Renin Release and Renal Pelvic Pressure in the Isolated Perfused Dog Kidney

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HARADA, T., SAKAMOTO, F., SUZUKI, M. and TSUCHIDA, S. *Renin Release and Renal Pelvic Pressure in the Isolated Perfused Dog Kidney*. Tohoku J. exp. Med., 1980, 130 (2), 203-204 — The perfused dog kidney was used for a study of the relationship between renin secretion and renal pelvic pressure. The kidney was completely isolated and perfused with perfluorochemical emulsion. During the elevation of renal pelvic pressure, renin secretion rate increased from 0.93 ± 0.43 to 5.54 ± 1.57 ng/g min, perfusion flow rate decreased temporarily and recovered within a few minutes. — renin release; renal pelvic pressure; isolated dog kidney; fluorocarbon

Considerable evidence implicates the sympathetic nervous system and the catecholamines in the regulation of renin release. Several hypotheses about renin release following ureteral constriction have been reported (Vander and Luciano 1967). Without complicating systemic effects, renin release was examined in the isolated dog kidney perfused with fluorocarbon emulsion at a constant perfusion pressure and flow rate to investigate the mechanism of renin release following pelvic pressure elevation.

Experiments were performed on isolated dog kidney. The kidney was perfused by the apparatus (pulsatile Harvard pump, Fig. 1) at the mean pressure of 122 ± 3 mmHg and maintained at 37°C . The oxygenator was supplied with a mixture of 95% oxygen and 5% carbon dioxide. The perfusate was composed of modified lactated Ringer's solution containing 10% perfluorochemical emulsion (Fluosol-43, Composition: Na^+ 130.0 mEq/liter; K^+ 4.0 mEq/liter; Ca^{++} 2.5 mEq/liter; Cl^- 112.0 mEq/liter; HCO_3^- 12.5 mEq/liter; Mg^{++} 2.0 mEq/liter; lactate 14.0 mEq/liter; perfluorotributylamine 10.0 g/100 ml; pluronic

Fig. 1. Schematic diagram of perfusion system.

F 68 1.28 g/100 ml; glucose 90.0 mg/100 ml; heparin sodium 2000 U/liter; creatinine 2.0 mg/100 ml; pH 7.5~7.7; osmotic pressure 290 mOsm/liter). A polyethylene catheter was inserted into the ureter to collect urine. Pelvic pressure was raised to 100 mmHg by gravity infusion through the ureteral catheter. Perfusion pressure and flow rate became stable within a few min. Experiments were conducted during steady-state perfusion. Perfusate samples for measurement of renin release were obtained immediately, at 10 min and at 20 min after the elevation of pelvic pressure, and also at 30 min after release of the elevation of pelvic pressure. The samples were mixed with nephrectomized dog plasma as the renin substrate. Plasma renin activity was determined by radioimmunoassay according to the modified method of Haber et al. The renin secretion rate was calculated as follows: $RSR = (\text{effluent PRA} - \text{affluent PRA}) \times \text{perfusion flow rate}$, and expressed as ng-AI/g of kidney min.

TABLE 1. *Effects of renal pelvic pressure elevation on renin release*

	PfP (mmHg)	PP (mmHg)	PFR (ml/g min)	Renin		
				a (ng-AI/ml)	e (ng-AI/ml)	RSR (ng-AI/g min)
Control	122.0 ±3.0	0±0	1.80 ±0.07	3.56 ±0.64	4.12 ±0.70	0.93 ±0.43
Immediately after PPE	128.6 ±2.8	100±0	1.65 ±0.08	5.60 ±1.26	8.40 ±1.27	4.77 ±2.29
10 min after PPE	125.0 ±2.4	100±0	1.81 ±0.07	2.90 ±1.05	5.94 ±0.83	5.54 ±1.57
20 min after PPE	122.0 ±3.0	100±0	1.81 ±0.07	5.02 ±0.23	6.94 ±0.63	3.42 ±1.00
30 min after release of PPE	120.6 ±3.7	0±0	1.87 ±0.09	5.64 ±0.59	5.80 ±0.39	0.337 ±1.21

PfP, perfusion pressure; PP, pelvic pressure; PFR, perfusion flow rate; RSR, renin secretion rate; e, plasma renin activity of effluent; a, plasma renin activity of affluent; PPE, pelvic pressure elevation. Results are expressed as mean±s.e. of experiments on 5 kidneys.

Perfusion with fluorocarbon emulsion maintained constant renal function and perfusion flow rate during 3–4 hr (Noto and Harada 1979). Table 1 summarizes experiments on 5 dogs. Renal arterial pressure rose to 128.6 ± 2.8 (mean±s.e.) mmHg, whereas the perfusion flow rate fell slightly immediately after the elevation of pelvic pressure. But, the perfusion flow rate had a tendency to recover to control level within a few min. The elevation of pelvic pressure raised the renin secretion rate to 5.54 ± 1.57 ng-AI/g min. Thirty min after the release of the pelvic pressure elevation, the renin secretion rate fell to control levels. These findings support a direct intrarenal effect of pelvic pressure elevation on the renin secretion rate. The increase of renin release following pelvic pressure elevation may be activated by reduced delivery of sodium to the distal nephron (macula densa mechanism), or by dilation of the afferent arterioles (autoregulation mechanism).

References

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