

4–6 months before the micropuncture study. The rats were then deliberately kept in uncleaned cages to speed up the autoinfection of the urinary tract by microorganisms from the feces. Eight animals prepared in this way were investigated. These animals had significantly higher blood urea nitrogen values. Two control groups were used: intact animals, and rats with temporarily ligated ureters injected i.v. with sterile saline only. No differences in measured values, even in animals with obvious uraemia, were obtained. The results indicate that the proximal intrinsic reabsorptive capacity of superficial nephrons in pyelonephritic rats, even with obvious uraemia of mild degree, do not differ significantly from control rats. From this point of view, our data are in accord with BRICKER's 'intact nephron hypothesis'. These data do not provide an explanation for the lack in concentrating power repeatedly described in human chronic

pyelonephritis. Further studies involving the state of the collecting ducts and renal medullary circulation will be required.

**Zusammenfassung.** Die tubuläre Resorptionskapazität und Passage-Zeit der Tubulusflüssigkeit wurde im proximalen Konvolut der Rattenniere mit experimenteller Pyelonephritis (mit und ohne Uraemie) gemessen. Es konnten keine Unterschiede zwischen gesunden und kranken Tieren gefunden werden, was für die BRICKERsche «Intact Nephron Hypothesis» sprechen würde.

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### Venous Geometry as Determined by Venous Pressure

It has been repeatedly recognized that the cross-sectional area of veins appears to be far from circular even in physiological conditions<sup>1</sup>. Although this fact is generally acknowledged, current literature is lacking of even basic in vivo studies, supplying direct quantitative data and limitations either for individual venous sections or for various species<sup>2</sup>. This uncertainty might be accounted for by the fact that hitherto venous size changes, whatever their cause, have been investigated indirectly as changes in volume, capacity, pressure etc. Thus the actual configuration of the transectional area of the vascular channels investigated has been thought to be of minor if any importance.

Using, in a recent study<sup>3</sup>, a more direct method of establishing sympathetic control of collecting veins, it became, on the other hand, essential to explore as accurately as possible the limits within which the configuration of the venous cross-sectional area – from elliptical to circular – might be determined.

Segments approximately 8 cm in length of femoral veins of 11 penthotal-anaesthetized dogs were exposed free from surrounding tissue and hemodynamically isolated by tying off all branches, including proximal connection. Through a canula inserted in the peripheral end, the segment was connected with a saline-filled reservoir to adjust transmural pressure to the desired level. After transmural pressure was established, the venous segment was frozen (Propan-butan mixture at liquid nitrogen temperature) and immediately afterwards their shape (i.e. their circumference) was determined by the aid of an instrument very similar to that used (to determine tooth-shape) in dentistry (dentimeter).

The 'venous-shaped' forms (0.05 mm thin wire) were photographed (Figure 1) and then in 10-fold magnification the major and the minor axis (perpendicular to each other) were measured by the aid of a micrometer.

The ratio of the 2 axes (major axis, i.e. horizontal diameter  $D_{max}$ , minor axis i.e. vertical diameter  $D_{min}$ ) was calculated and related to the actual transmural pressure.

As apparent in Figure 2, the  $D_{max}/D_{min}$  ratio higher than 1.6 at VP 2 cm  $H_2O$  with increasing transmural pressure declines sharply to values near 1.1 at PV 10 cm. At higher transmural pressure  $D_{max}/D_{min}$  ratio approximates asymptotically unity which indicates the diameter is practically identical in either direction. Consequently, at transmural pressure above 16.0 cm  $H_2O$  the cross-sectional area of the vein is to be considered as circular.

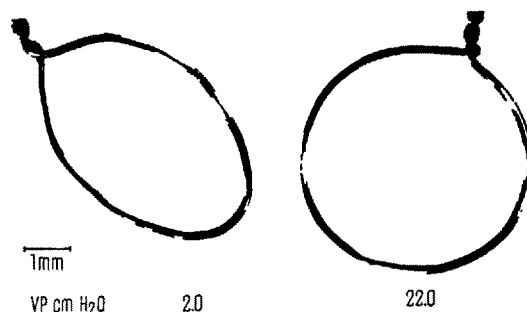


Fig. 1. Samples of the circumference of the dog's femoral vein as determined by the method described.

