BSc in Medical Sciences with SURGERY & ANAESTHESIA

Introduction
This course focuses throughout on the scientific principles underlying surgical and anaesthetic practice - it is the why of surgery and anaesthesia, not the how. The practice of modern surgery and anaesthesia is becoming even more scientific and evidence-based. The course will focus on the science behind the scalpel. Students will be encouraged to critically evaluate scientific evidence from primary sources. It is not the aim of the course for students to memorise large amounts of information on the mechanics of how clinical procedures are performed. Rather, we anticipate that students will develop improved scientific understanding and analytical skills. Ideally, when introduced to a new surgical scenario they should be able to identify the likely physiological and pathological processes underlying the case, and the possible effects of interventions and how these would be assessed. The content of the modules is closely coordinated, so that there is integration without repetition.

This course starts with a 2-week introductory course which will prepare students for the taught modules. The emphasis will be on science communication, team building, data management and interpretation and study design.

Followed by three 5-week taught modules (see below) and either a research project or a specialist course (two 5-week modules).

Course Director
Dr Michael Wilson  michael.wilson@imperial.ac.uk

Course Administrator
Dr Alison Cambrey  a.cambrey@imperial.ac.uk

Aims and Objectives
Provide a course that will allow the students to develop an understanding of the important scientific principles that affect every aspect of surgery and anaesthesia from basic molecular mechanisms to the design and interpretation of surgical trials.

Content
• Regeneration, Repair and Cancer Control
• Perioperative Medicine
• Safety, Technology and BioEngineering in Clinical Practice

Format of teaching
Teaching methods will include lectures, seminars, student presentations, discussions, debates, clinical demonstrations, practicals and tutorials.
Module 1: Regeneration, repair and cancer control

Module Director
Mr Duncan Spalding d.spalding@imperial.ac.uk

Aims
This module aims to introduce new areas of knowledge that include stem cells, miRNAs and siRNAs and others such as immunotherapy and gene therapy. The first part of the module will focus on the physiological and pathophysiological responses following surgery and has three major components - healing and lack of healing; tissue regeneration and tissue compensation; cancer as a model of surgical success or failure.

Healing and lack of healing will concentrate on the failure to repair internal tissues following invasive surgery. It will include the mechanical and biological properties of the tissues and the interaction of these with the physiological status of the patient; the scientific considerations that underlie strategies to improve healing; some future prospects for improved post-surgery healing.

Content
• Tissue regeneration and compensation
• Healing and stem cells
• Cancer as a model of surgical success or failure
• Cancer stem cells
• Cancer immunotherapy
• siRNAs and miRNAs
• Gene Therapy

Module 2: Perioperative Medicine

Module Director
Dr Michael Wilson michael.wilson@imperial.ac.uk

Module Leaders
Dr Istvan Nagy i.nagy@imperial.ac.uk
Dr Kieran O’Dea k.odea@imperial.ac.uk

Aims
The aim of this module is to provide a course on the science ‘on the edges’ of transplant surgery, covering anaesthesia, analgesia and intensive care. Students will develop their understanding of anaesthesia and pain medicine from molecular biology, through central nervous system activity and into clinical applications. In particular there will be a focus on methods being used to identify novel analgesic targets and ‘therapeutic’ consequences of anaesthetic agents: so less ‘how do I anaesthetise a patient for tumour removal’ and more ‘why does my choice of anaesthetic influence whether this tumour will come back?’.

The other aim of the module is to allow the student to develop an understanding of the importance of infection and immunity in the response to surgery, the ways in which these influence the healing process, whether beneficially or pathologically, and the rationales behind therapeutic and immunomodulatory interventions. Finally students will explore the ways in which technical advancements and personalised medicine will be driving the intensive care unit of the future.
Content
- Mechanisms of anaesthetic action
- Mechanisms of analgesic action
- Applied pharmacology
- Physiological Responses to Pain
- The good and the bad of anaesthetic agents
- Sepsis and respiratory distress
- Peri and post-operative infections
- The present and future of the intensive care unit

Module 3: Safety Technology and Bioengineering in Clinical Practice

Module Director
Dr Richard Abel richard.abel@imperial.ac.uk

Aims
The aim of this module is to introduce an understanding of the use of engineering principles and technology to the practice of medicine. The use of engineering in medicine is frequently referred to as bioengineering. Since engineering, biology and medicine are all diverse, the subject of bioengineering is, by its very nature, varied and wide. Although in Imperial College we are lucky to be able to provide the right mix of skills to lead the way in many areas of bioengineering, there is no way the entire subject can be taught in a short module.

The module will include an introduction to basic engineering terms and principles and apply them to the design of implants, fracture fixation methods, and the biomechanics of movement and function. It will also focus on how new technologies are applied to surgery, how they are designed, their advantages and limitations, and how they are integrated into clinical practice. Imperial College is a pioneer of new surgical technologies and clinical safety, and this module will draw heavily on this expertise. The main areas will be imaging techniques, minimally invasive surgery and clinical safety.

Content
- The design of medical implants and the body's response to them
- Materials influence on implant success from mechanical and physiological impact
- Biodynamics of human performance
- Imaging techniques
- Robotics
- Minimally invasive surgery
- Implementation of new techniques to clinical practice
- Safety of surgery and new technology
Projects
A wide variety of projects will be offered from the research groups within the Division of Surgery and Cancer. These range in type from systematic reviews, to human function and performance studies, to in vitro and in vivo laboratory projects. The course always offers many more projects than there are students, so there is something for everyone no matter their personal preferences.

