DIAGNOSTIC NUCLEAR MEDICINE

An Analysis of "Ablation of Thyroid Remnants" with I-131 in 511 Patients from 1947–1984: Experience at University of Michigan

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Between January 1947 and June 1983, 511 patients were given treatment doses of I-131 after surgery for thyroid cancer in the presence of I-131 uptake in thyroid remnants. Thirty-four patients were removed from the study leaving 462 patients with a 99% follow-up at 1 or more yr, with a mean follow-up of 15 yr. Of 267 patients with radioiodine uptake confined to the thyroid bed, 233 (87%) had ablation from the first dose of I-131 ranging from 100 to >200 mCi. The higher the percent uptake, the more difficult it was to achieve ablation. In the percentages of successful ablation, there were no significant differences between I-131 doses of: 100–149 mCi, 150–174 mCi, 179–199 mCi, and 200 mCi or more. The 100–149 mCi ablative dose may furnish "adjuvant" therapy for occult metastases.

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The original advocates of the use of 29.9 mCi of I-131 to ablate uptake in normal thyroid-gland remnants from a normal thyroid gland after surgical thyroidectomy, for treatment of well-differentiated thyroid cancer, believed that this dose would ablate the uptake in a normal remnant (*1*). Presumably, therefore, the 39% of their patients whose remnant was not ablated with 29.9 mCi and who required an additional 100-mCi dose later had thyroid cancer in a remnant previously judged "normal."

Two subsequent authors, who followed their patients for longer periods to check on "ablative" effects of 29 mCi of I-131 in normal remnants, found that a second dose was required in 12 out of 13 patients (*2*) and in 16 out of 17 patients (*3*).

One might conclude, therefore, either that 29.9 mCi will not permanently ablate uptake in the majority of "normal" thyroid remnants or that the majority of normal thyroid remnants actually contain well-differentiated thyroid cancer that concentrates I-131 less well than normal thyroid tissues. Wollman found that the most active I-131-concentrating thyroid cancer contained <40% of the I-131 concentration in normal thyroid tissue in the same individual (*4*).

Data are lacking relating the following parameters to the success rate in "ablating" the uptake in the remnant, as followed up to 37 yr: the sex and age of the patient, the dose range for the first "ablating" dose, the number of doses, the total administered dose, or the presence or absence of known metastases before or after treatment. We present our data on 511 patients given treatment doses of I-131 at the University of Michigan Hospitals for the presence of uptake in thyroid remnants, between January 1947 and June 1983, followed for a mean period of 15 yr, (range 0.20 to 37.4 yr).

METHODS

Most of the papillary carcinomas contained follicular elements. No "pure papillary" carcinomas are included. "Follicular" carcinomas contained no appreciable papillary elements.

Our methods of selecting patients for treatment by surgery and I-131 have been described (*5,6*). Routinely,

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the lobe of the thyroid gland containing a suspicious nodule is totally removed, along with the isthmus. A frozen section is done, and if the carcinoma is larger than 1.0 cm, a total extracapsular thyroidectomy is completed. If the frozen section is equivocal and the permanent histologic sections show a cancer, a total thyroidectomy is done within a few days to 6 wk later. Thyroid hormone is withheld for 6 wk after the operation.

Iodine-131 images of the neck and chest (and other areas when indicated) were done 24 hr after 2 mCi of $Na^{131}I$, using a rectilinear scanner in 1954, a photoscanner in 1962, a wide-field gamma camera with high-energy collimator in 1979, or a pinhole collimator in 1982. If significant uptake is found in the region of the thyroidal bed, cervical lymph nodes, lungs, or bones, a therapeutic dose of $Na^{131}I$ is administered. The patient is discharged from the hospital when the total-body content of I-131 has decreased to <30 mCi. The patient is given a maintenance dose of 0.15–0.2 mg of sodium L-thyroxine. After a year, replacement thyroid hormone is discontinued for 6 wk and the following tests are repeated: serum TSH (beginning 1974), T_4 (1971–), CBC, chest radiograph, and scintigrams of the neck and chest (and other areas as indicated). If the image shows no significant uptake, the patient resumes taking thyroid hormone and is asked to return in 2 yr. When the I-131 images are normal 3 yr after treatment, the patient is asked to return at intervals of 5 yr for life.

