

QUESTION 13

A patient was administered I-131 for a thyroid ablation in your medical center. The patient is incontinent for urine and will be on a catheter with a urine collection bag.

GIVEN

Quantity of I-131 administered: 7400 MBq of I-131 (200 mCi)

For most thyroid ablation patients, approximately 1/2 of the patient's administered activity will be gone within the first 24 hours due to biological elimination and radioactive decay.

I-131 physical half life: 8.04 days

For I-131, the Gamma Constant = 2.2 R-cm²/hr-mCi

For 364 keV photons: 1.4 x 10⁷ photons/s-cm² yields an exposure rate of 1 R/hr

I-131 Radiations: β with an average energy of 0.180 MeV 100 % emission rate.
 0.08 MeV gamma; 2.6% emission rate
 0.364 MeV gamma; 82% emission rate
 0.723 MeV gamma; 1.6 % emission rate

I-131 biological half life in the thyroid: 138 Days
 Mass of thyroid: 20 grams

Available survey instruments include a "Pancake" style GM survey meter and a thin window NaI(Tl) probe.

At the 24 hour mark, the patients urine output is 1000 ml.

POINTS

- 10** **A** The dose rate from the urine collection bag at 24 hours is 47 mR/hr at 1 foot as measured with an air ion chamber. The bag has not been emptied. What is the amount of I-131 in the urine?

- 20** **B** The patient became very combative and threw the urine collection bag against a wall. The bag burst and a nurse proceeded to clean up the spill. The nurse tells you about this event the next day. You decide to perform a field screening to determine if the nurse had an iodine uptake. For the two instruments listed in the "Given" section state one pro and one con of using each instrument to check the nurse's thyroid, and your recommendation for use.

- 10 C Field screening shows that the nurse did intake I-131. The nurse's thyroid is counted for 10 minutes using a fixed germanium thyroid detector. The results indicate 1800 counts in the 0.364 MeV photon peak. The background count rate in this spectral region is 80 cpm. The detection efficiency for this photon is 1×10^{-3} c/d. Estimate the amount of I-131 in the nurse's thyroid at the time of the count. Show all work. Give your result in units of nCi.
- 40 D For thyroid-to-thyroid irradiation, MIRD pamphlet #11 gives an absorbed dose per unit cumulative activity factor ($S_{\text{Thyroid} \leftarrow \text{Thyroid}}$) of 2.2×10^{-2} Rad/ $\mu\text{Ci}\cdot\text{h}$. A 100 μCi deposition of I-131 was measured in the thyroid of a janitor that assisted in the cleanup of the spill.
- 1) Calculate the committed dose equivalent to the janitor's thyroid from the 100 μCi deposition. **Show all work.**
 - 2) Calculate the committed effective dose equivalent received by the janitor from the 100 μCi deposition. **Show all work.**
 - 3) Is intervention advisable? **Explain your answer.**
- 20 E The non-stochastic inhalation ALI for I-131 is 50 mCi. Will a simple ratio of the I-131 detected within the thyroid to the ALI given above provide a reasonably accurate estimate of the CEDE? **Explain your answer?**