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978-1-107-63782-5 - Basic Physiology for Anaesthetists  
David Chambers, Christopher Huang and Gareth Matthews  
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# Basic Physiology for Anaesthetists

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**DC:**

Book-writing is rather like parenthood: one cannot fully anticipate the time commitment required. For their (generally) unwavering support, I would like to thank my wife, Sally, and my girls, Georgie and Eliza.

**CH:**

*In memoriam absentium, in salutem praesentium:* I would like to thank my friends and teachers, Charles Michel, Richard Adrian, Sir David Weatherall and John Ledingham for pointing out the way over the years.

**GM:**

I would like to thank my wife, Claire, for her support. I would also like to thank Professor Christopher Huang (CH) for teaching me physiology for many years and his immense dedication to the subject.

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## Foreword

The authors of this comprehensive physiology textbook have brought together their backgrounds in clinical practice and scientific research to produce a work in which the importance of an in-depth knowledge of physiology is translated into clinically relevant applications. The central relationship between the clinical practice of anaesthesia and the science of physiology is illustrated with precision throughout the volume, and the practical question and answer format provides a clear foundation for examination revision.

This book is an enjoyable and thought-provoking read, and brings together the crucial importance of understanding the principles of physiology which are as relevant to the practising clinician as they are to the scientist.

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## Preface

An academically sound knowledge of both normal and abnormal physiology is essential for day-to-day anaesthetic practice, and consequently for postgraduate specialist examinations.

This project was initiated by one of us (DC) following his recent experience of the United Kingdom Fellowship of the Royal College of Anaesthetists examinations. He experienced difficulty locating textbooks that would build upon a basic undergraduate understanding of physiology. Many of the anaesthesia-related physiology books he encountered assumed too much prior knowledge and seemed unrelated to everyday anaesthetic practice.

He was joined by a Professor in Physiology (CH) and a Translational Medicine and Therapeutics Research Fellow (GM) at Cambridge University, both actively engaged in teaching undergraduate and postgraduate physiology, and in physiological research.

This book has been written primarily for anaesthetists in the early years of their training, and specifically for those facing postgraduate examinations. In addition, the account should provide a useful summary of physiology for critical care trainees,

senior anaesthetists engaged in education and training, physician assistants in anaesthesia, operating department practitioners and anaesthetic nurses.

We believe the strength of this book lies in our mixed clinical and scientific backgrounds, through which we have produced a readable and up-to-date account of basic physiology, and provided links to anaesthetic and critical care practice. We hope to bridge the gap between the elementary physiology learnt at medical school and advanced anaesthesia-related texts. By presenting the material in a question and answer format, we aimed to emphasize strategic points, and give the reader a glimpse of how each topic might be assessed in an oral postgraduate examination. Our numerous illustrations seek to simplify and clearly demonstrate key points in a manner easy to replicate in an examination setting.

*David Chambers  
Christopher Huang  
Gareth Matthews  
Manchester and Cambridge.*

