MODULE-10

CCD batch-32

Objective

PC M10 L1

- To enumerate the basic principles of management of diabetes mellitus during surgery.
- To highlight the special care during days of sickness.
- To focus on the special aspects of Ramadan fasting.
- To discuss on prevention of diabetes mellitus.

DM in special situations

PC M10 L2

- Sicknesses like fever, vomiting and diarrhoea; fasting during Ramadan, and surgery in a diabetic person are considered as special situations in this chapter.
- During these periods the routine day-to-day management of diabetes needs to be adjusted.
- Surgery in diabetic persons is associated with increased prioperative complications. Surgery can be made safe with optimal care of diabetes.
- During sick days and Ramadan fasting, control of diabetes needs special attention to overcome the interruptions in lifestyle.

Surgery	Sickness like fever, vomiting & diarrhoea	Fasting during Ramadan
		

Surgery & DM

PC M10 L3

- Surgery in diabetic persons has associations with increased risk of per-operative and post-operative complications compared to those in non-diabetic persons.
- This is due to the involvement of their vital organs including the autonomic nervous system in the course of the disease.
- With optimal care, a surgery can be safe in diabetics. Necessary surgical procedures should not be avoided due to diabetes.

Some key points regarding surgery of diabetic persons

- Poor metabolic control results in acute metabolic complications by the surgical stress which may endanger life.
- The infection, if develops, tends to become virulent; it further worsens the metabolic stability, thus creates a vicious cycle.
- Hyperglycemia itself leads to impaired wound healing, deficient formation of granulation tissue and thereby poor tensile strength of collagen. The fibroblast formation takes longer time and there is a deficient capillary growth into the wound. The chemotactic, phagocytic and bactericidal activity of the neutrophil is deficient. There is impaired humoral host defense mechanism and abnormal complement function.
- Aim should be to have optimal control of diabetes in all diabetics undergoing surgery. This may not be always feasible, especially in an emergency situation.

Factors to be considered during planning surgery

- Type of diabetes mellitus
- Treatment - diet, oral anti-diabetic drugs, insulin etc.
- Metabolic status
- Vascular status - mainly cardiac, also renal and cerebral
- Neurological status - specially of autonomic nervous system
- Type of surgery - emergency or elective; minor or major procedure
- Type of anesthesia
- Post-operative oral intake

General principles of management (Step 1 & 2)

PC M10 L4

The general principles for safe surgery in diabetic persons is to follow some stepwise actions. There are 5 steps of actions.

Steps of management for surgery for person with DM	
Steps	**Actions**
1	**Pre-operative assessment**
2	**Actions of day prior to surgery**
3	**Actions of day of surgery**
4	**Actions during operation**
5	**Post-operative care**

Steps 1 and 2 are pre-operative assessment and actions of day prior to surgery respectively

Step 1. Pre-operative assessment for surgery for person with DM	
1	**Pre-operative assessment must be done in close consultation with the physician, surgeon and anesthetist.**
2	**It should include assessment of any diabetic complications or associated conditions, which may increase surgical risk, eg cardiac autonomic neuropathy.**

Step 2. Actions of day prior to surgery for person with DM	
1	**Long acting secretagogues and biguanides should be changed prior to surgery.**
2	**For major surgeries, the patient may be kept nil per oral (NPO) over-night prior to surgery; in patients with gastroparesis, the duration of NPO should be around 10-12 hours.**

General principles of management (Step 3,4 & 5)

PC M10 L5

Steps 3, 4 and 5 are actions on day of surgery, action during surgery and post-operative care respectively.

Step 3. Actions of day of surgery for person with DM	
1	**Anti-diabetic medications are omitted on the morning of the operation.**
2	**Surgery should be scheduled as early as possible in the morning.**
3	**In all major surgeries glucose-insulin infusion should be started. The unit of insulin to be added to 5 or 10% dextrose or dextrose saline needs to be individualized and adjusted as per the results of the glucometer readings. Blood glucose should be monitored 1 to 2 hourly; it should be in the range of 6.0-10.0 mmol/L. Glucose-insulin-potassium infusion may be considered according to situations.**
4	**During minor surgery glucose-insulin infusion may sometimes be required in uncontrolled diabetes, but not in stable state.**

Step 4. Actions during operation for person with DM	
1	The choice of the anaesthetic agent is best left to the anaesthetist; there is no preferred choice of anaesthetic agent for diabetics.
2	Cardiovascular status should be closely monitored during surgery.
3	The glucose-insulin administration is continued where it is required; it is guided by blood glucose monitoring.

