Experimental Renal Hypertension in the Dog Following Renal Ischemia.* (17680)

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Experimental renal hypertension can be produced with regularity in the dog by constricting the renal arteries(1-3). Wakerlin and associates have succeeded in producing experimental renal hypertension in 100% of dogs by using a standardized technique of renal artery constriction(4). The present research took advantage of this accuracy in producing experimental hypertension in the dog, by using it as a tool in studying the effects of varying degrees of renal damage on subsequent experimental hypertension production in the same animal.

Methods. Nineteen experimental and 10 control dogs were used varying in age, weight, and sex. The experimental dogs were divided into 4 groups and observed for a control period of from one to 2 months. Three groups of 5 dogs each received respectively 2, 4, and 5 hours simultaneous bilateral renal artery occlusion following the control period and the fourth group of 4 dogs received 6 hours of occlusion. A recovery period of one month was allowed each dog after renal artery occlusion. Following this period the dogs were subjected to bilateral renal artery constriction (3-week interval between constrictions) according to the standardized technique referred to above. Mean femoral arterial pressure, blood urea nitrogen (BUN), phenolsulfonphthalein excretion (PSP)(5), and urinalysis changes were observed at semiweekly or more frequent intervals.

Results. Ten control dogs, receiving bilateral renal artery constriction without preliminary bilateral renal artery occlusion, all showed a rise in mean femoral arterial pressure averaging 43 mm of mercury for the period of observation which was 4 or more months following bilateral renal artery constriction. The mean arterial pressure change of a typical dog in this group is shown in Fig. 1. The changes in the mean femoral arterial pressure of the dogs which survived the renal damage induced by bilateral renal artery occlusion and subsequent bilateral renal artery constriction demonstrated 2 major patterns which were quite unlike the control group. Seven dogs which developed mild renal damage from 2 and 4 hours of bilateral renal artery occlusion, as evidenced by a modest rise in blood urea nitrogen with slight to no change in phenolsulfonphthalein excretion, evidenced the changes in mean arterial pressure shown in Fig. 2, namely a sharp rise in the mean arterial pressure in the first month following the renal artery constriction. The pressure was seen to fall toward normal in the third month following bilateral renal artery constriction and in some of the dogs the pressure returned almost to the normotensive control level. Four dogs survived severe renal damage, produced in 3 of the dogs by 4 hours and in one by 6 hours of bilateral renal artery occlusion. In these 4 dogs very slight or no rise in pressure was seen for a period of 3 or more months following bilateral renal artery constriction. Two of the dogs were sacrificed at the end of 3 months and 2 of the dogs were observed for a longer period. It will be noted from Fig. 3, which represents the typical changes in mean arterial pressure

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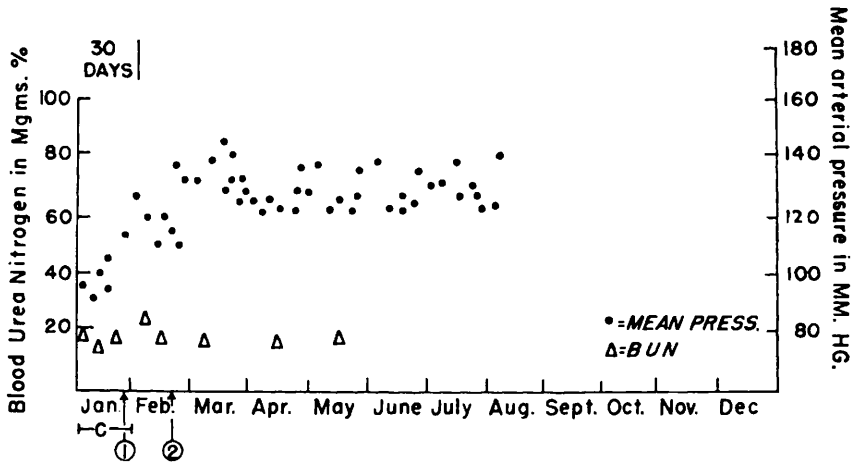

FIG. 1.
A typical control dog showing the changes in the mean arterial pressure (●) following bilateral renal artery constriction [(1), (2)]. A rise in pressure was seen in all control dogs. (△) Blood urea nitrogen. ←C→ = Control period.

