CONSULTANT'S CORNER

Submit questions to Newsline, *c/o The Society of Nuclear Medicine, for Consultant's Corner. Questions will be referred to authoritative members for response and published in future issues. Every letter should contain the writer's name and address, but these will be omitted upon request.*

Q: How do you determine the dose of iodine-131 to treat functioning differentiated metastatic thyroid cancer?

A: Patients with differentiated thyroid cancer, excluding medullary and undifferentiated tumors, as well as papillary primaries less than 1.5 cm, are studied. Thyroidectomy by surgery or radioactive iodine, and withdrawal of thyroid replacement (6 weeks for thyroxine; 4 weeks for triiodothyronine), is necessary before tracer evaluation. The serum thyrotropin will become elevated, except in the case of strongly functioning metastases.

Since most single treatments are insufficient to control metastases, we advocate using the largest safe dose at each treatment. Experience at Memorial Sloan-Kettering Cancer Center over the last 30 years indicates that up to 200 rads to the blood does not produce clinically significant marrow suppression. A 5-day tracer study is made of the whole-blood concentration (for the β-dose) and of the body retention (by direct measurement and by difference from the urine excretion for gamma dose) (*1*). It is necessary to strike a balance between a large dose (to facilitate imaging of the tumor) and a small dose (to avoid detector saturation in measuring body retention and urine concentration). We use 1 mCi, a limit determined by the whole-body counter.

Radiation dose (measured in rads) to the blood per millicurie administered is estimated using the Marinelli formulae (*2*), which assumes that all of β-energy is absorbed in whole blood and that both iodine-131 and the critical organ (bone marrow) are uniformly distributed in the body. Although more ideal, we have not used the absorbed fraction dosimetry because of the geometric complexities of iodine-131 and marrow distribution. Body retention, at 48 hr after a treatment dose, must not exceed 120 mCi. This may lead to an outpouring of labeled protein into the blood from a damaged tumor. Body retention should not exceed 80 mCi in the presence of diffuse lung metastases. This may induce radiation pneumonitis.

In our patients, 200 rads are delivered to the blood by 70 to 650 mCi, the average value being 300 mCi (*3*). An analysis of 80 dosimetric studies indicates that an arbitrary dose of 200 mCi would undertreat 54% of patients and overtreat an additional 3%. Most doses in the 150 to 200 mCi range are inadequate.

We require imaging evidence of function in metastatic sites before giving large treatment doses. Quantifying tumor uptake in terms of rads expected necessitates calculation of tumor volume, the estimation of turnover and internal absorption, as well as the assumption of uniform distribution within the tumor (*4*).

In summary, because of the vagaries of determining the *tumor* dose, we calculate the amount of iodine-131 that will deliver and administer the largest safe dose (200 rads) to the *blood (marrow)* at each therapeutic intervention.

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References

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