The European Society of Cardiology

Core Syllabus

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EUROPEAN SOCIETY OF CARDIOLOGY

ESC Core Syllabus

A learning framework for the continuing medical education of the general cardiologist

Prepared by the Education Committee of the European Society of Cardiology

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ESC Education Committee 2002 – 2004

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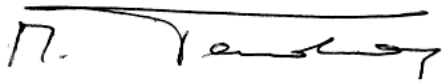
Foreword

It is with great pleasure that we present the European Society of Cardiology (ESC) Core Syllabus, a learning framework for the Continuing Medical Education (CME) of the cardiologist. The ESC has an important role in the education and training of cardiologists. The ESC Core Syllabus has been developed specifically to this end. It has been developed by the Education Committee of the ESC with strong support from the Scientific Department of the ESC, and is the fruit of many months' hard work and close collaboration with all the relevant ESC bodies, namely the Working Groups, Associations and Councils.

It is the best didactically orientated syllabus in the field of cardiology, representing a comprehensive guide for all teaching and training programmes in cardiology. The broad range of subjects covered in this work provide the basis that every cardiologist, whether in training or already professionally active, should strive to attain and keep current.

We hope that in the future, this syllabus will become the reference outline for all teaching material and courses in cardiology, and that it will be validated through widespread use as a basis for the teaching of cardiology. At the ESC, we also aim to ensure that educational activities in our discipline are organised in keeping with this guide, and that the syllabus itself is kept up-to-date, dynamic and in tune with scientific and technological advances in the field of cardiovascular disease. We hope that it will be an invaluable tool for you.

Jean-Pierre Bassand, President
European Society of Cardiology



Michal Tendera, President-Elect
European Society of Cardiology

Preface

The provision of Continuing Medical Education is a key activity of the European Society of Cardiology (ESC). In an ever-changing world it is important that the ESC defines the areas of clinical medicine in which the institution seeks a leadership role. The purpose of producing a Core Syllabus is to lay out the range of knowledge that the ESC would expect the European cardiologist to possess. This document is a driving force for the ESC to deliver educational resources to assist cardiologists in achieving appropriate educational goals.

Prof Roberto Ferrari
Chairman of the ESC Education Committee

Dr Peter Mills
Chairman of the ESC
Core Curriculum Subcommittee

Introduction

- The Continuing Medical Education (CME) of Cardiologists is a core component of the activities of the European Society of Cardiology (ESC).
- The Education Committee of the ESC, a group of European experts, has been given the task of identifying the core clinical knowledge for a general cardiologist or cardiovascular physician.
- The Education Committee of the ESC recognises the enormous effort National Societies invest in their educational activities, and the great value of these activities. The role of the ESC is to provide guidance, and to unify standards with respect to the content of knowledge for Cardiology and Cardiovascular Medicine in Europe.

Throughout this document, the words 'Cardiology' and 'Cardiovascular Medicine' should be regarded as synonymous.

(I) The Core Syllabus

The ESC Core Syllabus is a framework of the core clinical knowledge that a cardiologist needs to possess.

The Core Syllabus does not intend to cover entirely the expertise possessed by sub-specialists such as interventionalists, electrophysiologists or echocardiographers.

(II) The purpose of the Core Syllabus

The Core Syllabus provides a structure for the educational activities of the ESC both internally and in its external relations with other societies.

Internal role of the Core Syllabus

- The Core Syllabus is designed to serve as a platform to facilitate a structured approach to CME for cardiologists. The Education Committee will use the document to develop educational courses and products accordingly.
- The development of Euro Heart Surveys.
- The development of Clinical Practice Guidelines.
- It is also hoped that over a period of years the contents of the Core Syllabus will assist in defining the structure of the educational sessions at the annual ESC congress.

External role of the Core Syllabus

- To assist in standardising the breadth and content of teaching and learning in cardiology delivered by the National Societies.
- To present the scope of the knowledge that cardiologists and trainees are required to learn and develop to be a practising cardiologist.
- To influence the political agenda with respect to medical education in Cardiovascular Medicine, thereby improving patient care throughout Europe.

(III) Contents of the Core Syllabus

- Recent developments in the basic sciences with respect to Cardiovascular Medicine must be a part of the Core Syllabus.
- It is important that cardiologists should be educated in the appropriate selection of both non-invasive and invasive diagnostic procedures as well as being competent to carry out these procedures where relevant.
- ESC Guidelines, where available, are referred to at the end of each chapter.
- To remain sensitive to developments in cardiology and allied specialties in the field of Cardiovascular Medicine, the Core Syllabus does require to be constantly updated. This concerns drug treatments and interventional and surgical treatments.

(IV) Relationships with other committees

- The ESC Education Committee has consulted on

the contents of the Core Syllabus with the Working Groups and Associations of the ESC and the National Societies of Cardiology. The constituent groups of the ESC will be consulted each time the content of the document is updated.

(V) European Board for Accreditation in Cardiology (EBAC)

The role of EBAC is to assure a high level of quality in international CME and Continuing Personal Development (CPD) in cardiology programmes throughout Europe. It is hoped that the Core Syllabus will facilitate the cooperation of EBAC and the ESC Education Committee in developing educational guidelines.

(VI) Future development

The Core Syllabus is the first stage in the process of the development of a Core Curriculum, an objective for the ESC over the coming years.

The Core Curriculum will be an expansion of the Core Syllabus based on educational objectives. It will specify learning, teaching and assessment methods.

There are many generic skills that a physician needs to acquire. Those of particular importance to the CME of cardiologists include:

- Team leading skills.
- Communication skills with respect to both patients and colleagues.
- Appropriate handling of ethical and legal issues.
- Managing the relationship between the specialist and trainee cardiologists.
- Financial planning and management skills.

It is anticipated that the identification of appropriate teaching, learning and assessment methods would be developed in collaboration with EBAC.

Roberto Ferrari and Peter Mills

Acknowledgements

The editor acknowledges the work of current and previous Education Committees of the ESC in the drafting and revision of this document and is very grateful to them for their individual and collective efforts.

The Working Groups of the ESC and National Societies of Cardiology have been consulted throughout the development of this document and the editor wishes to thank them for their valuable contributions.

1 Non-invasive Imaging – Echocardiography, CMR, CT and Nuclear Techniques

1.1 Purpose

- To obtain diagnostic images by non-invasive means of cardiac structure and function. The quality of images from non-invasive techniques is constantly improving.

1.2 Principles

The clinician has four modalities from which to select:
- Ultrasound
- Cardiac Magnetic Resonance
- Conventional X-rays
- Radio-nuclear Imaging

1.3 Imaging and measurements of cardiac structure and function

- Ventricular chamber and wall dimensions
- LV mass
- Ventricular volumes
- Ejection/regurgitant fractions
- Calculation of shunt size
- Calculation of valve stenosis
- Estimation of valvular regurgitation
- Estimation of LV diastolic function
- Calcification of coronary arteries
- Myocardial perfusion
- Myocardial disease
- Pericardial disease
- Cardiac tumours
- Congenital heart disease
- 'Non-invasive coronary angiogram'

1.4 Summary table of non-invasive imaging

(See over)

Table 1 Summary table of non-invasive imaging

	Echocardiography	**CMR**	**CT**	**Nuclear**
Principles	Ultrasound	Cardiac Magnetic Resonance	X-ray	Radio-nuclear Imaging
Techniques	M-mode 2-dimensional (2D) mode Doppler imaging Contrast echocardiography	2D mode Perfusion imaging Late enhancement	2D 3D	Planar angiography SPECT Gated SPECT Gated blood pool SPECT PET
Indications	Volumes and shunt Ejection fraction LV mass Chamber and wall dimensions Valvular stenosis Valvular regurgitation LV Diastolic function Congenital heart disease	Volumes Ejection fraction LV mass Shunt	Ca^{++} CAD	Myocardial perfusion Viability RV and LV volumes Ejection fraction Phase analysis Shunt
Modalities	Transthoracic echo Transoesophageal echo Stress test	Cine-MR MR angiography T1 imaging	Ultra-fast CT Coronary angiogram	Rest metabolism Stress
Future developments	3-dimensional (3D) mode Myocardial imaging Intracardiac echo			MIBG Adrenergic reserve

2 Invasive Imaging – Cardiac Catheterisation and Angiography

2.1 Equipment

- X-ray tube and radiation exposure
- Catheters
- Pressure recording setting
- Oxygen analysis

2.2 Percutaneous techniques of catheterisation

- Right side of the heart
- Left side of the heart
  - Transseptal approach

2.3 Measurements during cardiac catheterisation

- Pressure measurements
- Blood oxygen
- Catheter position
- Flow and shunt calculations
- Ventricular volume
- Resistance
- Valve area calculations

2.4 Selective angiography

- Filming techniques
- Contrast media
- Uses of cardiac angiography
  - Left ventriculography; assessment of ejection fraction and wall motion
- Assessment of valve regurgitation
- Current indications

2.5 Selective coronary arteriography

- Techniques; angiographic views
- Indications and contraindications
- Interpretation: lesions; dominance; collaterals; coronary artery anomalies; fistula; limitations
  - Right coronary artery
  - Left coronary artery
  - Saphenous vein grafts and internal mammary arteries
- Complications

2.6 Coronary blood flow and pressure assessment

- Measurements of flow; Doppler flow
- Fractional flow reserve
- Hyperaemic stimuli
- Intracoronary blood flow and ischaemia

3 Genetics

3.1 The molecular basis for genetic transmission

3.1a Deoxyribonucleic acid (DNA); genes; chromosomes

3.1b Ribonucleic acid (RNA) and protein synthesis

3.1c Origin of genetic disease

3.1d Genetics of single gene disorders

- Types of mutation and genetic heterogeneity
- Mendelian transmission
- Genetic penetrance and expressivity
- Patterns of inheritance (autosomal dominant; autosomal recessive; X-linked and mitochondrial inheritance)

3.1e Polygenic inheritance of cardiac disease

3.2 Chromosomal mapping and identification of a disease-related gene

3.3 Clinical evaluation for genetic disease

- Family history
- Pedigree chart
- Genetic counselling

3.4 Cardiovascular disease due to single gene mutations

3.4a Hypertrophic cardiomyopathy

3.4b Pompe's disease (Type II glycogen storage disease)

3.4c Leopard syndrome

3.4d Friedreich's ataxia

3.4e Dilated cardiomyopathy

- Idiopathic dilated cardiomyopathy
- X-linked dilated cardiomyopathy
- X-linked cardioskeletal myopathy (Barth's syndrome)
- Familial arrhythmogenic right ventricular dysplasia

3.5 Muscular dystrophies with cardiac involvement

3.6 Metabolic defects causing cardiomyopathy

3.6a Carnitine deficiency

3.6b Phytanic acid storage disease

3.6c Medium-chain acetyl-CoA dehydrogenase deficiency

3.6d Fabry's disease

3.6e Homocystinuria

3.7 Mitochondrial cardiomyopathies

3.8 Connective tissue disorders

3.8a Marfan's syndrome

3.8b Ehlers–Danlos syndromes

3.8c Familial aneurysms

3.8d Cutis laxa

3.8e Pseudoxanthoma elasticum

3.9 Primary disorders of rhythm and conduction

3.9a Romano–Ward long QT syndrome

3.9b Jervell–Lange–Nielsen LQTS

3.9c Familial atrial fibrillation

3.9d Wolff–Parkinson–White syndrome

3.9e Autosomal dominant atrioventricular block

3.10 Cardiovascular disease associated with chromosome abnormalities

3.10a Down's syndrome

3.10b Turner's syndrome

3.10c Catch 22 syndrome

3.10d Shprintzen velo-cardio-facial syndrome

3.11 Gene therapy

3.11a Principles of gene therapy

3.11b Vector systems (viral vectors; non-viral vectors)

3.11c Therapeutic target

3.11d Animal models: transgenic technology

4 Clinical Pharmacology

For each of the classes of drugs listed below, consider the following aspects:

- Classification and chemistry
- Mode of action
- Pharmacokinetics
- Adverse effects and toxicity
- Interactions
- Indications
- Contraindications
- Practical aspects
- Pharmacodynamics: receptors
- Pharmacokinetics: absorption; bioavailability; distribution; biotransformation; excretion
- Pharmacogenetics
- Statistical principles of clinical trials on cardiovascular drugs; evidence-based therapy

4.1 Angiotensin-converting enzyme inhibitors

4.2 Angiotensin receptor blockers

4.3 Antiarrhythmic drugs

4.4 Anticoagulants

4.5 Antiplatelet agents

4.6 Beta-blockers

4.7 Calcium antagonists

4.8 Digitalis

4.9 Diuretics

4.10 Inotropic drugs

4.11 Nitrates

4.12 Statins

4.13 Other cardiovascular drugs

4.14 Other lipid-lowering drugs

4.15 Other vasodilating drugs

4.16 Drugs in development

5 Cardiovascular Disease Prevention – Risk Assessment and Management

5.1 Definition of risk factors

- Concept of primary and secondary prevention

5.2 Risk assessment in primary prevention (i.e. a strategy to reduce the risk of coronary artery disease in the general population), multifactorial risk interaction: risk scoring charts

