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| Chapter title | Subchapter | Lesson | Content |
| Preventing and managing complications of diabetes | Overview of diabetes complications | Complications of diabetes are more likely to develop when blood glucose is not controlled | * Common complications of diabetes include diseases of the large blood vessels (macrovascular disease) and of the small blood vessels (microvascular disease), including retinopathy (eye disease), nephropathy (kidney disease) or neuropathy (nerve damage or disease).      * Persistent hyperglycaemia is strongly associated with the development of diabetes-associated complications. For this reason, it is important that individuals with diabetes keep their blood glucose levels close to the normal range. * Unfortunately, diabetes complications are typically asymptomatic until they have progressed to an advanced stage. Early detection is therefore critical to allow for early intervention that can help to delay progression of disease and to improve quality of life for people with diabetes. |
| Macrovascular complications | Macrovascular disease is a common complication of diabetes | * Macrovascular disease affects the large blood vessels in the body, such as the coronary arteries and the principal arteries in the brain and limbs. It includes both cardiovascular diseases (such as ischaemic heart disease and peripheral artery disease) and cerebrovascular diseases (such as stroke). * Macrovascular complications affect more than 10% of people with diabetes and are sometimes present at diagnosis of type 2 diabetes. * The main disease mechanism is atherosclerosis, which is thickening or hardening of the arteries via an accumulation of fatty deposits, cholesterol and other products in artery walls. As a result, blood vessels become stiff, sometimes reducing blood flow to the organs and tissues. * Cardiovascular disease is a leading cause of mortality for people with diabetes, with approximately half of diabetes deaths attributable to cardiovascular disease. * Risk for developing cardiovascular disease increases with higher fasting plasma glucose levels.      * By contrast, hypoglycaemia may also be associated with increased risk of cardiovascular disease due to reduced blood flow in the heart and electrical disturbances. Chronic hypoglycaemia may accelerate the development of cardiovascular disease and atherosclerosis and may exacerbate ischaemia in the brain, increasing the risk of stroke. * Keeping blood glucose as close to the normal range as possible is therefore critical to reduce risk for cardiovascular complications. |
| Type 2 diabetes and cardiovascular disease share some common risk factors | * Diabetes is an independent risk factor for cardiovascular disease. Additionally, many conditions and lifestyle factors that are common in people with type 2 diabetes are risk factors for cardiovascular disease.      * Cardiovascular risk factors should be routinely assessed and modifiable risk factors should be managed where appropriate. For example, all individuals with diabetes should be advised to stop smoking, increase their physical activity, and manage overweight and obesity as detailed in the chapter on “Lifestyle management for people with diabetes”. * Blood glucose levels should also be carefully managed to achieve appropriate glycaemic targets.   Reflection question: Do you routinely assess your patients with diabetes for additional cardiovascular risk factors? |
| Hypertension is the most common modifiable risk factor for macrovascular disease | * Hypertension is common in people with diabetes, with around two-thirds of people meeting the diagnostic criteria. People with diabetes and unmanaged hypertension are four times more likely to develop heart disease than people who have neither condition. * This means regular screening and treatment, where appropriate, is important. Blood pressure (BP) should be measured using an appropriately sized cuff at every clinic visit. The patient should be in a seated position, having rested for at least 5 minutes. * Hypertension treatment is indicated in people with diabetes when either systolic blood pressure is ≥130 mmHg or when diastolic blood pressure is ≥80 mmHg, or when both systolic and diastolic blood pressures are above the threshold values. |
| Lipid levels should be assessed regularly and treated where necessary | * Higher levels of LDL-cholesterol are associated with increasing cardiovascular risk. Low HDL-cholesterol and high triglycerides are also associated with increased cardiovascular risk. * Screening for dyslipidaemia should be carried out at diagnosis and every 1–2 years from age 40 onwards. * To date, interventions to reduce LDL-cholesterol levels are the only ones shown to improve cardiovascular outcomes, making them the primary target of lipid-modifying therapy.      * Lifestyle modifications have some efficacy in improving lipid levels. These include the reduction of saturated fat, trans fat and cholesterol intake, as well as an increased intake of omega-3 fatty acids and viscous fibre, combined with weight loss (if indicated). * Statins are recommended by the WHO for all people with type 2 diabetes aged 40 years or older, but only if this does not negatively impact access to glucose-lowering and blood pressure-lowering medication.   Reflection question: What proportion of individuals with type 2 diabetes aged 40 or over are prescribed statins in your clinic? |
