Chapter IV

Results

Effects of Russell's viper venom on general circulation (Table 1-2, Fig 1)

Group I : animals treated with 10 mg/kg of MK 422 and 5 mg/kg of imidazole before envenomation.

Effects of Russell's viper venom on general circulation in group I are shown in Table 1 and Fig 1 (upper panel). After envenomation, the decrease of mean arterial pressure was not significant in the period of 20 minutes. Then mean arterial blood pressure started to increase to control level until the end of the experiment. The significant rising in packed cell volume (PCV) was noted in 20 and 40 minutes of envenomation period from 34.2±6.08 to 40.8±7.44 and 39.8±6.83% respectively. Envenomation produced a significant elevation of heart rate after 40 minutes venom injection ($P<0.05$, $P<0.001$).

Group II : animals treated with 10 mg/kg of MK 422, 5 mg/kg of imidazole and 0.7 ug/kg/min at left intrarenal arterial infusion of prazosin, respectively, before envenomation.

The data in Table 2 and Fig 1 (lower panel) show that

Table 1. Effects of Russell's viper venom on general circulation in five dogs.

Parameter	0.9% Saline (Intrarenal arterial infusion)											
	Control		MK 422 (10 mg/kg i.v.)		IMID (5 mg/kg i.v.)				Post-envenomation (RVV 0.1 mg/kg i.v.)			
Time elapse (min)	0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	200-220	220-240
MAP (mmHg)	114.33±22.78	117.33±21.13	102.0±30.4	108.33±26.25	117.5±25.62	121.0±27.6	120.5±26.2	121.1±27.2	105.26±32.04	122.5±34.36	131.34±51	130.33±31.26
PCV (%)	33.9±5.73	34.2±6.08	35.1±6.87	34.9±6.59	35.9±6.8*	36.2±6.76*	35.7±9.1*	36.0±6.2*	40.8±7.44*	39.8±6.83*	38.3±8.46	35.8±7.87
HR(beat/min)	140.4±24.96	135.6±27.36	145.2±30.71	141.6±30.77	151.2±25.6*	154.8±29.21	152.9±32.21*	154.2±27.71	154.8±45.77	169.2±40.11*	174.0±31.46***	183.6±30.48***

Group I : Effects of Russell's viper venom on general circulation in animals treated with 10 mg/kg of MK 422 and 5 mg/kg of imidazole before envenomation.

* P<0.05; ** P<0.01; *** P<0.001 with respect to control period of each time.

Table 2. Effects of Russell's viper venom on general circulation in five dogs.

Parameter	0.9% Saline (Intrarenal arterial infusion)						PRAZOSIN (0.7 ug/kg/min intrarenal arterial infusion)					
	Control		MK 422 (10 mg/kg i.v.)		IMID (5 mg/kg i.v.)		Post-envenomation (RVV 0.1 mg/kg i.v.)					
Time elapse (min)	0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	200-220	220-240
MAP (mmHg)	116.0±17.58	118.0±20.63	108.5±14.9**	105.16±19.82**	112.0±17.26*	112.0±16.4	103.5±13.82	102.16±13.19	92.67±17.14*	102.33±14.37	103.17±15.86	103.21±14.44
PCV (%)	31.1±9.69	31.1±9.47	32.0±9.11	31.6±9.42	31.6±9.97	32.1±9.86	31.8±9.54	31.6±9.57	31.1±11.67	31.8±10.38	29.0±9.37	30.3±10.41
HR(beat/min)	165.6±39.71	159.6±44.62	158.4±51.89	160.8±52.2	156.0±41.35	163.2±39.21	176.4±48.3	171.6±48.11	180.0±43.06	190.8±39.66	199.2±38.98	198.7±40.02

Group II : Effects of Russell's viper venom on general circulation in animals treated with 10 mg/kg of MK 422 and 5 mg/kg of imidazole and 0.7 ug/kg/min of prazosin before envenomation.

* $P<0.05$; ** $P<0.01$; *** $P<0.001$ with respect to control period of each time.

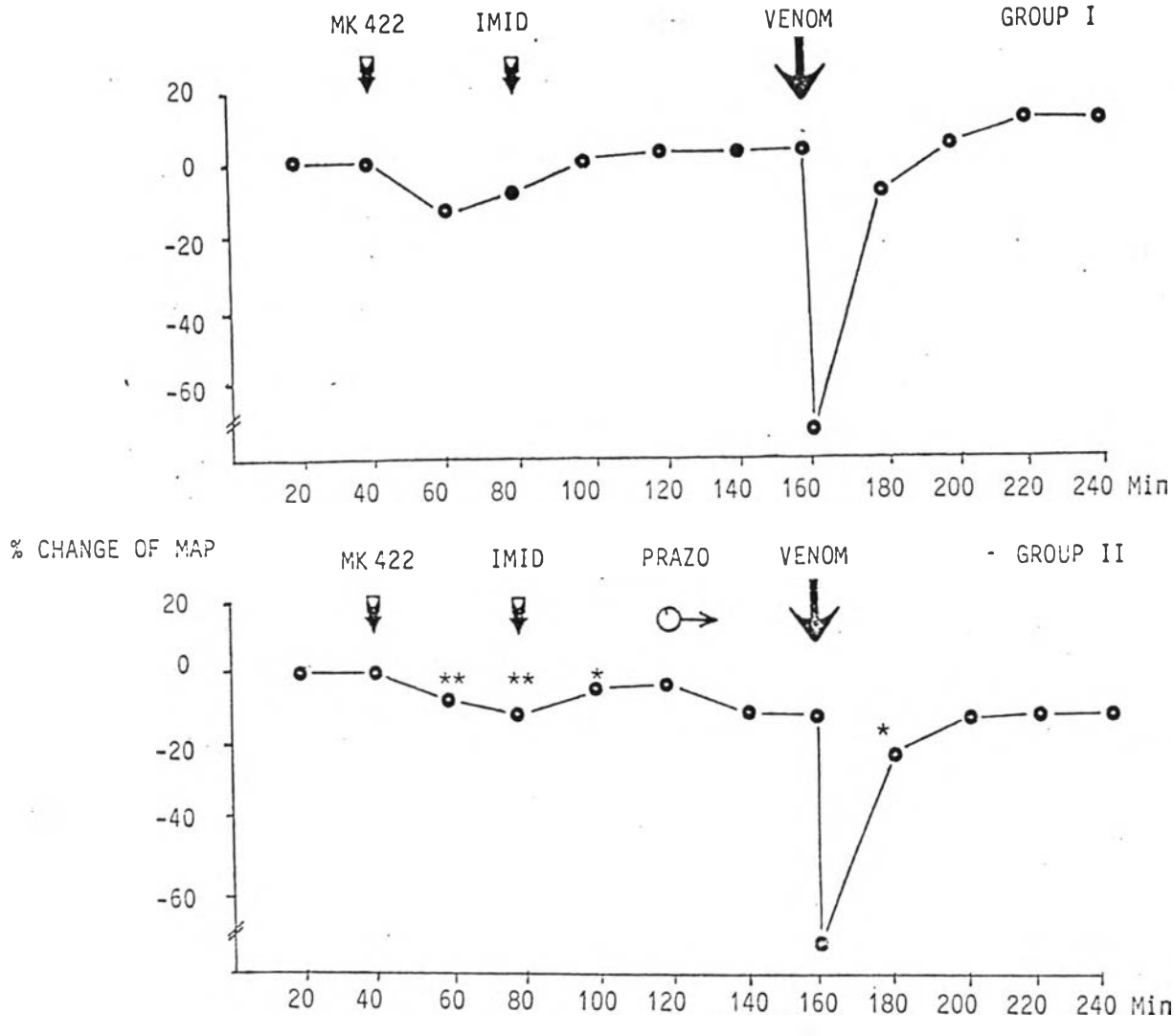

Fig 1 : Effects of intravenous injection of Russell's viper venom on % change of mean arterial pressure (MAP) in group I (upper panel) and group II (lower panel).
Values are statistically significantly different from control period of each time,
* P<0.05, ** P<0.01, *** P<0.001

intravenous injection of 0.1 mg/kg of Russell's viper venom within 20 minutes depressed mean arterial pressure (MAP) significantly from 118.0 ± 20.63 to 92.17 ± 17.14 mmHg ($P<0.05$). After a period of 20 minutes, mean arterial blood pressure started to increase to the under control level. The packed cell volume (PCV) did not change from control level after envenomation. The change in heart rate (HR) was apparent after envenomation but the increase in heart rate (HR) was not significant.

Effects of Russell's viper venom on renal hemodynamics. (Table 3-4, Fig 2-6)

Group I : animals treated with 10 mg/kg of MK 422 and 5 mg/kg of imidazole before envenomation.

There results in Table 3 show that effective renal plasma flow (ERPE), effective renal blood flow (ERBF) and glomerular filtration rate (GFR) were slight decreased by MK422 and imidazole but there were significant decline of effective renal plasma flow (ERPE) within the first period of MK422 and the 40 minutes and 80 minutes of imidazole in the left kidney and of effective renal blood flow (ERBF) within 20 minutes in the left kidney of MK 422 period. Envenomation caused suddenly anuria during 20 minutes. Effective renal plasma flow (ERPF) and glomerular filtration fell to the lowest level at 40 minutes after venom injection in both kidneys ($P<0.05$) (Fig 2,4). Intravenous injection of Russell's viper venom caused a marked reduction of effective renal blood flow within 40 minutes ($P<0.01$) in the right kidney. However, the reduction of effective renal blood

flow in the left kidney was not significant in the same period. Filtration fraction altered slightly by MK 422 and imidazole injection. After anuria period, filtration fraction was not different from the control level in both kidneys. Renal vascular resistance was slightly increased by the effect of imidazole. After envenomation, it progressively elevated throughout the experiment period in left and right kidney.

Group II : animals treated with 10 mg/kg of MK 422, 5 mg/kg of imidazole and 0.7 ug/kg/min at left intrarenal arterial infusion of prazosin, respectively, before envenomation.

The data in Table 4 indicated that intravenous injection of 10 mg/kg of MK 422, 5 mg/kg of imidazole and continuous intrarenal arterial infusion 0.7 ug/kg/min of prazosin produced a mild decrease in effective renal plasma flow (ERPF), effective renal blood flow (ERBF) in both right and left kidney, but intrarenal arterial infusion of prazosin in the left kidney at the period of 40 minutes caused elevation of glomerular filtration rate (GFR) from 1.57 $\pm$ 0.24 to 2.8 $\pm$ 0.21 ml/min/kg bw. Intravenouse injection of Russell's viper venom caused slightly reduction of these parameters within 20 minutes in the right kidney. The left kidney was shown a significant decline of effective renal plasma flow (ERPF) and renal blood flow (ERBF) at 20 minutes ($P<0.05$). However, the reduction of glomerular filtration rate was not significant at 20 minutes. After a 20 minutes period of envenomation, the elevation of glomerular filtration rate (GFR) was

Table 3. Effects of Russell's viper venom on renal hemodynamic of the right (Rt) and the left (Lt) kidney in five dogs of group I.

