MODULE-9

CCD batch-32

Objective

PC M9 L1

- To discuss the basic principles of management of diabetes mellitus in the young population.
- To discuss the basic principles of management of diabetes mellitus in the older people.
- To discuss the basic principles of management of diabetes mellitus during pregnancy.

DM in the young

PC M9 L2

- Diabetes mellitus in childhood and adolescence is most often type 1 diabetes. But they have the chance of developing T2DM and other specific types of diabetes.
- Now-a-days T2DM is developing in the young at a very high rate.
- Diagnostic and management issues in this group of population is different from that of adult.

T1DM in the young

- Type 1 diabetes is growing by 3% per year in children and adolescents, and by 5% per year among pre-school children.
- Of these type 1 diabetic children the highest number of cases (26%) live in Europe. Finland, Sweden, Denmark, Norway and the UK have higher incidence rates for type 1 diabetes in children.
- Globally, there are close to 11,00,000 children under the age of 20 years with type 1 diabetes. Every year, more than 132,000 children under the age of 20 years develop type 1 diabetes.

T2DM in the young

- Type 2 diabetes mellitus in children is relatively less common than in adult. But now-a-days it is being reported more frequently and is associated with rising rate of obesity among the children.
- T2DM was once seen as a disease of adults. Today, this type of diabetes is growing at alarming rates in children and adolescents. In the USA, it is estimated that T2DM represents 8-45% of new-onset diabetes cases in children depending on geographic location. Over a 20-year period, type 2 diabetes has doubled in children in Japan, so that it is now more common than type 1.
- Type 2 diabetes in children is becoming a global public health issue with potentially serious outcomes. T2DM affects children in both developed and developing countries. Over half of children with diabetes develop complications within 15 years.

Screening for diabetes in children

PC M9 L3

Whom to screening for diabetes among children?	
All types of DM	**Children with symptoms of diabetes**
T2DM	**Children wit risk factor(s) of DM:** • **Obesity (BMI > 85th percentile for age & sex** • **Family history ofT2DM** • **Mother was DM/GDM during the child's gestation** • **Ethnic susceptibility** • **Features of insulin resistance: eg anacthosis nigricans, hypertension, dyslipidemia, polycystic ovary syndrome (PCOS), low birth weight**

Some points on screening for DM in children
• **Diabetes in children usually presents with classical symptoms. Random blood glucose (RBG) or Fasting blood glucose (FBG) are often sufficient to label them as diabetic. OGTT should be avoided if possible because that may result in very high blood glucose after oral glucose load.**
• **Children with obesity plus 1 or more risk factor should be screened at the age 10 years or at onset of puberty.** • **If normal then once in every 3 years.**
• **In many tropical countries, including Bangladesh, there is a substantial number of young lean diabetic cases with or without pancreatic calcification that are assigned as specific type of diabetes; previously they were called 'Malnutrition Related Diabetes Mellitus'(MRDM).**

Principles of diabetes management in childhood

PC M9 L4

Management of the diabetes in children needs special skill in this field. Three fundamental components of DM management in children:

- Drugs
- Diabetic education
- Medical Nutrition Therapy (MNT) and exercise

- They do not differ much from those of adults. However, they mostly need insulin because they are either of type 1 DM or of other types with severe insulin deficiency.

Targets of diabetes management

1. Glycemic targets				
Pre-meal (Fasting)	**Post-meal**	**Bed time**	**Hypoglycemia**	**HbA1c%**
5.0 - 8.0	**5.0 - 10.0**	**6.7 - 10.0**	**No**	**< 7.5**

Targets of 2. Growth and 3. Diabetic Education (DE)	
2. Growth	**Within +/- 2.5 SD of growth chart**
3. DE	**Teaching, training, and empowerment to take part in treatment such as SMBG & insulin administration**