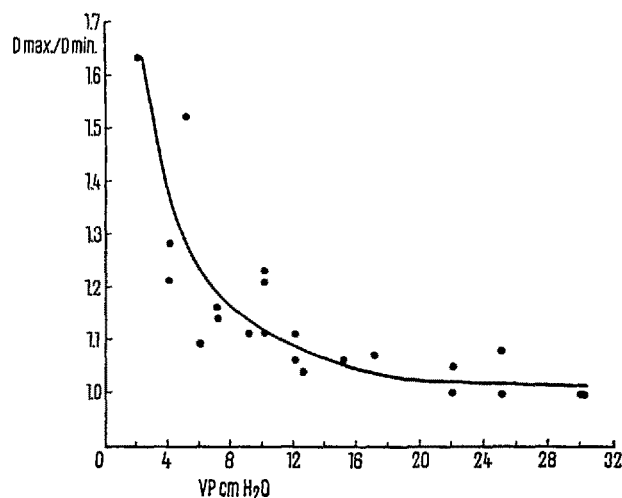


Fig. 2. Major to minor axis ratio ( $D_{max}/D_{min}$ ) of the femoral vein (abscissa) related to transmural pressure (PV, cm  $H_2O$ , ordinata).

<sup>1</sup> R. S. ALEXANDER, in *Handbook of Physiology* (American Physiological Society, Washington 1963), sect. 2, vol. 2.

<sup>2</sup> This paper was ready for publication when comparable studies on cats were reported by B. ÖBERG, *Acta physiol. scand.* 77, 233 (1967).

<sup>3</sup> J. GERO and M. GEROVÁ, *Experientia* 24, 811 (1968).

Conclusion: changes in shape of collecting veins as determined by transmural pressure were studied in vivo. Major to minor axis ratio of femoral veins in dogs was shown to decrease with increasing transmural pressure from  $D_{max}/D_{min}$  1.6 (at PV < 2 cm H<sub>2</sub>O), approaching asymptotically unity (PV > 16.0 cm H<sub>2</sub>O)<sup>4</sup>.

**Zusammenfassung.** Es wird die Abhängigkeit der Gefäßquerschnittsform der Vena femoralis vom Binnendruck in vivo am narkotisierten Hund untersucht. Bei zunehmendem Binnendruck vermindert sich die Relation des grossen Horizontaldurchmessers zum kleinen Vertikaldurchmesser ( $D_{max}/D_{min}$  > 1,6/ bei Venendruck < 2 cm H<sub>2</sub>O) exponentiell, bis sich der Quotient bei einem Venen-

druck über 16 cm H<sub>2</sub>O asymptotisch dem Wert 1,0 annähert. Es ergibt sich, dass die Venenquerschnittsform bei einem Binnendruck über 16 cm H<sub>2</sub>O als praktisch rund zu betrachten ist.

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## Effects of Environmental Temperature-Humidity and Cage Density on Body Weight and Behavior in Mice

Environmental temperature<sup>1-3</sup> and cage density<sup>4,5</sup> have been shown to influence body weight and behavior. Although cage density interacts with environmental temperature to potentiate<sup>4</sup> or inhibit<sup>6</sup> the effects of temperature on survival, the nature of this interaction could be expected to have differential effects when examined in reference to other measures of biological and behavioral adaptation. The present report investigates the effects of rearing mice under different conditions of environmental temperature-humidity and cage density on body weight and a test of swimming survival.

