Chapter IV

Results

Effects of intravenous $CaCl_2$ infusion on general circulations

Group I : Control animals

As shown in table 1, the results are expressed on mean±S.E. After intravenous saline infusion, all parameters did not indicate the significant changes throughout the experimental period.

Group II : Hypercalcemic animals

Effects of intravenous $CaCl_2$ infusion on general circulations are shown in table 2. The $CaCl_2$ infusion caused a significant increase in mean arterial blood pressure (MAP) from 109.45±9.21 to 128.26±12.48 mmHg ($p<0.01$) within 1 hour after $CaCl_2$ infusion and maintained at the higher level till the end of the experiment. Pulse pressure (PP) and packed cell volume (PCV) increased slightly throughout the experimental period without statistically significance. The significant decrease in heart rate(HR) from the control value of 145±10 to 105±19 beats/min ($p<0.05$) was noted at the 3^{rd} hour of $CaCl_2$ infusion. Cardiac output (CO) showed a marked decrease at the 3^{rd} hour period of $CaCl_2$ infusion from 151.95±31.96 to 60.93±13.79 ml/min/kg.bw. ($p<0.01$). Plasma volume

Table 1 Effects of intravenous isotonic saline infusion on general circulations of four control dogs. (Mean±S.E.)

	Saline infusion			
		Saline infusion		
Variables	control	1 hr.	2 hr.	3 hr.
MAP	126.63	128.10	128.16	129.97
(mmHg)	±7.67	±8.25	±8.66	±7.36
PP	38.75	35.62	34.58	35.62
(mmHg)	±4.27	±2.57	±2.08	±2.57
HR	146	144	141	143
(beats/min)	±9	±8	±10	±10
CO	160.75	164.23	150.82	140.69
(ml/min/kg.bw.)	±19.94	±17.84	±25.37	±13.09
PV	49.49	47.38	47.41	48.39
(ml/kg.bw.)	±4.16	±3.70	±3.57	±4.05
BV	66.14	62.77	62.81	64.12
(ml/kg.bw.)	±5.24	±4.89	±4.81	±5.39
PCV	25.25	25.00	25.00	25.00
(%)	±0.63	±0.41	±0.41	±0.41
TPR	100	98.86	110.56	116.89
(%)		±3.96	±7.05	±6.21

Table 2 Effects of intravenous $CaCl_2$ infusion on general circulations of five dogs. (Mean±S.E.)

	Saline infusion			
		After $CaCl_2$ infusion		
Variables	Control	1 hr.	2 hr.	3 hr.
		*	*	**
MAP	109.45	128.26	136.20	144.39
(mmHg)	±9.21	±12.48	±12.35	±8.96
PP	41.00	43.94	45.52	51.81
(mmHg)	±2.32	±4.44	±4.44	±9.83
			*	*
HR	145	117	105	105
(beats/min)	±10	±23	±19	±19
			**	**
CO	151.95	107.05	72.78	60.93
(ml/min/kg.bw.)	±31.96	±22.81	±19.50	±13.79
		*	*	*
PV	46.20	39.81	31.08	29.17
(ml/kg.bw.)	±4.28	±3.72	±3.03	±1.07
		*	*	*
BV	66.81	57.32	45.40	42.92
(ml/kg.bw.)	±6.01	±5.59	±4.95	±2.71
PCV	30.80	30.40	31.10	31.80
(%)	±1.60	±1.48	±1.42	±1.31
		*	**	***
TPR	100	182.05	273.73	338.99
(%)		±29.62	±22.03	±21.39

p-value with respect to control, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

(PV) as well as blood volume(BV) decreased from 46.20±4.28 to 29.17±1.07 ml/kg.bw. ($p<0.05$) and from 66.81±6.01 to 42.92±2.71 ml/kg.bw. ($p<0.05$) at the end of the experiment. Total peripheral vascular resistance (TPR) increased sharply to 182 % at the 1st hour period and significant increased progressively to 273 % and 338 % at the 2nd and 3rd hour period of $CaCl_2$ infusion, respectively.

Group III : Animals pretreated with a low dose of Verapamil (6 μg/kg in the rate of 1 ml/min)

The results of changes in general circulations in dogs given intravenous $CaCl_2$ infusion and pretreated with a low dose of Verapamil are shown in table 3. During given Verapamil alone, mean arterial blood pressure decreased significantly from the control value of 110.34±8.15 to 91.24±5.36 mmHg ($p<0.05$) and then it was not altered significantly from the control value after 3 hour period of intravenous $CaCl_2$ infusion. Pulse pressure increased slightly only at the 1st hour period of $CaCl_2$ infusion from 39.98±4.96 to 46.82±5.21 mmHg($p<0.05$). Heart rate significantly decreased in the period of infusion Verapamil alone ($p<0.05$) and more significantly decreased after 3rd hour of $CaCl_2$ infusion from 145±5 to 98±4 beats/min ($p<0.01$) at the end of the experiment. A significant decline in cardiac output was apparent from 99.78±8.08 to 53.96±10.42 ml/min/kg.bw. ($p<0.05$) after $CaCl_2$ infusion. At the 3rd hour period after $CaCl_2$ infusion, both plasma volume and blood volume marked decreased from 42.81±1.96 to 23.77±1.88 ml/kg.bw. and from 63.66±3.18 to 35.09±1.84 ml/kg.bw. ($p<0.001$), respectively.

Table 3 Effects of intravenous $CaCl_2$ infusion on general circulations of five dogs pretreated with a low dose of Verapamil (6 μg/kg in the rate of 1 ml/min). (Mean±S.E.)

		Verapamil infusion			
		Before $CaCl_2$	After $CaCl_2$ infusion		
Variables	Control	infusion	1 hr.	2 hr.	3 hr.
		*			
MAP	110.34	91.24	109.08	110.73	111.43
(mmHg)	±8.15	±5.36	±5.22	±7.17	±9.82
			*		
PP	39.98	40.88	46.82	45.75	46.05
(mmHg)	±4.96	±4.90	±5.21	±6.07	±5.62
		*	*	**	**
HR	145	129	108	101	98
(beats/min)	±5	±7	±6	±7	±4
			**	***	**
CO	99.78	97.24	64.88	45.25	53.96
(ml/min/kg.bw.)	±8.08	±8.06	±6.17	±6.89	±10.42
			**	***	***
PV	42.81	37.04	30.44	21.42	23.77
(ml/kg.bw.)	±1.96	±2.78	±1.31	±1.73	±1.88
			**	**	***
BV	63.66	56.09	44.41	31.43	35.09
(ml/kg.bw.)	±3.18	±5.62	±1.06	±2.02	±1.84
PCV	32.60	33.40	31.55	32.05	32.60
(%)	±1.66	±1.44	±1.75	±2.01	±2.06
		**	**	**	*
TPR	100	79.85	142.58	226.24	198.25
(%)		±3.00	±8.41	±22.94	±25.88

p-value with respect to control, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Total peripheral vascular resistance decreased about 20 % from the control level in the period of infusion Verapamil alone and then it increased gradually to 142 %, 226 % and 198 % at the 1st, 2nd and 3rd hour period during $CaCl_2$ infusion, respectively. During experiment no change in packed cell volume was noted.

Group IV : Animals pretreated with a high dose of verapamil (12 µg/kg in the rate of 1 ml/min)

Results of changes in general circulations in dogs given intravenous $CaCl_2$ infusion and pretreated with the high dose of Verapamil are shown in table 4. During given a high dose of Verapamil alone, mean arterial blood pressure decreased markedly from the control value of 115.98+4.96 to 88.28±4.32 mmHg ($p<0.001$) and then it returned to normal values after 3 hour period of $CaCl_2$ infusion. Pulse pressure increased slightly at the 1st hour of $CaCl_2$ infusion from 39.50±6.04 to 50.17+6.98 mmHg ($p<0.05$). A significant decline in heart rate was observed at the 1st hour of $CaCl_2$ infusion from 145+9 to 113+14 beats/min ($p<0.05$) and declined progressively to 108+26 beats/min ($p<0.01$) at the end of the experiment. Cardiac output increased significantly in the period of pretreated with Verapamil alone ($p<0.01$) but it returned to a lower level as compared to the control value from 132.71+24.99 to 91.31+24.21 and to 80.64±16.41 ml/min/kg.bw. ($p<0.01$) at the 2nd and 3rd hour period of $CaCl_2$ infusion, respectively. It was found that plasma volume decreased gradually from 46.02±3.59 to 36.45+4.90 ($p<0.01$) and to 37.43+3.34 ml/kg.bw. ($p<0.05$) at the 2nd and

Table 4 Effect of intravenous $CaCl_2$ infusion on general circulations of five dogs pretreated with a high dose of Verapamil (12 µg/kg in the rate of 1 ml/min). (Mean±S.E.)