- Categories of absolute risk
  - High-risk individuals
  - Intermediate-risk
  - Low-risk

5.3 Smoking

- Cardiovascular effects of smoking
- Effects on cardiovascular morbidity and mortality; risk stratification
- Objectives of treatment: primary and secondary prevention of adverse events
- Smoking cessation programmes
- Nicotine replacement therapy
- Effects of smoking cessation on prognosis
- Practice recommendations

5.4 Dyslipidaemia

- Definitions and epidemiology
- Classification, metabolism and biological actions of serum lipids and lipoproteins
  - High LDL-cholesterol
  - Low HDL-cholesterol
  - Hypertriglyceridaemia
- Effects on cardiovascular morbidity and mortality (e.g. promotion of atherogenesis)
- Measurement of lipid profile number and timing of readings
- Risk stratification
- Objectives of treatment in primary and secondary prevention
- Dietary management; atherogenic diet
- Main classes of lipid-lowering drugs (clinical trials, cost-effectiveness, indications and contraindications, adverse effects)
- Selection of treatment regimen for individual patients taking into account concomitant diseases

5.5 Diabetes mellitus (see also Chapter 7)

- Definitions and epidemiology
- Pathophysiology of diabetes mellitus and impaired glucose tolerance
- Diabetes and other vascular risk factors: lipoprotein disorders, thrombosis, advanced glycosylation end-products
- Effects on cardiovascular morbidity and mortality
- Identification of patients at risk of diabetes mellitus
- Risk stratification
- Objectives of treatment (primary and secondary prevention of adverse events)
- Dietary management
- Main classes of oral hypoglycaemic agents and insulin formulations (clinical trials, indications, contraindications, benefits, adverse effects)
- Selection of treatment regimen for each patient (including targets for blood glucose and blood pressure control)

5.6 Hypertension (see also Chapter 6)

- Definitions and epidemiology
- Pathophysiology: sympathetic nervous system; renin–angiotensin–aldosterone system; endothelin; nitric oxide; insulin resistance; genetic factors
- Effects on cardiovascular morbidity and mortality
- Diagnosis of hypertension: measures of blood pressure; ambulatory monitoring

- Evaluation of patients: cardiac; renal; vascular
- Practice recommendations of the Joint National Committee for Detection, Evaluation and Treatment of High Blood Pressure
- Objectives of treatment (primary and secondary prevention of adverse events)
- Treatment: dietary management; lifestyle modifications; antihypertensive drugs
- Comorbidity and other risk factors

5.7 Physical inactivity

- Definition of physical activity and fitness
- Assessment of physical activity and fitness
- Relationship between physical activity and cardiovascular disease
- Effects of exercise on cardiovascular risk factors (e.g. blood pressure, lipids, diabetes, body weight, mortality and morbidity)
- Application and monitoring of physical activity

5.8 Left ventricular hypertrophy (LVH)

- Definitions: ECG definitions; echocardiographic definitions
- Prevalence: population studies; predictors (age, systolic blood pressure)
- Pathology: anatomical distribution of hypertrophy; changes in cardiac myocyte size; myocardial fibrosis; reduction in capillary density; diastolic and systolic dysfunction
- Prognostic implications (Framingham study): association with overall and cardiovascular mortality; heart failure; acute myocardial infarction; ischaemic heart disease contribution to risk in individuals and populations
- Clinical features: exertional dyspnoea; angina; palpitations; sustained cardiac impulse
- Diagnosis: 12-lead ECG; chest X-ray; echocardiography
- Treatment objectives
  - Regression of LVH: primary and secondary prevention of CV events, improvement of cardiac function

5.9 Obesity

- Definitions and epidemiology
- Pathophysiology of obesity: early- and late-onset obesity; significance of fat distribution, body mass index and waist–hip ratio; impact of gender
- Effects on cardiovascular morbidity and mortality (e.g. promotion of ischaemic heart disease, association with diabetes, dyslipidaemia and hypertension)
- Risk stratification
- Objectives of treatment: weight control; reduction of cardiovascular risk
- Dietary management
- Exercise programmes
- Weight-reducing drugs
- Selection of treatment regimen (target weight, calorie intake, physical activity)
- Management of obesity in children
- Practice recommendations

5.10 Other factors

5.10a The mind and the heart

- Role of the mind in CAD: psychological stress; personality characteristics
- Role of the mind in hypertension: epidemiological and experimental studies
- Behavioural treatment of hypertension
- Role of the mind in arrhythmias: effects of emotional stress on cardiac rate and rhythm; association between psychological stress and arrhythmias; psychological disturbances associated with sudden death and implantable cardiac defibrillators

5.10b Psychosocial factors

5.10c Homocysteine levels

5.11 ESC Guidelines

European Guidelines on Cardiovascular Disease Prevention in Clinical Practice – Executive Summary: *Eur Heart J* 2003; 24(17): 1601–10 (this document is also published in the *European Journal of Cardiovascular Prevention and Rehabilitation* 2003; 10(4): S1–S10)

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

6 Hypertension

6.1 Definition and epidemiology of essential hypertension

6.1a Definitions of hypertension

6.1b Epidemiology

- Distribution of SBP and DBP across populations; changes with age
- Public health aspects of hypertension
- Circadian rhythms

6.2 Aetiology of essential hypertension

6.2a Social and environmental aspects

- Obesity

6.2b Possible mechanisms

- Hormonal changes
- Neurological aspects

6.3 Complications and consequences of essential hypertension

6.3a Cardiovascular effects

- Changes in cardiac and arterial structure and function
- ECG and echocardiography features
- Factors influencing the complications of hypertension: age; gender; social class; race; smoking; diabetes mellitus; dyslipidaemia; obesity
- End-organ changes

6.3b Effects on non-cardiac arterial systems

- Cerebral changes: physiological changes (autoregulation of blood flow); pathological changes (stroke, transient ischaemic attack, subarachnoid haemorrhage, dementia)
- Renal changes: physiological changes (mechanisms to maintain renal function); pathological changes (accelerated decline in renal function with age; changes in malignant hypertension)
- Retinal changes: changes in retinal arteries; exudates; haemorrhages

6.4 Diagnosis and assessment of essential hypertension

6.4a Blood pressure measurement

- Conventional (clinic) measurement: number and timing of readings; use and calibration of equipment; technique; 'white coat' hypertension
- Automated sphygmomanometers; ambulatory monitoring

6.4b Symptoms and signs of target organ damage

- Medical history, including cardiovascular risk assessment
- Cardiac function
- General examination

6.4c Diagnostic procedures

- ECG
- Echocardiography
- Chest X-ray
- Blood and urine examination
- Ambulatory monitoring

6.5 Management of essential hypertension

6.5a General considerations

- Risk stratification and assessment of need for treatment: indications for immediate or urgent treatment
- Objectives: control of BP; reduction of CV risk; primary or secondary prevention of complications
- Non-pharmacological measures

6.5b Antihypertensive therapy

- Properties of drug classes
- Selection of regimen: pretreatment and target BP; concomitant disorders; adverse effects; detection and management of resistant hypertension
- Patient education and compliance; dealing with adverse effects
- Management of other risk factors (e.g. diabetes, dyslipidaemia)

6.6 Secondary hypertension

6.6a Renovascular hypertension

- Pathology: causes of renal artery stenosis
- Clinical features: signs of malignant hypertension
- Screening: history and physical signs; detection of renal artery obstruction; confirmation of renovascular hypertension
- Management: drugs, angioplasty, surgery

6.6b Bilateral renal parenchymal disease

- Common causes: diabetic nephropathy; acute and chronic glomerulonephritis; polycystic kidney disease; interstitial nephritis, radiation nephritis; analgesic nephropathy, pyelonephritis
- Pathology
- Management: antihypertensive therapy; dialysis

6.6c Hypertension induced by hormonal contraceptives and conjugated oestrogens

- Compounds used: oestrogens; progestagens; doses and combinations
- Management: BP monitoring; transfer to progestagen-only pill or alternative contraceptive; antihypertensive therapy

6.6d Other forms of secondary hypertension

- Drug-induced
- Coarctation of the aorta: pathogenesis of hypertension; diagnosis; complications; management
- Adrenocortical disorders
- Other endocrine disorders: phaeochromocytoma

6.7 ESC Guidelines

- Guidelines for the Management of Arterial Hypertension – *Journal of Hypertension* 2003; 21: 1011–53
- Expert Consensus Document on Angiotensin Converting Enzyme Inhibitors in Cardiovascular Disease is scheduled to be published in 2004
- Expert Consensus Document on Beta-adrenergic receptor blockers is scheduled to be published in 2004

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

7 Diabetic Heart Disease

7.1 Diabetes mellitus

- Incidence
- Diagnostic criteria for diabetes mellitus and impaired fasting glucose tolerance
- Type I, type II

7.2 Coronary heart disease and diabetes mellitus

7.2a Epidemiology

- Morbidity and mortality
- Added significance of other risk factors in patients with diabetes
- Plasma glucose levels; insulin levels

7.2b Pathophysiology of cardiovascular complications

- Hyperglycaemia
- Hyperinsulinaemia
- Oxidative stress
- Dyslipidaemia
- Procoagulant and antifibrinolytic state

7.2c Role of risk factor intervention

- Glycaemic control: haemoglobin A_{1c}
- Hypertension treatment
- Dyslipidaemia treatment

7.2d Screening for coronary artery disease in diabetics

- Indications

7.2e Treatment issues in diabetics with coronary artery disease

- Aspirin
- Beta-blockers
- Thrombolytic agents
- Control of glycaemia
- Angiotensin-converting enzyme inhibitors
- Glycoprotein IIb/IIIa blockers
- Insulin-sulphonylureas
- Revascularisation: percutaneous coronary intervention versus coronary artery bypass graft

7.3 Diabetic cardiomyopathy

- Epidemiology
- Pathology: myocardial fibrosis; coronary arteriole changes
- Pathophysiology: collagen accumulation; calcium handling abnormalities; protein kinase C activation; autonomic neuropathy
- Clinical presentation
- Diagnosis: echocardiography (systolic and diastolic function, cardiac mass)
- Therapy

7.4 Cardiovascular autonomic neuropathy

- Incidence
- Clinical presentation
- Diagnosis: parasympathetic and sympathetic function tests
- Consequences: angina recognition; ischaemia threshold; systolic and diastolic function; arrhythmias; coronary blood flow regulation; perioperative haemodynamic instability
- Treatment
- Long-term prognosis

7.5 ESC Guidelines

- Guidelines for the Management of Cardiovascular Diseases in Diabetics are scheduled to be published in 2005

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

8 Acute Coronary Syndromes (ACS)

8.1 Epidemiology of ACS

8.1a Incidence and prevalence of ACS; scope and cost of ACS

8.1b Risk factors for ACS

- Demographic: age; sex
- Dyslipaemia
- Diabetes mellitus
- Family history of early onset of coronary artery disease
- Hypertension
- Homocysteine
- Personal/lifestyle factors: cigarette smoking; physical activity; obesity; social class; atherogenic diet; postmenopausal status

8.2 Pathophysiology

8.2a Regulation of coronary blood flow

(i) Anatomical and haemodynamic considerations
- Anatomy of the coronary arteries: origin; principal branches; normal variants; collaterals
- Determinants of coronary blood flow: driving pressure; extravascular pressure; diastolic time per minute; coronary vascular resistance

(ii) Physiological control of myocardial perfusion. Determinants of myocardial oxygen consumption
- Metabolic regulation; myogenic regulation and neural regulation
- Mechanisms of autoregulation: adenosine; ATP; oxygen; carbon dioxide; hydrogen ions; potassium; prostaglandins; nitric oxide
- Physiological vasodilator and pathological vasoconstrictor function

8.2b Pathology

(i) Myocardial ischaemia
- Mechanisms of myocardial ischaemia: flow-limiting stenosis; coronary collateral circulation; coronary spasm; microvascular dysfunction

(ii) Atherosclerosis of the epicardial coronary arteries
- The process of atherosclerosis: plaque formation and evolution
- Inflammation; infection
- Plaque types: endothelial abnormalities; eccentric and concentric stenoses; medial atrophy; disruption of internal elastic lamina; fibrous and lipid-rich plaques; recanalisation; calcification
- Mechanisms of progression and regression

(iii) Events that precipitate ACS
- Plaque fissuring: anatomical basis; possible causes
- Results of plaque fissuring: dissecting haemorrhage; intra-intimal thrombosis; healing and stabilisation
- Plaque erosion

(iv) Non-atheromatous coronary artery disease (CAD)
- Congenital coronary artery anomalies; dissection of coronary arteries; arterial bridging; coronary aneurysms; coronary artery arteritis
- Myocardial infarction with normal coronary arteries

8.2c Relationship between coronary artery occlusions and clinical syndromes

- Unstable angina
- Vasomotor abnormalities in unstable angina
- Acute myocardial infarction (AMI): evidence for total vessel occlusion

8.2d Pathological events in AMI

(i) Events at the infarct site
- Functional changes: cessation of contraction; biochemical changes (ATP depletion, acidosis)
- Structural changes in the myocyte
- Factors affecting infarct size: spontaneous or therapeutic reperfusion; role of collaterals
- Relationships between size and location of infarction and clinical consequences