Step 5. Post-operative care for person with DM	
1	The glucose-insulin administration is continued (where required) till the patient is able to take oral, food.
2	At this time, if the blood glucose is not under fair control, short acting insulin can be given in small doses.
3	Once patient is back on his/her routine diet and is stable, he/she can be managed with the regimen he/she was on prior to surgery.

Specific strategies of surgery with DM
PC M10 L6

- Four different strategies are followed in 4 different types of situations as described in the following table.

1	For minor surgery in well controlled DM
2	For major surgery (requiring over-night NPO)
3	For poorly controlled DM
4	For emergency surgery

1. Strategies for minor surgery in well controlled DM	
1	Patient on short acting secretagogues and/or insulin should omit breakfast and the morning dose. The drug(s) should be restarted once patient is back on routine diet after operation.
2	Patient on long acting secretagogues should replace with shorter acting secretagogues at least 5 days prior to surgery.
3	Per-operative glucose-insulin drip is usually avoided.

2. For major surgery (requiring over-night NPO)	
1	Diabetes should be controlled by insulin.
2	Per-operative glucose-insulin drip is essential.
3	In the post-operative period, once diet is resumed, patients usually do better with short acting insulin therapy.
4	Restarting of the patent's previous regimen can be done once the patient is fully stable.

Strategies for poorly controlled DM & in emergency

PC M10 L7

3. Strategies for poorly controlled DM	
1	Insulin is used to control diabetes in all types of operations.
2	Hospitalization of the patient at least 3 days before operation.
3	Short acting insulin is preferred; but this also depends on type of DM and operation etc.
4	Per-operative glucose-insulin drip is required, especially in major surgery.

4. Strategies for emergency surgery	
1	Patient is hospitalized.
2	Insulin infusion is started and frequent monitoring of blood glucose is done.
3	Electrolytes, acid base status and urinary ketone levels are checked.
4	If feasible surgery is delayed till blood glucose comes below 20 mmol/L and ketonuria disappears.
5	If delaying is not possible, operation with intensive management of diabetic sate is to be done.
6	Other managements according to general principles of emergency surgery should be followed.

DM management on sick days

PC M10 L8

- During illnesses like fever, vomiting or diarrhoea, a diabetic person often develops hyperglycemia and ketosis, and sometimes hypoglycemia.
- To prevent these, certain management principles are followed. These are:

Tests, calorie intake & medicine			
Glucose & ketone		Intake of fluid & food	Anti-diabetic medicine
			

• **Frequent tests for blood glucose & ketone in urine**	• **Sufficient intake is necessary to maintain fluid balance.** • **If the blood glucose is low, sweetened fluids, eg fruit juice is to be given to avoid hypoglycaemia.** • **If blood glucose is elevated, low calorie soft drinks, soup or broth may be given.**	• **The anti-diabetic agents should not be stopped altogether;** • **Dose of insulin / secretaguges may need to be reduced.** • **Longer acting secretaguges may need to be replaced by shorter acting ones or insulin.** • **In case of vomiting or diarrhoea metformin/ alfa-glucosidase inhibitors are withdrawn temporarily.**

Some key points on sick days' management

The principles of sick days are to be followed until the blood glucose is <12 mmol/L and ketone diminishes or disappears.

- In situations with fever, the infective focus should be treated.
- Treatment for vomiting/diarrhoea may also be required.
- Hospitalization is considered if:
  - Vomiting or diarrhoea persists for longer than 6 hours
  - Sick for 2 days and not getting better
  - Moderate ketonuria persists despite treatment
  - Blood glucose remains above 14 mmol/L
  - Moderate ketonuria persists despite treatment
  - Very young individual
  - Abdominal pain
  - Hyperventilation
  - Co-existing serious diseases

Ramadan fasting & diabetes mellitus

PC M10 L9

More than 50 million people with diabetes worldwide fast during Ramadan. During fasting a Muslim must abstain from eating, drinking, use of oral medications, parenteral rehydrating or energy providing fluid or medication, and smoking from predawn (Sahur/sehri) to sunset (Ifter).

- However, there are no restrictions on food or fluid from ifter to sehri.
- Diabetic patients are at risk of harmful consequences due to the changes in pattern and amount of food and fluid intake during Ramadan.

Harmful consequences associated with fasting

Hypoglycemia (7.5 fold increase in severe hypoglycemia in T2DM)

- Hyperglycemia (5 fold increase in severe hyperglycemia in T2DM)
- Ketoacidosis
- Dehydration
- Thrombosis
- Severity of the risk in an individual ie categorization depends on factors namely diabetic control, treatment regimen and co-existing disease.

