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Cover image:
Confocal micrograph of fluorescently labelled HeLa cells.
Nuclei are labelled in blue, tubulin in green and actin fibres in red.

Courtesy of:
Kevin Mackenzie
Microscopy and Histology Core Facility
Institute of Medical Sciences
University of Aberdeen
http://www.abdn.ac.uk/ims/microscopy-histology
Course Summary
The course will cover the physiology and pathophysiology of the mammalian heart and circulatory system. Normal control and adaptation of the cardiovascular system will be examined in detail. The mechanism of action of drugs currently used to treat cardiovascular diseases, such as heart disease and hypertension will be discussed. Practical work will be used to illustrate experimental techniques that are routinely applied to derive knowledge of the function of the cardiovascular system.

Course Co-ordinator: Dr Fiona Murray

Course Aims & Learning Outcomes
1. To provide core knowledge of the physiology of the mammalian cardiovascular system at an advanced level.
2. To relate the pathophysiology of the cardiovascular system to the pharmacology at both a systems and cellular level.
3. To give experience of the appropriate technical skills used in examining the operation of the cardiovascular system.

Course Teaching Staff
Course Co-ordinator(s):
Dr Fiona Murray (FM)

Other Staff:
• Prof G. Nixon (GFN), Medical Sciences g.f.nixon@abdn.ac.uk
• Dr D. Scott (DAS), Medical Sciences d.scott@abdn.ac.uk
• Dr J. Hislop (JH), Medical Sciences james.hislop@abdn.ac.uk

Assessments & Examinations
Students are expected to attend all lectures, laboratory classes and other elements of the course, and to complete all class exercises by the stated deadlines. Completed assignments will be handed in at after the assessment or uploaded in MyAberdeen via Turnitin. It is imperative that any reasonable excuses for the late handing in of work are made to the course organiser (Dr F. Murray) before the deadline date. Otherwise the work will not be marked and the class certificate, which is required to sit the examination, may be withheld. The minimum performance acceptable for the granting of a class certificate is attendance at 75% of the lecture classes, and presentation of all set course work, written and oral.
a). Continuous assessment - 20% of the total assessment will be based on 2 case studies prepared throughout the six weeks of the course. An additional 10% will be based on a laboratory report.

b). Examination - This will take place in the summer diet, April/May, with the re-sit examination in July. It will take the form of an essay-based examination, which will comprise 70% of the assessment for BM3501. The precise format will be a choice of 2 essay questions from a total of 4. The 4 questions will be split into 2 sections and students will answer 1 question from each section i.e. either question 1 or question 2 from section A AND either question 3 or question 4 from section B. Dr Murray will give further information on the exam during the course. All assessments (continuous and examined) will be made using the University Common Grading Scale (copy attached). The continuous assessment mark will normally be considered at a student’s second diet of examination. It will be used in cases where a student has been unable to sit the first diet on medical or other grounds.

**Class Representatives**

We value students’ opinions in regard to enhancing the quality of teaching and its delivery; therefore in conjunction with the Students’ Association we support the Class Representative system.

In the School of Medicine, Medical Sciences and Nutrition we operate a system of course representatives, who are elected from within each course. Any student registered within a course that wishes to represent a given group of students can stand for election as a class representative. You will be informed when the elections for class representative will take place.

**What will it involve?**

It will involve speaking to your fellow students about the course you represent. This can include any comments that they may have. You will attend a Staff-Student Liaison Committee and you should represent the views and concerns of the students within this meeting. As a representative you will also be able to contribute to the agenda. You will then feedback to the students after this meeting with any actions that are being taken.

**Training**

Training for class representatives will be run by the Students Association. Training will take place within each half-session. For more information about the Class representative system visit [www.ausa.org.uk](http://www.ausa.org.uk) or email the VP Education & Employability [vped@abdn.ac.uk](mailto:vped@abdn.ac.uk). Class representatives are also eligible to undertake the STAR (Students Taking Active Roles) Award with further information about this co-curricular award being available at: [www.abdn.ac.uk/careers](http://www.abdn.ac.uk/careers).
Problems with Coursework

If students have difficulties with any part of the course that they cannot cope with alone they should notify the course coordinator immediately. If the problem relates to the subject matter general advice would be to contact the member of staff who is teaching that part of the course. Students with registered disabilities should contact Mrs Jenna Reynolds (medsci@abdn.ac.uk) in the School Office (based in the IMS, Foresterhill), or Mrs Sheila Jones (s.jones@abdn.ac.uk) in the Old Aberdeen office associated with the teaching laboratories, to ensure that the appropriate facilities have been made available. Otherwise, you are strongly encouraged to contact any of the following as you see appropriate:

- Course student representatives
- Course co-ordinator
- Convenor of the Medical Sciences Staff/Student Liaison Committee (Prof Gordon McEwan)
- Personal Tutor
- Medical Sciences Disabilities Co-ordinator (Dr Derryck Shewan)

All staff are based at Foresterhill and we strongly encourage the use of email or telephone the Medical Sciences Office. You may have a wasted journey travelling to Foresterhill only to find staff unavailable.

