From the results mentioned above it seems likely that the catalytic action played by thiamine in the metabolism in the living body is due to the following mechanism rather than to a redox system between the thiol form of thiamine and thiamine disulfide, proposed by Zima *et al.* Namely, an equilibrium reaction like (1) seems to be taking place in the living body, and the catalytic action of thiamine will be due to the dehydrogenating or oxidative action on certain substrata which are affected when thiamine cysteine (IV) or its homologues produced by the reaction revert to their original components.

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The Effect of Whole Blood Transfusion on Dogs Receiving a Maximal Sublethal (LD_0) Exposure to Ionizing Radiation[1]

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Allen and his associates (*1*) have reported the effects of whole blood transfusion in the treatment of the acute illness in dogs produced by whole-body x-irradiation. Their data show that 4 of 10 transfused animals died consequent to a 175-r exposure that was not lethal for the control animals. This suggests that in the lower dose levels of irradiation, transfusions may kill animals not fatally injured by irradiation.

A similar study is reported here to help define the hazard, if one exists, of compatible whole blood transfusion to the dog suffering acute radiation sickness following a maximal LD_0 total body exposure.

Twenty unanesthetized mongrel dogs were paired as closely as possible with respect to weight, sex, age, and blood type. Each animal was subjected to 300 r of whole-body x-irradiation from a 1-Mev machine. One of each pair, following irradiation, served as a control while the other received typed, crossmatched, compatible whole blood on a predetermined basis of three transfusions a week beginning on the 4th day postirradiation and continuing for 4 weeks. The blood was drawn from donor animals into standard ACD solution 48–72 hr prior to its administration, and stored at 4° C. Blood was transfused into a leg vein in an amount of 5 cc/kg of body weight at each transfusion. Sufficient blood was withdrawn from each animal 3 times weekly in order to determine its hematocrit, RBC, WBC, and platelet counts.

[1] This paper is based on work performed under contract with the United States Atomic Energy Commission and the Armed Forces Special Weapons Project at the University of Rochester Atomic Energy Project, Rochester, New York.

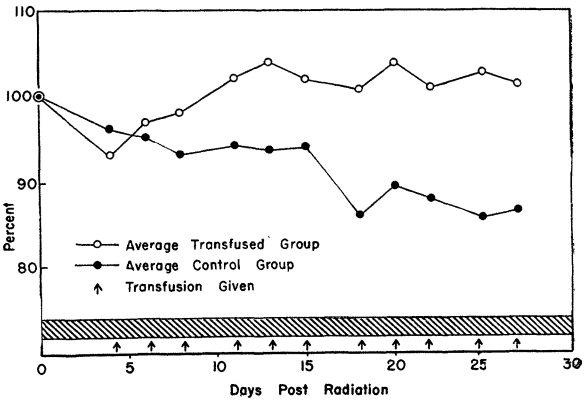

FIG. 1. Percentage preradiation hematocrit.

A fourteen-dog donor colony was maintained. Each donor and recipient animal was typed for the presence or absence of the canine A factor. A+ blood was given to A+ recipients and A− blood to A− recipients. The blood was crossmatched for major and minor incompatibility just prior to transfusion.

The diet of the donor colony was supplemented with daily feedings of horse meat and iron which maintained the donor hematocrits at approximately 95% of their control levels.

Results. Mortality: None of the animals in either group succumbed during the 28-day observation period.

Hematology: Figure 1 shows that the average hematocrit for the transfused dogs was restored to the preradiation value by the blood transfusions, whereas the control group's average hematocrit fell gradually in a linear fashion. The average platelet count (Fig. 2) and white blood cell count (Fig. 3) for the control and the treated groups were essentially the same.

Transfusion reactions: No clinical hemolytic or anaphylactoid reactions occurred.

Under the conditions of this experiment, the findings of Allen *et al.* could not be confirmed. Allen's x-ray factors differed from ours, but in both experiments the lethality of the exposure appeared to be

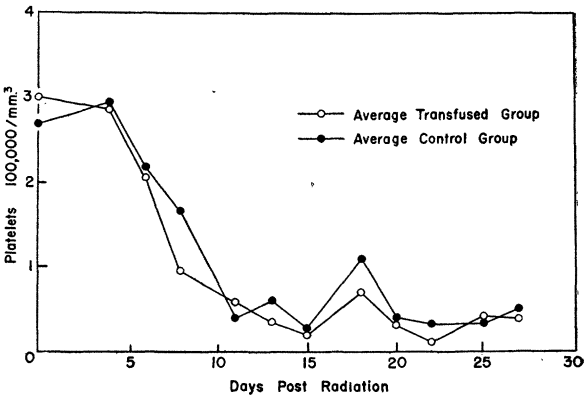

FIG. 2. Average platelet counts.

