CHANGES IN THE LEVELS OF LUTEINIZING HORMONE AND TESTOSTERONE IN THE CIRCULATION OF AGEING MALE RATS

G. D. GRAY

Department of Physiology, Stanford University School of Medicine, Stanford, California 94305, U.S.A.

(Received 26 September 1977)

Pituitary-testicular function changes substantially with increasing age in male rats; the levels of testosterone and gonadotrophins in the circulation are reduced in old animals (Ghanadian, Lewis & Chisholm, 1976; Riegel & Meites, 1976; Chan, Leatham & Esashi, 1977). However, previous studies compared only young and very old rats (more than 18 months) and the development of age-related changes in the concentrations of testosterone and gonadotrophins has not been examined. Since ageing is a complex interaction of physiological changes over a prolonged period of time, information on the precise timing of the various changes is important in establishing functional relationships in the ageing process. This study investigates hormonal changes in a group of male rats between 8 and 21 months old.

Adult male Long–Evans rats were housed three/cage in a temperature-controlled room with a 14:10 h light: darkness cycle (lights on 05.00 h). Blood samples were obtained from groups of ageing rats at 8, 13, 15, 17, 19 and 21 months of age. Groups of 6–12 young rats (3–4 months) were also sampled at each time point to provide control values. Samples were collected at 11.00 h by cardiac puncture after ether anaesthesia; the procedure was completed within 3–4 min of disturbing the animal. The concentrations of hormones were determined by radioimmunoassay, according to the methods of Niswender, Midgley, Monroe & Reichert (1968) for luteinizing hormone (LH; NIH-LH-RP1) and Frankel, Mock, Wright & Kamel (1975) for testosterone. Intra-assay coefficients of variation were 9.3% for LH and 5.4% for testosterone; interassay coefficients were 10.1 and 6.3% for LH and testosterone respectively.

Nine of the 19 ageing rats died or developed obvious pathological conditions (tumours, lung dysfunction, weight loss) before completing the study and the last sample for each of these animals was also sampled from the data. Changes in the levels of LH and testosterone in the plasma (Fig. 1) were examined by analysis of variance and subsequent t-tests (Kirk, 1968). The level of testosterone in the plasma declined progressively with increasing age: ageing rats first showed a significant difference from young animals at 15 months (P<0.01), although they also had slightly lower levels at 13 months. By 21 months, the level of testosterone in the plasma of ageing rats was one-third of the value in young rats. The level of LH also declined with age: values were significantly lower than those of young animals at 13 months (P<0.05) and again at 17, 19 and 21 months (P<0.05). The percentage reduction in the level of LH was smaller and less consistent than that for testosterone. The ten ageing rats which remained healthy throughout the experiment showed essentially the same pattern of change in the levels of hormones with age as the entire group. The various groups of young rats did not differ significantly among themselves in the levels of either LH or testosterone.

Ageing effects on pituitary-testicular function are evident as early as 13–15 months in male rats. It is unlikely that the effects are due entirely to ill-health since care was taken to eliminate unhealthy animals from sampling and many apparently healthy and long-lived animals had very low titres of LH and testosterone by 15 months. The levels of both LH...
Fig. 1. Concentrations (means ± s.e.m.) of LH (a) and testosterone (b) in the plasma of ageing male rats (solid line) and control groups of young (3-4 months) male rats (shaded area). Numbers of ageing rats sampled at each age are given in parentheses.

and testosterone demonstrated changes at around the same age, suggesting that the reduction in testosterone may be, at least in part, the result of decreased stimulation of the testes by gonadotrophins. Testicular deficiencies may also be involved, given the much larger reduction in the concentration of testosterone compared with that of LH. Caution should be exercised in evaluating the LH data since the time required for cardiac puncture was probably sufficient for a small 'stress-induced' increase in the level of LH above the basal value. It is concluded, however, that the level of LH declines with increasing age and at no time is there an increase as occurs in men (Stearns, MacDonell, Kaufman, Padua, Lucman, Winter & Faiman, 1974).

The author was supported by a National Research Service Award from the National Institute of Aging; the research was funded by NIH grant HD-00778 to J. M. Davidson. Drs E. Smith, D. Tallentire and B. Siddal are thanked for their assistance. Radioimmunoassay reagents were supplied by Drs G. Niswender, B. Caldwell and L. Reichert and by the NIAMDD pituitary hormone distribution program.

REFERENCES