

# Primary FRCA Syllabus

Candidates should be able to demonstrate a good understanding of the fundamentals of clinical anaesthetic practice, with an ability to discern when more senior assistance will be required.

## **Anaesthetic equipment and safety**

Physical principles underlying the function of the anaesthetic machine, pressure regulators, flowmeters, vaporizers, breathing systems. Absorption of carbon dioxide  
Principles of lung ventilators, disconnection monitors  
Manufacture and storage of oxygen, nitrous oxide, carbon dioxide, compressed air.  
Pipeline and suction systems, gas cylinders  
Humidification devices  
Minimum monitoring requirements  
Environmental control of the operating theatre including scavenging systems for waste  
anaesthetic gases and vapours  
Pre-use checks of anaesthetic machine, breathing systems and monitoring apparatus  
Anaesthetic records and critical incidents  
Function and use of related anaesthetic and resuscitation equipment including that used for regional anaesthesia. Airways, tracheal tubes, tracheostomy tubes, laryngeal masks, oxygen therapy equipment, self-inflating bags, spinal and epidural needles, intravenous cannulae and transfusion devices  
Sterilisation and cleaning of equipment

## **Preoperative assessment**

Implications for anaesthesia of commoner medical conditions. In particular, respiratory diseases (e.g. asthma, chronic obstructive airway disease), cardiac disease (e.g. angina pectoris, valvular disease, myocardial infarction, pacemakers, arrhythmias), vascular disease (e.g. hypertension), sickle cell disease and anaemias, rheumatoid arthritis, renal dysfunction and insufficiency, plasma electrolyte disturbance (e.g. hyper- and hypokalemia), diabetes mellitus, liver disease  
Implications for anaesthesia of commoner surgical conditions, trauma, intestinal obstruction and acute abdominal emergencies  
ASA classification and other pre-anaesthetic scoring systems such as Glasgow coma scale  
Interpretation of relevant preoperative investigations, plasma electrolytes, haematology, disturbances of acid/base status, ECG, X-rays, pulmonary function tests and clotting abnormalities  
Preoperative assessment of a patient of any age (excluding neonates) for elective or emergency surgery  
Restriction of food and fluid by mouth, cessation of smoking, correction of dehydration  
Assessment of difficulty of tracheal intubation  
Precautions in the management of the infective patient (e.g. hepatitis B positive or HIV positive)  
Anaesthetic implications of current drug therapy such as beta blockers, antihypertensive drugs, tricyclic antidepressant agents and monoamine-oxidase inhibitors, insulin, anti-diabetic drugs, anticoagulants, contraceptives

## **Assessment of post-operative analgesic needs**

Premedication

Rationale for premedicant drugs. Choice of drugs, advantages and disadvantages

### **Induction**

Intravenous and inhalational induction of anaesthesia; advantages and disadvantages, techniques

Recognition and management of anaphylactic and anaphylactoid reactions including follow up and patient information

Indications for tracheal intubation.

Management of difficult intubation and failed intubation

Recognition of correct placement of tracheal tube, oesophageal and endobronchial intubation, complications

Causes of regurgitation and vomiting during induction, prevention and management

Technique of cricoid pressure. Pulmonary aspiration

Induction of anaesthesia in special circumstances, head injury, full stomach, upper airway obstruction

### **Intraoperative**

Ability to deal with emergencies before, during and after anaesthesia and the ability to stabilise a patient's condition until senior assistance can be obtained.

Techniques of maintenance of anaesthesia. To provide adequate analgesia using opioids and other analgesic drugs. To prevent awareness. Management of appropriate intermittent positive pressure ventilation. Airway control. Intraoperative fluid therapy. Minimal monitoring

Diagnosis and management of important critical incidents during anaesthesia including: cyanosis, hypertension, hypotension, cardiac arrhythmias, bronchospasm, respiratory obstruction, increased peak inspiratory pressure, hyper- and hypocarbia, failed intubation, failed reversal

Management of massive haemorrhage, volume expansion, blood transfusion (hazards including incompatibility reaction), gas embolism, malignant hyperthermia

Correct intraoperative positioning on theatre table - complications, prone position

Diagnosis and treatment of pneumothorax

### **Postoperative**

Causes and treatment of failure to breathe at end of operation, suxamethonium apnoea- management

Care of the unconscious patient

Recovery room diagnosis and treatment of inadequate pulmonary ventilation, cyanosis, hypo- and hypertension, shivering, stridor. Oxygen therapy, indications and techniques

Methods of pain management. Assessment of pain and analgesic techniques

Prevention, diagnosis and treatment of postoperative pulmonary atelectasis, deep vein thrombosis and pulmonary embolus

