STUDIES ON EXPERIMENTAL HYPERTENSION

II. The Effect of Resection of Splanchnic Nerves on Experimental Renal Hypertension*

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(Received for publication, September 14, 1936)

The original purpose of this investigation was to determine whether complete sympathectomy would prevent or cure the type of experimental renal hypertension which can be produced in normal dogs by partial clamping of the renal arteries (1). Bacq, Brouha and Heymans (2) claim that ablation of the sympathetics in the dog can prevent the hypertension that follows denervation of the carotid sinus and section of the depressor nerves. The integrity of the vasomotor system is evidently necessary for this type of hypertension. It was felt therefore that total sympathectomy, before and after the clamping of the renal arteries for the production of hypertension, would also give some estimate of the importance of the vasomotor nervous mechanism in the development of the renal type of hypertension.

Before the work had progressed very far it was reported (3–5) that a lowering of the blood pressure occurs in some human cases of hypertension as a result of excision of the thoracic portion of the splanchnic nerves alone. Back of this work was evidently the idea that the vasomotor nervous mechanism affecting the splanchnic zone alone could be an important determining factor in the pathogenesis of various types of hypertension. It was decided therefore first to test the effect of excision of the splanchnic nerves in the prevention and cure of experimental renal hypertension.

EXPERIMENTS

In four normal dogs the entire thoracic portion of the splanchnic nerves and the lower four dorsal sympathetic ganglia were excised on both sides at one opera-

* This study was supported by the Beaumont-Richman-Kohn Fund.

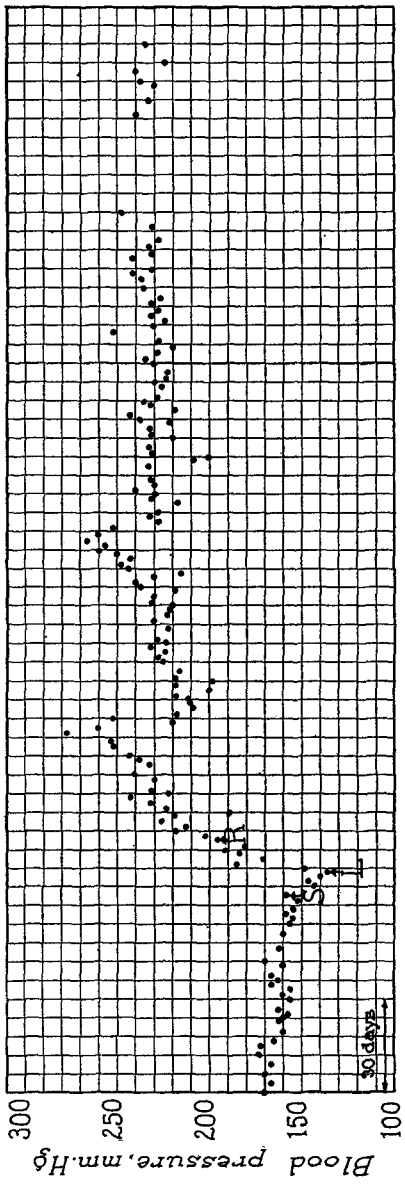
tion. The intrathoracic route was used, with the animal under ether anesthesia and artificial respiration. The incision was made in the 11th interspace (the dog has 13 ribs) and the proper exposure secured by packing and retraction. A small electric lamp at the end of a sterile metal holder was inserted into the chest whenever necessary to aid the dissection and excision of the nerves. After a variable period following this operation the renal arteries were partially clamped in the way previously described (1) for the production of hypertension.

Blood pressure determinations were made frequently as before (1), by the van Leersum carotid loop method, which gives only the systolic pressure. In addition, however, for the purposes of a check by a method that is more objective than the van Leersum method, so called mean blood pressure values were obtained at intervals by direct puncture of the femoral artery. This was done with a 21 gauge needle which was connected to a mercury manometer by means of pressure tubing filled with 4 per cent sodium citrate. In both normal and hypertensive periods these mean pressure readings were always somewhat lower than those obtained by the van Leersum carotid loop method, but the values corresponded fairly closely and significant changes were detected by both methods.