| Antiplatelet therapy is recommended for secondary prevention of cardiovascular disease | * Use of antiplatelet treatment, such as aspirin, is recommended only for secondary prevention of cardiovascular events, even for people with diabetes. * Individuals with diabetes who have survived a cardiovascular event should be prescribed 75–100 mg of acetylsalicylic acid (aspirin) daily, provided they have no history of major bleeding. * Regular aspirin treatment is associated with a significant reduction in serious cardiovascular events in people with diabetes and existing cardiovascular disease. * If aspirin is not tolerated, clopidogrel 75 mg/day should be prescribed. Both aspirin and clopidogrel are included in the WHO model list of essential medicines. |
| Meet Tia, a 65-year-old woman with type 2 diabetes | Let’s reflect on what we have learnt so far in this chapter and begin to put learnings into practice.    Tia is a 65-year-old woman with type 2 diabetes. She was diagnosed 12 months ago with a fasting plasma glucose of 8.1 mmol/l (146 mg/dl) and obesity, but no other comorbidities. 12 months later, Tia reports for her annual diabetes review. While discussing lifestyle, Tia mentions she struggles to follow a healthy diet and often finds herself snacking on unhealthy foods. She reports not having the time or energy for physical activity, so this is not part of her routine.  Vital signs  Weight: 88 kg  Height: 157 cm  BMI: 35.7 kg/m2  Fasting plasma glucose: 7.8 mmol/l (141 mg/dl)  HbA1c: 7.7% (61 mmol/mol)  **Family history**   * History of cardiovascular disease on maternal and paternal sides   + Mother had history of transient ischaemic attack   + Father died of myocardial infarction aged 79 years   **Reflection questions**   * What risk factors does Tia have for cardiovascular disease? * Which of her cardiovascular risk factors are modifiable? How would you address these risk factors? * What additional tests could you run to determine Tia’s cardiovascular risk? * Regardless of her cardiovascular risk, are there any medications beyond glucose-lowering medications that Tia should be prescribed?   **Now that you have reflected on these questions, see below for an example of how you could respond.**  Tia has several risk factors for cardiovascular disease, some of which are modifiable and others that are not. Her modifiable risk factors that we are aware of include obesity, hyperglycaemia and lack of physical activity. Other modifiable risk factors could include hypertension and dyslipidaemia. Tia’s non-modifiable risk factors are older age and a family history of cardiovascular disease.  To have a comprehensive understanding of Tia’s cardiovascular risk, further tests should be carried out. These include blood pressure check (carried out at every clinic visit) and screening for dyslipidaemia (carried out every 1–2 years).  The WHO advises that everyone with diabetes over the age of 40 should be prescribed a statin, provided this does not limit their access to glycaemic-lowering medications. |
| Overview of microvascular complications | Microvascular complications include nephropathy, neuropathy and retinopathy | * Other complications of diabetes typically involve the microvascular system via damage to small blood vessels in different organs of the body. This type of complication may arise in the eye (retinopathy), the kidney (nephropathy) or the nerves (neuropathy). * Microvascular complications have different levels of severity, from subclinical stages to terminal end stages (blindness, amputation, end-stage renal disease), and each develop with variable rates of progression and symptoms.      * In their late stages, microvascular complications are associated with a significant reduction in quality of life and increase in healthcare costs. * For this reason, targeted screening efforts to identify complications at a point when treatment can help to delay progression of disease are of the utmost importance for every person with diabetes. |
| Microvascular complications: kidney disease | Nephropathy is a common complication of diabetes associated with albuminuria | * Nephropathy describes deterioration of kidney function. It is a common microvascular complication of diabetes associated with a persistent decline in glomerular filtration rate. This is often called diabetic kidney disease. * Up to 40% of people with diabetes will develop some degree of nephropathy during their lifetime, with rates particularly high in Asian populations.   Reflection question: What proportion of your patients with diabetes have a diagnosis of nephropathy?   * The role of the kidneys is to filter and clean blood to remove waste products. They are also responsible for reabsorption of water, glucose and proteins. Kidneys that are working optimally do not excrete albumin, a protein found in the blood, into urine. * Over time, hyperglycaemia causes damage to the kidneys making it possible for larger molecules such as albumin to pass through the capillary walls.      * Nephropathy is characterized as albuminuria, which is the presence of excess albumin in urine, and/or a decreased estimated glomerular filtration rate. Higher albumin concentrations in urine are associated with worsened kidney function. |
| There are multiple tests for diagnosing diabetic kidney disease | * Early stages are often asymptomatic with the earliest clinical signs being elevated blood pressure and moderately increased urine albumin excretion. * Therefore, people with diabetes should be screened once a year with either the albumin/creatinine ratio in a spot urine sample or with estimated glomerular filtration rate (eGFR) using serum creatinine. * Watch Professor Kamlesh Khunti to learn more about diabetic kidney disease and how to screen and diagnose it.   **<<INSERT VIDEO HERE>>**  Reflection question: How often are you screening your patients with diabetes for kidney disease? |