(ii) Cardiovascular responses to AMI
- Remodelling of ventricle; hibernation and stunning
- Neuroendocrine activation and autonomic responses

8.3 Clinical features of ACS

8.3a Cardiac ischaemic chest pain

- Patient perceptions: location; severity; nature; time course

8.3b Examination of the cardiovascular system in ACS

- Peripheral arterial disease; added heart sounds or murmurs due to complications

8.3c Silent ischaemia and infarction

- Epidemiology
- Mechanisms and characteristics
- Triggers

8.4 Diagnostic procedures in unstable angina and non-ST elevation MI

- Definition and classification
- Initial clinical evaluation
- 12-lead ECG features of myocardial ischaemia in unstable angina: importance of recording during chest pain
- Serum markers: MB-creatine kinase (CK); cardiac troponin measurement; thresholds for AMI
- Acute myocardial perfusion imaging
- Chest pain units

8.4a Prognosis

- Risk stratification: clinical variables; myocardial enzyme markers; stress testing; coronary angiography
- Prognosis according to high-, intermediate- and low-risk groups

8.4b Treatment

- Medical treatment: antianginal agents (nitrates, beta-blockers, calcium channel blockers); anti-aggregation (aspirin, ticlopidine, platelet glycoprotein IIb/IIIa receptor blockers); antithrombins (unfractionated heparin, low molecular weight heparin, direct thrombin inhibitors)
- Coronary revascularisation: indication in subgroups

8.5 Diagnostic procedures in AMI

- Symptoms and signs suggesting infarction
- Differential diagnoses
- 12-lead ECG in AMI: ST elevation, ST depression and T wave changes in myocardial ischaemia and infarction; pathological Q waves; localisation of infarction; diagnosis and assessment of arrhythmias
- Laboratory studies
  - Markers for myocardial infarction: myoglobin; troponins T and I; total CK-MB activity; total CK-MB mass
  - White blood cell count; glycaemia and electrolytes
- Imaging in early AMI
  - Chest X-ray
  - Echocardiography
  - Radionuclide scintigraphy; magnetic resonance imaging; computed tomography

8.5a Complications of AMI

(i) Ischaemic complications
- Reinfarction
- Post-infarction angina

(ii) Arrhythmias
- Sinus
- Supraventricular arrhythmias
- Ventricular arrhythmias
- Heart block and intraventricular conduction disturbances

- Sudden cardiac death: incidence and risk factors
  - Ventricular fibrillation associated with acute ischaemia; reentrant arrhythmias in scarred left ventricle

(iii) Mechanical complications
- Left ventricular failure and cardiogenic shock
  - Left ventricular assist devices; cardiac transplantation
- Ventricular aneurysm and pseudoaneurysm
- Rupture of cardiac structures: free wall; ventricular septum; papillary muscles

(iv) Other complications
- Pulmonary emboli
- Systemic emboli

8.5b Treatment of AMI

(i) Prehospital management
- Emergency medical services; time delays
- Pain relief; oxygen; aspirin and beta-blockers in appropriate patients
- Potential value of prehospital thrombolysis in AMI
- Emergency interventions: defibrillation; management of acute circulatory failure

(ii) Early in-hospital management
- Importance of rapid assessment and transfer to specialist unit
- Selection for thrombolysis/angiography/PCI
- Organisation of the coronary care team
- Management of acute heart failure and cardiogenic shock; diagnosis of right ventricular infarction
  - Haemodynamic monitoring
  - Intra-aortic balloon counterpulsation
  - Inotropic agents
- Identification and management of mechanical complications (e.g. ventricular septal defect, mitral regurgitation)
- Management of arrhythmias and conduction disturbances: role of pharmacological treatment and pacing
- Emergency interventions: defibrillation

(iii) Pharmacology (thrombolytic and other drug therapy)
- Mode of action of thrombolytic agents
- Thrombolytic agents in AMI: clinical trials; benefits and risks; heparin and glycoprotein IIb/IIIa receptor blockers in conjunction with thrombolytic agents
- Pharmacological options (e.g. heparin, IIb/IIIa inhibitors) when thrombolytic agents are contraindicated in AMI

(iv) PCI in AMI
- Percutaneous coronary intervention: patient selection; equipment and techniques; antithrombotic regimens
- Transfer for patients with AMI for primary angioplasty
- Indications for rescue PCI

(v) Coronary artery bypass grafting (CABG): patient selection

(vi) Adjunctive therapy early in-hospital.
- ACE inhibitors; beta-blockers; aspirin, lipid-lowering agents
- Drug therapy for the modification of platelet function

8.5c Prognosis in AMI

(i) Risk stratification following AMI
- General considerations
- Evidence-based advice to patients

(ii) Objective assessments of left ventricular ejection fraction, residual ischaemia and risk of sudden cardiac death
- Exercise testing
- Cardiac imaging studies: radionuclide studies; echocardiography
- Coronary angiography: indications; prognostic value
- Selecting very-high-risk patients for automated implantable defibrillator

(iii) Secondary prevention and rehabilitation
- Discharge protocols from the coronary care unit and hospital care
- Reduction of risk factors: smoking cessation; dyslipaemia; inactivity
- Secondary prevention with aspirin, angiotensin-converting enzyme (ACE) inhibitors, beta-blockers, anticoagulants, statins
- Lifestyle issues: weight control; exercise; low-fat diet
- Cardiac rehabilitation

8.6 ESC Guidelines

- European Guidelines on Cardiovascular Disease Prevention in Clinical Practice – Executive Summary: *Eur Heart J* 2003; 24: 1601–10 (this document was also published in the *European Journal of Cardiovascular Prevention and Rehabilitation* 2003; 10(4): S1–S10)

- Management of acute myocardial infarction in patients presenting with ST-segment elevation – *Eur Heart J* 2003; 24: 28–66
- Management of acute coronary syndromes in patients presenting without persistent ST-segment elevation – Full Text: *Eur Heart J* 2002; 23: 1809–40
- Management of chest pain – *Eur Heart J* 2002; 23: 1153–76

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

9 Chronic Ischaemic Heart Disease (IHD)

9.1 Epidemiology of chronic IHD

9.1a Incidence and prevalence of chronic IHD; cost of chronic IHD

9.1b Risk factors for chronic IHD

- Demographic: age; sex
- Dyslipidaemia
- Diabetes mellitus
- Family history of early onset of coronary artery disease
- Hypertension
- Homocysteine
- Personal/lifestyle factors: cigarette smoking; physical activity; obesity; social class; atherogenic diet; postmenopausal status

9.2 Pathology of chronic IHD

9.2a Morphology of atherosclerotic lesions

- Diffuse intimal thickening
- Fatty lesions: fatty streaks; raised fatty plaques

9.2b Pathogenesis of focal lesions

- Initiation of smooth muscle cell proliferation: endothelial injury; modulation of smooth muscle cells; cell transformation; fibrin deposition
- Initiation of intracellular lipid accumulation
- Progression of lesions
- Interactions with blood vessels
- Endothelial dysfunction
- Vulnerable plaque

9.2c Effects of ischaemia on the cardiac myocyte

(i) Determinants of myocardial oxygen consumption
- Major: left ventricular wall tension; inotropic state; heart rate
- Minor: basal metabolism; generation of action potential; calcium uptake and release; substrate

(ii) Effects of ischaemia on cardiac myocyte function
- Contractile function: systolic; diastolic; recovery after reperfusion
- Biochemical changes in ischaemic myocardium: substrate use; ATP production; accumulation of metabolites
- Mechanism of contractile failure in ischaemia: mechanical and electrical changes; biochemical changes (ATP, inorganic phosphate, acidosis)
- Cardiac myocyte stunning and hibernation

9.2d Events precipitating a clinical angina attack

- Elevation of myocardial oxygen demand: exercise, anxiety, cold, meals
- Chronic responses to myocardial ischaemia: preconditioning; development of collaterals; cardiac myocyte stunning and hibernation; changes in pump function; reversible and irreversible effects
- Coronary spasm and vasomotor alterations

9.3 Clinical assessment of known or suspected chronic IHD

9.3a Chest pain

- Patient perception: nature (provoking factors exercise, meals, cold, anxiety); intensity; location; duration
- Significance of consistent versus variable effort tolerance/pain provocation
- Clinical syndromes of chronic IHD
  - Effort angina
  - Inadequate coronary vasodilatation syndromes
  - Refractory angina
  - Vasospastic angina
- Differential diagnosis of chest pain

9.3b Other symptoms and signs

- Dyspnoea
- Syncope
- Silent ischaemia

9.3c Diagnostic procedures

- Cardiovascular examination: arterial pulse; BP; cardiac impulse; heart sounds; cardiac murmurs
- Differential diagnosis: AMI; unstable angina; musculoskeletal causes of chest pain; pericarditis; aortic dissection; pulmonary embolism; gastrointestinal disorders
- Exercise test: protocols; lead systems; endpoints; interpretation (Bayes' theorem)
- Use of serum markers to exclude infarction
- Imaging studies: echocardiography; radionucleotide studies
- Coronary and left ventricular angiography: indications
- Recognition of vasospastic angina and Syndrome X: factors provoking symptoms
- Clinical management of patients with non-cardiac chest pain

9.4 Prognosis of chronic IHD

- Adverse prognostic factors
- Previous AMI
- LV dysfunction/HF
- Three-vessel disease
- Left main stem stenosis
- Concomitant disorders: diabetes; hypertension; dyslipidaemia
- Low threshold for ischaemia on exercise test
- Total ischaemic burden

9.5 Medical management of chronic IHD

9.5a Objectives of treatment

- Prevention and relief of anginal attacks
- Reduction of myocardial ischaemia (including silent ischaemia)
- Prevention of progression of underlying disease
- Preservation of cardiac structure and function

9.5b Drugs used in management of chronic IHD (mode of action; formulations; benefits; adverse effects)

- Nitrates
- Beta-blockers
- Calcium antagonists
- Potassium channel modifiers
- Comprehensive risk factor management
- Management of associated conditions: LV dysfunction; arrhythmias; anticoagulation in atrial fibrillation

9.5c Percutaneous coronary intervention (PCI) in the management of chronic IHD

- PCI: patient selection; equipment and techniques; designs and uses of balloons and stents; antithrombotic regimens following coronary interventional procedures; short- and long-term outcome

9.5d Coronary artery bypass graft surgery

- Coronary artery bypass graft surgery indications in the symptomatic and asymptomatic patient
- Patient selection
- Equipment and techniques.
- Selection of lesions and grafts
- Medical management after CABG
- Short- and long-term outcome
- New modalities: off-pump, minimally invasive

9.5e Health care delivery

- Chest pain units

9.6 Alternative methods for management of refractory angina

- Dorsal column stimulators

9.7 ESC Guidelines

- European Guidelines on Cardiovascular Disease Prevention in Clinical Practice – Executive Summary: *Eur Heart J* 2003; 24: 1601–10 (this document was also published in the *European Journal of Cardiovascular Prevention and Rehabilitation* 2003; 10(4): S1–S10)
- Management of Stable Angina Pectoris – *Eur Heart J* 1997; 18: 394–413

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

10 Myocardial Disease

10.1 Cardiomyopathies

10.1a Definition

10.1b Classifications

- WHO classification (1995)
- Functional classification of cardiomyopathies (cardiac dilatation, cardiac hypertrophy, cardiac restriction)
- Aetiological classification of cardiomyopathies
- Genetic classification

10.1c Dilated cardiomyopathies

- Definition
- Epidemiology
  - Primary versus secondary dilated cardiomyopathy
  - Familial dilated cardiomyopathy: mode of inheritance
  - Secondary dilated cardiomyopathy (ischaemic, hypertensive)
- Diagnosis and investigations
  - Clinical features: symptoms and signs of heart failure; arrhythmias; thromboembolism
  - Investigations: ECG; exercise testing; chest X-ray; echocardiography; magnetic resonance imaging; radionuclide imaging; cardiac catheterisation and coronary angiography; investigation of specific underlying causes; role of endomyocardial biopsy; genetic assessment
- Management
  - Management of heart failure
  - Prevention and treatment of arrhythmias
  - Prevention and treatment of thromboembolism
  - Cardiac resynchronisation therapy and implantable cardioverter–defibrillator therapy
  - Surgical myocardial revascularisation
  - Valve replacement and repair
  - Heart transplantation and alternatives
- Peripartum cardiomyopathy
  - Incidence
  - Pathogenesis
  - Clinical presentation
    - Symptoms and signs of heart failure
    - Thromboembolic events
    - Syncope
    - Sudden death
    - ECG
    - Echocardiography findings
  - Treatment
    - Standard heart failure therapy
    - Anticoagulation
    - Heart transplantation
- Alcoholic and toxic cardiomyopathies
  - Pathogenesis
    - Alcohol
    - Anthracyclines
    - Cocaine
  - Clinical features
  - Treatment