MNT & drugs treatment of DM in children

PC M9 L5

MNT
• **A meal plan is based on the individual's usual food intake, insulin therapy, exercise patterns etc.**
• **Timing and amount of food will depend on type of insulin, physical activity, lifestyle and results of blood glucose monitoring.**
• **All children with diabetes should be referred to a dietitian for counseling at diagnosis of diabetes and also subsequently if they have problem with their diet adjustment. Age-specific calorie calculating charts are available for measuring diet allowance.**

Drugs for DM in children on the basis of type & age	
Type DM (Age)	**Drug**
T1DM (any age)	**Insulin only**
T2DM (<10 years)	**Insulin only**
T2DM (10-18 years)	**Insulin or metformin**
T2DM (>18 years)	**Insulin or metformin or other agents**

Diabetes education for young diabetic

PC M9 L6

- Diabetes education is fundamental in treatment of young diabetics. Diabetes education needs to be a continuous process and repeated for it to be effective.
- They are to be trained to develop skill in all aspects of diabetes, especially insulin injection technique, dietary practice, home monitoring of blood glucose etc.
- Providing emotional support is very important.

Diabetes education according to age group

Infants and toddlers

- They are totally dependent on parents and care providers for injections, food and monitoring.
- Advised to stop or minimize erratic eating and activity.
- Educated on prevention, recognition and management of acute complications, specially hypoglycemia, because it is very common complication in this age group. …..

School going children

- Taught insulin injections and blood glucose monitoring.
- Trained on recognizing hypoglycemic symptoms and understanding self management.
- Taught to adapt to school programs, school meals, exercise and sports.
- Teachers/school authority should be involved.
- The parents are advised on the gradual development of the child's independence. …..

Adolescents

- Independent, responsible self-management appropriate to the level of maturity and understanding should be promoted.
- Strategies to manage transition to adulthood and progressive hand-over of responsibility are to be developed.

Sports and exercise of young diabetics

- Children with type 1 diabetes with good blood glucose control can do all levels of exercise, including leisure activities, recreational sports, and competitive professional performance.
- Exercise is more important for young type 2 diabetic, specially who are obese. The emphasis must be on adjusting the therapeutic regimen with the level of exercise and diet, and avoiding hypoglycemia.
- Extra attention and support of parents, teachers, school attendants and trainers may be necessary. …..

Sport and exercise according to age group

3-5 years	**May take part in free play, walking, running etc.**
6-9 years	**May start learning to play team sports such as football, cricket etc.**
above 10 years	**May be able to take part in all complex sports, like basketball, football, tennis, hockey etc.**

- In the case of adolescents, hormonal changes can contribute to the difficulty in controlling blood glucose levels. So extra care is required for exercise in the age group.

Hypertension & dyslipidemia in children

PC M9 L7

Hypertension in the young with DM

- Hypertension in childhood is defined as systolic or diastolic blood pressure >95th percentile for age, sex and height.
- 'High-normal' blood pressure is defined as systolic or diastolic blood pressure >90th but <95th percentile for age, sex and height. …..
- Treatment of high-normal blood pressure is given through lifestyle measures. If target blood pressure is not reached within 3-6 months, pharmacologic treatment should be initiated.
- Drug treatment should be started as soon as hypertension is confirmed. ACE inhibitor is the preferred agent. The goal of treatment is a blood pressure consistently <90th percentile for age, sex and height.

Dyslipidemia in the young with DM

- A fasting lipid profile should be performed in children ≥10 years of age soon after diagnosis of DM (after diabetes control).
- If lipid is abnormal, annual monitoring is advised.
- If in acceptable limit (LDL <100 mg/dl), 3-5 yearly monitoring is recommended.
- Initial therapy includes blood glucose control and MNT.
- After the age of 10 years, statin is recommended in patients who do not reach target with lifestyle changes. The goal of therapy is an LDL <100mg/dl.

DM in the older people

PC M9 L8

- The definition of old age is arbitrary. 60 years may be taken as beginning of old age. People over 60 years of age form about 15% of total population globally.
- Among total diabetics of the world, 60-year group constitutes about 35%. And among total population over 65 years of age, 25% are diabetics.
- So they are putting a great impact on general as well as in diabetic populations.