| The onset and progression of diabetic kidney disease can be delayed | * If left untreated, diabetic kidney disease is characterized by a continuous decline in eGFR, increased arterial blood pressure, and high risk of cardiovascular disease and mortality. Once the stage of proteinuria is reached, renal failure occurs after approximately 5 to 7 years if left untreated.      * The main pharmacological treatments for albuminuria are ACE inhibitors or angiotensin II receptor blockers (ARBs). These treatments should not be combined. * End-stage renal disease requires renal replacement therapy (either haemodialysis, peritoneal dialysis or renal transplant). |
| Individuals with reduced kidney function may have specific medical needs | * As kidney function declines, it is important to regularly monitor kidney function. eGFR is a helpful clinical tool to do this.      * Some medications need to be adjusted based on estimated kidney function.   + Metformin treatment should be stopped if eGFR is <30 ml/min/1.73 m2.   + No dose adjustment is required for gliclazide or glipizide. Glimepiride should be started conservatively at 1 mg daily in people with CKD stages 3, 4 and 5 (without dialysis).   + No dose adjustments are required for insulin. |
| Microvascular complications: retinopathy | Retinopathy is very common in people with diabetes and is a leading cause of blindness if left untreated | * Retinopathy, or diabetic eye disease, is a highly specific microvascular complication of diabetes and is a leading cause of vision loss in both working-age adults and older adults. * Compared with other complications, retinopathy can usually be delayed or prevented if identified promptly due to advances in screening and treatment. * Despite this, diabetic retinopathy is very common. About 75% of people with type 1 diabetes and 50% of people with type 2 diabetes develop retinopathy in their lifetime. Additionally, 25% of people with type 2 diabetes may develop diabetic macular oedema, which is a leading cause of blindness. |
| Prolonged hyperglycaemia is a risk factor for development of diabetic retinopathy | * Diabetic retinopathy occurs because prolonged hyperglycaemia can lead to blockage of the small blood vessels supplying the retina, cutting off its blood supply. This can result in early-stage eye complications collectively known as non-proliferative retinopathy. * If new blood vessels develop to restore blood flow to the retina, this is classified as proliferative retinopathy. Often the new blood vessels don’t develop properly and can leak fluid into the retina from small bulges called microaneurysms. The fluid can cause swelling in a part of the retina called the macula – this is known as diabetic macular oedema. * Risk factors for development of diabetic retinopathy are outlined in the figure below.      * Management of blood glucose levels and blood pressure have been shown to be effective in preventing vision loss due to diabetic retinopathy. * Beyond retinopathy, diabetes is also associated with an increased risk of other vision-threatening conditions, including cataracts and glaucoma. |
| Screening is an important tool in the prevention and detection of retinopathy | * Diabetic retinopathy is often asymptomatic in the early stages. Vision loss only occurs at advanced stages. Consequently, regular screening is critical for early identification and treatment. * People with type 2 diabetes should be screened for retinopathy by a trained person upon diagnosis, and every 2 years thereafter, or as recommended by an ophthalmologist, for:   + visual acuity and   + direct or indirect ophthalmoscopy (dilated pupils) or retinal fundus photography. |
| Retinopathy is treatable if identified early | * Diabetic retinopathy should always be treated in specialist care. Timely treatment of retinopathy with laser photocoagulation, a type of laser eye surgery, can reduce the risk of vision loss. * In advanced proliferative retinopathy, some recovery of visual acuity can be achieved by vitrectomy, a surgery to remove some or all of the vitreous humour from the eye. * Anti-vascular endothelial growth factor (anti-VEGF) treatment, administered via an intravitreal injection, can prevent some visual loss in diabetic macular oedema. * Glycaemic management is important to prevent development and worsening of retinopathy. However, abrupt tightening of blood glucose levels may cause deterioration in vision. For this reason, it is important to lower blood glucose levels gradually in patients with diabetes and retinal changes. |
| Microvascular complications: neuropathy | Diabetic neuropathy is a complication associated with prolonged hyperglycaemia | * Diabetic neuropathy, or nerve damage, can present in a variety of ways. The most common include:   + autonomic neuropathy (affecting the autonomic and central nervous systems)   + distal symmetrical peripheral neuropathy (predominantly sensory). * As with other microvascular complications of diabetes, diabetic neuropathy is primarily a consequence of prolonged hyperglycaemia. * Other risk factors include:   + dyslipidaemia   + smoking   + older age   + diabetes duration * Signs and symptoms of diabetic neuropathy are shown below. Patients with suspected autonomic neuropathy should be referred to specialist care. |
