOALS OF MANAGEMENT

Aspi J. Irani

SUMMARY

Daily, lifelong insulin injections are essential for the survival of children with Type 1 diabetes mellitus (T1DM).

Medical nutritional therapy, planned physical activity and self monitoring of blood glucose and urine ketones are other very important aspects of treatment.

Hospitalization for initial management and education is required in most, though not in all, newly diagnosed cases.

Management of childhood diabetes needs a team approach. The patient must have round-the-clock access to a team member.

Patients and their families must be educated in self management of diabetes, including prevention and first aid management of diabetes related emergencies (hypoglycemia and ketosis).

Psychosocial problems must be anticipated and addressed.

A childhood and adolescent diabetes support group must be established in each city.

Even with the best available treatment, it is not possible to achieve a normal metabolic milieu. The goals of treatment therefore are to keep the child symptom free, ensure normal growth and development, with HbA1c as close to the normal range as possible.

The lower the HbA1c value, the lower the risk for development/progression of long term microvascular and macrovascular complications. However, the risk of hypoglycemia arises sharply.

The therapeutic plan and goals of therapy should be individualized depending on the patient’s abilities, motivation, finances, age, daily schedule and the availability of medical services.

Regular screening for long term complications and co-morbidities must be undertaken.

There is no medication other than insulin for control of diabetes, though in selected cases metformin and amylin may have some role.

At present there is no cure for T1DM, but it should be controlled to the best possible extent.
INSULIN THERAPY
Aspi J. Irani

SUMMARY

Insulin replacement therapy is essential for the survival of children with T1DM.

For day to day management insulin is injected subcutaneously, two or more times a day. It can be injected with a syringe, a disposable pen, a reusable pen or it can be given as a continuous subcutaneous infusion (the insulin pump).

Short acting human insulin or a rapid acting analog (to provide a “bolus” to cover post meal glycemia) as well as an intermediate acting human insulin or long acting basal analog (for basal insulin supply) are both essential for day to day management. Insulin pumps use only a rapid acting analog for both bolus as well as basal phases. In treatment of DKA only short acting human insulin is used.

Basal bolus regimens involve taking 3 or more injections a day but give more flexibility of lifestyle and better control than the split-mix regimen.

The choice of regimen should be based on the assessment of the patient’s motivation, capability and financial position.

The usual dose of insulin varies between 0.5-1.5 units/kg/day according to the stage of diabetes and the age and maturation of the child.

The correct techniques of storing insulin, mixing insulins and injecting insulin should be taught to all patients.

Hypoglycemia and lipohypertrophy are the two main complications of insulin therapy encountered with the newer preparations. With a little bit of care both can be prevented.
**TABLE 3. Insulin Regimens for Children and Adolescents with T1DM**

The horizontal columns indicate the time of insulin administration. The vertical rows indicate the insulin regimen and the insulin preparation given at each of the indicated times.

<table>
<thead>
<tr>
<th>Common Insulin Regimens</th>
<th>Pre-breakfast</th>
<th>Pre-lunch</th>
<th>Pre-dinner</th>
<th>Bedtime</th>
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<td>Split-mix regimen (2 injections a day)</td>
<td>Regular or rapid acting analog plus NPH</td>
<td>-</td>
<td>Regular or rapid acting analog plus NPH</td>
<td>-</td>
</tr>
<tr>
<td>Split-mix regimen (3 injections a day)</td>
<td>Regular or rapid acting analog plus NPH</td>
<td>-</td>
<td>Regular or rapid acting analog</td>
<td>NPH</td>
</tr>
<tr>
<td>Basal-bolus regimen (using human insulins)</td>
<td>Regular plus NPH</td>
<td>Regular</td>
<td>Regular</td>
<td>NPH</td>
</tr>
<tr>
<td>Basal-bolus regimen (using a combination of human insulin and analogs)</td>
<td>Regular</td>
<td>Regular</td>
<td>Regular</td>
<td>Glargine* or Detemir</td>
</tr>
<tr>
<td>Basal-bolus regimen (using analogs)</td>
<td>Rapid acting analog</td>
<td>Rapid acting analog</td>
<td>Rapid acting analog</td>
<td>Glargine*</td>
</tr>
<tr>
<td>Basal-bolus regimen (using analogs)</td>
<td>Rapid acting analog plus Glargine or Detemir</td>
<td>Rapid acting analog</td>
<td>Rapid acting analog</td>
<td>Glargine or Detemir</td>
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*Though Glargine was originally recommended at bedtime, it can be given at any other (constant) time of the day. Some patients may require two doses of Glargine in a day.*
NUTRITIONAL MANAGEMENT

Aspi J. Irani

SUMMARY

A dietician with special interest in pediatric diabetes must be part of the diabetes management team.

Children and adolescents with T1DM do not need a special diet (exceptions are those with obesity, hypertension, hyperlipidemia, nephropathy and celiac disease).

Caloric requirement is calculated as for any non-diabetic child. Normal growth is the best indicator of caloric sufficiency.

Meal planning is of utmost importance:

- to match insulin, exercise and meals,
- to regulate intake of dietary items that can increase risk of hypertension, macrovascular and macrovascular disease,
- to prevent hypoglycemia especially in relation to exercise and during night hours and
- to prevent hypoglycemia and ketoacidosis during intercurrent illnesses.

Fixed timings and carbohydrate content for each meal from day to day is necessary for patients on split-mix insulin regimen. They can be given a calorie exchange list to avoid monotony.

Those on basal-bolus regimen can have considerable flexibility in their meal timings and content with the intelligent application of carbohydrate counting and insulin to carbohydrate ratio.

50-60% of calories should be provided as carbohydrate. Sucrose is no longer forbidden but its use is better minimized. Complex carbohydrates and foods with low glycemic index give better postprandial control.

A high fiber diet may confer some benefit in children above 2 years of age.

Salt intake should be regulated to reduce risk of hypertension.
30% of calories should come from fats, with restriction of saturated fats to <10% and elimination of trans fatty acids.

Protein intake should not be higher than the recommendation for healthy children. Protein restriction is needed if microalbuminuria develops.

Sweeteners may be used if necessary. Diabetic snacks are not recommended.

Routine vitamin and mineral supplementation is not required.

Instructions on “eating out” must be provided.

A dietician with special experience in pediatric diabetes should be part of the team caring for the patient with T1DM.

Routinely, children with diabetes do not need a restrictive or special diet. They should be advised to eat all healthy foods in right amounts and avoid food items which are considered harmful to health. In fact, the entire family should convert to eating the same healthy food. The “silver lining in the dark cloud” when a child is diagnosed with diabetes is that the overall health of all other family members would improve if this simple guideline is followed.

