On the Pathogenesis of the Renoprival Hypertension in Dogs

Conflicting opinions exist, not only regarding pathogenesis of the so-called renoprival hypertension (GROLLMAN et al.[1]), but even on the existence of a form of hypertension due to the absence of renal tissue. GOLDBLATT[2] considers it an artefact, due to undetected overhydration, while LEONARDS et al.[3], HOUCK[4], and ORIBSON et al.[5] claim that overhydration per se is not sufficient to produce hypertension if renal tissue is present.

In this paper, the results obtained in an investigation into these points are described.

Materials and methods.

For this research, 39 mongrel dogs were used ranging in weight from 8 to 22 kg. Arterial pressure was measured according to GROLLMAN[6], and dogs having values higher than 150 mm Hg were discarded.

The ligature of the ureters was made in a single operation, whereas bilateral nephrectomy was performed in two operations. Immediately afterwards, a single dose of a broad spectrum antibiotic was administered intramuscularly, and, during anuria, 10 ml/kg/day of a 40% dextrose solution was infused intravenously. Overhydration was achieved by the method of HOUCK[4] and peritoneal dialyses according to GROLLMAN et al.[7].

The extracellular fluid compartment was measured with the thiocyanate method, according to CARDOZO et al.[8], while the blood volume was calculated from the hematocrit value and the plasma volume. This was determined with the Coomassie blue, according to TAYLOR et al.[9].

Results

Group 1: *Dogs nephrectomized and maintained in water and sodium balance.* Animals in which the body weight did not change by more than 10% of the basal figure during the whole survival period, and in which the plasma sodium did not alter significantly, were considered to be in water and sodium balance. Dogs having greater weight changes and suffering from severe vomiting and/or diarrhoea were discarded.

[1] A. GROLLMAN, E. E. MUIRHEAD, and J. VANATTA, Am. J. Physiol. *157*, 21 (1949).
[2] H. GOLDBLATT, Circulation *17*, 642 (1958).
[3] J. R. LEONARDS and C. R. HEISLER, Am. J. Physiol. *167*, 553 (1951).
[4] C. R. HOUCK, Am. J. Physiol. *176*, 237 (1954).
[5] J. L. ORIBSON, C. L. CHRISTIAN, and E. PETERS, Arch. Path. *54*, 185 (1952).
[6] A. GROLLMANN, Am. J. Physiol. *173*, 364 (1953).
[7] A. GROLLMAN, L. B. TURNER, and J. A. MCLEAN, Arch. int. Med. *87*, 379 (1951).
[8] R. H. CARDOZO and I. S. EDELMAN, J. clin. Invest. *31*, 280 (1952).
[9] S. H. TAYLOR and J. P. SHILLINGFORD, Brit. Heart J. *21*, 497 (1959).

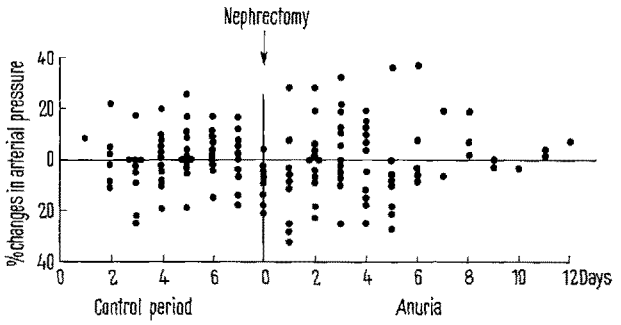

Fig. 1. Behaviour of the blood pressure in dogs nephrectomized bilaterally (*nephrectomy* indicates the removal of the second kidney) and maintained in water and sodium balance. No significant increase in the arterial pressure is detectable during anuria.

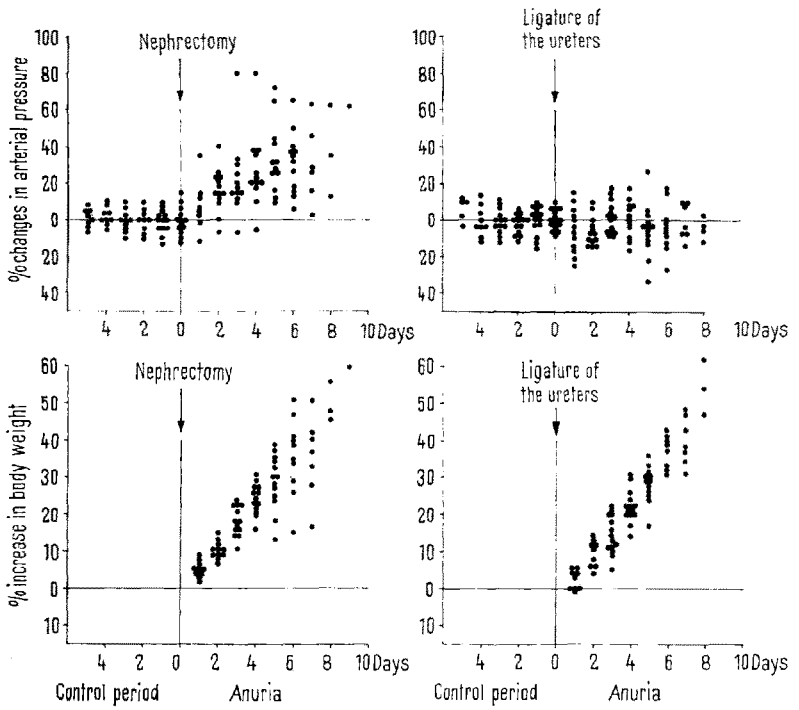

Fig. 2. Behaviour of the blood pressure and body weight in dogs nephrectomized bilaterally and in dogs submitted to ligature of the ureters. It is evident that, despite an increase of the body weight of the same magnitude in both groups of dogs, only the nephrectomized ones developed hypertension.

