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RADIATION EFFECTS AND MARROW-CRAFT STUDIES

Dosimetry (R. L. Hayes)

Dose to the intestinal tract. A tracer study of the dose received by the human intestinal tract as a result of the oral ingestion of radioactivity has been started. This study was prompted by the results obtained in a previous study of intestinal-tract dose in animals. The extreme variations obtained in the animal studies raised the question of the validity of assuming an "average behavior" in intestinal-dose calculations for maximum permissible concentrations (MPC) of various radioisotopes. The study with human beings is an attempt to find the limits of normal variation among individuals in rates of passage of "nonabsorbed" radioisotopes through the gastrointestinal tract. Present studies are being carried out with tracer doses of one such isotope, lanthanum-140. Most of the subjects so far studied have been elderly, and data from young subjects will be required before any definite conclusions can be reached. Nevertheless, the data so far collected indicate that, for elderly persons, the now recommended MPC for "nonabsorbed" radioisotopes (Handbook 69) is too high by as much as a factor of 10.

When suitable detection equipment is available we plan to expand this tracer study to include measurements of the urinary excretion and body retention of partially absorbed as well as "nonabsorbed" orally ingested isotopes. Such an extension of the present study is of fundamental interest, since most maximum permissible concentrations (Handbook 69) are now based on animal distribution data rather than on data from man.

Distribution of internal radiation dose. A knowledge of distribution is a valuable aid in the planning and evaluation of total-body irradiation therapy. In this type of therapy the absorbed dose (energy absorbed per unit weight) can also be of considerable importance. Using phantom techniques, we have made depth-dose and absorbed-dose measurements for the broad-beam cobalt-60 total-body irradiator. Measurements were made in compartmentalized phantoms designed to simulate an adult, an adolescent, and a child. The study provides information on the homogeneity of radiation dose and the total absorbed energy as a function of body size. As a further aid in defining total-body irradiation dosimetry, glass dosimeter measurements

of skin dose have been made on patients given total-body irradiation therapy. Such measurements serve as an indicator of the uniformity of the dose given.

Clinical Studies. (G. A. Andrews, B. W. Sitterson, A. L. Kretchmar, F. Comas, and D. A. Ross).

Studies on total-body irradiation in acute leukemia were continued and an assessment was made of the results of the first series of cases treated. These include eleven patients with acute or subacute leukemia. Of these patients, three were adults, one was an adolescent, and the rest were children. All except one had had extensive previous drug therapy. All had active leukemia at the time of treatment and some were in critical condition. The general plan of treatment was to stop antimetabolites, to continue steroid therapy if it was already under way, and to give a large single dose of total-body irradiation. Doses varied from about 200 r to more than 900 r. Bone marrow was obtained from homologous donors cross matched for the usual major blood types. The marrow was obtained by aspiration from the posterior iliac spine, iliac crests, and sometimes from other areas. Donors were given a general anesthetic. The marrow obtained appeared grossly cellular and smears indicated a high percentage of marrow elements as compared to peripheral leukocytes. Cell counts are believed to be erroneously low, chiefly because of clumping, and were highly variable. In the most favorable aspirations, several billion cells were obtained. The volume of marrow aspirate was generally from about 100 to 300 ml. Clumps were not broken up except for passing the marrow through a needle somewhat smaller than the one used for aspiration. Marrow was administered intravenously shortly after it was obtained. In most of the patients about four separate donors were used -- one on each day during the first five days or so after exposure. In one patient, in an effort to duplicate the technique of Mathé, a single donor was selected by compatibility of major and minor red cell types. No untoward results were attributed to the marrow administration. Three patients received radiation without marrow administration. Several types of results were seen and can be summarized in the following table:

1. Incomplete suppression of leukemic process:

Temporary suppression, then exacerbation with
proliferative phase and death -----2

Partial sustained suppression-----3 (2 received
no marrow)

2. Apparent complete or nearly complete suppression of
leukemic process:

Death in aplastic phase-----2

Remission-----3 (1 received
no marrow)

3. Early death:-----2

Twelve treatments are reported on eleven patients. One patient was treated twice with an interval of about six months between treatments.