Radioiodine is never given for ablation of remnants in the thyroidal bed unless significant uptake of I-131 (generally >0.5% of the dose at 24 hr) is demonstrated by the image. All possible thyroid tissue, normal or neoplastic, is excised from the neck short of mutilation, before treatment with I-131. It is frequently impossible to determine whether a patient has distant metastases before the removal of all normal thyroid tissue (*5,6*), which competes effectively with the metastases for uptake of I-131.

Our treatment of well-differentiated thyroid carcinoma has been divided for statistical purposes into ten procedures. In summary, these are:

Initial treatment of thyroid carcinoma.

1. Thyroidectomy done within 1 yr after a suspicious nodule has been detected.
2. Lobectomy with frozen section, and completion of total thyroidectomy within 6 mo.

Evaluation before radiation treatment.

3. Withholding of thyroid hormones for 6 wk before an I-131 image of the neck is made.
4. Scintigram made within 3 mo after the thyroidectomy.

Schedule for I-131 therapy.

5. Treatment with I-131 for residual I-131 uptake.
   (a) Not less than 100 mCi for uptake in the thyroidal bed.
   (b) Not less than 150 mCi for uptake in the cervical nodes.
   (c) Not less than 175 mCi for distant metastases.

Subsequent long-term evaluation plan.

6. T_4 given between follow-up examinations.
7. Reexamination of the patient within 1 yr after treatment with I-131.
8. Reexamination of patient at 3 yr, if the 1-yr scintigram is negative.
9. Reexamination of patient once every 5 yr if patient considered to be "disease-free" after 3 yr.

Retreatment.

10. Treatment again, with more than 150 mCi of I-131, if recurrence of uptake occurs.

Statistics. A logistic response curve was fitted to the data to quantify the relative influence of sex, age, dose, and location of most distant uptake of I-131. In Fig. 1, lung and bone categories were combined for theoretical reasons (*7,8*). A two-sample t-test was performed comparing mean age of males with mean age of females.

Population. The charts of 511 patients treated with I-131 were studied by one author (RR). The pathology slides for all patients were reviewed by one author (RL). The statistical analysis was done by one of the authors (CD).

From the original 511 patients we withdrew four cases with undifferentiated thyroid cancer, two with Hürthle cell cancer, and nine with medullary cancer. Thirty-four patients were excluded from the study because: (a) they were due for a 1 yr follow-up image in 1984 or 1985 (n = 10); (b) their charts or scintigram reports were lost (n = 2); (c) they were past due for follow-up and either did

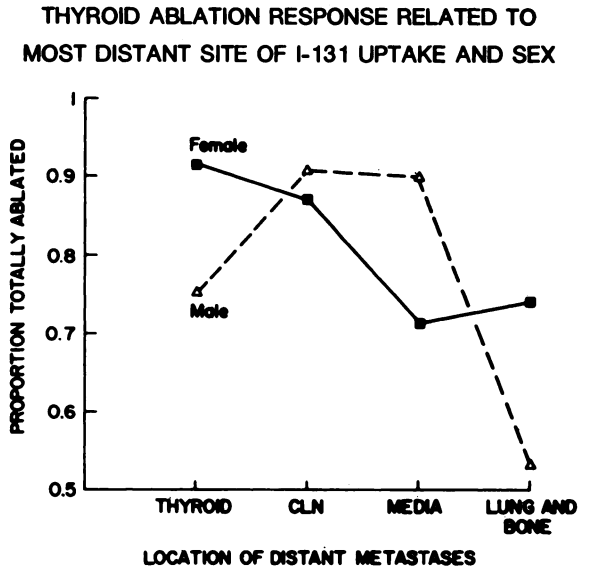

FIG. 1. Illustrating qualitative differences between males and females in total ablation of thyroidal-bed remnants with respect to location of most distant metastases.