10.1d Hypertrophic cardiomyopathy

- Definition: hypertrophic cardiomyopathy – a disease of the sarcomere
- Epidemiology
- Criteria for diagnosis
- Morphological characteristics
  - Morbid anatomical features
  - Histological features
- Genetics
  - Hypertrophic cardiomyopathy and candidate gene mutation
  - Hypertrophic cardiomyopathy as a Mendelian trait with autosomal dominant pattern of inheritance
  - Relationship between gene mutations and prognosis of hypertrophic cardiomyopathy
  - Genetic and echocardiographic evaluation of relatives of a proband

- Pathophysiology
  - Outflow obstruction
  - Diastolic dysfunction
  - Myocardial ischaemia
  - Supraventricular and ventricular arrhythmias
- Diagnosis and investigations
  - Clinical features: symptoms and signs (dyspnoea, fatigue, chest pain, palpitations, syncope)
  - Assessment of risk for sudden death, progressive heart failure, stroke associated with atrial fibrillation
  - Investigations: ECG; Holter monitoring; chest X-ray; echocardiography; MVO_2max exercise testing
- Treatment
  - Medical: prevention of sudden death in asymptomatic patients (amiodarone, implantable cardioverter–defibrillator); alleviation of symptoms (beta-blockers, calcium channel blockers, disopyramide); prevention of infective endocarditis
  - Surgical: indication for surgery; ventricular septal myotomy/myectomy; mitral valve repair or replacement
  - Electrophysiological therapy; dual-chamber pacing
  - Interventional therapy; alcohol septal ablation
- Prognosis
  - Relief of symptoms
  - Morbidity and mortality
  - Causes of death
  - Prognostic factors

10.1e Restrictive cardiomyopathy

- Definition
- Classification
- Clinical features
- Investigations: ECG; echocardiography; cardiac catheterisation; endomyocardial biopsy
- Differentiation from constrictive pericarditis: clinical; imaging; haemodynamic features
- Treatment

10.1f Infiltrative cardiomyopathies

- Amyloidosis
- Sarcoidosis
- Haemochromatosis
- Fabry's disease
- Pompe's disease
- Gaucher's disease

10.1g Obliterative endomyocardial disease

- Endomyocardial fibrosis
- Hypereosinophilic syndrome
- Carcinoid syndrome

10.2 Myocarditis

10.2a Aetiology and pathology

- Culprit organisms: viruses, bacteria, inflammatory; histological features; relationship to dilated cardiomyopathy; abnormalities of cellular immunity

10.2b Viral myocarditis

- Pathology
  - Enterovirus, parvovirus, echovirus and adenovirus
  - Histological features
  - Molecular basis of cardiotropic viral infections
  - Abnormalities of cellular immunity
- Clinical features: fever; chest pain; flu-like symptoms; lymphadenopathy; arrhythmias; cardiomegaly; pericardial friction rub; pulmonary oedema; heart failure
- Diagnostic procedures: laboratory findings; chest X-ray, ECG, echocardiography, contrast magnetic resonance imaging, nuclear cardiology, endomyocardial biopsy
- Treatment: general measures; immunosuppressive therapy; standard heart failure therapy; ventricular assist device therapy

10.2c Non-viral myocarditis

- Lyme carditis (infection with the spirochete *Borrelia burgdorferi*
- *Toxoplasma gondii*
- Chagas' disease (infection with *Trypanosoma cruzi)*
- Rheumatic carditis (group A streptococcal infection)

10.2d Non-infective myocarditis

- Churg–Strauss myocarditis (hypersensitivity myocarditis)
- Characteristics: peripheral eosinophilia and infiltration into the myocardium by eosinophils

10.3 ESC Guidelines

- Clinical Expert Consensus Document on Hypertrophic Cardiomyopathy: *Eur Heart J* 2003; 24: 1965–91

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

11 Pericardial Disease

11.1 Epidemiology

- Acute pericarditis
- Constrictive pericarditis
- Pericardial effusion
- Cardiac tamponade

11.2 Pathophysiology

- Structure and function of pericardium: roles in prevention of cardiac dilatation and diastolic coupling of the ventricles
- Causes of acute pericarditis: idiopathic relapsing; infectious; immunological; neoplastic; postirradiation; traumatic; uraemic

11.3 Diagnosis

11.3a Symptoms and signs

- Venous and arterial pulses and heart sounds
- Hepatomegaly and ascites

11.4 Investigations

- Chest X-ray
- ECG
- Echocardiography
- CT/MR scan

11.5 Diagnosis and management of pericarditis

- Tuberculous
- Bacterial
- Benign relapsing
- Neoplastic
- Rheumatoid arthritis and connective tissue disorders
- Renal failure

11.6 Constrictive pericarditis

11.6a Pathology

- Causes of constrictive pericarditis: idiopathic; postviral; tuberculous; rheumatoid; cardiac surgery; irradiation; neoplastic
- Mechanism: scarring of visceral and/or parietal pericardium; restriction of cardiac filling

11.6b Diagnosis and investigation

(i) Symptoms and signs
- Venous and arterial pulses and heart sounds
- Hepatomegaly and ascites

(ii) Investigations
- Identification of underlying cause
- Chest X-ray
- ECG
- Echocardiography
- CT
- Differential diagnosis (cardiac catheterisation, endomyocardial biopsy)

11.6c Management

- Medical: treatment of underlying cause (antitubercular regimens, antibiotics)
- Pericardiectomy: indications; use of sternotomy or thoracotomy; areas of pericardium removed; indications for cardiopulmonary bypass; operative mortality; long-term outcome

11.7 Cardiac tamponade

11.7a Pathology

- Structure and function of the pericardium

- Mechanism: accumulation of fluid in pericardium; rise in intrapericardial pressure; restriction of ventricular filling
- Causes: infective; haemorrhagic; neoplastic; serous

11.7b Diagnosis and investigation

- Symptoms and signs
- Investigations: identification of underlying cause; chest X-ray; ECG; echocardiography

11.7c Management

- Pericardiocentesis: indications; percutaneous technique; surgical drainage and pericardial biopsy

11.8 ESC Guidelines

- Guidelines on the Diagnosis and Management of Pericardial Diseases – Full Text *Eur Heart J* 2004; 25(7): 587–610

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

12 Cardiac Tumours

12.1 Epidemiology

- Primary cardiac tumours
- Metastatic cardiac tumours, including lymphoma

12.2 Pathophysiology

- Benign tumours (myxomas, lipomas, rhabdomyomas, fibromas, haemangiomas); malignant tumours (rhabdomyosarcomas, angiosarcomas, mesotheliomas)
- Effect of tumour size and location; effect of tumour type

12.3 Clinical features

- Impairment of cardiac function
- Systemic manifestations
- Systemic and pulmonary emboli
- Signs of physical obstruction to blood flow
- Pericardial involvement – constriction, restriction or tamponade

12.4 Diagnostic procedures

- Chest X-ray; echocardiography; computed tomography; magnetic resonance imaging

12.5 Management

- Complete tumour excision
- Partial resection + chemotherapy/radiotherapy
- Heart transplantation

13 Congenital Heart Disease

13.1 Definition

13.2 Epidemiology

- Overall incidence of congenital cardiac abnormalities
- Incidence of most common malformations

13.3 Aetiology

- Chromosomal and genetic abnormalities
- Environmental insults

13.4 Prevention

- Drugs and radiation exposure during pregnancy
- Genetic counselling for patients, parents and relatives

13.5 Pathophysiology

13.5a Nomenclature and description

- Advantages of sequential segmental analysis of cardiac structures
- Description of atria
- Description of ventricles
- Description of arterial trunks
- Description of connections between structures

13.5b Fetal and transitional circulations

- Fetal circulatory pathways
- Function of the fetal heart
- Changes at birth

13.6 Diagnosis and assessment

13.6a Clinical manifestations

- Presenting symptoms: pulmonary venous congestion; congestive heart failure; cyanosis; collapse; hypoxic spells; haemoptysis; cerebral and pulmonary complications, arrhythmias
- Systemic manifestations: growth retardation; respiratory infections; cerebral complications; pulmonary vascular disease
- Physical examination: upper–lower extremities perfusion and pulse; splitting of heart sounds; thrills; murmurs

13.6b Diagnostic procedures

- Chest X-ray: cardiac position and atrial arrangement; cardiac position and size; specific abnormalities of cardiac silhouette; pulmonary vascularity; asymmetrical perfusion of lungs
- ECG: QRS axis and voltage; T wave changes; heart rate and rhythm
- Blood gases: response to oxygen
- Echocardiography: cardiac, arterial and venous structures; blood flow
- Nuclear cardiology
- Magnetic resonance imaging
- Cardiac catheterisation

13.7 Principles of management

- Selection of medical or surgical therapy
- Medical management: considerations for infants, children, adolescents and adults
- Surgical management: basic approaches (palliation, anatomical correction, radical palliation, transplantation); general considerations in selection of procedure

13.8 Pathology, diagnosis and management of specific abnormalities

13.8a Atrial septal defect

- Morphology of interatrial communications; extent of atrial septum; location of defects
- Pathology: magnitude and direction of interatrial blood flow; right ventricular hypertrophy; development of cyanosis and heart failure; association with pulmonary vascular disease and arrhythmias
- Diagnosis: changes in heart sounds; chest X-ray (cardiac enlargement, enlargement of pulmonary knob and plethora); ECG (right ventricular hypertrophy, conduction defects, QRS changes); echocardiography (visualisation of interatrial communications); catheterisation (ventricular and arterial pressures, ventriculography)
- Percutaneous non-surgical closure
- Surgical management: surgical procedure; timing, indications and outcome

13.8b Atrioventricular septal defects

- Morphology: absence of atrioventricular septal structures; structure of atrioventricular valves and bridging leaflets
- Pathology: left-to-right shunting; atrioventricular valvular regurgitation; development of cyanosis and heart failure; association with pulmonary vascular disease and arrhythmias
- Diagnosis: changes in heart sounds; chest X-ray; ECG (right ventricular and biventricular hypertrophy, conduction defects, QRS changes); echocardiography (visualisation of atrioventricular valves and regurgitation); catheterisation (ventricular and arterial pressures, ventriculography)
- Surgical management: timing; procedure; operative mortality; long-term outcome

13.8c Ventricular septal defects

- Morphology: morphology of septal defects; association with other malformations
- Pathology: magnitude and direction of interventricular blood flow; relationships between size of defect, ventricular pressures and direction of blood flow
- Diagnosis: changes in heart sounds; chest X-ray; ECG (left ventricular hypertrophy, conduction defects, QRS changes); echocardiography (visualisation of size and type of defect, chamber size and function); catheterisation (ventricular and arterial pressures, ventriculography)
- Management: prophylaxis of bacterial endocarditis; timing, indications and long-term outcome of surgical procedures

13.8d Anomalous pulmonary venous connections

- Morphology: partial or total; connection sites of pulmonary veins
- Pathology: effects on circulatory function; clinical features; pulmonary oedema, dyspnoea and cyanosis
- Diagnosis: echocardiography (detection of anomalous connections, evaluation of blood flow); catheterisation (pressure measurement, assessment of oxygen saturation)
- Surgical management: correction of anomalous connections; closure of atrial septal defects

13.8e Tricuspid atresia

- Morphology: association with other malformations
- Pathology: pulmonary blood flow; admixture of systemic and pulmonary blood; cyanosis; heart failure; pulmonary hypertension
- Diagnosis: chest X-ray; echocardiography (small or absent right ventricle); catheterisation
- Management: balloon atrial septostomy; palliative operations designed to increase pulmonary blood flow; functional correction (Fontan operation); timing of surgery

13.8f Ebstein's anomaly of the tricuspid valve

- Morphology: atrialised right ventricular inflow; tricuspid valve regurgitation
- Pathology: severity of tricuspid atresia; associated malformations
- Diagnosis: ECG (right bundle branch block or Wolff–Parkinson–White syndrome); echocardiography (displacement of the tricuspid valve); catheterisation (atrial pressure recordings during right ventricular intracavitary ECG)
- Management: systemic pulmonary shunt; Fontan operation; surgical correction

13.8g Abnormalities of the left atrioventricular junction

- Morphology: congenital mitral stenosis; congenital mitral regurgitation; hypoplastic left ventricle; mitral atresia with patent aortic root

- Pathology: magnitude and direction of blood flow from left atrium; disturbances of pulmonary and systemic blood flow; development of pulmonary hypertension; volume overload and heart failure
- Diagnosis: clinical features; heart sounds; chest X-ray; ECG; echocardiography; catheterisation
- Management: heart failure and arrhythmia control; indications, timing and long-term outcome of surgery

13.8h Tetralogy of Fallot

- Morphology: ventricular septal defect; pulmonary stenosis; overriding of ventricular septum by aorta; right ventricular hypertrophy
- Pathology: right ventricular outflow obstruction; development of cyanosis; acute attacks
- Diagnosis: clinical features; heart sounds; chest X-ray (normal heart size, boot-shaped, reduced pulmonary vasculature); ECG (right axis deviation, ST segment and T wave changes); echocardiography (subpulmonary obstruction, atrioventricular septal defects); catheterisation; nuclear cardiology
- Management: spells management; total surgical correction; palliative surgery; timing, indications and outcome of surgery; postoperative complications

