Role of the Kidney in Hypertension due to Renal Infarction in the Rat, Determined by Renal Transplantation*

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PARTICIPATION of the kidney in pathogenesis of hypertension is well recognized. Hypertensive cardiovascular disease is produced by some experimental modifications of the kidney, such as renal artery clipping, renal segmental infarction or wrapping of the kidney. Acute rise in blood pressure following segmental infarction of the kidney might be attributable to the pressor substance but in chronic phase of this type of hypertension, neither renin nor other pressor agents play any role in the cause of this disorder. This paper reports the change of blood pressure and renin content of the kidney of inbred rats after renal transplantation, which has recent-

\[ \text{BLOOD PRESSURE (mmHg)} \]

\[ \text{DAYS AFTER INFARCTION} \]

Fig.1.

Key Words: Hypertension
Renal Infarction
Renal Transplantation

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ly used for the model of experimental renal transplantation by the method of Lee.\(^4\) The results suggest the presence of blood pressure regulating factor generated and carried by infarcted kidney.

After renal segmental infarction and contralateral nephrectomy, the rats developed marked hypertension on day seven and thereafter. Blood pressure was determined by the plethysmographic tail method\(^5\) and the course of blood pressure change is shown in Fig.1.

Infarcted kidneys were transplanted to the rats of identical strain 1) immediately, 2) 9–12 days, 3) 14 days or more after infarction was produced and 4) the segmental infarction was performed in isografts ten days after transplantation. The incidence of hypertension (>150 mmHg) was 1) 7/9, 2) 5/7, 3) 0/6, and 4) 2/2, respectively. Fig.2 shows the individual course of blood pressure change.

Transplantation of a normal kidney from the syngeneic strain to twelve recipient (BP 169 ± 11) after removal of the infarcted kidney lowered the elevated blood pressure to normal (BP 120 ± 11), when the transplantation was performed within six weeks after infarction was produced.

When the isografts were transplanted on the two hypertensive rats with infarcted kidney in situ both rats stayed at hypertension.

Five isografted rats were normotensive during the entire period of three months or more. By contrast, blood pressure of four out of six allografted rats was more than 150 mmHg, and their renin content on day seven was almost the same as rats receiving an isograft. Renin content of the transplanted kidneys was always lower than the non-transplanted single kidney (P<0.001).

As a summary, segmentally infarcted kidney of the rat had the potency to produce hypertension in another animal when it was transplanted to isogenic bilaterally nephrectomized recipient within 12 days after ligation of the renal artery branch. Hypertension thus formed was cured by transplanting normal isogenic kidney to the hypertensive rat provided infarcted kidney was removed. If the infarcted kidney was left, hypertension of five weeks' duration persisted after transplantation of normal kidney. Thus the participation of the kidney in initiation and maintenance of hypertension was proved in this model (Fig.3). No close relation was proved between renin content and blood pressure in this series of experiment. Renin content was always low in transplanted kidneys.

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Fig. 3. The results of transplantation of infarcted kidney.
HT: Hypertension, NT: Normotension.
* Hypertension develops after infarction of the isograft.

REFERENCES

DISCUSSION:
Chairman: TERUO OMAE, Kyushu Univ.
Dr. OMAE: Dr. Kawabe's paper is now open for discussion.
Dr. SOKABE: Many of us will have thought of this kind of experiment since over ten years ago. It was accomplished by Dr. Kawabe. The technique will have wide application. His experiment showed two important things. (1) The affected kidney is responsible not only for the initiation but also for the maintenance of hypertension, because transplantation of normal kidney cannot lower blood pressure unless it is removed. (2) A protective action of the kidney against hypertension may not play a primary role in the genesis of this type of hypertension.
Dr. EBIHARA: It will be too much to say from this experiment that maintenance mechanism of hypertension is also of renal origin.
Dr. KAWABE: I agree with Dr. Ebihara.
Dr. KOKUBU: We should consider two different mechanisms of renal hypertension, initiating and maintenance mechanism. There is no conclusive evidence to show that renin is not responsible for renal hypertension. An etiological role of renin cannot be denied even though hypertension is not correlated with PRA. Our experience showed that PRA determined at the time of 4 weeks following unilateral renal artery clipping in the rat did not correlate with a level of blood pres-
sure. In this experiment, however, PRA was always increased in the rats showing an acute increase in blood pressure in 10 days prior to the time of sacrifice, the end of 4 weeks.

Dr. KIRA: I would rather be against the concept of two different mechanisms of renal hypertension, i.e., renal humoral factor (renin) in acute stage and sympathetic nerve activity in chronic stage. I believe that renal humoral factor is responsible for the mechanism of renal hypertension both in acute and chronic stages. Most of the patients with renovascular hypertension are discovered in its chronic stage, yet the hypertension is often cured by reconstruction of renal blood supply or nephrectomy.

Dr. KANEKO: There is some difference between renovascular hypertension in humans and goldblatt-type renal hypertension in animals. In humans PRA is often increased even in chronic stage and removal of the affected kidney lowers blood pressure.

Dr. FUJII: In some of the animals with renal hypertension due to unilateral renal artery clipping in the presence of the contralateral kidney, an increase in PRA can be demonstrable not only in acute stage but also in chronic stage. Even in chronic stage of experimental renal hypertension removal of the clipped kidney can cause some reduction in blood pressure, whether or not PRA is increased.