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SELF-STUDY TEST

Pulmonary Nuclear Medicine

Questions are taken from the *Nuclear Medicine Self-Study Program I*, published by The Society of Nuclear Medicine

DIRECTIONS

The following items consist of a heading followed by lettered options related to that heading. Select the one lettered option that is best for each item. Answers may be found on page 318.

1. A 45-year-old white housewife with a 40 pack-year smoking history presents with progressive shortness of breath and an 8-pound weight loss. She denies febrile episodes, frequent respiratory infections, or excessive sputum production, but she has a dry cough. Her husband is bisexual. Clinical and laboratory examinations reveal cervical and inguinal lymphadenopathy and liver function abnormalities. Her ^{67}Ga scintigram is shown in Figure 1. Which *one* of the following is the most likely diagnosis?

A. bronchogenic carcinoma with lymph node metastases
B. Hodgkin's lymphoma
C. acquired immunodeficiency syndrome with *Pneumocystis carinii* pneumonia
D. sarcoidosis
E. hypersensitivity pneumonitis

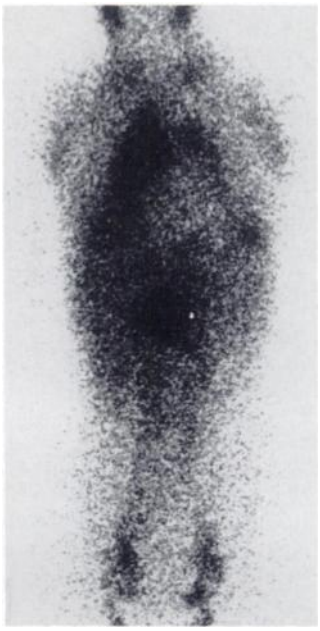

Figure 1

2. Which *one* of the following properties of a radioaerosol is *least* important in determining its rate of clearance from the lung?

A. solubility
B. lipophilicity
C. droplet size
D. pulmonary blood flow rate
E. alveolar-capillary membrane permeability

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SELF-STUDY TEST
Pulmonary Nuclear Medicine
ANSWERS

(continued from p. 203)

ITEM 1: Sarcoidosis

ANSWER: **D**

The gallium image shown in Figure 1 demonstrates increased uptake of tracer in the lungs and parotid regions. There is also a symmetrical pattern of nodal disease involving the cervical, supraclavicular, hilar, paraaortic, inguinal, and femoral nodes. Bronchogenic carcinoma with lymph node involvement may show pulmonary and mediastinal uptake of ^{67}Ga, as well as gallium localization in distant metastases. However, the symmetry of involvement would be highly unlikely for metastatic disease. Lymphoma is a good possibility, given this patient's history, except that patients with Hodgkin's disease often present with intermittent fever or night sweats. Although gallium uptake in nodal chains and in the lungs is consistent with lymphoma, the high degree of symmetry and the parotid involvement make this diagnostic possibility less likely than sarcoidosis, which is the best fit to the clinical and scintigraphic findings. The pattern of gallium uptake with hypersensitivity pneumonitis or with *Pneumocystis carinii* pneumonia in patients with AIDS rarely includes tracer uptake in the lymph nodes. Generally, there is diffuse pulmonary uptake of moderate to high intensity with *P. carinii* pneumonia and of low to moderate intensity in hypersensitivity pneumonitis. In patients with AIDS, hilar and mediastinal nodal ^{67}Ga uptake may be seen with secondary lymphoma or with infection due to *Mycobacterium tuberculosis* or *Mycobacterium avium-intracellulare*. Gallium accumulation associated with the lymphadenopathy of AIDS per se is usually of relatively mild intensity.

ITEM 2: Pulmonary Clearance of Radioaerosols

ANSWER: **D**

Numerous factors are important in determining the clearance rate of a radioaerosol from the lung. Major differences exist between the clearance rates and pathways of soluble and insoluble aerosols. Insoluble aerosols include those of particulate nature, such as ^{99m}Tc-colloids or albumin particles, which must be cleared from the airways and alveoli by either mucociliary action or by lymphatic drainage. Mucociliary clearance requires several hours, even from relatively central airways, and lymphatic clearance of particulates can take days to weeks. On the other hand, soluble radioaerosols are cleared quickly by gaining direct access to the pulmonary blood supply across the alveolar–capillary membrane.

The clearance rates of various soluble aerosols are influenced by a number of factors, including the lipophilicity and polarity of the agent. In general, the more lipophilic and polar compounds are likely to be absorbed more rapidly. The molecular weight of a compound, however, also seems to have an influence. Some relatively high molecular weight lipophilic compounds have slower pulmonary clearances than would be predicted from their lipid solubility alone.

Size is an important factor in radioaerosol clearance, whether the size refers to the molecular weight of a soluble compound, as mentioned above, or whether it refers to the physical size of the inhaled aerosol droplets. Larger aerosol droplets tend to deposit more centrally. From this central location, mucociliary clearance can act more effectively and quickly to clear the particles from the lungs. Conversely, if molecular size is considered, a larger compound may have a slower peripheral clearance. An agent with a combination of physical characteristics leading to the fastest clearance would have a relatively small molecular weight and be a polar, lipophilic compound delivered to the lung as a submicronic aerosol.

Alveolar–capillary membrane permeability appears to be a major factor in determining the clearance rate of soluble radioaerosols from the lung. The clearance of these compounds seems to be related far more closely to the available surface area for absorption across this membrane than to the pulmonary blood flow rate, itself. Total obstruction of pulmonary arterial flow to a lung leads to markedly diminished clearance of soluble radioaerosols, although a small amount of radioaerosol activity still may be absorbed through the bronchial circulation. However, within the typical range of pulmonary blood flow rates encountered in clinical practice, blood flow rate per se has relatively little influence on clearance rates.

Note: For further in-depth information, please refer to the syllabus pages included at the beginning of *Nuclear Medicine Self-Study Program I: Part I.*