**Method.** A sample of 200 male mice of the C3H/HeJ strain from a larger population maintained by one of the authors (E. P. L.) was used as subjects. These animals were obtained from the Production Department of The Jackson Laboratory at weaning age ( $21 \pm 3$  days). They were housed under a condition of environmental temperature-humidity [70°F with 60% relative humidity (R.H.), or 95°F with 30% R.H.], and a condition of cage density (4 or 8/cage). Thus, 50 mice were in one of each treatment condition. Cages were solid stainless steel (11 × 5 × 5 inches deep) with wire mesh covers and pine shavings as bedding. Food and water were available ad libitum.

All mice were reared in environmental chambers (Hot-pack, Inc., Philadelphia) under conditions of 12 h of light, 2 complete air changes per h, and the experimental conditions described above. The swimming survival test was conducted in a water tank described previously<sup>7</sup>. Except for weekly changing of cages and replenishing food and water, mice were not disturbed until 125 days of age. At this age, mice were placed in individual holding boxes and maintained at approximately 72°F while being transferred from one laboratory building to another. This required about 40 min and occurred immediately prior to the swimming survival test.

Ten mice from each experimental condition were assigned randomly to a water temperature condition (65, 75, 85, 95 or 105°F) for the swimming survival test. Each mouse was weighed, and a weight (weighted safety pin) in the ratio of 2 g of tail weight to 30 g of body weight was attached by a 9 mm wound clip 1 inch from the base of the tail. The mouse was held by the tail with forceps about 18 inches above the water surface and released. Swimming survival time (sec) was defined as the interval between release of the animal and the fifth consecutive second during which no part of its body was visible above the water surface. The animal was then removed.

**Results and discussion.** The mean body weights of the various groups of mice at 125 days of age are presented in the Table. Analysis of variance of these data show a significant environmental temperature-humidity effect ( $F = 237.76$ ,  $df = 1/196$ ,  $p < 0.01$ ) and a significant environmental temperature-humidity × cage density interaction ( $F = 8.82$ ,  $df = 1/196$ ,  $p < 0.01$ ). Comparisons of mean weight between the individual groups by the NEWMAN-KEULS method<sup>8</sup> showed that mice raised 8/cage at 95°F-30% R.H. weighed significantly less ( $p < 0.05$ ) than the other 3 groups. Regardless of cage density, mice raised at 95°F-30% R.H. weighed significantly less ( $p < 0.01$ ) than mice raised at 70°F-60% R.H. The environmental temperature-humidity effect on body weight is consistent with previous reports<sup>1,2,9</sup>. However, the independent effect of cage density is not consistent with previous investigations<sup>4,5</sup>. This discrepancy could be related to the differences in the size of cage densities employed (i.e. isolated versus grouped, or grouped versus grouped). The interactive effect of cage density and environmental temperature-humidity may be related to temperature increases induced in the cage and in the animal as a function of cage density<sup>10,11</sup>. These temperature increases may not be sufficient to result in reduced body weight of mice raised at 70°F-60% R.H. but may be sufficient to potentiate the effect already present at 95°F-30% R.H.

The mean swimming survival time as a function of water temperature for the different experimental groups is presented in the Figure. Analysis of variance showed a significant water temperature effect ( $F = 63.51$ ,  $df = 4/180$ ,  $p < 0.01$ ) and a significant environmental temperature-

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<sup>6</sup> J. KING and H. CONNON, *Physiol. Zool.* 28, 233 (1955).

<sup>7</sup> J. WERBOFF, B. N. HAGGETT and A. ANDERSON, *Physiol. Behav.* 2, 39 (1967).

<sup>8</sup> B. J. WINER, *Statistical Principles in Experimental Design* (McGraw-Hill, New York 1962).

<sup>9</sup> C. ROUBICEK, *Growth* 30, 79 (1966).

<sup>10</sup> G. FINK and R. LARSON, *J. Pharmac. exp. Ther.* 137, 361 (1962).

<sup>11</sup> E. GREENBLATT and A. OSTERBERG, *J. Pharmac. exp. Ther.* 131, 115 (1961).