13.8i Double-outlet right ventricle

- Morphology: abnormal relation between aorta, pulmonary trunk and right ventricle; ventricular septal defect; association with other malformations
- Pathology: mixing of pulmonary and systemic blood; pulmonary hypertension; cyanosis and heart failure
- Diagnosis: clinical features; heart sounds; chest X-ray; ECG; echocardiography; catheterisation; nuclear cardiology
- Management: palliative and reparative surgery; timing, indications and outcome

13.8j Complete transposition of the great arteries

- Morphology: concordant atrioventricular and discordant ventriculoarterial connections; associated abnormalities
- Pathology: bidirectional shunt; recirculation of systemic venous blood to aorta and pulmonary venous return to pulmonary trunk; pulmonary vascular obstructive disease; cardiac failure
- Diagnosis: clinical features; heart sounds; chest X-ray; ECG; echocardiography; catheterisation; nuclear cardiology
- Management: balloon atrial septostomy; corrective operations; timing, indications and outcome

13.8k Congenitally corrected transposition of the great arteries

- Morphology: discordant atrioventricular and discordant ventriculoarterial connections; associated abnormalities
- Pathology: effects of transposition; effects of associated abnormalities
- Diagnosis: clinical features; heart sounds; chest X-ray; ECG; echocardiography; catheterisation; nuclear cardiology
- Management: balloon atrial septostomy; corrective operations; timing, indications and outcome

13.8l Double-outlet left ventricle

- Morphology: abnormal relation between the aorta, pulmonary trunk and left ventricle; ventricular septal defect; association with other malformations
- Pathology: mixing of pulmonary and systemic blood
- Diagnosis: clinical features; heart sounds; chest X-ray; ECG; echocardiography; catheterisation; nuclear cardiology
- Management: reparative surgery; timing, indications and outcome

13.8m Common arterial trunk

- Morphology: location and structure of common arterial trunk; aortopulmonary window; associated abnormalities
- Pathology: perfusion of pulmonary vascular bed at same pressure as systemic vascular bed; significance of changes in pulmonary vascular resistance; development of pulmonary vascular disease and heart failure
- Diagnosis: clinical features; heart sounds; chest X-ray; ECG; echocardiography; catheterisation; nuclear cardiology
- Management: banding of pulmonary trunk; corrective procedures; timing, indications and outcome of surgical procedures

13.8n Pulmonary atresia

- Morphology: ventricular origin of atretic pulmonary trunk and aorta; connections of cardiac segments; integrity of ventricular septum

- Pathology: absence of outlet from right ventricle; maintenance of pulmonary circulation; heart failure development
- Diagnosis: clinical features; heart sounds; chest X-ray; ECG; echocardiography; catheterisation (right ventriculography); nuclear cardiology
- Management: balloon atrial septostomy; pulmonary valvotomy; shunt construction; timing, indications and outcome of surgical procedures

13.8o Pulmonary stenosis

- Morphology: site of stenosis; connections of cardiac segments; integrity of ventricular septum
- Pathology: pressure overload of right ventricle; right ventricular hypertrophy, dysfunction and failure
- Diagnosis: clinical features; heart sounds; chest X-ray; ECG; echocardiography; catheterisation (right ventriculography); nuclear cardiology
- Management: surgical procedures (balloon valvuloplasty, others); timing, indications and outcome of surgical procedures

13.8p Aortic stenosis

- Morphology: site of stenosis; connections of cardiac segments; integrity of ventricular septum
- Pathology: pressure overload of left ventricle; left ventricular hypertrophy, ischaemia, dysfunction and failure
- Diagnosis: clinical features; heart sounds; chest X-ray; ECG; echocardiography; catheterisation (left ventriculography); nuclear cardiology
- Management: surgical procedures (balloon valvuloplasty, replacement); timing, indications and outcome of surgical procedures

13.8q Patent ductus arteriosus

- Morphology: left- and right-sided ducts; structure of persistent duct as isolated lesion and in association with other abnormalities
- Pathology: communication between aorta and pulmonary arteries; direction of flow; mechanisms of heart failure development
- Diagnosis: clinical features; heart sounds; chest X-ray; ECG; echocardiography; catheterisation; nuclear cardiology
- Management: indomethacin; surgical procedures (ligation, catheter closure); timing, indications and outcome of surgical procedures

13.8r Coarctation of the aorta

- Morphology: ductal shelf; hypoplasia of isthmus; waist lesion; arch atresia; arch interruption; relationship to persisting or closed duct; association with other abnormalities; development of collateral vessels
- Pathology: abnormalities of blood flow; hypertension; pressure and volume overload; heart failure
- Diagnosis: clinical features; heart sounds; chest X-ray; ECG; echocardiography; catheterisation; nuclear cardiology
- Management: blood pressure control; surgical procedures (resection of coarcted segment, anastomosis construction, prosthetic patches); timing, indications and outcome of surgical procedures
- Percutaneous stenting

13.8s Congenital malformations of coronary arteries

- Morphology: anomalous origin of coronary arteries; other malformations
- Pathology: myocardial ischaemia; diversion of blood from myocardium; significance of pulmonary vascular resistance fall after birth; left ventricular hypertrophy, fibrosis and failure
- Diagnosis: clinical features; heart sounds; chest X-ray; ECG; echocardiography; catheterisation; nuclear cardiology
- Management: surgical procedures (reimplantation of aberrant artery, saphenous venous grafting); timing, indications and outcome of surgical procedures

13.8t Congenital malformations of pulmonary arteries

- Morphology: absence of one pulmonary artery; idiopathic dilatation of pulmonary trunk; origin of left pulmonary artery from right pulmonary artery; pulmonary arteriovenous malformations; association with other malformations
- Pathology: effects on pulmonary circulation; structure and function; mechanisms of heart failure development

- Diagnosis: clinical features; heart sounds; chest X-ray; ECG; echocardiography; catheterisation; nuclear cardiology
- Management: surgical procedures (correction, excision of arteriovenous malformations); timing, indications and outcome of surgical procedures

13.8u Aortic arch anomalies

- Morphology: abnormalities of brachiocephalic arteries; aberrant origin of right subclavian artery; left arch with right-sided proximal descending aorta; association with other malformations
- Pathology: tracheal compression; compression of oesophagus; effects of associated abnormalities
- Diagnosis: clinical features; heart sounds; chest X-ray; ECG; echocardiography; catheterisation; nuclear cardiology
- Management: surgical procedures; timing, indications and outcome of surgical procedures

13.8v Arteriovenous malformations

- Morphology: location; single or multiple; association with other malformations
- Pathology: arteriovenous communication; mechanisms of heart failure development
- Diagnosis: clinical features; location of malformations; ECG; echocardiography; catheterisation; nuclear cardiology
- Management: surgical procedures (ligation, clipping or embolisation of feeding arteries); timing, indications and outcome of surgical procedures

13.9 ESC Guidelines

- Management of Grown Up Congenital Heart Disease – *Eur Heart J* 2003; 24: 1035–84
- Guidelines for the Interpretation of the Neonatal Electrocardiogram – Full Text: *Eur Heart J* 2002; 23: 1329–44

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

14 Pregnancy and Heart Disease

14.1 Cardiovascular physiology during pregnancy and puerperium

14.1a Blood volume, cardiac output, heart rate and systemic vascular resistance changes during pregnancy

14.1b Haemodynamic changes during labour and delivery

14.1c Haemodynamic effects of Caesarean section

14.1d Haemodynamic changes postpartum

14.2 Cardiovascular evaluation during pregnancy

- History and physical examination: innocent systolic murmurs
- Electrocardiography: findings during pregnancy
- Chest X-ray: safety issues; position of the heart; increased lung markings; pleural effusion
- Echocardiography: normal findings
- Stress testing
- Magnetic resonance imaging
- Pulmonary artery catheterisation: flotation catheter
- Cardiac catheterisation

14.3 Assessing the risk of the cardiac disorder in the individual pregnant patient

14.4 Role of contraceptive advice

14.5 Relevant pathologies affecting the pregnant woman

14.5a Simple and complex congenital heart disease

- Maternal and fetal outcome
- Labour and delivery
- Eisenmenger syndrome: morbidity; mortality

14.5b Acquired valve disease

- Mitral stenosis
- Mitral regurgitation
- Aortic stenosis
- Aortic regurgitation
- Therapeutic strategies: surgical repair or replacement; balloon valvuloplasty

14.5c Prosthetic valves

- Valve selection
- Anticoagulation

14.5d Coronary artery disease

- Acute myocardial infarction: incidence; diagnosis; management (beta-blockers; aspirin; reperfusion strategy); non-invasive risk stratification
- Chronic coronary artery disease: risk assessment; management during pregnancy and peripartum period

14.5e Cardiomyopathies

- Hypertrophic: tocolytic agents and outflow tract obstruction
- Peripartum cardiomyopathy: incidence; symptoms; diagnosis; treatment; maternal and fetal outcome

14.5f Arrhythmias

- Incidence
- Management: safety of electrical cardioversion

14.5g Hypertension

- Chronic hypertension
- Gestational hypertension
- Preeclampsia–eclampsia: diagnosis; therapy; indications for delivery
- Antihypertensive drugs in pregnancy: acute and long-term treatment

14.5h Marfan's syndrome

- Maternal and fetal risk
- Clinical follow-up: aortic diameter

14.5i Aortic dissection

14.6 Therapy

14.6a Cardioactive drugs

14.6b Anticoagulants

14.6c Antihypertensives

14.6d Cardiac interventional techniques

14.6e Cardiac surgery

14.6f Multidisciplinary team – obstetricians, anaesthetists, clinical geneticists, neonatologists, cardiologists – in the management of labour

14.7 ESC Guidelines

- Expert Consensus Document on Management of Cardiovascular Diseases during Pregnancy: *Eur Heart J* 2003; 24: 761–81

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

15 Valvular Heart Diseases

15.1 Aortic stenosis

15.1a Aetiology

- Valvular aortic stenosis: congenital; acquired; significance of bicuspid and tricuspid valves; calcific stenosis; rheumatic stenosis
- Supravalvular aortic stenosis
- Subaortic stenosis

15.1b Pathophysiology

- Cardiac structure and function: LVH; systolic dysfunction; diastolic dysfunction

15.1c Diagnosis and assessment

- Symptoms: angina pectoris; syncope; dyspnoea; arrhythmias
- Signs: pulse and BP; apex beat; heart sounds; heart murmurs
- 12-lead ECG
- Chest X-ray
- Echocardiography: assessment of site and Doppler assessment of the degree of stenosis; assessment of LV function
- Doppler to measure aortic valve gradient/area
- Role of cardiac catheterisation

15.1d Natural history and progression

- Progression of stenosis: rate of progression; impact of calcification
- Complications: sudden death; development of HF; thromboembolism; infective endocarditis

15.1e Medical management

- Prevention of infective endocarditis
- Management of arrhythmias and HF
- Consideration of timing of surgical intervention

15.1f Surgical management

- Indications: symptoms; cardiac function; indications in asymptomatic patients; consideration of type of prosthesis
- Anticoagulation: indications and contraindications
- Complications: biological valves; mechanical valves
- Outcome: operative mortality; long-term outcome (survival, clinical status)
- Balloon valvuloplasty: patient selection

15.2 Aortic regurgitation

15.2a Pathology/aetiology

- Specific pathological causes
- Cardiac structure and function: LVH; systolic dysfunction; diastolic dysfunction; acute versus chronic regurgitation

15.2b Diagnosis and assessment

- Symptoms: angina pectoris; dyspnoea; fatigue; oedema
- Signs: pulse and BP; apex beat; heart sounds; heart murmurs
- 12-lead ECG
- Chest X-ray
- Echocardiography
- Cardiac catheterisation

15.2c Natural history and progression

- Clinical progression: rate of progression; effect of underlying cause
- Complications: development of HF; infective endocarditis

15.2d Medical management

- Prevention of infective endocarditis
- Management of HF

15.2e Monitoring of severity of regurgitation and timing of surgical intervention

15.2f Surgical management

- Indications: symptoms; cardiac function; indications in asymptomatic patients; selection for replacement or conservation
- Techniques: valve replacement; selection of prosthesis
- Complications: biological valves; mechanical valves
- Outcome: operative mortality; long-term outcome (survival, clinical status)

15.3 Mitral valve stenosis

15.3a Acute rheumatic fever

- Epidemiology
- Aetiology: role of streptococcal infection
- Pathology: diffuse inflammatory reaction
- Diagnosis: clinical features; evidence of streptococcal infection
- Course and prognosis: duration of acute attack; outcome of carditis
- Treatment
- Prevention

15.3b Pathology of rheumatic mitral valve disease

- Effects on valve structure and function: effects on chordae tendinae, cusp fusion and retraction
- Effects of mitral stenosis on intracardiac pressures
- Circulatory function in mitral stenosis: LV systolic dysfunction; LV diastolic dysfunction; right ventricular dysfunction; pulmonary hypertension; effects of exercise

15.3c Clinical features of mitral valve stenosis

- Symptoms: pulmonary oedema/congestion (dyspnoea, orthopnoea, cough, paroxysmal nocturnal dyspnoea)
- Signs: abnormal pulse, BP, apex beat, heart sounds; systolic murmurs; raised venous pressure; atrial fibrillation