In general, the leukemic cells proved to be strikingly sensitive to radiation and there was a massive destruction of these cells with a profound fall in peripheral white count and marrow cellularity in most cases. This destruction occurred chiefly within the first four or five days, and thus the patients with leukemia reached a phase of marrow aplasia much earlier than normal persons exposed to the same doses. Still, some of the leukemia cases showed greater resistance of the leukemic cells and never reached complete aplasia. This resistance was seen even in quite high doses and could not be correlated clearly with morphologic features of the leukemia. It appeared, however, that the older patients, with a less primitive type of leukemic cell, were more likely to show resistance. Further data would be needed to confirm this. An example of a very transient suppression of the leukemia, followed shortly by a proliferative leukemic phase, is shown in Figure 1.

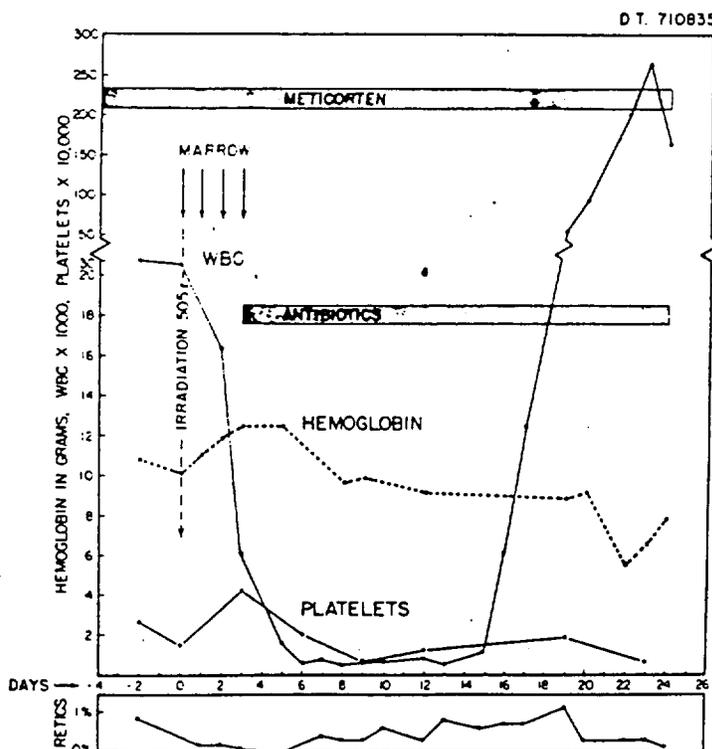


Fig. 1. Chart on patient No. 3. Only transient suppression of leukemic process by 505 r of irradiation.

Those who died with either exacerbation of leukemia or in an aplastic phase survived from periods of 17 to 25 days. It was sometimes impossible to determine the relative importance of leukemia and radiation injury as causes of death. Two very early deaths both occurred on the first posttreatment day. Deaths were due to hemorrhage and infection, with diffuse pulmonary bleeding prominent, particularly in one patient who died in an aplastic phase.

We have arrived at some conclusions about "ablation" of the bone marrow. It is not unusual for patients treated with big doses of radiation or nitrogen mustard to reach a state in which the marrow is apparently almost completely acellular. When patients die in this phase, either from hemorrhage or infection, the tendency is to say that the marrow was "completely ablated." However, the morphologic observation has great limitations and one cannot say from the appearance of the marrow that it has lost capabilities for either normal regeneration or further leukemic proliferation.

Evidence for success of the marrow graft was very slight. In one patient who had a good remission, a series of morphologic changes in the bone marrow might have been interpreted as indicating a very transient proliferation of the graft about a week after it was given, but this interpretation cannot be strongly supported.

Studies of red cell subtypes in donors and recipients were complicated by the fact that most of the patients had received transfusions before treatment and that difficulties were experienced in attempting quantitative identification of mixed cell populations. In general the red cell subtyping studies offered little support for a true marrow graft.

One of the most striking results of this study was the demonstration that large doses of total-body irradiation alone can produce remissions in leukemia. Previous literature on this subject has been somewhat conflicting but the consensus had been that irradiation was not beneficial in acute leukemia except for localized lesions. The most striking case in the series was a patient who had a very complete, although transient, remission after 360 r of total-body irradiation. In this patient (See Fig. 2) there is no possibility that drug therapy was responsible for the benefit, and the leukemia was in a florid state at the time of treatment.