		Verapamil infusion			
		Before $CaCl_2$	After $CaCl_2$ infusion		
Variables	Control	infusion	1 hr.	2 hr.	3 hr.
		***			
MAP	115.98	88.28	113.18	115.47	119.15
(mmHg)	±4.96	±4.32	±7.98	±6.58	±7.74
			*		
PP	39.50	41.50	50.17	46.25	46.75
(mmHg)	±6.04	±4.23	±6.98	±6.68	±7.19
			*	**	**
HR	145	134	113	106	108
(beats/min)	±9	±13	±14	±15	±26
		**		**	**
CO	132.71	184.10	120.43	91.31	80.64
(ml/min/kg.bw.)	±24.99	±26.66	±30.52	±24.21	±16.41
				**	*
PV	46.02	48.62	43.12	36.45	37.43
(ml/kg.bw.)	±3.59	±2.99	±4.58	±4.90	±3.34
		*		**	
BV	66.72	71.27	62.46	53.29	56.04
(ml/kg.bw.)	±4.59	±3.89	±5.73	±5.36	±3.18
PCV	31.00	31.70	31.10	32.50	33.40
(%)	±2.89	±2.89	±2.81	±3.39	±3.67
		**		**	**
TPR	100	54.21	113.64	155.25	169.54
(%)		±4.88	±10.39	±12.25	±3.84

P-value with respect to control, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

3rd hour of $CaCl_2$ infusion, whereas blood volume increased in the period of infusion Verapamil alone ($p<0.05$), and then it decreased from the control value of 66.72±4.59 to 53.29±5.36 ml/kg.bw. ($p<0.01$) at the 2nd hour of $CaCl_2$ infusion. Total peripheral vascular resistance decreased promptly near 46% from the control value in animals infusion with Verapamil alone and then it increased significantly to 155 % and 169 % at the 2nd and 3rd hour after $CaCl_2$ infusion. During the experiment, no change in packed cell volume was observed.

Group V : Animals pretreated with Prazosin
(20 µg/kg in the rate of 1 ml/min)

The results of changes in general circulations in dogs given intravenous $CaCl_2$ infusion and pretreated with Prazosin are shown in table 5. Mean arterial blood pressure decreased significantly from the control value of 116.12±5.08 to 95.81±3.94 mmHg ($p<0.01$) during given Prazosin alone and then it was not altered from the control value after 3 hour period of $CaCl_2$ infusion. Pulse pressure decreased from 38.00±0.93 to 29.26±1.78 mmHg($p<0.05$) and heart rate also decreased gradually from 153±11 to 110±10 beats/min ($p<0.05$) at the end of the experiment. A marked decline in cardiac output was observed in the 2nd and 3rd hour period of $CaCl_2$ infusion from 179.72±14.34 to 101.97±1.87 and to 99.65±5.23 ml/min/kg bw. ($p<0.01$) respectively. Plasma volume showed a slight decrease at the 1st hour period from 48.36±0.84 to 44.25±1.37 and decreased progressively to 37.00±2.20 ml/kg.bw. ($p<0.01$) at the end of the experiment. whereas blood volume decreased

Table 5 Effects of intravenous $CaCl_2$ infusion on general circulations of five dogs pretreated with Prazosin (20 μg/kg in the rate of 1 ml/min). (Mean±S.E.)

		Prazosin infusion			
		Before $CaCl_2$	After $CaCl_2$ infusion		
Variables	Control	infusion	1 hr.	2 hr.	3 hr.
		**			
MAP	116.12	95.81	113.81	118.96	116.22
(mmHg)	±5.08	±3.94	±4.20	±6.84	±6.47
		***	*	*	*
PP	38.00	27.00	28.99	30.25	29.26
(mmHg)	±0.93	±1.22	±1.27	±1.95	±1.78
		*	*	*	*
HR	153	137	106	106	110
(beats/min)	±11	±12	±12	±10	±10
				**	**
CO	179.72	188.93	134.93	101.97	99.65
(ml/min/kg.bw.)	±14.34	±11.60	±12.64	±1.87	±5.23
			*	**	**
PV	48.36	48.84	44.25	38.21	37.00
(ml/kg.bw.)	±0.84	±0.25	±1.37	±2.85	±2.20
				**	**
BV	71.72	70.88	64.89	55.38	53.70
(ml/kg.bw.)	±1.59	±2.20	±2.00	±3.19	±2.16
PCV	32.00	31.80	31.15	31.10	31.25
(%)	±2.07	±2.15	±2.38	±2.34	±2.34
		**		**	*
TPR	100	72.48	129.40	179.05	182.47
(%)		±4.35	±15.00	±11.14	±18.76

p-value with respect to control, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

persistently from 71.27±1.59 to 55.38±3.19 and to 53.70±2.16 ml/kg.bw. ($p<0.01$) at the 2nd and 3rd hour after $CaCl_2$ infusion, respectively. During given Prazosin alone, total peripheral vascular resistance decreased about 28 % from the control value and then it increased significantly to 179 % and 182 % at the 2nd and 3rd hour period after $CaCl_2$ infusion. No change in packed cell volume was observed during experiment.

Group VI : Animals pretreated with the combination of high dose of Verapamil and Prazosin

The results are summarized in table 6. During given the combined drugs period, mean arterial blood pressure decreased markedly from 114.62±3.31 to 79.96±2.84 mmHg ($p<0.001$) and maintained at the significant lower level till the end of the experiment. It was found that pulse pressure, cardiac output and packed cell volume did not significant change during the experiment. Heart rate decreased from 143±6 to 109±10 beats/min ($p<0.05$) at the 3rd hour of $CaCl_2$ infusion. Not only plasma volume but also blood volume decreased significantly from 49.71±3.34 to 43.12±3.36 ml/kg.bw. ($p<0.05$) and from 71.24±5.15 to 67.47±6.29 ml/kg.bw. ($p<0.05$) at the 3rd hour of $CaCl_2$ infusion, respectively. During given the combined drugs period, total peripheral vascular resistance decreased by approximately 43 % from the control value and it returned to the control value after 3 hour period of $CaCl_2$ infusion.

Table 6 Effects of intravenous $CaCl_2$ infusion on general circulations of five dogs pretreated with the combination of high dose of Verapamil and Prazosin. (Mean±S.E.)

		Verapamil + Prazosin infusion			
		Before $CaCl_2$	After $CaCl_2$ infusion		
Variables	Control	infusion	1 hr.	2 hr.	3 hr.
		***	***	**	**
MAP	114.62	79.96	97.64	98.64	99.66
(mmHg)	±3.31	±2.84	±3.88	±2.49	±1.85
PP	35.00	36.00	35.00	35.00	35.00
(mmHg)	±1.58	±3.32	±2.73	±3.53	±5.18
			**	*	*
HR	143	133	117	112	109
(beats/min)	±6	±4	±6	±9	±10
CO	176.58	221.22	175.34	161.23	139.53
(ml/min/kg.bw.)	±4.42	±18.82	±28.28	±31.12	±0.46
					*
PV	49.71	48.32	43.99	44.71	43.12
(ml/kg.bw.)	±3.34	±2.32	±4.04	±2.25	±3.36
					*
BV	71.24	68.98	62.48	63.34	67.47
(ml/kg.bw.)	±5.15	±4.40	+6.47	±4.31	±6.29
PCV	29.60	29.40	29.00	28.80	29.00
(%)	±3.14	±3.18	±2.96	±3.31	±3.27
		**			
TPR	100	57.79	93.95	110.29	130.22
(%)		±6.36	±12.99	±21.77	±24.05

P-value with respect to control, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

In comparison, the effects of intravenous $CaCl_2$ infusion on general circulations showed an increase in mean arterial blood pressure in group II-VI (Fig.1). Animals pretreatment with neither Verapamil nor Prazosin (group II) produced a sharp increase in mean arterial blood pressure. On the other hand, animals in group III-V could maintain the mean arterial blood pressure to the control level when received $CaCl_2$ infusion. Furthermore, in group VI, mean arterial blood pressure was lower significantly as compared to the control group throughout the experimental period. It should be noted that pulse pressure increased from the control value of animals in group II-IV, whereas group V decreased significantly (Fig.2). Heart rate (Fig.2), plasma volume and blood volume (Fig.3) of group II-VI progressive decreased significantly in the same pattern after $CaCl_2$ infusion. There was a statistically significant decrease in cardiac output of group II-V (Fig.4) during the experimental period. Total peripheral vascular resistance of group II-V showed a gradual increase after $CaCl_2$ infusion (Fig.5). No change in packed cell volume was observed during the experiment of all groups. However, it was noted that pulse pressure, cardiac output and total peripheral vascular resistance of group VI did not significantly alter from the control value throughout the experimental period.