Postoperative fluid therapy

Causes and treatment of postoperative nausea and vomiting

Minor and major adverse sequelae to anaesthesia and their management

## **Anaesthesia in special circumstances**

Principles of obstetric anaesthesia

Principles of the care of children (excluding neonates and infants) undergoing anaesthesia for straightforward surgical procedures, including ENT, eye and dental operations

Principles of general anaesthesia for simple ophthalmic procedures and a penetrating eye injury

Patients with a pacemaker

Advantages and problems associated with day surgery, appropriate anaesthetic techniques

Principles of neurosurgical anaesthesia as applied to the management of the head-injured patient

Problems of anaesthesia in the obese patient

Repeat anaesthesia - hepatic injury

Implications for the anaesthetist of viral hepatitis and HIV infections

Laparoscopic and minimally invasive procedures

Management of patients requiring transfer

## **Regional anaesthesia**

Indications, technique and management of the complications of spinal and epidural (including caudal approach) analgesia. Techniques including intravenous regional anaesthesia, brachial plexus block, femoral nerve block, inguinal field block, ankle block and dorsal nerve of the penis block

Local anaesthesia for awake tracheal intubation

## **Resuscitation**

Immediate care and resuscitation in patients of all ages. The guidelines promulgated by the European Resuscitation Council and the Resuscitation Council [UK] will be followed. The syllabus will include:

### **Patient assessment**

The principles and practice of life support

The principles and practice of recognition and management of life-threatening arrhythmias including defibrillation and drug therapy

The techniques of venous access and the intraosseous route

Management of the airway and ventilation in the emergency including care of cervical spine

Specific problems in paediatric resuscitation

Ethical aspects of resuscitation

### **Trauma**

Pathophysiology of trauma and hypovolaemia

Assessment, immediate care and management of trauma patients of all ages

Performance and interpretation of the primary and secondary survey

Immediate specific treatment of life-threatening illness or injury, with special reference to thoracic and abdominal trauma

Care of cervical spine injury

Emergency airway management and oxygen therapy  
Cannulation of major vessels for resuscitation and monitoring  
Management of hypovolaemic shock  
Chest drain insertion and management  
Pain management in trauma victims  
Candidates should be able to demonstrate a good understanding of human anatomy relevant to the practice of anaesthesia.

### **Respiratory System**

Mouth, nose, pharynx, larynx, trachea, main bronchi, segmental bronchi, structure of bronchial tree  
Pleura, mediastinum  
Lungs, lobes, bronchopulmonary segments. Structure of lungs  
Innervation of respiratory tract, blood supply and lymphatic drainage  
Diaphragm, muscles of respiration, innervation  
Cardiovascular system  
Heart, chambers, conducting system, blood and nerve supply. Pericardium  
Great vessels, main peripheral arteries and veins  
Fetal circulation

### **Nervous system**

Brain and spinal cord, structure of spinal cord, age variation, spinal meninges, subdural and extradural space, contents of extradural space, CSF  
Spinal nerves, dermatomes  
Cervical plexus, brachial plexus, nerves of arm  
Intercostal nerves  
Lumbar plexus, nerves of abdominal wall  
Sacral and coccygeal plexuses, nerves of leg  
Autonomic nervous system, sympathetic innervation, sympathetic chain, ganglia and plexuses  
Stellate ganglion  
Parasympathetic innervation. Coeliac plexus  
Cranial nerves. Trigeminal ganglion  
Vertebral column  
Cervical, thoracic and lumbar vertebrae  
Sacrum, sacral hiatus  
Ligaments of vertebral column

### **Areas of special interest**

Base of skull  
The thoracic inlet and 1st rib  
Intercostal spaces including paravertebral space  
Abdominal wall (including the inguinal region)  
Antecubital fossa  
Large veins of neck  
Large veins of leg  
Diaphragm  
Anatomy of tracheostomy, cricothyrotomy  
Eye and orbit  
Axilla

Candidates should have a good general understanding of human physiology, and recognise the need to apply physiological principles and knowledge to the clinical practice of anaesthesia.