If a course has been completed and students are no longer on campus (i.e. work from second semester during the summer vacation), coursework will be kept until the end of Freshers’ Week, during the new academic year. After that point, unclaimed student work will be securely destroyed.

Course Reading List

- Introduction to Cardiovascular Physiology, 6th Ed. (2018). Levick, J.R.
- Pathophysiology of Heart Disease, 5th Ed. (2011). Lilly, L.S. (Editor)
- Netter’s Illustrated Pharmacology, updated Ed. 2014. Raffa R, Rawls S. Beyzarov E.
- Medical Pharmacology and Therapeutics, 4th Ed. 2014. Waller D. Sampson T.

There are also other textbooks available in Heavy Demand or General Loan at the Medical School Library that may provide further information on haematology etc.
Lecture Synopsis

Lecture 1.  Introduction & Cardiac Muscle Physiology - Dr D. Scott

Review of cardiac muscle contractility. Reading: Levick, Chapters 1 & 2; Lilly, Chapter 1.

Lecture 2.  Excitation-contraction coupling in cardiac muscle - Dr D. Scott

The mechanisms which regulate the contractile function of cardiac muscle will be examined at the cellular level. These mechanisms will be related to structure of the cardiac cell. Reading: Levick, Chapter 3.

Lecture 3.  Cardiac rhythm and arrhythmias - Dr D. Scott

Revision of the cardiac action potential and conduction. Potential mechanisms of arrhythmias. Drugs used in the treatment of arrhythmias will be examined at a cellular and systems level. Reading: Levick, Chapters 4 & 5; Lilly, Chapters 4, 11, 12 & 17.

Lecture 4.  Endothelium – Prof G. Nixon

An introduction to the role of endothelium in the cardiovascular system. Reading: Levick, Chapter 9.

Lecture 5.  Vascular smooth muscle contractility– Prof G. Nixon

The mechanisms which increase intracellular calcium, and how this leads to contraction of smooth muscle at a cellular level, will be discussed. Reading: Levick, Chapter 12.

Lecture 6.  Physiology of platelets, haemostasis and thrombosis - Prof G. Nixon

What is haemostasis? Mechanisms of the fluid blood coagulation system; platelet function; blood vessel wall; fibrinolysis; natural inhibitors; an integrated haemostatic system. What is thrombosis? Involvement of coagulation and platelet activation in atherosclerosis and arterial thrombosis; the pathogenesis of heart attacks and stroke. Methods for study of platelets and coagulation. Reading: Rang et al., Chapter 24 and Moss and Pettit.
Lecture 7.  Pharmacology of anticoagulants and antiplatelet drugs- Prof G. Nixon

Anticoagulants – mechanisms of action; antiplatelet drugs - mechanisms; indications for use; effectiveness; factors in variability or resistance; drug interactions; side-effects; clinical trials; development of new drugs. Reading: Rang et al., Chapter 24 and Moss and Pettit

Lecture 8.  Atherosclerosis and Statins - Prof G. Nixon

The causes and cardiovascular consequences of atherosclerosis will be described. In addition, the therapeutics used to treat atherosclerosis, and particularly the success of statins, will also be discussed.

Lecture 9.  Intravenous (IV) Fluids & Medications – Dr D. Scott

In this lecture, we will discuss the various types of fluid and medications that are administered intravenously. Some of the most commonly prescribed “medications” in clinical practice are IV fluids, but do you actually know what they contain or what they do? We will consider the various ways that we can replace fluid, electrolytes and nutrients, and explain the properties of various crystalloid and colloid solutions. Finally, we will consider what happens if these solutions are given inappropriately.