not have it done or had it done elsewhere (in either case there were no data available regarding remnant ablation, (n = 18); (d) the patient died from causes other than thyroid cancer, with thyroid cancer present at death before the yearly follow-up study was performed (n = 3); or (e) the patient died from causes other than thyroid cancer, with thyroid cancer not present at death (n = 1). Withdrawal of 49 patients for the foregoing reasons left us with 462 patients with 99% follow-up at 1 or more yr after I-131 treatment, having I-131 uptake in the thyroidal bed; mean follow-up 15 yr (range 0.2 to 37.4). Two hundred and 67 patients had uptake confined to the thyroidal bed. One hundred and twenty-nine patients had their most distant uptake in cervical lymph nodes, 24 in the mediastinum, 22 in the lungs, and 20 in bone. The average percent uptake before the first radioiodine uptake was 6.01% (range 0.02 to 43.9%).

The thyroid remnant was eventually judged to be "ablated" in 95% of those deemed "ablated" when no residual uptake was seen in the thyroidal bed and the measured percent uptake in the neck was <1%. In the remaining 5% of patients, the uptake was found >1% in the absence of visible uptake in the scintigram. The term "partial ablation" was used when so little uptake was seen in the thyroid that it was decided not justifiable to treat the patient again. Partial-ablation uptakes ranged from 0.6–1.7% in the 99% of those so designated. The term "no ablation" was used when the imaged area of uptake was unchanged; the percent uptake then ranged from 1.7–4.5% in 99% of the patients. Ablation status was determined by a posttreatment percent uptake and scintigram performed after 1 yr in most cases, and no earlier than 9 mo, after each treatment dose. A number of senior staff in the nuclear medicine division read the studies for primary determination of whether total or partial ablation occurred from visual impressions of the image with reported percent uptakes as given here.

The remaining 462 patients—with 99% follow-up at 1 or more yr after I-131 treatment and with I-131 uptake in the thyroidal bed—break down demographically as follows: 452 Caucasians, one Asian, three Orientals, five Blacks, and one Pakistani. The sex split was 136 males and 326 females, with sex-specific mean ages at time of diagnosis of 38.6 and 36.2 yr, respectively (p >0.10); the overall mean age was 36.9.

The overall median age was 35 and the age range was from 6–79 yr. For women the median age was 34 yr, with age range 6–79. The median age for men was 36, range 9–79 yr.

RESULTS

Uptake confined to the thyroidal bed (Table 1). Out of 267 patients with radioiodine uptake confined to the thyroidal bed, 233 (87%) had total ablation from the first dose of I-131 ranging from 100 to >100 mCi. Of those 267, 96 patients were treated with 100–149 mCi, with total ablation achieved in 83 instances (86%), 97 were treated with 150–174 mCi, with 83 totally ablated (86%); 58 were treated with 175–199 mCi, with 52 totally ablated (90%); and 16 patients received >200 mCi, with 15 totally ablated (94%). The average preradioiodine treatment percent uptakes in those patients with total ablation, partial ablation, and no ablation were 5.22%, 9.91%, and 13.11%, respectively. Mean uptake is significantly less in the total ablation group than in the no ablation group. There is no significant difference in mean uptakes comparing total ablation with partial ablation or comparing partial ablation with no ablation (multiple comparison p = <0.05).