Categories of risk in DM for Ramadan

PC M10 L10

There are 4 categories of risk in patients with diabetes who fast during Ramadan these are as follows (as per ADA consensus).

Risk categories	Features
Very high risk group	• **Severe hypoglycemia within the last 3 months prior to Ramadan** • **Patient with history of recurrent hypoglycemia** • **Patient with hypoglycemia unawareness** • **Patient with sustained poor glycemic control** • **Ketosis within the last 3 months prior to Ramadan** • **Type 1 DM** • **Acute illness** • **Hyperosmolar hyperglycemic coma within the last 3 months** • **Patients who performs intense physical labour** • **Pregnancy** • **Patient on dialysis**

Risk categories	Features
High risk group	• **Patient with moderate hyperglycemia (average blood glucose between 150 and 300 mg/dl, HbA1c 7.5-9.0%)** • **Patients with renal insufficiency** • **Patients with advanced macrovascular complications** • **People living alone who are treated with insulin or sulphonylureas** • **Patients with comorbid conditions that present additional risk factors.** • **Old age with ill health** • **Drugs that may affect mentation**
Moderate risk group	• **Well controlled patients treated with short acting secretagogues such as repaglinide or nateglinide**
Low risk group	• **Well-controlled patients treated with diet alone, metformin or a thiazolidinedione who are otherwise healthy.**

- Diabetic people belonging to low and moderate risk group can perform Ramadan fasting and they have to follow general measures of management.
- People in very high risk group should observe the exemption for them regarding fasting.
- People in high risk group should consult a diabetologist to have an individual assessment before taking decision regarding fasting.

Management of diabetes during Ramadan
PC M10 L11

General considerations

- **Frequent monitoring of glycemic status:** Two important times are 2 hours after sehri and 1 hour prior to ifter. Testing at other times may also be done.
- **Nutrition:** In terms of calorie and composition, diet should remain same healthy and balanced as before Ramadan. Ingestion of large amount of foods rich in carbohydrate and fats during ifter should be avoided. A complex carbohydrate that is slow in digestion and absorption is good choice for sehri, while food with more simple carbohydrate may be taken during ifter. Sehri (pre-dawn meal) should be taken as late as possible.
- **Exercise:** Normal level of activity is recommended. Excessive physical activities may lead to hypoglycemia. Tarawih prayer can be considered as part of daily exercise program. Exercise between ifter and dinner may be undertaken.
- **Breaking the fasting:** If blood sugar goes <3.3 mmol/L (60 mg/dl) at any time, or <3.9 mmol/L (70 mg/dl) during first few hours of sehri, or > 16.7 mmol/L (300 mg/dl), and on sick days.
- **Medical assessment:** Glycemic status, BP and lipid profile are to be stabilized before Ramadan. Blood glucose must be checked after first few days of fasting to readjust the doses of the medications.

Specific measures for T2DM & T1DM
PC M10 L12

Type2 DM

- Patients on diet control only: risk during fasting is low.
- Patients on oral agents:
  - Risk of fasting hypoglycemia is low if on insulin sensitizers or DPP-4 inhibitors or GLP-1 agonists; but risk increases when secretagogues (specially longer acting) are used.
  - Biguanides: needs some dose adjustment.
  - Glitazones, DPP-4 inhibitors, GLP-1 agonists, alpha glucosides inhibitors: need no dose change.
  - Secretagogues: glimepiride/glicazide-MR/glinides are preferred preparations; sulphonylureas need some dose adjustment; glinides need no dose change.
- Patients on insulin: dose readjustment is to be made according to the type of insulin.
- Patients on once-daily-drug-regimen (OAD or insulin): the usual dose of antidiabetic agent can be taken at sun-set; sometimes the dose may need to be reduced.
- Patients on twice-daily-drug-regimen (OAD or insulin): the usual morning dose of antidiabetic agent is taken at sun-set; the evening dose is reduced to 50% and taken at

dawn.

- Patients on thrice-daily-drug-regimen (OAD or insulin):
  - The total dose of metformin is divided into two-thirds which is to be taken at sun set, and one-third at dawn.
  - In case of rapid acting insulin or glinides the usual dose can be taken with meals.
  - Short acting insulin is to be taken twice daily with larger share at sun-set.
- Patients on basal-bolus (4 times) insulin regimen: long acting insulin may be taken at sunset in reduced dose with rapid acting ones 2-3 times with meals (may be in reduced dose).