The most favorable results in this series were obtained, in general, with the lower radiation doses. No prolonged survivals were seen in patients treated with more than 600 r.

ACUTE LEUKEMIA (S.W. NO 910989) TREATED WITH WHOLE BODY IRRADIATION
(NO MARROW, NO ANTIMETABOLITES, NO STEROIDS)

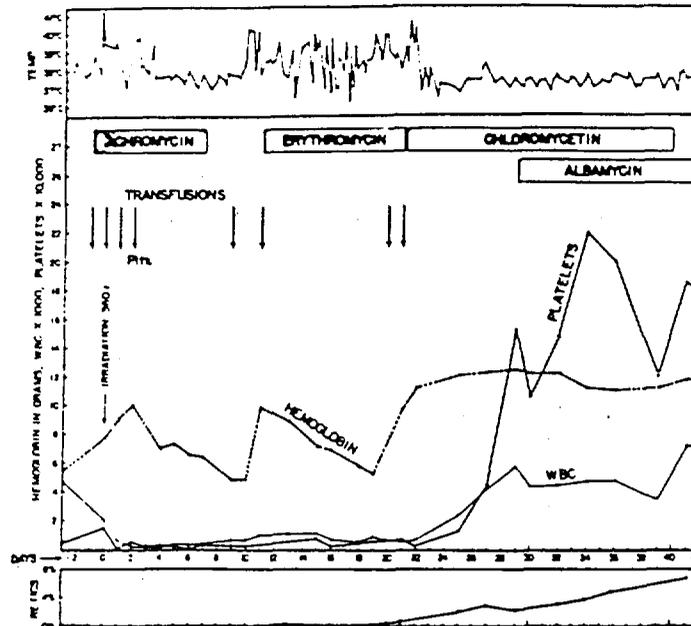


Fig. 2. Chart on patient No. 10. Remission from irradiation without marrow.

Another pertinent observation was that the regenerative phase started early in the three patients who had complete remissions. This is seen when the platelet curves, the white cell curves, and the leukocyte curves are compared with the Y-12 series of normal persons accidentally irradiated. (Figs. 3 and 4). It appears that recovery begins almost two weeks earlier in the irradiated leukemia patients than in the normal patients exposed at about the same dose. This difference in time sequence seems to involve a significant biological factor that may be of importance. Possible explanations for the earlier regeneration in the favorable leukemics can be listed as follows:

- 1) The type of radiation was different. The Y-12 accident included a neutron component.
- 2) Ages were different. The leukemics were children.
- 3) Marrow was cleared out faster in the leukemics, and this allowed space for regeneration.
- 4) Toxic products from radiation damage inhibit hematopoiesis. In the leukemics this destructive phase is completed earlier.
- 5) Severe pancytopenia must exist before stimulus for regeneration is activated.
- 6) In the leukemic, the cells that serve as precursors for eventual normal hematopoiesis are, for some reason associated with leukemia, in a state allowing more rapid proliferation once conditions are favorable.

