# Imperial College London

# BSc in Medical Sciences with ENDOCRINOLOGY

# Introduction

The Endocrine system provides a critical means of communication within the body and maintains a constant internal milieu in the face of an ever-changing external environment. It is thus essential for survival and adaptation throughout life and plays a key role in the balance between health and disease.

This course will comprise a two-week Introductory course, three 5-week taught modules and either a research project or a specialist course option (two 5-week modules).

# **Course Director**

Professor Glenda Gillies g.gillies@imperial.ac.uk

Project coordinator

Dr Kevin Murphy

k.g.murphy@imperial.ac.uk

# **Course Administrator**

Ms Olive Thomas

o.thomas@imperial.ac.uk

# **Overall Aims and Objectives**

- To encourage and develop the student's motivation, originality of thought and breadth of vision.
- To provide a supportive learning environment, underpinned by world class research;
- To provide distinctive modules within appropriate areas of endocrinology, drawing on the expertise and strengths of our academic staff.
- To produce graduates well trained in laboratory and research skills;
- To foster the ability to work independently and as part of a group, and to develop presentation skills, both written and oral
- To provide an insight into the major areas of interest in Endocrinology at both the basic science and clinical levels as well as an understanding of state-of-the-art technology that is used to further research in the field.
- To ensure that students are familiar with the fundamental principles of endocrine communication within the body, the underlying molecular events which support these processes, the pathological states that emerge when these processes malfunction and opportunities for the development of novel therapeutic targets.

# **Background Reading and reference texts**

Each lecture of the BS course is normally accompanied by some key references (reviews or original research papers) in leading scientific journals, which are freely accessible via *PubMed* using an Imperial computer or VPN connection. There is no single textbook which covers the course, but a comprehensive, general background can be found in the library in texts such as:

Laycock JF & Wise P: *Essential Endocrinology*, 3rd ed., Oxford University Press (1996) (basic science and clinical content)

Rang H, Dale M and Ritter, J: Pharmacology, 4th ed., (1999). (relevant for drug information)

**2nd Edition.** The Oxford Textbook of Endocrinology and Diabetes DOI: 10.1093/med/9780199235292.003.0134

# Content

The course will provide knowledge and understanding of:

- different scientific techniques and approaches available in molecular, cellular and whole body science;
- how to formulate hypotheses, what constitutes good experimental design and the development of a research plan;
- critical evaluation of scientific papers;
- how to use the library and literature searches to gather and organise information;
- methods available for analysing endocrine function and an appreciation of modern analytical developments;
- the basic concepts of molecular endocrinology that underpin hormone actions, how dysfunction relates to primary pathogenesis, and how this knowledge informs improvement in diagnosis and the potential for novel therapies;
- endocrine, paracrine and autocrine phenomena in the development of cancer;
- the endocrine control of food intake, energy expenditure and obesity;
- theories of the aetiology and pathogenesis of type 2 diabetes mellitus;
- the body's response to stress and how this might impact on immune, reproductive, cardiovascular and mental health;
- steroid hormone action in the brain; the concepts of organisational and activational effects that underpin sexual dimorphisms, neurodevelopmental consequences and the pathological implication for behavioural and neurodegenerative disease.

#### Format of teaching

The taught part of the course will comprise seminars/lectures and small group teaching, including Journal Clubs aimed at critical appraisal of published research papers and debates. For each module a significant portion of time is allowed each week for private study and preparation of in-course assessment. A proportion of the lectures of the Introductory Course and module 1 (circa 30%) will be given in conjunction with the Reproductive and Developmental Biology Course.

# Introductory Course

#### Module Leaders

Dr Pat Cover

p.cover@imperial.ac.uk

# **Specific Aims**

- to acquire transferable skills essential for academic success and future careers: these include writing good science; searching, storing and understanding the literature; data interpretation and critical analysis
- to develop these skills in the context of basic and clinical science relating to endocrinology: this focuses on the essential elements of the hypothalamo-pituitaryendocrine axes and communication pathways between the brain and periphery which underpin basic endocrine concepts and their clinical significance

#### Module 1: Hormone-dependent systems and Cancers

#### **Module Leaders**

Dr Alan Purohit	a.purohit@imperial.ac.uk
Dr Ian Godsland	i.godsland@imperial.ac.uk