TABLE 1. PATIENTS WITH RADIOIODINE UPTAKE CONFINED TO THYROIDAL BED

Initial dose (mCi)	Number of pts. treated	No. of pts. with total ablation	% of pts. with total ablation
100–149	96	83	86%
150–174	97	83	86%
175–199	58	52	90%
>200	16	15	94%
Total	267	233	87%

Most-distant uptake in cervical lymph nodes (Table 2). The cervical lymph nodes were reported as the site of most-distant metastases for 129 patients, with total ablation of the thyroidal bed achieved in 114 (88%) cases; 48 patients received doses of 100–149 mCi, with 41 achieving total ablation (85%); 35 patients received 150–174 mCi, with 28 total ablation (80%); 37 received 175–199 mCi, with 36 total ablation (97%); and nine out of nine remnants were ablated when dosages of >200 mCi were administered (100%).

TABLE 2. PATIENTS WITH RADIOIODINE UPTAKE IN THYROIDAL BED, WITH CERVICAL LYMPH NODES AS MOST DISTANT SITE OF METASTASES

Initial dose (mCi)	Number of pts. treated	No. of pts. with total ablation	% of pts. with total ablation
100–149	48	41	85%
150–174	35	28	80%
175–199	37	36	97%
>200	9	9	100%
Total	129	114	88%

TABLE 3. PATIENTS WITH RADIOIODINE UPTAKE IN THYROIDAL BED, WITH MEDIASTINUM AS MOST DISTANT SITE OF METASTASES

Initial dose (mCi)	Number of pts. treated	No. of pts. with total ablation	% of pts. with total ablation
100–149	6	5	83%
150–174	5	3	60%
175–199	9	8	89%
>200	4	3	75%
Total	24	19	79%

TABLE 4. PATIENTS WITH RADIOIODINE UPTAKE IN THYROIDAL BED, WITH LUNG AS REGION OF MOST DISTANT METASTASES

Initial dose (mCi)	Number of pts. treated	No. of pts. with total ablation	% of pts. with total ablation
100–149	9	7	78%
150–174	5	3	60%
175–199	5	1	20%
>200	3	2	67%
Total	22	13	59%

Most-distant uptake in the mediastinal lymph nodes (Table 3). Twenty-four patients had most-distant metastatic uptake in the mediastinum, with total ablation in the thyroidal bed in 19 cases (79%). The mediastinal nodes are an extension of the cervical lymph nodes outside of the neck region, and thus are considered the next most distant type of metastasis. Six patients received dosages of 100–149 mCi, and five were totally ablated (83%); nine received 175–199 mCi, with eight totally ablated (89%); four received >200 mCi, and three were totally ablated (75%).

Most-distant uptake in the lungs (Table 4). Thirteen out of the 22 cases, with uptake in the lung as their most distant region of metastatic activity, had total ablation in the thyroidal bed (59%). Nine patients received 100–149 mCi, and seven were totally ablated (78%); five received 150–174 mCi, with three totally ablated (60%); five received 175–199 mCi, with one totally ablated (20%); three received >200 mCi, with two totally ablated (67%).

Most-distant uptake in the bone (Table 5). Bone was reported to be the most distant region of metastatic activity in 20 cases, and 15 had total ablation of the thyroidal bed (75%). Three patients received 100–149 mCi and all three were totally ablated (100%); five received 150–174 mCi, and total ablation occurred in three (60%); seven received 175–199 mCi, with five totally ablated (71%); five were given dosages of >200 mCi, with four totally ablated (80%).

Relationship of "ablation" to number of treatment doses. Four hundred and twenty-eight patients were treated with one dose of I-131 (92%), 25 patients with two doses, eight with three doses, and one patient with six doses.

The 25 patients treated with two doses, ranging from 100 to >200 mCi, had a remnant in the thyroidal bed with radioiodine uptakes ranging from 0.8–4.0%. They were thought to benefit from an additional treatment dose of I-131. In 19 instances total ablation (76%) did occur after the addition dose(s). Eight patients were treated with three doses of I-131 because of relatively high uptakes (2.3–4.5%) persisting in the thyroidal bed. However, only three patients achieved total ablation (38%). The single patient treated with six doses achieved only partial ablation after each treatment dose: two of >200 mCi and four of 150–174 mCi. This patient was a 67-yr-old white female with the lung as the region of the most-distant metastases.