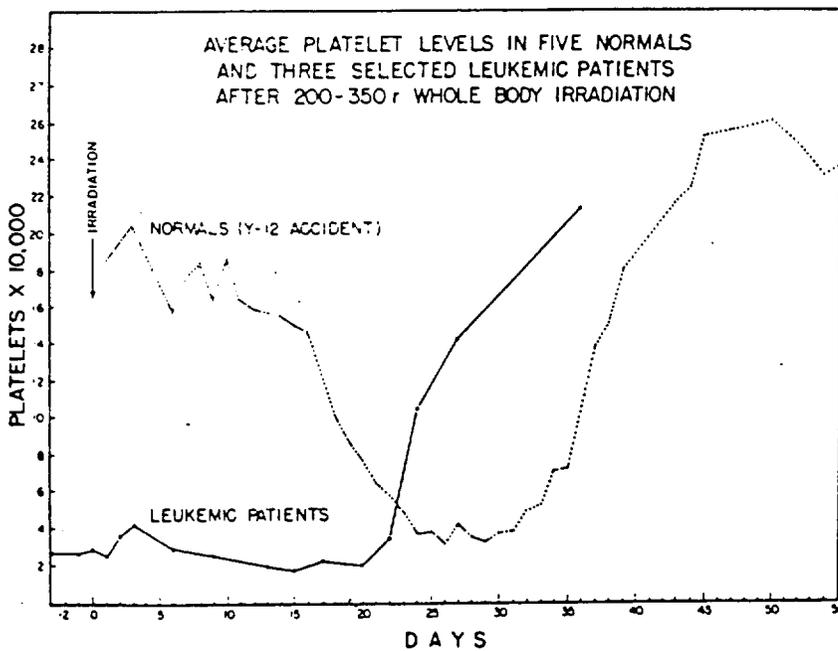
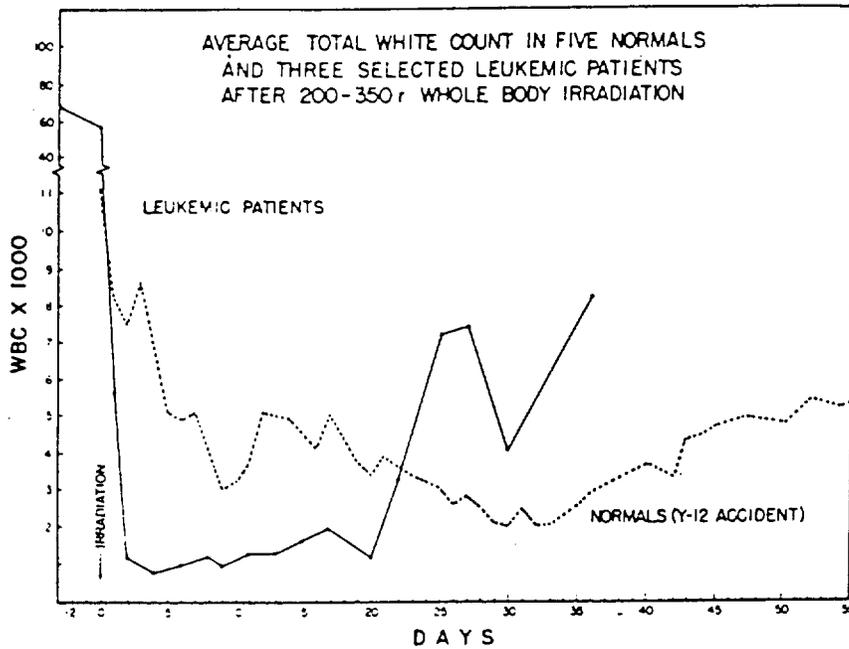


Fig. 3 and Fig. 4. Average white blood cell and platelet counts in 3 patients who developed remissions in leukemia after radiation (cases No. 1, 2, 10) compared with 5 normals accidentally irradiated in Y-12 incident with doses of 236 to 365 rads.

These two facts, (1) that irradiation alone can produce remissions and (2) that these remissions begin earlier than in normal persons treated at the same dose, are likely to lead to an erroneous belief that a marrow graft has been obtained when the results seen are due to the radiation treatment alone.

A summary of our current impressions of the treatment of leukemia by irradiation and marrow grafting is as follows:

- 1) Total-body irradiation alone produces remissions in some cases of acute leukemia.
- 2) Remissions cannot be accepted as proof of marrow transplantation, either temporary or permanent.
- 3) In most cases of acute leukemia, the leukemic cells appear to be radiosensitive, and there is profound cell destruction after a single large dose of radiation. This cell destruction may contribute to early deaths. Even when it appears that all the cells have been destroyed, exacerbation of the leukemia occurs later.
- 4) The term "marrow ablation" should be used very carefully. Many patients who survive a single dose of radiation or marrow-damaging drug have gone through a phase of apparent marrow ablation.
- 5) In the leukemic patient who responds favorably to total-body irradiation, the phase of marrow recovery begins about two weeks earlier than in normal patients exposed to the same radiation dose. An explanation for this fact would probably have general importance.

