

Renal Plasma Flow During Moderate Exercise of Several Hours' Duration in Normal Male Subjects.

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That exercise produces a decline in renal plasma flow is now established.^{1,2} In a previous report² the degree of reduction was found to be progressive for at least 30 minutes as exercise proceeds and was directly related to the severity of the exercise. The effects of long-sustained exercise have not, to our knowledge, been determined and it is with this topic that the present report deals.

Method. Technically the method employed in this work was identical with that previously described² except that the time spent on the treadmill totalled 3 hours. Para-amino-hippurate was used to determine renal plasma flow. As in the previous experiments a moderate water diuresis was instituted and urine samples were collected by voluntary micturition. The exercise was at the rate of 3 miles per hour at 5% grade.

Material. Four normal male students, aged 22 to 27 years, were employed for the study. Three of the subjects had been studied extensively in previous experiments on the effects of exercise of relatively short

duration. A single experiment employing exercise of long duration was done on each subject.

Results. Fig. 1 and Table I summarize the effects of long-continued exercise on the renal plasma flow in these 4 subjects. At this level of exercise the renal plasma flow declined to a relatively stable value during the first 40 to 60 minutes of exercise. The value reached during the first hour was relatively well maintained in these 4 subjects for the remaining 2 hours of exercise. The degree of decline in the first 32 minutes of work corresponded almost exactly to that determined in previous experiments² at the same level of work.

In 2 of the subjects the renal plasma flow had returned to within 10 per cent of resting levels 40 minutes after cessation of work. In a third subject the resting value was slightly exceeded at the end of 40 minutes. No studies of recovery were carried out on the fourth subject.

Discussion. The decrease in renal plasma flow in response to moderate exercise is, it appears, a progressive phenomenon only during the first 40 to 60 minutes of the exercise. Continuation of the stress for 2 full hours beyond this point resulted in no further decline in the amount of plasma flowing through the kidney. It is well established that the cardiovascular system can adjust relatively quickly to various levels of work, permitting the work to be continued without further circulatory adjustment until the subject approaches the point of exhaustion. That the kidney participates in the circulatory changes is clearly shown in this and previous experiments. The shunting of blood away from the kidney reaches a maximum relatively early in sustained exercise and is continued until the work ceases. The adjustment of renal plasma flow in response to exercise is, however, not as rapid as some other circulatory changes. In

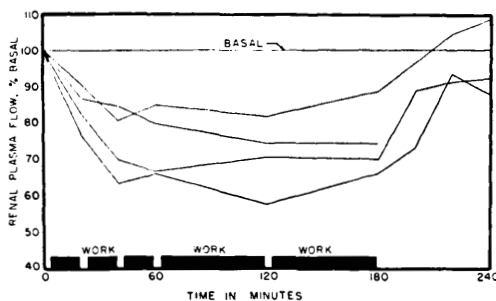


FIG. 1.

Changes in renal plasma flow in 4 normal male subjects during and after walking 3 m.p.h. at 5% grade.

¹ Barelay, J., Cooke, W., Kennedy, R., and Nutt, M., *J. Physiol.*, 1945-46, **104**, 14P.

² Chapman, C., Henschel, A., Minckler, J., Forsgren, A., and Keys, A., *J. Clin. Invest.*, 1948, **27**, 639.

TABLE I.

Renal Plasma Flow in cc per Minute, Corrected to 1.73 sq. m. Body Surface, During and After Work of Relatively Long Duration at the Rate of 3 m.h.p. at 5% Grade.

Subject	Basal	Work					Recovery		
		20 min.	40 min.	1 hr	2 hr	3 hr	20 min.	40 min.	60 min.
BS	512	416	315	332	360	355	452	458	471
PW	576	499	487	459	425	425	—	—	—
WW	523	484	431	452	434	462	—	557	723
SN	607	466	385	402	345	399	456	566	535
Mean	555	466	405	411	391	410	454	516	578

work of this type, the increase in pulse rate and oxygen uptake, for example, are maximal 10 to 15 minutes after initiation of exercise.

Presumably, as the subject approaches exhaustion other changes in the renal plasma flow take place but in none of our experiments were the subjects seriously taxed by the work imposed.

Recovery was studied in 3 subjects for one hour after cessation of exercise. Although the number of experiments is too small to permit statistical testing, the speed of the recovery process after 3 hours of exercise seems to be much the same as after only 32 minutes of this work. In neither case was it as rapid as return of the pulse rate or blood pressure to resting levels.

Summary. 1. Renal plasma flow was studied by the para-amino-hippurate clearance method during moderate exercise of relatively long duration in 4 healthy young men. 2. During the first 16 minutes of walking 3 m.p.h. at 5% grade the renal plasma flow fell from 9 to 23.2% (of the resting control); during the second 16 minute period it fell from 15.4 to 36.6% and during the third 16 minute period from 18.5 to 33.7%. 3. During the second and third hours of exercise (2 consecutive 56-minute periods), there was little further change in the renal plasma flow. 4. In 2 of 3 experiments where recovery was studied, the renal plasma flow had returned to within 10% of the resting control value one hour after cessation of exercise.

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Asymmetrical Suppression of Vertebral Epiphyseal Growth with Ionizing Radiation.

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(Introduced by L. J. Soffer.)

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Ionizing radiation can suppress growth of epiphyses. Many studies of this phenomenon have been made on long bones, but only Engel¹ has previously described the deformities resulting from irradiation of the growing spine. He placed radium needles alongside the spines of young goats and produced a wedge deformity of the adjacent vertebrae.

The narrowing of the vertebrae occurred on the side nearer the radium, and the resultant scoliosis was concave on the same side.

We have tried additional technics in radiation of the spine in growing animals. Using radon seeds for interstitial radiation and 140 kV x-rays for external radiation, our preliminary experiments have attempted to establish a useful dosage range for suppression of vertebral epiphyseal growth in baby rabbits.

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¹ Engel, D., *Am. J. Roentgenol. and Rad. Therapy*, 1939, **42**, 217.