Parameter		0.9% Saline (Intrarenal arterial infusion)											
		Control		MK 422 (10 mg/kg i.v.)		IMID (5 mg/kg i.v.)				Post-envenomation (RVV 0.1 mg/kg i.v.)			
Time elapse (min)		0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	200-220	220-240
RPF	Rt	4.22±2.16	4.68±2.56	3.73±1.96	3.97±2.26	3.78±1.91	3.68±1.83	3.75±1.72	3.67±1.80	Anuria	1.56±0.86*	2.74±1.93	3.0±2.74
(ml/min/	Lt	4.20±2.4	4.41±2.48	3.66±2.24*	3.7±2.26*	3.54±1.94	3.23±1.77*	3.45±1.49	3.24±1.81*	Anuria	1.63±1.06*	2.62±2.07*	3.27±3.22
kg bw)													
RBF	Rt	8.03±1.02	8.62±1.35	6.93±0.92	7.59±1.86	7.91±1.86	7.8±1.85	7.9±1.85	7.82±1.87	Anuria	3.48±1.14**	6.12±2.86	5.61±2.91
(ml/min/	Lt	7.72±1.93	7.94±1.45	6.4±1.96*	7.29±2.07	7.59±2.59	6.97±2.33	7.32±2.41	7.03±2.29	Anuria	4.27±2.77	5.63±2.93	5.95±3.57
kg bw)													
GFR	Rt	1.43±0.31	1.54±0.35	1.38±0.34	1.47±0.41	1.71±0.46	1.67±0.37	1.72±0.36	1.68±0.33	Anuria	0.58±0.19*	1.16±0.55	1.08±0.47
(ml/min/	Lt	1.45±0.24	1.50±0.47	1.30±0.41	1.43±0.34	1.68±0.25	1.53±0.33	1.65±0.29	1.54±0.28	Anuria	0.68±0.39*	1.06±0.52	1.13±0.56
kg bw)													
FF%	Rt	26.91±3.9	27.11±3.75	31.25±8.87	31.3±11.48	35.89±14.03	35.64±14.81	35.78±14.17	35.60±14.79	Anuria	27.35±3.72	31.22±4.57	29.46±5.26
	Lt	29.29±5.66	28.95±7.56	32.04±8.99	32.83±13.39	40.21±22.08	39.48±23.28	40.44±23.15	39.51±22.98	Anuria	27.15±4.52	31.58±4.88	29.27±4.96
RVR	Rt	83.62±8.33	80.34±7.37	84.94±20.04	85.8±21.54	92.17±34.11	97.8±44.18	94.06±38.12	97.78±42.08	Anuria	258.95±221.78	233.14±308.79	194.7±176.12
	Lt	89.75±18.68	89.77±24.08	94.86±21.02	95.73±47.78	107.95±70.39	118.86±75.4	110.28±72.06	116.78±73.1	Anuria	324.1±416.89	275.36±375.95	209.29±221.05

P.value with respect to control, * P<0.05; ** P<0.01; *** P<0.001

Table 4. Effects of Russell's viper venom on renal hemodynamic of the right (Rt) and the left (Lt) kidney in five dogs of group II.

Parameter		0.9% Saline (Intrarenal arterial infusion)						PRAZOSIN (0.7 ug/kg/min intrarenal arterial infusion)					
		Control		MK 422 (10 mg/kg i.v.)		IMID (5 mg/kg i.v.)		Post-envenomation (RVV 0.1 mg/kg i.v.)					
Time elapse (min)		0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	200-220	220-240
RPF	Rt	8.75±5.51	8.62±5.51	8.04±3.75	7.37±3.97	6.07±1.59	6.74±1.4	6.81±2.82	7.48±2.52	5.9±2.21	7.33±4.53	7.41±3.59	7.43±3.43
(ml/min/	Lt	9.21±4.36	7.49±3.2	6.97±2.69	6.86±2.34	5.9±0.78	6.35±1.16	6.23±3.43	7.15±1.59	4.52±2.89	7.63±3.2	7.05±3.51	7.04±3.12
kg bw)													
RBF	Rt	12.42±6.48	12.2±6.39	11.73±4.5	10.59±4.65	8.9±1.61	9.89±0.97	10.02±3.6	10.96±3.08	8.6±2.75	10.59±5.33	10.24±3.75	10.42±4.12
(ml/min/	Lt	13.43±5.64	10.8±3.72	10.05±2.88	10.17±3.51	8.92±2.43	9.37±1.08	8.95±4.01	10.41±1.31	6.23±2.82	11.21±3.65	9.75±3.69	9.82±3.25
kg bw)													
GFR	Rt	1.71±0.16	1.78±0.12	1.8±0.19	1.65±0.16	1.75±0.07	2.05±0.32	1.75±0.59	1.71±0.20	1.37±0.4	1.8±0.35	1.64±0.20	1.67±0.19
(ml/min/	Lt	1.75±0.27	1.57±0.24	1.54±0.46	1.67±0.26	1.73±0.18	1.91±0.34	1.45±0.49	2.8±0.21	1.02±0.53	1.62±0.25	1.51±0.21	1.53±0.25
kg bw)													
FF	Rt	24.21±9.56	25.23±9.23	25.78±9.58	25.91±8.44	30.15±6.44	31.33±7.61	27.42±9.71	24.86±8.25	23.12±8.07	26.82±8.58	23.91±9.49	25.29±9.26
%	Lt	22.46±9.58	23.61±8.41	23.26±7.26	26.48±9.42	29.87±5.67	30.75±8.0	25.86±6.14	28.5±4.08	23.0±8.36	23.62±7.03	28.09±8.64	28.15±8.23
RVR	Rt	63.53±22.32	65.84±26.61	60.26±23.02	64.36±22.29	75.85±17.71	67.63±15	66.96±20.85	58.34±17.54	68.97±27.26	66.87±26.78	62.55±12.68	64.58±14.85
(10^3	Lt	58.43±23.93	69.6±24.83	66.25±13.71	67.76±30.92	78.61±24.92	72.4±20.74	77.7±28.33	58.74±11.72	95.68±28.34	57.71±16.0	65.81±12.31	68.51±10.10
dynesec/													
cm^5													

P.value with respect to control, * P<0.05; ** P<0.01; *** P<0.001

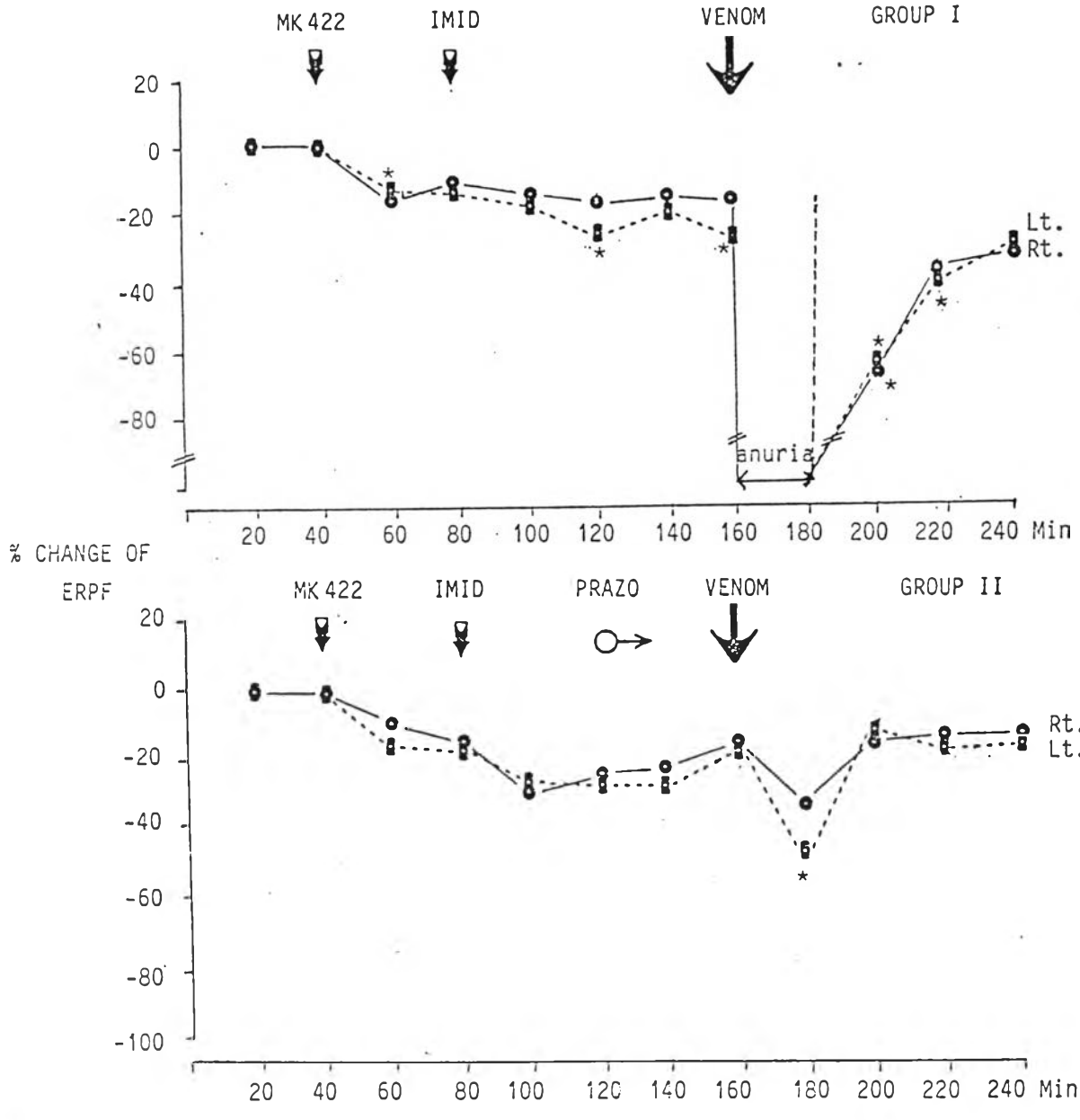

Fig 2 : Effects of intravenous injection of Russell's viper venom on % change of effective renal plasma flow (ERPF) in right and left kidney of group I (upper panel) and group II (lower panel).
Values are statistically significantly different from control period of each time,
* P<0.05, ** P<0.01, *** P<0.001

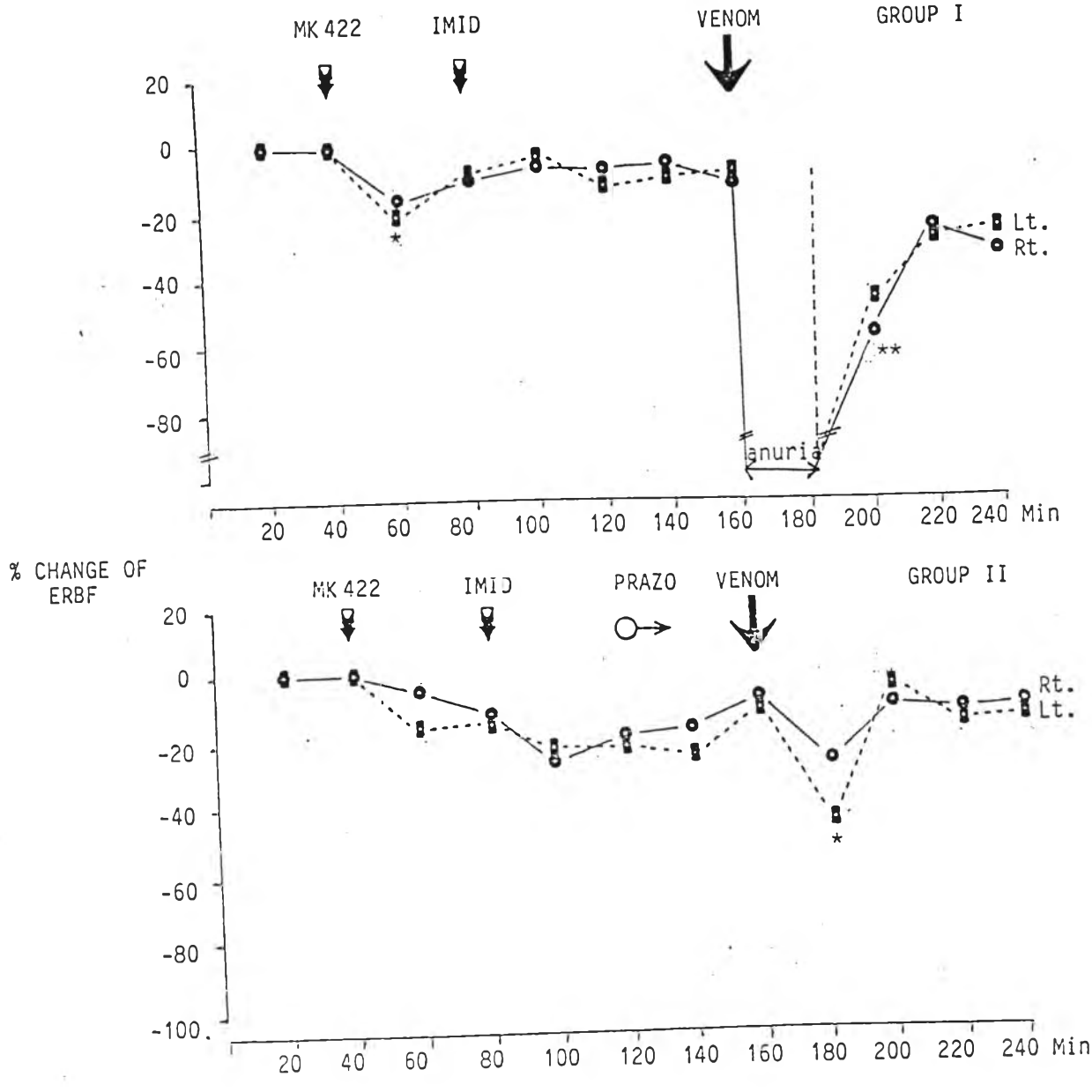

Fig 3 : Effects of intravenous injection of Russell's veiper venom on % change of effective renal blood flow (ERBF) in right and left kidney of group I (upper panel) and group II (lower panel).
Values are statistically significantly different from control period of each time,
* P<0.05, ** P<0.01, *** P<0.001