The pattern of response (total thyroidal ablation) to location of most-distant metastases differed significantly for men and women (Fig. 1) ($p = 0.018$).

For women, the more distant the metastasis the more difficult it was to ablate the thyroidal remnant ($p = 0.026$). Dose ($p = 0.1471$) and age ($p = 0.7074$) had no significant impact on the ability to ablate totally the remnant in women.

For men, the ability to ablate the remnant increased as the most distant metastases extended to the cervical lymph nodes and mediastinum, it then dropped off precipitously for those with bone and lung metastases ($p = 0.095$). In contrast to women, age in men had the most significant impact on the ability to achieve total ablation ($p = 0.003$), which decreased with increasing age. Location of most distant metastasis had a marginally in-

TABLE 5. PATIENTS WITH RADIOIODINE UPTAKE IN THYROIDAL BED, WITH BONE AS REGION OF MOST DISTANT METASTASES

Initial dose (mCi)	Number of pts. treated	No. of pts. with total ablation	% of pts. with total ablation
100–149	3	3	100%
150–174	5	3	60%
175–199	7	5	71%
>200	5	4	80%
Total	20	15	75%

significant effect compared with age ($p = 0.095$) and dose was insignificant ($p = 0.52$).

DISCUSSION

This study of 462 patients with well-differentiated thyroid cancer, treated with $Na^{131}I$ after surgery had left demonstrable I-131 uptake in the thyroid bed, and 99% of whom were followed for more than a year (mean 15 yr, range 0.2–37.4 yr), is unique. The unique factors are: the number of patients, the duration of follow-up, the relation of size and number of doses to "ablation" of uptake in the thyroidal remnant, and the considerations of age and sex of patient and of location of most distant metastases concentrating radioiodine.

Out of 267 patients with radioiodine uptake confined to the thyroidal bed, 233 (87%) achieved ablation from the first dose of I-131, consisting of 100 or more mCi. It is noteworthy that total ablation was similarly achieved (88%) in the 129 patients with cervical lymph nodes being reported as the site of most distant metastases. This incidence of total ablation greatly exceeds those of all reports using doses ≥ 30 mCi (*1*,*9*–*12*).

The higher the percent uptake the more difficult it was to achieve ablation. In a review of the published literature, Sisson (*10*) also rightly concluded that the larger the residual gland, the more likely was persistence of function after I-131 therapy. Our average % uptake (6.0%) did not differ significantly from the 7.2% average uptake of Snyder et al. (*9*) who, with an average of 30 mCi, achieved a 61% ablation at 3 mo to 1 yr after treatment (*9*). DeGroot and Reilly (*11*) destroyed thyroid remnants in 83% of 18 individuals reexamined at 3–12 mo, but their pretreatment uptakes are the lowest recorded in the literature, ranging from 0.2–6.0% (average not given). Ramaciotto et al. (*12*) ablated uptake in eight out of 20 patients (40%) followed at 6-mo intervals after treatment until "negative," with a 0.3% uptake (range 0 to 0.87%, median 0.26%). They also eradicated normal remnants more often when the tracer uptake was <5%. McCowan (*1*) reported successful ablation in 21 of 36 patients (58%) receiving 30 mCi. Thus the average reported success rate with a 30-mCi dose is ~60% with follow-up at 3-mo intervals up to 5 yr, as compared with our success rate of 87% after one dose of 100–149 mCi and a mean follow-up of 15 yr.

There was no significant difference in % ablated between I-131 doses of 100–149 mCi, 150–174 mCi, 175–199 mCi, and 200 mCi or more. The senior author started in 1947 with a 5-mCi "ablation" dose. He increased this dose with each patient until the success rate leveled off with 100–149 mCi, rather than repeatedly taking the patient off thyroid hormone for 6 wk and giving repeated and larger "ablation" doses.

