Electrolyte Balances Following Total Body X-Irradiation. (21936)

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One of the prominent features of irradiation sickness is the attendant upset of salt and water metabolism. Depending upon the species, this may be manifested in the forms of vomiting, diarrhea, and diuresis. An exact determination of the changes in electrolyte balance following total body x-irradiation is, therefore, of interest.

Methods. Twenty 250 g male white rats (Rolfsmeyer Co., Madison, Wisconsin) were placed in metabolism cages over siliconized glass funnels, and allowed free access to distilled water and a diet containing 60% sucrose, 18% lactalbumin, 16.9% Crisco, 4% modified Wesson salt mixture (minus its Na^+, K^+, and Cl^-), 1% liver extract (Wilson Co., liver fraction D, Lot 41863), 0.1% choline hydrochloride, with supplements of thiamine, pyridoxine, riboflavin and calcium pantothenate. Roughly 5% of the Na^+, K^+, and Cl^- intake was furnished by the diet; coming largely from the liver extract. The remainder of the sodium and potassium chlorides was administered daily by intraperitoneal injection. In the control period the average total electrolyte intake was 1.55 meq of sodium, 2.37 meq of potassium, and 2.54 meq of chloride per 48-hour period. Under these conditions the electrolyte intake was largely independent of the level of food intake. Each 48 hours, the food intake and body weight were recorded, and the excreta were removed for analysis. The excreta were collected quantitatively in barium hydroxide solution, evaporated to dryness, and ashed at 500°C for 12 hours. Sodium and potassium determinations were made on food, injection solutions, and excreta, with a flame photometer attachment to the Beckman DU Spectrophotometer. Chlorides were determined on the same samples by the Volhard method. After 18 days of control study, 16 of these animals were given a total body dose of 700 r of x-ray (140 kv., 0.25 mm Cu, 1 mm Al). In preliminary tests, with larger groups of animals, this dose was

TABLE I. Difference between Electrolyte Balances of Experimental and Control Rats before and after Total Body X-irradiation.

Pre-X-ray days	K^+	Na^+	Cl^-
0- 2	+.050	+.180	+.124
2- 4	−.093	+.145	+.050
4- 6	−.081	+.127	+.014
6- 8	+.156	+.031	+.047
8-10	−.113	+.061	+.168
10-12	+.162	+.107	+.214
12-14	+.016	+.196	−.077
14-16	−.100	−.121	−.007
16-18	−.136	−.008	−.364
Avg =	−.015	+.080	+.019
σ =	.116	.101	.169
Post-X-ray days			
0- 2	−.567†	−.245*	+.066
2- 4	−.866†	−.558†	+.124
4- 6	−.112	+.045	−.424*
6- 8	−.033	−.178*	−.143
8-10	+.214	+.312	+.183

* Significant at 5% level ($.01 < P \leq .05$).
† " " 1% " ($P \leq .01$).

found sufficient to kill half of the animals within a 2-week period. Balance studies were continued for an additional 10 days following irradiation. Four of the animals maintained in metabolism cages were used as parallel controls. They received no x-irradiation, but otherwise were handled in the same manner as the experimental animals. Balance data obtained from these controls were used as a base-line in the interpretation of the data obtained from the irradiated animals. The figures in Table I represent the difference in balance between the experimental and the control groups at each period. In this way it was possible to minimize any effect due to handling at the time of irradiation, and to compensate for the fact that the 300 g male white rat was still gaining weight. This procedure also tends to minimize the effect of any consistent bias in analytical methodology.

Results. In Table I it is seen that the potassium, sodium, and chloride balances are significantly altered following total body x-irradiation with an LD_{50} dose of x-ray. There is a marked loss of potassium during the first 4 days following irradiation, with a gradual recovery to a positive value by 8-10 days following irradiation. The changes in sodium balance are roughly parallel with those in the potassium balance data. Quite a different picture is seen in the chloride data, however. The chloride balance remains close to zero for the first 4 days of the post-irradiation period, and only after the 4th day is there a significantly negative balance. Again, there is evidence of recovery in the later periods.

The data of Table I represent the means of over 800 independent determinations carried out in triplicate. The control day-to-day standard deviations, representing the over-all analytic and physiologic variations, are only 5-7% of the intake. This degree of uncertainty is even further decreased by the large amount of control data available for comparison. The changes observed under these conditions are statistically significant ($P<.05$ for chloride and $P<.01$ for sodium and potassium), and clearly define the nature of the post-irradiation electrolyte balance changes in the rat exposed to an LD_{50} dose of total body x-irradiation.

Discussion. From previous reports in the literature, it can be inferred that following irradiation the body electrolyte balances become positive(1-3), negative(4-7), or are uninfluenced(8). Unfortunately, none of these reports presents balance results which are statistically significant.

The main features of the post-irradiation electrolyte balances, as defined in Table I, are: (A) a prompt (0-4 day) loss of K^+ and Na^+, (B) a delayed (4-6 day) loss of Cl^-, and (C) a recovery of electrolyte beginning at the 8-10 day period.

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Studies on the O Antigen of *Salmonella typhosa* IV. Endotoxic Properties of the Purified Antigen. (21937)

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Toxic manifestations induced in man and experimental animals by Gram-negative bacteria have been established as referable to their production of a distinctive component, variously described as somatic antigen, endotoxin, pyrogen, and tumor hemorrhagic agent. These specific attributes of endotoxins have been described, particularly by Burrows(1), Bennett and Beeson(2), and Thomas(3). Endotoxins are generally referred to as complexes of polysaccharide, lipid, and protein; however, the precise chemical composition of the complex in relation to endotoxic activity has not been established. Biological properties of endotoxins have been studied for the most part with relatively crude preparations, frequently culture filtrates or extracts(4). Those purified products in recent investigations(5-9), contained significant quantities of nitrogen, which probably represented appre-