Pathologic Changes in Total-Body Irradiation (Bill M. Nelson)

Ten patients treated for leukemia with total-body irradiation (in the range of 200 to 800 r) have now come to autopsy at ORINS. Microscopic studies have been completed on all but the most recent one. With the possible exceptions of the bone marrow, the histologic observations so far fail to demonstrate responses in various tissues that would differ from the expected effects of the same doses of radiation given locally rather than to the entire body. The marrow in two patients dying 17 and 18 days (after doses of 790 and 500 r respectively) was quite aplastic, without evidence of residual leukemia. No morphologic (or clinical) evidence of successful marrow transplantation was found in any of the six patients given intravenous infusions of fresh marrow from homologous donors. The six patients surviving more than three weeks (24 days to 219 days) all died with leukemia and with little, if any, apparent residual effect of the radiation in the sections of marrow. All ten deaths could be attributed to hemorrhage or infection. At least five deaths can be attributed to leukemia, since death occurred after recovery from the irradiation. The two early deaths (within two days after irradiation)

may also be credited to leukemia, although radiation effects were detected at autopsy. A patient with granulocytic leukemia, dying in the fourth week after radiation, was found to have fibrosis of the marrow. This fibrosis seems to have been present before treatment and no fibrosis was seen in the other patients.

Further analysis of the autopsy observations is needed to investigate possible distinguishable features of the deaths attributable to radiation. In particular, the frequent occurrence of severe pulmonary hemorrhage is of interest. The lack of characteristic gastrointestinal lesions is noteworthy and suggests the possible use of higher doses.

Follow-up on Y-12 Accident Patients (B. W. Sitterson, A. L. Kretchmar, and G. A. Andrews)

In March 1959, about nine months after exposure, the five high-dose patients from the Y-12 radiation accident were admitted to the hospital for three days to obtain studies under conditions of diet and physical activity comparable to those under which earlier studies had been done. The three low-dose patients were seen as outpatients at this time. All eight patients were seen again as outpatients in August 1959.

Subjectively, they still reported varying degrees of undue fatigue, weakness and stiffness in muscles, popping noises in joints, insomnia, irritability, and nervousness. Some of these difficulties were most prominent in low-dose patients, with no apparent correlation between the dose of radiation and the severity of these symptoms. In general they seemed to have improved slowly and progressively. Physical examinations showed no significant abnormalities and no objective findings to account for these symptoms.

One patient (Patient D) had a recurrence and increase in severity of the vague abdominal pain that was noted during the period of hospital care immediately after the accident. Upper and lower gastrointestinal X-ray studies showed no abnormality. Treatment with antispasmodic and antacid medications resulted in noticeable improvement. This patient also developed symptoms of memory lapses and disturbance in balance when walking downhill, but not on level ground or going uphill. A consultant neurosurgeon examined him and found no significant abnormal neurological observations. The consultant's opinion was that the symptoms were functional.

Hematological studies have shown that the hemoglobin, hematocrit, white blood cell count, differential count, and platelet count of all the patients are within normal limits.

The results of special biochemical studies are reported in a separate section of this report.

Ophthalmological and slit-lamp examinations have been done on all the patients by a consultant ophthalmologist at approximately six-month intervals. Sperm counts have also been obtained at periodic intervals, with participation on a voluntary basis.

Comparison of Y-12 Patients with Yugoslavian Accident Victims (G. A. Andrews)

In connection with the total-body irradiation program and the interest in marrow transplants, we at the Medical Division are comparing the Y-12 accident victims, the Yugoslavian accident victims, and the leukemic patients given total-body irradiation. It is generally agreed that the physical data on the Yugoslav victims are not adequate to allow a clear estimate of the dose of radiation. Whether or not the apparently successful bone-marrow transplant was life saving in these patients is a question that is difficult to answer in the absence of clearly established dosage. Efforts are being made here to compare the hematologic response of the Y-12 and Yugoslav groups of patients on the assumption that the blood changes and clinical observations may help to indicate relative dosages.