Health status of older people			
	Apparently good health	Intermediate health	Poor health
Life expectancy	More	Intermediate	Less
Physical/mental fitness	More	Intermediate	Less
Independence	More	Intermediate	Less
Management	Less relaxed	Intermediate	More relaxed

- For diagnosis of DM, all general recommendations apply for those in good health. Those with intermediate/poor health, testing should be done when clinically indicated, by simpler procedures, eg RPG, FPG or HbA1c.
- Management of DM in old people depends on their health status determined by life expectancy, physical and mental fitness, and independence.

Treatment goals are set according to health status		
Health status	Pre-meals (Fasting) (mmol/L)	HbA1c%
Good	7.2	< 7.5
Intermediate	8.3	< 8.0
Poor	10.0	< 8.5

- Contribution of PPBG at all HbA1c levels is higher compared to FBG in older people.

MNT & physical activity in older people

PC M9 L9

Points to consider for MNT

- Swallowing or eating difficulties may be present.
- Adequate fluid is to be ensured to avoid dehydration.
- Malnutrition or weight loss should be taken care.
- Tube feeding or parenteral nutrition may be needed in some. …..

Points to consider for physical activity

- Older people are encouraged to be active as condition allows, from regular exercise to simple home-based mobility.
- Risk assessment should be done before recommending activity.
- Risk of injury with fall and hypoglycemia is to be considered.
- Physical (physio-) therapy may be needed for some.

Drug treatment of DM in older people

PC M9 L10

- ‘Start low, go slow’, applicable to most medications.
- Agents which preferentially lower postprandial hyperglycemia may be more effective in achieving glycemic goals without increasing the risk of fasting hypoglycemia.
- Swallowing difficulty may limit oral drug intake.

- Metformin is first-line therapy. Metformin may cause unintended weight loss and higher gastrointestinal side-effects.
- Among sulfonylureas, glibenclamide has the highest risk of hypoglycemia; gliclazide has the lowest. Glibenclamide should be avoided. …..
- Glinides and AGI may be considered in postprandial hyperglycemia. Glinides are also useful in erratic eating habits.
- Insulin may provide anabolic benefit in frail ones. Long acting insulin analogue is safe and efficacious in older people.
- DPP-4 inhibitor/GLP-1 agonist may also be considered.
- Rapid/short acting insulin targets post-prandial blood glucose better.
- Visual, motor and cognitive impairments may hamper insulin injection. Insulin pen devices can simplify administration.
- Complex regimens should be avoided to reduce errors

Acute emergencies & comorbidities

PC M9 L11

- Hypoglycemia and sick day management plan should be strengthened.
- Older people are more prone to hypoglycemia. BG <6.0 mmol/L is to be avoided.
- HbA1c <7.0% should be taken as warning of possible over-treatment.

Causes of hypoglycemia in elderly

- Polypharmacy
- Erratic meals and unusual activity
- Renal, hepatic impairment
- Malabsorption, swallowing problems
- Defective counter regulatory system, antecedent/unaware hypoglycemia
- Cognitive impairment, less expression of symptoms

Hyperglycemia & comorbidities

- Like hypoglycemia, timely recognition and management of hyperglycemic emergencies (DKA, HHS) in older people must be ensured.
- Comorbidities of DM in older people include cognitive impairment, falls, pain, arthritis, fractures, hearing impairment, functional disability, urinary incontinence, obesity, stroke, CHF, periodontal disease, cancer, depression, hypertension, dyslipidemia etc. All these should be addressed as much as possible.