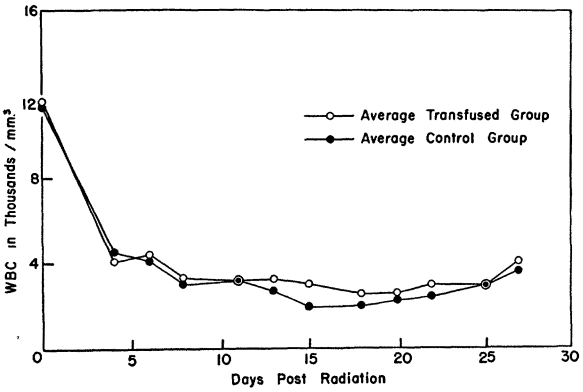

FIG. 3. Average leucocyte counts.

equivalent as determined by other dose-mortality data from each laboratory. In both instances the total body dose given appeared to be the greatest that could be administered in each laboratory without producing death (except in the rare highly susceptible dog).

Although the present experiment offers no direct evidence, it seems possible that the transfusion reactions encountered by Allen *et al.* may be responsible for the mortality of the otherwise nonfatally irradiated dogs. Incompatible transfusion, not fatal to the normal dog, may constitute an injury that is lethal to some of the irradiated animals. This point is under investigation in our laboratory at present.

Typing for the presence of the canine A factor in the erythrocytes of both donors and recipients and crossmatching were carried out on all transfusions of dog blood administered during the course of these experiments. We would take strong exception to the statement of Allen *et al.* that the blood groups of dogs are much less well defined than those of man. In the laboratories of the Department of Medicine of the University of Rochester up to the present time, 8 distinct dog blood-grouping factors have been demonstrated, and the respective isoantibodies characterized. The *in vivo* and *in vitro* characteristics of the first 5 of these have been described in detail in previous publications (*2–12*). These isoantibodies are produced by immunization of dogs with erythrocytes containing agglutinogens which they do not possess in their own red cells. The first of these antibodies described, canine anti-A, is a potent hemolysin capable of producing severe hemolytic transfusion reactions when either anti-A-containing plasma is given to an A+ dog, or A+ cells are given to a recipient immunized for this factor. The A factor is a very potent antigen, thus giving rise to potential hemolytic transfusion reactions in dogs subjected to repeated transfusions. Since approximately 65% of dogs carry this factor, the possibility of isosensitization is high with randomly chosen donors and recipients. Canine anti-A may be very difficult to detect in saline-containing systems, and crossmatches done by this method may not detect this incompatibility. Thus, proper choice of donor and recipient with regard to this factor is important if major hemolytic reactions are to be avoided in experiments involving transfusions of dogs with donor blood.

Anti-B, -C and -D behave as simple agglutinins and the corresponding factors are less antigenic than the A factor. Anti-E occupies a position intermediate between these two groups of antibodies in that under some circumstances it is capable of causing rapid destruction of donated cells. The detailed characteristics of these and the more recently encountered isoantibodies will be published elsewhere (*13*).

Using these precautions, we have administered over 400 therapeutic transfusions to irradiated dogs during the past year, many of which were given to previously transfused dogs, during the course of this and other experiments. We have seen no clinical hemolytic transfusion reactions in this experience, neither have we encountered anaphylactoid reactions with aggravation of the hemorrhagic diathesis of the irradiated dog. An occasional animal vomited or defecated following too rapid infusion of blood. However, we have been unable to detect evidences of hemolysis following such reactions. We do not feel that the irradiated dog is more susceptible than normal to transfusion reactions when compatible blood is administered. In experiments where therapeutic effects of transfusion are being measured it is very important that these precautions to minimize transfusion reactions be observed.

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Effect of Posture on the Elimination of Radon in the Breath[1]

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In persons retaining a substantial radium burden 1 year after contamination, over 95% of the radium is fixed in the skeletal tissues (*1*). A large portion of the radon which emanates from the radium is carried away by the blood stream as a dissolved gas. Much

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