Proceedings of the Iowa Academy of Science

Volume 76 | Annual Issue Article 46

1969

Effects of Hypothermia on Absorption of P-32 in Mice

Bruce C. Luecke
Grinnell College

Effects of Hypothermia on Absorption of P-32 in Mice

BRUCE C. LUECKE[1]

Abstract. Twenty male white mice were intraperitoneally injected with 210 microcuries of P-32 each. Ten were returned to a 25 degree C. environment and ten others to a 5 degree C. environment with similar food, light, and water provisions. Half of each temperature group was killed and frozen 24 hours following injection while the remaining ten were killed and frozen three weeks following injection. Relative absorptive functions of six organs were studied showing that hypothermia resulted in lower P-32 uptake and longer retention.

The purpose of the study was (1) to attempt to determine the effects of hypothermia on distribution of P-32 in mice, and (2) to test the hypothesis that a significant reduction in the level of P-32 absorption would be observed at temperatures below 25° C. in the mice.

S. Hornsey (1959) reported that hypothermic mice at 0-5° C. were afforded protection from X-radiation compared to room-temperature controls. Similarly, hypothermia should "protect" the organs of the body from high absorption of internal P-32.

EQUIPMENT AND PROCEDURES

Twenty male white mice were injected intraperitoneally with 210 microcuries of P-32. Injection was accomplished under light ether anesthesia.

All animals were kept in plastic, crude-cotton lined, tubs with wire overcoverings. These were cleaned once a week during the experiment. Purina Lab Chow was used for feeding and external water bottles were affixed to each cage.

Hypothermic animals were cooled from room temperature to 5° C. in a Percival low-temperature chamber for a period of eight days before injection. No individual body temperature readings were taken. The object of the study was to determine the effects of hypothermia (5° C.) on absorption of P-32.

Twenty-four hours after injection, half of each temperature group was killed by ether anesthesia and frozen. The remaining half of each group was killed in the same manner three weeks following injection. These animals were also frozen.

Six organs, the liver, spleen, testes, kidneys, small intestine, and both femur bones were excised and allowed to air-dry on preweighed planchets. Final dryings were completed in a 105° C. oven, and

[1] Biology Department, Grinnell College, Grinnell, Iowa 50112.

samples were then ground in a mortar before weighing. After weighing, all samples were counted on a Baird-Atomic thin-window gas flow counter with 2π geometry, within a 24-hour period to minimize the need for isotope decay corrections. Background counts were taken after every third count to assure accuracy and to note any contamination which might warrant cleaning of the counter. Each organ was counted for all animals so that a correction was not necessary within the organ counts.

Results

The comparative absorptive activities of the several organs in hypothermic and room-temperature mice were found to differ widely. Figure 1 shows that those organs directly related to the blood in their function, bone, intestine, spleen, and kidney, had absorbed more P-32 after 24 hours than the testes with their smaller blood supply.

The spleen showed the greatest initial per gram uptake of P-32 of the organs studied. The femur bone and intestine, expected to be highly absorptive, were approximately equal in P-32 uptake, but less active than the spleen. The other organs studied, kidneys, testes, and liver, all showed less than half the P-32 uptake of spleen on a per-gram basis. In each case, the P-32 uptake in the hypothermic animals amounted to approximately two-thirds that in the room-temperature animals. The testes and intestine in the hypothermic animals showed approximately 50% as much P-32 uptake as those in room-temperature animals.

Three weeks after injection, a very different picture of the effects of hypothermia appeared. Both femurs and testes showed relatively high P-32 counts per minute per gram. The femur showed a 50% loss of P-32 over three weeks in the room-temperature animals, while a smaller loss in P-32 was observed in the hypothermic mice.

In the liver, small intestine, kidneys, and spleen, there was only 40% as much P-32 after 3-weeks, on a proportional basis, as was retained by animals sacrificed 24 hours after injection. The spleen, although exhibiting the greatest proportional loss, retained the greatest actual amount of P-32 of this group of organs. In each of these organs, the final amount of P-32 in the room-temperature group was slightly below that in the hypothermic group.

Discussion

Consistent results were obtained using five animals in each temperature-time group studied. Despite the bone's high uptake of