Hyperglycemia (DM) & pregnancy

PC M9 L12

- Pregnancy with hyperglycemia is a high risk health status. Care must be given with an aim to make pregnancy as safe as in a non-diabetic state for both the expectant mother and the baby.
- Such a goal is feasible if blood glucose can be maintained to a non-diabetic level throughout the pregnancy.
- Diabetes in pregnancy has associations with acute as well as chronic maternal and foetal complications. …..
- Good diabetic control throughout pregnancy as well as improved neonatal management has lead to a reduction in the incidence of morbidity and mortality associated with pregnancy in diabetic women.
- Spontaneous abortions and congenital anomalies are seen much less when good diabetic control has been established prior to conception and maintained during the first 6-8 weeks of pregnancy.
- Multidisciplinary preconception care improves the outcome of pregnancy in terms of both the mother and the baby.

DM & pregnancy: types & problems

PC M9 L13

- Two types of diabetes during pregnancy:
  - **Pre-pregnancy diabetes mellitus** - woman is a known diabetic before she becomes pregnant
  - **Gestational diabetes mellitus (GDM)** - glucose intolerance is detected first time after the woman becomes pregnant
- Diabetes during pregnancy is mostly due to GDM. Recent global prevalence of hyperglycemia in pregnancy (both pre-pregnancy and GDM) is about 17% of live births; 84% of those are due to GDM.

Problems of pregnancy in diabetes in the mother

- Pregnancy loss - abortion/intrauterine death
- Pre-eclampsia, eclampsia, polyhydramnios
- Difficulty in diabetes control
- Deterioration of pre-existing complications, e.g. retinopathy, nephropathy etc.

Problems of pregnancy in diabetes in the baby

- Macrosomia [birth weight above 4500 grams (some prefer 4000 grams as cut-off), or above 90th percentile for gestational age] caused by chronic maternal hyperglycemia causing fetal hyper-insulinism that results in excessive fat deposition and organomegaly. It affects 15-45%pregnancies.
- Intra-uterine growth retardation. Neonatal hypoglycemia due to sudden withdrawal of maternal glucose at birth in presence of fetal hyper-insulinism. It affects 25-40% pregnancies.
- Polycythemia and hyperbilirubinemia, partly due to response to relative hypoxia in utero. …..

- Neonatal hypocalcemia due to functional hypoparathyroidism.
- Respiratory distress syndrome due to delayed maturation of the enzyme machinery for synthesis of lung phospholipids.
- Congenital malformations (2-6 times higher than non-diabetic pregnancies; these are much higher for some particular malformations), eg cardiac or renal anomaly, caudal regression, CNS defects etc.

Pre-pregnancy diabetes

PC M9 L14

- Pregnancy in all women with known diabetes must be pre-planned. Diabetic women of child bearing age and desirous of pregnancy, must be thoroughly counseled.
- Pre-conception counseling must include intensive education about:
  - Importance of tight glycemic control before and during pregnancy
  - Medical nutrition therapy, physical activity
  - Skill on insulin injection techniques, home monitoring of blood glucose
  - Need for close and regular follow-up

Pre-conception treatment of DM

- Oral anti-diabetic agents and other non-insulin injectable agents must be discontinued.
- The women are managed with lifestyle modification and insulin (if necessary) to achieve tight metabolic control, which is defined by HbA1c <6.5%.
- At all times blood glucose should be within the target. If the control is not within goal, pregnancy plan should be postponed until target is achieved.
- They should be investigated and treated for complications of diabetes or any associated illnesses prior to pregnancy.

GDM & its screening

PC M9 L15

- Any degree of glucose intolerance with onset or detection for the first time during pregnancy is called GDM. Placental hormones are responsible for the development of GDM.

Risk factors for GDM

- Previous history of GDM
- Age ≥25years
- Bad Obstetric History (BOH) eg delivered baby Large for Gestational Age - LGA (>9lb/4 kg at term delivery) or Small for Gestational Age SGA (< 5.5lb/2.5 kg at term delivery), abortion, stillbirth or difficulty to conceive
- Excessive weight gain during pregnancy
- Others: BMI >23 kg/m^2, A1C ≥5.7%, IGT or IFG, physical inactivity, first degree relative with DM, hypertension, HDL <35mg/dl, TG >250mg/dl, PCOS, acanthosis nigricans, history of CVD

Schedule of screening for GDM

- **At 1st prenatal visit:** If there is one or more risk factors of DM (or mother wants to know her status)
- **During 24-28th weeks of gestation:** In all pregnancies (mandatory).
- **During 34-36th weeks of gestation:** for negative cases during 24-28 weeks of gestation and there is one or more risk factors of DM (optional).