15.3d Diagnostic procedures in mitral valve stenosis

- 12-lead ECG
- Chest X-ray
- Echocardiography: visualisation of valve structure and function; detection of regurgitation (Doppler); assessment of LV structure and function
- Cardiac catheterisation

15.3e Natural history and progression

- Complications: cardiac dysfunction and HF; pulmonary oedema; atrial fibrillation; systemic embolisation;
- Mitral stenosis: survival; relationship to functional impairment; events provoking clinical deterioration

15.3f Medical management

- Pharmacological control of heart rate in atrial fibrillation
- Anticoagulants: importance of systemic embolisation; effect of atrial fibrillation on justification of anticoagulants
- Prevention of infective endocarditis
- Balloon valvuloplasty in mitral stenosis: patient selection; operative technique; immediate and delayed complications; short- and long-term outcome

15.3g Surgical management

- Indications: symptoms; indications in asymptomatic patients; selection for replacement or conservation
- Surgical techniques: for a) conservation and b) prosthesis choice for replacement
- Complications: biological valves; mechanical valves
- Outcome: operative mortality; long-term outcome

15.4 Mitral valve regurgitation

15.4a Pathology of rheumatic mitral regurgitation

- Circulatory function in mitral regurgitation: acute versus chronic regurgitation; LV systolic dysfunction; right ventricular dysfunction; effects of exercise

15.4b Pathology of non-rheumatic mitral regurgitation

- Coronary disease: papillary muscle rupture; papillary muscle dysfunction; LV dilatation
- Chordal rupture: mitral valve prolapse; infective endocarditis
- Calcification of valve annulus
- Infective endocarditis: chordal rupture; perforation of valve cusps
- Circulatory function in mitral regurgitation: acute versus chronic regurgitation; adaptive mechanisms (LV and left atrial hypertrophy); causes of decline in LV contractility

15.4c Clinical features of mitral valve regurgitation

15.4d Diagnostic procedures in mitral valve regurgitation

15.4e Natural history and progression

- Mitral regurgitation: survival; comparison with stenosis; events provoking clinical deterioration; causes of death in medically and surgically treated patients

15.4f Mitral valve prolapse

- Pathology
- Prevalence: association with connective tissue disorders
- Structural basis: myxomatous degeneration of cusp tissue; degeneration of chordae tendinae and annulus
- Diagnosis and assessment
- Clinical features: non-specific symptoms (chest pain, dyspnoea, fatigue, dizziness); palpitations, dizziness and syncope associated with arrhythmias; exertional dyspnoea associated with mitral regurgitation
- Clinical examination: general; mid–late systolic clicks; late systolic murmurs; pansystolic murmurs
- Investigations: chest X-ray; ECG; exercise testing; echocardiography and Doppler; angiography; haemodynamics
- Management
- Natural history and complications: development of mitral regurgitation; infective endocarditis and arrhythmias
- Management: antibiotic prophylaxis; investigation and treatment of arrhythmias; management of chest pain; anticoagulation (particularly after stroke or TIA and in presence of atrial fibrillation); management of mitral regurgitation

15.5 Tricuspid stenosis

15.5a Pathology

- Epidemiology
- Changes in valve structure and function

15.5b Diagnosis and assessment

- Clinical features
- Clinical examination: general; mid-diastolic murmur; abnormal pulses; pulsation over right atrium
- Investigations: chest X-ray; ECG; echocardiography and Doppler; haemodynamics

15.5c Management

- Natural history and complications: association with mitral valve lesions
- Medical management
- Surgical management: indications; techniques for conservation

15.6 Tricuspid regurgitation

15.6a Pathology

- Epidemiology: predominance of functional over organic dysfunction; association with specific syndromes
- Structural basis: changes in valve structure and function; changes in cardiac structure and function (particularly right ventricle)

15.6b Diagnosis and assessment

- Clinical features: symptoms related to reduced forward flow (tiredness, reduced exercise capacity); symptoms of venous congestion (oedema, hepatic enlargement, abdominal swelling); symptoms related to primary left-sided cardiac lesion

- Clinical examination: general (cachexia, jaundice); systolic pulsation in jugular veins; atrial fibrillation; pansystolic murmur, ascites
- Investigations: chest X-ray; ECG; exercise testing; echocardiography and Doppler; angiography; haemodynamics

15.6c Management

- Natural history and complications: association with primary lesion elsewhere in heart; development of fluid accumulation and ascites
- Medical management: control of fluid retention; management of arrhythmias; treatment of primary lesion
- Surgical management: indications (e.g. endocarditis); techniques (excision, annuloplasty, division of fused commissures, replacement); outcome

15.7 Acquired pulmonary valve disease

15.7a Pathology

- Epidemiology: pulmonary stenosis (carcinoids, heart disease, others); pulmonary regurgitation (pulmonary hypertension, infective endocarditis, rheumatic heart disease, others)
- Structural basis: changes in valve structure and function; changes in cardiac structure and function

15.7b Diagnosis and assessment

- Clinical examination: signs/symptoms related to valve dysfunction (right ventricular hypertrophy, murmurs); symptoms of coexisting disorders (carcinoid disease, pulmonary hypertension)
- Investigations: chest X-ray; ECG; exercise testing; echocardiography and Doppler; angiography; haemodynamics

15.7c Management

- Medical management: management of infective endocarditis; treatment of primary lesion
- Surgical management: indications; techniques (excision, annuloplasty, division of fused commissures, replacement); outcome

16 Infective Endocarditis

16.1 Epidemiology

16.1a Incidence in hospital and community studies

16.2 Pathophysiology

16.2a Responsible organisms: bacteria; fungi; other micro-organisms

16.2b Predisposing lesions

- Loss of integrity of the endothelial lining
- Traumatic procedures
- Intravenous drug abuse
- Thrombus formation
- Rheumatic heart disease
- Congenital heart disease
- Intracardiac prosthetic materials

16.2c Acute endocarditis

- Acute septicaemia
- Destruction of cardiac tissue
- Abscess formation
- Disseminated coagulopathy

16.2d Anatomical location and pathological consequences of vegetations/abscesses

16.2e Immunological processes

- Immune complex formation and distribution
- Dysglobulinaemia
- Anaemia

16.2f Extracardiac pathology: embolisation

16.3 Clinical features

16.3a General

- Flu-like symptoms
- Symptoms and signs of heart failure
- Petechiae
- Splinter haemorrhages
- Osler's nodes

16.3b Cardiac

- Regurgitant murmurs
- Acute heart failure
- Pulmonary oedema
- Acute myocardial infarction

16.3c Other features

- Embolisation
- Cerebral symptoms
- Renal impairment

16.3d Clinical features of individual types of endocarditis

16.4 Diagnosis and assessment

16.4a Laboratory investigations

- Urine microscopy
- Blood counts
- Blood culture
- Inflammatory markers (erythrocyte sedimentation rate, C-reactive protein)

16.4b Microbiology

- Interpreting results of blood cultures
- Culture-negative endocarditis
- Discussion of antibiotic therapy

16.4c ECG

- Detection of conduction abnormalities

16.4d Echocardiography

- Assessing severity of valvular regurgitation
- Detection of vegetations
- Detection of abscesses
- Role of transoesophageal echocardiography

16.4e Differential diagnosis

- Chronic infections
- Chronic inflammation
- Postcardiotomy syndrome
- Cardiac tumours

16.5 Management

16.5a Antimicrobial prevention of endocarditis

16.5b Medical

- Importance of ascertaining sensitivity of culprit organism in each patient
- Antibiotic regimens
- Prophylactic regimens

16.5c Surgical

- Indications
- Surgical procedures
- Operative mortality

16.5d Prognosis

- Eradication of infection
- Mortality rates
- Causes of death
- Relapse rates

16.6 ESC Guidelines

- Guidelines on the Management of Infective Endocarditis – Executive Summary – *Eur Heart* J 2004; 25(2): 267–76
- Guidelines on the Management of Infective Endocarditis – Full Text (WebPosted) 2004 – **www.escardio.org**

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

17 Heart Failure (HF)

17.1 Epidemiology

17.1a Definitions

- Definitions of heart failure (HF) used in epidemiological studies and clinical trials

17.1b Epidemiology

- Incidence and prevalence
- Hospital admission rates

17.2 Pathology of HF

17.2a Models of HF

- Clinical models of HF: systolic and diastolic HF; forward and backward failure; left- and right-sided failure; high-output versus low-output HF
- Theoretical models of HF

17.2b Aetiology of HF

- Causes of HF: myocardial disease; valve disease; pericardial disease
- Myocardial disease: IHD (local dyskinesia, aneurysm, stunned/hibernating myocardium, diffuse dysfunction); dilated cardiomyopathy (alcohol, myocarditis, familial, idiopathic); hypertension; drugs (negative inotropic effects); infections affecting myocardial function, hypertrophic cardiomyopathy, amyloid, restrictive cardiomyopathies, thyroid disease, heavy metal poisoning
- Causes of 'high-output' HF: anaemia; arteriovenous fistula; Paget's disease; beriberi; thyrotoxicosis; pregnancy

17.2c Adaptive and maladaptive responses to HF

(i) Myocardial responses
- Responses of cardiac myocytes to volume and pressure load shifts
- Hypertrophy of the myocardium: changes in cavity volume and wall thickness; sarcomere addition; myocyte slippage; relationship to volume and pressure overload

(ii) Systemic responses (implications for treatment and mechanisms of action of drugs)
- Sodium and water retention leading to increased ventricular filling pressure (Starling's law)
- Neurohormonal activation: sympathetic nervous system (plasma and cardiac catecholamine levels, receptor down-regulation); renin–angiotensin–aldosterone system (RAAS); vasopressin; atrial natriuretic peptides; prostaglandins
- Increased arteriolar resistance
- Renal responses: changes in renal blood flow; mechanisms to maintain glomerular filtration rate; changes in tubular sodium reabsorption and water retention

17.2d Cause of symptoms of HF

- Shortage of breath in acute HF: relationship to left atrial pressure and LV end-diastolic pressure; relief by diuretics
- Shortage of breath in chronic HF: poor relationship to left atrial pressure and peak oxygen consumption; possible roles of lung changes and metabolic factors
- Fatigue: increased vascular resistance in skeletal muscles; muscle atrophy; metabolic mechanisms

17.3 Clinical examination of the HF patient

17.3a General examination

- Symptoms: breathlessness; fatigue; weakness; cough
- Assessment of severity of symptoms: NYHA classification

17.3b Cardiac examination

- Oedema; ascites
- Heart rate and rhythm
- Arterial and venous pulses
- BP
- Palpation of precordium
- Heart sounds

17.4 Diagnostic procedures in the patient with known or suspected HF

17.4a Objectives of diagnostic procedures

- Confirmation of diagnosis
- Identification of cause of HF
- Estimation of prognosis
- Selection of therapy
- Assessment of response to treatment

17.4b Diagnostic tests

- 12-lead ECG
- Chest X-ray: cardiac size, detection of pulmonary venous hypertension
- Natriuretic peptides (BNP and NTproBNP)
- Echocardiography: evaluation of systolic function and wall motion; detection and assessment of valve dysfunction; assessment of diastolic function; cardiac tumours; intracardiac shunt
- Exercise testing: objectives (measuring MVO_2max, assessment of prognosis, evaluation of response to treatment)
- Other assessments: nuclear cardiology; MRI; coronary and left ventricular angiography; endomyocardial biopsy
- Laboratory assessments: full blood count; electrolytes; serum lipids; tests of renal and hepatic function

17.5 Medical management of HF

17.5a Medical management of acute HF

(i) General considerations
- Haemodynamic monitoring: routine (heart rate, BP, urine output, physical signs); additional (Swan–Ganz catheter)

(ii) Recommendations
- Initial therapy for acute left heart failure
- Diuretics
- Vasodilators (nitroprusside, nitrate or ACE inhibitor): mechanism of increase in tissue perfusion (reduction of resistance to ejection [afterload])
- Discontinuation of unnecessary or harmful drugs
- Inotropic agents
- Management of arrhythmias

17.5b Medical management of chronic HF

(i) General considerations
- Objectives of medical management: relief of symptoms; prevention of progression; prevention of complications; prolongation of life
- Discontinuation of unnecessary or harmful drugs
- Non-pharmacological interventions: patient education; diet; smoking cessation; exercise programme and rehabilitation
- Assessment of the response to therapy: relief of symptoms and signs; improvement of exercise capacity or cardiac performance; changes in neurohormonal activity
- Where appropriate, palliative and supportive care

(ii) Drug therapy
- Diuretics
- ACE inhibitors
- Angiotensin II receptor blockers
- Non-ACE inhibitor vasodilators
- Beta-blockers
- Spironolactone
- Digoxin
- Management of concomitant disorders: arrhythmias; thromboembolism; hypertension; angina; dyslipidaemia; diabetes

(iii) Pacing techniques
- Pacing in acute HF: superiority of atrial pacing
- Pacing devices in chronic HF

17.5c Surgical management of HF

(i) Mechanical circulatory support (mode of action; haemodynamic effects; indications; contraindications; duration of support; outcomes)
- Intra-aortic balloon counterpulsation
- Left ventricular assist devices