### **General**

Organisation of the human body and control of internal environment  
Differences between neonates, infants, children, adults and the elderly  
Function of cells; genes and their expression  
Cell membrane characteristics; receptors  
Protective mechanisms of the body

### **Biochemistry**

Acid base balance and buffers  
Ions e.g. Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>++</sup>, Cl<sup>-</sup>, HCO<sub>3</sub><sup>-</sup>  
Body fluids and their functions and constituents  
Capillary dynamics and interstitial fluid  
Osmolarity: osmolality, partition of fluids across membranes

### **Lymphatic system**

Special fluids especially cerebrospinal fluid and ocular fluids. Also pleural, pericardial and peritoneal fluids  
Haematology and Immunology  
Red blood cells: haemoglobin and its variants. Blood groups  
Haemostasis and coagulation  
White blood cells  
The inflammatory response  
Immunity and allergy

### **Muscle**

Action potential generation and its transmission  
Neuromuscular junction and transmission  
Muscle types  
Skeletal muscle contraction  
Smooth muscle contraction  
Motor unit

### **Heart/Circulation**

Cardiac muscle contraction  
The cardiac cycle: pressure and volume relationships  
Regulation of cardiac function; general and cellular  
Control of cardiac output  
Rhythmicity of the heart  
Electrocardiogram and arrhythmias  
Neurological and humoral control of systemic blood pressures, blood volume and blood flow (at rest and during physiological disturbances e.g. exercise, haemorrhage and Valsalva manoeuvre)

Peripheral circulation: capillaries, vascular endothelium and arteriolar smooth muscle, tissue  
Characteristics of special circulations including: pulmonary, coronary, cerebral, renal, portal and fetal

### **Renal tract**

Blood flow and glomerular filtration and plasma clearance  
Tubular function and urine formation  
Regulation of fluid and electrolyte balance  
Regulation of acid-base balance  
Micturition

### **Respiration**

Gaseous exchange: O<sub>2</sub> and CO<sub>2</sub> transport, hypoxia and hyper- and hypocapnia, hyper- and hypobaric pressures  
Pulmonary ventilation: volumes, flows, dead space. Effect of IPPV on lungs  
Mechanics of respiration: ventilation/perfusion abnormalities  
Regulation of respiration  
Non-respiratory functions of the lungs

### **Nervous System**

Functions of nerve cells and synaptic mechanisms  
The brain: functional divisions - cortex, midbrain, medulla, limbic system, brain stem and cerebellum  
Intracranial pressure: cerebrospinal fluid, blood flow  
Maintenance of posture  
Autonomic nervous system  
Neurological reflexes  
Motor function: spinal and peripheral  
Senses: receptors, nociception, special senses  
Pain: afferent nociceptive pathways, dorsal horn, peripheral and central mechanisms, neuromodulatory systems, supraspinal mechanisms, visceral pain, neuropathic pain, influence of therapy on nociceptive mechanisms  
Spinal cord: anatomy and blood supply, effects of spinal cord section  
Liver  
Functional anatomy and blood supply  
Metabolic functions  
Gastrointestinal  
Gastric function; secretions, nausea and vomiting  
Gut motility, sphincters and reflex control  
Digestive functions

### **Metabolism**

Nutrients: carbohydrates, fats, proteins, vitamins and minerals  
Metabolic pathways, energy production and enzymes; metabolic rate  
Hormonal control of metabolism: regulation of plasma glucose, response to trauma  
Physiological alterations in starvation, obesity, exercise and the stress response  
Body temperature and its regulation

## **Endocrinology**

Mechanisms of hormonal control: feedback mechanisms, effect on membrane and intracellular receptors

Hypothalamic and pituitary function

Adrenocortical hormones

Adrenal medulla

## **Pancreas**

Thyroid and parathyroid hormones and calcium homeostasis

Pregnancy

Physiological changes associated with normal pregnancy

Functions of the placenta: dynamics of placental transfer

Fetus: changes at birth

Candidates should have a good understanding of general pharmacological principles, together with knowledge of drugs likely to be encountered in (a) basic anaesthetic practice and (b) current treatment of patients presenting for anaesthesia.

## **GENERAL PHARMACOLOGY**

Applied chemistry

Types of intermolecular bonds

Laws of diffusion. Diffusion of molecules through membranes

Solubility and partition coefficients

Ionization of drugs

Drug isomerism

Protein binding

## **Mode of action of drugs**

Receptors:

Dynamics of drug:receptor interaction. Graphical representations of receptor binding.

Agonists, antagonists, agonist/antagonists, partial agonists, inverse agonists.

Efficacy and potency. Receptor function and regulation. Tolerance

Metabolic pathways; enzymes; drug:enzyme interactions; Michaelis Menten equation

Ion channels:

Types of ion channels. Relation to receptors. Gating mechanisms. Types of drug action

Signal transduction: cell membrane/receptors/ion channels to intracellular molecular targets, second messengers

Membranes:

Action of gases and vapours

Other mechanisms:

Osmotic effects. pH effects. Adsorption and chelation. Oxidation and reduction

Mechanisms of drug interactions:

Inhibition and promotion of drug uptake. Competitive protein binding. Receptor interactions. Enzyme inducers and inhibitors. Addition, subtraction and synergism

Effects of metabolites and other degradation products.

