Effect of Gut Retention on the Effective Whole Body Half-Time of Iodine-131 in Thyroid Cancer Patients

Russell Maxon, Stephen R. Thomas, and Harry Maxon

University of Cincinnati, College of Medicine, Cincinnati, Ohio

The whole body radiation dose resulting from iodine-131 (^{131}I) therapy in patients with thyroid cancer is directly related to the effective whole body half-time of ^{131}I in those patients. In 101 studies on 64 patients referred for quantitative whole body radioiodine scans for thyroid cancer, the effective whole body half-time was found to be significantly greater ($p < 0.05$) when gut retention was maximal. These results indicate that gut retention is a significant contributor to the whole body half-time of ^{131}I. The routine use of non-iodine-containing laxatives at the time of ^{131}I studies and therapy may be useful in decreasing whole body ^{131}I retention times and, therefore, in decreasing whole body radiation doses, and should be considered in such patients.

Radioactive ^{131}I has been used diagnostically and therapeutically for many years in patients with well-differentiated thyroid cancer. In such patients the goal is to deliver therapeutic amounts of radiation to the tumor sites from ^{131}I while minimizing exposure to other organs. Our protocols require that the patients stop thyroid hormone supplements for up to 6 wk prior to scanning in order to stimulate tumor uptake. The ^{131}I that does not go into thyroid tissues or cancers is generally excreted via salivary and gastric secretions (*1*) and urine (*2*). Although the main route of excretion is through the urine, a significant amount of radioiodine may also be excreted through the gut. As these patients are almost always hypothyroid, they often are constipated with prolonged gut retention of ^{131}I in the stool. The purpose of this study was to see whether there was any direct relationship between gut retention and the whole body half-life of ^{131}I.

METHODS

We reviewed 101 sets of radioiodine scans on 64 patients previously referred for diagnostic radioiodine studies. All patients had undergone prior surgical removal of the thyroid gland for well-differentiated thyroid cancer between 1983 and 1986. Thirty studies were in men with an average age of 36.8 yr. Seventy-one studies were in women with an average age of 42.9 yr. Of the 101 patient studies, 43 showed no scintigraphic evidence of residual thyroid tissue or thyroid cancer, 33 revealed residual thyroid tissue alone, 17 showed metastases without residual thyroid tissue, and 8 were positive for both residual thyroid tissue and nodal metastases.

Radioiodine scans were performed using previously described methods (*3*), and patients were routinely asked to urinate before scanning. The scans showed the anatomic distribution of residual ^{131}I in the patient after the oral administra-

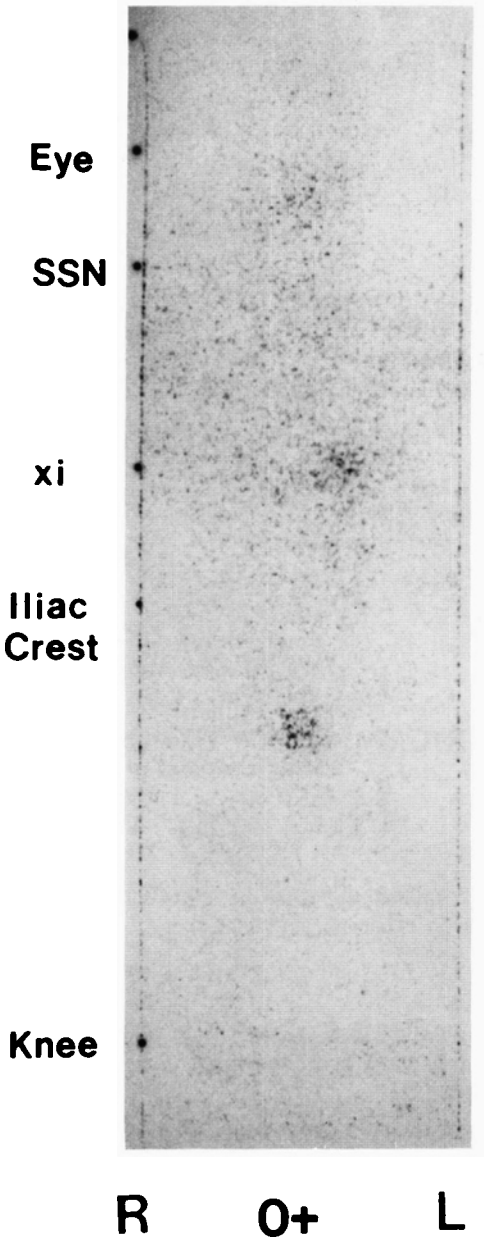

FIG. 1. A 72-hr whole body scan illustrating minimal ^{131}I gut retention (grade 0).