# Abbreviations

<b>ACE</b>	angiotensin-converting enzyme	<b>ETT</b>	endotracheal tube
<b>ACh</b>	acetylcholine	<b>FAD</b>	flavin adenine dinucleotide
<b>AChE</b>	acetylcholinesterase	<b>FEV<sub>1</sub></b>	forced expiratory volume in 1 s
<b>AChR</b>	acetylcholine receptor	<b>F<sub>i</sub>O<sub>2</sub></b>	fraction of inspired oxygen
<b>ADH</b>	antidiuretic hormone	<b>FRC</b>	functional residual capacity
<b>ADP</b>	adenosine diphosphate	<b>FVC</b>	forced vital capacity
<b>AF</b>	atrial fibrillation	<b>GBS</b>	Guillain–Barré syndrome
<b>AGE</b>	alveolar gas equation	<b>GFR</b>	glomerular filtration rate
<b>ARDS</b>	acute respiratory distress syndrome	<b>GI</b>	gastrointestinal
<b>ARP</b>	absolute refractory period	<b>Hb</b>	haemoglobin
<b>ATP</b>	adenosine triphosphate	<b>HbA</b>	adult haemoglobin
<b>AMP</b>	adenosine monophosphate	<b>HbF</b>	fetal haemoglobin
<b>ANS</b>	autonomic nervous system	<b>HPV</b>	hypoxic pulmonary vasoconstriction
<b>ANP</b>	atrial natriuretic peptide	<b>HR</b>	heart rate
<b>APTT</b>	activated partial thromboplastin time	<b>ICF</b>	intracellular fluid
<b>AV</b>	atrioventricular	<b>ICP</b>	intracranial pressure
<b>BBB</b>	blood–brain barrier	<b>IVC</b>	inferior vena cava
<b>BMR</b>	basal metabolic rate	<b>LMA</b>	laryngeal mask airway
<b>BNP</b>	brain natriuretic peptide	<b>LOH</b>	loop of Henle
<b>BSA</b>	body surface area	<b>LOS</b>	lower oesophageal sphincter
<b>CA</b>	carbonic anhydrase	<b>LV</b>	left ventricle
<b>C<sub>a</sub>O<sub>2</sub></b>	arterial oxygen content	<b>LVEDP</b>	left ventricular end-diastolic pressure
<b>CBF</b>	cerebral blood flow	<b>MAC</b>	minimum alveolar concentration
<b>CC</b>	closing capacity	<b>MAO</b>	monoamine oxidase
<b>CCK</b>	cholecystokinin	<b>MAP</b>	mean arterial pressure
<b>CI</b>	cardiac index	<b>MET</b>	metabolic equivalent of a task
<b>CMR</b>	cerebral metabolic rate	<b>MetHb</b>	methaemoglobin
<b>CNS</b>	central nervous system	<b>MG</b>	myasthenia gravis
<b>CO</b>	cardiac output	<b>MPAP</b>	mean pulmonary artery pressure
<b>CoA</b>	coenzyme A	<b>MW</b>	molecular weight
<b>COHb</b>	carboxyhaemoglobin	<b>N<sub>2</sub>O</b>	nitrous oxide
<b>COPD</b>	chronic obstructive pulmonary disease	<b>NAD<sup>+</sup></b>	nicotinamide adenine dinucleotide
<b>CPET</b>	cardiopulmonary exercise test	<b>NMJ</b>	neuromuscular junction
<b>CPP</b>	cerebral perfusion pressure	<b>OER</b>	oxygen extraction ratio
<b>CSF</b>	cerebrospinal fluid	<b>PAC</b>	pulmonary artery catheter
<b>C<sub>v</sub>O<sub>2</sub></b>	venous oxygen content	<b>P<sub>a</sub>O<sub>2</sub></b>	arterial tension of oxygen
<b>CVP</b>	central venous pressure	<b>P<sub>a</sub>CO<sub>2</sub></b>	arterial tension of carbon dioxide
<b>CVR</b>	cerebral vascular resistance	<b>P<sub>B</sub></b>	barometric pressure
<b>DBP</b>	diastolic blood pressure	<b>PCT</b>	proximal convoluted tubule
<b>DCT</b>	distal convoluted tubule	<b>PCWP</b>	pulmonary capillary wedge pressure
<b>DNA</b>	deoxyribonucleic acid	<b>PE</b>	pulmonary embolism
<b>ECF</b>	extracellular fluid	<b>PEEP</b>	positive end-expiratory pressure
<b>ECG</b>	electrocardiogram	<b>PEEP<sub>e</sub></b>	extrinsic PEEP
<b>EDV</b>	end-diastolic volume	<b>PEEP<sub>i</sub></b>	intrinsic PEEP
<b>EEG</b>	electroencephalogram	<b>PEFR</b>	peak expiratory flow rate
<b>EF</b>	ejection fraction	<b>PNS</b>	peripheral nervous system
<b>EPO</b>	erythropoietin	<b>PPP</b>	pentose phosphate pathway
<b>ER</b>	endoplasmic reticulum	<b>PRV</b>	polycythaemia rubra vera
<b>ESV</b>	end-systolic volume	<b>PT</b>	prothrombin time

Abbreviations

<b>PTH</b>	parathyroid hormone	<b>SBP</b>	systolic blood pressure
<b>PVR</b>	pulmonary vascular resistance	<b>SR</b>	sarcoplasmic reticulum
<b>RAA</b>	renal–angiotensin–aldosterone	<b>SV</b>	stroke volume
<b>RAP</b>	right atrial pressure	<b>SVC</b>	superior vena cava
<b>RBC</b>	red blood cell	<b>SVR</b>	systemic vascular resistance
<b>RBF</b>	renal blood flow	<b>SVV</b>	stroke volume variation
<b>RMP</b>	resting membrane potential	<b>TF</b>	tissue factor
<b>RNA</b>	ribonucleic acid	<b>TLC</b>	total lung capacity
<b>RR</b>	respiratory rate	<b>TOE</b>	trans-oesophageal echocardiography
<b>RRP</b>	relative refractory period	<b><math>\dot{V}/\dot{Q}</math></b>	ventilation–perfusion
<b>RSI</b>	rapid sequence induction	<b><math>\dot{V}_A</math></b>	alveolar ventilation
<b>RV</b>	residual volume	<b>VC</b>	vital capacity
<b>RVEDV</b>	right ventricular end-diastolic volume	<b><math>\dot{V}_E</math></b>	minute ventilation
<b>RVF</b>	right ventricular failure	<b><math>V_T</math></b>	tidal volume
<b>SA</b>	sinoatrial	<b>vWF</b>	von Willebrand factor
<b>S<sub>a</sub>O<sub>2</sub></b>	arterial haemoglobin oxygen saturation		