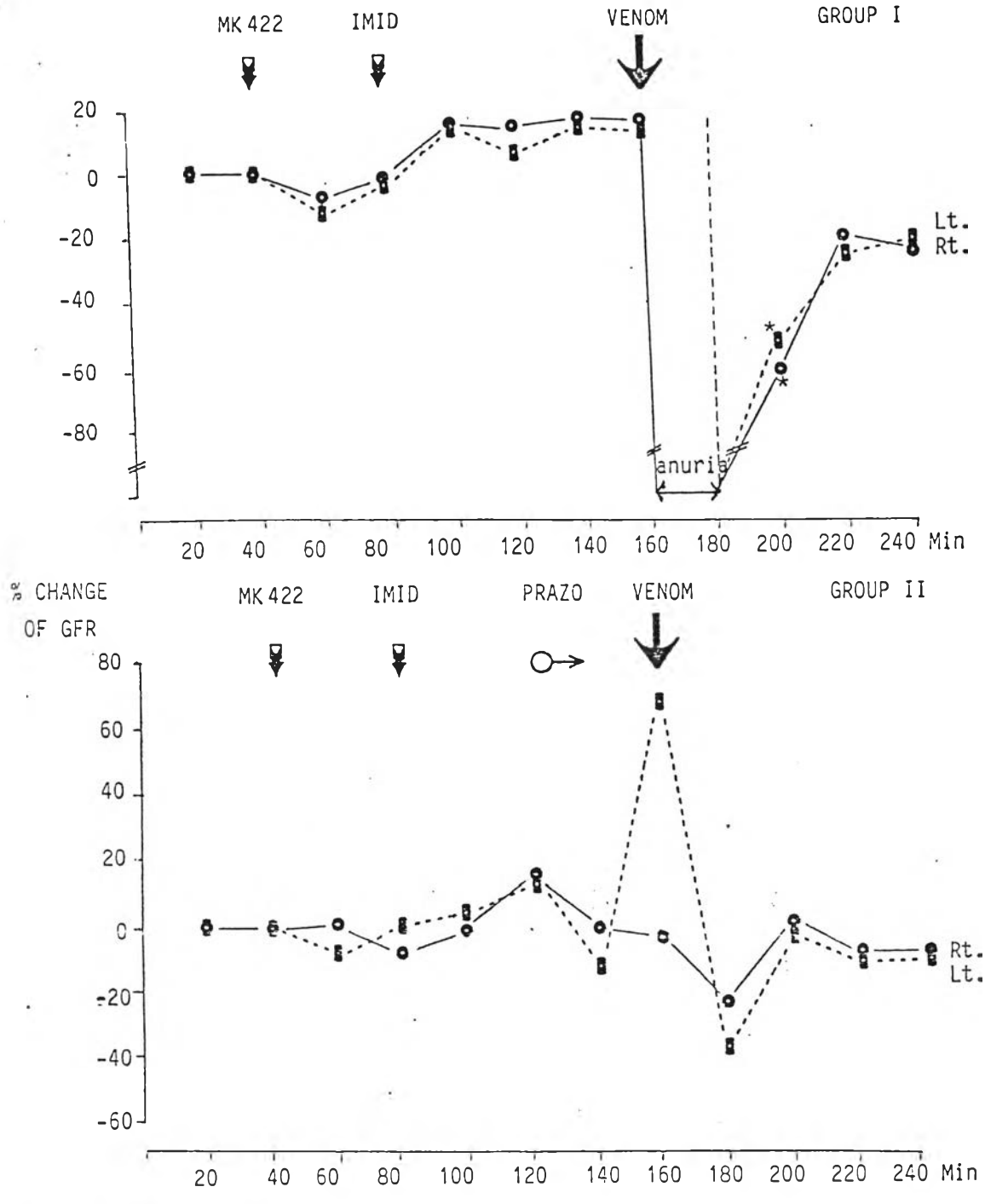

Fig 4 : Effects of intravenous injection of Russell's viper venom on % change of glomerular filtration rate (GFR) in right and left kidney of group I (upper panel) and group II (lower panel).
Values are statistically significantly different from control period of each time,
* P<0.05, ** P<0.01, *** P<0.001

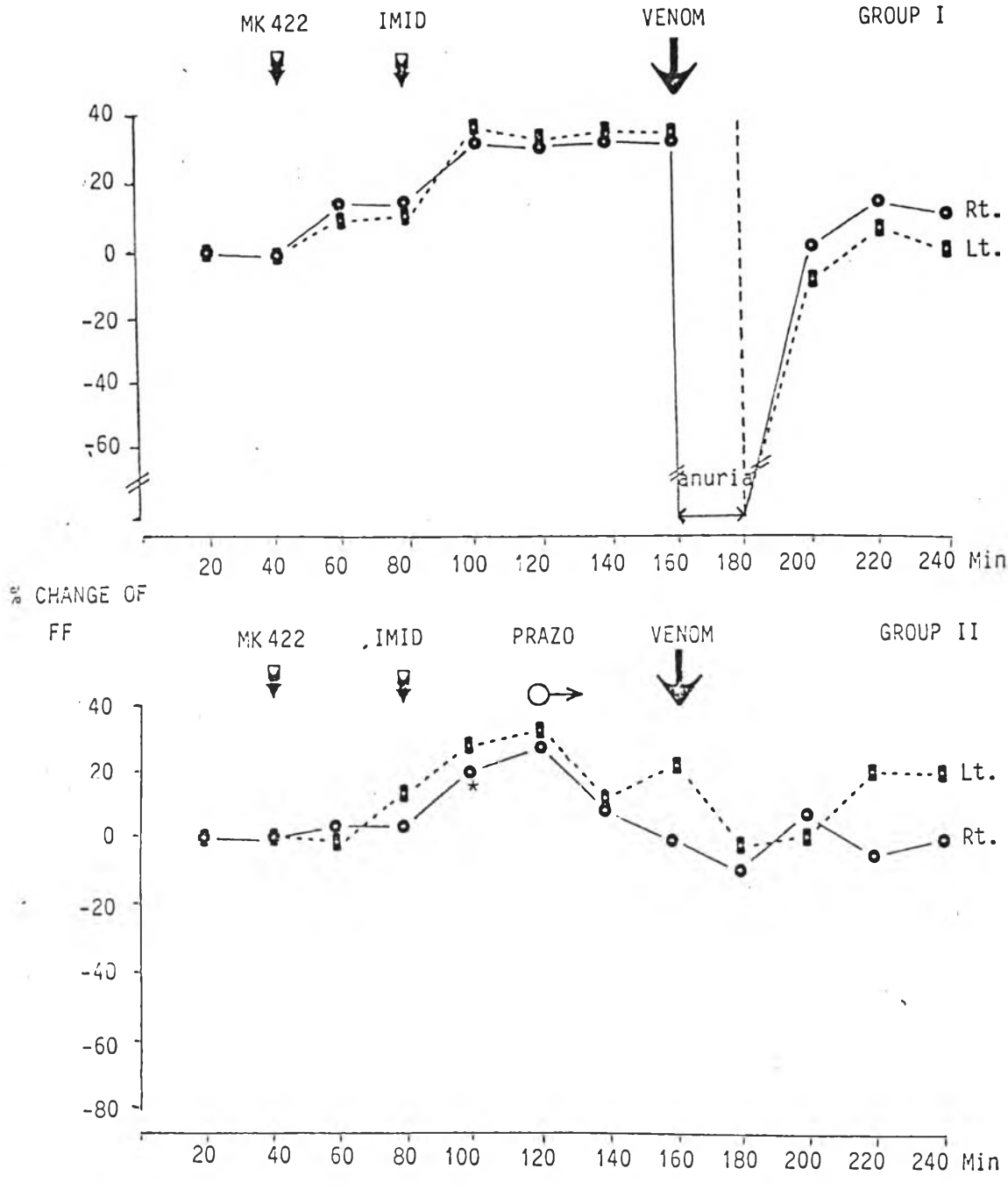

Fig 5 : Effects of intravenous injection of Russell's viper venom on % change of renal vascular resistance (RVR) in right and left kidney of group I (upper panel) and group II (lower panel).
Values are statistically significantly different from control period of each time,
* P<0.05, ** P<0.01, *** P<0.001

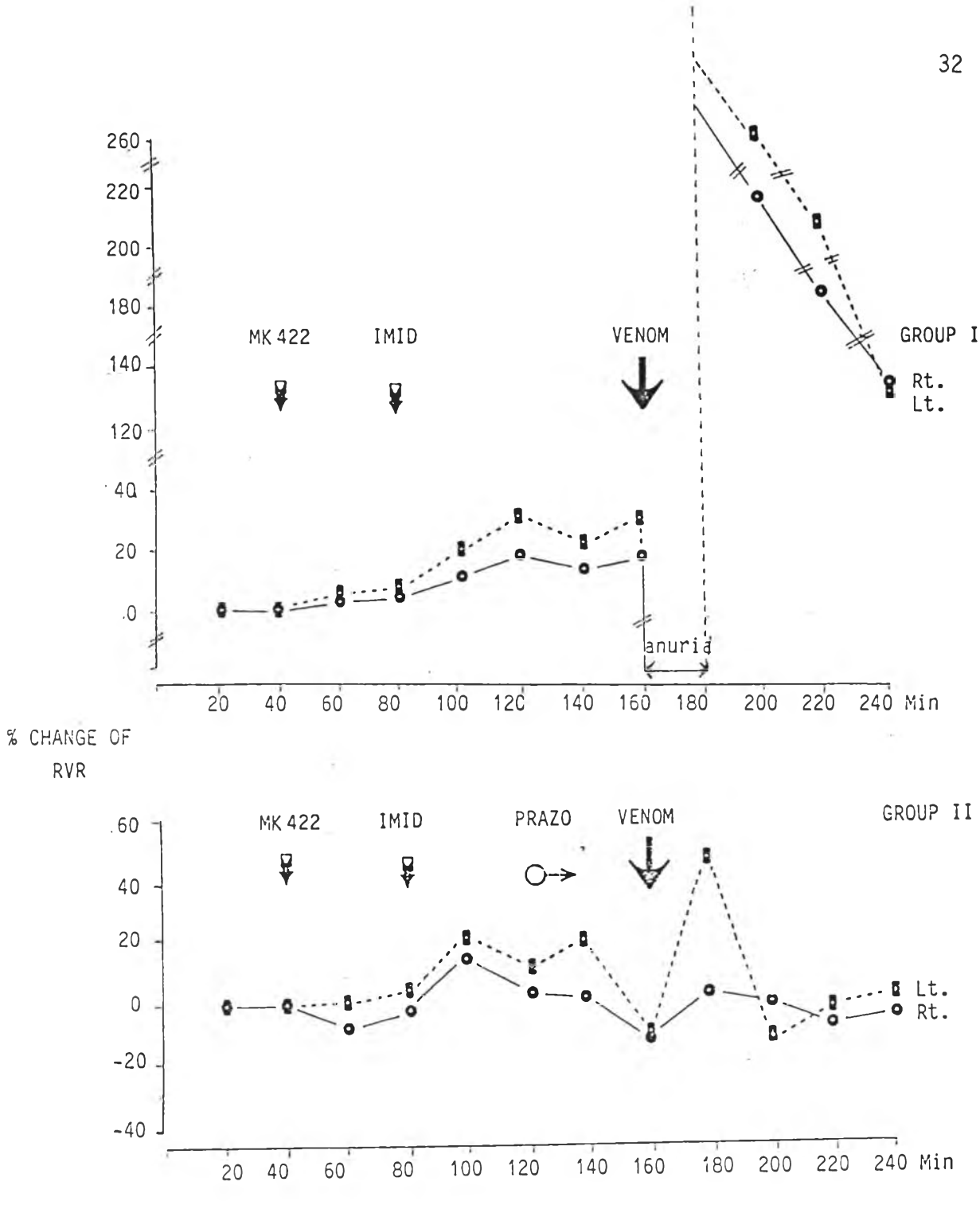

Fig 6 : Effects of intravenous injection of Russell's viper venom on % change of urine volume (V) in right and left kidney of group I (upper panel) and group II (lower panel). Values are statistically significantly different from control period of each time,
* P<0.05, ** P<0.01, *** P.0.001

observed throughout the experiment. Filtration fraction (FF) was slightly decreased after envenomation in both kidneys (Fig 5). Envenomation produced a marked increase in renal vascular resistance (RVR) in the left kidney, but renal vascular resistance (RVR) increased slightly in the right kidney (Fig 6).