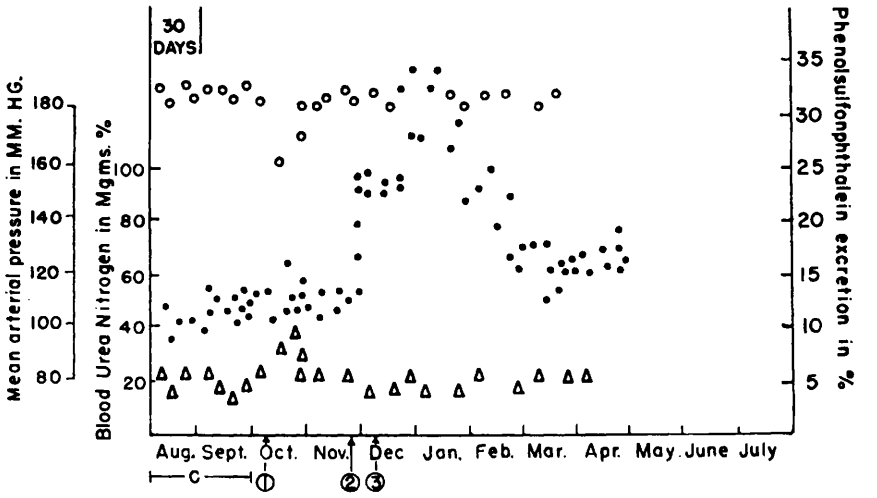

FIG. 2.
Showing the changes in Bun (blood urea nitrogen) concentration (△), PSP (phenolsulfonphthalein) excretion (○), and mean arterial pressure (●), following bilateral renal artery occlusion for two hours (1), and following bilateral renal artery constriction [(2), (3)]. ←C→ = Control period.

for the dogs of this group that following bilateral renal artery constriction, the mean arterial pressure remained normotensive for 5½ months and then rose during a subsequent observation period of 2 months.

The other dog became hypertensive after a 3 months' normotensive period following bilateral renal artery constriction. The abrupt rises in pressure seen in these two dogs were not associated with a change in the blood urea nitrogen concentration.

Discussion. The results thus far suggest that there is an effect of preliminary renal damage resulting from bilateral renal artery occlusion on experimental renal hypertension production in the dog. No attempt is made at

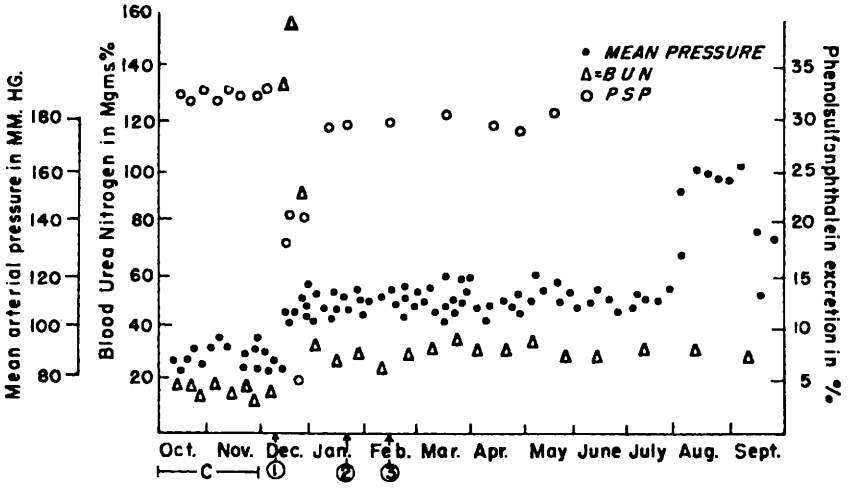

FIG. 3.

Showing the changes in Bun (blood urea nitrogen) concentration (△), PSP (phenolsulfonphthalein) excretion (○), and mean arterial pressure (●), following bilateral renal artery occlusion for four hours (↑1), and following bilateral renal artery constriction [(↑2), (↑3)]. ←C→ = Control period.

this time to explain the mechanisms involved (6-9) for it is felt that an expansion of the series of dogs surviving severe renal damage is needed and more detailed information on changes in renal function, pathophysiology and histochemistry is indicated.

Summary. The effect of preliminary renal ischemia produced by bilateral renal artery occlusion for 2, 4, 5 and 6 hours on subsequent experimental renal hypertension production on 19 dogs has been studied. In general the results suggest that previous renal damage of both a mild and severe degree has an effect on experimental renal hypertension. Seven dogs receiving mild renal injury showed a very high rise in mean arterial pressure in the first month following bilateral renal artery constriction, and a subsequent fall in pressure to near normotensive levels. The 4 dogs that survived more severe renal damage showed slight to no rise in mean arterial pressure during the first 3 or more months following bilateral renal artery constriction. The dogs of this group which were observed for more than three months showed an abrupt rise in mean arterial pressure, one 3 months and the other 5½ months after bilateral renal artery constriction.

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