Careful meal planning is a must for children and adolescents with T1DM.

ROLE OF MEAL PLANNING

Meal planning is necessary in T1DM for the following reasons:

- To ensure normal growth and prevent obesity (the latter being very common in adolescent girls with T1DM.)
- To match food intake to the action profile of insulin (though whenever possible one should try to select an insulin regimen to match the child’s preferred eating pattern.)
- To regulate the intake of food items that would predispose to hypertension, microvascular and macrovascular disease, all of which are commoner in T1DM than in the general population.
- To prevent the progression of certain complications if detected at an early stage.
- To prevent hypoglycemia, especially at nights and in relation to exercise.
- To help prevent ketoacidosis or hypoglycemia during intercurrent illnesses.

INDICATIONS FOR A SPECIAL DIET

Children with T1DM do not need a special diet except under certain circumstances. A special diet is necessary only for those who are obese (reducing
diet), develop microalbuminuria (mild protein restriction), hypertension (salt restriction), hyperlipidemia (special fat restricted diet: reduce fat intake to 25% of total calories, saturated fat to <7% and increase consumption of monounsaturated fatty acids or MUFA and omega-3 fatty acids), celiac disease (gluten elimination) or pernicious anemia (vitamin B12 supplementation).

**CALORIC REQUIREMENT**

The caloric requirement is higher than normal soon after diagnosis and after recovery from DKA. This phase lasts till the pre-illness weight has been regained (being the period of catch up growth after a state of “starvation amidst plenty”).

At other times, the caloric requirement of a child with T1DM is calculated as for any non-diabetic child of the same age, weight, sex and race and level of activity.

It must be noted that the child’s appetite and growth are more important determinants of caloric adequacy than any formula.

**IMPORTANCE OF GROWTH PLOTTING**

Growth must be plotted on appropriate growth charts once in 6 months.

Inadequate weight gain or weight loss (detected on serial growth plotting) would point to the possibility of insufficient caloric intake or insufficient insulin doses. Adolescent girls may try to miss insulin when they realize it leads to weight loss. Other causes to be considered include poorly controlled diabetes, hyperthyroidism, celiac disease, Addison’s disease, an associated chronic illness such as tuberculosis or an eating disorder.

Excessive weight gain could be due to overeating, especially intake of junk foods (with over-insulinization). Other causes include hypothyroidism and frequent hypoglycemia with over-correction.

**THE MEAL PLAN**

The meal plan should be finalized in consultation with the patient and parents. The plan should be built around the child’s preferred eating habits (timing and type of meals). In order to ensure compliance, changes should be made in the child’s pre-illness meal timings and habits only if essential. This is now possible thanks to the more flexible basal-bolus insulin regimen, coupled with frequent SBGM, knowledge of carbohydrate counting and intensive patient education.

In a child on the split-mix insulin regimen, meal timings and carbohydrate content should be constant for a given meal from day to day. Ideally there should be three main meals, two mid-meal snacks to cover the peak hours of insulin action plus a bedtime snack to prevent nocturnal hypoglycemia.
A calorie exchange list should be provided to avoid monotony. The child can be given a sample diet and for each item in the sample diet a list of alternatives with similar carbohydrate and calorie content is provided. The exchange list divides foods in six groups: milk, vegetable, fruit, fat, cereal or bread, pulse or meat. An item from one group can be exchanged only for any other item from the same group in the amount specified.

If the child is started on a basal-bolus regimen (especially with the use of insulin analogs) it is possible to have greater flexibility: meals can be delayed or even omitted, and the carbohydrate intake can be varied from day to day. To make this possible, the patient is taught the carbohydrate content (count) of various foods.

Individualized insulin to carbohydrate ratio is established for different parts of a day. This ratio can be calculated roughly using the formula 500 divided by TDD: this gives the grams of carbohydrate for which 1 unit of rapid acting insulin is required. Using this ratio, the patient takes a bolus insulin dose just before eating, after estimating the amount of carbohydrate in the meal.

**PERIODIC REVIEW OF MEAL PRESCRIPTION**

Children and adolescents with T1DM should visit a dietician once in 6 months as meal requirements may change rapidly on account of fast growth, puberty and frequent changes in activity and school schedules in this age group. Patients should also periodically weigh foods to have a better concept of portion sizes and they should be supplied with standardized measures such as spoons, katoris, and cups and so on.

**ROLE OF SELF BLOOD GLUCOSE MONITORING (SBGM)**

SBGM plays an important role in fine tuning the meal plan. This tool should be used by the patient to study the effects of various foods and physical activities on blood glucose levels in different situations. Experience gained from SBGM is the best guide for perfecting the meal plan.

**DIET IN INFANTS AND TODDLERS**

In the first 6 months exclusive breast feeding or a humanized infant formula is recommended. After 6 months, weaning foods in the form of cereals and pulses, fruits, vegetables and meats should be gradually introduced. In infants below 2 years of age a grazing diet is most appropriate.

After 9 months of age, the rate of weight gain, and consequently the appetite, decline significantly, causing parental anxiety. Parents must be informed that this is natural. Further, they must be counseled that babies at this age are negativistic and so forced feeding or coaxing may prove counterproductive, leading to food refusal and a difficult behavioral problem.
Toddlers eat best by imitation and hence the infant above 9-12 months should be made to sit with the mother (if not the entire family) to eat. Toddlers are attracted by the appearance of the food; hence decorating the meal can go a long way in improving compliance. Meal times should be pleasant. Toddlers will cannot resist temptation: unhealthy snacks and junk foods should therefore not be kept in the house (“out of sight is out of mind”) and under no circumstances should these be offered as rewards.

WHAT IS HEALTHY EATING?

1. Carbohydrates

50-60% of the total calories in the diet should be derived from carbohydrates. Carbohydrates are consumed as fruits, vegetables, cereals, legumes (peas, beans or lentils) and milk. The traditional Indian diet is high in carbohydrate.

Low carbohydrate diets are not recommended as carbohydrates are important sources of energy, fiber, vitamins and minerals.

Carbohydrates are the chief proximate principal in food that influences blood glucose. Insulin needs to be matched to the carbohydrate intake (rather than calorie content) at each meal. For this it would be ideal to teach patients the carbohydrate content of common foods and snacks and establish insulin to carbohydrate ratio for different times of the day for each patient. Those on a basal-bolus regimen can calculate the pre-meal insulin to match the anticipated carbohydrate intake at each meal. If a patient is on a split-mix regimen taking a fixed insulin dose from day to day, the carbohydrate content too should be fixed for a given meal from day to day.