Effects of Russell's viper venom on renal function. (Table 5-10, Fig 7-16)

Group I : animals treated with 10 mg/kg of MK 422 and 5 mg/kg of imidazole before envenomation.

In Fig 7 (upper panel) show that the urine flow rate increased significantly at the 20 minutes and 60 minutes of imidazole in both kidneys. The effects of Russell's viper venom gradually decreased urine flow rate (v) until urine was not collected at the first 20 minutes, then urine flow rate (V) slightly increased to approach the under level of control in both kidneys. But urine flow rate did not significant decrease from the control level.

The response of osmolar clearance (C_{osm}) to the venom was similar to urine flow rate, the lowering value was significantly found in 40 and 60 minutes from 56.31 $\pm$ 17.18 to 15.62 $\pm$ 8.58 and 35.34$\pm$21.44 ul/min/kg bw ($P<0.001$, $P<0.05$) respectively (Table 5) in the left kidney and from 67.58 $\pm$ 19.92 to 16.91 $\pm$ 9.81 ul/min/kg bw ($P<0.05$) in the right kidney. Whereas free water clearance (C_{H_2O}) significantly increased in 40 and 60 minutes after envenomation in the right kidney but it slightly increased throughout the experiment in the left kidney (Fig 9, upper panel).

Urinary osmolar excretion ($U_{osm}V$) was suppressed significantly in 40 and 60 minutes from 16.04 ± 4.97 to 4.51 ± 2.52 and 10.17±6.16 mOsm/min/kg bw ($P<0.001$, $P<0.05$) respectively in the left kidney and from 19.18±5.48 to 4.88±2.85 at 40 minutes after envenomation in the right kidney ($P<0.05$) (table 5). Urinary excretion of sodium ($U_{Na}V$) also decreased throughout the experiment period. The significantly decrease of urinary excretion of sodium ($U_{Na}V$) was seen in 40 minutes after envenomation in the right and the left kidney from 6.29±2.95 to 1.13±0.95 uEq/min/kg bw and from 5.17±1.43 to 1.08±0.85 uEq/min/kgbw respectively ($P<0.05$) (table 7). Fractional excretion of sodium significantly was suppressed throughout the experiment in the left kidney and the significant decline in fractional excretion of sodium (FE_{Na}) was in 40 minutes after envenomation in the right kidney from 2.95±1.05 to 1.23±0.78% ($P<0.05$) (table 9). There were no significant differences in urinary excretion of potassium (U_KV) and fractional excretion of potassium (FE_K) after Russell's viper venom was injected. The slight increase of urinary excretion of potassium (U_KV) was observed. However, fractional excretion of potassium (FE_K) slightly decreased after envenomation (Fig 12,15). Urinary excretion of chloride ($U_{Cl}V$) and fractional excretion of chloride (FE_{Cl}) significantly was suppressed in the same pattern after envenomation (Fig 13,16).

Group II : animals treated with 10 mg/kg of MK 422, 5 mg/kg of imidazole and 0.7 ug/kg/min at left intrarenal arterial infusion of prazosin, respectively, before envenomation.

The results in Fig 7 indicated that urine flow rate (v) increased slightly in the period of MK 422 and imidazole but it decreased slightly in the period of prazosin. When Russell's viper venom was injected, it produced a marked reduction of urine flow rate (v) at period of 20 minutes but it was not significant and returned to the control level in both kidneys. Osmolar clearance (C_{osm}) increased significantly in the period of imidazole from 64.13±21.07 to 91.0±10.74 and 84.86 ± 20.08 ul/min/kg bw. in 20 and 40 minutes respectively ($P<0.05$) and reduced to the control level in the period of prazosin. Osmolar clearance (C_{osm}) decreased slightly after envenomation in both kidneys (Fig 8, lower panel). The results in Fig 9 showed that free water reabsorption increased slightly after MK 422, imidazole and prazosin period in the right kidney but it decreased slightly in the period of MK 422 in the left kidney. Free water reabsorbtion decreased slightly in 20 and 40 minutes then it increased to approach the control level at the end of experiment.

Urinary osmolar excretion ($U_{osm}V$) decreased slightly in both kidneys after envenomation. Urinary sodium excretion ($U_{Na}V$) increased significantly after imidazole infusion from 4.74±2.63 to 8.19±2.29 and 7.4±3.08 uEq/min/kg bw. in 20 and 40 minutes respectively in the right kidney and from 4.42±3.07 to 7.4±4.8 and 7.1±4.38 uEq/min/kg bw in 20 and 40 minutes respectively ($P<0.05$) in the left kidney. However, urinary excretion of sodium ($U_{Na}V$) decreased slightly after prazosin infusion to the control level. Envenomation decreased urinary sodium excretion at a period 20 minutes, then urinary sodium excretion increased throughout the experiment in both kidneys (Fig 11, lower panel) as well as the effects of Russell's viper venom

reduced fractional excretion of sodium (FE_{Na}) at the first 20 minutes then fractional excretion of sodium returned to the control level (Fig 14, lowper panel).

Urinary potassium excretion (U_KV) increased slightly throughout the pre-treated venom. Urinary excretion of potassium (U_KV) increased significantly in right and left kidney at the first 20 minutes of imidazole and the second 40 minutes of imidazole respectively ($P<0.05$). When Russell's viper venom was injected, urinary potassium excretion (U_KV) did not only slightly increase throughout the experiment in both kidneys but also the period of 60 minutes the left kidney increased significantly from 0.78 ± 0.14 to 1.32 ± 0.34 uEq/min/kg bw ($P<0.05$) (Fig 12, lower panel). Fractional excretion of potassium (FE_K) increased significantly at the first period of imidazole and at the both period of prazosin of the right kidney and at the first 20 minutes of prazosin of the left kidney. After envenomation, fractional excretion of potassium (FE_K) increased slightly in the left kidney but this parameter increased significantly at 20, 60 and 80 minutes from 14.67 ± 3.17 to 35.0 ± 13.06, 29.18 ± 10.02 and $29.31\pm10.9\%$ respectively (Fig 15, lower panel). The changes of urinary excretion of chloride ($U_{Cl}V$) and fractional excretion of chloride (FE_{Cl}) similared to urinary excretion of sodium ($U_{Na}V$) and fractional excretion of sodium (FE_{Na}) (Fig 11, 13, 14 and 16).

Table 5. Effect of Russell's viper venom on renal function of the right (Rt) and the left (Lt) kidney in five dogs of group I

Parameter		0.9% Saline (Intrarenal arterial infusion)											
		Control		MK 422 (10 mg/kg i.v.)		IMID (5 mg/kg i.v.)				Post-envenomation (RVV 0.1 mg/kg i.v.)			
Time elapse (min)		0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	200-220	220-240
V (ul/min/ kg bw)	Rt	23.32±18.18	23.75±16.06	27.67±16.08	29.7±13.04	40.89±19.63*	36.44±18.95	38.92±16.22*	37.10±18.45	Anuria	7.22±6.71	19.77±20.7	15.4±18.37
	Lt	28.06±21.67	28.79±15.37	29.63±18.07	33.5±11.72	42.94±21.36*	40.99±17.9	41.32±20.06*	40.89±16.23	Anuria	7.12±5.9	22.39±23.86	16.74±17.35
C_{osm} (ul/min/ kg bw)	Rt	66.18±25.3	67.58±19.92	65.41±26.81	75.76±19.93	87.18±18.74	80.57±10.86*	86.97±16.75	80.23±9.97*	Anuria	16.91±9.81*	36.65±20.85	38.86±24.41
	Lt	60.7±4.83	56.31±17.18	70.01±32.35	74.54±22.49	82.0±15.32*	84.54±15.67	83.12±15.33*	84.78±15.15	Anuria	15.62±8.58***	35.34±21.44*	37.32±24.6
C_{H_2O} (ul/min/ kg bw)	Rt	-42.86±19.93	-43.83±9.52	-37.74±17.4	-46.07±16.84	-53.33±13.83	-44.13±14.55	-48.05±16.52	-43.13±14.47	Anuria	-9.68±5.2**	-16.68±12.97*	-23.45±12.9
	Lt	-32.64±21.04	-27.51±30.87	-40.39±19.32	-41.04±18.51	-39.06±26.75	-43.36±17.45	-41.80±17.03	-43.89±15.63	Anuria	-8.98±7.5	-12.96±12.97	-20.56±16.06

P.value with respect to control, * P<0.05; ** P<0.01; *** P<0.001

Table 6. Effects of Russell's viper venom on renal function of the right (Rt) and the left (Lt) kidney in five dogs of group II.

Parameter		0.9% Saline (Intrarenal arterial infusion)						PRAZOSIN (0.7 ug/kg/min intrarenal arterial infusion)					
		Control		MK 422 (10 mg/kg i.v.)		IMID (5 mg/kg i.v.)		Post-envenomation (RVV 0.1 mg/kg i.v.)					
Time elapse (min)		0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	200-220	220-240
V	Rt	42.29±41.8	34.77±28.39	48.8±36.57	45.64±29.64	48.56±27.05	44.28±26.9	35.06±26.52	34.39±27.53	16.68±16.1	34.15±25.57	30.54±20.29	32.14±20.10
(ul/min/	Lt	39.98±29.05	31.25±21.32	43.82±32.98	42.65±25.93	45.96±27.31	37.26±24.21	34.3±25.71	34.65±23.42	17.94±21.09	32.86±31.19	28.75±19.01	30.52±20.02
kg bw)													
Cosm	Rt	68.27±16.11	64.13±21.07	82.04±24.1	78.64±15.15	91.0±10.74*	84.86±20.08*	71.33±34.48	73.67±35.34	41.73±23.94	57.26±15.19	64.97±15.2	66.21±15.72
(ul/min/	Lt	70.42±32.06	55.96±28.25	59.23±28.47	63.38±29.04	77.99±40.39	72.24±31.95*	67.83±37.16	71.82±30.77	33.3±31.9	51.9±19.13	58.59±23.48	59.12±20.0
kg bw)													
C_{H_2O}	Rt	-25.94±40	-29.36±36.2	-33.25±27.09	-33.01±33.4	-42.44±26.62	-43.06±24.82	-36.29±11.59	-39.28±14.81	-25.05±15.16	-23.1±18.37	-34.43±15.73	-34.43±17.0
(ul/min/	Lt	-39.11±17.95	-24.7±32.38	-15.4±35.75	-20.69±35.68	-32.02±31.9	-34.99±21.7	-33.53±13.61	-37.16±11.43	-15.36±10.63	-19.04±14.01	-29.84±11.89	-28.6±18.79
kg bw)													

P.value with respect to control, * P<0.05; ** P<0.01; *** P<0.001

Table 7. Effect of Russell's viper venom on urinary osmolar and electrolyte excretion of the right (Rt) and the left (Lt) kidney in five dogs of group I.