(ii) Revascularisation
- Patient selection for revascularisation
- Selection of procedure (PTCA or CABG)

(iii) Surgical remodelling of left ventricle

(iv) Heart transplantation
- Patient selection
- Indications
- Contraindications

17.5d Results of heart transplantation

- Actuarial survival
- Quality of life
- Long-term complications; post-transplant vasculopathy; complications of immunosuppressive therapy

17.6 Prognosis of HF

17.6a Predictors of prognosis

- NYHA class
- Assessments of cardiac function: LV ejection fraction; LV dilatation
- Peak oxygen consumption on exercise; MVO_2max
- Biochemical assessments: electrolyte abnormalities; neurohormonal activation
- HF survival score: development; validation; predictive value

17.6b Outcomes

- Causes of death: pump failure; sudden death; reinfarction
- Results from population studies and clinical trials: mortality; morbidity; hospital admission

17.7 Cor pulmonale

17.7a Causes

- Vascular: thromboembolic disease; primary pulmonary hypertension)
- Chronic obstructive pulmonary disease (COPD)
- Bronchiectasis; cystic fibrosis
- Pulmonary fibrosis
- Extrapulmonary: pleural symphysis; scoliosis; thoracoplasty; respiratory muscle weakness; obesity–hypoventilation syndrome; sleep apnoea syndrome

17.7b Epidemiology of cor pulmonale associated with COPD

- Aetiology: cigarette smoking; other factors
- Pathology: medial hypertrophy of small muscular pulmonary arteries; intimal changes; increased airway resistance; ventilation–perfusion mismatch; increased pulmonary artery pressure; right ventricular hypertrophy, dysfunction and failure; haemodynamic abnormalities

17.7c Diagnosis and assessment of cor pulmonale associated with COPD

- Clinical features: chronic cough; progressive dyspnoea; wheezing; ankle oedema
- Physical signs: signs of airway narrowing (hyperinflated chest, tachypnoea); central cyanosis; signs of right ventricular dysfunction (ankle oedema, raised venous pressure, right ventricular heave)
- Diagnostic procedures: chest X-ray (lung hyperinflation, cardiomegaly, enlargement of central pulmonary arteries); ECG (right axis deviation, tall P and R waves, changes in S and T waves); measurements of respiratory function (FEV_1, blood gases); echocardiography; laboratory tests
- Polysomnography (in patients with sleep apnoea)

17.7d Management of cor pulmonale associated with COPD

- Acute respiratory failure: treatment of bronchial infections; treatment of fluid retention (diuretics); bronchodilators; inspired oxygen; artificial ventilation
- Chronic cor pulmonale: bronchodilators; diuretics; vasodilators; inspired oxygen; respiratory stimulant drugs

17.7e Cor pulmonale associated with other respiratory disorders

- Bronchiectasis
- Cystic fibrosis
- Pulmonary fibrosis
- Sleep apnoea syndromes
- Asthma

17.8 ESC Guidelines

- Guidelines for the Diagnosis and Treatment of Chronic Heart Failure – Full Text: *Eur Heart J* 2001; *22*: 1527–60
- An update of the Guidelines for the Diagnosis and Treatment of Chronic Heart Failure is scheduled to be published in 2004
- Guidelines on the Diagnosis and Treatment of Acute Heart Failure are scheduled to be published in 2004

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

18 Primary Pulmonary Hypertension (PPH)

18.1 Definition; Classifications

- WHO classification (1998)
- Functional classification

18.2 Epidemiology

- Incidence of PPH
- Aetiology
- People in high-risk groups
- Genetics

18.3 Pathology

- Normal morphology of pulmonary vasculature
- The vascular pathological features of PPH
  - Plexogenic arteriopathy
- Severity of pathological findings
- Pulmonary hypertension in children

18.4 Pathophysiology

- General mechanisms of pulmonary hypertension
- Molecular and cellular mechanisms of pulmonary vascular remodelling
- The role of hormone and inflammatory mediators in the pathogenesis of PPH

18.5 Clinical features

- Progressive exertional dyspnoea
- Angina of effort
- Syncope
- Right heart failure
- Oedema
- Ascites
- Sudden death

18.6 Investigations

- Blood tests, arterial blood gases
- Chest X-ray, ECG, echocardiography, spiral computed tomography, magnetic resonance imaging
- Pulmonary function test
- Cardiopulmonary stress testing
- Ventilation–perfusion lung scan
- Cardiac catheterisation and pulmonary angiography
- Lung biopsy

18.7 Diagnosis

- Exclusion of secondary causes of PPH
- Chest X-ray, echocardiography
- Cardiac catheterisation

18.8 Prognosis

- Prognostic markers
  - Clinical
  - Haemodynamic

18.9 Management

- Medical treatment: controlled clinical trials with new compounds; anticoagulants; prostacyclin
- Surgical treatment: pulmonary endarterectomy; heart–lung transplantation
- Interventional treatment: atrial septostomy

18.10 ESC Guidelines

- Guidelines on the Diagnosis and Treatment of Pulmonary Arterial Hypertension are scheduled to be published in 2004

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

19 Rehabilitation and Exercise Physiology

19.1 Definition of rehabilitation

19. 2 Target population

19. 3 Categories of patients: high – intermediate – low risk and risk stratification

19.4 Programme components

- Multidisciplinary approach
- Role of the cardiologist
- Medical care

19.5 Exercise training

- Sports cardiology including physiological effects, screening and sports in specific heart conditions
- Indications and contraindications
- Type of training (endurance and strength)
- Training modalities
- Intensity, frequency and duration
- Monitoring and safety

19.6 Exercise testing

- Exercise physiology
- Indications and contraindications
- Modalities of exercise testing
  - Conventional exercise ECG (treadmill or bicycle)
  - Spiroergometry
  - Walking test including 6 minutes walk-test and determination of walking distance in patients with peripheral artery disease
- Protocols, procedures and interpretation
- How to select the appropriate exercise test
- Prognostic value
- Drugs in exercise testing
- Exercise testing in specific groups of patients
- Monitoring and safety

19.7 Chronic disease self-management and quality of life

- Patient education on heart disease rehabilitation
- Diet
- Smoking
- Psychosocial status, particularly depression
- Stress management
- Sexual problems
- Vocational status/return to work

19.8 Programmes for specific populations

- Multiple risk factors and stable disease
- Post PTCA
- Post MI
- Heart failure
- Valvular disease
- Cardiac surgery
- The elderly
- Women
- Congenital heart disease
- ICD
- Heart transplantation

19.9 Rehabilitation settings

19.10 Outcomes and assessment methods

19.11 Safety

19.12 Attendance and adherence

19.13 Specific population challenges; ageing, gender, socioeconomic status, culture

19.14 Chronic disease, self-management and quality of life

19.15 Position papers and guidelines

20 Arrhythmias

For each of the arrhythmias below, knowledge of the following aspects is required:

- Epidemiology
- Pathophysiology (if specific)
- Diagnosis and clinical features
- Prognosis including risk evaluation
- Guideline links

20.1 Basic principles for the cardiologist

20.1a Electrophysiology and electrocardiology

- Anatomy of the conduction system
- Ion channel function and regulation
- Propagation through the heart
- Basic principles of electrocardiology
- Mechanisms of arrhythmias (automaticity, triggered activity, reentry)

20.1b Diagnostics

- Clinical evaluation (history, physical examination)
- 12-lead ECG
- ECG monitoring (Holter, event monitoring, implantable event monitoring)
- Signal-averaged ECG
- Carotid sinus massage
- Tilt testing
- Invasive electrophysiology testing (indications, diagnostic yield)
- Exercise testing
- Cardiac magnetic resonance imaging (CMR)/cardiac CT imaging

20.1c Pharmacology

(See Chapter 4)

20.1d Knowledge of the indications for non-pharmacological therapy

- External and internal defibrillation
- Cardioversion
- Cardiac pacing
- Catheter ablation techniques (including mapping systems)
- Implantable cardioverter defibrillators
- Surgical ablation techniques

20.2 Classification

20.2a Supraventricular and ventricular premature beats

20.2b Tachyarrhythmias with narrow QRS complex

- Atrial tachyarrhythmias (atrial fibrillation, atrial flutter, other intra-atrial reentry tachycardias, focal atrial tachycardias, multifocal atrial tachycardia)
- Junctional tachycardias (AV nodal reentry, non-paroxysmal junctional tachycardias)
- Preexcitation syndromes

20.2c Tachyarrhythmias with broad QRS complex

- Supraventricular (preexisting bundle branch block, functional bundle branch block, antegrade conduction via accessory pathways)
- Ventricular tachycardias monomorphic (idiopathic, accompanying structural heart disease, bundle-branch reentry, interfascicular reentry)
- Ventricular tachycardias polymorphic (ischaemic, torsade de pointes)

20.2d Ventricular fibrillation

20.2e Bradyarrhythmias

- Sick sinus syndrome (sinus bradycardia, sinoatrial block, sinus arrest, brady–tachy syndrome)
- AV conduction abnormalities (AV block I–III)
- Intraventricular conduction disturbances

20.3 Therapy

20.3a Antiarrhythmic drugs

- Classification
- Pharmacology
- Indications
- Contraindications
- Side-effects

20.3b Defibrillation and cardioversion

- Mechanism of action
- Different options (internal, external, automatic)
- Indications
- Complications

20.3c Cardiac pacing (temporary, permanent)

- Physiology of pacing
- Nomenclature; pacemaker features; follow-up
- Indications
- Complications

20.3d Implantable cardioverter–defibrillators

- Mechanism of action
- ICD features, follow-up
- Indications
- Complications

20.3e Catheter ablation

- Energy sources, basic principles
- Indications
- Complications

20.3f Surgical ablation

- Energy sources, basic principles
- Indications
- Complications

20.4 ESC Guidelines

- ACC/AHA/ESC Guidelines for the Management of Patients with Supraventricular Arrhythmias – Executive Summary: *Eur Heart J* 2003; 24: 1857–97
- ACC/AHA/ESC Guidelines for the Management of Patients with Supraventricular Arrhythmias – Full Text (WebPosted) 2003 – **www.escardio.org**

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

21 Atrial Fibrillation

21.1 Epidemiology

- Definition
- Demographics; risk factors
- Economic implications

21.2 Pathophysiology

- Causes and mechanisms
- Clinical implications

21.3 Classification

- Acute
- Paroxysmal (first attack, recurrent attacks untreated, recurrent attacks treated)
- Chronic

21.4 Diagnostic procedures

- Initial evaluation (history, physical examination, 12-lead ECG)
- Biochemistry; thyroid hormone tests
- Echocardiography
- ECG monitoring (Holter monitoring, implantable loop recorders)

21.5 Prevention of embolic complications

- Assessment of embolic risk
- Strategies for prevention of embolic events

21.6 Treatment

21.6a Rhythm versus rate control

21.6b Conversion to sinus rhythm

- Pharmacological cardioversion
- Electrical cardioversion
- Anticoagulation and restoration of sinus rhythm

21.6c Prevention of recurrences

- After successful cardioversion
- In paroxysmal atrial fibrillation

21.6d Control of ventricular rate

- Criteria
- Drugs
  - Digoxin
  - Calcium antagonists
  - Beta-blockers
  - Other drugs
- Other interventions

21.6e Pacemaker therapy

- Pacing for rate support; VVIR versus DDDR
- Antitachycardia pacing; preventive algorithms
- Multisite or alternative site pacing
- Atrial defibrillator (within implantable cardioverter–defibrillator devices)

21.6f Catheter ablation

- Ablation/modification of AV node for rate control; prevention of sudden death
- Curative ablation: mechanism; techniques; success rates; complications

21.6g Surgery

- Mechanism; techniques; success rates; complications

21.7 Management strategies according to presentation of atrial fibrillation

- Paroxysmal
- Permanent
- Persistent
- After coronary artery bypass grafting
- In congestive heart failure

21.8 ESC Guidelines

- ACC/AHA/ESC Guidelines for the Management of Atrial Fibrillation – Full Text: *Eur Heart J* 2001; 22: 1852–923
- ACC/AHA/ESC Guidelines for the Management of Atrial Fibrillation – Executive Summary: *J Am Coll Cardiol* 2001; 38: 1231–65

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

22 Syncope

22.1 Epidemiology

- Definition
- Demographics; prognostic classification; recurrences
- Economic implications

22.2 Pathophysiology

- Regulation of cerebral circulation
- Neurocardiogenic mechanism

22.3 Classification

- Neurally mediated (including situational)
- Orthostatic
- Cardiac (arrhythmias, structural heart diseases)
- Cardiovascular
- Non-syncopal attacks (syncope-like conditions)

22.4 Diagnostic procedures

- Initial evaluation (history, physical examination, 12-lead ECG)
- Echocardiogram
- Carotid sinus massage
- Tilt testing
- ECG monitoring (Holter monitoring, implantable loop recorders)
- Electrophysiology testing (indications, diagnostic yield)
- ATP test
- Signal-averaged ECG
- Cardiac catheterisation and angiography
- Neurological and psychiatric evaluation