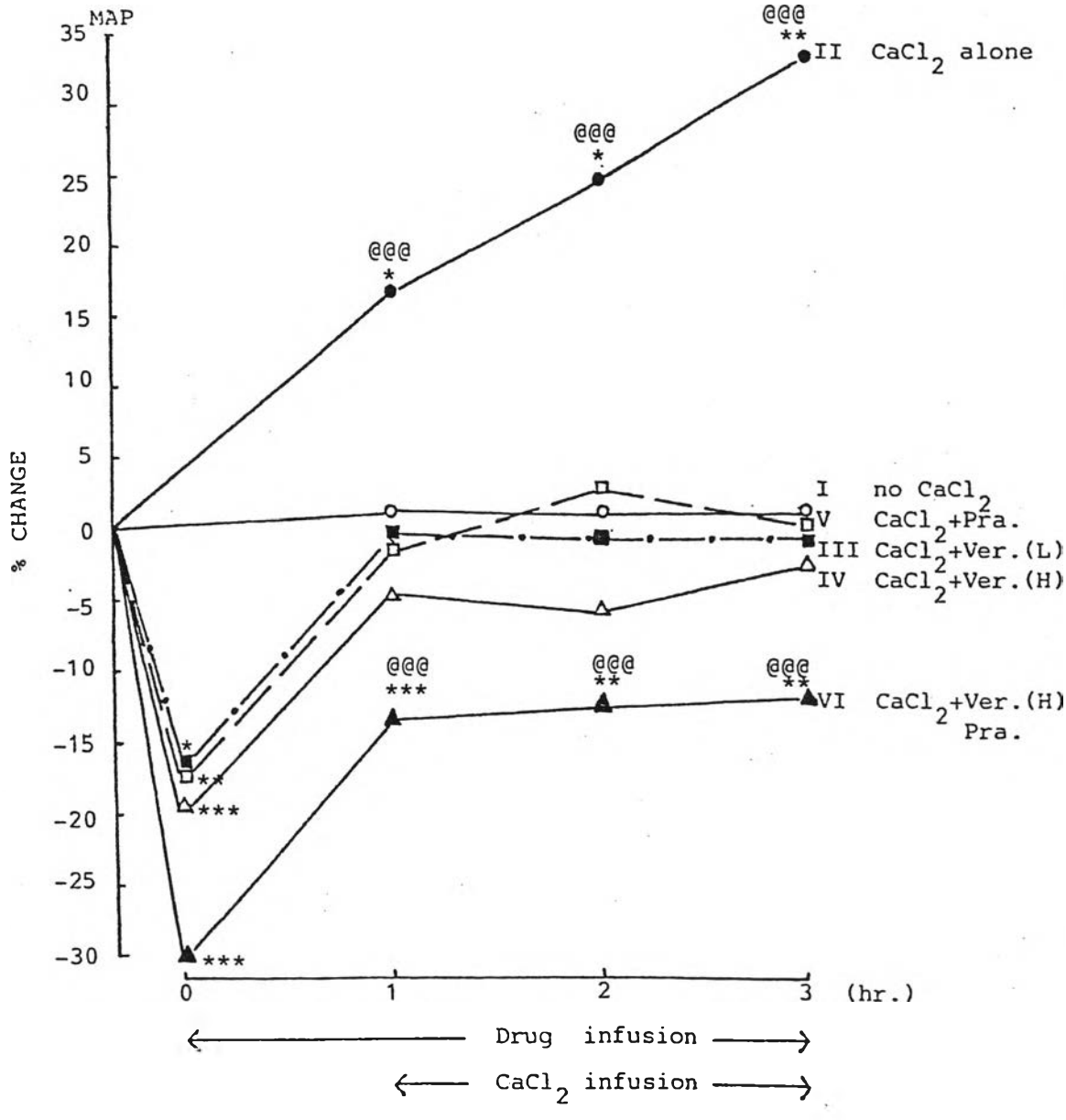

Fig.1:Percentage changes of mean arterial blood pressure(MAP) in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H) dose of Verapamil(Ver.),Prazosin(Pra.) and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to group I at the same time interval, $^{@@@}p<0.001$

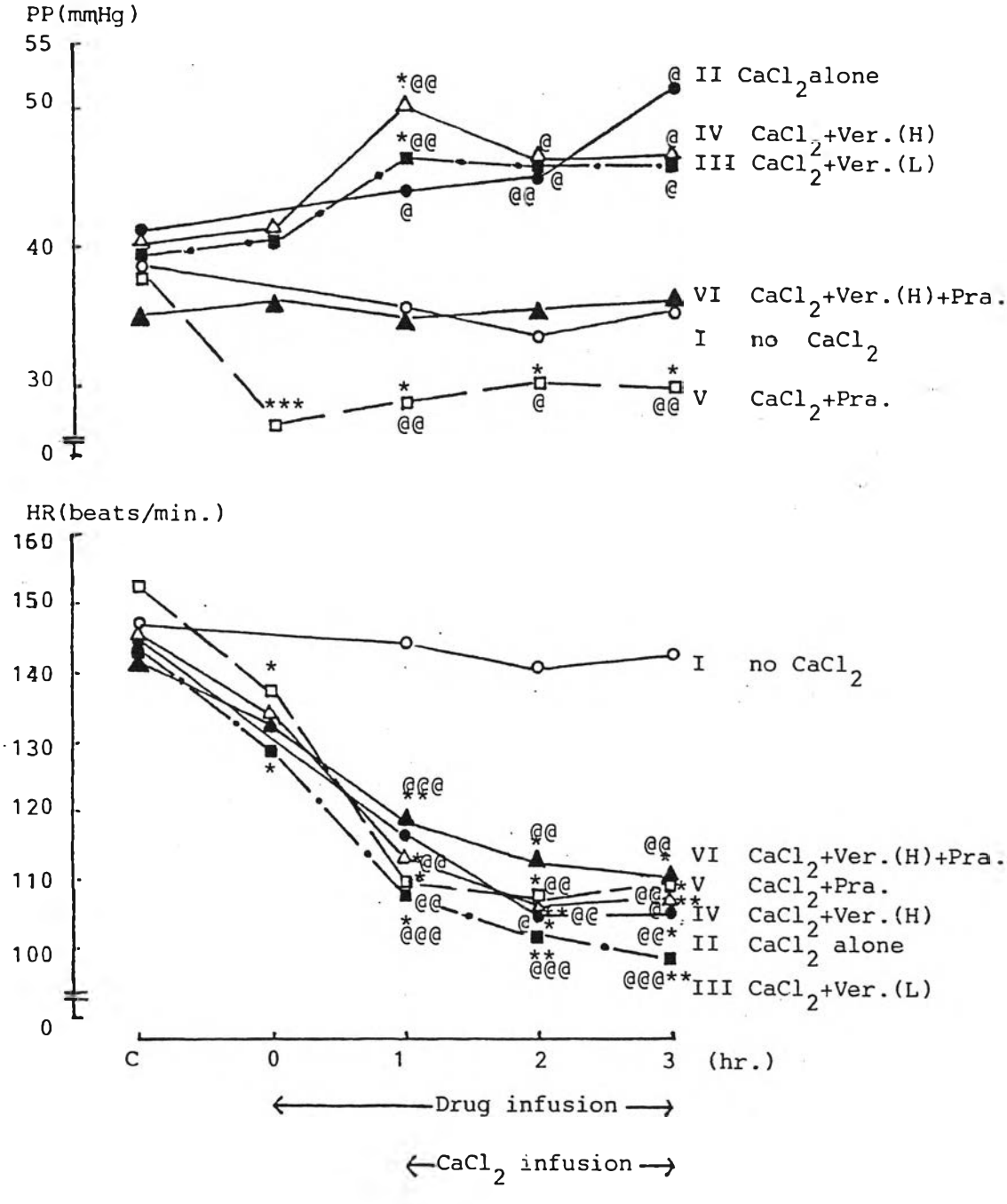

Fig.2:Changes of pulse pressure(PP) and heart rate(HR) in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H) dose of Verapamil(Ver.),Prazosin(Pra.) and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+ Pra.]. The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to groupI at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