In a dosage comparison based on hematologic effects, it is clear that there are some qualitative differences between the two groups of patients. The Yugoslav group showed much greater granulocyte and lymphocyte depression, but the platelet depression, except in the patient who died, was generally no more severe than in the Y-12 group. Biological and clinical information indicates with considerable certainty that the one Yugoslav victim who died received a much higher dose than any in the Y-12 group. At the other extreme the one Yugoslav who recovered without bone marrow probably received a dose lower than the average of the five in the Y-12 group. The most critical comparison is between the four Yugoslavs who received bone marrow and recovered and the five in the Y-12 group. For the purposes of such comparison, the blood data were averaged for each group and a comparison was made for the averages. An analysis of these charts indicates the following:

Reticulocytes: Neither group had complete suppression of reticulocytes. The Yugoslavs were somewhat lower on the fifth day than the Y-12 group. Subsequently an increase occurred and the two groups remained almost identical, with a secondary depression between the twenty-fifth and thirty-first days. After that a striking reticulocytosis was seen, considerably more profound in the Yugoslav than in the Y-12 group, with both groups reaching their peak level at about 47 days after exposure.

Lymphocytes: The early lymphopenia was much more profound in the Yugoslav group and lymphocyte levels remained distinctly lower throughout the first two months. Both groups showed some increase in lymphocytes at the fortieth day, and then another slight slump during the subsequent three weeks.

Platelets: The initial platelet levels were somewhat lower in the Yugoslav group, but at about the twenty-second day the curves become identical. After the twenty-seventh day, however, recovery in the Yugoslavs took place a little more rapidly than in the Y-12 group. On the other hand, later in the recovery phase between the fortieth and fiftieth days, the Y-12 levels were higher than those in the Yugoslav group. Platelets were counted by the Brecher and Cronkite method in the Y-12 group and by the Feissly method in the Yugoslav group.

Granulocytes: Granulocytes were much more profoundly depressed in the Yugoslav group and reached much lower levels between the twenty-sixth and thirty-fifth days. Recovery seemed to occur at about the same time in the two groups.

In attempting to assess this information in terms of evidence relating to the success or failure of the marrow graft in the Yugoslav patients, several serious problems are presented: 1) The dose of radiation is poorly established for the Yugoslavs. 2) Comparison of clinical and laboratory data is handicapped by the differences in methods used and by the fact that the Yugoslavs were given many types of medication and treatment. 3) The bone marrow was given to the Yugoslavs rather late, shortly before spontaneous recovery might have been expected, if it is assumed that the Yugoslavs followed the same pattern as the Y-12 group.

In spite of all these difficulties we would like to present the following tentative conclusions:

1. The four intermediate-dose Yugoslav victims probably received a higher radiation dose than the five Y-12 victims. This is based upon clinical data (early and profound epilation, eventual cataracts) as well as upon hematologic comparisons.
2. The recovery in the Yugoslav group occurred in about the same time as in the Y-12 group. If the radiation dose was higher for the Yugoslavs and recovery is normally later with a higher dose, then it might be argued that the marrow treatment had hastened recovery somewhat. In view of the uncertainties involved, it appears that the only strong evidence for function of the graft is in the red-cell identification studies reported by the French.

Attempted Autografts with Large Doses of Nitrogen Mustard. (A. L. Kretchmar, B. W. Sitterson and G. A. Andrews)

A clinical study, with a carefully controlled series of patients, has been completed in which autologous bone marrow grafts were attempted after a large single dose of nitrogen mustard had been given.

Patients in this series were selected without any knowledge of whether they would be given marrow or serve as controls. The selection was made on clinical grounds and, as far as possible, patients with metastases to bone marrow were excluded. After the decision to include a patient in the series, assignment to the "control" or "graft" group was made on the basis of a table of random numbers. The patients in the series were numbered in consecutive sequence and those numbered 2, 6, 7, and 10 were given an infusion of autologous bone marrow. One other patient who was given autologous marrow (and who had been treated before this method of selection of control subjects was instituted) was also included in the analysis of results.