Prevention of DM

PC M10 L13

Diabetes mellitus, a chronic debilitating disease, is associated with a range of severe complications.

- Prevention of diabetes is feasible and is evident in many studies done in various countries.
- Prevention means preventing or delaying diabetes as well as the complications both in terms of beginning and progression.
- The prevention is done by modifying the modifiable risk factors.

Types of DM Prevention		
Primary prevention	**Secondary prevention**	**Tertiary prevention**
Refers to avoiding the onset of the disease (diabetes)	**Means early detection of diabetes and prompt initiation of treatment to prevent complications of diabetes.**	**Aims to delay and/or prevent further progression of the diabetic complications.**

Primary prevention

PC M10 L14

Type 2 diabetes is the commonest form of diabetes.

- Although a heterogeneous disorder, progression from insulin insensitivity to pre-diabetes, then to diabetes is now well understood.
- The risk factors for type2 diabetes are: a) aging, b) family history of type2 diabetes, c) over-weight/obesity, d) physical inactivity e) pregnancy, f) intra-uterine and early childhood malnutrition g) stress and h) smoking.
- Except age and family history all others are amenable to modification.
- Many of these risk factors are common for other non-communicable diseases (NCDs).

Primary prevention of type 2 DM

Prevention of type 2 DM is important because:

- It is the most prevalent type of diabetes.
- It is putting on tremendous burden:
  - Rapidly and enormously rising number.
  - Acute and chronic complications; 50% patients present with chronic complications.
  - 15% patients have depression.
  - 8.4% of global all-cause mortality. …..
  - Economic impact- diabetics spend 10.8% of total health expenditure globally.
  - Diabetes care is still suboptimal; less than one-third patients achieve target HbA1c.
- It has recognizable pre-diabetic stage.
- It has identifiable risk factors.
- It is preventable by simple measures.
- It is part of NCDs having shared risk factors and benefit of prevention.
- There is now substantial evidence that type 2 DM can be prevented and its complications can also be prevented or delayed. Identification of individuals at risk of developing diabetes can be done effectively. Diabetes prevention programs focus on lifestyle modification, specifically modest weight loss and increased physical activity.

Approach to primary prevention of DM

PC M10 L15

Primary prevention can be achieved through two basic approaches:

A. Population approach

B. High-risk group approach

A. Population approach

A.1. Creation of mass awareness

- Incorporation of basic information in school text book curriculums
- Use of mass media, eg newspapers, radio, television etc.
- Use of social organizations, eg religious institutes, voluntary organizations etc.

A.2. Care of risk factors

- Creation of facilities for performing physical activities, like sports, gyms etc.
- Promotion of healthy eating habits, like campaign against 'fast food culture' etc.

B. High-risk group approach

This approach of primary prevention is in fact a clinical approach where physicians perform the following activities …..

B.2. Measurement of risk

It is possible to identify and stratify people at increased risk based on age, BMI, waist

circumference, activity level, family history etc.

B.3. Intervention

It is done by ensuring weight management, regular physical activity, medical nutrition therapy and even by using drugs (like metformin) to modify the risk factors.

Risks of type 2 DM in Asian countries

Bangladesh and other Asian countries are at higher risk of type 2 diabetes and its complications because:

- Risk of type 2 DM starts at lower BMI
- More prone to abdominal obesity, low muscle mass and insulin resistance
- Higher visceral or subcutaneous fat despite lower waist circumference or BMI
- Urbanization – rapid nutritional transition, reduced physical activity, mental stress
- Increase in smoking …..
- Intra-uterine or early childhood malnutrition
- Increased prevalence of GDM, risking mother and baby
- Chronic arsenic exposure
- Genetic susceptibility
- Earlier age of onset of DM

- Asian people are more vulnerable to some complications eg CAD, stroke, nephropathy, some malignancies and all cause mortality. Therefore, countries of this region should adopt their national policy to prevent diabetes mellitus.

Primary prevention of type 1 DM

For type 1 diabetes genetic and immunological markers are available but these are costly.

- It is not feasible to use them for population-based identification, but specific high-risk groups can be screened. The cost effectiveness, and social and moral issues of such screening activities remain unclear.
- Some suggested strategies include encouraging breast-feeding, use of antioxidants and beta cell rest by giving insulin to individuals with identified genetic and immunological markers.
- As yet there is no evidence to suggest that type 1 diabetes can be prevented, but none-the-less efforts continue, as it is a goal worth pursuing.