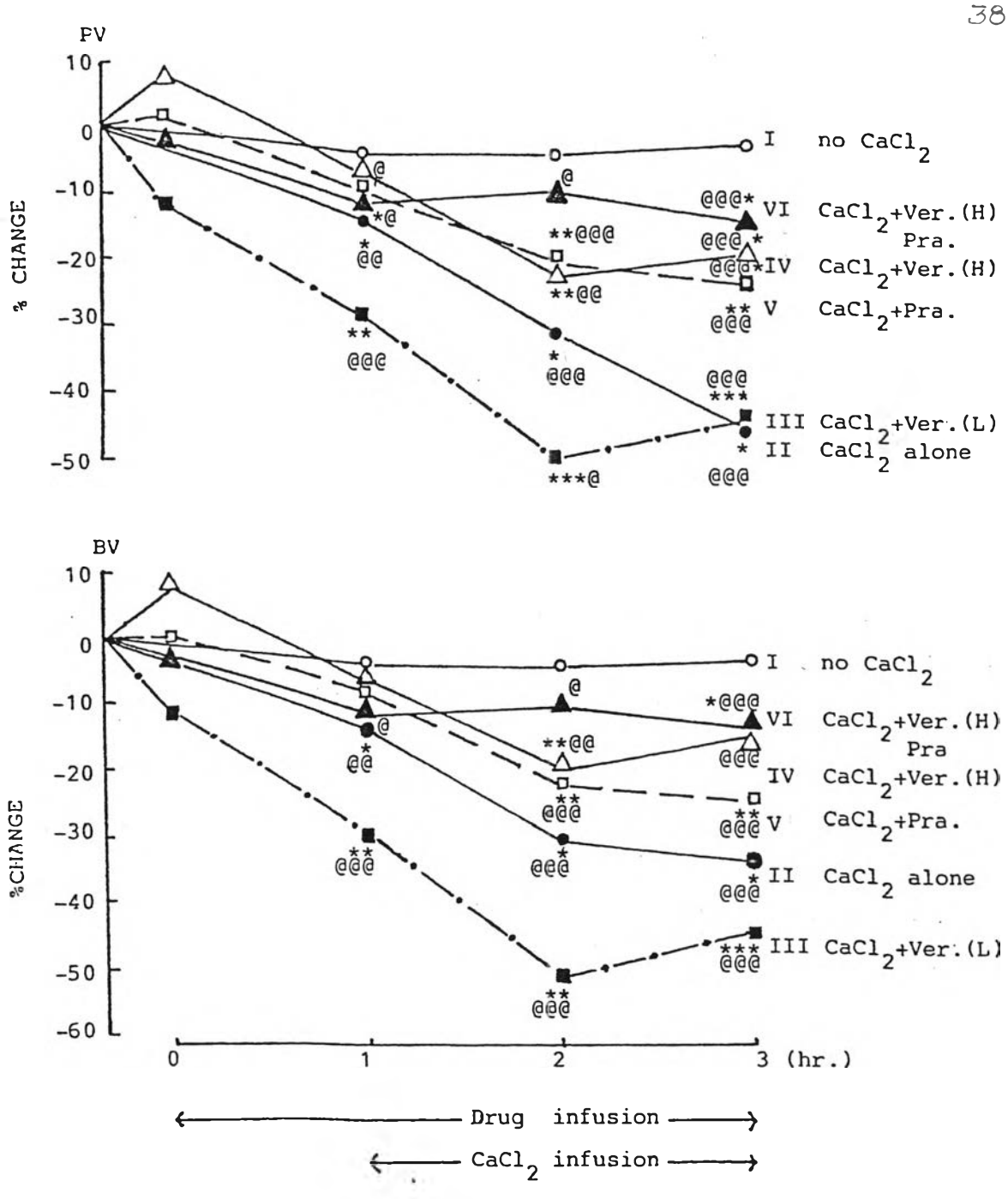

Fig.3 :Percentage changes of plasma volume(PV) and blood volume(BV)in dcgs infusion with $CaCl_2$and pretreated with low(L) or high(H) dose of Verapamil(Ver.),Prazosin(Pra.) and the combined drugs between high dose cf Verapamil and Prazosin[Ver.(H)+Pra.].The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to groupI at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

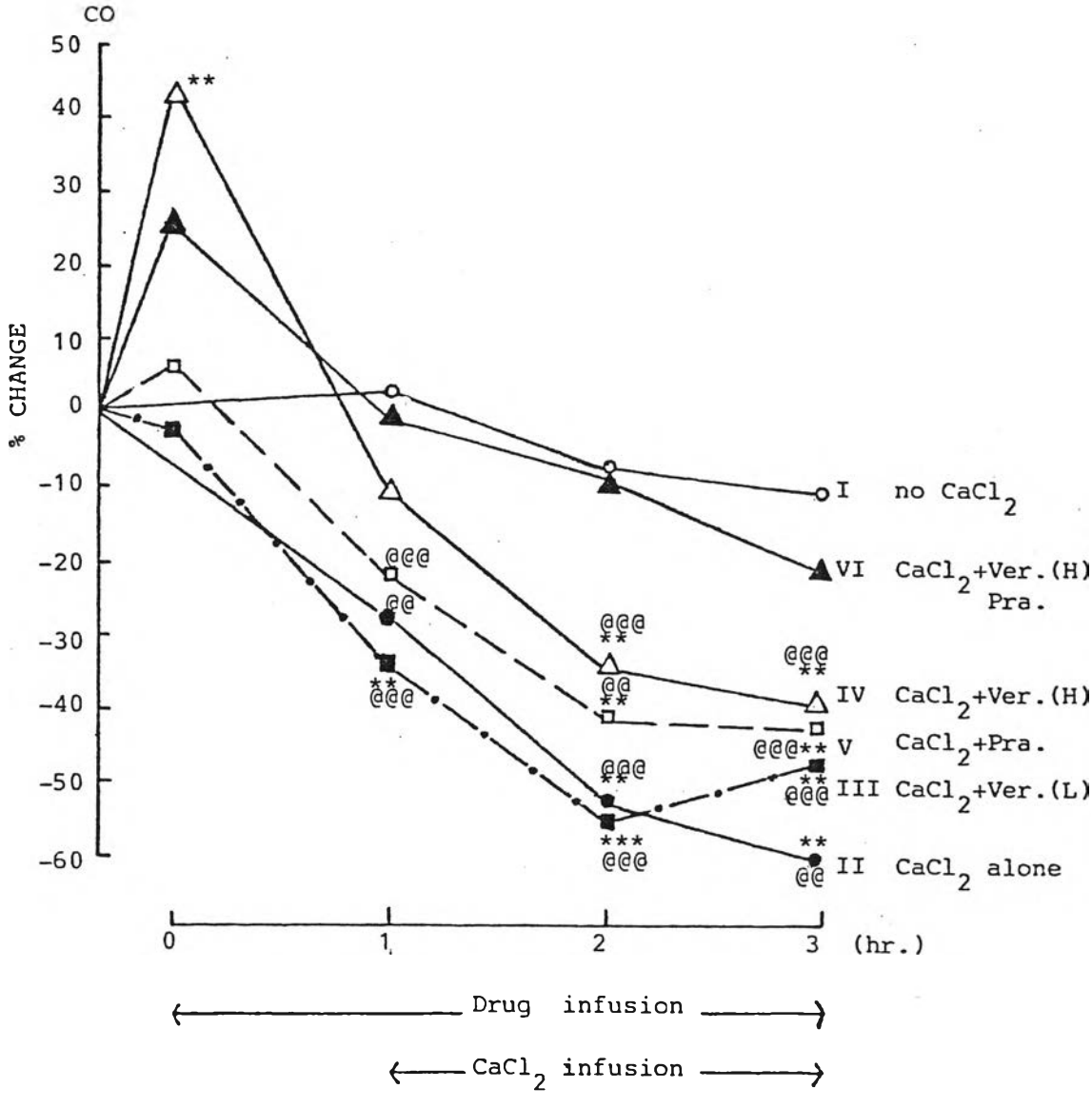

Fig.4:Percentage changes of cardiac output(CO) in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H) dose of Verapamil (Ver.),Prazosin(Pra.) and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respect to control condition of each group, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to groupI at the same time interval, $^{@@}p<0.01$, $^{@@@}p<0.001$

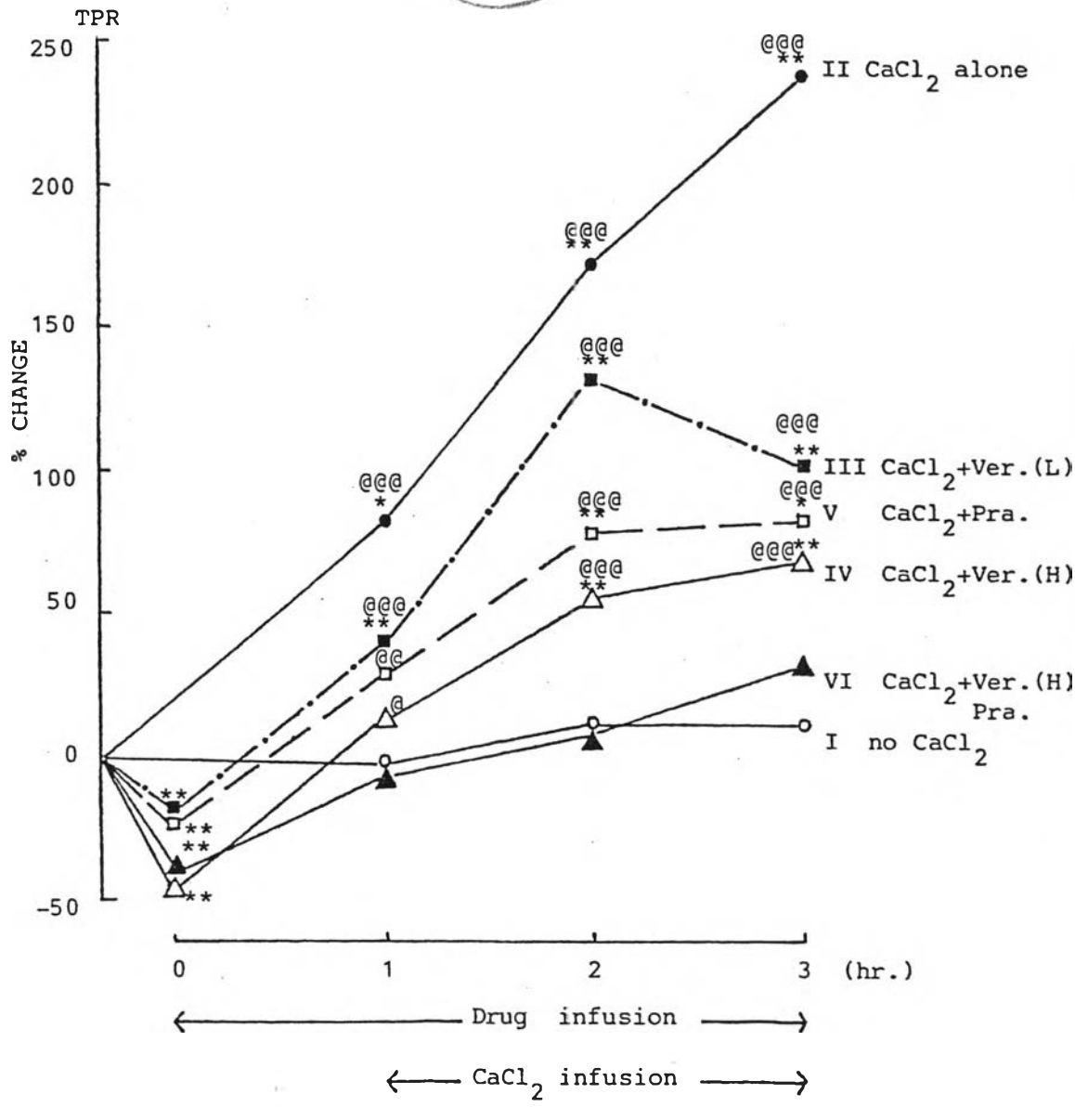

Fig.5:Percentage changes of total peripheral resistance(TPR) in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H) dose of Verapamil(Ver.),Prazosin(Pra.) and the combined drugs between high dose cf Verapamil and Prazosin[Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respect to control ccndition of each group, $^{*}p<0.05$, $^{**}p<0.01$

p-values with respect to groupI at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

Effects of intravenous $CaCl_2$ infusion on renal hemodynamics

Group I : Control animals

The results are shown in table 7. There were significant increases in the rate of urine flow (V), urinary osmolar excretion ($U_{Osm}V$) and osmolar clearance (C_{Osm}) by approximately 49 %, 18% and 19 % respectively at the 3rd hour after intravenous isotonic saline infusion; whereas urinary osmolality decreased from 825.88±115.36 to 628.91±91.41 mOsm/kg ($p<0.05$) at the end of the experiment. No siginificant differance in the other variables were noted.