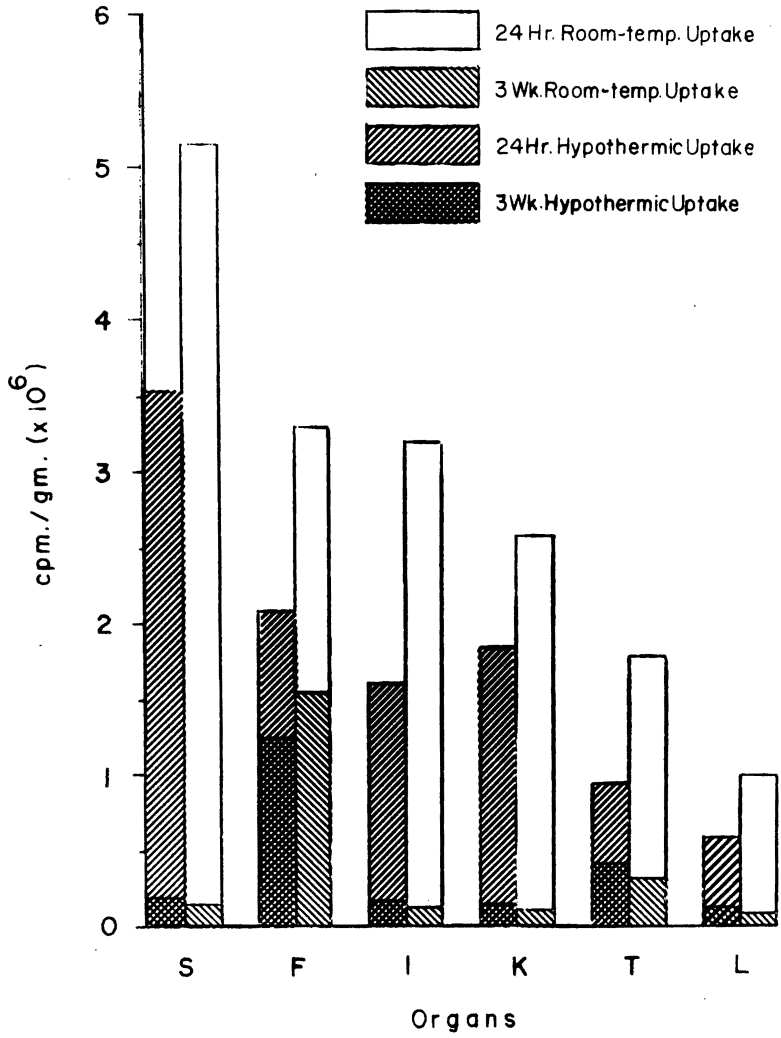

Fig. 1. Mean number of counts per minute per gram recorded in each organ 24 hours and 3 weeks after injection. F, femur; L, liver; K. kidney; T, testes; S, spleen; I, small intestine.

P-32, the difference in P-32 content found in the spleen and femur seems to reflect the spleen's active erythrocyte catabolism, and the femur's lower proportion of erthrocyte production.

The high uptake by the intestine and kidneys is indicative of their functions relative to the blood. Since the injection was intraperitoneal, the amount of P-32 absorbed by the other organs was not dependent on the absorptive activity of the intestine.

The testes, whose rapidly dividing cells might be expected to absorb large amounts of P-32, absorbed somewhat less than all other organs except the liver, possibly because the blood supply passing through the intestine, and diffusing P-32 in the peritoneum, reaches other active absorbers before the testes.

Of the organs studied, the liver absorbed the least P-32 on a per-gram basis. Previous experiments by Clemedsen and Nelson (1960) indicate that the liver accumulates P-32 in a diffuse and homogenous manner, thus after a certain threshold, P-32 would tend to be eliminated via the blood stream.

Table 1. Mean number of cpm./gm. per organ (x 10^6).

Room Temp. (20°C)		
	24 Hour	3 Week
Spleen	5.161	.163
Femur	3.293	1.546
Small Intestine	3.179	.123
Kidney	2.582	.113
Testes	1.800	.309
Liver	1.046	.083

Hypothermic (5°C)		
	24 Hour	3 Week
Spleen	3.548	.192
Femur	2.076	1.253
Small Intestine	1.612	.167
Kidney	1.849	.152
Testes	.953	.409
Liver	.582	.121

Table 1 shows retention and distribution of P-32 in each of the organs studied, 24 hours and 3 weeks after injection. Hypothermia reduced the amount of P-32 absorbed in both groups.

In those organs supporting rapid cell division, such as the femur and testes, the loss of P-32 was much reduced in both room-temperature and hypothermic animals. In every organ studied, the loss of P-32 in room-temperature animals was much greater than in the hypothermic animals.

Results of this experiment complement the results of Hornsey (1959) on the protective effects of hypothermia for mice exposed

to external radiations. Hypothermia reduces the effects of internal emitters by slowing their absorption into the various organs of the body, and, although radiation is present over a longer period of time, the amount may be low enough so that some recovery can take place while the emitter is still present.

ACKNOWLEDGEMENTS

I wish to express my thanks to Dr. B. F. Graham, Dept. of Biology, Grinnell College for advice and encouragement given me during the course of the study. I also wish to thank Mr. Jeff Wolfson, Grinnell College, for his assistance.

LITERATURE CITED

CLEMEDSEN, CARL-JOHAN and ARNE NELSON, 1960, General Biology: The Adult Organism. *Mechanisms in Radiobiology Vol. II.*, Errara, M. and Forssberg, A. (Ed.). Academic Press (N.Y.).

HORNSEY, S. 1959. Fertility and Lifespan of Mice Protected by Hypothermia Against Total-Body Irradiation. Med. Research Council Exp. Radiopath. Research Unit, London *Gerontologia* (Basel) 3/3. (Abstract).