Digestible carbohydrates are classified as starches and sugars. Starches are complex carbohydrates; they are slowly digested and absorbed and hence do not produce a rapid or sharp rise in blood glucose. They also contain other nutritional components and fiber. They are consumed in natural or in refined forms – the former should be preferred. Sugars (glucose, fructose, lactose and the table sugar or sucrose) occur naturally in foods (fruits, milk, and vegetables) or may be added in manufacturing or before consumption – they produce sharper swings in blood glucose.

Up to 10% of the total calories may be consumed as “added sugar” so long as it is part of a fiber rich meal, and spaced out through the day. However, sucrose provides only “empty” calories, has an adverse effect on dental health and snacks with sucrose (e.g. mithai, ice creams and chocolates) are usually also high in saturated fat content. Hence, in general, we prefer to advice our patients against adding sucrose to beverages or eating sucrose containing snacks, but they may occasionally be permitted specifically for the prevention of hypoglycemia before
prolonged exercise, as total denial would encourage non-compliance. Such snacks should not be given for reversal of acute hypoglycemia, as the fat content slows down sugar absorption.

Foods that produce lower postprandial blood glucose (PPBG) excursions are to be preferred, these foods are said to have a low glycemic index (GI). The GI compares PPBG response to constant amounts of different carbohydrate containing foods. It measures the rise above fasting in BG area in first 2 hours after ingestion of 50 g of the carbohydrate under study compared with the response to a reference food (glucose or white bread). Please note that the GI of white bread (maida) is the same as of glucose!

Foods with a low GI are those that produce lower rise in BG over the first 2-3 hours after ingestion.

- Examples of low GI foods include oats, barley, beans, lentils, legumes, soybeans, kidney beans, cashew nuts, pasta, noodles, strawberries, apple, orange, fructose, full cream milk and yogurt.
- Foods with high GI include white bread, white rice, puffed rice, bajra, jowar, ragi, maize, semolina, tapioca, cornflakes, baked potato, and honey.
- Foods with moderate GI include sugar, basmati rice, honey, popcorn, ice cream, dried rice noodles, black gram, green gram and croissants.

GI depends on multiple factors other than the type of carbohydrate – these include the style of cooking, state of ripeness, degree of processing and macronutrient distribution of the meal of which the carbohydrate is a part. A recent meta-analysis showed a 0.4% decline in HbA1c with low GI foods as against high GI foods.

2. Fiber

Indigestible carbohydrates present in food are designated as “dietary fiber” or “unavailable carbohydrates”. A fiber intake equal to the child’s age in years plus 5 g is known to be beneficial. The traditional Indian diet is naturally high in fiber content.

To increase fiber intake, patients should be advised to consume whole fruits with skin and edible seeds, vegetables, legumes, oats, beans and whole grain cereals.

Soluble fiber (found in dried beans, peas, oat bran, barley, apples, prunes, citrus fruits, watermelon, carrots and potatoes) improves total and LDL cholesterol levels by binding to bile salts, slows carbohydrate absorption by delaying gastric emptying thus giving a flatter blood glucose curve and may reduce insulin requirement. Insoluble fiber (present in whole wheat products, fruit skin, green
beans, dark green leafy vegetables, and seeds and nuts) helps bowel movement and prevents constipation.

A high fiber diet is not recommended in children below 2-3 years of age as they need a calorie dense diet.

Certain precautions need to be taken when going on a high fiber diet – introduce gradually; step up water intake; anticipate flatulence, abdominal cramps and bloating; and provide supplements of calcium and trace elements particularly iron and zinc.

3. Protein

Protein intake should be 15% (12-20%) of the caloric requirement. Higher protein intakes are not recommended. The protein requirement is 2 g/ kg at 1 year, 1 g/ kg at 10 years and 0.8-0.9 g/ kg in adolescence.

Proteins from animal sources (fish, milk, egg white, poultry and meats) are of better quality than those from vegetarian sources (soya, beans, and lentils) as they provide all essential amino acids. However, proteins from vegetarian sources are accompanied with fiber and complex carbohydrates and contain less of saturated fat in contrast to those from animal sources, which are more likely to be associated with higher salt and saturated fat content. When consuming non-vegetarian sources of protein, skin and visible fat should be removed. Soya foods have been shown to reduce LDL cholesterol and triglycerides.

If microalbuminuria develops, protein intake should be restricted to 10% of the total calories since increased glomerular perfusion or filtration is a key factor in progression to nephropathy. Microalbuminuria cannot be prevented by consuming a lower than normal protein diet.

4. Fat

Fats should provide 30% of total calories (higher in infants below 2 years of age). All fats provide the same number of calories (9 per g), but some are beneficial to the cardiovascular system while others can be harmful. Hence attention needs to be paid to both the amount and the quality of fat in diet.

**Saturated fat** consumption should not exceed 10% of the total calories. Higher intakes are associated with increased risk of cardiovascular disease. Saturated fats are the main components of LDL cholesterol. They raise serum total cholesterol (LDL as well as HDL). They are chiefly derived from animal sources including dairy products. They are found in egg yolk, flesh foods, poultry skin and in those fats that are solid at room temperature (butter, ghee, cream, palm oil, coconut oil). Non-vegetarian foods with low saturated fat content are fish, lean meat and poultry without skin and fat. In patients with raised LDL cholesterol the saturated
fat intake needs to be further reduced to below 7% of total calories while cholesterol intake should be less than 200 mg per day.

**The unsaturated fats** are classified as polyunsaturated and monounsaturated fatty acids. They are mainly derived from plant and vegetable sources. These fats have beneficial effects on LDL cholesterol and in the case of MUFA, also on HDL cholesterol. They help to reduce the risk of cardiovascular disease.

**Polyunsaturated fatty acids (PUFA)** should make up 10% of calories. These are essential fatty acids (not synthesized in the body). They are classified as omega-6 and omega-3 fatty acids.

Omega-6 PUFA is found in various cooking oils (safflower, sunflower, soya, cottonseed, corn, peanut and sesame) and in pulses, vegetables, cereals, nuts, seeds, eggs and poultry.

Omega-3 PUFA may have a beneficial influence on coronary heart disease, serum triglycerides and the immune system and are found particularly in cold water fatty fish. About 250 gm of fish should ideally be consumed every week. For the vegetarian, flaxseeds, walnuts, soybean, canola oil, kidney beans, tofu, broccoli, spinach, cauliflower, and Chinese cabbage are good sources of omega-3 fatty acids.

**Monounsaturated fatty acids (MUFA)** should make up 10-15% of the total calories. They are found in olive, canola, groundnut, peanut, sesame, rice-bran and mustard oils and in almonds and avocados. A diet using monounsaturated fat rather than carbohydrate to lower saturated fat in diet gives better postprandial blood glucose levels with equivalent lowering of LDL cholesterol; however it may cause undesirable weight gain and does not significantly improve HbA1c levels.