22.5 Treatment

- General principles
- Neurally mediated syncope (drugs, head-up tilt test training, pacing)
- Orthostatic syncope (volume expansion, diet, drugs, stockings)
- Cardiac arrhythmias (pacing, drugs, ablation, implantable cardioverter–defibrillator)
- Structural heart disease (amelioration of the specific structural lesions or their consequences)
- Cardiovascular (drugs, angioplasty, surgery)

22.6 Specific issues

- Need for hospitalisation (indications)
- Syncope in the elderly
- Syncope in children
- Syncope and driving

22.7 ESC Guidelines

- Guidelines on the Management (Diagnosis and Treatment) of Syncope – Full Text *Eur Heart J* 2001; 22: 1256–306
- Guidelines on the Management (Diagnosis and Treatment) of Syncope – Executive Summary: *Europace* 2001; 3: 253–60
- Guidelines on the Management (Diagnosis and Treatment) of Syncope (Update) is scheduled to be published in 2004

Details of the latest ESC Guidelines can be found in the guidelines section of the Knowledge centre at **www.escardio.org**

23 Sudden Cardiac Death and Resuscitation

23.1 Definitions

- Sudden cardiac death (SCD)
- Cardiac arrest
- Cardiovascular collapse

23.2 Epidemiology

- Overall incidence
- Population subgroups and risk of SCD
- Time dependence of risk
- SCD in coronary artery disease patients: left ventricular dysfunction; ventricular ectopy

23.3 Causes of SCD

- Coronary artery abnormalities
- Ventricular hypertrophy, including hypertrophic cardiomyopathy
- Dilated cardiomyopathies including ischaemic cardiomyopathy; acute cardiac failure
- Inflammatory or infiltrative disorders of the myocardium
- Arrhythmogenic right ventricular cardiomyopathy
- Valvular heart disease
- Marfan's syndrome
- Congenital heart disease
- Electrophysiological abnormalities: abnormalities of the conduction system; repolarisation abnormalities; ventricular fibrillation without structural or functional abnormality; long Q-T syndromes
- Neurohumoral and central nervous system influences
- Sudden infant death syndrome and sudden death in children

23.4 Pathology

- Coronary arteries: acute lesions; chronic abnormalities
- Ventricular myocardium; acute or healed myocardial infarction; hypertrophy; aneurysm

23.5 Pathophysiology

23.5a Tachyarrhythmias

- Structural abnormalities
- Functional alterations
- Premature ventricular contractions
- Ventricular tachycardia, ventricular fibrillation

23.5b Bradyarrhythmias and asystolic arrest

23.5c Pulseless electrical activity

- Primary
- Secondary

23.6 Clinical characteristics

- Prodromal symptoms
- Onset of the terminal event
- Clinical features of cardiac arrest
- Biological death
- Course of survivors of cardiac arrest
- Clinical profile of survivors of out-of-hospital cardiac arrest

23.7 Management of cardiac arrest

23.7a Community-based interventions

- Importance of initial electrophysiological mechanism
- Time from onset of cardiac arrest to initial defibrillation and survival
- Emergency rescue system design and survival

23.7b Treatment

- Techniques of cardiopulmonary resuscitation (CPR)
  - Prehospital CPR; ventilation and chest compression
  - Defibrillation; automatic external defibrillators
  - 'Chain of survival'
- Legal and ethical issues related to resuscitation, e.g. termination of CPR or 'not for resuscitation'

23.7c Advanced life support and definitive resuscitation

- Ventricular fibrillation, ventricular tachycardia: defibrillation; cardioversion; pharmacotherapy (adrenaline, antiarrhythmic agents, sodium bicarbonate, magnesium)
- Bradyarrhythmic and asystolic arrest: confirm diagnosis; pacing; pharmacotherapy
- Pulseless electrical activity

23.7d Post cardiac arrest care

- Primary cardiac arrest in acute myocardial infarction
- Secondary cardiac arrest in acute myocardial infarction
- Cardiac arrest associated with non-cardiac disorders
- Survivors of out-of-hospital cardiac arrest

23.8 Therapy for prevention of cardiac arrest

23.8a Antiarrhythmic drug strategies

- Ambulatory ECG recording
- Programmed electrical stimulation

23.8b Surgical interventions

23.8c Catheter ablation

23.8d Implantable defibrillators

23.9 Therapeutic strategies for specific patient groups

23.9a Primary prevention

23.9b Secondary prevention

- Role of implantable defibrillators for patients who 'survive' sudden cardiac death

23.10 SCD and public safety

23.11 ESC Guidelines

- Guidelines on Sudden Cardiac Death (Update) – Editorial: *Eur Heart J* 2003; 24: 13–15
- Sudden Cardiac Death – Executive Summary: *Europace* 2002; 4: 3–18
- Sudden Cardiac Death – Full Text: *Eur Heart J* 2001; 22: 1374–450

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24 Diseases of the Aorta and Trauma to the Aorta and Heart

24.1 Aneurysm of the thoracic aorta

- Definition
- Aetiology: atherosclerosis; non-inflammatory cystic medial degeneration; inflammatory aneurysms
- Clinical features: development of aortic valve regurgitation; expansion of thoracic aneurysm sac; compression or erosion of adjoining structures
- Diagnostic procedures: chest X-ray; echocardiography; aortic angiography; CT; CMR
- Surgical management: indications for surgery (resection of affected segment, replacement with Dacron graft, stent-grafts); operative mortality; long-term results

24.2 Dissection of the thoracic aorta

24.2a Aortic dissection

- Definition and classification
- Aetiology: development of intimal tear; cleavage within medical layer; creation and propagation of false lumen
- Clinical features: severe tearing chest pain; acute syncope; neurological signs
- Diagnostic procedures: chest X-ray; transoesophageal echocardiography; aortic angiography; CT; magnetic resonance imaging
- Medical management: blood pressure control
- Surgical management: indications for surgery; surgical techniques; operative mortality; long-term results
- Long-term therapy and follow-up

24.2b Haematoma of the aorta

- Intramural haematoma: definition; symptoms; diagnosis; natural history; therapy
- Penetrating atherosclerotic ulcer: definition; symptoms; diagnosis; natural history; therapy

24.3 Aortic atheromatous disease

- Thrombotic or cholesterol emboli

24.4 Aortitis

- Definition: aetiological classification (syphilitic, non-syphilitic bacterial, non-bacterial)
- Aetiology: inflammatory cell infiltrate in aortic wall; medial necrosis and scar formation
- Clinical presentation: syphilitic aortic aneurysm; aortic valve regurgitation; coronary ostial stenosis; Takayasu's aortitis
- Diagnostic procedures: serological testing; aortic imaging
- Medical management: treatment of syphilis; culture and treatment of non-syphilitic infections; chronic steroid therapy in Takayasu's aortitis
- Surgical management: indications for surgery; surgical techniques; operative mortality; long-term results

24.5 Traumatic rupture of the aorta

24.5a Aetiology

- Incidence
- Causes: deceleration injuries; direct external injuries

24.5b Pathophysiology

- Site of rupture
- Mechanisms: movement of heart relative to fixed aorta; abrupt rise in intraluminal pressure

24.5c Clinical features

- Clinical examination: radiating pain; upper limb hyperextension; presentation without evidence of chest trauma

- Diagnostic procedures: chest X-ray; aortography; computed tomography

24.5d Management and results

- Urgency of immediate surgical intervention
- Surgical procedure: protection of spinal cord; bypass of aorta; direct anastomosis; grafting
- Outcome: survival; causes of death

24.6 Trauma to the heart

24.6a Aetiology

- Incidence
- Causes: penetrating trauma; blunt trauma; electrical injury

24.6b Pathophysiology

- Structures injured
- Effects of penetrating and blunt trauma
- Effects of pericardial leakage
- Development of intracardiac shunts

24.6c Clinical features

- Clinical examination: signs and symptoms of tamponade or hypovolaemia
- Features of myocardial contusion, cardiac rupture, coronary artery injury, ventricular aneurysms and septal damage
- Diagnostic procedures: chest X-ray; echocardiography; assessment of cardiac enzymes
- Presentation with penetrating thoracic injury but no definite evidence of cardiac penetration

24.6d Management and results

- Medical: relief of chest pain; management of complications (arrhythmias, heart failure, valve dysfunction)
- Surgical: repair of septal defects; repair of chambers; ligation of injured coronary arteries; valve repair or replacement; thoracotomy
- Indications for cardiopulmonary bypass
- Outcome: survival

24.7 ESC Guidelines

- Diagnosis and Management of Aortic Dissection – *Eur Heart J* 2001; 22: 1642–81

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25 Peripheral Arterial Diseases

25.1 Epidemiology and pathology

- Epidemiology of peripheral arterial disease
- Anatomy and physiology of the arterial system
- Mechanisms of arterial diseases; atherosclerosis; aneurysmal disease; vasospastic disorders
- Effects of peripheral arterial disease on circulatory function
- Risk factors

25.2 Diagnosis and assessment

- Clinical examination: symptoms and signs
- Assessment of peripheral vascular function
- Recognition of ischaemia to skeletal muscles, kidneys, lungs and CNS
- Objective assessments: Doppler ultrasound; other investigations
- Risk stratification: risk of peripheral ischaemia and target organ damage
- Evaluation of need for conservative (e.g. compression bandaging), medical or surgical treatment
- Acute ischaemia

25.3 Medical management

- Pharmacological management of vasospastic disorders (e.g. vasodilators, calcium antagonists)
- Management of arteritis
- Management of claudication
- Peripheral angioplasty
- Management of associated disorders (e.g. atherosclerosis, hypertension)
- Long-term follow-up
- The diabetic foot (see also Diabetic Heart Disease, p. 11)

25.4 Surgical management

- Patient selection
- Presurgical preparation
- Peripheral artery bypass grafting
- Postsurgical management
- Long-term follow-up

25.5 Prognosis

- Clinical progression of peripheral vascular disease and claudication
- Association with other cardiovascular disorders
- Long-term results of medical and surgical therapy

26 Thromboembolic Venous Disease

26. 1 Epidemiology

26.1a Incidence of venous thromboembolism/ pulmonary embolism (VTE/PE)

26.1b Risk factors

- Genetic
- Thrombophilia: deficiency of antithrombin III, proteins S and C; hyperhomocysteinaemia, factor V Leiden mutation; antiphospholipid antibodies; lupus anticoagulant
- Environmental/lifestyle factors
- Comorbidities
- Hormonal factors: oral contraceptives; hormone replacement therapy

26.2 Pathophysiology

26.2a Virchow's triad

- Clot propagation

26.2b Pulmonary embolism

- Increased pulmonary vascular resistance
- Ventilation–perfusion mismatch
- Right ventricular pressure overload
- Right ventricular ischaemia and hypokinesis

26.3 Clinical presentation/diagnosis

26.3a Deep vein thrombosis

- Clinical probability
- Low, intermediate and high probability
- Measurement of fibrin D-dimer
- Venous compression ultrasonography
- Venography – selected cases
- Diagnostic algorithms

26.3b Massive PE

- Dyspnoea
- Syncope
- Physical findings – tachycardia; hypotension; auscultatory findings

26.3c Electrocardiogram: right ventricular strain; right bundle branch block; precordial T wave inversion

26.3d Chest X-ray

26.3e Blood tests

- Serum enzymes; troponins – cardiac troponin I (cTnI); cardiac troponin T (cTnT); blood gases
- D-dimers: sensitivity and specificity

26.3f Echocardiography: two-dimensional and transoesophageal

- Intracardiac thrombus; right ventricular septal bulging; right ventricular and inferior vena cava dilatation; pulmonary hypertension

26.3g Other imaging techniques

- Spiral computed tomography
- Ventilation–perfusion (V/Q) lung scan
- Pulmonary angiography
- Magnetic resonance, pulmonary angiography

26.3h Diagnostic algorithms for PE

26.4 Differential diagnosis of acute PE

- Acute coronary syndrome/myocardial infarction
- Aortic dissection
- Cardiac tamponade
- Tension pneumothorax

26.5 Prognosis and risk stratification

- Echocardiography
- Troponins (cTnI; cTnT)

26.6 Treatment

26.6a Primary treatment (massive PE – hypotension and/or right ventricular strain)

- Thrombolysis (systemic or local)
- Embolectomy – surgical or percutaneous
- Mechanical fragmentation

26.6b Adjunctive measures

- Heparin therapy (unfractionated heparin [UFH]; low-molecular-weight heparin [LMWH])
- Pain relief
- Oxygenation
- Mechanical ventilation
- Inotropic support

26.6c Secondary prevention

- Heparin therapy (UFH; LMWH)
- Warfarin sodium
- Inferior vena caval filters

26.6d Chronic PE/pulmonary hypertension

- Thromboendarterectomy
  - Rationale; results; complications

26.7 Prevention of DVT/PE

26.7a Mechanical measures

- Graduated compression stockings
  - Rationale and results
- Inferior vena caval filters
  - Selection of patients

26.7b Pharmacological agents

- UFH; LMWH
  - Clinical trials and guidelines

26.7c Specific situations: orthopaedic surgery; non-orthopaedic surgery; pregnancy; medical conditions – intensive care unit

26.8 ESC Guidelines

- Guidelines on Diagnosis and Management of Acute Pulmonary Embolism – *Eur Heart J* 2000; 21: 1301–36

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