For reprints contact: Harry Maxon, University of Cincinnati, College of Medicine, Mail Location #577, Cincinnati, OH 45267-0577.

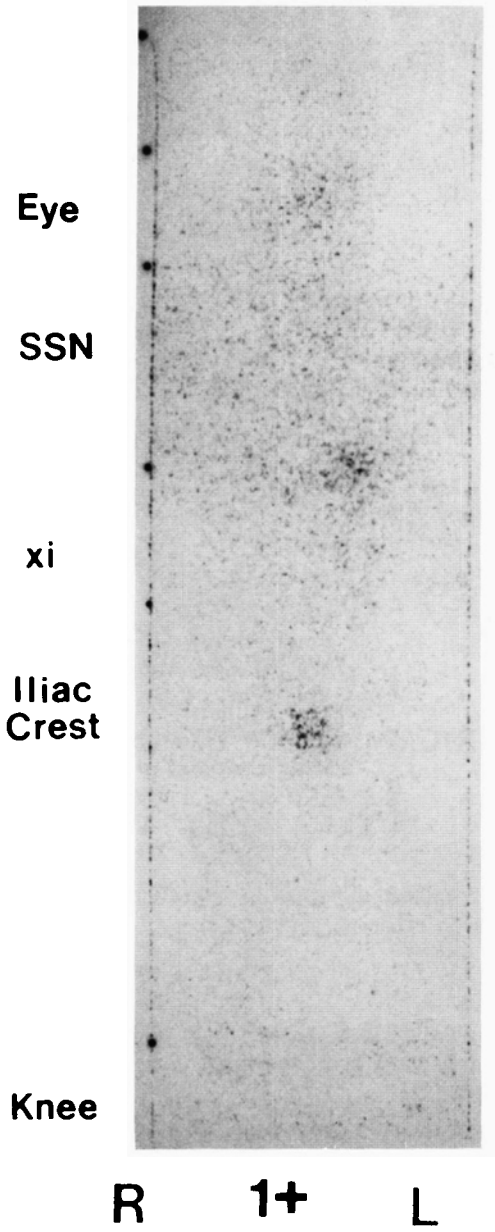

FIG. 2. A 72-hr whole body scan that shows one to two loops of bowel with less intense activity than the bladder (grade 1+).

