Strategy and interpretation of paraclinical investigations in respiratory diseases

Investigations recommended and commonly used in respiratory diseases are:

- bacteriological (sputum),
- functional (spirometry, bronchial hyperreactivity measurement, plethysmography),
- blood gas analysis (gasometry and pulse oximetry), imaging (standard cardio-pulmonary radiography, CT),
- bronchoscopy with broncho-alveolar lavage,
- puncture of the pleural fluid.

Of these, sputum examination, spirometry and standard pulmonary radiography are routine tests, which can be recommended and interpreted by the family doctor in current practice, for patients who may be outpatient or before referral to other specialists (pneumologist, internist, allergist etc).

Sputum examination

It is indicated in all productive cough situations, provided it is harvested correctly and sent to the laboratory as soon as possible (max. 2 hours).

After macroscopic appearance, the sputum may be:

- mucous - transparent, the consequence of hypersecretion of mucus due to a viral infection, smoking or allergenic exposure,
- muco-purulent - usually in acute bacterial over-infections, and
- purulent - more consistent and yellowish-green in color,in bacterial infections with aerobic or anaerobic germs.
- fetal odor suggests infections with anaerobic germs.
- hemoptysis in tuberculosis, neoplasm or pulmonary infarction,
- bricks in acute pneumonia.

Microscopic examination of sputum supplemented with antibiogram will be performed in specialized laboratories and confirm the etiological diagnosis. In clinical practice, most often the treatment of respiratory infections is done empirically, taking into account the most commonly incriminated microbial agents. Sputum examination is required in case of adverse development and suspected severe infection, including tuberculosis.

Spirometry - is a cost-effective and reproducible functional investigation that provides useful information for diagnosis and can be performed in the family doctor's office.

Spirometry is mandatory:

- for confirmation of obstructive pulmonary disease, especially asthma or COPD,
- to assess the reversibility of bronchial obstruction,
- establishing the degree of severity,
- for monitoring the therapeutic response,
- establishing the long - term strategy and
- assessing the prognosis of the disease.
- for preoperative evaluation,
- assessment of the degree of invalidity for the purpose of expertise of work capacity
- in epidemiological studies to determine the prevalence and severity chronic respiratory diseases.

In order to perform a correct spirometry, the patient must be compliant and follow the standardized technical method.

The interpretation of spirometry is based on the aspect of the flow-volume curve and the values of the following parameters:

- forced vital capacity (FVC)
- the maximum expiratory volume per second (FEV1),
- Tiffneau index (FEV1 / FVC report)
- maximum expiratory average rates at 25%, 50% and 75% of FVC (MEF25, MEF 50 and MEF 75),
- peak expiratory flow rate (PEF)

The physiological variations of these parameters are dependent on

- sex,
- age and
- height,
- and the values vary according to:
    - muscle contraction force,
    - pulmonary elasticity and
    - the size of the airways.

There are two functional tables defined by the FEV1 alteration and of the maximum mean expiratory rates: the obstructive syndrome and the restrictive.

Obstructive syndrome is characterized by decreased FEV1 and FEV1 / VC ratio, following airway obstruction, produced by their intrinsic narrowing or diminished pulmonary elastic recoil (as in pulmonary emphysema).

The maximum average expiratory rates, especially MEF 50, signal obstruction to flow in peripheral airways, and their decrease characterizes distal obstructive syndrome, commonly encountered in forms mild or at the onset of obstructive pulmonary disease.

Restrictive syndrome is characterized by low VC and FEV1 values, with normal or increased FEV1 / VC ratio. In the case of mixed ventilation, all parameters are decreased, respectively VC, FEV1, FEV1 / VC ratio and peripheral flows**.**

Ventilatory dysfunction is considered to be mild when parameter values are between 60 and 80% of predicted values, average when values are between 40 and 60% and severe when values are below 40% of predicted.At present, it is preferred to mention directly the percentage of FEV1 and / or VC reduction over the theoretical value, without having to specify the degree of severity.

Measurement of bronchial hyperreactivity

Bronchial hyperreactivity represents sensitivity abnormal bronchi upon contact with various allergic stimuli or non - allergic, such as physical (cold air), chemical (SO 2, NO 2) and pharmacological (acetylcholine, methacholine). Bronchial hyperreactivity is characteristic of bronchial asthma, but is found in other conditions such as rhinitis, bronchitis, respiratory viruses and in smokers.