Parameter		0.9% Saline (Intrarenal arterial infusion)											
		Control		MK 422 (10 mg/kg i.v.)		IMID (5 mg/kg i.v.)				Post-envenomation (RVV 0.1 mg/kg i.v.)			
Time elapse (min)		0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	200-220	220-240
$U_{Na}V$	Rt	5.98±3.83	6.29±2.95	5.85±3.23	7.10±2.71	8.74±2.61	7.96±2.41	8.67±2.59	7.82±2.32	Anuria	1.13±0.95*	2.74±2.43	3.13±2.85
(uEq/min/	Lt	5.3±1.87	5.17±1.43	5.91±4.08	7.54±2.66	7.07±2.73	8.16±1.85*	8.09±1.27	8.14±1.72*	Anuria	1.08±0.85**	2.74±2.41	3.09±2.39
kg bw)													
$U_{K}V$	Rt	1.06±0.49	1.11±0.46	0.96±0.36	1.29±0.23	1.64±0.57*	1.70±0.63	1.66±0.60*	1.71±0.56	Anuria	0.61±0.27	0.95±0.5	0.81±0.42
(uEq/min/	Lt	1.02±0.55	1.10±0.86	1.23±0.67	1.26±0.34	1.31±0.6	1.76±0.74	1.42±0.64	1.74±0.72	Anuria	0.71±0.48	0.79±0.36	0.72±0.41
kg bw)													
$U_{Cl}V$	Rt	5.51±3.41	5.28±2.12	5.10±2.85	6.37±2.73	7.83±2.86	7.58±3.06	7.78±2.97	7.55±2.86	Anuria	0.93±0.77*	2.17±2.48	2.25±3.13
(uEq/min/	Lt	4.93±2.0	4.83±1.9	5.40±4.04	6.61±2.38	6.66±2.88	7.62±2.54*	6.97±2.72	7.59±2.39*	Anuria	0.88±0.67**	2.12±2.29*	2.02±2.21*
kg bw)													
$U_{osm}V$	Rt	18.71±7.02	19.18±5.48	18.8±7.67	21.73±5.59	24.78±5.53	22.95±3.33	24.02±4.35	22.47±3.76	Anuria	4.88±2.85*	10.56±6.01	11.2±6.97
(mOsm/min/	Lt	17.19±1.54	16.04±4.97	20.09±9.15	21.38±6.37	23.31±4.63*	23.98±4.37*	23.01±4.20*	23.97±4.17*	Anuria	4.51±2.52***	10.17±6.16*	10.74±7.02
kg bw)													

P.value with respect to control, * P<0.05; ** P<0.01; *** P<0.001

Table 8. Effects of Russell's viper venom on urinary osmolar and electrolytes excretion of the right (Rt) and the left (Lt) kidney in five dogs of group II.

Parameter		0.9% Saline (Intrarenal arterial infusion)						PRAZOSIN (0.7 ug/kg/min intrarenal arterial infusion)					
		Control		MK 422 (10 mg/kg i.v.)		IMID (5 mg/kg i.v.)		Post-envenomation (RVV 0.1 mg/kg i.v.)					
Time elapse (min)		0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	200-220	220-240
$U_{Na}V$ (uEq/min/kg bw)	Rt	5.6±3.03	4.74±2.63	6.82±4.4	6.53±2.32	8.19±2.29*	7.4±3.08*	6.74±4.57	6.41±5.28	2.39±2.53	4.96±2.94	6.08±2.93	5.98±2.76
	Lt	5.98±3.9	4.42±3.07	5.25±3.12	6.14±3.87	7.4±4.8*	7.1±4.38*	6.22±4.06	6.71±4.65	2.74±3.06	4.68±3.77	5.24±3.49	5.09±3.64
$U_{K}V$ (uEq/min/kg bw)	Rt	1.04±0.21	0.85±0.16	1.03±0.21	1.05±0.31	1.23±0.23*	1.19±0.24	1.37±0.46	1.45±0.4	1.49±0.61	1.49±0.63	1.37±0.39	1.42±0.41
	Lt	0.98±0.14	0.78±0.14	0.86±0.31	1.06±0.42	1.18±0.4	1.16±0.26*	1.12±0.34	1.4±0.47	1.07±0.69	1.57±0.71	1.32±0.34*	1.52±0.48
$U_{Cl}V$ (uEq/min/kg bw)	Rt	5.72±3.42	4.93±2.79	7.59±4.7	7.21±3.54	8.6±3.51*	8.0±3.71*	6.92±5.04	6.53±5.34	2.65±2.72	4.13±2.68	5.44±2.59	5.53±2.43
	Lt	5.71±4.08	4.39±3.13	5.23±3.31	6.01±3.68	7.71±5.69	7.04±4.79	6.57±4.8	6.68±4.93	2.99±3.37	4.02±3.41	4.32±3.26	4.38±3.04
$U_{osm}V$	Rt	19.4±4.4	18.42±5.89	23.77±6.67*	22.64±3.86*	26.08±2.37	24.27±5.47	20.39±9.8	21.18±10.2	11.97±6.9	16.42±4.45	18.8±4.5	18.67±4.21
	Lt	20.02±9.02	16.06±7.98	17.17±8.27	18.12±7.92*	22.28±11.34	20.6±8.94	19.36±10.56	20.63±8.91	9.53±8.9	14.89±5.53	16.96±6.8	17.0±5.58

P.value with respect to control, * P<0.05; ** P<0.01; *** P<0.001

Table 9. Effects of Russell's viper venom on fractional electrolytes excretionnal of the right (Rt) and the left (Lt) kidney in five dogs of group I.

Parameter		0.9% Saline (Intrarenal arterial infusion)											
		Control		MK 422 (10 mg/kg i.v.)		IMID (5 mg/kg i.v.)				Post-envenomation (RVV 0.1 mg/kg i.v.)			
Time elapse (min)		0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	200-220	220-240
FE_{Na} %	Rt	2.84±1.19	2.95±1.05	2.94±1.26	3.48±0.95	3.85±1.41	3.39±0.97	3.58±1.12	3.44±0.95	Anuria	1.23±0.78 *	1.34±0.97	1.75±1.24
	Lt	2.65±0.91	2.68±1.15	3.05±1.57	3.89±1.4	3.15±1.35	3.77±0.66	3.63±0.97	3.75±1.10	Anuria	1.03±0.53 *	1.54±1.14 *	1.63±0.98 *
FE_K %	Rt	23.63±11.8	22.55±10.45	20.85±4.2	28.07±4.94	28.64±11.31 *	28.46±7.84	29.11±8.83 *	28.63±7.77	Anuria	32.15±8.73	25.76±8.86	24.97±8.34
	Lt	22.13±12.51	23.38±19.17	28.84±15.47	27.3±6.51	23.3±11.17	31.73±9.27	30.11±7.73	31.54±10.42	Anuria	32.36±13.32	23.75±6.05	21.87±7.4
FE_{Cl} %	Rt	3.23±1.33	3.06±1.04	3.26±1.41	3.95±0.9	4.27±1.87	4.04±1.41	4.19±1.37	4.09±1.74	Anuria	1.28±0.73 *	1.3±1.22	1.58±1.80
	Lt	3.02±1.09	3.08±1.64	3.48±1.96	4.38±1.48	3.6±1.58	4.46±1.39	3.98±1.53	4.42±1.4	Anuria	1.04+0.39 *	1.44+1.29 **	1.55+1.51 *

P.value with respect to control, * P<0.05; ** P<0.01; *** P<0.001

Table 10. Effects of Russell's viper venom on fractional electrolytes excretion of the right (Rt) and the left (Lt) kidney in five dogs of group II.

Parameter		0.9% Saline (Intrarenal arterial infusion)						PRAZOSIN (0.7 ug/kg/min intrarenal arterial infusion)					
		Control		MK 422 (10 mg/kg i.v.)		IMID (5 mg/kg i.v.)		Post-envenomation (RVV 0.1 mg/kg i.v.)					
Time elapse (min)		0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	200-220	220-240
FE_{Na} %	Rt	2.28±1.24	1.97±1.16	2.92±2.27	2.77±0.93*	3.25±0.91*	2.60±1.12	2.51±1.47	2.57±2.05**	1.37±1.48	2.23±1.46	2.91±1.39	2.97±1.31
	Lt	2.54±1.68	2.13±1.67	2.22±1.26	2.47±1.39	3.06±2.13	2.53±1.45	2.83±1.25	2.34±1.6	1.87±1.79	2.27±2.11	2.68±2.04	2.44±2.32
FE_K %	Rt	18.71±3.81	14.67±3.17	16.86±4.66	19.34±5.12	20.77±3.95*	17.37±4.11	24.28±6.8*	25.49±6.03*	35.0±13.06*	28.74±14.28	29.18±10.02*	29.31±10.9*
	Lt	17.6±3.77	15.34±3.64	16.62±3.82	19.03±5.54	20.05±6.42	18.02±4.2	23.85±5.69*	21.33±7.17	34.59±17.89	29.13±11.68	30.28±10.33	32.17±9.2
FE_{Cl} %	Rt	2.87±1.63	2.54±1.45	4.11±2.88	3.95±2.11	4.54±2.01*	3.41±1.56	3.11±1.75	3.31±2.64	1.85±1.97	2.36±1.71	3.31±1.61	3.39±1.22
	Lt	3.01±2.08	2.64±2.06	2.86±1.78	3.12±1.81	4.26±3.48	3.05±1.86	3.72±1.89	2.98±2.26	2.47±2.44	2.47±2.45	2.79±2.46	2.71±2.28

P.value with respect to control, * P<0.05; ** P<0.01; *** P<0.001

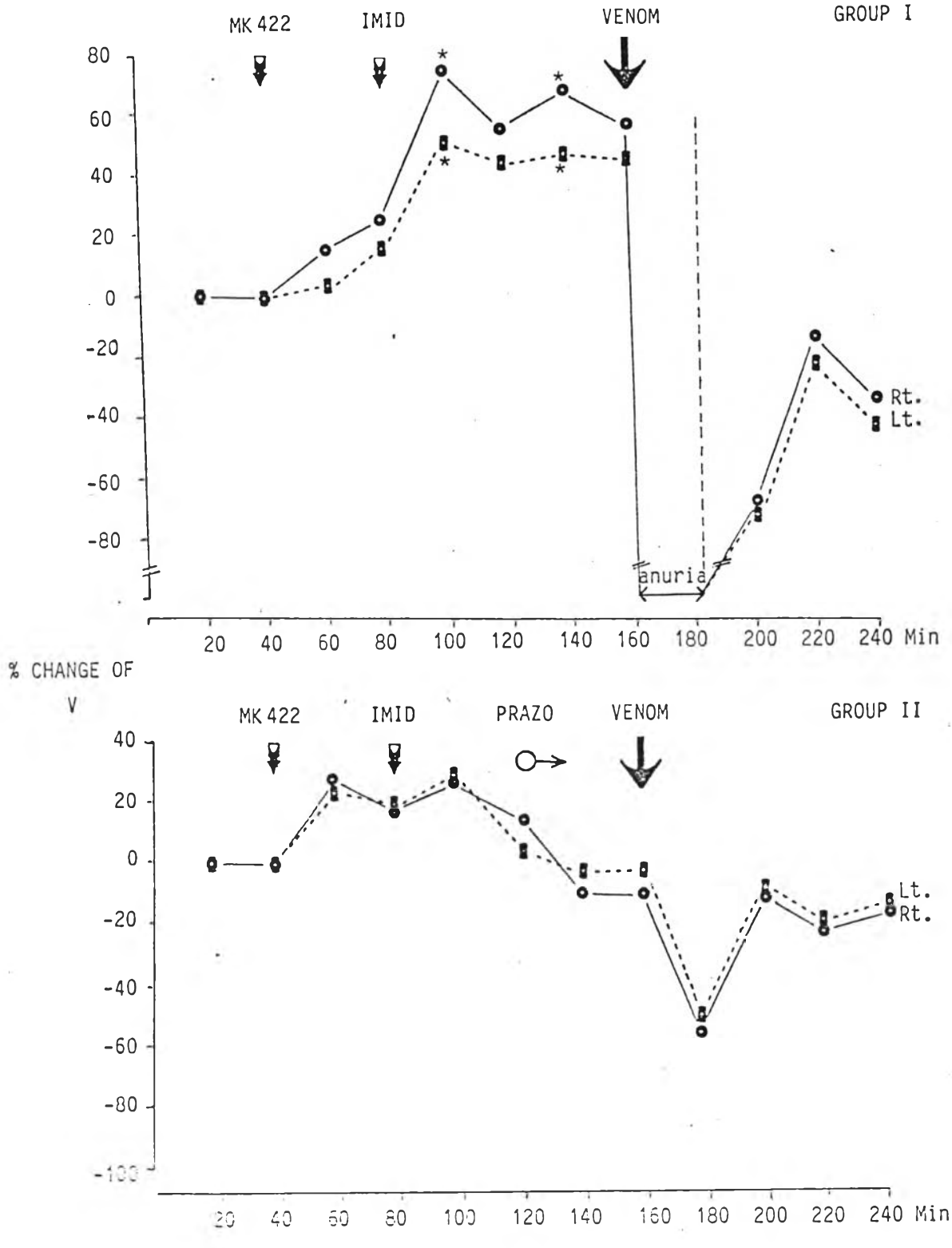

Fig 7 : Effects of intravenous injection of Russell's viper venom on % change of urine flow rate (V) in right and left kidney of group I (upper panel) and group II (lower panel). Values are statistically significantly different from control period of each time,