One milligram per kilogram of nitrogen mustard was given to all patients. This dose was administered intravenously in 20 to 30 ml of saline over an interval of 10 to 15 minutes, including the time required for dissolving the nitrogen mustard and manipulating the infusion apparatus. This was done while the patient was still under general anesthesia and after bone marrow had been aspirated. The aspiration was for diagnostic purposes in the control group, but in the autograft group enough additional material was aspirated to obtain a total marrow volume of 140 to 150 ml. An interval of 4 to 6 hours separated the time of administration of mustard from the infusion of the marrow. During this interval the marrow suspension (diluted with 1/3 volume of citrate-salt solution) was kept in a plastic bag at room temperature. (In the first two trials the marrow was kept at refrigerator temperature until it was warmed to room temperature and immediately infused.)

There was no significant difference in the degree of depression of white blood cells and platelets, of the time required for beginning of marrow regeneration, and of the rate of regeneration between the control subjects and the group that were given autologous marrow transfusions. Regeneration of platelets was a little more rapid in one of the autologous-marrow group. There is no evidence that the infusion of marrow had any effect on the clinical course or on the degree of marrow depression that was induced by this large dose of mustard. We conclude that spontaneous regeneration of bone-marrow function after 1 mg/kilo of nitrogen mustard begins in the third week after the administration of the drug and is dramatic in its rapidity; normal levels of circulating white blood cells and platelets may be reached in the twenty-fourth to twenty-eighth day after mustard. The autologous

marrow graft does not effectively contribute to this regeneration. It may be that at larger mustard doses or with many times the number of autologous cells used in this series (4×10^6 to 1.3×10^7), a significant contribution from the autograft would be apparent.

Recent and contemplated studies relating to the marrow problem.

a) Low-dose total-body irradiation. We are giving single doses of 50 r to various hematologic disorders and are studying the effects on blood and bone marrow. We have treated only a few patients, but we believe that this type of study will help to show the radiosensitivity of various cell types and may yield other information on radiation effects. From the literature one can learn that many patients have been treated with total-body irradiation in this dose range, but variations in technique, time-dose relationships, and methods of study make comparison of the data difficult.

b) Effects of local irradiation to the spleen on "hypersplenic states." Dr. Comas, Dr. Nelson, and other members of our staff have been studying patients with various diseases believed to have some degree of hypersplenism. In some of these patients they have obtained red cell survival curves with chromium-51 before and after radiation to the spleen. The treatment to the spleen has been with a dose somewhat higher than is usually used for lymphomas or hematologic disorders.

c) Effects of local irradiation on marrow. By means of multiple aspirations as compared with similar marrow studies on areas not in the field of radiation, we have made preliminary study of the effects of local irradiation to bone marrow. This study should yield worthwhile information on the mechanism of production of hematologic depression by radiation that does not include all the body's marrow. We expect comparison with total-body irradiation effects to be valuable.

Radioiodine

Iodine-132 studies in thyroid carcinoma. Flora Pascasio, B. W. Sitterson, and G. A. Andrews have been using radioactive iodine to treat metastatic carcinoma of the thyroid in patients who have undergone total thyroidectomy. Several measures, thought to influence favorably the uptake of iodine by the malignant tissue, are in general use. Little information is available, however, from definite studies concerning the effectiveness of these measures in humans.

Iodine-132, with a half life of 2.3 hours, should permit repeated uptake determinations within a relatively short time. Thus the effect of various measures on iodine uptake could be determined on the same tumor mass in one patient with elimination of variables arising from long-time intervals between uptake studies. Preliminary work using iodine-132 to determine the effect of withholding thyroid medication, giving exogenous thyroid stimulating hormone, and prior administration and omission of antithyroid drugs has been done in two patients with suitably large and isolated tumor masses. Standard thyroid uptake technique, with a B filter to shield the tumor mass and obtain body background, was used. The dose of iodine-132 for each uptake determination was one millicurie.

Results indicate that using the standard thyroid uptake technique may not be feasible. Because of variation in size and shape of tumor masses, use of the B filter does not appear to give reliable body-background counts and some other way of determining this will be necessary. Also some reasonably accurate method of determining the depth of tumor masses within the body is needed to arrive at the proper distance between skin and the detector. In the two patients studied, the counts obtained at various time intervals after the dose seem to indicate that by the time the tumor has reached its peak uptake the isotope has already decayed to such low levels of activity that counting is difficult. Consequently it may be necessary to use larger doses of iodine-132 or another isotope of iodine with a somewhat longer half life.

