# Microvascular complications in diabetes



Microvascular complications are common and serious long-term consequences of diabetes, primarily due to the chronic hyperglycemia associated with the disease. These complications affect small blood vessels, leading to damage in several organ systems, notably the eyes, kidneys, and nerves. The pathophysiology of microvascular complications involves a combination of metabolic disturbances, including advanced glycation end products (AGEs), oxidative stress, and endothelial dysfunction, which contribute to vascular damage and dysfunction over time.

## Types of microvascular complications

- Diabetic retinopathy (DR)
  - Prevalence:
    - One of the most common causes of blindness in working age adults, affecting up to 80% of people with diabetes after 20 years of disease duration.
  - Pathophysiology:
    - Hyperglycaemia leads to endothelial cell dysfunction, increased vascular permeability, and retinal ischemia. These changes cause capillary leakage, neovascularization, and, eventually, retinal scarring.
  - Stages:
    - Background diabetic retinopathy
    - Non-proliferative diabetic retinopathy (NPDR)
    - Proliferative diabetic retinopathy (PDR)
    - Diabetic macular oedema (DME)
  - Screening:
    - Annual eye exams with fundus photography or dilated eye exams are recommended for all individuals with diabetes.

# • Diabetic nephropathy (DN)

- Prevalence:
  - A leading cause of end-stage renal disease (ESRD), with around 20-40% of patients with type 1 and type 2 diabetes developing nephropathy.
- Pathophysiology:
  - Chronic hyperglycaemia leads to the accumulation of AGEs, glomerular basement membrane thickening, mesangial expansion, and glomerulosclerosis. These changes result in albuminuria and progressive loss of kidney function.
- Stages:
  - Early stage: Microalbuminuria (30-300 mg/day)
  - Late stage: Macroalbuminuria (>300 mg/day)
- Screening:
  - Annual measurement of urinary albumin-to-creatinine ratio (ACR) and estimated glomerular filtration rate (eGFR) to detect early signs of nephropathy.

#### • Diabetic neuropathy

- Prevalence:
  - Affects approximately 50% of individuals with diabetes and is a major cause of morbidity, leading to pain, loss of sensation, and disability.
- Pathophysiology:
  - Hyperglycaemia induces metabolic and vascular changes that lead to nerve damage. These changes include the accumulation of sorbitol and fructose in nerves, which can cause osmotic stress and nerve injury. Additionally, poor blood glow due to vascular damage can impair nerve function.
- Types:
  - Peripheral neuropathy commonly presents as pain, tingling or numbness in the feet and hands
  - Autonomic neuropathy can affect various systems, including cardiovascular (e.g. orthostatic hypotension - blood pressure drops on standing increasing the risk of falls), gastrointestinal (e.g. gastroparesis), and genitourinary (e.g. erectile dysfunction).
- Screening:
  - Annual foot exams and assessment for neuropathic symptoms are recommended

#### **Risk factors**

- Chronic hyperglycaemia persistent high blood glucose levels are the most significant risk factor for the development of microvascular complications.
- Hypertension elevated blood pressure accelerates the progression of retinopathy, nephropathy, and neuropathy.
- Dyslipidaemia abnormal lipid levels, particularly elevated triglycerides, have been associated with an increased risk of microvascular complications.
- Duration of diabetes the longer the duration of diabetes, the greater the risk of developing microvascular complications.
- Genetic factors some individuals may be genetically predisposed to developing complications.
- Poor glycaemic control HbA1c levels >7% increase the risk of microvascular damage.

### Prevention and management

- Glycaemic control tight control of blood glucose (maintaining HbA1c below 7%) is important l for preventing or delaying the onset of microvascular complications.
- Blood pressure management Targeting blood pressure levels below 140/90 mmHg is recommended, with ACE inhibitors or angiotensin II receptor blockers (ARBs) being preferred for individuals with diabetic nephropathy.
- Lipid control statin therapy is recommended for the management of dyslipidaemia and to reduce cardiovascular risk, particularly for individuals over 40 years of age or with comorbid conditions.
- Regular screening:
  - Annual eye exams for diabetic retinopathy.
  - Regular monitoring of renal function (e.g., ACR and eGFR) for diabetic nephropathy.
  - Foot exams to detect diabetic neuropathy.
- Medications:
  - SGLT2 inhibitors and GLP-1 receptor agonists have shown benefits in improving both glycaemic control and kidney function.
  - Antioxidant and anti-inflammatory therapies are under investigation for their potential role in mitigating microvascular complications.

#### Summary

Microvascular complications in diabetes, including retinopathy, nephropathy, and neuropathy, significantly contribute to morbidity and mortality. Prevention and early detection through tight glycaemic control, regular screening, and management of associated risk factors such as hypertension and dyslipidaemia are key to reducing the burden of these complications. Continuous monitoring and tailored interventions are essential for improving long-term outcomes for individuals with diabetes.

#### References

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