Group II : Hypercalcemic animals

Results in table 8 show that effective renal plasma flow (ERPF) and effective renal blood flow (ERBF) decreased significantly from 7.11±1.08 to 3.99±0.32 ml/min/kg.bw. ($p<0.05$) and from 10.41±1.75 to 5.83±0.54 ml/min/kg.bw. ($p<0.05$) within 2 hour after $CaCl_2$ infusion and were decreased progressively to 3.79±0.36 and to 5.60±0.59 ml/min/kg.bw. ($p<0.05$), respectively at the end of the experiment. It has been shown that the similar trend was observed for glomerular filtration rate (GFR) from 1.81±0.17 to 1.42±0.14 ml/min/kg.bw. ($p<0.05$). There was a marked increase in renal vascular resistance (RVR) by approximately 175 % ($p<0.05$) at the 1st hour of $CaCl_2$ infusion and more significant to 243 % ($p<0.01$) at the end of the experiment. No significant change in renal fraction (RF) was

Table 7 Effects of intravenous isotonic saline infusion on renal hemodynamics in the left kidney of four control dogs. (Mean±S.E.)

Variables	Control	Saline infusion		
		Saline infusion		
		1 hr.	2 hr.	3 hr.
ERPF (ml/min/kg.bw.)	7.11 ±0.45	6.92 ±0.59	6.56 ±0.44	6.91 ±0.48
ERBF (ml/min/kg.bw.)	9.49 ±0.60	9.17 ±0.81	8.89 ±0.62	9.16 ±0.67
GFR (ml/min/kg.bw.)	1.72 ±0.10	1.73 ±0.10	1.69 ±0.10	1.78 ±0.08
FF (%)	24.26 ±1.34	25.21 ±1.31	25.31 ±1.08	25.98 ±1.32
RF (%)	6.27 ±0.88	6.05 ±0.75	6.28 ±0.88	6.75 ±0.73
RVR (%)	100	105.31 ±4.09	108.20 ±4.24	106.70 ±2.73
V (ml/min)	0.37 ±0.08	0.42 ±0.10	0.42 ±0.08	0.55* ±0.09
$U_{Osm}V$ (μOsm/min)	271.49 ±39.74	279.87 ±34.33	280.31 ±32.36	319.88* ±34.38
C_{Osm} (ml/min)	0.95 ±0.14	0.97 ±0.12	0.97 ±0.11	1.13* ±0.11
C_{H_2O} (ml/min)	-0.58 ±0.07	-0.55 ±0.04	-0.54 ±0.05	-0.57 ±0.08
P_{Osm} (mOsm/kg)	285.50 ±1.65	285.87 ±0.97	285.00 ±3.30	281.63 ±3.22
P_{Na} (mEq/L)	136.75 ±1.60	135.00 ±1.51	135.75 ±0.69	135.50 ±1.69
P_K (mEq/L)	3.12 ±0.06	3.22 ±0.06	3.18 ±0.04	3.20 ±0.06
P_{Cl} (mEq/L)	115.25 ±1.56	114.75 ±0.98	114.87 ±1.26	115.50 ±1.73
P_{Ca} (mEq/L)	3.26 ±0.05	3.26 ±0.07	3.22 ±0.03	3.12 ±0.07
P_{Pi} (mEq/L)	2.81 ±0.35	2.86 ±0.37	2.84 ±0.36	2.89 ±0.39

*P-value with respect to control, $^*p<0.05$

Table 8 Effects of intravenous $CaCl_2$ infusion on renal hemodynamics in the left kidney of five dogs. (Mean±S.E.)

Variables	Saline infusion			
		After $CaCl_2$ infusion		
	Control	1 hr.	2 hr.	3 hr.
ERPF (ml/min/kg.bw.)	7.11 ±1.08	4.76 ±0.47	3.99* ±0.32	3.79* ±0.36
ERBF (ml/min/kg.bw.)	10.41 ±1.75	6.89 ±0.76	5.83* ±0.54	5.60* ±0.59
GFR (ml/min/kg.bw.)	1.81 ±0.17	1.59 ±0.18	1.36* ±0.14	1.42** ±0.14
FF (%)	27.22 ±3.24	33.52 ±1.84	34.48 ±2.61	37.74* ±1.86
RF (%)	8.24 ±1.97	8.32 ±2.29	10.13 ±2.11	11.05 ±2.10
RVR (%)	100	175.36* ±22.68	220.22* ±32.53	243.35** ±24.18
V (ml/min)	0.32 ±0.13	0.83 ±0.17	0.84 ±0.15	1.03* ±0.12
$U_{Osm}V$ (μOsm/min)	188.42 ±41.35	344.79* ±58.21	343.29* ±47.59	304.20** ±28.10
C_{Osm} (ml/min)	0.66 ±0.14	1.21* ±0.20	1.21* ±0.17	0.97* ±0.13
C_{H_2O} (ml/min)	-0.39 ±0.04	-0.38 ±0.08	-0.33 ±0.08	0.66* ±0.02
P_{Osm} (mOsm/kg)	283.80 ±1.28	279.50 ±2.63	281.80 ±1.06	283.00 ±1.06
P_{Na} (mEq/L)	138.60 ±1.36	138.40 ±2.06	138.40 ±2.13	139.20 ±1.48
P_K (mEq/L)	3.22 ±0.12	3.36 ±0.12	3.45 ±0.25	3.37 ±0.24
P_{Cl} (mEq/L)	111.80 ±1.93	114.40 ±2.55	115.30 ±2.19	116.30 ±2.04
P_{Ca} (mEq/L)	3.82 ±0.09	6.28*** ±0.16	6.66*** ±0.14	6.87*** ±0.17
P_{Pi} (mEq/L)	2.67 ±0.22	3.31** ±0.17	3.69** ±0.37	3.88** ±0.40

P-value with respect to control, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

observed; whereas filtration fraction (FF) increased from 27.22±3.24 to 37.74±1.86 % ($p<0.05$) at the 3rd hour of $CaCl_2$ infusion. The rate of urine flow (V) increased progressively from the control value of 0.32±0.13 to 1.03±0.12 ml/min ($p<0.01$) while urine osmolality (U_{Osm}) decreased from 950.00±234.78 to 350.60±37.81 mOsm/kg (p 0.05) at the end of the $CaCl_2$ infusion. Both urinary osmolar excretion ($U_{Osm}V$) and osmolar clearance (C_{Osm}) increased significantly from 188.42±41.35 to 304.20±28.10 μOsm/min ($p<0.01$) and from 0.66±0.14 to 0.97±0.13 ml/min ($p<0.05$) at the 3rd hour of $CaCl_2$ infusion, respectively. Free water clearance (C_{H_2O}) increased significantly from -0.39±0.04 to 0.66±0.02 ml/min ($p<0.05$) at the end of $CaCl_2$ infusion. Plasma osmolality (P_{Osm}), plasma concentration of sodium (P_{Na}), potassium (P_K) and chloride (P_{Cl}) were constant throughout the experiment; while plasma concentration of calcium (P_{Ca}) increased gradually from 3.82±0.09 to 6.28±0.16 mEq/L ($p<0.001$) at the 1st hour and to 6.87±0.17 mEq/L ($p<0.001$) at the 3rd hour of $CaCl_2$ infusion. The plasma concentration of inorganic phosphorus (P_{Pi}) was also enchanced during $CaCl_2$ infusion ($p<0.01$).