**Trans fatty acids** are produced by heating liquid vegetable oils in presence of hydrogen (partial hydrogenation) to make them less liquid and are found in processed foods, commercially prepared fried fast foods and baked products. They not only raise the LDL cholesterol but also lower HDL cholesterol, making them even more dangerous than saturated fats. There is no documented beneficial role for them in the human body. Patients must be told to avoid any product containing “hydrogenated oil” or “partially hydrogenated oil”.

### 5. Salt

Children with T1DM are more likely than non-diabetic children to develop hypertension. They also are more likely to consume higher amounts of salt as the stress is on a “non-sweet” diet. It would be prudent to restrict salt to 2 g per 1000 calories. Further restriction may be indicated if hypertension sets in.

Patients should be advised to restrict canned or packaged foods, baked products, pickles, pappad, sauces, and Chinese foods. They can use flavor
enhancers such as herbs, lemon juice, vinegar, spices, onions, tamarind, and green pepper.

6. Vitamin and Mineral Supplementation

Routine provision of vitamins and minerals is not indicated except in patients who are on a restrictive diet, or have celiac disease, pernicious anemia or achlorhydria.

Potassium supplementation is important for patients recovering from DKA till they reach the pre-DKA weight.

Diabetes puts body tissues under increased oxidative stress. However, there is no evidence that increasing dietary consumption of antioxidants improves health outcomes. Fresh fruits and vegetables are good natural sources of anti-oxidants.

7. Sweeteners

Sweeteners are classified as nutritive and non-nutritive. Of the nutritive sweeteners, fructose contains calories similar to sucrose but with a lower GI: fructose has a GI of 29 as against 69 of sucrose. However, added fructose may have an adverse effect on serum lipids and hence its use as a replacement for sucrose in the diet is not recommended.

The sugar alcohols such as xylitol, sorbitol and mannitol contain half the calories of sucrose and have a better GI. They are considered safe, though in excess, they may cause diarrhea.

The nutritive sweeteners are included in diabetic snacks. Diabetic snacks may not have an important role any longer as sucrose is no longer “out of bounds”. Further these snacks are often high in calories and saturated fat content.

The non-nutritive (artificial) sweeteners are virtually calorie free. These include aspartame, sucralose, stevia, saccharin, and acesulfame potassium. All are fairly safe in amounts recommended by the American Diabetes Association, but most children can do without them.

MEAL PLANNING ON “SICK DAYS”

When the child is unwell, anorexia may lead to hypoglycemia while elevated levels of the counter-regulatory hormones can cause hyperglycemia and even ketoacidosis. Meal planning plays an important role in preventing both hypoglycemia and ketoacidosis during intercurrent illnesses. (See Chapter 12: Sick Day Management for more details.)

If the illness is accompanied with appearance of ketones and a blood glucose level above 180 mg/ dL, the child should be coaxed to have plenty of salty liquids to compensate for polyuria, prevent dehydration, and replace salt loss in urine.
On the other hand if blood glucose is below 180 mg/dL, with presence of ketones in urine or blood the patient should be encouraged to have sweet liquids to prevent hypoglycemia while insulin administration can be continued to correct the ketosis.

On sick days small, frequent meals and cool liquids of child’s choice are better accepted and tolerated.

**PREVENTION AND MANAGEMENT OF HYPOGLYCEMIA**

All children with diabetes must carry 2 sweets (boiled candy) or a plastic pouch with 3-4 teaspoons of powdered sugar or glucose for prompt ingestion in case of symptoms of hypoglycemia. Children must also carry a fruit or a few biscuits with them when in school or college, in case for some reason there is a delay in returning home for a meal. (See Chapter 10: Hypoglycemia for more details.)

Patients must be instructed on the importance of ingesting a snack prior to unaccustomed (not part of daily schedule) physical activity: approximately 15 g carbohydrate for 30 minutes exercise. This snack should provide a readily absorbable form of carbohydrate plus a sustained supply of carbohydrate for prolonged activity. (See Chapter 9: Exercise and Physical Activity for more details.)

Additional bedtime snack to prevent delayed post-exercise hypoglycemia after intense evening exercise is also important. The role of the nocturnal snack cannot be over-stressed as frequency of hypoglycemia is highest at night in sleep. The bedtime snack should have a low glycemic index with some protein and fat to cover the long hours of fasting during sleep.

**EATING OUT**

Children and particularly adolescents will need to eat out periodically under peer pressure (if not personal choice). The dietician must check with the patient the eating houses that are likely to be frequented and then guide them on the most appropriate items to order at each such place and the carbohydrate content of those meals or snacks. With knowledge of the carbohydrate content of the eatables and the child’s individual insulin to carbohydrate ratio it is possible to ensure that the blood glucose is not adversely affected when eating out.

**COMPLIANCE WITH THE MEAL PLAN**

Compliance with the meal plan is difficult to achieve. This is due to various factors which must be carefully addressed. These factors include faulty cooking and eating habits of the family, emotional state of the child, forced feeding by parents, exposure to TV ads, food faddism, peer pressure when eating away from home, sharing of food or snacks in school, frequent parties, unrealistic
“standardized” diet prescriptions and an eating disorder to mention a few. Each of these issues has been discussed earlier in this article. Appropriate counseling of both parents, siblings and in a joint family the grandparents is necessary. Informing the school authorities about the dietary needs of the child (not missing a meal and additional snack before unaccustomed activity) is essential.

SPECIAL DIABETIC PRODUCTS

Diabetic cookies, pies, cakes, and candies mislead the diabetic patient into believing that decreased sucrose or sugar intake is all that is needed to regulate blood glucose levels. Patients must be taught how to read and interpret food labels. Most of the “diabetic” snacks are high in calories and fat – they belong to the times when sucrose was forbidden and have no role in modern nutritional management of T1DM.
HOME MONITORING OF CHILDREN WITH DIABETES

M Vijayakumar

SUMMARY

Type 1 diabetes is characterized by fluctuating blood sugars from day to day.

Yet, to prevent or minimize long term complications, it is important to keep as many of the blood sugar readings in or near the normal range as possible, particularly in adolescents and adults.

Monitoring sugars at home with the help of a glucometer allows the patient and family to adjust insulin doses for hypoglycemia, high blood glucose, unplanned exercise, and ketosis on sick days.

Home BG testing involves high cost of strips as well as the pain of finger pricks 2 to 4 times a day. However, since urine glucose will be positive only if BG is above 200 mg/dl, and also will not diagnose hypoglycemia, the expenditure and pain are considered justified due to the high dividends obtained for the short as well as long term health of the child.