# **Specific Aims**

- to understand the means of communication within the endocrine system: from hormone and receptor genes to signalling molecules and whole-body responses
- to relate abnormalities at gene, molecular and cellular levels to disruptions in endocrine function and the emergence of disease states, especially relating to reproductive, thyroid and bone disorders
- to examine the role of steroid hormones and other agents in the development and progression of endocrine-related cancers (breast, ovarian, endometrium, prostate)
- to identify current and promising molecular targets for novel endocrine-based cancer therapies

# Content

- The nuclear receptor superfamily
- Wnt signalling
- G-protein-coupled receptors and signal transduction
- Growth factors and receptor signalling by tyrosine kinases
- Steroid hormone receptors and control of gene expression
- Molecular endocrinopathies basic concepts and examples
- Thyroid hormone disorders
- Hormonal control of bone metabolism and pathogenesis of osteoporosis
- Pathophysiology of bone
- Reproductive endocrinology and polycystic ovarian syndrome
- Aromatase, aromatase inhibitors and cancer
- Steroid sulphatase inhibitors
- Drug resistance and cancer
- Molecular biology and cancer
- Prostate cancer
- Growth factors and tumour susceptibility genes
- Pathways of apoptosis
- Control of tumour angiogenesis
- Gut hormone tumours
- Multiple endocrine neoplasia
- Pituitary tumours

# Module 2: Type 2 Diabetes Mellitus, Metabolism and Obesity

# Module Leaders

Dr Kevin G Murphy Dr Ian Godsland k.g.murphy@imperial.ac.uk i.godsland@imperial.ac.uk

# Specific Aims

- To understand the endocrine control of intermediary metabolism, food intake and energy expenditure
- To develop an understanding of the theories of the aetiology and the pathogenesis of Type 2 diabetes mellitus, including the molecular basis, the contribution of the intrauterine environment and diet as well as the relative roles of increased insulin resistance and deficient insulin secretion.
- To appreciate the role of signalling pathways between gut and brain in regulating feeding behaviour and obesity

# Content

- Introduction to diabetes and obesity
- history and epidemiology of diabetes
- insulin resistance and secretion in the aetiology of T2DM
- pancreatic development and diabetes
- insights from T2DM prevention trials
- the molecular basis of insulin sensitivity
- inflammation and T2DM
- diabetic dyslipidaemia
- diabetes and cancer
- the metabolic syndrome
- Insulin action and ovarian function
- Assessment of insulin secretion and insulin resistance
- The thrifty phenotype and fetal programming
- pregnancy insulin resistance and foetal growth
- Fatty acids and diabetes
- Central regulation of energy expenditure
- Hypothalamic nutrient and fuel sensing
- Obesity and society
- The thrifty genotype, why is T2DM so prevalent
- · Polycystic ovaries clinical issues with insulin resistance
- GLP-1 and diabetes
- Hypothalamic appetite control
- The melancortin system
- Opioids, cannabinoids and classical neurotransmitters
- The brainstem and appetite regulation
- Leptin and insulin neuropeptide signalling
- Ghrelin, PYY, PP and appetite control
- Adiponectin and the adipocytokines
- Bariatric surgery
- Hydroxy-steroid dehydrogenase, cortisol and obesity
- Anti-obesity drugs
- Foetal programming and bodyweight
- The genetics of obesity
- neuronal effects of metabolic regulators
- nuclear hormones and metabolism

# Journal Clubs (typical examples)

- 1. Neuronal effects of metabolic regulators.
- 2. Fatty acids, metabolic and endocrine affects.
- 3. Gestational diabetes mellitus.
- 4. Polycystic ovary syndrome

# **Debates (typical examples)**

- 1. This house believes in resistance is primary in the pathogenesis of type II diabetes rather than an insulin deficit
- 3. This House believes that hypothalamic dysfunction is primary in the aetiology of diabetes rather than central adiposity and non-alcoholic steato hepatitis.
- 4. This house believes that obesity is a will power problem rather than a medical problem.

There will also be a debate between teams of students on a topical issue in obesity and diabetes.