Diagnosis of GDM

PC M9 L16

- OGTT with 75 gms of glucose drink and 3 samples (fasting, 1-hour and 2-hour) glucose assay is the standard test.
- One or more value (s) above cut off is considered positive. …..

Diagnosis of GDM/overt DM (based on ADPSG, ADA & WHO criteria)		
FBG	**<5.1 mmol/L** **5.1-<7.0 mmol/L** **≥7.0 mmol/L**	**Normal** **GDM** **Overt DM**
1 hr PG (75 gm OGTT)	**<10.0 mmol/L** **≥10.0 mmol/L** **No specific value**	**Normal** **GDM** **Overt DM**
2 hr PG (75 gm OGTT)	**<8.5 mmol/L** **8.5-<11.1 mmol/L** **≥11.1 mmol/L**	**Normal** **GDM** **Overt DM**
RPG (with symptoms of hyperglycemia)	**No specific value** **≥11.1 mmol/L**	**GDM** **Overt DM**
HbA1c%	**No specific value** **≥6.5%**	**GDM** **Overt DM**

Targets & checkup schedule

PC M9 L17

Targets of diabetes management during pregnancy (based on ADA guideline)		
Glycemic targets	**Blood (plasma) glucose**	• **Fasting/pre-meal <5.3mmol/L** • **1 hour post-meal <7.8 mmol/L** • **2 hour post-meal <6.7 mmol/L**
	HbA1c	**< 6.0% (once in each trimester)**
	Hypoglycemia	**No**
Blood pressure		• **Systolic 110-135 mm of Hg** • **Diastolic <85 mm of Hg**
Weight gain		**10-15 kg(for person with normal weight & singleton pregnancy)**

Diabetic education	Mother (& family member)	Teaching, training & empowerment to take part in management (SMBG & insulin injection)

Check-up schedule of diabetic pregnancy

(both pre-pregnancy diabetes and GDM)

Follow-up schedule	Follow up at clinic	Once every two weeks up to 30th gestational week and thereafter once every week.
	Team care	Office treatment should comprise of a team of specialists - diabetologists, obstetricians and nutritionists.
Important antenatal check-up	check-up in addition to SMBG audit	• Retinal and renal assessment - 1st visit • Detailed ultrasound (anomaly scan) - 20th week; ultrasound monitoring of fetal growth and amniotic fluid volume - 28thweek • Tests of fetal well-being - 38th week. (Some of these are repeated periodically)

Lifestyle & drugs treatment

PC M9 L18

MNT	Calorie requirement	Daily total calories intake is to be 30 kcal/kg of ideal body weight in first trimester, and 38 kcal/kg of ideal body weight thereafter.
	Calorie distribution	Carbohydrate 50-60%, fat 30%, protein 10-20% (protein may be increased in exchange of carbohydrate).
	Nutrient supplements	Adequate supplementation of iron, folic acid and calcium.
	Meal pan	• Major meals: breakfast, lunch, dinner. • Snacks: mid-morning, mid-afternoon and bedtime (Bedtime snack is essential to prevent fasting ketonuria).
Physical activity		Moderate physical activity should be encouraged.

Drug therapy

Insulin	Insulin is the only drug recommended for use in pregnancy.
	Insulin therapy should be instituted if dietary compliance fails to maintain glycemic target or blood glucose is much higher.
	In pre-pregnancy diabetes shift from OAD to insulin when pregnancy is planned.
	Insulin is started at a dose of 0.2-0.5 u/kg day. Human short and intermediate acting insulins, and insulin analogues aspart, lispro and detemir are recommended during pregnancy.
	Dose requirement will show increasing trend with duration of pregnancy, specially in mid-pregnancy. Multiple dose insulin therapy can better attain target of blood glucose levels.
SMBG	SMBG is required to maintain tight glycemic control.