Blood glucose goals are much more liberal for young children below about 6 years of age, as repeated hypoglycemic insult to the developing brain has tremendous risk for permanent cognitive impairment.

Monitoring urine ketones with the help of ketone strips enables home management of mild ketosis associated with sick days.
* Before increasing the night NPH insulin, possibility of Somogyi phenomenon should be kept in mind and glucose estimation should be done at 2-3 AM.

**TABLE 1. Preventive Insulin Adjustment in Split-Mix Insulin Regimen**

<table>
<thead>
<tr>
<th>SMBG reading</th>
<th>Insulin to be altered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasting</td>
<td>Night NPH *</td>
</tr>
<tr>
<td>Pre-lunch</td>
<td>Morning regular</td>
</tr>
<tr>
<td>Pre-dinner</td>
<td>Morning NPH</td>
</tr>
<tr>
<td>Bed time</td>
<td>Night regular</td>
</tr>
</tbody>
</table>

**TABLE 1A. Preventive Adjustments in Basal Bolus Regimes using Analogs**

<table>
<thead>
<tr>
<th>SMBG reading</th>
<th>Insulin to be altered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasting and pre-meals</td>
<td>Long acting analog</td>
</tr>
<tr>
<td>Post meal</td>
<td>Rapid or regular before that meal</td>
</tr>
</tbody>
</table>

**TABLE 2. Target Blood Glucose Levels**

<table>
<thead>
<tr>
<th>Time</th>
<th>Blood glucose levels age &lt; 6 years</th>
<th>Blood glucose levels age 6 - 12 years</th>
<th>Blood glucose levels age &gt; 12 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasting and pre-meal</td>
<td>100-180 mg/dL</td>
<td>90 - 180</td>
<td>90 - 130 mg/dL</td>
</tr>
<tr>
<td>Bed time and midnight</td>
<td>110 - 200 mg/dL</td>
<td>100 - 180</td>
<td>90 - 150 mg/dL</td>
</tr>
</tbody>
</table>
Clinic visits for a child with diabetes should consist of meetings with a team, not just a doctor.

The diabetes management team consists of a pediatric diabetes specialist, diabetes educator, dietician, psychologist and social worker. In India, many teams may be incomplete due to lack of trained personnel.

History should include aspects of schooling, sports, social issues and diabetes knowledge, as well as aspects of diabetes care particularly hypoglycemia.

Examination should include assessment of growth and puberty, in addition to examination for diabetes related long term morbidity.
LABORATORY MONITORING

Anna Simon

SUMMARY

Glycosylated hemoglobin (HbA1c) is the single most important laboratory monitoring for a child with T1DM.

Thyroid disease, celiac disease, may have to be screened for.

Microvascular complications screen includes microalbuminuria and lipid profile.
EXERCISE AND PHYSICAL ACTIVITY

Anna Simon

SUMMARY

Physical activity should be considered as an important aspect of management of T1DM.

Regular physical activity has been demonstrated to improve glycemic control, physical fitness and muscle strength and psychological well-being. Children participating in sports or programmed exercises should be supervised and should have access to sweetened drinks and snacks.

Extra caution should be taken when undertaking solo sports or events in water (or mid-air).

Blood glucose levels should be monitored before, during and after physical activity.

Do not inject insulin into a site that will be heavily involved in muscular activity.

Extra carbohydrate intake and/or reduction of insulin dosage may be necessary; previous experience and blood glucose monitoring will help to determine the appropriate adjustments required with diet and insulin therapy.

A general recommendation is that for every 30 min of moderate to intensive sport or physical activity, 15 g or an extra serving of carbohydrate should be consumed.

Extra carbohydrates should be taken if blood glucose is <100 mg/ dL at bedtime and check blood glucose at 3 AM as well.

Strenuous physical activity should be avoided if blood glucose concentration is >250 mg/ dL, especially if ketones are present. This will require insulin supplementation as well.
HYPOGLYCEMIA

Anju Virmani

SUMMARY

Hypoglycemia in a child with diabetes is defined at a BG < 70 mg/dl. In an infant or toddler, BG should be maintained above 100 mg/dl.

Treatment should aim for best possible glycemic control, without significant hypoglycemia.

The child, family, school staff and other caregivers should be educated about suspecting, confirming and managing hypoglycemia.

Ideally the child should have an I-card or wear some form of identification indicating diabetes.

Sugar or glucose 1 to 3 tsf, is useful to immediately raise BG, followed by a small snack. Glucagon (0.3 to 0.5 mg S/C for a young child, 1.0 mg for an older child) should be available at all times.

Prevention of hypoglycemia includes attention to bedtime and midnight BG, delayed hypoglycemia after exercise, hypoglycemia unawareness syndrome.

Pathological causes include hypothyroidism, celiac disease, renal failure.

Hypoglycemia (“hypo”) is the commonest acute complication of diabetes control in children. It is usually defined as a blood sugar < 70 mg/dL, but in toddlers, action should perhaps be taken at levels <100 mg/dL. Repeated episodes can cause cognitive dysfunction, especially in the very young child.

CAUSES

Hypoglycemia is commonly due to:

- Excessive insulin action,
- Inadequate or delayed food intake, or
- Excessive or unplanned exercise.

Hypos can occur with several regimens. The split-mix regimen, comprising two shots of regular and NPH insulin often leads to hypoglycemia if mid-meal snacks are not taken, or at night.
Conversely, attempts at very tight glycemic control can also increase the number of hypo episodes.

Hypos are particularly common in the honeymoon phase. If the child is admitted, insulin dose should be reduced by 10% at the time of discharge, to prevent hypos which may occur with the increased activity at home.

The next sharp drop in blood glucose (BG) levels comes when the initial glucotoxicity settles down, so insulin requirements also fall rapidly. Frequent BG monitoring is especially important in the first few weeks after diagnosis to prevent these hypos.

Later in life, if hypos suddenly and unexpectedly increase in frequency, one should think of hypothyroidism, celiac disease, renal compromise and/or failure, or rarely hypoadrenalism. All these conditions are more common in T1DM.

In general, throughout the lifetime of a person with diabetes, constant vigil is needed, with frequent BG monitoring, proper rotation of injection sites and judicious use of analogs a insulin pumps where they can be afforded, to reduce the frequency of hypos.

CONSEQUENCES

Hypoglycemia can result in abnormal behavior, drowsiness, convulsions, coma, or if prolonged, death. It can be so frightening that the diabetic child and his/her family may refuse to try for tight glycemic control for fear of hypoglycemia. Recurrent hypoglycemia can lead to hypoglycemia unawareness, increasing the risk of later episodes.

