Imperial College
London

BSc in Medical Sciences with CARDIOVASCULAR SCIENCES

Introduction
Cardiovascular disease is the leading cause of global morbidity and mortality. This course will provide students with an understanding of the scientific foundations of the study of cardiovascular disease and an introduction to the epidemiology, investigation and treatment of cardiovascular disease. This course will consist of a two week foundation course for the BSc, three 5-week taught modules and either a research project or a specialist course (two 5-week modules).

Course Director
Professor Alun Hughes a.hughes@imperial.ac.uk

Course Administrator
Uzma Chaudhary u.chaudhary@imperial.ac.uk

Aims and Objectives
The course will give a firm grounding in the scientific foundations of the study of cardiovascular disease.
Specifically, the course will provide students with:

- A sound knowledge and understanding of cardiovascular science, extending to current research controversies and challenges
- An understanding of and critical approach to the scientific evidence on which this knowledge is based
- An appreciation of the fundamental principles and practice of scientific research within the field
- An introduction to the epidemiology, investigation, management and treatment of cardiovascular disease

Content
The medical sciences as applied to normal and abnormal function of the cardiovascular system will be studied in detail. This will include consideration of the cellular and molecular processes related to the normal function of the heart and vasculature, and their derangement in disease. There will also be an introduction to the principles of epidemiology, diagnostic imaging and therapeutic strategies as applied to cardiovascular disease.

Format of teaching
The course will be taught in a mixture of lectures, teaching seminars, small group journal clubs, practical demonstrations, practical classes and tutorials.

Introduction to Cardiovascular Sciences BSc Course

Module Leaders

Professor Sian Harding s.harding@imperial.ac.uk
Dr Julia Gorelik j.gorelik@imperial.ac.uk

Learning objectives

- To understand the nature and purpose of the scientific method and its relation to the practice of medicine
- To learn basic concepts related to B.Sc. year Modules 1, 2 and 3.
- To understand the design of the laboratory-based project aspect of the course and the process of choosing a supervisor and subject
- To develop further information technology skills
- To apply information technology and journal reading skills to a Journal Club assignment.

Module 1: Cellular cardiology

Module Leaders

Professor Ralph Knoell r.knoell@imperial.ac.uk
Professor Steve Marston s.marston@imperial.ac.uk
Dr Cesare Terracciano c.terracciano@imperial.ac.uk

Aims and Content

- To understand the structure and development of the heart, including the cardiac myocyte, interconnections between myocytes, and the mechanisms that bring about contraction and relaxation of the myocyte (excitation-contraction coupling) in normal and diseased hearts.
- To understand the electrophysiological properties of the heart and how disturbances in electrophysiological properties predispose the heart to arrhythmias.
- To be able to describe the molecular aspects (stimuli, signalling and regulation of gene and protein expression) of cardiac adaptation to increased workload (cardiac hypertrophy) and ischaemia / reperfusion.
- To have knowledge of developing technologies and novel approaches for the treatment of heart failure (e.g. cell transplantation, gene therapy, restoration of the cell cycle) and be able to discuss these in the context of the molecular aspects of heart failure.
- To understand the molecular basis of heart disease, different human mutations in a wide variety of different genes will be discussed.

Module 2: Vascular Biology & Cardiovascular Pharmacology

Module Leaders

Professor Alun Hughes a.hughes@imperial.ac.uk
Dr Anna Randi a.randi@imperial.ac.uk
Dr Michael Schachter m.schachter@imperial.ac.uk

Aims and Content

- To introduce students to the range of physiological functions performed by the vasculature.
- To understand normal vascular biology and its derangement in disease.
- To understand the basic pharmacology of the cardiovascular system, including cellular and molecular aspects of vascular function

Module 3: Cardiovascular Imaging, Epidemiology and Electrophysiology

Module Leaders

Dr Phang Boon Lim p.b.lim@imperial.ac.uk
Professor Nicholas Peters n.peters@imperial.ac.uk
Professor Neil Poulter n.poulter@imperial.ac.uk
Professor Richard Underwood r.underwood@imperial.ac.uk

Aims and Content

- To provide an introduction to the imaging techniques used to assess cardiovascular anatomy and function in health and in disease.
- To evaluate the determinants, distribution and optimal prevention of cardiovascular diseases.
- To understand the pros and cons of different types of studies used to investigate the causes and treatments for cardiovascular diseases and to explore the relative values of the high risk and population strategies of prevention.
- To provide an overview of Cardiac electrophysiology and diagnostic tools used in studies and clinical management.
- To explore cardiac electrophysiology in the form of practical examples and case studies and attend demonstrations and workshops.

Modules 4-5

Project Part C

A wide variety of laboratory-based, clinical and computer-based projects will be offered. Students may elect to carry out a library project if they wish.