In women, the more distant the metastases were from the thyroid gland, the more difficult it was to destroy the thyroidal remnant.

In general, the larger the primary cancer the higher the incidence of metastases. Increasing age, particularly past 50, is also associated with a higher incidence of distant metastases (*5*).

In men, the ability to ablate the remnant increased as the most-distant metastases extended to the cervical lymph nodes and mediastinum; it then dropped precipitously for those with lung and bone metastases. In contrast to women, in men age had the most significant impact on the ability to achieve total ablation, decreasing with increasing age. Location of most distant metastases had a marginally insignificant effect compared with age, and dose was insignificant.

There is no question today that we should "ablate" normal thyroid tissue as a part of the treatment of well-differentiated thyroid cancer. If the postthyroidectomy remnant is large, it may, through synthesis of thyroid hormone, inhibit secretion of thyrotropin. Conditions will then not be optimal for the stimulation of thyroid metastases, which usually require high levels of thyrotropin to be detected and treated efficiently. Therefore, in patients who harbor substantial amounts of normal tissue and exhibit little or no elevation of remnant thyrotropin concentration, reduction of remnant by I-131 treatment will permit a more sensitive search for metastatic disease (*10*).

We found (*5*) that 41 patients (40% of 103 with distant metastases) had distant metastases first detected at an average of 7.44 yr (range 1–25 yr) after surgical establishment of the diagnosis of thyroid cancer. The majority of these patients had had inadequate surgery and no (or inadequate) radioiodine therapy. We also reviewed our experience and that of others (*5*) showing that cervical lymphnodal, pulmonary, and osseous metastases can be detected by I-131 images when the metastases had not yet been palpable or visible by radiography, and were therefore "occult" by definition.

It is also true, however, that complete destruction (i.e., ablation) of all normal tissue is not required to achieve profound hypothyroidism and high thyrotropin levels. Furthermore, there is no proof at present that ablation of small remnants lowers the rate of recurrence of cancer (*10*).

The senior author prefers 100 mCi or more, however, when there is reason to destroy the uptake in the remnant. However, because his success rate is higher than when he and others use 30 mCi or less; only one dose is required in 87% of patients, and not one of our 103 patients with distant metastases—treated with much larger total doses and followed for up to 35 yr—has died with or from leukemia, nor was there an increased incidence of second cancers (*5*). We also found no decreased fertility or abnormal birth history in 43 children treated with a mean dose of 196 mCi with a maximum total dose of 691 mCi, followed for a mean period of 18.7 yr (range 14–25) (*13*).

We also reported in 1970 (*14*) that when I-131 therapy was stopped short of near zero of I-131 uptake in the thyroidal remnant and metastases, the death rate was significantly higher than when I-131 achieved ablation. Two hundred and 29 patients (87.0%) had ablation after I-131 treatment. In this group the death rate was only 3.1%. Thirty-four patients (12.9%) had persistent uptake after cessation of treatment with sodium [I-131]iodide. The death rate (58.8% in the latter group) was significantly higher ($p < 0.005$) than that in the group where ablation of uptake was achieved.

Since we can ablate uptake in "occult" metastases to lymph nodes, lung, or (more rarely) bone, the possibility should be considered that the 100 to 149 mCi ablation dose—in addition to achieving "ablation of a normal remnant" and making possible a more sensitive search for metastases—is actually treating occult metastases that are not detected by scintigram. Further evidence for this concept has been furnished by Nemec et al. (*15*). In 206 patients with differentiated thyroid cancer, the distributions of iodine-131 were compared after diagnostic (200–500 μCi) and thyroablative (~100 mCi) doses. In the diagnostic images, only normal thyroid tissue could be seen, whereas in one fourth of the patients the therapeutic images showed tumor tissue as well, usually in lymph node metastases. In patients in whom all tumor was believed to have been removed by surgery alone, a "preventive" I-131 ablation was used, and in 16 of these 97 patients tumor was revealed in the therapeutic image.

