

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.

Interstitial Radiation. Radon seeds were implanted just lateral to a lumbar intervertebral space. Films of the spine were made with seeds *in situ* (Fig. 1) in order to evaluate positioning and dosage. Fourteen rabbits had a total of 24 seeds implanted; 10 rabbits had two seeds in each, and 4 animals had 1 seed in each. These seeds were equivalent to 0.2, 0.4, or 0.6 millicurie of radium on total decay and were filtered by the equivalent of 0.3 mm of platinum. Of these 14 animals 10 died of gastro-intestinal infections less than 3 weeks after implantation of radon seeds. The 4 surviving animals had a total of 6 seeds. Wedging occurred adjacent to 2 seeds, both of which were placed in apposition with the intervertebral space and contained 0.6 mc of radon on total decay. (Fig. 2) Other implanted sites did not show wedging because of poor positioning of seeds or lower radon content of the seeds.

External Radiation. Asymmetrical radiation of the growing epiphyses of the vertebral bodies was also effected by directing a narrow beam of x-rays to one side of the lumbar spine. Under intravenous anesthesia to immobilize the rabbits one side of the spine was treated with dosages (in air) ranging from 300 to 1200r. Radiation factors were: 140 kV, 20 ma., 30 cm target skin distance, filtration of 0.25 mm Cu, and 1 mm Al., HVL 0.50

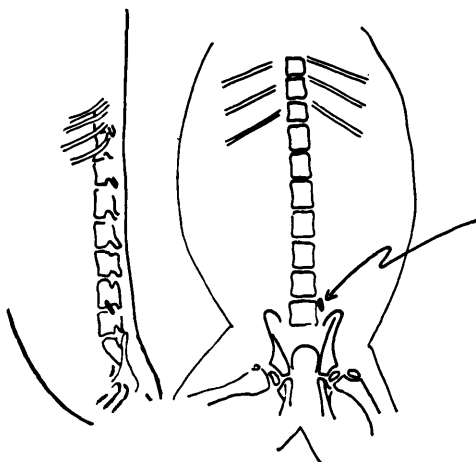


FIG. 1. (Tracing from roentgenogram). Anteroposterior and lateral roentgenograms made immediately after implantation to show position of implanted radon seed (arrow). The spine is straight.

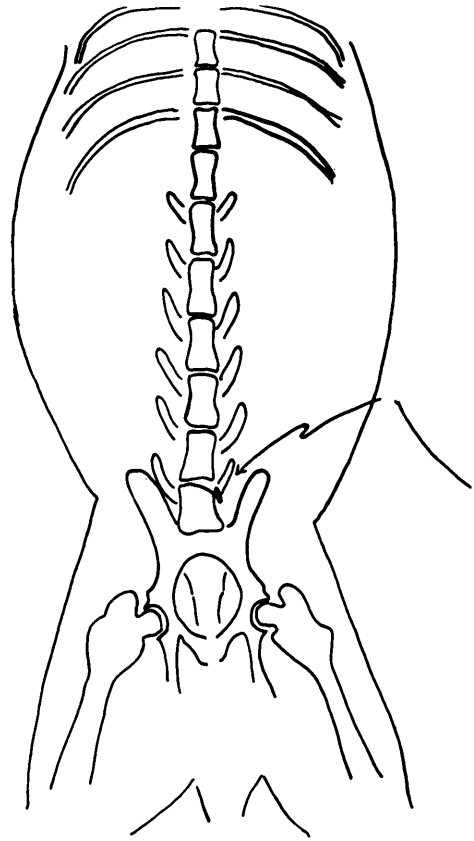


FIG. 2. (Tracing from roentgenogram). Same rabbit as in Fig. 1. This film was made 110 days after implantation of radon seed and illustrates asymmetrical growth of both vertebrae adjacent to the 0.6 mc. radon seed (arrow). In this instance the middle of the epiphyses nearest the seed received an estimated dose of 2680r while the opposite side of these vertebral epiphyses received 670r. The growth suppression varied directly with the dosage.

mm Cu., and a flux of 60 r/min. The field size was 1 x 7 cm, and the dose at the middle† of the vertebral bodies at a depth of 1.5 cm was 70% of the air dose^{2,3} at the center of the field. Accuracy of field was verified by exposing x-ray films with the rabbits under anesthesia and with the therapy machine in place ready for treatment (Fig. 3).

Of rabbits irradiated externally 11 died of

† Midway between anterior and posterior edges.

² Glasser, O., Quimby, E. H., Taylor, L. S., and Weatherwax, J. L., *Physical Foundations of Radiology*, Paul B. Hoeber, Inc., N. Y., 1944.

³ Clarkson, J. R., *Brit. J. Radiol.*, 1941, **14**, 265.

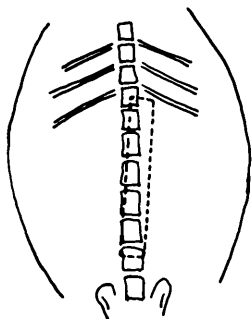


FIG. 3. (Tracing from roentgenogram).

This shows the spine of a three week old rabbit with 1×7 cm radiation field indicated by dotted line. Dose to the middle of the vertebral bodies involved was 1000r.

gastro-intestinal infections. The five survivors received dosages to the region midway between the anterior and posterior surfaces of the vertebral bodies of 100r, 350r, 700r, or 1000r. Only the 2 animals which received the highest dosage showed marked wedging on the irradiated side of the vertebrae. (Fig. 4). Slight wedging was seen in an animal which received 700r.

Summary. The lumbar spines of 30 young rabbits were unilaterally irradiated with radon seeds and X-rays. Twenty-one animals died of gastro-intestinal disturbances unrelated to radiation. Five of the 9 survivors showed wedging of the vertebral bodies with the narrowing of the bodies on

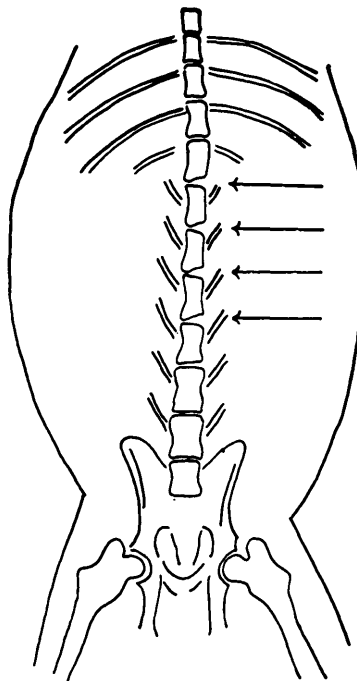


FIG. 4. (Tracing from roentgenogram).

This shows the spine of the same rabbit 54 days later. Wedged vertebrae are indicated by arrows.

the more heavily irradiated side. Dosage estimates indicate that growth of the epiphyses of the vertebral bodies of baby rabbits may be suppressed with 700 to 1000 r to the epiphysis. Doses of 350 r or less have no apparent effect on the growth.