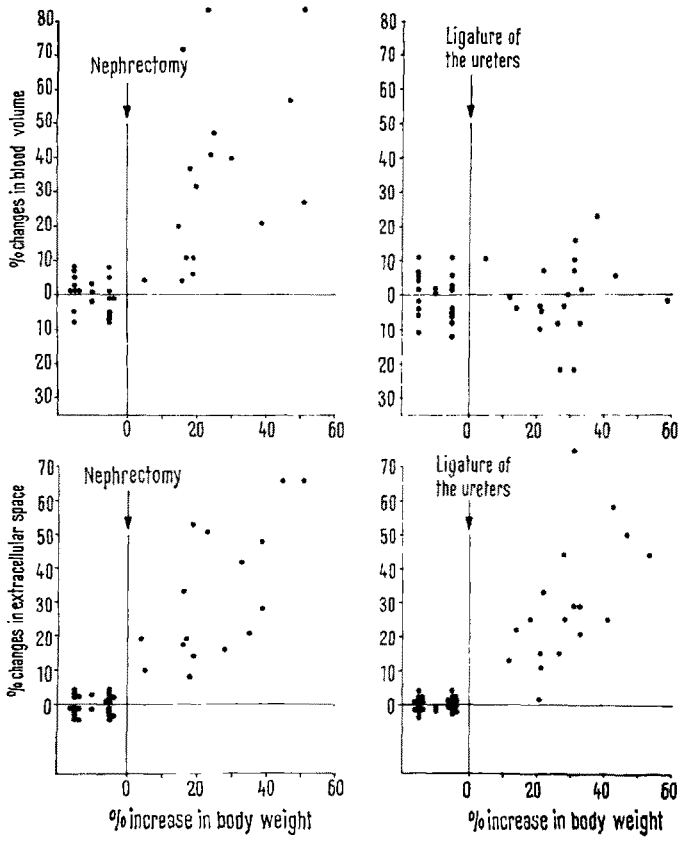

Fig. 3. Behaviour of the thiocyanate space and blood volume as a function of the changes in the body weight in dogs nephrectomized bilaterally and in dogs submitted to ligature of the ureters. While the thiocyanate space increases in both groups, the expansion of the blood volume is detectable only in the nephrectomized animals.

All the animals of this group, including those submitted to peritoneal lavage and surviving for longer periods of time, showed no appreciable increases in the arterial pressure (Figure 1).

Group 2: *All the dogs nephrectomized and overhydrated* had an increase in the arterial pressure (Figure 2). In this group, the changes in the thiocyanate space, as well as those in the blood volume, were grossly proportional to the increase in the body weight occurring during anuria (Figure 3).

Group 3: *Dogs submitted to ligature of the ureters and overhydration* showed no significant changes in the arterial pressure during the whole period of anuria, despite an increase of the body weight of the same magnitude as that of the previous group (Figure 2). The changes in the thiocyanate space were proportional to those in the body weight but no significant increase was observed in the blood volume (Figure 3).

Discussion

Failure of hypertension to develop in the nephrectomized dogs maintained in water and sodium balance, strongly suggests that the removal of both kidneys is not sufficient by itself to produce an increase in the blood pressure. The same finding has been described by MERRILL et al.[10] for renoprival humans submitted to repeated hemodialyses.

However, when overhydration is produced in the nephrectomized dogs, the blood pressure immediately increases, as has been observed by HOUCK[4], ORIBSON et al.[5], and LEONARDS et al.[3]. Overhydration appears to be necessary for blood pressure to increase in the nephrectomized dogs and, particularly, the expansion of the blood volume. This has been found also to be correlated with the hypertension resulting from the constriction of the renal arteries (LEDINGHAM et al.[11]). The expansion of the blood volume seems to be part, as a causal factor, of the so-called renoprival hypertension, since in dogs with ligature of the ureters, whose blood volume remained constant despite the overhydration, no increase in the arterial pressure was observed. The causes of the different distribution of the fluid administered in the two groups of dogs are unknown.

Riassunto. L'ipertensione arteriosa non compare nel cane nefrectomizzato bilateralmente, se non si associa la iperidratazione. La iperidratazione, peraltro, non produce ipertensione nel cane con ureteri legati. Solo nei cani renoprivi e iperidratati si ha un aumento del volume del sangue.

S. GIOVANNETTI, A. BIGALLI, and P. L. BALESTRI

Clinica Medica Generale dell'Università di Pisa (Italy), November 25, 1964.

[10] J. P. MERRILL, C. GIORDANO, and D. R. HEETDERKS, Am. J. Med. *31*, 931 (1961).

[11] J. M. LEDINGHAM and R. D. COHEN, Canad. Med. Ass. J. *90*, 292 (1964).