Diagnostic Testing

SS Visser
Pulmonology
UP
Tests

- Conventional XRC
- Computerized Tomography
- Magnetic resonance Imaging
- Scintigraphic Imaging
- Pulmonary Angiography

- Ultrasound
- Lung Function
- Skin prick testing
- Sputum
- Bronchoscopy
- Pleural aspiration and biopsy
- Lung biopsy
Conventional XRC

- Initial dx study to evaluate respiratory disorders
- Routine XRC not cost effective but can provide evidence of disease in asymptomatic persons being investigated for another reason
- PA and lateral views (upright)
- Lateral decubitis views (fluid movement)
- Apical lordotic views (lung apices)
- PA views (supine, portable)
Chest Radiographic Patterns

- Solitary circumscribed density – nodule (<6cm) or mass (>6cm)
- Localized veiling
- Diffuse interstitial disease
- Diffuse alveolar disease
- Diffuse nodular disease
Solitary circumscribed density

- Primary or metastatic neoplasm
- Localized infection (bacterial abscess, mycobacterial or fungal infection)
- Wegener’s granulomatosis (single/multiple nodules)
- Rheumatoid nodule (single/multiple)
- Vascular malformation
- Bronchogenic cyst)
Localized veiling

- Pneumonia (bacterial, mycobacterial, atypical or fungal)
- Neoplasm
- Radiation pneumonitis
- Bronchitis obliterans + organizing pneumonia
- Pulmonary infarction
Diffuse interstitial disease

- Idiopathic pulmonary fibrosis
- Lung fibrosis + systemic rheumatic disease
- Sarcoidosis
- Drug-induced lung disease
- Pneumoconiosis
- Hypersensitivity Pneumonitis
- Infection
- Eosinophylic Granuloma
Diffuse Alveolar Disease

- Cardiogenic pulmonary oedema
- Acute respiratory distress syndrome
- Diffuse alveolar haemorrhage
- Infection (Pneumocystis, viral or bacterial pneumonia)
- Sarcoidosis
Diffuse Nodular Disease

- Metastatic neoplasm
- Hematogenous spread of infection (bacterial, mycobacterial or fungal)
- Pneumoconiosis
- Eosinophylic Granuloma
Fluoroscopy

- Indicates pulsating lesions
- Movement of hemi-diaphragms (normal, paradoxical, absent)
- Localizes lesions more precisely (rib, parenchyma or pleura)
Computerized Tomography

- Cross-sectional images distinguish between densities that would be superimposed on XRC (is lesion in rib, pleura or parenchyma)
- Better evaluation of densities (Hounsfield units to measure air, fat, muscle, blood, calcification or water)- pleural effusion or tumour
- Accurate assessment of size of lesion (follow up of nodules)
CT

- Assessment of hilar and mediastinal disease and staging of lung cancer
- Distinguish vascular from non-vascular structures by means of contrast ($I_2$) - lymph nodes vs blood vessels.
- Detect cavitation +/- fluid in masses
- Spiral CT angiography can detect emboli in segmental and larger pulmonary arteries
High resolution CT (cross-sectional images 1-2mm thick – usual is 10mm) and reconstruction with high-spatial-resolution algorithms allow recognition of subtle parenchymal and airway disease such as bronchiectasis, emphysema and diffuse parenchymal disease like lymphangitis carcinomatosis, sarcoidosis, idiopathic pulmonary fibrosis and eosinophylic granuloma.
HRCT pathognomonomic patterns

- Peripheral distribution of interstitial fibrosis = IPF
- Nodules sub-pleural, peribronchial and perivascular = sarcoidosis
- Mosaic perfusion and localized hyperinflation = bronchiolitis obliterans with organizing pneumonia
- Bullae = emphysema
- Honeycombing = end stage lung disease
- Cystic ring shadows and peribronchial thickening = bronchiectasis
Magnetic Resonance Imaging (MRI)

- Limited usefulness in parenchymal diseases
- Better for imaging of abnormalities near lung apices, spine, thoracoabdominal junction
- Vascular lesions can be distinguished from non-vascular without need for contrast – e.g. abnormal mediastinal and hilar densities and aortic aneurysm and dissection.
Radioactive isotopes IV or via inhalation allow the lung to be imaged with a gamma camera.

Most commonly: **Ventilation/perfusion** scan for evaluation of pulmonary embolism – **Perfusion scan**: albumin macroaggregates labeled with technetium 99m lodge in pulmonary capillaries – distribution of isotope follows distribution of blood flow – a thrombus will cause a perfusion defect.
V/P Scan

- **Ventilation Scan**: radiolabeled Xenon gas is inhaled to demonstrate distribution of ventilation – a defect in isotope deposition is caused by parenchymal conditions e.g. pneumonia.

- For diagnosis of fresh pulmonary embolism a defect in perfusion occurs in the presence of normal ventilation, so-called “mismatch”.

- Matched perfusion and ventilation defects are indicative of parenchymal disease or old pulmonary embolism (atelectasis of unperfused lung due to ↓ surfactant production).
Quantitative V/P Scan

- Indicated in patients with impaired lung function where resection or pneumonectomy is considered.