* P<0.05, ** P<0.01, *** P<0.001

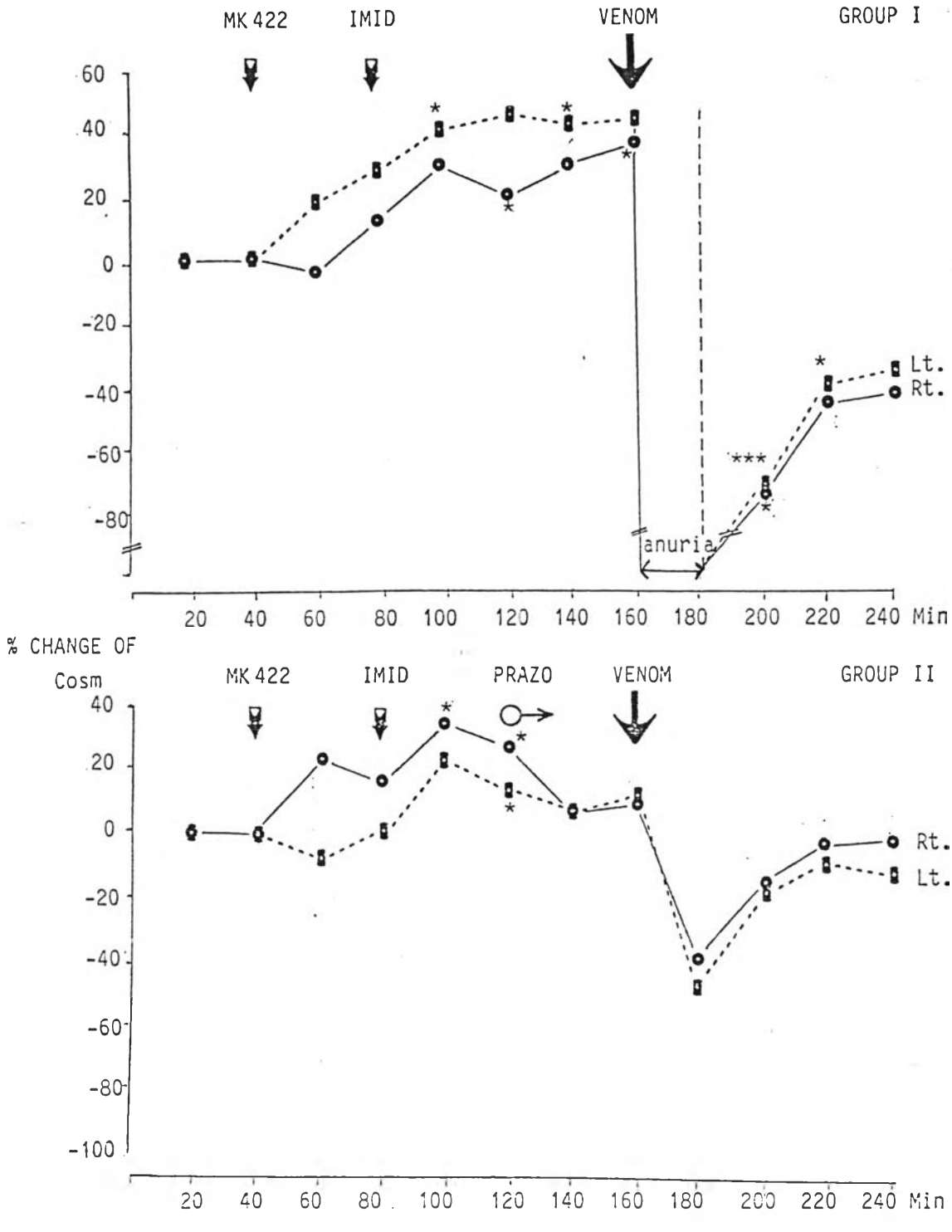

Fig 8 : Effects of intravenous injection of Russell's viper venom on % change of osmolar clearance (Cosm) in right and left kidney of group I (upper panel) and group II (lower panel). Values are statistically significantly different from control period of each time,
* P<0.05, ** P<0.01, *** P<0.001

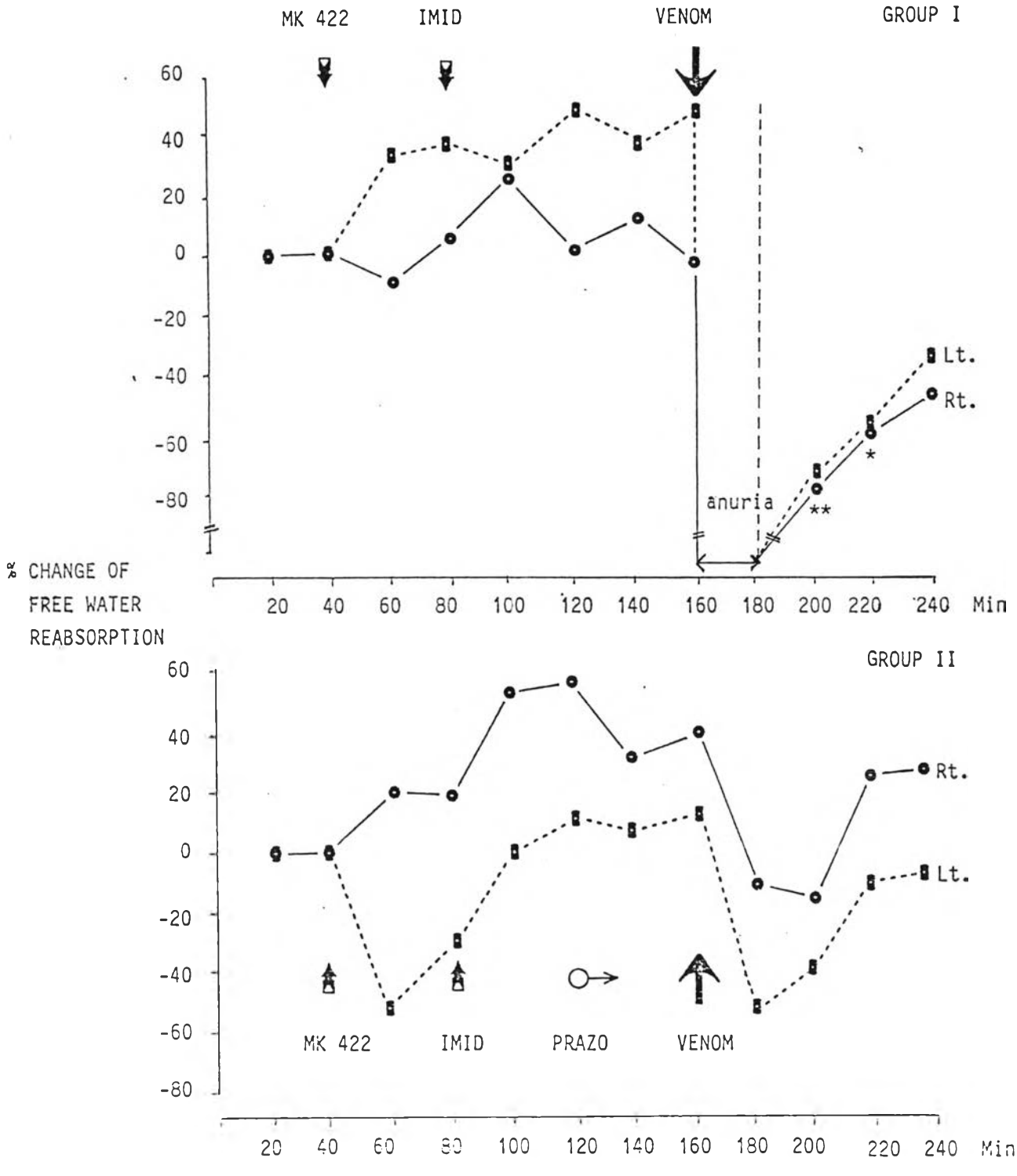

Fig 9 : Effects of intravenous injection of Russell's viper venom on % change of decrease free water clearance ($C_{H\ O}$) in right and left kidney of group I (upper panel) and group II (lower panel).
Values are statistically significantly different from control period of each time,
* $P<0.05$, ** $P<0.01$, *** $P<0.001$

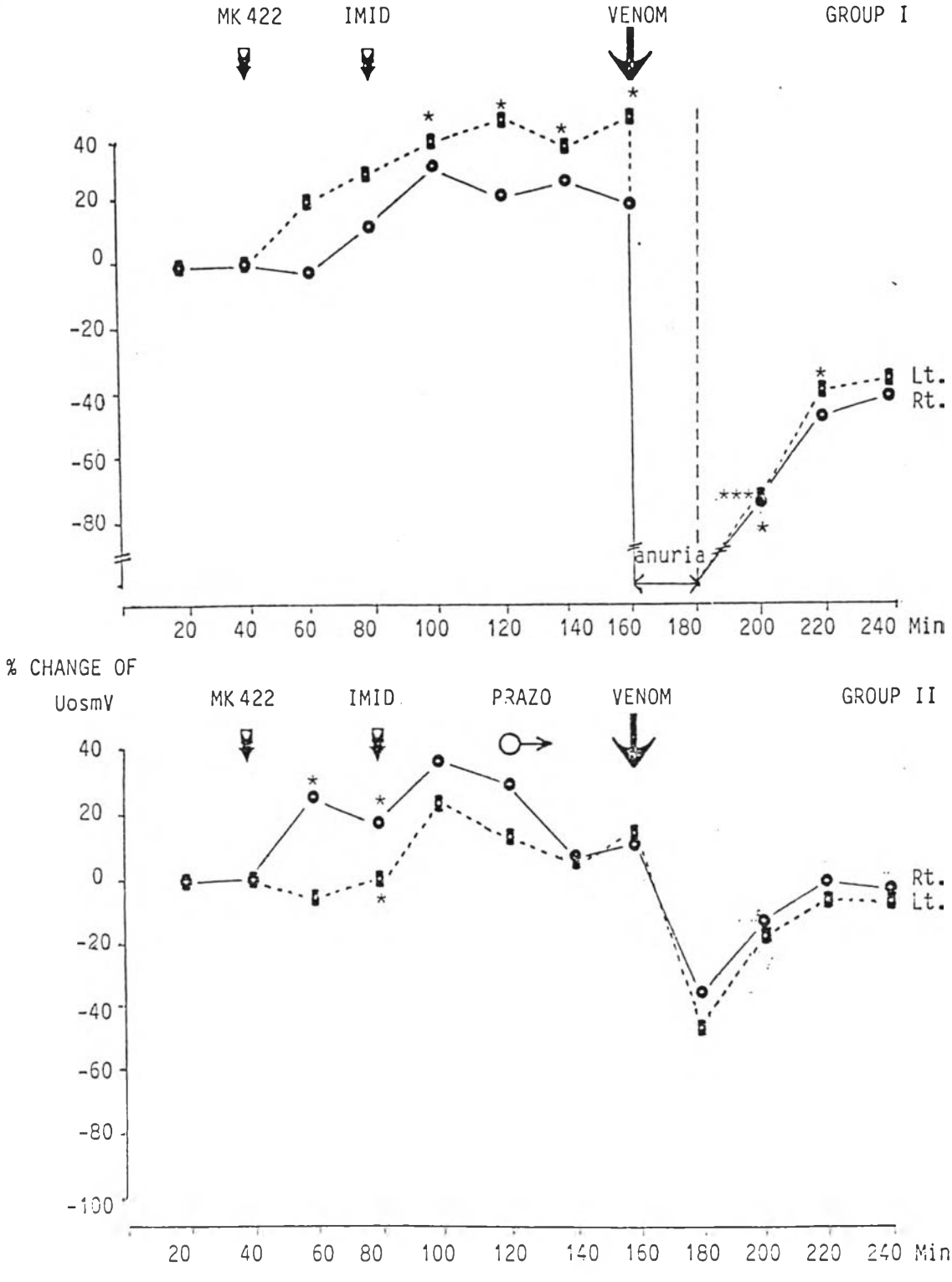

Fig 10 : Effects of intravenous injection of Russell's viper venom on % change of urinary osmolar excretion (Uosm V) in right and left kidney in group I (upper panel) and group II (lower panel).