Bronchial hyperreactivity assessment tests are:

- provocative tests on bronchoconstrictive pharmacological agents, on physical agents,
- allergen specific challenge tests and
- bronchodilation tests.

Of these, only bronchodilatory tests can be performed and interpreted by the family doctor, who must also know the significance of the challenge tests. Bronchodilator tests confirm bronchial hyperreactivity by measuring the response to a bronchodilator agent administered to a patient with obstructive syndrome.

The evaluation of the bronchodilatory effect is done by measuring the same functional parameters, generally FEV1 and PEF, before and after 15 minutes after the administration of a short-acting bronchodilator, usually salbutamol 200-400 μg. The test is positive when the FEV1 increases by 12% and 200 ml from baseline, and PEF and FEF5O increase by 25%.

The bronchoconstriction or challenge test has much narrower indications and is performed only in specialized services, under close supervision, with the possibility of emergency intervention, in case of a severe bronchospastic response.

The main indication is the confirmation of the asthma diagnosis, when the other diagnostic criteria are not sufficient for the assessment of the etiology and severity of the occupational asthma. Blood gas analysis can be performed directly, by puncture of a peripheral artery, usually the radial or femoral artery, or indirectly, using a pulseoximeter, which measures oxygen saturation of arterial blood (Sa02).

Pulse oximetry is a simple and non-invasive method, which can help the family doctor diagnose a more severe respiratory illness, such as acute asthma, and intervene with emergency treatment just before being sent to the hospital. The normal value of Sa02 is 95-97%, corresponding to a value of partial blood pressure of arterial blood (Pa02) between 80 and 100 mmHg. Hypoxemia is considered mild when Pa02 drops below 70 mmHG, moderate between 45 and 60 mmHg and severe below 45 mmHg. The partial pressure of CO2 in arterial blood (PaC02) in adults varies between 35 and 45 mmHg and is not influenced by age. Hypercapnia is mild when PaC02 increases between 46 and 50 mmHg, moderate at values between 50 and 70 mmHg and severe at values over 70 mmHg.

Standard pulmonary radiography

The correct interpretation of a pulmonary radiography implies the fulfillment of the quality technical standards, the follow-up of all the anatomical elements, the position of the patient and possibly the possibility comparison with previous examinations.

Combining clinical patient information can help interpret pulmonary radiography, especially when there is a clinical suspicion of more severe disease, such as lung cancer, tuberculosis or other severe infections. The x-ray examination sequence is not fixed, generally it is prefers to start with the trachea position, which is slightly to the right of the line median, contour and width of mediastinum and then the two pulmonary threads - position, contour and density. They are evaluated comparatively and any difference in density or contour must be verified by the incidence of the profile and by comparison with previous images.

The lungs are examined, the position of the horizontal slit, diaphragms, cost-phrenic and cardio-phrenic angles, appearance pleura and chest wall.

Pathological parenchymal images can be:

- alveolar,
- interstitial,
- bronchial and solitary round opacities.

The causes of pulmonary opacities are multiple, including practically all the pathological processes that determine the filling of the alveolar spaces and the small bronchi. The alveolar opacities have liquid density, imprecise contour, can be confluent and have an aerial bronchogram. They can be localized, systematized (lobe or segmental) or diffuse, bilateral.

The most common causes are bacterial pneumonia, pulmonary tuberculosis, pulmonary infarction, pulmonary edema, pulmonary vasculitis. Systematized opacities may have substrate alveolar syndrome or pulmonary atelectasis, the latter being produced generally by bronchial obstruction. Atelectasis is systematized, retractable, homogeneous opacity, high density and no air bronchogram.

Causes of pulmonary atelectasis are foreign bodies, endobronchial tumors, mucus plugs or extraluminal compression.

Interstitial pulmonary opacities are produced by nonspecific thickening or infiltration of interstitial tissue due to proliferation of inflammatory or neoplastic origin or fluid infiltration. There are net opacities, non-confluent and non-systematic, without aerial bronchogram, with linear, nodular, reticulo-nodular appearance.

Solitary round opacities pose the problem of differential diagnosis between malignant tumors, benign tumors, tubeculoma, aspergilloma, chronic pneumonia, pulmonary cysts, rheumatoid or vasculitis nodules such as Wegener's disease or opacities of vascular origin. Any pathological image on a standard x-ray and which does not change after the treatment requires supplementing with more efficient imaging investigations, in specialized services.