RADIOBIOLOGY

A Cellular Component of Thymic Function

THYMECTOMY in the new-born[1,2] or in the adult irradiated mouse[3] leads to a long-lasting suppression of the ability to respond to primary antigenic challenge. It has been shown in both instances that thymus grafting is effective in restoring immunological competence[2,4,5] and, furthermore, when using a cytologically marked thymic graft, it has been possible to detect cells derived from the graft in the spleen and lymph nodes[2,5]. It has, therefore, been suggested[5] that it may be these donor cells which are directly responsible for the recovery of the primary immune response in thymus-grafted animals.

In order to test this possibility, six *CBA* male mice were thymectomized[6], irradiated (850 r.) and given 5 million syngeneic bone marrow cells. On the day of irradiation, each mouse was grafted under the kidney capsule with a single thymus lobe from a 1–3-day-old *CBA/T6T6* mouse. (The cells of *CBA/T6T6* mice are characterized by a pair of small marker chromosomes.) Twenty-eight days later half the mice were given an injection of sheep red cells (0·2 ml. of a 20 per cent suspension in Alsever's solution). Three days after challenge the animals were killed and cytological preparations were made following the methods of Ford and Hamerton[7] and Rothfels and Siminovitch[8]. The slides were analysed and the results are shown in Table 1.

Table 1. CYTOLOGICAL ANALYSIS OF SPLEENS FROM *CBA* MICE BEARING A CYTOLOGICALLY MARKED (*CBA/T6T6*) THYMUS GRAFT

Uninjected mice				Mice injected with sheep cells			
Mouse No.	No. of cells scored	% *CBA*	% *CBA/T6T6*	Mouse No.	No. of cells scored	% *CBA*	% *CBA/T6T6*
1	38	89·5	10·5	4	50	66·0	34·0
2	46	100	0	5	50	80·0	20·0
3	47	93·6	6·4	6	50	86·0	14·0

There is a significant increase ($P < 0·05$) in the number of marked donor cells found in the spleens of the injected mice. This would indicate that cells, presumably derived from the thymic graft, are capable of dividing in response to antigenic stimulation. It is not, therefore, unreasonable to suppose that the thymus graft restores immunological function, at least in part, by itself providing appropriate cells. The implications of this preliminary finding are the subject of further investigation.

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[1] Miller, J. F. A. P., *Lancet*, ii, 748 (1961).
[2] Miller, J. F. A. P., *Proc. Roy. Soc.*, B, **156**, 415 (1962).
[3] Miller, J. F. A. P., Doak, S. M. A., and Cross, A. M., *Proc. Soc. Exp. Biol. Med.*, **112**, 785 (1963).
[4] Martinez, C., Dalmasso, A. P., and Good, R. A., *Ann. N.Y. Acad. Sci.*, **113**, 933 (1964).
[5] Leuchars, E., Cross, A. M., and Dukor, P., *Transplantation* (in the press).
[6] Miller, J. F. A. P., *Brit. J. Cancer*, **14**, 93 (1960).
[7] Ford, C. E., and Hamerton, J. L., *Stain Technol.*, **31**, 247 (1956).
[8] Rothfels, K. H., and Siminovitch, L., *Stain Technol.*, **33**, 73 (1958).

Removal of Radiocæsium from Beef

Two of the long half-life nuclides of major interest in food and feedstuffs which result from fall-out are radiostrontium and radiocæsium. Cæsium is almost always associated with the other alkali metals and particularly resembles potassium. Hood and Comar[1] demonstrated that ^{137}Cs is absorbed and distributed rapidly in the soft tissues and the body fluids, including milk. In distribution investigations, these authors found that the greatest accumulation of radiocæsium occurred in the muscles as compared with other body tissues. Ekman[2] reported that radiocæsium accumulated more rapidly in the physiologically active muscles than in inactive muscles; however, ultimately the inactive muscles were reported to have a higher content.

Using four human subjects, Richmond, Furchner and Langham[3] found that radiocæsium had a biological half-life of about 135 days. Other workers have reported half-lives varying from 100 to 150 days. Combined with the fact that radiocæsium has a considerable biological half-life in man and that the two most important nuclides, ^{134}Cs and ^{137}Cs, have physical half-lives of approximately 2·8–30 years, respectively, it becomes increasingly important to consider the significance of radiocæsium intake from the point of view of health.

In the inland arctic regions, caribou and reindeer are the main sources of meat and milk for the Eskimos and the Lapland tribes. In the arctic these herbivorous animals subsist essentially on lichens which are known to concentrate radiocæsium from fall-out. Meat from these areas has been reported to contain significant levels of radiocæsium. Whole-body counting investigations of human beings by Palmer *et al.*[4,5] and Liden and Andersson[6] in Alaska, Finland and Sweden have demonstrated that these arctic inhabitants have high radiocæsium body burdens as compared to other peoples. In northern regions of the world, some uncomplicated treatments for removing ^{137}Cs and ^{134}Cs from muscle may now be of value. In the temperate zones also, if cattle and other domestic animals grazed on pasture contaminated with heavy amounts of fall-out and then had to be utilized for human consumption, knowledge of some removal techniques would be valuable. Meyer *et al.*[7] reported that the loss of ^{134}Cs from cooked beef muscle was related to the amount of water used and the exposed surface area. Average activity removed was 19 per cent from oven roasts, 43 per cent from braised steaks, and 53 per cent from stew. Additional treatments prior to cooking may be of value to reduce the level of radiocæsium in the tissue. Data are reported here on the removal of radiocæsium from raw beef muscle from a heavy steer which had received intravenously a 10-mc. dose of ^{134}Cs.

Since radiocæsium accumulates in the soft tissue, it must be to a degree associated with the muscle and plasma proteins in a manner similar to the relationship sodium and potassium ions have with these proteins. If radiocæsium associates with proteins, then the degree of association might be affected by changes in *p*H. Cæsium-134 was more easily leached from cubed samples of longissimus dorsi (L.D.) at the isoelectric point of rigor, *p*H 5·5, than from samples at *p*H 6·4 and 5·7 removed from the steer carcass at earlier post-mortem times. After subjecting the leaching solutions to ultrafiltration[8] and counting portions of the filtrate and residue, it was found that the soluble protein fraction had the same c.p.m./ml. as did the filtrate; thus this experiment failed to demonstrate any association between ^{134}Cs and the leachable protein.

Variable volumes of leaching solution (0·85 per cent sodium chloride) had little effect on the total amount of activity removed from meat cubes over a given period of time. The most effective removal treatments incorporated agitation and replacement of the leaching solution. In four changes of saline solution and a total of 2 h agitation, 63 per cent of the ^{134}Cs was removed from 2·5-cm slices of L.D. muscle. Twenty-eight per cent of the ^{134}Cs was removed from the steaks during the first 30-min period of agitation (Fig. 1). When ground chuck was treated similarly, 75 per cent of ^{134}Cs was leached from the meat