Long-range study of carcinoma of the thyroid. We have studied a considerable number of patients with carcinoma of the thyroid. Further follow-up and additional cases have been obtained in the group with small areas of functioning thyroid tissue (either tumor or normal thyroid) left in the neck after attempted total thyroidectomy for carcinoma. Results continue to indicate the value of complete thyroidectomy and use of rather large test doses of iodine-131 to locate metastases.

Treatment of hyperthyroidism and effects of iodine-131 on thyroid tissue. The clinical staff has treated a small number of cases of hyperthyroidism and obtained some further information on histologic effects in the thyroid gland. We are also beginning to study surgical

biopsy of thyroid glands treated with iodine-131.

Carcinoma of the ovary, effusions, and colloidal radioisotopes.

We have treated a small number of patients with effusions during the year and have obtained some further information on the comparison of colloidal gold-198 and yttrium-90. A small amount of carrier (in the range of 25 mg), along with the therapeutic dose of yttrium-90, appeared adequate to ensure localization of the radioisotope, and apparently cut down on the adverse reactions to the stable yttrium. We have seen several cases of carcinoma of the ovary and have continued the long-range study on combined therapy with repeated surgery and intraperitoneal gold-198.

Hematologic Disorders.

An increasing emphasis on hematology characterized the year. This was largely related to the program in radiation effects and an increased number of patients with acute leukemia and other blood disorders. In addition to the data already mentioned, we have obtained valuable information on long-range follow-up of patients with polycythemia. Examples of myeloproliferative transitions are becoming more common in our series of cases. In these patients studies with iron-59 and chromium-51 are quite puzzling. Splenectomy seems occasionally to be indicated, but the criteria for recommending it are far from clear.

Calcium-47 studies in patients.

With the receipt of the first available calcium-47, Dr. Flora Pascasio and members of the staff studied the metabolism of calcium-47 in four patients. Two received oral doses of 0.190 millicurie; two received intravenous doses of 0.095 millicurie. Fecal and urinary excretions were determined and blood levels were obtained. Daily linear scans were taken for 12 days and it was possible to obtain satisfactory external counts, in great contrast to the situation with calcium-45, a pure beta emitter. The patients were on a low calcium diet two days before and during the 12 days of the procedure. No stable calcium was added to the activity. At the time of administration, the specific activity was about 0.24 millicurie per milligram. The calcium was given as calcium chloride. The ratio of calcium-47 to calcium-45 was approximately 2:1.

The following summarizes the observations:

Plasma levels:

Oral doses: Peak of activity appeared 1 to 3 hours after administration. Significant activity was detected at 30 minutes.

Intravenous doses: Peak activity appeared at 2 minutes. At the 7th to 8th day the plasma levels were similar in both groups.

Urinary Excretion:

Peak excretion was in the first 24 hours for both groups, 5 per cent in patients with intravenous doses, 3 per cent in those with oral doses. During the 12 day period, peak excretion was 13 to 18 per cent of total activity given for intravenous doses, and 5 and 12 per cent for oral doses.

Fecal Excretion:

Total: Oral: 40 per cent of dose in one patient.
Intravenous: 10 to 12 per cent of dose.

Linear Scans:

With oral doses, the intestinal activity was apparent up to three and four days. The later oral-dose scans and the intravenous-dose scans showed a profile consistent with general skeletal deposition. The largest activity was over the thorax and abdomen with small peaks at knee and ankle.

CLINICAL TELETHERAPY

F. Comas

The volume of patients in the clinical teletherapy program increased slightly over 1958. Nine hundred treatments were given to 64 new patients. (This includes localized and total-body irradiation). About half the treated patients suffered from lymphomas of several types. Special interest was centered on patients with carcinoma of the urinary bladder, forming part of a long-range study on management of this disease with radiation therapy. This is preceded by an exploratory laparotomy to accurately map out the extent of the primary tumor and regional lymph-node metastases, in an effort to minimize "geographical misses." Among the patients so far treated, two have shown tumor persistence at the primary site, in spite of vigorous irradiation. The third has completed therapy too soon to be evaluated.

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