Project Coordinator

Dr Michael Schachter m.schachter@imperial.ac.uk

Past BSc Project Titles in Cardiovascular Sciences

- Urinary sodium excretion in relation to cardiac structure and function in UK White Europeans and African Caribbeans
- 'Purification and Characterisation of Human Cardiac Progenitor Cells
- Role of inducible vasoacitve genes (iNOS and COX-2) in endothelial dysfunction induced by bacterial and viral mimetics
- Effect of methylglyoxal (MG) on expression of nitric oxide synthase
- Na+/Ca2+ exchange inhibition as a potential strategy for the treatment of heart disease.
- Risk stratification in dilated cardiomyopathy. Role of fibrosis
- Protein kinase signalling to gene expression in cardiac myocytes
- Characterisation of growth and proliferation in cardiomyocytes derived from human embryonic stem cells
- The pattern of septal motion in patients before and after cardiac surgery: origin of the “wiggle”.
- Regulation of angiogenesis by the ETS transcription factor Erg

- Patterns of aortic arch arteries in congenital heart defects
- Role of Phosphorylcholine antibodies in heart transplant recipients
- Biomechanical analysis of abdominal aortic aneurysms (AAA)
- Role of COX-1 and COX-2 in vascular function at the level of the endothelium and at the level of the underlying vascular smooth muscle
- Regulation of heart valve calcification
- Genetic determinants of cardiac function: strain differences in murine calcium handling
- Pericardial fat – a novel risk factor for cardiovascular disease?
- Risk stratification in Ischaemic Heart Disease. Importance of myocardial scar detection
- Analysis of Mitral Valve Doppler Waveform and comparison to BP (Finapres) changes during non-invasive haemodynamic optimisation of heart failure devices
- Protein kinase signalling to gene expression in cardiac myocytes
- Role of TLR4 in the normal functioning of the endothelium
- Is it worth developing new drugs for cardiovascular disease?
- Evaluation of Resolution Recovery Software for myocardial perfusion studies (MPS)
- Role of COX - 2 in cardiovascular health and disease
- The use of Induced Pluripotent Stem Cell (IPSC) derived cardiomyocytes as disease models
- Role of protein kinase C epsilon (PKCε) in vascular protection
- The role of microvascular dysfunction in the pathogenesis of dilated cardiomyopathy
- Does the broccoli extract sulphoraphane regulate monocyte thrombogenicity?
- Assessment of Interstitial Myocardial Fibrosis in Heart disease
- Making new blood vessels: all you need is Erg
- Comparison of Planar and SPECT Radionuclide Ventriculography
- Assessment of infarct border zone morphology following modification by pharmacological gap junction modulators
- The prognostic significance of mid-wall fibrosis in dilated cardiomyopathy
- Mechanical unloading: potential treatment for heart failure

- Abnormal ECG referrals to Cardiology Clinics
- Assessment of microvascular ischaemia in Hypertrophic cardiomyopathy
- Separation of pressure waves directing blood flow using pressure-only analysis
- Is myocardial contraction band necrosis an important histological signature in victims of sudden cardiac death during emotional stress?
- The mouse cardiomyocyte as an in vitro model of stress cardiomyopathy
- The effect of AV delay on exercise capacity in patients with biventricular pacemakers and heart failure
- Effect of heart rate on optimal AV delay of CRT devices and the need to measure signal changes using an algorithm of alterations instead of steady state pacing
- Does Felcainide inhibit spontaneous Ca release events and triggered beats in normal cardiac myocytes?
- Examining the effect of glycaemic control on inflammatory and metabolic responses in the critically ill child following surgery for congenital heart disease
- Endothelial cells dysfunction in systemic inflammation:implications for cardiac surgery
- How to make new blood vessels: A new role for von Wilebran factor

What do the students think of the BSc in Cardiovascular Sciences?

'The course started with a brief introduction to the anatomy and development of the cardiovascular system. These were the foundations of the course which proved useful at every aspect. Then the function and morphology was well integrated which brought in the electrophysiological functions and intricate morphology into perspective. Module 2 included the pharmacological functions and major diseases of the cardiovascular system and the last module was a mixture of epidemiology and imaging techniques in cardiovascular disease with more in depth electrophysiological mechanisms.

I liked the way it was a very gradual course where each previous lecture served as an introduction to the next which enabled deeper understanding of the course. Also the lecturers were very helpful and very efficient with answering our questions which made us feel reassured.

The days when we visited labs and hospitals to see the imaging techniques were the main highlights as it brought to life what we had been learning.

Overall it was a great course and there are not negative aspects worthy of mention.'

'Cardiovascular Sciences is a challenging yet enjoyable BSc choice. You are thrown into the deep end in the first module, with the (delights!) of biochemistry befuddling your brain, however the support and encouragement of lecturers will get you through. From then on, the course material is interesting and relevant to clinical practice. Assessments are fairly frequent, but this is appreciated when it comes to the exams. An excellent, well organised BSc choice, with variety, highly enthusiastic lecturers and a few laughs along the way!'