

# **BSc SYLLABUS**

**YEARS ONE AND TWO**

## **INFECTION CONTROL AND LABORATORY SAFETY**

- Sterilisation and disinfection methods and definitions
- Viruses/bacteria
- Use of filters
- Aseptic technique
- Special precautions for testing immunocompromised patients or those with infection
- Handling of fluids – blood sputum
- COSHH
- Handwashing
- Frequency of cleaning and sterilising equipment
- Laboratory safety including handling, recognition and storage of gas cylinders, disposal of clinical waste
- BLS
- Fire and electrical safety

## **RESPIRATORY ANATOMY AND PHYSIOLOGY**

### **Respiratory Tract**

- Nasal passages
- Pharynx
- Larynx
- Trachea
- Bronchi
- Bronchioles
- Alveoli
- Alveolar capillary membrane
- Histology (special cell types including epithelial cells, goblet cells, ciliated cells etc)
- Respiratory defence mechanisms (1) mechanical defence - mucociliary escalator, cough reflex, nasal filter); (2) non-specific immune components (alveolar macrophages); (3) specific immune components (neutrophils, antibodies, T and B cells, BALT)

### **Thorax**

- Sternum
- Vertebral column
- Ribs
- Clavicle
- Scapulae
- Mediastinum (containing heart, oesophagus, great vessels)
- Pleural membranes
- Lung lobes and bronchopulmonary segments
- Diaphragm

### Innervation and circulation

- Pulmonary circulation
- Bronchial circulation
- Distribution of pulmonary blood flow and effects of intravascular pressures
- Pulmonary vascular resistance
- Autonomic nerve supply (sympathetic and parasympathetic)
- Role of adrenergic and cholinergic receptors

### Control of breathing

- Respiratory control centre in brain (medulla, pons, higher centres)
- Role of chemoreceptors
- Autonomic nervous system
- Reflexes

### Gas exchange

- Gas laws
- Anatomical and physiological dead space
- Principles of diffusion: partial pressures, gas transfer
- Process of gas phase, membrane and blood phase diffusion
- Oxygen and carbon dioxide transport
- Effects of anatomical and physiological shunts
- Oxygen dissociation curve
- Ventilation/perfusion ratio

### Acid base balance

- processes of gas exchange
- oxygen and carbon dioxide transport
- ventilation/perfusion ratio
- effects of shunts
- acid base balance - metabolic acidosis, respiratory acidosis, metabolic alkalosis, respiratory alkalosis

## **RESPIRATORY MECHANICS (1)**

- Inspiratory muscles: diaphragm, sternocleidomastoid, external intercostals
- Accessory muscles of inspiration
- Expiratory muscles (rectus abdominis, external oblique muscle)
- Quiet breathing and active breathing
- Pressure changes during breathing (pleural, alveolar and mouth pressures)
- Changes in shape and size of thorax
- Static properties of the lung including elastic recoil of lungs, chest wall and respiratory system
- Physiological determinants of lung volumes
- Dynamic properties of the lungs including airways resistance, pulmonary resistance, flow volume relationships and the effects of density and viscosity of inspired gas
- Distribution of ventilation and perfusion relationships in the lung

## **PATHOPHYSIOLOGY (1)**

- Indications for performing lung function tests
  - assess whether any abnormality of lung function is present
  - assess the severity of lung disease and to aid in the establishment of a differential diagnosis
  - To assess the response to treatment such as corticosteroids and evaluate changes in lung function occurring over time such as the rate of deterioration
  - to provide an objective measurement of lung function for occupational health or industrial reasons
  - research purposes
  - to investigate the presence and severity of sleep related breathing disorders such as obstructive sleep apnoea
  - assess exercise tolerance and capability of patient in order to quantify the limitation placed on an individual by the lung disease or to evaluate the response to an intervention such as LVRS or pulmonary rehabilitation
  - assessment of suitability for transplantation or surgical interventions that require anaesthesia
- Contraindications for performing tests
  - recent pneumothorax
  - recent myocardial infarction or unstable cardiovascular status
  - poor compliance with tests and inability to perform measurements (nausea, vomiting)
  - recent thoracic or abdominal surgery
  - aortic aneurysm
  - active bacterial infection of the respiratory tract
  - pneumomediastinum
  - recent eye surgery
  - haemoptysis of unknown origin
  - specific contraindications relating to individual tests eg exercise testing, assessment for supplementary oxygen etc
- Pathophysiology in different diseases and effects on lung function:
  - Intrathoracic airways obstruction (asthma, chronic bronchitis, emphysema)
  - Extrathoracic airways obstruction (fixed, variable)
  - Restrictive ventilatory defects (pulmonary fibrosis, diseases of the chest wall, neuromuscular disorders)
  - Hypoxaemia (ventilatory failure, V/Q inequality, anatomical shunts)
  - Hypercapnia (disorders of the respiratory centre, respiratory nerves and muscles, disorders of the chest wall, airways and lung parenchyma)
  - Pulmonary embolism
  - Effects of cigarette smoking (chronic bronchitis and emphysema, carcinoma of the bronchus)
  - Occupational lung disease (pneumoconioses, asbestosis, farmers lung, asthma, extrinsic allergic alveolitis)