Delivery & hypoglycemia of newborn

PC M9 L19

Timing & mode delivery

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Term vaginal delivery	Term vaginal delivery is feasible in most diabetic pregnancies by meticulous control of diabetes, modern obstetric technology, monitoring of fetal well-being (by studying fetal heart rate) and lung maturity (by testing amniotic fluid).
Delivery considered earlier	Delivery may be considered earlier in presence of unfavourable conditions, e.g. uncontrolled diabetes, hypertension, chronic diabetic complications, pre-eclampsia, foetal growth retardation, etc.
Caesarean section	Caesarean section is usually required if the foetal weight >4.5 kg.

Diabetes management during labor and delivery

During delivery	Blood glucose should be between **4.0-6.9 mmol/L** in order to prevent neonatal hypoglycemia. It is best achieved by continuous glucose-insulin infusion, because it is essential to meet the energy expenditure of active labour. Blood glucose should be monitored hourly.
After delivery	The infusion is stopped immediately after the delivery of the baby. During this time regular insulin in small dose is given before meals in pre-pregnancy diabetics; pre-pregnancy regular schedule of insulin may be started when the condition is fully stable. In almost all GDM cases insulin is not at all required after delivery; they become euglycemic. There is about 65% chance of developing GDM in subsequent pregnancy. In all GDM cases OGTT should be done 6-12 weeks after delivery; if it is normal, OGTT should be repeated every 3-year, as these group of individuals are at high risk of future diabetes (50% in 10 years).

Hypoglycemia in newborn

Risk	All newborns of diabetic mothers have risk to develop hypoglycemia
Check up	Blood glucose levels must be checked by heel prick within 30-60 minutes of birth and continued at regular intervals until one is sure that there is no risk for hypoglycemia.
Definition	Neonatal hypoglycemia is defined as blood glucose level less than 40 mg/dl.
Treatment	If the glucometer readings are between 25 and 40 mg/dl, 10-15 ml of 10% glucose is given orally; repeated if necessary and feeding is started as soon as possible.
	If the glucometer readings are less than 25 mg/dl, intravenous 10% dextrose at the rate of 6 mg/kg/minute is started. Bolus doses are to be avoided as this may stimulate the already overactive pancreas to secrete more insulin and add to the problem.
	Blood glucose monitoring is continued until the danger of hypoglycemia is completely over, usually in 24 hours; sometimes it may take 72 hours.

Summary

PC M9 L20

There are 18 sections in this module 8. I understand the following points:

- The basic principles of management of diabetes mellitus in the young population.

- The basic principles of management of diabetes mellitus in the older people.
- The basic principles of management of diabetes mellitus during pregnancy.

Further reading

- Text Book of Diabetes, 4th edition, edited by Richard I G Holt, Clive S Cockram, Allan Flyvbjerg & Barry J Goldstein, Wiley-Blackwell, 2010
- Standards of Medical Care in Diabetes, ADA (American Diabetes Association), 2018.
- Global IDF (International Diabetes Federation) /ISPAD(International Society for Pediatric & Adolescent Diabetes) Guideline for Diabetes in Childhood & Adolescence, 2011.
- Global Guideline for Managing Older people with Type 2 Diabetes, IDF (International Diabetes Federation),2013.
- Diagnostic Criteria & Classification of Hyperglycemia First detected in Pregnancy, WHO (World Health Organization), 2013.
- International Association of Diabetes & Pregnancy Study Groups Recommendations on the Diagnosis & Classification of Hyperglycemia in Pregnancy, Diabetes Care, volume 33, number 3, 2010.
- Diabetes and Pregnancy, an Endocrine Society Clinical Practice Guideline, 2013.

Thank you