Group III : Animals pretreated with a low dose of Verapamil (6 μg/kg in the rate of 1 ml/min)

The result of changes in renal hemodynamics in dogs given intravenous $CaCl_2$ infusion and combined pretreatment of low dose of Verapamil are shown in table 9. After $CaCl_2$ infusion, effective renal plasma flow and effective renal blood flow decreased progressively from the control value of 7.33±1.34 to 5.24±1.22 ml/min/kg.bw. ($p<0.01$)

and from 10.80±1.82 to 7.67±1.65 ml/min/kg.bw. ($p<0.001$) at the end of the experiment; whereas glomerular filtration rate decreased significantly only at the 3rd hour of $CaCl_2$ infusion from 1.47±0.16 to 1.25±0.11 ml/min/kg.bw. ($p<0.05$). It was found that filtration fraction and renal fraction increased significantly about 30 % and 57% respectively at the 2nd hour of $CaCl_2$ infusion. During given Verapamil alone, renal vascular resistance reduced gradually about 15% from the control value and then it increased to 127 % at the 1st hour of $CaCl_2$ infusion and maintained the higher level to 154 % at the end of the experiment. The urine osmolality reduced from 632.10±83.77 to 253.20±12.95 mOsm/kg ($p<0.05$) at the 3rd hour of $CaCl_2$ infusion. Not only the rate of urine flow but also urinary osmolar excretion increased progressively from 0.34±0.08 to 1.68±0.16 ml/min ($p<0.001$) and from 190.84±27.14 to 419.63±35.26 μOsm/min ($p<0.01$), respectively at the end of the experiment. Osmolar clearance increased persistently and showed a significant value at the 2nd hour ($p<0.05$) and the 3rd hour of $CaCl_2$ infusion ($p<0.01$). Similar increase in free water clearance was also exhibited significantly in all periods of $CaCl_2$ infusion. No significant differances of plasma osmolality, plasma concentration of sodium, potassium and chloride were noted between before and after $CaCl_2$ infusion. Plasma concentration of calcium was significant increased continuously all the periods of experiment ($p<0.001$). Plasma concentration of inorganic phosphorus was also increased persistently ($p<0.01$) throughout the experiment.

Table 9 Effects of intravenous $CaCl_2$ infusion on renal hemodynamics in the left kidney of five dogs pretreated with a low dose of Verapamil (6 μg/kg in the rate of 1 ml/min). (Mean±S.E.)

Variables	Control	Verapamil infusion			
		Before $CaCl_2$ infusion	After $CaCl_2$ infusion		
			1 hr.	2 hr.	3 hr.
ERPF (ml/min/kg.bw.)	7.33 ±1.34	7.04 ±1.09	5.87* ±1.13	5.09* ±1.03	5.24** ±1.22
ERBF (ml/min/kg.bw.)	10.80 ±1.82	10.51 ±1.49	8.53* ±1.55	7.43** ±1.38	7.67*** ±1.65
GFR (ml/min/kg.bw.)	1.47 ±0.16	1.48 ±0.16	1.38 ±0.12	1.28 ±0.10	1.25* ±0.11
FF (%)	21.05 ±1.61	21.74 ±1.57	25.44 ±2.89	27.77* ±3.42	27.59 ±3.92
RF (%)	10.64 ±1.14	10.75 ±0.77	12.85 ±1.45	16.22* ±1.28	14.02 ±0.75
RVR (%)	100	85.75* ±3.42	127.23* ±7.05	156.25* ±15.52	154.95* ±18.67
V (ml/min)	0.34 ±0.08	0.43 ±0.06	0.92 ±0.25	1.43** ±0.21	1.68*** ±0.16
$U_{Osm}V$ (μOsm/min)	190.84 ±27.14	190.15 ±9.40	331.20 ±67.14	381.75* ±62.56	419.63** ±35.26
C_{Osm} (ml/min)	0.66 ±0.09	0.66 ±0.02	1.14 ±0.22	1.32* ±0.21	1.46** ±0.11
C_{H_2O} (ml/min)	-0.32 ±0.03	-0.21 ±0.04	-0.23* ±0.07	0.11* ±0.06	0.23*** ±0.07
P_{Osm} (mOsm/kg)	288.40 ±2.64	286.00 ±3.20	287.90 ±2.26	286.90 ±3.08	285.10 ±4.18
P_{Na} (mEq/L)	143.60 ±1.12	143.60 ±1.25	143.30 ±0.81	143.80 ±0.51	143.00 ±0.91
P_K (mEq/L)	3.00 ±0.08	2.89 ±0.09	3.08 ±0.05	3.10 ±0.05	3.08 ±0.06
P_{Cl} (mEq/L)	114.20 ±1.23	111.80 ±0.80	113.70 ±1.46	114.90 ±1.25	115.30 ±1.36
P_{Ca} (mEq/L)	3.67 ±0.23	3.67 ±0.26	6.17*** ±0.18	6.40*** ±0.22	6.60*** ±0.27
P_{Pi} (mEq/L)	2.58 ±0.18	2.61 ±0.20	3.37* ±0.27	3.68** ±0.23	3.79** ±0.28

P-value with respect to control, *$p<0.05$, **$p<0.01$, ***$p<0.001$

Group IV : Animals pretreated with a high dose of Verapamil (12 μg/kg in the rate of 1 ml/min)

The results show in the table 10 Intravenous $CaCl_2$ infusion caused a decline of both effective renal plasma flow and effective renal blood flow from the control value of 6.49±0.57 to 4.50±0.29 ml/min/kg.bw. ($p<0.05$) and from 9.42±0.75 to 6.75±0.23 ml/min/kg.bw. ($p<0.05$) at the 3rd hour of $CaCl_2$ infusion. During given Verapamil alone, glomerular filtration rate increased slightly and then reduced to a lower level as compared to the control value at the end of the experiment ($p<0.05$). Renal fraction did not alter, whereas filtration fraction increased continuously throughout the end of $CaCl_2$ infusion ($p<0.01$). Verapamil infusion alone caused a decline of renal vascular resistance approximately 32 % ($p<0.001$) but after combined infusion with $CaCl_2$ solution, it was increased and reached to be a statistical significance ($p<0.05$) to 122 %, 134 % and 144 % at the 1st , 2nd and 3rd hour of $CaCl_2$ infusion, respectively. The rate of urine flow increased ($p<0.05$) while urine osmolality was reduced persistently ($p<0.01$) after $CaCl_2$ infusion. Urinary osmolar excretion and osmolar clearance constant increased and revealed a significant value at the 2nd and 3rd hour of $CaCl_2$ infusion. Free water clearance increased significantly in all the experimental periods during $CaCl_2$ infusion. However, it was shown that plasma osmolality, plasma concentration of sodium, potassium and chloride were not significant differance between before and after $CaCl_2$ infusion. Either plasma concentration of calcium or inorganic phosphorus was increased markedly

Table 10 Effects of intravenous $CaCl_2$ infusion on renal hemodynamics in the left kidney of five dogs pretreated with a high dose of Verapamil (12 μg/kg in the rate of 1 ml/min). (Mean±S.E.)

		Verapamil infusion			
		Before $CaCl_2$	After $CaCl_2$ infusion		
Variables	Control	infusion	1 hr.	2 hr.	3 hr.
ERPF (ml/min/kg.bw.)	6.49 ±0.57	7.10 ±0.38	5.09* ±0.22	4.68* ±0.30	4.50* ±0.29
ERBF (ml/min/kg.bw.)	9.42 ±0.75	10.44 ±0.56	7.45* ±0.52	6.94* ±0.23	6.75* ±0.23
GFR (ml/min/kg.bw.)	1.41 ±0.07	1.56 ±0.03	1.32 ±0.05	1.31* ±0.05	1.23* ±0.08
FF (%)	22.08 ±1.24	22.13 ±1.05	26.07* ±0.79	28.34** ±1.66	27.82* ±2.52
RF (%)	8.57 ±2.10	6.22 ±1.02	7.81 ±1.69	9.99 ±2.31	9.81 ±1.88
RVR (%)	100	68.29*** ±2.87	122.40* ±6.55	134.63* ±10.03	144.22* ±15.44
V (ml/min)	0.25 ±0.06	0.58 ±0.20	1.44* ±0.48	1.81* ±0.48	1.65* ±0.36
$U_{Osm}V$ (μOsm/min)	172.93 ±21.97	235.71 ±50.58	448.68 ±126.56	432.92* ±104.50	375.51* ±68.56
C_{Osm} (ml/min)	0.61 ±0.07	0.85 ±0.17	1.60 ±0.45	1.52* ±0.36	1.32* ±0.24
C_{H_2O} (ml/min)	-0.26 ±0.04	-0.27 ±0.05	-0.16* ±0.07	0.27* ±0.19	0.53* ±0.25
P_{Osm} (mOsm/kg)	283.20 ±1.76	271.80 ±10.18	281.50 ±1.98	282.00 ±1.48	282.50 ±1.41
P_{Na} (mEq/L)	140.80 ±0.37	140.20 ±0.19	140.80 ±0.34	141.60 ±0.19	141.20 ±0.75
P_K (mEq/L)	3.26 ±0.10	3.20 ±0.10	3.20 ±0.08	3.15 ±0.11	3.27 ±0.09
P_{Cl} (mEq/L)	117.60 ±0.92	117.00 ±0.89	117.60 ±0.51	119.30 ±0.51	118.40 ±0.76
P_{Ca} (mEq/L)	3.71 ±0.08	3.69 ±0.10	6.40*** ±0.20	6.69** ±0.32	6.81** ±0.34
P_{Pi} (mEq/L)	2.54 ±0.12	2.53 ±0.14	3.22** ±0.08	3.51** ±0.05	3.45** ±0.13

P-value with respect to control, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

from 3.71±0.08 to 6.81±0.34 mEq/L ($p<0.01$) and from 2.54±0.12 to 3.45±0.13 mEq/L at the end of $CaCl_2$ infusion, respectively.