Text-figs. 1 and 2 illustrate the results which were obtained in two of the dogs (2-28 and 2-35), and are illustrative of the group. They show that the usual rise of blood pressure which follows the production of renal ischemia also occurs in animals with splanchnic nerves and lower four dorsal sympathetic ganglia excised. The rise of blood pressure was of the usual order and it has persisted for many months. In these animals there was no accompanying disturbance of renal function, as indicated by tests for urea clearance, quantity of nitrogenous metabolites in the blood and output of phenolsulfonephthalein in the urine. Similar results were obtained in two more animals (2-40 and 2-41).

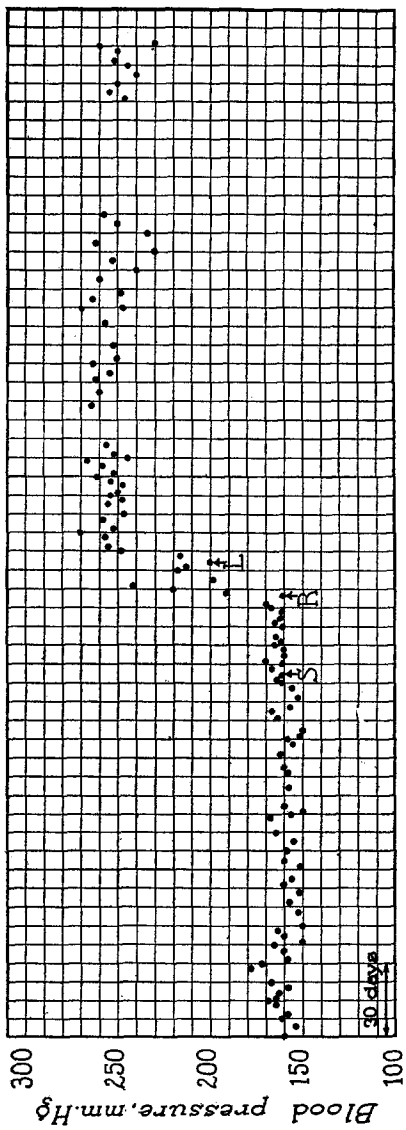
In two other dogs (1-51 and 2-37) the clamping of the renal arteries was purposely made very great but not quite complete. The result was that these animals developed not only the rise of blood pressure but also serious impairment of renal function and clinical uremia. They died a few days after the operation. Text-fig. 3 illustrates the blood pressure and chemical changes in the blood of one of these dogs (1-51).

The results in both groups demonstrate that bilateral excision of splanchnic nerves and lower four dorsal sympathetic ganglia does not prevent the rise of blood pressure and other effects (1) that may follow the production of various degrees of renal ischemia in dogs.



TEXT.-FIG. 1. Dog 2-28. Weight 16 kilos. S, bilateral excision of thoracic portion of splanchnic nerves and lower four dorsal sympathetic ganglia. L, moderate constriction of left main renal artery by means of special silver clamp (1). R, moderate constriction of right main renal artery.

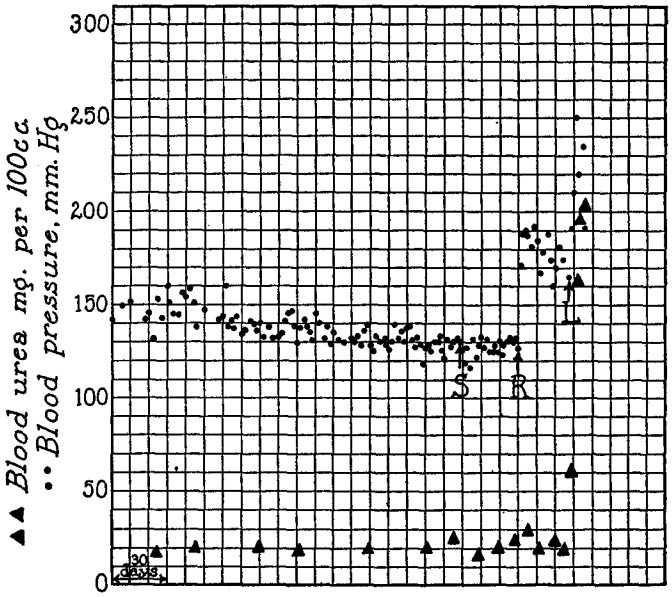
The blood pressure rose in the usual way (1) following the production of renal ischemia and has remained elevated for 9 months. The animal is still alive.



