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Reactions of the Vessels of the Rat Kidney after Experimental Occlusion of the Renal Artery for Various Periods. (19658)

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The kidney of the rat is well adapted to the study *in vivo* of gross vascular changes. The renal vessels of the rat appear to be especially sensitive to vasoconstrictor influences, and the vessels on the surface of the kidney are too few to interfere with color changes resulting from changes in the caliber of, and in the blood flow through, vessels of the superficial cortex. Therefore, we have used the rat in making gross observations concerning the reactivity of renal cortical vessels after varying periods of occlusion of the renal artery.

We previously observed that renal vasoconstriction appears to be limited to the vessels of the cortex(1,2). When the renal artery was suddenly completely occluded, the entire cortex of the kidney blanched severely, provided the vessels had not been manipulated previously. The cortical vessels evidently constricted briefly and squeezed the blood from the cortex. However, study of cut sections showed that the medulla retained its normal red color and its vessels remained filled with erythrocytes.

When the occlusion of the renal artery was released after only 5 to 15 seconds, the rat kidney appeared hyperemic for the next 10 to 30 seconds, as indicated by the bright pink color and the fullness of all vessels on the surface of the kidney when magnified and observed through a dissecting microscope. The kidney rapidly regained its normal color and appearance after this transient occlusion. Evidently, a brief period of hyperemia followed the brief period of ischemia.

When the occlusion of the renal artery was maintained for approximately one minute, after release of the occlusion the surface of the kidney appeared dark red or blue for 3 to 7 minutes, after which the normal color returned. If only one branch of the renal artery was occluded for a similar period, that portion of the kidney supplied by this vessel showed the congested appearance after release of the occlusion. The congested appearance of the portion of the kidney supplied by the vessel previously occluded could be contrasted with the normal appearance of the remainder of the kidney. After an intravenous injection of India ink, the region supplied by the vessel

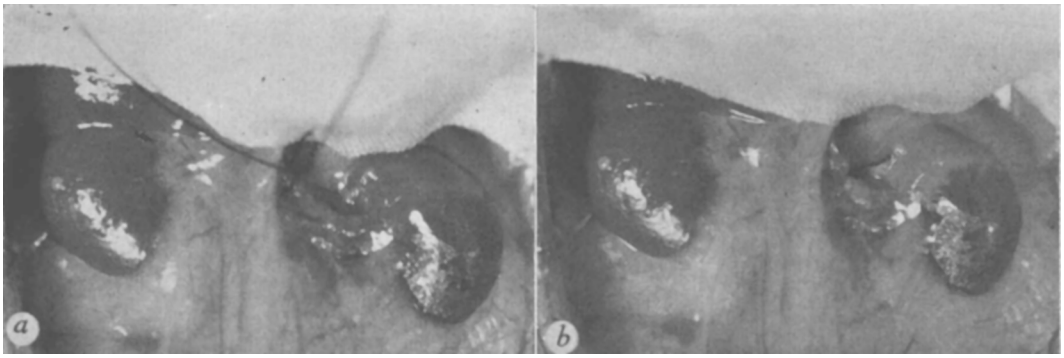

FIG. 1. Failure of congested renal vessels to constrict again shortly after previous occlusion of the supplying artery: *a*, branch of the renal artery supplying the lower half of the kidney on the right was occluded for 40 sec, during which this area of the kidney blanched; after release of the occlusion of the supplying artery, the involved half of the kidney became congested and dark in color, as shown; *b*, same preparation as shown in *a*: the main renal artery to the kidney, shown on the right, was tied off immediately after the picture shown in *a* was taken; the upper half of the kidney then blanched, as shown, but the lower half remained congested, indicating that vessels in this half of the kidney failed to constrict again.

previously occluded filled with ink more slowly than did the unaffected renal tissue, but became darker in color and the ink left it at a slower rate than that at which it left the normal renal tissue. Thus, it appeared that blood was flowing at a slower rate in the dilated vessels in the region of the kidney, the artery to which had been previously occluded for a brief period.

After the renal artery was released after a brief clamping, reclamping after a few seconds would not cause the kidney to again blanch so markedly. This was clearly demonstrated by first clamping one branch of the renal artery for a minute (that region of the kidney supplied by the vessels blanching during this time), then releasing this clamp for 5 or 10 seconds, and then occluding the main renal artery. After the main renal artery was clamped, the region of the kidney supplied by the branch of the artery first occluded remained dark, while the remainder of the kidney supplied by arterial branches not previously occluded blanched markedly (Fig. 1). Thus, after a brief period of severe ischemia, the vessels of the kidney lose the ability to constrict. However, when the interval between repeated brief clampings of the renal artery was more than a minute, the vessels regained the ability to constrict with each occlusion of the renal artery.

When the renal artery was occluded for a period of 20 to 60 minutes, the recovery of blood flow through the kidney at first appeared only in certain regions in a haphazard pattern. Gradually the flow returned to all regions of the kidney within 10 to 15 minutes, and after that the kidney regained its normal color. When the renal artery was occluded for 2 or 3 seconds at intervals of 5 to 10 seconds, the kidney became dark and greatly congested. The entire cut surface of such a kidney also appeared congested. These changes occur independent of renal innervation; that is, they occur in the denervated kidney as well as in the innervated organ.

Summary. 1. Brief cortical vasoconstriction of the kidney followed occlusion of a renal artery not previously manipulated. When occlusion of the artery was maintained only a few seconds, an equally brief period of renal hyperemia followed. 2. More prolonged occlusion produced a short period of renal vasodilatation and congestion followed release of the occlusion. During this period of dilatation, the vessels did not respond by vasoconstriction to repeated occlusion of the renal artery.

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