Group V : Animals pretreated with Prazosin
(20 µg/kg in the rate of 1 ml/min)

As shown in table 11. Both effective renal plasma flow and effective renal blood flow were declined continuously from the control value an achieved significant value at the 2nd and 3rd hour of $CaCl_2$ infusion ($p<0.05$). $CaCl_2$ infusion caused a reduction of glomerular filtration rate at all experimental periods ($p<0.01$). Owing to the fall in glomerular filtration rate and effective renal plasma flow, the filtration fraction did not alter significantly (Fig.11). No alteration of renal fraction was also observed. During given Prazosin alone, renal vascular resistance reduced markedly about 21 % and then it returned to a higher level after $CaCl_2$ infusion by approximately 144 % and 152 % at the 2nd and 3rd hour of $CaCl_2$ infusion, respectively. The rate of urine flow increased progressively while urine osmolality reduced significantly ($p<0.05$) all the experimental periods of $CaCl_2$ infusion. At the same time period, urinary osmolar excretion as well as osmolar clearance elevated significantly ($p<0.05$). Free water clearance increased persistently and revealed a statistical significance at the 2nd and 3rd hour of $CaCl_2$ infusion ($p<0.001$, $p<0.01$). There were no alterations in plasma osmolality, plasma concentrations of sodium, potassium and chloride throughout the experimental period of $CaCl_2$ infusion. Plasma concentration of calcium increased strikingly and

Table 11 Effects of intravenous $CaCl_2$ infusion on renal hemodynamics in the left kidney of five dogs pretreated with Prazosin (20 μg/kg in the rate of 1 ml/min). (Mean±S.E.)

		Prazosin infusion			
		Before $CaCl_2$	After $CaCl_2$ infusion		
Variables	Control	infusion	1 hr.	2 hr.	3 hr.
ERPF (ml/min/kg.bw.)	5.85 ±0.69	6.06 ±0.66	4.81 ±0.40	4.30* ±0.57	4.04* ±0.61
ERBF (ml/min/kg.bw.)	8.59 ±1.00	8.90 ±0.94	7.01 ±0.67	6.33* ±0.99	5.95* ±1.01
GFR (ml/min/kg.bw.)	1.44 ±0.11	1.50 ±0.11	1.28** ±0.09	1.29* ±0.08	1.23** ±0.09
FF (%)	24.52 ±1.51	25.36 ±1.47	27.01 ±1.50	31.19 ±2.41	32.04 ±2.67
RF (%)	4.76 ±0.35	4.69 ±0.42	5.58 ±1.05	6.45 ±1.20	6.31 ±1.50
RVR (%)	100	79.90** ±2.85	121.35 ±12.30	144.17* ±13.67	152.23* ±16.58
V (ml/min)	0.23 ±0.05	0.40 ±0.09	0.80* ±0.19	1.10** ±0.26	1.30* ±0.36
$U_{Osm}V$ (μOsm/min)	151.31 ±14.21	210.58* ±28.81	300.99* ±44.88	314.93* ±50.25	338.81* ±55.58
C_{Osm} (ml /min)	0.52 ±0.05	0.72* ±0.09	1.03* ±0.15	1.08* ±0.16	1.16* ±0.18
C_{H_2O} (ml/min)	-0.28 ±0.04	-0.32 ±0.08	-0.20 ±0.08	0.09*** ±0.07	0.23** ±0.16
P_{Osm} (mOsm/kg)	290.60 ±3.03	288.20 ±3.64	288.90 ±2.45	288.80 ±2.36	289.70 ±2.94
P_{Na} (mEq/L)	138.60 ±1.21	139.40 ±1.53	138.90 ±1.04	138.60 ±1.23	137.60 ±0.88
P_K (mEq/L)	3.24 ±0.05	3.26 ±0.05	3.24 ±0.07	3.16 ±0.06	3.19 ±0.09
P_{Cl} (mEq/L)	119.60 ±0.87	116.80 ±1.15	119.30 ±0.81	119.10 ±0.24	119.20 ±0.79
P_{Ca} (mEq/L)	3.47 ±0.07	3.52 ±0.06	5.91*** ±0.17	6.12*** ±0.22	6.36*** ±0.26
P_{Pi} (mEq/L)	2.44 ±0.17	2.81 ±0.10	3.47* ±0.13	3.54** ±0.09	3.47* ±0.13

P-value with respect to control, *p<0.05, **p<0.01, ***p<0.001

plasma concentration of inorganic phosphorus also increased slightly from 3.47±0.07 to 6.36±0.26 mEq/L ($p<0.001$) and from 2.44±0.17 to 3.47±0.13 mEq/L ($p<0.05$), respectively at the end of the experiment.

Group VI : Animals pretreated with the combination both of the high dose of Verapamil and Prazosin

The results are shown in the table 12. It was noted that effective renal plasma flow, effective renal blood flow, filtration fraction and renal fraction were not affected by intravenous $CaCl_2$ infusion throughout the experimental period in dogs pretreated with the combined drugs of high dose of Verapamil and Prazosin. Glomerular filtration rate trened to be a higher level and reached significantly only at the 1st hour of $CaCl_2$ infusion from 1.52±0.09 to 1.79±0.02 ml/min/kg.bw. ($p<0.05$). Renal Vascular resistance showed a marked reduction ($p<0.001$) in all the periods of $CaCl_2$ infusion. The rate of urine flow increased from 0.28±0.05 to 1.78±0.38 ml/min ($p<0.05$) at the 3rd hour of $CaCl_2$ infusion. Urine osmolality declined progressively ($p<0.01$) during $CaCl_2$ infusion. Either urinary osmolar excretion or free water clearance gradually increased from 214.37±23.25 to 362.57±67.29 uOsm/min ($p<0.05$) and from 0.49±0.07 to 0.47±0.13 ml/min ($p<0.01$) respectively at the end of the experiment. The significant increased in osmolar clearance was observed at the 1st hour ($p<0.01$) and the 2nd hour ($p<0.05$) but insignificant change was apparent at the 3rd hour of $CaCl_2$ infusion. No marked changes of plasma osmolality plasma concentration of sodium potassium and chloride were apparent in

Table 12 Effects of intravenous $CaCl_2$ infusion on renal hemodynamics in the left kidney of five dogs pretreated with the combination of the high dose of Verapamil and Prazosin. (Mean±S.E.)

Variables	Control	Verapamil and Prazosin infusion		
		Before $CaCl_2$ infusion	After $CaCl_2$ infusion	
			1 hr.	2 hr.	3 hr.
ERPF (ml/min/kg.bw.)	6.35 ±0.54	7.35 ±0.98	6.89 ±0.66	6.71 ±0.62	6.89 ±0.76
ERBF (ml/min/kg.bw.)	9.00 ±0.59	10.32 ±1.05	9.58 ±0.67	9.36 ±0.57	9.63 ±0.81
GFR (ml/min/kg.bw.)	1.52 ±0.09	1.70 ±0.16	1.79* ±0.02	1.69 ±0.08	1.68 ±0.82
FF (%)	24.40 ±2.19	23.81 ±2.09	26.88 ±2.20	25.86 ±2.11	25.17 ±2.19
RF (%)	5.09 ±0.24	4.73 ±0.42	5.87 ±0.69	6.61 ±1.19	7.95 ±1.33
RVR (%)	100	62.21*** ±4.30	80.34*** ±1.73	82.91*** ±1.97	82.56** ±5.07
V (ml/min)	0.28 ±0.05	0.42 ±0.11	1.54** ±0.25	1.89** ±0.36	1.78* ±0.38
$U_{Osm}V$ (μOsm/min)	214.37 ±23.25	247.84 ±30.32	471.32** ±48.37	450.38* ±83.72	362.57* ±67.29
C_{Osm} (ml/min)	0.77 ±0.08	0.88 ±0.11	1.69** ±0.17	1.61* ±0.30	1.31 ±0.24
C_{H_2O} (ml/min)	-0.49 ±0.07	-0.45 ±0.06	-0.15* ±0.09	0.29** ±0.10	0.47** ±0.13
P_{Osm} (mOsm/kg)	279.20 ±4.25	282.00 ±1.58	278.50 ±2.19	278.90 ±3.16	275.90 ±1.70
P_{Na} (mEq/L)	146.60 ±1.56	145.60 ±1.43	145.90 ±1.51	145.10 ±1.52	143.80 ±1.31
P_K (mEq/L)	3.14 ±0.06	3.18 ±0.05	3.33 ±0.04	3.57 ±0.19	3.51 ±0.18
P_{Cl} (mEq/L)	120.60 ±1.80	118.00 ±0.71	118.50 ±0.76	117.70 ±0.95	117.50 ±0.96
P_{Ca} (mEq/L)	3.51 ±0.05	3.54 ±0.06	5.51*** ±0.06	6.47*** ±0.22	6.18*** ±0.08
P_{Pi} (mEq/L)	2.77 ±0.32	2.81 ±0.33	3.09* ±0.26	3.46** ±0.22	3.29* ±0.20

P-value with respect to control, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

animals between pre and post $CaCl_2$ infusion. The prominent increase in plasma concentration of calcium was observed from 3.51±0.05 to 6.18±0.08 mEq/L ($p<0.001$) while plasma concentration of inorganic phosphorus elevated slightly from 2.77±0.32 to 3.29±0.20 mEq/L ($p<0.05$) at the end of the experiment.

