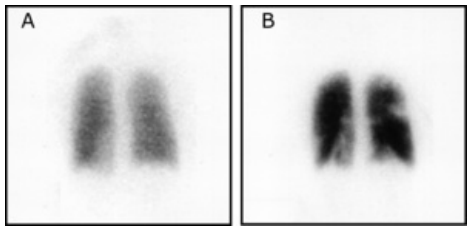
Radionuclide examinations of the respiratory tract

Radionuclide examinations of the respiratory tract help mainly in the evaluation of lung parameters and functions. The examination of the respiratory tract also includes nuclear methods for searching for and monitoring inflammatory and malignant processes in the chest.

The methods can be divided according to the monitored parameter into:

- **ventilation** examination ;
- **pulmonary perfusion** examination ;
- examination of the **permeability of the alveolocapillary membrane** ;
- screening for **tumors** and **inflammation** ;
- examination of **ciliary epithelial function** .



Ventilation and perfusion scintigraphy of the lungs - **mismatch A** - homogeneous distribution of the radiopharmaceutical on the ventilation scintigram, **B** - hypoperfused deposits on the perfusion scintigram, outages indicate sites of pulmonary artery embolization.

Ventilation lung scintigraphy

Ventilation lung scintigraphy monitors the extent of gas exchange between the environment and the alveoli. According to the recording, it is divided into **dynamic** and **static** .

Radiopharmaceuticals

For methods of ventilatory pulmonary scintigraphy, it is necessary to use gaseous radionuclide or labeled liquids dispersed in the mist. **^{133}Xe** and **^{81m}Kr** are radioactive gases with a short half-life. This makes it excellent for this method, where it is necessary to obtain as many signals as possible in a short interval of several breaths. A significant disadvantage is the short half-life of the parent radionuclides and thus the need for frequent renewal of the source (generator). Examination with these radionuclides can be combined with other methods that use technetium, as their photons have different energies.

^{99m}Tc s used significantly less for ventilation scintigraphy. It is necessary to dissolve it in water (in the form of pertechnetate) and then turn the marked solution into a mist. This is done either in **ultrasonic nebulizers** (Latin nebula = fog, steam) or by means of **spray nozzles** .

Dynamic ventilation scintigraphy

The patient receives a tube in his mouth connected to a tank with a marked gas, from which CO_2 is taken and oxygen is supplied.

Recording begins when the valve to the reservoir is opened to the patient. We observe an **increase and distribution of activity in the lung area** , which corresponds to the penetration of the labeled gas into the alveoli. This phase is called **wash-in** .

After stabilization, reaching **equilibrium** , the activity above the lungs does not increase. The **time taken** for the equilibrium to reach and the **maximum activity** is important .

Then the valve to the tank closes again and the so-called **wash-out** phase is recorded . In this phase, the labeled gas escapes from the alveoli and thus the activity above the lungs is reduced.

Static ventilation scintigraphy

The examinee inhales marked gas or mist throughout the examination. We monitor the examination with a scintillation camera.

When using technetium-labeled aerosols, it is necessary to take into account the formation of artifacts, which are formed by the deposition of radiopharmaceuticals on the mucous membrane of the respiratory tract. Swallowed radioactive saliva also enters the esophagus and stomach .

Perfusion lung scintigraphy

The examination is performed on patients with suspected pulmonary pathology. Typical indications include pulmonary embolism , pulmonary hypertension , R → L shunt defects , and chronic obstructive pulmonary disease .

Radiopharmaceuticals

Microspheres or **^{99m}Tc-albumin** macroaggregates are used to monitor the vascular bed in the lungs . The particles must be large enough to wedge in the capillary bed, but they must not be too large so as not to end their path in the arterial part. The optimal size is between 10 and 50 µm.

Embodiment

The marked particles are administered intravenously, application into the veins on the dorsum of the foot is suitable, so we can directly monitor the possible source of thrombus .

The particles pass through the right heart, the arterial pulmonary circulation and embolize the capillary circulation. About every tens of thousands of capillaries are clogged, so there should be no significant increase in lung pressure.

We monitor the lung area with a scintillation camera . Both planar scintigraphy and SPECT can be performed . Planar scintigraphy is less accurate, but SPECT complicates the patient's breathing movements.

Results

The result of the examination is a display of places through which blood flowed and where marked particles were trapped. We compare the overall shape of the riverbed, the differences between the right and left lungs, the difference in blood supply to the bases and apexes. Local outages, or places of increased activity, indicate a pathological lesion (abscess, malignant tumor ...).

We further compare the scintigram with the examination of the lung ventilation (see above). We monitor the relationships of places with blood supply failure and ventilation failure.

- Mismatch - characteristic of embolization. The perfusion scintigram is abnormal, the ventilation scintigram is normal.
- Match - characteristic of bronchopulmonary diseases (typical for COPD, for example). The perfusion and ventilation scintigram will have the same outages in a certain area.

Examination of inflammation and malignancy

Inflammation

^{67}Ga-citrate , **^{111} In-labeled leukocytes** and **^{99m}Tc-anti neutrophil** antibodies are most commonly used to monitor inflammation . **^{18}F-FDG** are used in the PET examination.

inflammatory deposits appear as so-called "hot nodules" in which the radiopharmaceutical accumulates. The lesion may also occur in the surrounding tissues (mediastinum , chest wall). For its exact localization it is suitable to use hybrid SPECT / CT or PET / CT.

Knowledge of the patient's clinical facts is essential for the final diagnosis of an inflammatory lesion, as most radiopharmaceuticals are also taken up by tumors (see below).

Malignancies

^{67}Ga-citrate, ^{201}Tl-chloride can be used for malignancies , and**^{18}F-FDG**for PET examination. If the nature of the tumor or metastasis is known,**^{111}In and ^{201}Tl labeled antibodies can be used .** Labelled somatostatin analogues **can also be used in endocrine tumors .**

Examination and evaluation of results is similar to inflammation (see above).

Links

Related Articles

- Pulmonary ventilation - perfusion ratio

References

- KUPKA, Karel – KUBINYI, Jozef – ŠÁMAL, Martin, et al. *Nukleární medicína.* 1. edition. P3K, 2007. 185 pp. ISBN 978-80-903584-9-2.