Values are statistically significantly different from control period of each time,

* $P<0.05$, ** $P<0.01$, *** $P<0.001$

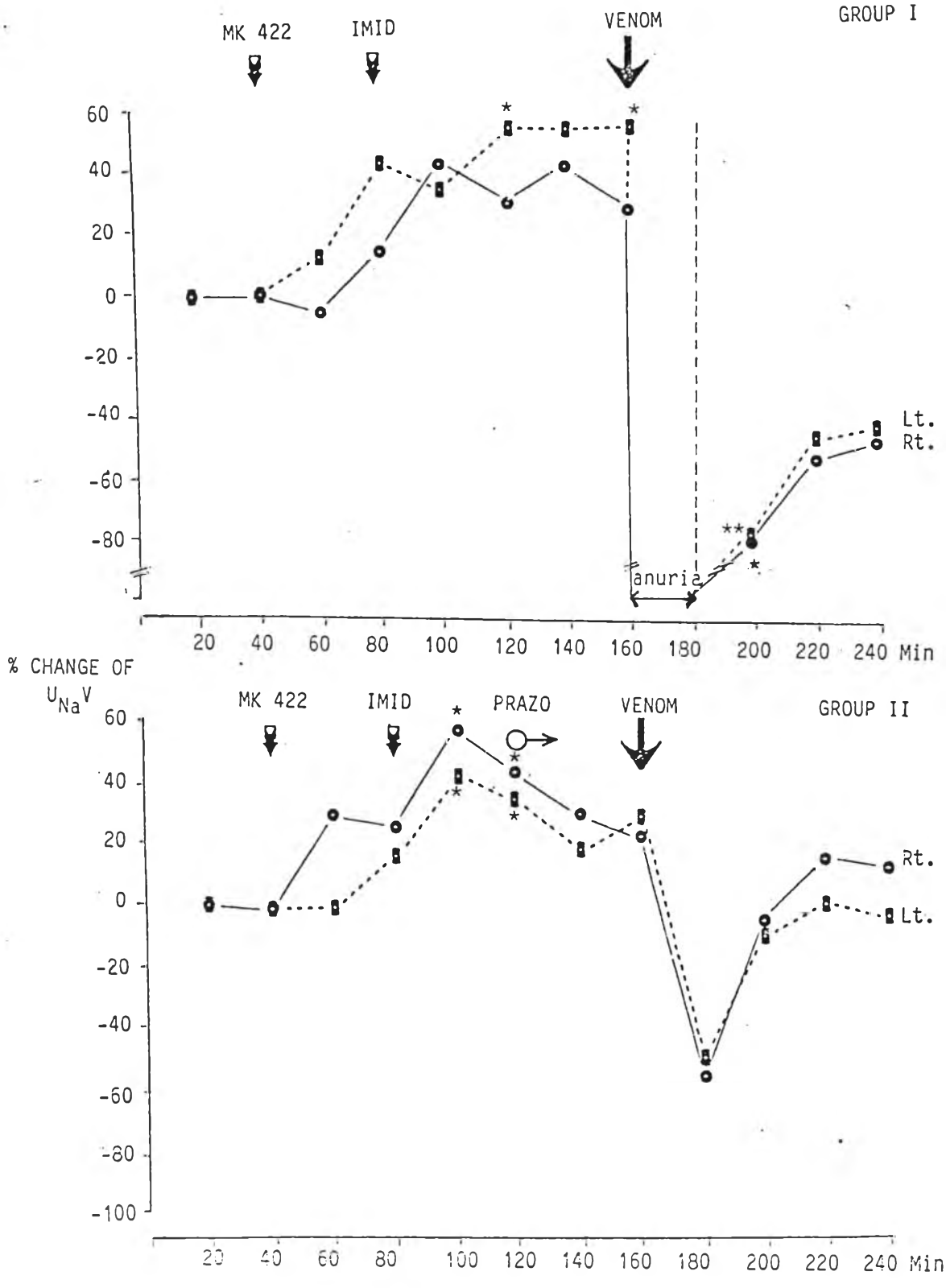

Fig 11 : Effects of intravenous injection of Russell's viper venom on % change of sodium excretion ($U_{Na}V$) in right and left kidney of group I (upper panel) and group II (lower panel). Values are statistically significantly different from control period of each time,
* P<.05, ** P<0.01, *** P<0.001

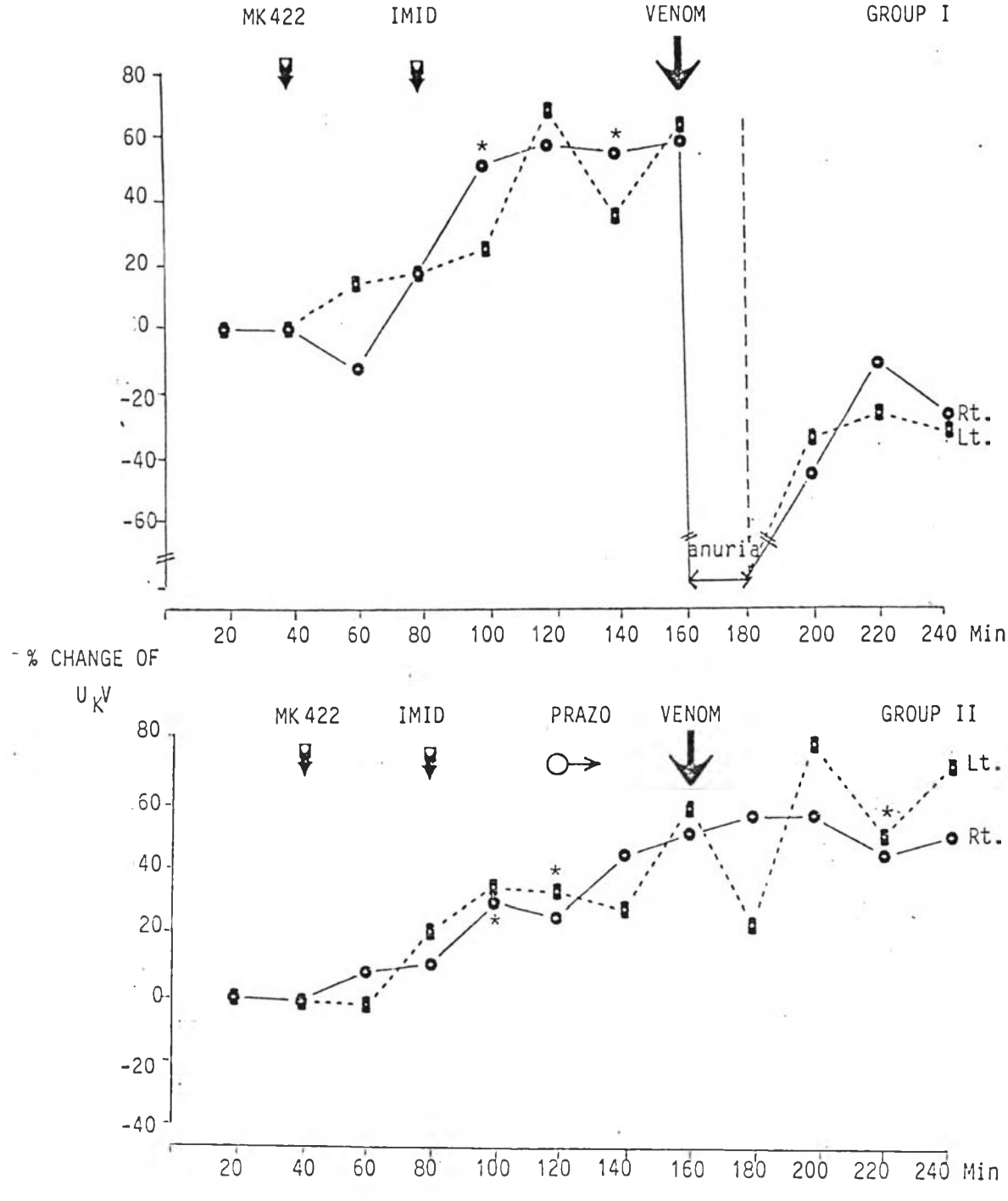

Fig 12 : Effects of intravenous injection of Russell's viper venom on % change of potussium excretion (U_KV) in right and left kidney of group I (upper panel) and group II (lower panel).
Values are statistically significantly different from control period of each time,
* P<0.05, ** P<0.01, *** P<0.001

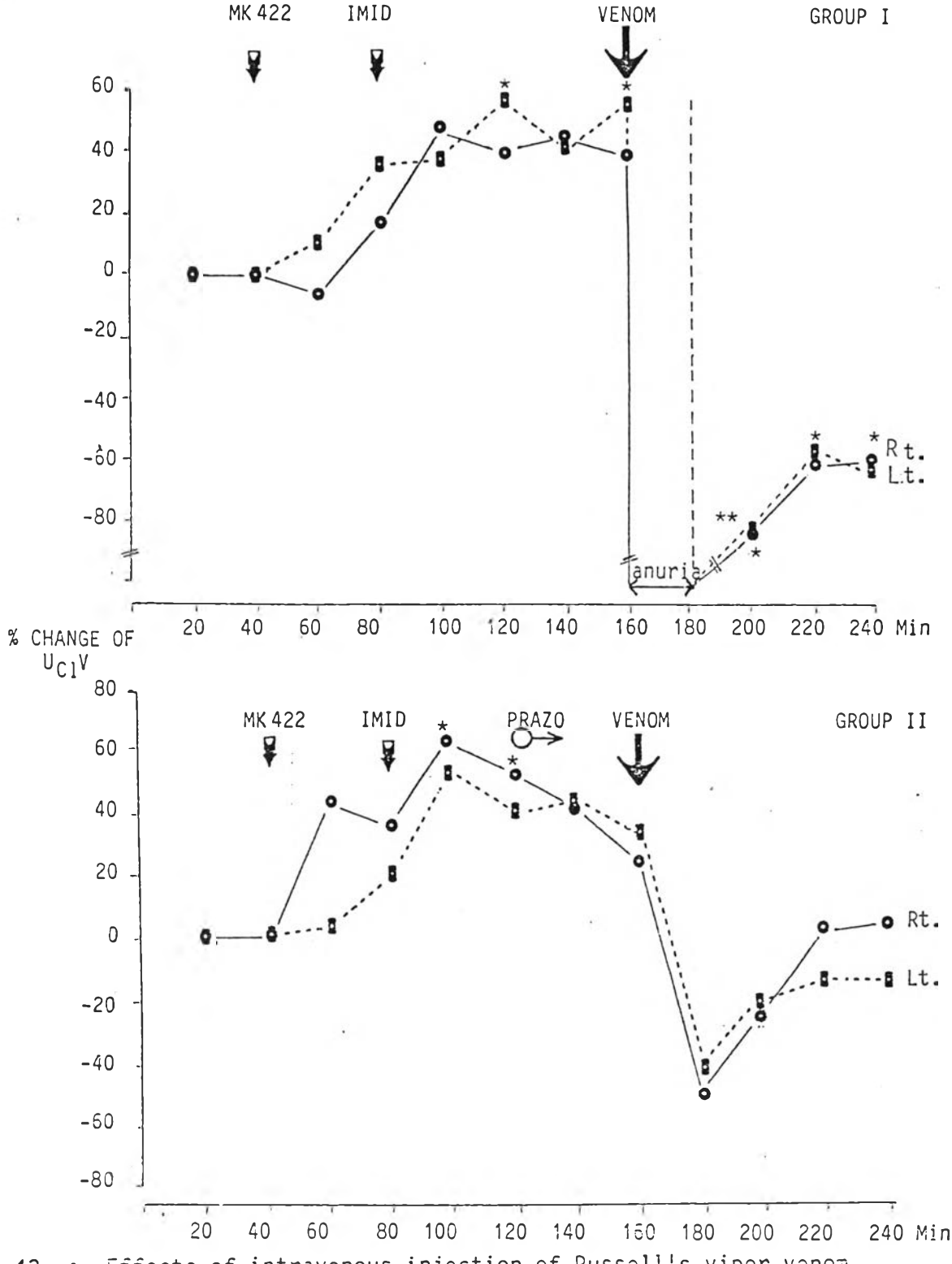

Fig 13 : Effects of intravenous injection of Russell's viper venom on % change of urinary cholryde excretion ($U_{C1}V$) in right and left kidney of group I (upper panel) and group II (lower panel).