Lecture 10.  Introduction to special circulations - Dr D. Scott

Each tissue has its own special function, and this often calls for specialised vascular control. The skin, for example, regulates body heat, and its blood flow is controlled largely by temperature. In the heart, by contrast, metabolic rate dominates vascular control. Five circulations (heart, skeletal muscle, skin, brain and lung) are introduced during this lecture to illustrate both their physiological importance and their contrasting characteristics. Reading: Levick, Chapter 15.

Lecture 11-12.  Pathophysiology and Pharmacology of heart disease (Ischaemic heart disease/Congestive heart failure) – Dr F. Murray

The causes, risk factors, diagnosis and symptoms of Acute – MI. Chronic – angina pectoris and silent ischaemia will be defined. Drugs used in their management and their mechanism of action, adverse reactions and tolerance will be discussed: Beta-blockers, calcium channel antagonists, nitrates, potassium channel openers, aspirin/clopidogrel, and statins.

The causes, diagnosis and symptoms of heart failure will be defined. The role of RAAS system, systolic dysfunction and oedema in heart failure will be outlined. Drugs used in the management of heart failure and their mechanism of action, treatment regimens and
adverse reactions will be discussed: Diuretics, beta-blockers, digoxin, anticoagulants, ACE inhibitors, Angiotensin receptor antagonists, aldosterone antagonists.

Novel drug targets for heart disease will also be considered. Reading: Lilly, Chapters 6, 9, 16 & 17. See also individual drugs in Rang et al.

**Lecture 13. Pathophysiology and Pharmacology of hypertension - Dr F Murray**

Essential and secondary hypertension will be defined. Changes in afterload and peripheral vascular resistance will be described and the resulting pathophysiological changes, e.g. heart failure renal failure, cerebral haemorrhage. The classes of drugs used in the treatment of hypertension will be described. The physiological effects of these drugs in hypertension treatment and their mechanism of action will be discussed: Calcium channel blockers, ACE inhibitors, beta blockers, alpha blockers and other vasodilators. Reading: Lilly, Chapters 13 & 17. See also individual drugs in Rang et al.

**Lecture 14. Pathophysiology and Pharmacology of Diabetes - Dr D. Scott**

This session will cover the pathophysiology of diabetes mellitus. The lecture will briefly cover how diabetes is diagnosed and monitored and what therapeutic options are available to control blood sugar levels and minimise diabetic complications. We will end by considering why diabetes can enhance cardiovascular risk. Reading: Rang et al., Chapter 26.

**Lecture 15. Pathophysiology and Pharmacology of Pulmonary Hypertension – Dr. F Murray**

Pulmonary hypertension will be defined. The symptoms, causes and diagnosis of pulmonary hypertension will be outlined. Details of the changes in the structure of the pulmonary artery and the resulting right ventricular hypertrophy with the disease will be described. Drugs used in the treatment of pulmonary hypertension and their mechanism of action will be discussed: Calcium channels antagonists, Prostacyclin analogues, Endothelin receptor antagonists and Phosphodiesterase 5 inhibitors. Novel drug targets for pulmonary hypertension will also be considered. Reading: Lilly, Chapters 3 & 17. See also individual drugs in Rang et al.

**Practical/Lab/Tutorial Work**

**Laboratory Work**

This will take the form of 1 day of "wet" lab practical and will examine how blood samples are routinely analysed for specific metabolites. Students will carry out assays on specimens that are provided for them to understand how they might handle samples in a working research laboratory. In addition, students will be expected to record results from an exercise simulation using PC’s, where they can investigate what results they might measure during a real research project. Finally, we will investigate the effects of exercise on real human
subjects by taking small blood samples and analysing these using an automated blood analyser. Students will also be instructed about the safety and ethical concerns that they might have to consider when working with human subjects and blood samples.

Case Studies

You are required to complete 2 case study assessments on particular areas of cardiovascular physiology or pharmacology. Each case study will contribute 10% of the continuous assessment mark and the lab report 10% towards your final course mark. The content of each case study will be circulated to the class approximately 1 week before the deadline for completion. All students will have to undertake independent revision and study in order to find out the answers as you will not be able to rely on lecture notes alone. On the date of completion of a case study, the class will write their answers for the questions they have revised on pre-prepared answer sheets under exam conditions during a one-hour session. At the end of that hour, the completed answer sheets will be collected for marking. Students are strongly encouraged to include as much extra reading, mechanistic detail and relevant discussion as they can during these case study assessments. Brief one word or one-line answers are unlikely to gain you enough credit to pass, so you must ensure you are fully prepared for these assessments.
University Policies

Students are asked to make themselves familiar with the information on key institutional policies which been made available within MyAberdeen (https://abdn.blackboard.com/bbcswebdav/institution/Policies). These policies are relevant to all students and will be useful to you throughout your studies. They contain important information and address issues such as what to do if you are absent, how to raise an appeal or a complaint and how seriously the University takes your feedback.