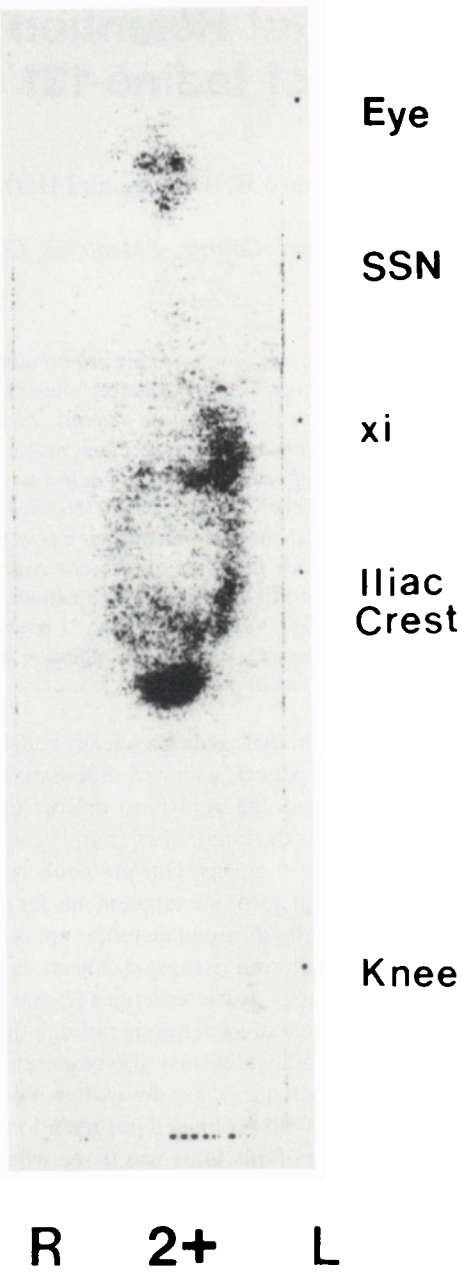

FIG. 3. A 72-hr whole body scan demonstrating activity in more than two loops of bowel that is equal to or more intense than the bladder (grade 2+).

tion of approximately 2 mCi of ^{131}I, at a time when the patient was not taking any thyroid hormone and was following a low iodine diet.

An arbitrary qualitative grading system for gut activity was developed. A grade of 0, 1+, or 2+ was assigned to all studies depending on how much gut activity was visible after 72 hr. Zero meant no to very little activity was detectable on the scan; 1+ meant only one or two loops of bowel showed ^{131}I, which was less intense than activity in the bladder; 2+ meant that either more than two loops showed residual iodine or any single loop concentrated ^{131}I more intensely than the bladder.

Effective whole body half-time determinations were made using sequential external whole body counting techniques (*3*). Two data sets were constructed: one in which the effective whole body half-time data were grouped by gut activity score, and another in which the gut activity scores were grouped according to other scan findings (e.g., presence of metastases, residual thyroid tissue, etc.). The means and standard deviations were determined using a one-way analysis of variance to evaluate the significance of differences in mean effective whole body half-times and in mean gut scores between the various groups.

RESULTS AND DISCUSSION

Examples of 0, 1+, and 2+ gut activity are shown in figures 1, 2, and 3, respectively. There were 23 studies with grade 0 gut activity. Their mean effective whole body half-time was

14.5 ± 3.2 hr. Thirty-nine studies had 1+ gut activity with a mean effective whole body half-time of 16.7 ± 5.2 hr. Thirty-nine studies had 2+ gut activity with a mean effective whole body half-time of 22.5 ± 11.8 hr.

Results of the analysis of variance indicated that the difference between the effective whole body half-times in groups with 0 and 1+ gut uptake was not significant. The differences between groups with 0 and 2+ gut uptake and between those with 1+ and 2+ gut uptake were significant ($p < 0.05$). When the mean gut uptake scores were analyzed by the pattern of radioiodine uptake exclusive of gut (e.g., no residual thyroid tissue or metastases, residual thyroid alone, residual thyroid tissue plus metastases, or metastases alone), there were no significant differences ($p = 0.62$). These analyses suggest that gut activity is an important determinant in the effective whole body half-times of these patients.

In conclusion, the effective whole body half-time is significantly greater when gut uptake is maximal, suggesting that the use of laxatives to decrease gut retention may be useful in shortening the whole body half-time of ^{131}I during radioiodine therapy for thyroid cancer and, therefore, in reducing radiation doses to organs other than the thyroid cancer in question. We have adopted this policy in our laboratory.

ACKNOWLEDGMENTS

We wish to thank the many Nuclear Medicine Technologists in our laboratory who so painstakingly performed the exams, George Alexander and Judy Hughes, for review of the manuscript, and Judith Clark for assistance in manuscript preparation.

REFERENCES

1. Hays MT, Solomon DH. Influence of the gastrointestinal iodide cycle on the early distribution of radioactive iodide in man. *J Clin Invest* 1965; 44:117-127.

2. Goodwin WE. Total accountable radioiodine; combined thyroid uptake and urinary excretion of ^{131}I in study of thyroid function. *Metabolism* 1953;2:238-247.

3. Thomas SR, Maxon HR, Kereiakes JG, et al. Quantitative external counting techniques enabling improved diagnostic and therapeutic decisions in patients with well differentiated thyroid cancer. *Radiology* 1977;122:731-737.