Values are statistically significantly different from control period of each time,

* $P<0.05$, ** $P<0.01$, *** $P<0.001$

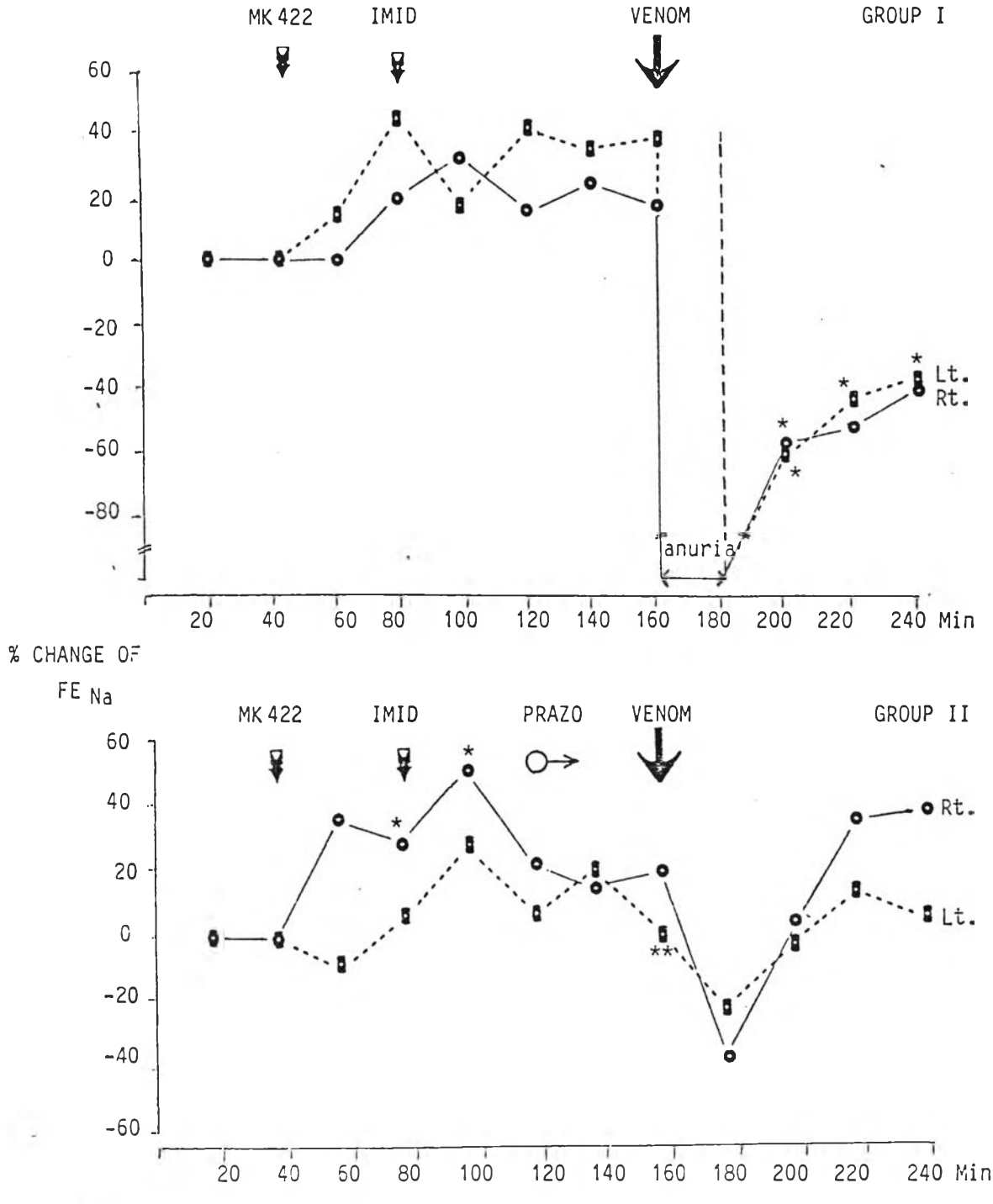

Fig 14 : Effects of intravenous injection of Russell's viper venom on % change of fractional excretion of sodium (FE_{Na}) in right and left kidney of group I (upper panel) and group II (lower panel).
Values are statistically significantly different from control period of each time,
* P<0.01, ** P<0.05, *** P<0.001

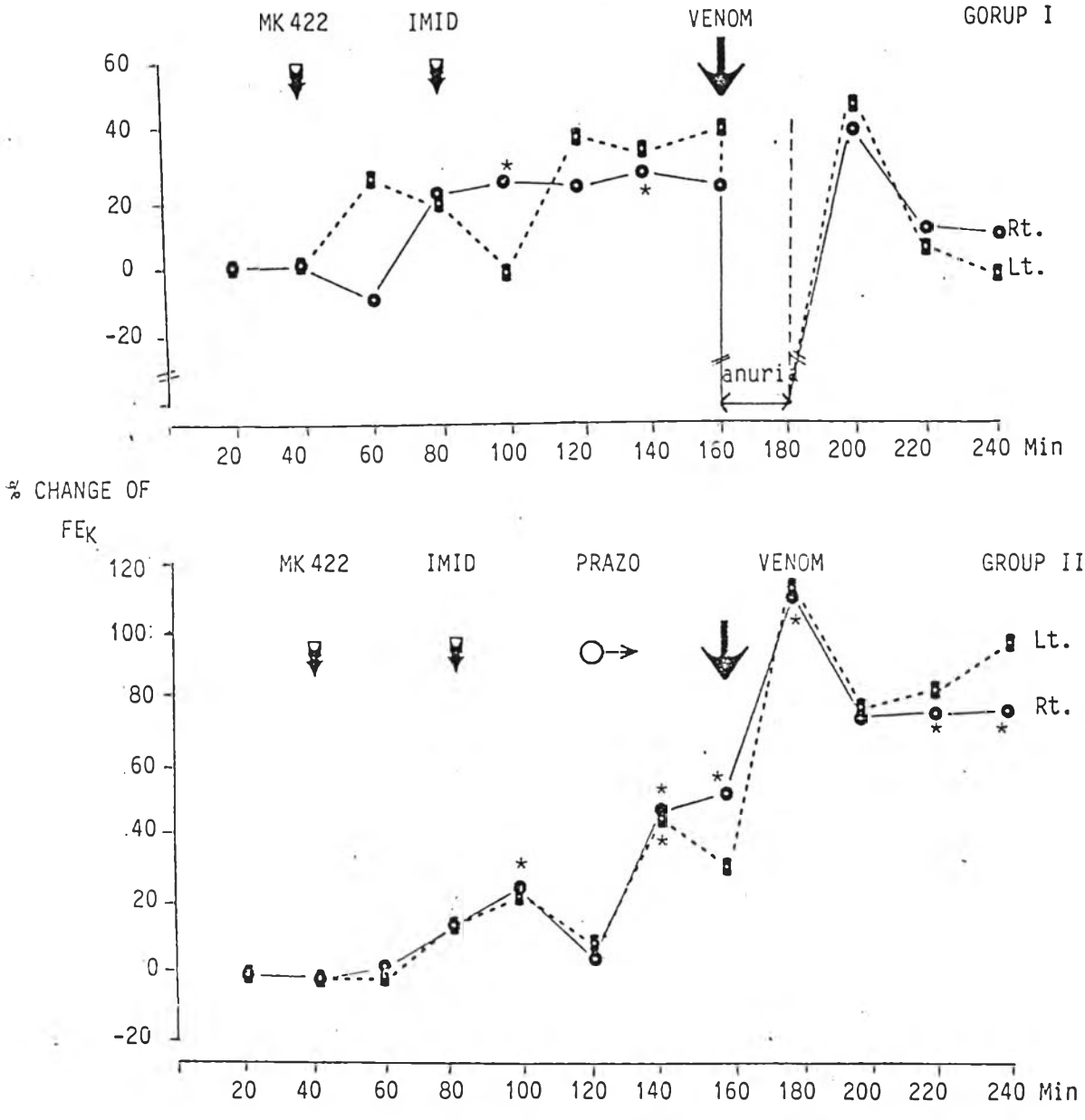

Fig 15 : Effects of intravenous injection of Russell's viper venom on % change of fractional excretion of potassium (FE_K) in right and left kidney of group I (upper panel) and group II (lower panel).
Values are statistically significantly different from control period of each time,
* $P<0.05$, ** $P<0.01$, *** $P<0.001$

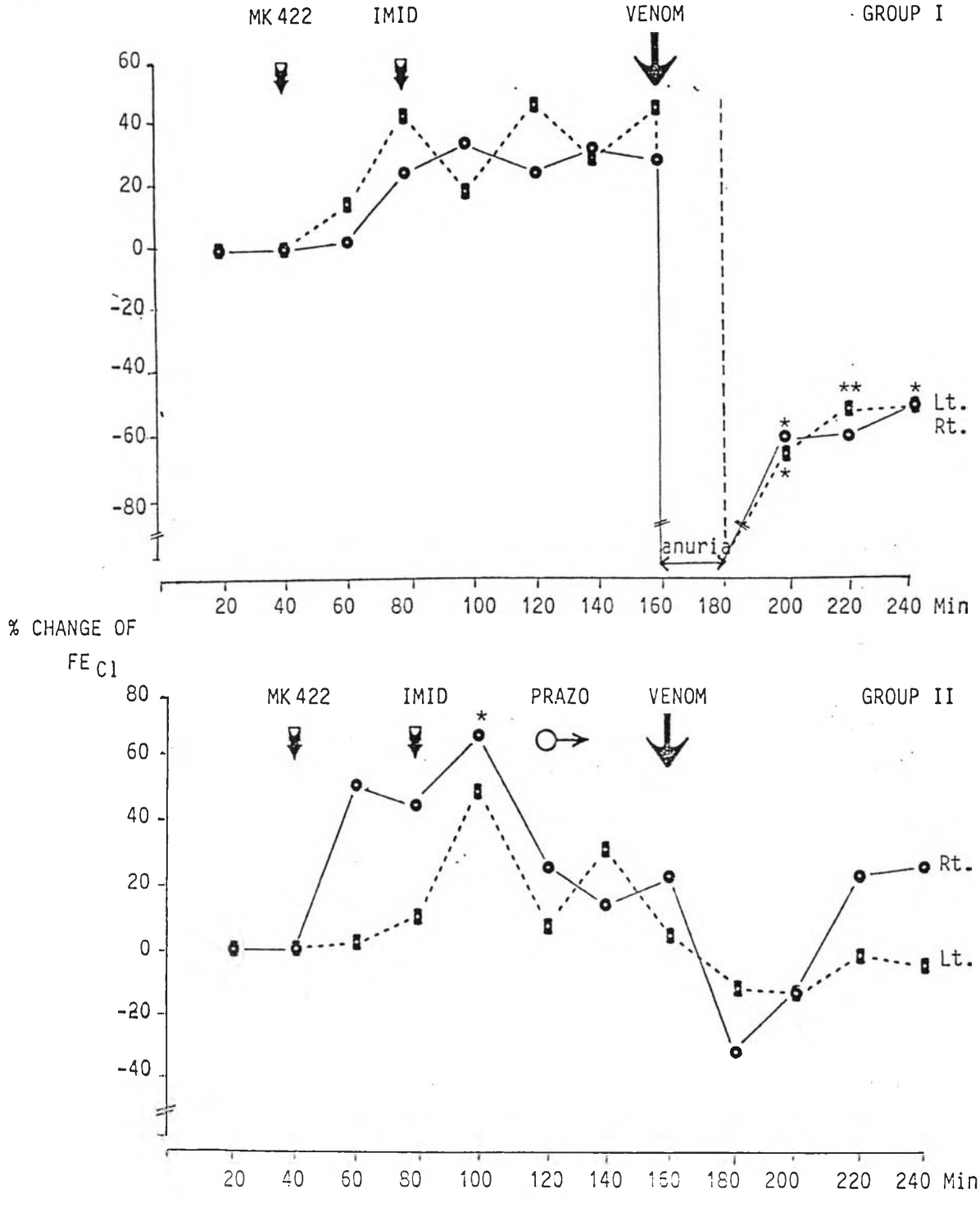

Fig 16 : Effects of intravenous injection of Russell's viper venom on % change of fractional excretion of chloride (FE_{Cl}) in right and left kidney of group I (upper panel) and group II (lower panel).
Values are statistically significantly different from control period of each time
* $P<0.05$, ** $P<0.01$, *** $P<0.001$