These institutional policies should be read in conjunction with this programme and/or course handbook, in which School and College specific policies are detailed. Further information can be found on the University’s Infohub webpage or by visiting the Infohub.

The information included in the institutional area for 2018/19 includes the following:

- Absence
- Academic Appeals & Complaints
- Assessment (Common Grading Scale)
- Codes of Practice on Student Discipline (Academic and Non-Academic)
- Class Certificates
- Exam Results
- Transcripts
- MyAberdeen
- TurnitinUK
- Feedback
- Communication
- Aberdeen Graduate Attributes
- The Co-Curriculum
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<th>% Mark</th>
<th>Category</th>
<th>Honours Class</th>
<th>Description</th>
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| A1    | 22          | 90-100 | Excellent     | First         | • Outstanding ability and critical thought  
• Evidence of extensive reading  
• Superior understanding  
• The best performance that can be expected from a student at this level |
| A2    | 21          | 85-89  |               |               |                                                                                                                                                    |
| A3    | 20          | 80-84  | Excellent     |               |                                                                                                                                                    |
| A4    | 19          | 75-79  |               |               |                                                                                                                                                    |
| A5    | 18          | 70-74  |               |               |                                                                                                                                                    |
| B1    | 17          | 67-69  | Very Good     | Upper Second  | • Able to argue logically and organise answers well  
• Shows a thorough grasp of concepts  
• Good use of examples to illustrate points and justify arguments  
• Evidence of reading and wide appreciation of subject |
| B2    | 16          | 64-66  |               |               |                                                                                                                                                    |
| B3    | 15          | 60-63  |               |               |                                                                                                                                                    |
| C1    | 14          | 57-59  | Good          | Lower Second  | • Repetition of lecture notes without evidence of further appreciation of subject  
• Lacking illustrative examples and originality  
• Basic level of understanding |
| C2    | 13          | 54-56  |               |               |                                                                                                                                                    |
| C3    | 12          | 50-53  |               |               |                                                                                                                                                    |
| D1    | 11          | 47-49  | Pass          | Third         | • Limited ability to argue logically and organise answers  
• Failure to develop or illustrate points  
• The minimum level of performance required for a student to be awarded a pass |
| D2    | 10          | 44-46  |               |               |                                                                                                                                                    |
| D3    | 9           | 40-43  |               |               |                                                                                                                                                    |
| E1    | 8           | 37-39  | Fail          | Fail          | • Weak presentation  
• Tendency to irrelevance  
• Some attempt at an answer but seriously lacking in content and/or ability to organise thoughts |
| E2    | 7           | 34-36  |               |               |                                                                                                                                                    |
| E3    | 6           | 30-33  |               |               |                                                                                                                                                    |
| F1    | 5           | 26-29  | Clear Fail    | Not used for Honours | • Contains major errors or misconceptions  
• Poor presentation |
<p>| F2    | 4           | 21-25  |               |               |                                                                                                                                                    |
| F3    | 3           | 16-20  |               |               |                                                                                                                                                    |
| G1    | 2           | 11-15  | Clear Fail/Abysmal | -              | • Token or no submission |
| G2    | 1           | 1-10   |               |               |                                                                                                                                                    |
| G3    | 0           | 0      |               |               |                                                                                                                                                    |</p>
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<td>14:00-15:00</td>
<td>FLT</td>
<td>Introduction &amp; Cardiac muscle Physiology</td>
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<td>DAS</td>
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<td>Excitation-contraction coupling in the heart</td>
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<td>Vascular smooth muscle contractility</td>
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<td>Physiology of platelets, haemostasis and thrombosis</td>
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<td>Intravenous Fluids</td>
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<td>Pathophysiology and Pharmacology of Heart Disease – Part 2</td>
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<td>Case Study Assessment II</td>
<td>Lecture</td>
<td>DAS/FM</td>
</tr>
</tbody>
</table>

**Staff**

- Dr. F. Murray (FM), Medical Sciences
- Prof. G. Nixon (GFN), Medical Sciences
- Dr. D. Scott (DAS), Medical Sciences
- Dr. J. Hislop (JH), Medical Sciences