生理的機能の変動から予知されるマウス放射線感受性の系統差*

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われわれは，すでに，体重，尿中 Na/K 比等の生理的変動の程度が個体により異なり，その変動の程度が個体の放射線感受性と一定の関係にある事を示した．本報告では，この関係が系統差のレベルで成立するかどうかを知ろうとした．すなわち，体重の生理的変動から，われわれの考え方にしたがって放射線感受性が低いと予知した個体を選び，各系統，CF1, dd/YF, C57BL/6, CBA の集団中にその個体が何パーセント含まれるかを計算した．一方，各系統のＬＤ50/30を文献上から選び，両者の関係をしらべた．結果は，放射線感受性が低いと予知される個体が多く含まれる系統ほど，その系統のＬＤ50/30が高かつた．したがつて個体差をもとめる上でわれわれが示した考え方が，集団レベルでも成立すると思われる．

THE STRAIN DIFFERENCES IN RADIOSENSITIVITY OF MICE AS* PREDICTED FROM THE FLUCTUATION OF PHYSIOLOGICAL FUNCTIONS

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The strain differences in the radosensitivity of mice form a suitable methodical approach to the study of the causes of different radiosensitivity of individuals. The differences in the physiological functions, observed among the various mice strains, can, according to some investigators, be correlated to a different radiosensitivity of these strains (13, 5).

Recently we presented a method consisting in the study of time-fluctuation of some physiological functions, permitting to characterize the regulatory balance of the individual. The principle of this method is based on following the responses of physiological functions, such as, e.g. the changes in the Na/K ratio in the urine, to the stress impulse. The different response of individuals to multiple stress, determined by the degree of homeostatic fluctuation of the chosen parameter, has made it possible to predict the probable radiosensitivity of individuals of the same non-inbred strain (7, 8, 9). Similar results were obtained by Ueno (14) in the study of the daily fluctuation in the total body weight of mice stressed by isolation prior to radiation exposure. The aim of that work was to verify the possibility whether the same methodical principle can also be applied for explaining the different radiosensitivity of various inbred strains of mice.

In mice of four strains the fluctuation of the body weight was studied in the coura of a ten day's isolation and the character of this fluctuation was compared with the literary given date of radiosensitivity of these strains, expressed in LD 50/30. For the experiments we used mice of the CBA strain (n=73, 40

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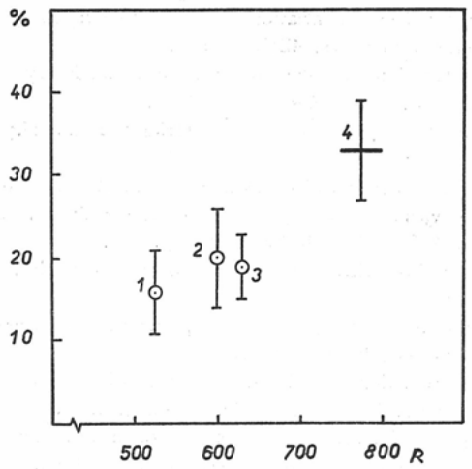
males, 33 females; mean body weight 20.9), C57BL/6 strain (n=100, 50 males, 50 females; mean body weight 18.8 g), dd/YEF strain (n=50, males; mean body weiht 18.7 g), and CF 1 strain (n=50, females; mean body weight 23.4 g). At the beginning of the experiments the mice were 60 days old, which corresponds approximately to literary data, from which the values LD 50 were taken. On the basis of literary data we took, LD 50 approximately 750–800 Rf or CBA strain (1), about 630 R for C57BL/6 strain (3, 2, 12), 600 Rf or dd/YF strain (6), 525 R for CF 1 strain (11). The absolute values of LD 50 of mice strains observed in various laboratories may vary according to the conditions of experiment. However the relative differences in radiosensitivity of the strains used have been demonstrated repeatedly, some of them in our laboratory. In our experimental material we jointly used males and females, because the differences in

Fig. 1. x: LD 50 of CF 1 strain (1), dd/YF strain (2), C57 BL/6 strain (3), CBA strain (4). y: percentage of theoretically radioresistant individuals. Vertical lines show standard deviation.



LD 50 between males and females are relatively slight and do not influence the relative differehces in the sensitivity of the strains used (3, 12). At the beginning of the experiments the mice were put separately in individual plastic cages (12 hours light and 12 hours dark cycle, laboratory chow and water ad libitum, the temperature of the room being controlled at 24 ± 1°C). The weight of the individual mice was registered at 10:00 a.m. every day for a period of 10 days (for details see Ueno 1964).

The degree of homeostatic fluctuation of the body weight was determined in the individual aimals by the method of "Mean Square Successive Difference" and expressed by the value σ^2 (4). The mean value δ^2 of the entire experimental complex, irrespective of the strain used, corresponds to 0.55. Around this value we can find the middle fluctuation of physiological functions, characterizing the regulatory balanced individuals and, according to our previous experience, the individuals with the relatively highest resistance to irradiation. Higher and lower δ^2 values, corresponding to the extreme positions of the distribution of this parameter, can be found in individuals with a higher radiosensitivity (Ueno 1964). In our experimental material, individuals with a δ^2 value within the range of 0.40–0.70 were marked as theoretically radioresistant. The percentage of theoretically radioresistant individuals, determined according to this criterion in the individual strains, was compared with the data of LD 50 of these strains.

The results are presented in Fig. 1. It is evident that the percentage of radioresistant individuals rises proportionally with the presumed value LD 50. When using the X^2 test, the differences in per cent of present theoretically radioresistant individuals between the strains CBA-CFl and CBA-C57BL/6 was confirmed as statistically significant ($P<0.05$).

The results show that the chosen indicator of the physiological state of the individual, formerly applied to the interindividual difference within the strains, looks to be also applicable to the genetically conditioned interstrain differences in radiosensitivity. As was pointed out by Roderick (10), genetically radioresistant animals tend to be genetically fit in general. The parameter of balance of the homeostatic regulatory functions chosen by us appears from this aspect as an indicator of genetical fitness at a higher organization level.

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