Cardiovascular disorders and blood dyscrasias

Learning Objectives:

1. Identify the signs of retinal vascular disease

2. Understand the ocular effects of cardiovascular disease and blood dyscrasias

3. Recognise the risk factors of cardiovascular disease

4. Understand the importance of systemic treatment in the management of retinal vascular disease

Suggested Reading:

Kanski's Clinical Ophthalmology (6th Ed.) Chapter 16
Frank RN. Diabetic Retinopathy. *N Eng J Med* 2004;350:48-58
Recchia FM, Brown GC. Systemic disorders associated with retinal vascular occlusion. *Curr Opin Ophthalmol* 2000;11:462-467
Klein R, Klein BEK. The relation of systemic hypertension to changes in the retinal vasculature – The Beaver Dam Eye Study. *Trans Am Ophthalmol* Soc 1997;95:329-48

Overview
Clinical features
Hypertension
Retinal vein occlusion
Retinal artery occlusion
Blood dyscrasias

Clinical features of retinal vascular disease
Microaneurysms
Haemorrhages
Cotton wool spots
White-centred retinal haemorrhages
Vessel changes
Neovascularisation

Microaneurysms
Small round dark red dots on the retinal surface
Increasing numbers are associated with capillary occlusion
Retinal haemorrhages
Superficial nerve fibre layer ⇨ flame-shaped haemorrhages
Deeper layers of the retina ⇨ blot and dot haemorrhages
Subhyaloid space ⇨ boat-shaped pre-retinal haemorrhage
Cotton wool spots
Yellowish-white colouration of the retina
Swelling occurs because the blood supply is impaired – injuring the nerve fibres
Cotton-wool spot appearance

White-centred retinal haemorrhages

Neovascularisation
New vessels that grow tend to be poor quality and leak or rupture – causing blindness
Name according to their origin on the retina, disc or elsewhere

Hypertensive retinopathy
First described by Marcus Gunn in the 19th century in a series of patients with hypertension and renal disease
Also known for Marcus Gunn pupil (unilateral lesion in afferent pathway anterior to the chiasm)
50 years later reported that severity of retinopathy is an indicator of overall mortality
3-year survival 70% in subjects with generalised retinal arteriolar narrowing
6% in subjects with optic disc swelling
Spectrum of retinal vascular signs in people with elevated blood pressure
High blood pressure >140-160 systolic

- 90-95 diastolic

Pathology of hypertensive retinopathy
Systemic hypertension
Vasoconstrictive stage (retinal arteries constrict in response to a rise in blood pressure)
Focal narrowing of retinal arteries
Diffuse narrowing of retinal arteries
Sclerotic stage (intimal thickening, hyperplasia of medial wall)
Increase in arterial reflex (copper wiring)
Arteriovenous crossing changes
Exudative stage (disruption of BBB, necrosis of smooth muscle and endothelial cells)
Microaneurysms, haemorrhages, hard exudates and cotton-wool spots
Vasoconstrictive stage
Generalised retinal arteriolar narrowing
Sclerotic stage
Severe or accelerated hypertension
Sustained hypertension
Marked constriction of vessels and focal vessel damage
Leakage into vessel wall causes closure or further narrowing of arterioles and focal ischaemia of the retina
Changes in retinal blood vessels, optic nerve and choroidal vessels
Patient becomes
symptomatic
Exudative stage
Microaneurysms
Retinal haemorrhages (flame-shaped, blot and dot, boat-shaped)
Hard exudate
Cotton-wool spots
Occasionally get disc swelling

Complications
Retinal artery occlusions
Retinal vein occlusions
Ischaemic optic neuropathy
Retinal artery macroaneurysms
Choroidal infarcts

Why is it important to recognise and diagnose?
Diagnose hypertension
Severity of hypertension
Risk of other retinal vascular complications of hypertension (macroaneurysms, branch vein occlusions)
Associated with
Increased risk of stroke (2-4x)
Cognitive decline

Cardiovascular mortality

Retinal vein occlusion
Mechanism
Blockage of blood flow within the central retinal vein or branch retinal vein

Outside the wall – compressive e.g. related to raised IOP (compressing CRV as it passes through lamina cribiosa), AV crossing point
In the wall – vasculitic (phlebitis)
In the lumen – thrombotic (hypercoagulability)

Vascular risk factors
Age (typically middle-aged/elderly)
Hypertension (38-61%)
Smoking (51%)
Diabetes mellitus (13-15%)
Dyslipidaemia (32-57%)
Obesity
Male
Prev thrombo-embolic disease

CRVO
Present with sudden painless loss of vision
Initial fall in VA varies from 6/9 to HM
May have RAPD
Fundoscopy: flame, dot and blot haemorrhages, cotton wool spots, swollen optic disc and macular oedema

Management
Define whether perfused or nonperfused
Investigations including FFA
Systemic work-up for associated disease
Regular review
Consider treatment

Treatment
Improve VA
There is no consistently proven treatment to improve visual acuity
tPA/vein cannulation
laser induced chorioretinal anastomosis
radial optic neurotomy
Prevent neovascularisation
Laser retinal photocoagulation

Visual prognosis with CRVO
Initial VA is the strongest predictor of final VA

Branch retinal vein occlusion

Natural history and prognosis

Retinal artery macroaneurysm
Vascular dilation or outpouching of a retinal artery or arteriole
Primarily unilateral (10% bilateral)
Women > men
Age 60-70