- Regional ventilation and perfusion are determined and used to assess post operative lung function
Gallium Scan

- Gallium is an isotope concentrated in inflammatory and neoplastic cells and is useful to localize an inflammatory focus not clinically evident e.g. osteomyelitis or abscess.
- It is also of value to measure activity in interstitial lung diseases e.g. sarcoidosis (uptake in lacrimal glands, parotids, mediastinal and hilar lymph glands and lung parenchyma- Panda bear sign).
- Also of value in PCP pneumonia in immunocompromised patients.
Allergy Testing

- Skin prick tests: positive control = histamine, negative control = saline, allergic responses are measured as wheal and flare and compared with controls.
- IgE, ECP and RAST
- Eosinophils in sputum and peripheral blood
- PPD skin test for Tb and cell mediated immunity
- Anergy found in sarcoidosis, HIV, lymphoma, disseminated Tb.
Sputum

- Microscopy: Gram stain: epithelial cells and pus cells to determine quality (Q 0-3)
- Gram + or - Cocci and bacilli
- mycobacteria (Ziehl Nielsen stain Tb)
- eosinophils, creola bodies, Kurschman spirals
- Culture and sensitivity
- Cytology neoplastic cells, hemosiderin filled macrophages
Lung Function Tests

- Spirogram to measure lung volumes and capacities
- Flow volume loop to measure forced vital capacity, FEV1 and flow indices such as PEFR, PEF 50, PEF 25-75.
- Airway resistance
- Diffusion
- Blood gases
- Respiratory muscle function and Exercise studies
**Bodyplethysmography**

**Patient Information**

- **Last Name:** VERNEY
- **First Name:** W
- **Identification:** GT42468758
- **Date of Birth:** 05/05/1943
- **Age:** 63 Years
- **Sex:** Male
- **Weight:** 79 kg
- **Height:** 176 cm

**Graphs and Data**

- **Flow [L/s]** vs. **Volume shift [ml]**
- **Flow [L/s]** vs. **Flow rate [ml/s]**
- **Flow rate [ml/s]** vs. **Flow rate [ml/s]**

**Table: SR tot and SR eff**

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**Table: VC, FVC, TLC**

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**Table: FVC, FEV1, FEV1 & FVC**

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**Table: DLCO SB, VA, DLCO/VA**

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**Table: PBC-He, RV-He, TLC-He**

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**Table: DLCOc SB**

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**Carboxyhemoglobin**
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<td>3. CAT HAIR</td>
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<td>5. FEATHER MIX</td>
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<td>13. MOULD MIX</td>
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TECHNOLOGIST
DOSE RESPONSE CURVE

FALL IN FEV₁

METHACHOLINE CONCENTRATION (mg/ml)

SEVERE  MODERATE  MILD

PC20 : __________ mg/ml
PRETORIA ACADEMIC HOSPITAL
DEPARTMENT OF INTERNAL MEDICINE
LUNG FUNCTION UNIT
TELEPHONE: (012) 354 1923

HEIGHT 1.64 m
WEIGHT
WARD

PREDICTED VALUE CALCULATION

<table>
<thead>
<tr>
<th>GROUP</th>
<th>P1 max (cmH₂O)</th>
<th>PE max (cmH₂O)</th>
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<td>142 - (1.03 x Age)</td>
<td>180 - (0.91 x Age)</td>
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<tr>
<td>WOMEN</td>
<td>-43 + (0.71 x Ht)</td>
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<td>BOYS</td>
<td>44.5 + (0.75 x Wt)</td>
<td>35 + (5.5 x Age)</td>
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<tr>
<td>GIRLS</td>
<td>40 + (0.57 x Wt)</td>
<td>24 + (4.8 x Age)</td>
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PREDICTED VALUE: MIP: 79.12 cmH₂O  MEP: 93.7 cmH₂O

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<tr>
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<th>ACTUAL</th>
<th>% PRED</th>
<th>MEP (cmH₂O)</th>
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<tr>
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<td>50</td>
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<td>64%</td>
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CLINICAL TECHNOLOGIST: AS + NO
Reference: Benatar, Hewlett & Nunn 1973
Invasive Procedures

- Pleural aspiration + Pleural biopsy (effusion)
- Bronchoscopy with lavage, BAL and transbronchial biopsy (infection, tumour, interstitial lung disease)
- Transthoracic needle aspiration/biopsy
- Mediastinoscopy + biopsy (tumour or gland)
- Open lung biopsy (diffuse lung infiltrate or tumour)
- Pulmonary Angiography (thrombo-embolism)
1. Direct Vision Biopsy
- Direct vision permits transendoscopic sample collection of a selected area utilizing a biopsy forcep.
- The complete line of OLYMPUS biopsy forceps allows for an appropriate forcep to be used to obtain a sample based on the specific condition or disease.

2. Cytology Sampling of the Bronchi
- A collection of cells from the wall of the bronchi is made with the cytology brush or curette. The cytology brush provides cytology samples from a large superficial area of the proximal airway. The curette provides samples from deep bronchial areas, not easily accessible with a cytology brush.
- OLYMPUS has expanded its line of cytology brushes by offering brushes which allow for more reliable and accurate diagnosis.

3. TBLB (Trans-Bronchial Lung Biopsy)
- TBLB allows tissue sampling to establish definitive bronchoscopic diagnosis of diffuse parenchymal disease and focal nodules, masses and infiltrates.
- Within the complete line of OLYMPUS biopsy forceps are specific tools to collect samples from areas beyond the bronchial wall.

4. TBAB (Trans-Bronchial Aspiration Biopsy)
- TBNA is used to sample tissue outside the tracheobronchial tree, generally from mediastinal lymph nodes or from primary tumors adjacent to the airway.
- OLYMPUS provides 21g, 13mm aspiration needles with a standard port or side port design.

5. Foreign Body Removal
- An extensive selection of grasping forceps allow extraction of foreign bodies that have been aspirated.
- The types of grasping forceps include magnetic extractor, rat tooth, three nail, rubber tip and W-shape.
Employees over 30 years old

Employees under 30 years old

At least they understand each other on Wednesday