Severe hypoglycemia is more likely in:

- Toddlers and very young children,
- Adolescents, especially when they are rebelling,
- Those with longer duration of diabetes, and
- Those with low HbA1c values.

SYMPTOMS AND SIGNS

Symptoms and signs of hypoglycemia may be

- Adrenergic: uneasiness, shakiness, palpitations, and/or cold sweats.
- Neuroglucopenic: difficulty in vision, hearing, or concentrating, slurred speech, confusion, dizziness, abnormal gait, drowsiness, coma, seizures, death (“dead in bed”).
- Headaches, mood swings, poor school performance, nightmares, and depression, apart from the classical symptoms.
Transient neurologic deficits: hemiplegia and aphasia, which can occur with prolonged hypoglycemia.

**Some Caveats**

1. Symptoms and signs do not correlate well with BG levels, and may vary from person to person, and episode to episode.

2. Marked symptoms may occur if the BG drops sharply ("pseudohypoglycemia"), so it is important to test BG whenever possible to confirm if the level is indeed low. Otherwise, patients often treat themselves for adrenergic symptoms merely because there is a drop in BG from high to normal values.

3. Conversely, a hypo maybe missed and BG appears to be normal or even high if rebound hyperglycemia occurs quickly, or testing is delayed.

4. The accuracy of capillary testing is less in the low range.

   Therefore though there is no specific cut-off value for defining hypoglycemia, most people would consider levels below 70 mg/ dL as diagnostic, and aim to keep BG above 90 mg/ dL. In very young children, higher levels are targeted at, because symptoms may not be picked up easily. Adrenergic symptoms and counter-regulatory responses are lesser

   During sleep,

   After an episode of severe hypoglycemia,

   In those with tight control, and

   In those with long duration of diabetes.

   In fact, if adrenergic symptoms are very mild or ignored, then neuroglucopenic symptoms may be the first indication of trouble ("hypoglycemia unawareness"). Hypoglycemia unawareness may occur in a child having repeated episodes of hypoglycemia. It is often reversible, with hypoglycemia awareness returning once there are less hypos with less strict control of blood sugars. It is therefore important to encourage ongoing frequent BG monitoring, especially before and after exercise, during illnesses, and periodically in the middle of the night. Continuous glucose monitoring systems (CGMS) have provided a wealth of information about glucose patterns in individual patients, and may be useful occasionally (see Chapter 16). In children who do not test frequently for financial or other reasons, families should be asked to be vigilant, and make sure BG is tested when hypoglycemia is suspected.
Severity
1. Mild or moderate hypoglycemia is defined as when the patient can manage to treat him/herself. This may be

   Symptomatic ("documented symptomatic hypoglycemia"), or

   Asymptomatic: Asymptomatic episodes are important because they increase the risk of severe hypoglycemia and of hypoglycemia unawareness.

2. Severe hypoglycemia: is defined as when the patient has altered sensorium (coma or convulsions) and so needs help for management (glucagon or IV glucose)

MANAGEMENT
The aim of treatment is to normalize BG levels to above 100 mg/ dL.

Mild to Moderate Hypoglycemia
If the BG is more than 60 mg/ dL and the sensorium is normal, the child should be given:

1. 5-15 g of carbohydrate orally. This should preferably be in the form of free sugars, because the presence of fat delays the absorption of the sugar. Thus the child can be given glucose, sugar, regular cold drink (not diet drink), if not available, juice or honey.

2. This is followed after 10-15 minutes by a retest of BG, and then

   If still low, repeat glucose administration.

   If >100 mg/ dL, give a snack e.g. glass of milk, fruit, sandwich, glucose biscuits, chocolate, etc., to make sure that the BG does not dip again.

Severe Hypoglycemia
This needs urgent action. The management include the following steps:

1. **Injection of glucagon**, if available, given intramuscularly or subcutaneously: 10-30 µg/kg: 0.5 mg for children younger than 10 years of age; 1 mg for older adolescents. If sensorium improves, a snack should be given (as above); to make sure BG does not dip again.

2. If glucagon is not available, the child should be put in a lateral position to prevent aspiration and a thick paste of glucose (glucose powder with a few drops of water) smeared onto the dependent cheek pad. Sugar or any other powdery substance or thin liquids like a glucose solution or honey should NOT be given forcibly to the semi/ unconscious child.
3. If the child is in a medical facility, then **IV infusion of 10% dextrose** should be started: 5 mL/kg, (or I/V push of 2 ml/kg 25% dextrose) till sensorium stabilizes and the child can tolerate oral intake comfortably. At this time, a snack should be given, as above. Observation for 12-24 hours is needed because vomiting or a recurrence may occur.

4. **Rest**: No further strenuous physical activity should be allowed.

**PREVENTION**

Special attention must be paid to high risk groups which include:

- Very young children and toddlers.
- Children with low HbA1c.
- Children on low cost regimens (NPH absorption is very variable and can be associated with a significant risk of hypos. The risk of hypos is lower with insulin pumps, and with basal-bolus regimens using insulin analogs.)
- When treatment regimen or daily routine is changed (e.g. small child moves from play school to regular school; class teachers no longer supervise eating of tiffin; or during preparation for a sports day or a cultural evening, etc.)
- Athletes.
- When hypoglycemia has occurred recently.
- Children with significant autonomic neuropathy.
- Associated diseases: renal failure, possible hypothyroidism, hypocortisolism, or celiac disease.

**SOME PRACTICAL HINTS**

- BG should be checked frequently in the day for all children, but more often in high risk groups or times, e.g. during and after strenuous sport. It should also be checked at 2-3 AM periodically, and 10-12 hours after alcohol ingestion. Mid-meal snacks are important for those on NPH insulin.

- The close family members, as well as teachers, bus driver, sport teacher, coach should all be aware of the symptoms, and the action required to be taken. Extra carbohydrate is necessary for every 45 minutes of sports or play. Two or three sweets in pillow packs and a packet of glucose biscuits must always be available, in the child’s pocket AND school bag, in the school bus or van, in the sports teacher’s locker, and in the school medical room, etc.

- The child and family must be asked if they are carrying a diabetes identity card, a sample of which is appended below.
Families should be encouraged to keep Inj. Glucagon at home or when traveling. Glucagon is now available in India, and may be life-saving.

Families should be encouraged to keep a thick paste of glucose in a sealed box at home. They should also be encouraged to obtain glucose gel from abroad, as this is convenient when traveling.

BG testing must be done when traveling or during sports. They must know that carbohydrate must be given (15 g, contained in 3 tsf sugar or about 120 ml juice, raises sugar by about 20 mg/dL) and exercise should be stopped if BG dips.

Patients should be encouraged to take milk at bedtime, unless of course hyperglycemia is occurring at night.