50-75% have history of hypertension
Occur at bifurcations or AV crossings
Spontaneously involute
Treat if involve central vision (laser)

Retinal artery occlusion
Central retinal artery occlusion
Initially described by von Graefe in 1859
Acute blockage of blood flow within the central retinal artery
Cause acute and irreversible decline in visual acuity
Pathophysiology
Arteriosclerotic thrombosis
Vasculitis e.g. giant cell arteritis
Embolic impaction (platelet aggregates, cholesterol, calcium, fat, parasites, air)
Vasospasm
Systemic hypotension
Dissecting aneurysm within central retinal artery

> 75% have generalised atheromatous disease (frequently associated with diabetes ± hypertension)
Systemic associations
Central retinal artery occlusion
Presents with acute, unilateral, painless loss of vision occuring over seconds
10% have history of amaurosis fugax (transient visual loss)
RAPD usually present
Fundoscopy: superficial retinal whitening (develops over few hours), cherry red spot in the foveola
May have cilioretinal arterial sparing of foveola (10%)

Retina becomes milky because of infarction
Tissue necrosis makes the tissue lose its normal transparency
Red-orange colour of the fovea appears in stark contrast to the milky retinal oedema
Called a “cherry-red spot”

Retinal artery occlusion
Retinal intra-arterial emboli present in 20%:
Cholesterol (Hollenhorst plaque) – glistening yellow, typically from carotid arteries
Calcific – large white plaque, generally originates from cardiac valves
Fibrin-platelet – longer and dull white; may originate from carotids or cardiac valves
Management
Prognosis with CRAO
Poor visual outcome – usually worse than 20/200, often perception of light
Cilioretinal artery may allow retention of good central acuity
Risk of iris or angle neovascularisation
- approx 18% will progress to iris neovascularisation within 4-6 weeks after acute obstruction
- if iris neovascularisation develops consider laser panretinal photocoagulation (PRP) to help prevent neovascular glaucoma

Branch retinal artery occlusion
Acute blockage of blood flow within a branch retinal artery
Acute, painless, unilateral visual field loss
Prognosis good if fovea not involved (most patients improve to 6/12 or better without treatment, although corresponding field defect persists)

Blood dyscrasias
Changes in composition of blood
Vessel changes – calibre, colour, length & permeability
Also changes
in flow,
viscosity,
coagulation,
oxygen transportation, etc.,

Blood dyscrasias
Anaemias
Thrombocytopaenia
Hyperviscosity
Monoclonal gammopathy (e.g. Waldenstroms)
Polycythaemia
Multiple myeloma
Leukaemia

Clinical features
Flame haemorrhages and dot and blot haemorrhages
White-centred retinal haemorrhages (Roth spots)
Cotton wool spots
Vessel dilatation & tortuosity
Retinal exudate
Optic nerve swelling
Neovascularisation

Anaemias
Group of disorders characterised by either a decrease in the number of RBC, decrease in Hb, or both
Retinal changes usually innocuous and rarely of diagnostic importance
Characterised by: haemorrhages, cotton-wool spots and venous tortuosity
Ischaemic retinopathy in severe anaemia
36-year-old woman with severe megaloblastic anaemia (Hb 58, low B12, low folate)
Presented with decreased VA
VA and fundoscopy returned to normal after 28 days of treatment for anaemia
Leukaemias
Cancer of white blood cells (produced by bone marrow)
Described as acute or chronic, lymphoblastic (lymphocytes) or myeloid (monocytes or granulocytes)
Ocular involvement more common with acute forms
Any or all ocular structures may be involved
Leukaemic retinopathies
Complications related to anaemia, thrombocytopaenia, hyperviscosity
White-centred retinal haemorrhage, cotton wool spots, venous dilatation & tortuosity & pre-retinal haemorrhages
Peripheral retinal neovascularisation (chronic myeloid leukaemia)
Rarely, leukaemic pigment epitheliopathy secondary to choroidal infiltration – leopard spot retina
Opportunistic infections

Case
30 year old woman undergoing chemotherapy for acute leukaemia complained of dark patches in her vision
Severe anaemia with a haemoglobin concentration of 40
Haemorrhages

Cotton wool spots
White-centred haemorrhages
Resolved following transfusion

Sickle cell anaemia
Inherited disorder of haemoglobin
Point mutations of haemoglobin molecule
Causes intravascular 'sickling' of red blood cells when hypoxic
Occurs in African/ Mediteranean populations
Sickled red blood cells cause obstruction within retinal vasculature
Visual loss reported in 10-20% of eyes with sickle cell disease

Sickle cell retinopathy
Proliferative and nonproliferative
Nonproliferative
Salmon patch haemorrhage (oval-shaped area of intraretinal or preretinal blood)
Iradescent spot
Black sunburst lesion
Proliferative
Five stages
Proliferative sickle cell retinopathy
Peripheral arteriolar occlusion
Peripheral arteriovenous anastomoses
Neovascularisation ('sea fan')
Vitreous haemorrhage
Fibrovascular proliferation and traction
'Sea fan' neovascularisation

Key points
Recognise clinical features of retinal vascular disease
Recognise hypertensive changes
Retinal vein occlusion and retinal artery occlusion as causes of acute, unilateral, painless loss of vision. Recognise appearance of each
Treating the whole person not just the eye!