"Adjuvant" chemotherapy has been accepted to treat occult metastases in breast cancer patients who after surgery have no demonstrable metastases. It is a well-accepted fact (*16*,*17*) that adjuvant radiotherapy, using relatively small rad doses, to clinically uninvolved lymph nodes in carcinoma of the breast, head and neck, testicle, prostate, and bladder is effective in controlling potential disease in these nodes.

It is the senior author's opinion that the 100 to 149 mCi ablating dose also constitutes "adjuvant" radiation therapy for occult metastases not detected with I-131 imaging, particularly when the pretreatment I-131 uptake is <4%. It will take time and collaboration of many medical centers to prove this opinion. We are currently accumulating these data.

In the meantime, our data and those of others seem to agree that the larger the remnant is, as reflected by uptakes more than 5%, the more difficult it is to achieve ablation with any dose, or repeated doses. Surgeons must aid the remnant ablation and the subsequent, more intensive search for metastases with I-131, with the best possible total thyroidectomy.

Lastly, it is important to try to achieve ablation with one dose of I-131, because there is increasing evidence that a suboptimal radiation dose decreases the biologic half-life (and effective half-life) of subsequent radiation doses, thus decreasing the chance of curing the patient (*18*,*19*).

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The Education and Research Foundation of the Society of Nuclear Medicine Fellowship/Pilot Research Grant

The Education and Research Foundation of the Society of Nuclear Medicine welcomes applications for Student Fellowships and Pilot Research grants. These awards are made possible through donations from SNM members as well as from various commercial firms whose products are used in the practice of Nuclear Medicine. Applications received prior to December 15 of any year will be evaluated by the ERF Board on a competitive basis. Awards will be announced on or about February 15 of the following year.

STUDENT FELLOWSHIP GRANTS

These awards are designed to stimulate interest among students in the United States and Canada in the field of Nuclear Medicine. The awards are intended to provide an opportunity to spend elective quarters and/or summers in active departments working and associating with experts in the field. Maximum grant: $1,500. Letters of application should be submitted in duplicate and should contain the following: applicant's name, address, birth date, period for which support is requested, name and institution of sponsor, previous education, previous research, and brief summary of the proposed project, including an appropriate bibliography. Application forms should be requested from the office of the E&R Foundation. Additional applications may be submitted prior to May 1, 1985.

PILOT RESEARCH GRANTS

The goal of this research support is to provide money to young scientists working in Nuclear Medicine who desire support for a research project. Priority will be given to those proposals that are of a pilot nature in either clinical or basic research. The grants are not intended to support salaries, purchase major equipment, or for travel, but are designed to provide essential materials so that innovative ideas can be quickly tested. Maximum grant:$3,000. Additional applications may be submitted prior to May 1, 1985.

SPECIAL ANNOUNCEMENT: FIFTH TETALMAN MEMORIAL AWARD

A fund has been established in the ERF by friends of Marc Tetalman, M.D., who was a tragic homicide victim while attending the SNM meeting in Atlanta in June 1979. This fund will permit an award of $3,000 to be made in June, 1985 to a young investigator (35 years of age or younger) who is pursuing a career in Nuclear Medicine. This award is to be repeated annually. It is possible that additional contributions to our fund will permit the stipend to be increased in future years. Applicants should submit prior to March 1, 1985 a curriculum vitae together with data supporting current research efforts.

All letters and applications should be addressed to:

Walter Wolf, Ph.D.
President, E&R Foundation
c/o Society of Nuclear Medicine
475 Park Avenue South
New York, NY 10016

Erratum

In the article entitled "Patterns of Skeletal Scintigraphy and Their Relationship to Plasma and Urinary Levels in Systematic Mastocytosis," Vol. 25, August 1984, pp. 859-864 a line of type was dropped due to a printer's error.
The first line, first full paragraph in the second column should read: Laboratory tests of bone disease fail to demonstrate skeletal disease in systematic mastocytosis.