# Module 3: Neuroendocrinology in Health and Disease.

#### Module Leader

Professor Glenda Gillies g.gillies@imperial.ac.uk

# **Specific Aims**

- To provide an understanding of the response of the body and brain to stressful stimuli with specific reference to the regulation of the hypothalamo-pituitary-adrenal (HPA) axis and interactions of the stress axis with the immune system, cardiovascular system and brain/behaviour.
- To assess the impact of early life exposure to stress and stress hormones on physiological processes and disease susceptibility in later life
- To illustrate the roles of gonadal steroids on sexual differentiation of the neuroendocrine hypothalamus, and how this impacts on central control of reproduction, growth and stress responses.
- To explore the non-reproductive roles of sex hormones on brain function outside the hypothalamus, and how they contribute to a sex bias in CNS disorders.
- With this understanding, to highlight the scope for new therapeutic approaches to disease.

# Content

# Seminars/Tutorials/Lectures

- The neuroendocrine concept.
- The hypothalamus: co-ordinator of the stress response.
- Stress; a protective mechanism or a health hazard?
- The host-defence system and neuroendocrine-immune inter-communication in health and disease
- Behavioural and autonomic responses to stress.
- HPA axis and psychiatric disease
- Stress hormones and reproductive competence.
- Glucocorticoids, stress and hypertension.
- Neurodevelopmental implications of glucocorticoid exposure during early human development.
- Early programming actions of sex steroid hormones in the brain: lessons from the hypothalamo-pituitary-gonadal axis.
- Changing patterns of growth hormone secretion from birth to adulthood: regulatory mechanisms and biological significance.
- Paediatrics and perinatal stress/distress
- The endocrine contribution to sex differences in CNS disorders
- Trophic and protective effects of oestrogen in the adult brain: implications for stroke and neurodegenerative diseases (Alzheimer's, Parkinson's).
- Environmental estrogens: where do they come from, what might they be doing to us and how can we test this?

# **Journal Clubs**

# Modules 4-5

# Projects

A wide variety of laboratory-based, clinical and computer-based projects will be offered. Students may also elect to carry out a library project. Project descriptions for 2010-2011 can be found on the intranet.

# Society for Endocrinology

The Society for Endocrinology offers free membership to students studying Endocrinology. All students on this course are encouraged to take up membership, and further details and benefits can be found at <a href="http://www.endocrinology.org/">www.endocrinology.org/</a>

In addition, the Society has awarded the Imperial College Endocrinology BSc Course a grant to support the **Society for Endocrinology Undergraduate Achievement Award**. This is a prize of £100 plus a certificate for the student achieving the highest in-course assessment marks for each of modules 1-3.

# Past BSc Project Titles in Endocrinology

- Insulin resistance pre and post haemodialysis
- Hormonal influences on the developmental trajectories of midbrain dopaminergic populations
- Predictors of disease recurrence and morbidity in patients with treated acromegaly
- Changes in taste after bariatric surgery
- Validation of haemoglobin A1c for diagnosis of diabetes mellitus in an Asian population
- Measures of regional body fat and cardiovascular risk factors
- Long term follow up of patients with a pituitary non-functioning adenoma
- To assess whether a detectable circulating C-Peptide level in subjects with type 1 diabetes is associated with less glucose variability and fewer hypyglycaemic episodes at low HbA1c levels.
- Measures of insulin resistance-related risk factor clustering and cancer mortality
- Role of PASK in the regulation of insulin and glucagon production and secretion
- Development of peptide drugs to block Rab27 function.
- The WWOX tumour suppressor is a modulator of paclitaxel response in ovarian cancer cells.
- Clinical Audit of Hypopituitarism after Traumatic Brain Injury
- Expression of steroidogenic enzymes and steroid hormone receptors in normal and malignant breast tissues and blood
- Functional magnetic resonance imaging of appetite in obesity surgery
- Epidemiological trends: incidences of hypoglycaemia recorded by London ambulance service during Ramadan among fasting diabetes patients
- Audit of Vitamin D levels in obese women with Gestational Diabetes Mellitus and glucose tolerant women.
- Hepcidin and iron metabolism in patients starting maintenance haemodialysis.