Methodology of clinical trials

## **Pharmacokinetics**

Drug uptake from the gastrointestinal tract

Presystemic metabolism: bioavailability

Drug uptake from the skin. Transdermal administration systems

Drug uptake by tissues:

Muscle, subcutaneous, CSF, extradural space. Factors determining the distribution of drugs: perfusion, molecular size, solubility, protein binding. Significance of drug uptake by the lung

The influence of drug formulation on disposition

Body compartments

Distribution of drugs to organs and tissues:

Influence of specialised membranes. Tissue binding and solubility. Materno-fetal distribution. Distribution in CSF and extradural space

Modes of drug elimination:

Direct excretion

Metabolism in organs of excretion: phase I & II

Non-organ breakdown of drugs

Pharmacokinetic analysis:

Concept of a pharmacokinetic compartment

Apparent volume of distribution

Clearance. Clearance concepts applied to whole body and individual organs

Relation to the Fick principle

Simple compartmental models

Physiological models based on perfusion and partition coefficients

Pharmacokinetic variation: influence of body size, sex, age, disease, pregnancy, anaesthesia, trauma, surgery, smoking, alcohol and other drugs

Pharmacodynamics: concentration-effect relationships. Hysteresis

Pharmacogenetics. Familial variation in drug response

Adverse reactions to drugs: hypersensitivity, allergy, anaphylaxis, anaphylactoid reactions

## **SYSTEMATIC PHARMACOLOGY**

Anaesthetic gases and vapours

Hypnotics, sedatives and intravenous anaesthetic agents

Opioids and other analgesics

Non steroidal anti-inflammatory drugs

Neuromuscular blocking agents

Drugs acting on the autonomic nervous system: cholinergic and adrenergic agonists and antagonists

Drugs acting on the heart

Antihypertensives

Anticonvulsants

Diuretics

Antibiotics

Corticosteroids and other hormone preparations

Antacids. Drugs influencing gastric secretion and motility

Antiemetic agents

Local anaesthetic agents

Plasma volume expanders

Antihistamines

Antidepressants

Anticoagulants

Trainees should understand the physical principles upon which methods of clinical measurement are based. Knowledge of clinical measurement techniques should be limited to principles and basic method.

Mathematical concepts: sinusoids, exponentials and parabolas. Exponential functions and logarithms

Basic measurement concepts: linearity, drift, hysteresis, signal:noise ratio, dynamic response

SI units. Fundamental and derived units

Simple mechanics: Mass, Force, Work and Power

Heat: simple calorimetry. Conduction, convection, radiation. Mechanical equivalent of heat: laws of thermodynamics

Physics of gases. Absolute and relative pressure. The gas laws. Triple point: critical temperature. Density and viscosity of gases. Laminar and turbulent flow. The Bernoulli principle

Freezing point, melting point. Latent heat. Vapour pressure. Colligative properties; osmometry

Basic concepts of electricity and magnetism. Capacitance, inductance and impedance

Amplifiers. Band width, filters. Amplification of biological potentials: ECG, EMG, EEG.

Sources of electrical interference

Processing, storage and display of physiological measurements. Bridge circuits

Basic principles of lasers

Principles of cardiac pacemakers and defibrillators

Electrical hazards: causes and prevention. Electrocutation, fires and explosions.

Diathermy and its safe use

Principles of pressure transducers.

Resonance and damping, frequency response

Measurement of pressure. Direct and indirect methods of blood pressure measurement. Pulmonary artery pressure

Measurement of volume and flow in gases and liquids. The pneumotachograph and other respirometers. Peak flow measurement. Spirometry. Cardiac output

Measurement of temperature and humidity

Measurement of gas concentrations, especially oxygen, carbon dioxide, nitrogen, nitrous oxide, volatile anaesthetic agents

Measurement of pH, pCO<sub>2</sub>, pO<sub>2</sub>

Simple tests of pulmonary function

Capnography

Pulse oximetry

Measurement of neuromuscular blockade

Measurement of pain

## **BASIC STATISTICS**

Candidates will be required to demonstrate understanding of basic statistical concepts, but will not be expected to have practical experience of statistical methods. Emphasis will be placed on methods by which data may be summarised and presented, and on the selection of statistical measures for different data types.

Candidates will be expected to understand the statistical background to measurement error and statistical uncertainty.

## **Descriptive statistics**

Categories of data. Statistical distributions (Gaussian,  $\chi^2$ , binomial) and their parameters. Non-parametric measures of location and variability. Graphical presentation of data

Deductive and inferential statistics

Simple probability theory. Confidence intervals. Linear regression. Linear correlation  
The null hypothesis. Type I and type II errors. Probability of error occurrence, and the power of a test to detect a significant difference, Bland-Altman plot. Choice of simple statistical tests for different data types