TEXT-FIG. 2. Dog 2-35. Female. Weight 22 kilos. S, bilateral excision of thoracic portion of splanchnic nerves and lower four dorsal sympathetic ganglia. R, moderate constriction of right main renal artery by means of special silver clamp (1). L, moderate constriction of left main renal artery.

The blood pressure rose, following the production of renal ischemia, and has remained elevated for 7 months. The animal is still alive.

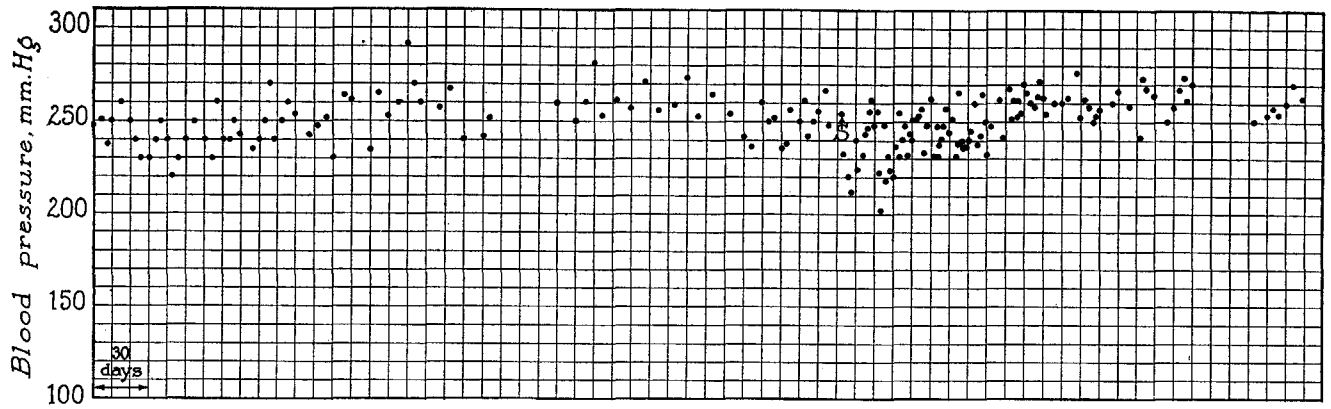
The next step was to determine the effect of excision of splanchnic nerves and lower four dorsal sympathetic ganglia on experimental renal hypertension that had been in existence for a variable period. This is comparable to the curative method used in human beings.



TEXT.-FIG. 3. Dog 1-51. Female. Weight 16 kilos. S, bilateral excision of thoracic portion of splanchnic nerves and lower four dorsal sympathetic ganglia. R, severe constriction of right main renal artery by means of a special silver clamp (1). L, severe constriction of left main renal artery.

The blood pressure rose after each clamping. The concentration of urea nitrogen, non-protein nitrogen and creatinine in the blood rose steadily until death. The animal became comatose and developed convulsions 2 days after the clamping of the second renal artery. This state continued until death which occurred 6 days after the constriction of the left renal artery.

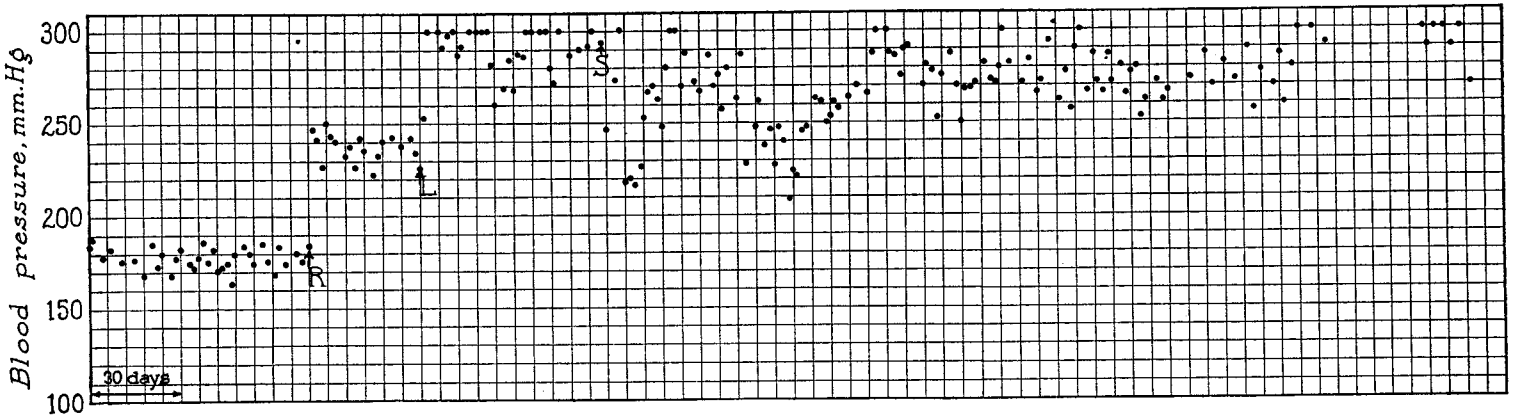
Text-fig. 4 (dog 5-9) shows the effect of excision of the thoracic portion of the splanchnic nerves and lower four dorsal sympathetic ganglia on persistent experimental renal hypertension that had been present for nearly 4 years. During a period of a few weeks following the excision of the nerves, the blood pressure varied considerably and at times was lower than during the period immediately preceding this