During routine visits, prevention and treatment strategies should be briefly asked for, doubts clarified and knowledge gaps filled. Families must be reminded that emergencies occur without warning.

After each episode of hypoglycemia, the insulin-diet-exercise regimen should be reviewed to identify triggers so they can be avoided in the future.

Prevention is important as repeated episodes can interfere with school performance and sports, cause long term cognitive dysfunction, cause hypoglycemia unawareness, prevent the parents from trying for tight glycemic control due to anxiety, result in accidents, and even death (e.g. “dead in bed”).

**NOCTURNAL HYPOGLYCEMIA**

This should be suspected if the child

- Has nightmares,
- Wakes up confused or with a headache,
- Has low or unexpectedly high fasting BG, or low bedtime sugars.

A bedtime glass of milk may be useful, especially after strenuous play in the evening. Insulin doses should be aggressively reduced to prevent nocturnal hypoglycemia.
**SUMMARY**

Diabetic ketoacidosis (DKA) is a life-threatening condition requiring early diagnosis and appropriate treatment.

DKA should ideally be managed in a center equipped to treat the condition under the supervision of an experienced pediatrician. In resource-poor settings stabilization followed by early referral to a higher center is recommended.

Laboratory tests should be interpreted with caution due to known fallacies.

Children younger than 2 years and those with severe DKA should be managed in an ICU.

Close clinical and laboratory monitoring is essential for successful management of DKA.

Hydration is the mainstay of management of DKA. Rapid and excessive fluid administration should however be avoided due to the risk of cerebral edema.

Insulin should be withheld in the initial hydration phase.

Continuous intravenous infusion of insulin is the standard of care for pediatric DKA. In resource-poor settings intermittent intramuscular insulin may be used. Intravenous bolus of insulin should be avoided.

Potassium replacement is required in children with DKA even if the initial potassium levels are normal.

Bicarbonate should be used only in children with pH less than 6.9 and cardiac compromise.

Resolution of acidosis is the primary criteria for reduction of insulin infusion rate.

Mannitol and dextrose should be available at bedside of all patients with DKA for emergent treatment of cerebral edema and hypoglycemia.
Cerebral edema should be considered in all patients with sudden deterioration of neurological and clinical status.

Insulin infusion should be discontinued 30 minutes after the administration of subcutaneous insulin.

Appropriate management during sick days and invasive procedures is essential for prevention of DKA.
Table 2. Guidelines for Fluid Infusion Rate (ml/Hour) in DKA

<table>
<thead>
<tr>
<th>Weight</th>
<th>Level of dehydration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mild/Nil</td>
</tr>
<tr>
<td>5 kg</td>
<td>24</td>
</tr>
<tr>
<td>7 kg</td>
<td>33</td>
</tr>
<tr>
<td>8 kg</td>
<td>38</td>
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<td>34 kg</td>
<td>95</td>
</tr>
<tr>
<td>36 kg</td>
<td>98</td>
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</tbody>
</table>

Table 4. Laboratory Parameters and Response to Treatment in DKA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Expected</th>
<th>Concern</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood sugar</td>
<td>Decrease by 50-100 mg/ dL/ hour</td>
<td>Decline &gt; 100 mg/ dL/ hour Decline &lt; 50 mg/ dL/ hour</td>
<td>Add dextrose to IV hydration fluid Prepare fresh infusion, flush tubing with insulin</td>
</tr>
<tr>
<td>Blood pH</td>
<td>Resolution by 12 hours</td>
<td>Persistent at 12 hours</td>
<td>Exclude infection, shock, lactic acidosis</td>
</tr>
<tr>
<td>Serum sodium</td>
<td>Increase</td>
<td>Increase &lt; 2 mmol/ L/ hour</td>
<td>Increase sodium concentration in fluid</td>
</tr>
<tr>
<td>Serum potassium</td>
<td>Gradual decrease</td>
<td>Hypokalemia</td>
<td>Increase potassium concentration in fluid</td>
</tr>
<tr>
<td>Anion gap</td>
<td>Resolution by 12 hours</td>
<td>Elevated at 12 hours</td>
<td>Exclude lactic acidosis, consider infection</td>
</tr>
<tr>
<td>Plasma osmolality</td>
<td>Stable</td>
<td>Decrease by &gt; 2 mOsm/ kg/ hour</td>
<td>Increase sodium concentration, decrease fluid rate</td>
</tr>
<tr>
<td>Blood count</td>
<td>Decrease</td>
<td>Persistently elevated</td>
<td>Exclude infection</td>
</tr>
<tr>
<td>Blood urea</td>
<td>Decrease</td>
<td>Persistently elevated</td>
<td>Exclude renal failure</td>
</tr>
</tbody>
</table>
SICK DAY MANAGEMENT

Aspi J. Irani

SUMMARY

Never omit insulin when sick. Insulin dose can be reduced if child is anorexic or vomiting with BG below 100 mg/dL.

Follow BG and urine or blood ketones. These should be checked every 2-4 hours. Never go by the appetite alone.

Give additional supplements of rapid acting analog or regular insulin when ketones are raised with BG above 180 mg/dL.

If child cannot eat his usual diet, give plenty of liquids orally in frequent small sips. Offer sweetened liquids when BG is less than 180 mg/dL and salty liquids when BG is above 180 mg/dL.

Consider “mini dose glucagon” if BG is less than 80 mg% with raised ketones and child cannot accept or retain oral liquids. If this is not practical, hospitalization for intravenous dextrose may be required.

Hospitalize urgently for impending DKA if child has more than 3 vomits, significant abdominal pain, drowsiness or breathlessness.

It is the responsibility of the medical team to ensure that every patient is fully conversant with these “sick day” guidelines. Clear written instructions should be given to the family and the school authorities.
PSYCHOSOCIAL ASPECTS

M. Vijayakumar

SUMMARY

Attention to psychological issues is as important as insulin administration, meal planning, self blood glucose monitoring (SBGM) and exercise.

Stages of shock and grief at the time of diagnosis, progressing to disbelief, denial, anger, false hopes, confusion and depression later; and finally resolution and acceptance, may all occur. Financial worries may loom large.

Clinically significant depression is not uncommon.

Psychological evaluation, recognition of abnormal coping, and intervention, may help prevent major crises.

Support groups are helpful in allowing “senior”, experienced families to come to the help of families with a newly diagnosed child.
PROCEDURES AND SURGERY

M. Vijayakumar

SUMMARY

The counterregulatory hormones rise during surgery or other stress, and result in high BG and ketones.

Diabetes increases the risk of infections, and influences wound healing, therefore excellent BG control is desirable prior to elective surgery.