## **PHARMACOLOGY (1)**

- Types of inhaled drugs including bronchodilators
- Advantages of using the inhaled route for drug delivery
- Deposition of drugs – aerosol kinetics
- Delivery systems – jet and ultrasonic nebulisers, metered dose inhalers
- Procedures for use of different inhalation devices
- Use of volume spacing devices
- Mode of action and side effects of bronchodilators (adrenergic and anticholinergic drug types)
- Assessment of response to bronchodilators including measurements and presentation of results and interpretation of outcome

## **BASIC STATISTICS AND USE OF REFERENCE VALUES**

- Normal distribution
- Standard deviation
- Standardised residuals
- Linear regression
- Uses and limitations and derivation of reference values
- Correction for adolescence and non Caucasian populations
- Calculations and presentation of predicted values and predicted ranges

## **PHYSICS AND GAS LAWS**

- Gas laws including Boyle's and Charles' Law
- Definition and application of BTPS, ATPS, STPD and saturated water vapour pressure
- Determination of temperature and pressure
- Correction of gas volumes to BTPS

## **PHYSIOLOGICAL MEASUREMENT THEORY (1)**

### *Respiratory gas analysis*

- Ultraviolet, paramagnetic, infra red and thermal conductivity analysers to include principles of operation, physical properties of gases undergoing analysis, interfering gases, calibration of analysers and verification
- Gas analysis to include oxygen, carbon dioxide, carbon monoxide, helium, nitrogen
- Electrochemical methods of analysis to include oxygen, carbon dioxide and carbon monoxide
- Mass spectrometry

### *Spirometry*

- Measurements: FEV<sub>1</sub>, FVC, VC, PEF, maximal flow volume curves and indices of flow
- Equipment: flow and volume measuring devices. Laboratory based vs portable handheld (including wedge bellows, flow turbine, pneumotachograph, dry rolling seal, water sealed spirometers, ultrasonic, peak flow meters)
- Advantages and disadvantages of using sealed and open spirometers
- Limitations, advantages and disadvantages of each device and principles of measurement

- Structure and principles of operation of Wright or Mini-Wright peak flow meter
- Calibration and maintenance of peak flow meter
- Measurement of maximal flow volume curves: values and limitations, integrators and differentiators, XY recorder, oscilloscope and VDU to display results
- Guidelines for the measurement of respiratory function: technical acceptability of tests, pre test requirements, correction to BTPS
- Use of MDIs, volume spacing devices and nebulisers
- Assessment of the response to bronchodilator therapy in the laboratory and guidelines for reversibility testing

*Lung volumes (students must be familiar with one method used routinely)*

- Measurements: FRC, TLC, RV, ERV, IVC, EVC, TV, IC, IRV, TGV
- Equipment: either helium dilution, nitrogen washout and body plethysmography
- Limitations, advantages and disadvantages of the method and principles of measurement
- Closed circuit spirometry – principles of operation, correct introduction of the patient, oxygen addition, carbon dioxide removal, use of appropriate correction factors, measurement of equipment dead space
- Calibration and equipment specification
- Routine cleaning and maintenance procedures
- Quality control
- Guidelines for the measurement of respiratory function: technical acceptability of tests, pre test requirements, correction to BTPS

*Transfer factor*

- Measurements:  $T_{LCO}$ ,  $K_{CO}$ ,  $EffV_a$
- Awareness of different components of transfer factor
- Equipment: single breath-breath holding technique for carbon monoxide; rebreathing technique and steady state technique
- Limitations, advantages and disadvantages of each method and principles of measurement
- Calibration and equipment specification
- Routine cleaning and maintenance procedures
- Quality control
- Guidelines for the measurement of respiratory function: technical acceptability of tests, pre test requirements, correction to BTPS
- Factors influencing measurements in normal lungs

**INTERPRETATION (1)**

- Spirometry (obstructive vs restrictive lung disease)
- Flow volume curves (obstructive, restrictive, extra- and intra-thoracic airways obstruction)
- Recognition of the uses and limitations of reference values
- Standardised residuals
- Classification of airflow obstruction (mild, moderate, severe)
- Full lung function tests (**basic recognition** of restrictive vs obstructive diseases)
- Recognition of the need to deliver a bronchodilator

### **PRACTICAL COMPETENCIES (1)**

- Spirometry (including MFVC)
- Lung volumes (via one named method)
- Gas transfer (single breath method)
- Delivery of a bronchodilator via MDI, MDI with spacing device, nebuliser)

