UPTAKE OF SULPHATE ^{35}S BY LEUKAEMIC HUMAN BONE MARROW *IN VIVO*

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(RECEIVED FOR PUBLICATION OCTOBER 5, 1954)

A previous communication has reported the specific uptake of ^{35}S sulphate by the myeloid cells of human bone marrows *in vitro* (Lajtha, Ellis, and Oliver, 1953). Experiments *in vivo* on rats and rabbits confirmed the findings *in vitro*: uptake by the early myeloid cells, and no uptake by the nucleated red cells or lymphocytes. Repeated large doses of ^{35}S sulphate (1–2 $\mu\text{C/g.}$ daily for seven days) were found to be non-toxic in animals.

In view of the localization of the isotope in the myeloid foci of the marrow and of the low energy emission of ^{35}S (0.167 MeV), a fairly localized irradiation of the myeloid cells of the bone marrow could be expected. It was decided to attempt to study the uptake of ^{35}S sulphate *in vivo* in human bone marrow, and to investigate the effect of such treatment in acute leukaemia.

Material and Method

Six patients with acute leukaemia were chosen for the study: two cases of myeloblastic-paramyeloblastic leukaemia, two cases of myeloblastic-monoblastic leukaemia, and two cases of lymphoblastic leukaemia.

The ^{35}S was obtained from the Atomic Energy Research Establishment, Harwell ($\text{Na}_2^{35}\text{SO}_4$, carrier free, sterile, pH 7, in physiological saline, 1 mC/ml. activity). The administration was by intravenous injection except in two young children, where it was given intragluteally with hyaluronidase to hasten absorption from the site of injection.

The doses ranged from 1 to 10 mC on alternate days, the total dose varying between 25 and 100 mC. The urine of the patients was collected and the activity measured.

Daily full blood counts were performed on the patients: Hb, total white blood and differential counts, and platelet counts. Apart from the two children, sternal marrow was examined both at the

beginning and at the end of the ^{35}S sulphate course. Autoradiographs were prepared from the marrow and from the peripheral blood at the end of ^{35}S sulphate treatment (Lajtha, 1954).

Results

Measurements on the radioactivity of the urine indicated that over 80% of the intravenously administered ^{35}S sulphate is excreted within six hours. No subjective or objective side-effects were noted in any of the patients.

The clinical and haematological course of leukaemia was not altered in any of the patients.

The autoradiographs from the bone marrows indicated a maximum uptake of the order of 500 to 1,000 atoms ^{35}S in the early promyelocytes and myelocytes, and considerably less in the blast cells. This uptake, however, was noted only in those patients who received large doses of ^{35}S sulphate (10 mC on seven alternate days).

Discussion

The experiments demonstrated the uptake of ^{35}S sulphate by human myeloid cells *in vivo*. The two cases of lymphoblastic leukaemia (i.e., blast cells accompanied by large and small lymphocytes) were included in the series because experiments *in vitro* indicated an uptake of ^{35}S by several blast cells from the peripheral blood.

Calculations on the probable radiation dose to the cells by the incorporated ^{35}S indicated that in our series the maximum probable dose within a clump of myeloid cells may be of the order of 4 rads/24 hours. In most cells, however, the radiation dose would be considerably less. Considering the limited life span of the cells in the bone marrow and the slow dose rate of radiation, no significant growth-inhibiting effect can be expected.

Summary

Following experiments *in vitro* which indicated an uptake of ^{35}S by human bone marrow cells, six patients with acute leukaemia were given courses of ^{35}S sulphate.

The uptake of ^{35}S sulphate by blast cells and early myeloid cells in human bone marrow *in vivo* has been demonstrated.

The ^{35}S sulphate treatment did not depress the marrow elements and did not produce improvement in the course of the disease.

This work is part of an investigation carried out under a full grant from the British Empire Cancer Campaign.

REFERENCES

- Lajtha, L. G. (1954). *J. photogr. Sci.*, **2**, 130.
 ——— Ellis, F., and Oliver, R. (1953). *Brit. J. Cancer*, **7**, 401.