Secondary prevention of DM

PC M10 L16

Early detection of diabetes and prevention of micro- and macroangiopathies in a diabetic person is termed secondary prevention. Studies documented that approximately 50% of type 2 diabetic patients already have complications at detection of their diabetes. Early detection of diabetes to initiate its treatment thereby to halt or delay these complications is the aim of secondary prevention. …..

- Diabetes awareness in the community and amongst physicians to enhance the routine screening of population at risk is important. Screening should be considered in all individuals ≥40 years of age, and if normal should be repeated every 3 years. Screening should be done at a younger age and/or more frequently in those with BMI ≥25 kg/m^2 plus one or more additional risk factors of diabetes (in the previous table). Testing in pre-diabetics should be done yearly. …..

Target of secondary prevention of diabetes

Parameters	Target
Fasting /pre-meal PG	**<6.0 mmol/L**
Post-meals PG	**<8.0 mmol/L**
HbA1c	**<7.0%**
LDL cholesterol	**<100 mg/dl**
HDL cholesterol	**>40 mg/dl (male) & >50 mg/dl (female)**
Triglyceride	**<150mg/dl**
Blood pressure	**Systolic <140 & Diastolic <80 mm of Hg**
Body weight	**BMI <25kg/M^2** **Waist circumference (WC) <90 cm (male) & <80cm (female)**
Diabetic education	**Teaching, training & empowerment to take part in treatment**

- Such an approach is cost effective, as costs of treating complications resulting from undiagnosed and untreated diabetes are great.
- Several factors have been identified as risk factors that are associated with deterioration of multiple organ function in a diabetic person. In addition to glycemic. control, strict control of blood pressure delays/prevents development of retinopathy, nephropathy and cardiovascular diseases; control of lipid abnormalities improves coronary, cerebrovascular and peripheral vascular complications. Cessation of smoking, weight control and physical activity are beneficial.

Tertiary prevention of DM

PC M10 L17

Interventions designed to minimize consequences of diabetes and help rehabilitation fall under this category. Here attempts are directed to contain damage by aggressive therapy to arrest or delay progression of complications. Each complication may be addressed with special objectives and strategies reducing morbidity and mortality. …..

Screening for complications

- **Type 1 DM**
  - At or after 5 years of diagnosis (or earlier); then every year (in absence of complications)
- **Type 2 DM**
  - At diagnosis; then every year (in absence of complications)

Effective strategies of tertiary prevention

Prevention of lower limb amputation

- Improved foot care
- Reduction of risk factors
- Control of hyperglycemia, etc.

Prevention of cardiovascular disease

- Control of hypertension
- Control of dyslipidemia
- Cessation of smoking
- Control of hyperglycemia, etc. …..

Prevention of renal disease

- Control of hypertension
- (When necessary) low protein diet
- Control of hyperglycemia, etc.

Prevention of blindness

- Control of hypertension
- Laser photocoagulation
- Control of hyperglycemia, etc.

- Diabetic complications account for 60% of diabetes related health care costs (direct costs) and almost 80-90% of indirect costs. Preventing complications is therefore not only beneficial to individuals but also to the society as a whole. Economic analysis from the different studies

has shown that prevention programs are cost effective. Other studies also have shown that simple measures, like education and awareness also help.

- Comprehensive care of diabetes with patient education and awareness about complications can bring about a remarkable reduction in blindness, end-stage renal diseases (ESRD), lower extremity amputation and cardiovascular events.

There are 16 sections in this module 10. I understand the following points:

- The basic principles of management of diabetes mellitus during surgery.
- The special care during days of sickness.
- The special aspects of Ramadan fasting.
- How to prevention of diabetes mellitus.

- Text Book of Diabetes, 4th edition, edited by Richard l G Holt, Clive S Cockram, Allan Flyvbjerg & Barry J Goldstein, Wiley-Blackwell, 2010
- Davidson's Diabetes Mellitus- Diagnosis & Treatment, 5th edition, edited by A P Harmel & R Mathur, Saunders, 2004.
- Clinical Diabetes- Translating Research into Practice, 1st edition, VA Fonseca, Saunders, 2006.
- Standards of Medical Care in Diabetes, ADA (American Diabetic Association), 2018.
- Recommendations of Management of Diabetes during Ramadan, Update 2010, Diabetes Care, volume 33, number 8, 2010.
- Prevention of Diabetes Mellitus, WHO (World Health Organization) Technical Report Series 844, 1994.
- Development Programme for the Prevention & Care of Diabetes in Finland, Finnish Diabetes Association, 2001.

Thank you