Editorial

Afferent Impulses in the Renal Nerves

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It has not been settled whether there are receptors having baroreceptive functions in the kidney. Page and McCubbin studied the systemic arterial pressure responses to nervous and chemical stimulation of the kidney and found no baroreceptors or chemoreceptors in the kidney.9 Heymans observed no reflex in the perfused kidneys of spinal dogs.4 On the other hand, Irisawa found a fall in systemic arterial pressure during elevation of the pressure in a blind sack preparation of the renal artery, and suggested the existence of baroreceptors in the wall of the renal artery.5 Likewise, Ueda and his co-workers observed reflex hypotension during elevation of the perfusion pressure in the kidney of dogs, and suggested the existence of a depressor reflex originating from the kidney.14

The centripetal impulses in the renal nerves were recorded by several workers.2,7,8,10,13 Åström and Crafood showed two types of the impulses in rats; the ones of rapidly adapting and of slowly adapting. However, they observed no impulses discharging spontaneously.2 We studied the afferent impulses in dogs and found two types which were different in the mode of excitation in response to mechanical stimuli; the impulses of low voltages, spontaneously discharging and of slowly adapting (type A), and the ones of higher voltages and threshold, not spontaneously discharging, and of rapidly adapting (type B). Two discharge patterns were observed in type A impulses; the ones which were discharging irregularly with no relation to renal arterial, venous or intrarenal pressure waves, and the ones which were discharging regularly at the ascents of the intrarenal pressure waves, but not at the ascents of the renal arterial pressure waves. The number of the both impulses changed with a rise or fall of mean intrarenal pressure.16

The afferent impulses in the renal nerves were increased by compression of the surface of the kidney,2,7,11,15 by occlusion of the renal vein,10,15 by elevation of the perfusion pressure in the renal artery,8 and by elevation of the intrapelvic pressure.16 The impulses of the both types appeared or increased during these manoeuvres in our experiments.16

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As to the direct stimuli activating the renal receptors, an increase in renal arterial pressure\(^1\) and an increase in renal venous pressure were suggested.\(^{10}\) Åström concluded that the slowly adapting spikes were activated by increased intrarenal tension, while the rapidly adapting spikes by increased venous pressure.\(^2\) In our experiments in which intrarenal pressure was changed toward different directions with renal arterial or venous pressure, the afferent impulses of both types increased or decreased respectively with a rise or fall in intrarenal pressure, but not associated directly with changes in renal arterial pressure or in renal venous pressure.\(^{16}\)

The type A impulses increased momentarily at the initiation of a fall in intrarenal pressure and then vanished or decreased following the intravenous injection of vasopressor agents such as norepinephrine, epinephrine, methoxamine or angiotensin II. They increased markedly with a return or overshoot of the intrarenal pressure. The type B impulses appeared momentarily at descending or ascending limbs of intrarenal pressure.\(^{16}\)

The impulses of both types were recorded even after the renal capsule was resected or after the intrapelvic injection of procaine. However, they disappeared after the injection of procaine into the renal artery.\(^{15}\)

The impulses recorded appeared to come from receptors locating in the interstitial or fatty tissues in the kidney, but not from receptors in the wall of the renal artery. Fujiwara and others found the nerve endings which they thought to join the medullated fibers in the adventitia of the spiral arteries and their surrounding interstitial tissues or fatty tissues.\(^{1,2,3,6,11,12}\)

The efferent renal nerve activity vanished or decreased and was followed by a fall in systemic arterial pressure during compression of the kidney or occlusion of the renal vein.\(^{15}\) The efferent impulses of a renal nerve was inhibited by electrical stimulation of the cut central end of another renal nerve.\(^{8,15}\) The systemic arterial pressure decreased as much as 30 mm.Hg during the stimulation of the cut central end of the renal nerve, suggesting that the renal receptors participated in the changes of sympathetic nerve activity and systemic blood pressure.\(^{15}\) However, it is obscure whether the renal receptors be participating in the regulation of systemic arterial pressure or of renal circulation in physiological conditions.

**References**