BSc Project Titles carried out 2016-17

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<th>Project Title</th>
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<tr>
<td>Bone Microdamage</td>
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<td>Measuring cognitive load associated with non-technical skill in endovascular simulation</td>
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<td>Stakeholder Views of Surgeon-Specific Mortality Data</td>
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<td>The impact of psychological factors on vascular surgery</td>
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<td>The effect of hip and knee arthroplasty on gait: Does patient reported outcome measures correlate to change in gait after surgery?</td>
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<td>Does morphology and disease severity for hip osteoarthritis correlate to a type of gait pattern?</td>
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<td>Validation of trueness and precision of a novel augmented reality platform for measuring acetalubar cup implant orientation in a training simulator</td>
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<td>Acetabular Reaming using 3D-printed reamers: How Precise should we be during Hip Replacement Surgery, the &quot;Operation of the Century&quot;?</td>
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<td>A Novel Augmented Reality Platform For Teaching Acetabular Cup Implant Orientation Skills: A Randomised Control Trial.</td>
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<td>Pre-clinical evaluation of a novel coating-implant combination for the future of hip resurfacing</td>
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<td>Evaluation Spectrophotometric Intracutaneous Analysis (SIA) as quantitative tool to assess Vitiligo</td>
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<td>Toxic Shock in the Paediatric burn population.</td>
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<td>Comparison of circulating biomarker levels in individuals with different stages of chronic venous disease and controls</td>
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<td>Thrombophilia in non-thrombotic chronic venous disease of the lower limb</td>
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<td>Title: Characteristics of patients with venous leg ulceration referred to community and secondary care hospitals</td>
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<td>Intraoperative hyperspectral circumferential resection margin assessment for GI cancer surgery</td>
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<td>The impact of fasting on exhaled breath testing in patients with oesophago-gastric cancer</td>
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<td>A multicentre Cohort Study of Pain in Isolated Severe Extremity Trauma</td>
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<td>Investigating lower limb tissue perfusion changes with calf exercises after reconstruction surgery: A feasibility study</td>
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<td>Sensitivity of a musculoskeletal model of the wrist</td>
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<td>The effect of BOAST 4 compliance on patient health related outcomes</td>
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<td>Laparoscopy: The utility in trauma</td>
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<td>iknife for the early detection of colorectal Cancer</td>
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<td>Characterisation of laryngeal cancer using positron emission tomography (PET) texture analysis</td>
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<td>The Impact of Robotic Surgery on Prefrontal Cortical Activation</td>
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<td>Patient-specific simulation of pneumoperitoneum for laparoscopic surgical planning</td>
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<td>Evaluation of the PREPARE digital health platform to enable supported self-management in patients with gastro-oesophageal cancer: pilot study of impact of technology on prehabilitation and enhanced recovery protocols</td>
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<td>Ultrasound-augmented neurosurgical image-guidance for the resection of glioblastoma</td>
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<td>Role of the innate immunity in influencing the anticancer immune-response in lung cancer.</td>
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<td>The neural control of shivering tremor</td>
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<td>Examining the electrophysiology and clinical significance of evoked-potentials in a model of lower limb ischaemia</td>
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What do the students think of the BSc in Surgery and Anaesthesia?

'With the fast moving pace of technology and molecular biology, a sound understanding of the science behind and the future of surgery and perioperative medicine is a must for tomorrow's doctors.

It is very difficult to generalise the day in the life with this BSc, except to say that every day provided new and exciting challenges.

The Surgery and Anaesthesia BSc provides a uniquely broad perspective across 3 challenging and rewarding modules. The first, regeneration, repair and cancer control, looks in detail at the spectrum of current and cutting-edge palliative and curative, surgical, targeted and personalised treatments for cancer and end stage disease, and the emergence of stem cells as a versatile tool for regeneration. We had the chance to observe cutting-edge research being presented by leaders in their field by attending a symposium and conference in the fields of stem cell research and hepatobiliary surgery respectively.

The second module, perioperative medicine, explores the advances in the treatment of inflammatory and neuropathic pain, the mechanisms of anaesthesia and the impact of surgery and the inevitable perioperative inflammation in critically ill patients.

The final module consolidates the thrust of innovation and the opportunities and pitfalls of bringing an idea from bench to bedside whilst ensuring patient safety remains a top priority. This requires an holistic approach, looking not only at the technologies themselves but also the implications for the training and selection of 21st century surgeons and the management of the hospitals they work in with the advent of new technology based methods of learning. The module also explores the wide base of home-grown and world-leading innovation in minimally invasive technologies that will define the future.

Overall I feel the course has given me the ability to understand the evidence-base behind the treatments and procedures we routinely subject our patients to and will undoubtedly help me to make sound decisions and promote progress in the best interests of the health of my patients.'

'Rigorous, challenging, a right hoot! Probably sums up Surgery & Anaesthesia BSc nicely. Everyone has something to say about the BSc – Is it hard? Can I get a first? Can I get published? Is it worth it? All very reasonable questions and the answer to all of those is a resounding YES.

Surgery BSc is probably quite self-selective but the aim of the following is to show the rest that it has something for everyone. It is a fantastically diverse BSc bringing together topics from other BSc's and is taught by world class lecturers; never before have I been so enthused and stimulated.'
And finally, a few words from the external examiner

“This is an outstanding BSc degree, covering contemporary topics within Surgery and Anaesthesia that is unrivalled elsewhere [nationally and internationally]. The balance between practical clinical and laboratory based developments is strong, and equips capable candidates with a firm grasp of key areas for the future.”

“Internationally leading BSc course, with superb mix of basic, translational and clinical academic content.”

“In its’ current form, this BSc is the “market leader” for the clinical areas covered.”