| Loss of sensation is a known precursor for foot ulcers and amputation | * Peripheral diabetic neuropathy is common and may be present in as many as 50% of people with diabetes. It affects the feet and legs first, followed by the hands and arms. * Peripheral neuropathy is one of the major causes of foot ulcers and amputations in people with diabetes. Other causes include peripheral artery disease and significant trauma. * Neuropathy leads to reduced sensation and sometimes foot deformities, causing abnormal loading of the foot. For these individuals, minor trauma (e.g. caused by ill-fitting shoes) can go unnoticed and, without treatment, result in ulceration. * A diabetic foot ulcer is a localized injury to the skin and/or underlying tissue below the ankle. Disruption of the skin, such as a cut, makes it possible for microbes to colonize subcutaneous tissues. In many cases the wound becomes infected, requiring antimicrobial treatment and often surgical intervention. * Risk factors for diabetic foot ulcers are outlined in the figure below.      * Efforts should be made to prevent diabetic foot ulcers prior to development. There are five key elements that underpin efforts to prevent foot ulcers:  1. Identifying the at-risk foot 2. Regularly inspecting and examining the at-risk foot 3. Educating the patient, family and healthcare professionals 4. Ensuring routine wearing of appropriate footwear 5. Treating risk factors for ulceration  * Screening for peripheral neuropathy and other foot problems should be carried out at least once a year in people with diabetes. Screening involves asking patients about common symptoms and examination of the foot to assess loss of protective sensation. * Watch Dr SP Chan explain how to carry out a foot screening for people living with diabetes   **<<INSERT VIDEO HERE>>**   * If individuals have painful peripheral neuropathy they should be referred to specialized care for pharmacological pain management. Remember to remind patients about the importance of glycaemic management. |
| Foot screening frequency should depend on an individual’s risk | * In some cases, people with diabetes should be screened for foot disease more than once annually. Individuals at moderate risk should be screened every 3–6 months, and for those at high risk, every 1–3 months. * The table below details how to determine an individual’s risk level.      * People with diabetes should also be reminded of the importance of:   + good quality, well-fitting footwear   + not going barefoot   + regular foot care including keeping feet clean and doing regular self-inspections for cuts and/or blisters   + carefully cutting nails straight across and filing the edges to reduce risk of ingrown toenails   + getting regular treatment by a trained professional (podiatrist) for removal of callus, protection or draining of blisters, treatment of ingrown or thickened nails or fungal infections.   Reflection question: How often do you remind people with diabetes about the importance of good foot care? |
| Other health complications of diabetes | People with diabetes may experience sexual dysfunction | * Impaired sexual function is a frequent complication for both men and women with diabetes. Sexual dysfunction is associated with increased incidence of depression and worsened quality of life. * Erectile dysfunction is defined as the persistent inability to achieve or maintain an erection sufficient enough to permit satisfactory sexual intercourse. * Men with diabetes have around a 3.5-fold higher risk of erectile dysfunction than those without diabetes. Data suggest that more than 50% of men with diabetes also have erectile dysfunction, with prevalence increasing with age and duration of diabetes.      * Beyond sexual dysfunction, there is a direct correlation between erectile dysfunction and cardiovascular disease. Erectile dysfunction can precede the onset of coronary artery disease by 2–5 years. It can, therefore, present an opportunity for the early diagnosis of silent coronary artery disease and stroke. * Erectile dysfunction is also linked to other complications of diabetes and is known to be more frequent and severe in individuals with peripheral neuropathy and chronic kidney disease. * Understanding of sexual dysfunction in women with diabetes is less conclusive due to a lack of research and social taboos surrounding female sexuality. However, it is understood that women with diabetes report:   + loss of libido   + problems with orgasm   + reduced lubrication   + dyspareunia (pain during/after intercourse)   + lower sexual satisfaction than women without diabetes. * It is important to speak to people with diabetes about their sexual health when culturally acceptable to do so. |
| People with diabetes should be educated about the importance of oral hygiene | * Oral health describes the state of the mouth, teeth and orofacial structures (e.g. palate, nasal septum and cavity, tongue). Good oral health is important in maintaining eating habits and contributes to self-confidence, well-being and the ability to socialize and work without pain or embarrassment. * Periodontal disease is now recognized as a complication of diabetes. Chronic periodontal disease results in progressive destruction of the supporting tissues of the teeth, which may lead to tooth loss. It is known to be one of the most common reasons for tooth loss in people with diabetes. * People with diabetes have a twofold greater risk of developing periodontal disease compared to those without diabetes. This may be due to an increased inflammatory response coupled with impaired wound healing and repair. * Dental caries (tooth decay and cavities) are common causes of pain, infection and tooth loss. They are associated with worsened quality of life, poorer nutrition and potentially worsened glycaemic management. People with diabetes have higher incidence of dental caries than people without diabetes. * Increased blood glucose is associated with reduced salivary flow which increases the risk of developing plaque, tooth decay and gum disease. * To reduce the risk of oral diseases, everyone, including people with diabetes, should aim to practice good oral hygiene as outlined in the figure below. |