Insulin doses may have to be adjusted from the night before major surgery, and on the morning of a minor surgery. **Insulin must never be completely missed.**

Attention must be paid to fluid and electrolyte balance.
CONTINUOUS SUBCUTANEOUS INSULIN INFUSION (INSULIN PUMP)

Anurag Bajpai

SUMMARY

An insulin pump, the size of a small mobile phone, pumps regular insulin or rapid acting analog, through a plastic tubing and butterfly needle, into a subcutaneous site. The pump can be programmed with different basal rates, say high rates to counter early morning dawn phenomenon, or low rates to counter exercise induced hypoglycemia. Boluses are given just prior to meals and large snacks.

Insulin pumps have the advantage of providing good glycemic control with lower frequency of hypoglycemia and better quality of life.

Careful patient selection and intensive education is essential for successful insulin pump treatment.

Children on insulin pumps should check blood glucose levels at least four times a day (pre-meal and at bedtime).

Emergent correction of hyperglycemia is mandatory for prevention of DKA in children on insulin pump.

Insulin injection using a syringe or pen should be used to correct hyperglycemia in children on insulin pumps in the presence of ketosis.
Continuous glucose monitoring systems (CGMS) measure interstitial fluid glucose continuously. By calibrating the system with 2 to 4 capillary BG values, continuous “blood glucose” values can be read off without extra pricks.

They are indicated in children with uncontrolled diabetes and significant glycemic excursions.

Real time glucose monitoring would be of help in preempting and preventing diabetic emergencies like severe hypoglycemia and DKA.
TRAVEL AND HOLIDAYS

Aspi J. Irani

SUMMARY

Before planning a long journey, a check up is advisable.
Facilities for medication, food, emergencies, should be found out prior
to travel.
Cool transport of insulin, general non-diabetes related medication, food,
clean footwear are some items whose availability should be ensured.
Extra exercise may necessitate decrease in doses
Air travel has a set of precautions including letters to be carried and
planning for changing time zones.
DIABETES CAMPS
Aspi J. Irani
INFORMING THE SCHOOL AUTHORITIES

Aspi J. Irani

Children spend a large part of their day in school. Staff members and some close school mates of the child with T1DM should be familiar with the special needs of the child.

It is recommended that a social worker belonging to the medical team should meet the school authorities in person and also hand over written guidelines for care of the child or adolescent with T1DM.

The following messages need to be conveyed to the school authorities:

- **T1DM is not a contagious disease.** It is not caused by overeating or lack of physical activity or any other act of omission or commission on the part of the child or the family members.

- **The child with diabetes needs to take 2-4 injections of insulin each day, check blood glucose, eat healthy food at fixed timings and take certain precautions prior to physical exercise.**

- A child with well controlled diabetes can lead a near normal life. The child with T1DM should not be treated differently from other children.

- **Diabetes does not affect the academic performance, provided it is well controlled.** Diabetes will not affect the extracurricular activities of the child, provided certain pre- and post-activity precautions are observed.

- The child with diabetes does need some special care and attention, but this must be provided in an unobtrusive manner.

- **Teachers and close friends should be familiar with the symptoms of high blood glucose, in particular, polyuria and polydipsia.** If the child frequently asks for permission to drink water or visit the rest room he/ she should not be denied permission; however, the parents should be alerted as these are indicators of poor diabetes control.

- **Teachers and close friends should be conversant with the early symptoms and the first aid management of hypoglycemia.** If the child complains of hypoglycemia or is found to be drowsy, confused or behaving in an erratic manner, he/ she should be promptly given 3 teaspoons of glucose powder or powdered sugar (which the child must carry in a plastic pouch in his/ her
pocket at all times). This should be followed with a snack in the form of a fruit, sandwich or biscuits (which also the child should carry in his/ her school bag at all times).

- **Teachers must be aware that the child needs to eat on time;** meals should never be skipped or delayed, even if for some reason the child needs to be detained in the school beyond routine timings.

- **The child must be allowed to consume an extra snack** before, and at times even after, unaccustomed physical activity.

- **Child should be granted permission to check blood glucose,** if he/ she has been advised by the doctor to perform tests during school hours.

- **Ideally the school should have a nurse** who can administer and/ or supervise the administration of a morning or afternoon dose of insulin (if indicated), check blood glucose (when needed) and administer a shot of glucagon (in case of severe hypoglycemia). Frequent communication between the nurse and the medical team can lead to improvement in control of diabetes.

- **The staff at school must have the telephone numbers of the child’s parents and medical team members in case of any emergency.**
Diabetes education is the cornerstone to successful management of children with T1DM.

Centers caring for children with T1DM should develop written and structured program for ‘Diabetes Self Management Patient Education’.

The diabetes self management patient education program should be individualized according to the age, stage of diabetes, socioeconomic and educational status and cultural values of the patients and their families.

Diabetes education team should at the minimum comprise of a diabetic educator and a dietician.

No child with T1DM should be discharged from the hospital without the understanding of survival skills of insulin injection, blood glucose testing and hypoglycemia by the patient and the family.

Diabetes self management patient educational material written in lay terms in local language should be provided to the family.

Families should be encouraged to join patient support groups for T1DM, at enrolment.
DIABETES IN TODDLERS

Aspi J. Irani

SUMMARY

Toddlers present with more acute and severe symptoms of insulinopenia compared to older children.

They eat unpredictably, hence hypoglycemia is a greater possibility. Repeated hypoglycemia to the developing brain must be avoided at all costs. Therefore the goals of therapy are relaxed for this age group, if so needed.

The availability of glucagon at home is of greatest importance in this age group.
DIABETES IN ADOLESCENTS
Anju Virmani

SUMMARY

Many aspects of adolescence impact diabetes management, often adversely.

The presence of a chronic condition like diabetes places great demands on the psychology of the youngster.

The special issues include physical and emotional changes, insulin resistance and glycemia, academic and career issues, privacy, confidentiality and freedom, and transition to adult care.
THE FUTURE
Anurag Bajpai

SUMMARY

A structured program should be developed for transition of adolescents with T1DM to adult care.

Young adults with T1DM should be counseled against risk taking behaviors like smoking and consumption of alcohol and illicit drugs.

Counseling on reproductive health, academics and career are integral to management of young adults with T1DM.

Although the patients should be educated about the latest developments in the treatment of diabetes, the need for long term insulin should be emphasized.
These guidelines on practical diabetes management in childhood have been written specially keeping in mind the social and economic conditions in which our patients live and we work. Nevertheless, every attempt has been made to refer to international texts and clinical practice guidelines as recent as 2011. The handbook should be useful to pediatricians, pediatric endocrinologists and endocrinologists, diabetologists and physicians, nurse educators, dieticians and counselors.