TEXT-FIG. 4. Dog 5-9. Female. Weight 14 kilos. S, bilateral excision of thoracic portion of splanchnic nerves and lower four dorsal sympathetic ganglia.

The systolic blood pressure of this dog was elevated for 4 years before the excision of the splanchnic nerves, due to the production of bilateral renal ischemia. In this text-figure are given the pressures for 13 months before the excision of the splanchnics. The pressures for the 1st year following production of bilateral renal ischemia are given in a previous publication (1). During the 2 year interval the pressure remained elevated to the same degree as in the 2 years that have been recorded in the charts.

For 8 months following the excision of the splanchnics and the lower four dorsal sympathetic ganglia, the pressure has remained elevated to about the same level as during the 4 years prior to this operation. The animal is still alive.



TEXT.-FIG. 5. Dog 2-10 Male. Weight 20 kilos. R, moderate constriction of right main renal artery by means of a special silver clamp (1). L, moderate constriction of left main renal artery. S, bilateral excision of intrathoracic portion of splanchnic nerves and lower four dorsal sympathetic ganglia.

For a period of about 3 months following this operation the blood pressure was very irregular and, at times, dropped considerably, but never reached normal levels. For the past 6 months, the blood pressure has been as high as it was before the excision of the splanchnics. The animal is still alive.

operation, but it soon returned to the original level and has now remained elevated for 8 months.

Text-fig. 5 (dog 2-10) shows the effect of excision of the splanchnic nerves and lower four dorsal sympathetic ganglia in an animal in which the elevation of blood pressure had been present for only 3 months. This animal also showed some lowering of the blood pressure and considerable variation of the pressure for a short period following the operation, but the pressure soon returned to the pre-operative hypertensive level and has remained elevated for 9 months. No significant permanent lowering of blood pressure occurred in two other hypertensive dogs (6-0 and 1-17) following excision of the splanchnic nerves and lower four thoracic sympathetic ganglia.

SUMMARY AND DISCUSSION

Excision of the thoracic portion of the splanchnic nerves and the lower four dorsal sympathetic ganglia on both sides failed to prevent the development of persistent hypertension which, in dogs, follows the production of renal ischemia by partial clamping of the renal arteries (1). In dogs with this type of experimental renal hypertension existent for varying lengths of time (up to about 4 years), excision of the splanchnic nerves and the lower four dorsal sympathetic ganglia failed to effect any degree of permanent lowering of the blood pressure.

For the dog, at least, these results tend to minimize the importance of the splanchnic vasomotor mechanism in the pathogenesis of renal hypertension. This is in agreement with the conclusions of Prinzmetal and Wilson (6) and of Pickering (7) about the part played by the vasomotor system in human hypertension. It is also in agreement with the work of Page (8), and of Collins (9), who showed that in dogs excision of the extrinsic renal nerves alone does not prevent experimental hypertension due to renal ischemia. Although the results of this investigation fail to give experimental support for the operation that is being practised on human beings with hypertension, yet they do not necessarily controvert the reports of beneficial effects in some cases of human hypertension. Further study of the effects on man is necessary before the results of this operation can be adequately evaluated.

CONCLUSION

In dogs, excision of the thoracic portion of the splanchnic nerves and the lower four dorsal sympathetic ganglia, on both sides, does not prevent, cure or permanently lower in any degree experimental renal hypertension produced by renal ischemia.

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