- Clinical outcomes of controversial management areas in pregnancies affected by diabetes
- The role of CIDE proteins in Adipose tissue
- The prevalence, cost and pattern of use of Complementary and Alternative Medicine (CAM) among a multiethnic sample of individuals with diabetes mellitus.
- The role of p38 MAPK and MAPK Phosphatase-1 in mediating the pituitary response to LPS Regulation by glucocorticoids/annexin 1
- Dual aromatase-sulphatase inhibitors for breast cancer therapy
- Structured Education for Type 1 Diabetes
- Pancreatitis- The epidemiology; The link with serum trigylcerides and new diabetes drugs
- Histopathological prediction of malignancy in phaeochromocytomas and paragangliomas using tissue microarrays.
- The effects of amino acids on GLP-1 release
- Assessing the effect of Liraglutide on glycaemic control and weight in a diverse type 2 diabetes population
- White Matter Tract Changes in Obesity and Associated Metabolic and Psychological Traits
- Dual Aromatase- Sulphatase inhibitors for breast cancer therapy
- 51Cr-EDTA for assessment of alterations in glomerular renal function after bariatric surgery
- The role of different dietary fatty acids in the release of appetite hormones
- The outcomes of surgery for pituitary adenomas
- New-onset diabetes mellitus after transplantation (NODAT)-a clinical review with relevance to its clinical management
- Vitamin D deficiency in patients undergoing Bariatric Surgery
- Diurnal changes in hepcidin and circulating iron in health and in renal failure
- Impact of human polymorphic variations in miR34 on insulin secretion
- How does social isolation (an animal model of depression) influence the expression of MAP kinase phosphatase (recently identified as a key factor in the pathophysiology of depression) within the hypothalamo-pituitary-adrenocortical axis?
- Impact of diabetes on hospital admissions and ward discharges
- Effect of a Structured Community Obesity Treatment Programme on Morbid Obesity Patients
- How do amino acids inhibit appetite?
- The effect of ancient man's diet on gut hormone release

- Free fatty acid receptor 2 and glucose homeostasis
- The diagnostic utility of the urine calcium creatinine ratio to diagnose primary hyperparathyroidism during vitamin D replacement
- Evaluation of adjuvant lithium in hyperthyroid patients receiving radioactive iodine
- Is PAS-domain containing protein kinase involved in circadian rhythm regulation in pancreatic alpha- and beta- cell?
- The role of the hypothalamic-pituitary-thyroid-axis in the adult skeleton
- A single centre assessment of pituitary radiotherapy
- A systematic review of X-linked hypophosphataemia in a single centre.
- The role of the type 2 diabetes gene, HHEX, in pancreatic beta-cell function.
- The role of follicular stimulating hormone signalling in the adult skeleton

# What do the students think of the BSc in Endocrinology?

'The Endocrinology BSc combines lectures, practicals, small group tutorials and ethical debates, as well as regular student-organised events – something for everyone!

The course is structured as 3 modules of 5 weeks each, with assessment in the form of coursework, exams at the end of the year and a 10-week project (may be laboratory or humanities based). The timetable consists of 2-3 lectures on average a day, with up to 5 tutorials per module. The course is based across St Mary's Hospital and the Hammersmith Hospital campuses – just a short walk from Westfield shopping centre!

The first module revises much of the basic sciences covered in the first and second year medical curriculum, whereas the second and third modules cover the more clinical aspects of diabetes, appetite regulation and neuroendocrinology. Most students find the more clinical aspects of the course most enjoyable, in particular the detailed study of diabetes and the implications of rising obesity rates. The course is led and taught by a mixture of clinicians and academic researchers who are leading world specialists in their respective fields. The course module leaders are also highly supportive of the students and help is just an email away if you need it!

Throughout the course of the year, there is certainly scope to keep up with extra-curricular activities; I am currently President of ICSM Surgical Society and also find the time to play in the medical school lacrosse team.

I would most definitely recommend this course to fellow students; the course material is challenging, interesting and highly relevant to later clinical practice as a physician.'

'Endocrinology is a well-structured and taught preclinical course and this extends to the BSc pathway. The three modules (Molecular endocrinology and endocrine-related cancers/Type 2 diabetes mellitus, metabolism and obesity/Neuroendocrinology, health and disease) address important topics in day to day clinical medicine integrating both the molecular mechanisms of disease and the basis of current and future treatment. As the course is so broad there is something to suit everybody. I would urge you to consider this pathway as it provides strong scientific teaching onto which you can base future academic work as well as covering subjects which you will encounter frequently, as a future clinician, in any speciality. I have certainly found it useful for the specialty subjects covered in the 5th year curriculum.'