In comparison, the effect of intravenous $CaCl_2$ infusion on renal hemodynamics showed a significant decrease in effective renal plasma flow (Fig.6), effective renal blood flow (Fig.7) and glomerular filtration rate (Fig.8) in animals of group II-V. Animals without pretreatment of Verapamil or Prazosin (group II) produced a striking reduction in effective renal plasma flow, effective renal blood flow and glomerular filtration rate when compared with the animals in group III-V after $CaCl_2$ infusion. It was indicated that these variables could be elevated to a higher level in animals pretreatment with a combined doses of Verapamil and Prazosin (group VI). The similar opposite pattern was also observed in renal vascular resistance (Fig.9). Animals in group II-VI showed a higher level of renal fraction when compared with the control group (group I), whereas filtration fraction increased significantly only in group II-V and insignificant in group VI (Fig.10). The percentage changes of the rate of urine flow (Fig.11), urinary osmolar excretion (Fig.12), osmolar clearance (Fig.12) and free water clearance (Fig.13) of animals in group II-VI were greater than the mean value in the same period of control group (group I), while urine osmolality (Fig.11) was shown in the opposite pattern. However, there were no significant changes in

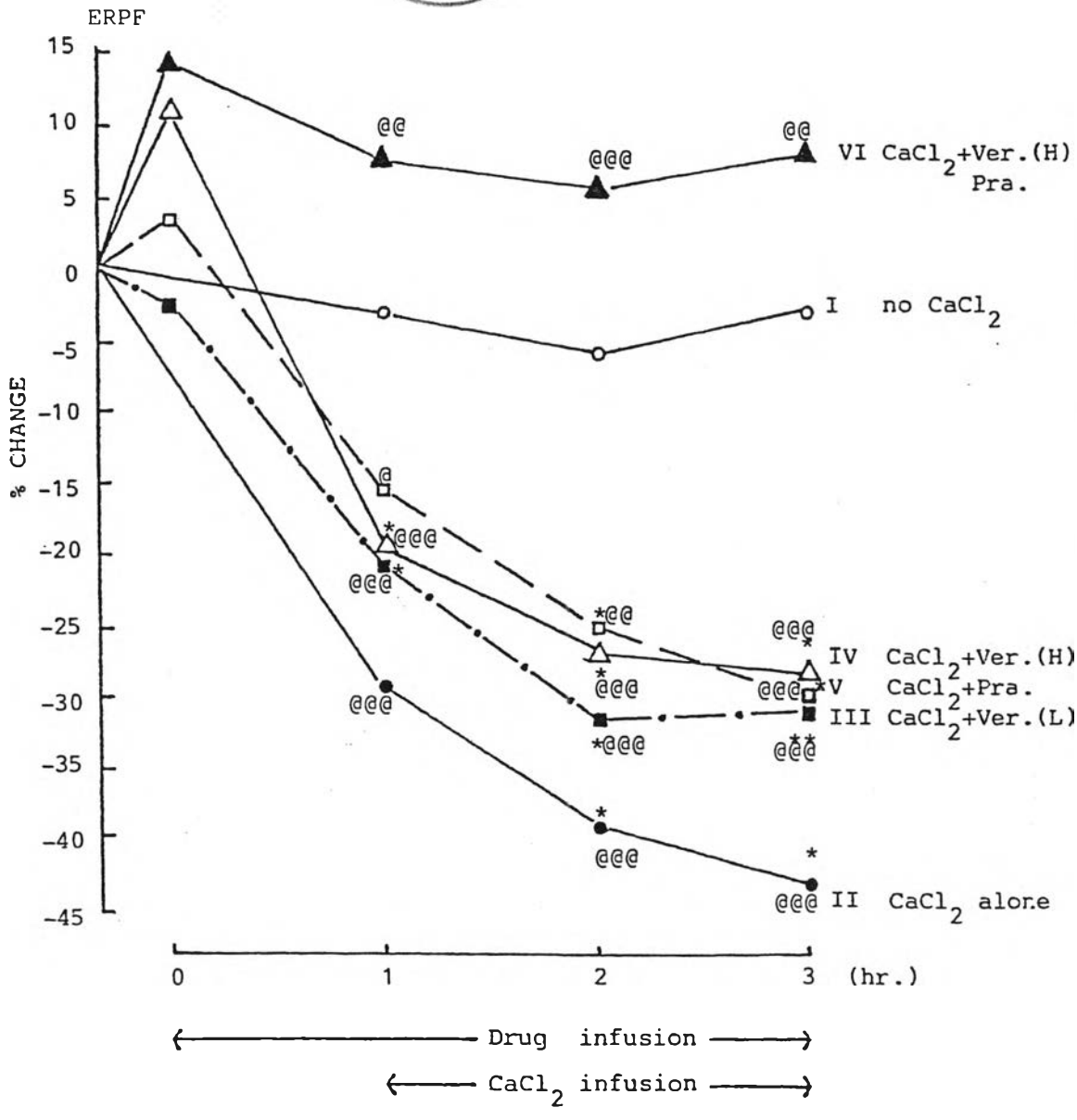

Fig.6: Percentage changes of effective renal plasma flow(ERPF)in dogs infusion with $CaCl_2$and pretreated with low(L)or high(H)dose of Verapamil(Ver.),Prazosin(Pra.) and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$

p-values with respect to groupI at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

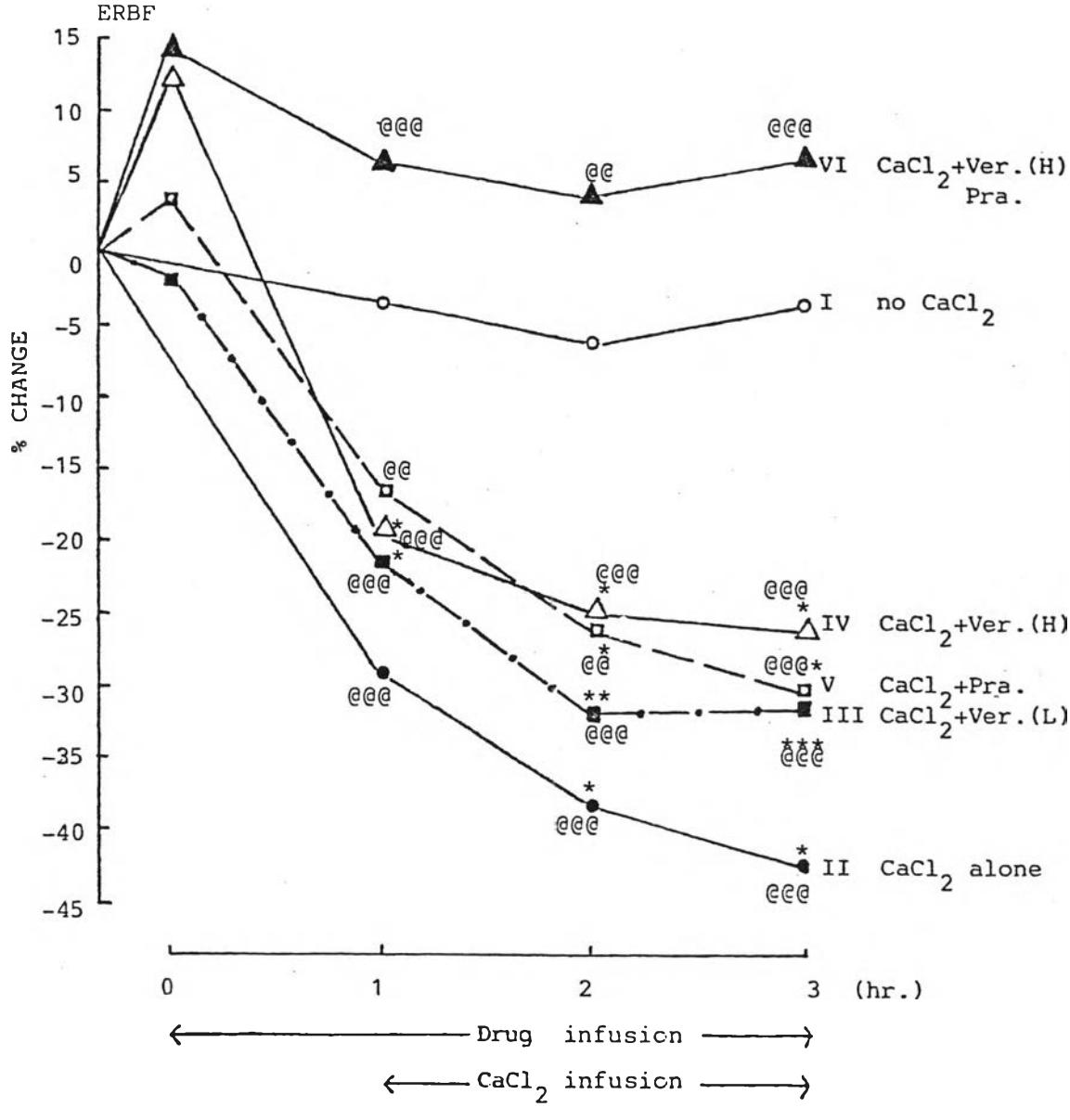

Fig.7 :percentage changes of effective renal blood flow(ERBF)in dogs infusion with $CaCl_2$and pretreated with low(L) or high(H) dose of Verapamil(Ver.),Prazosin(Pra.)and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to groupI at the same time interval, $^{@@}p<0.01$, $^{@@@}p<0.001$

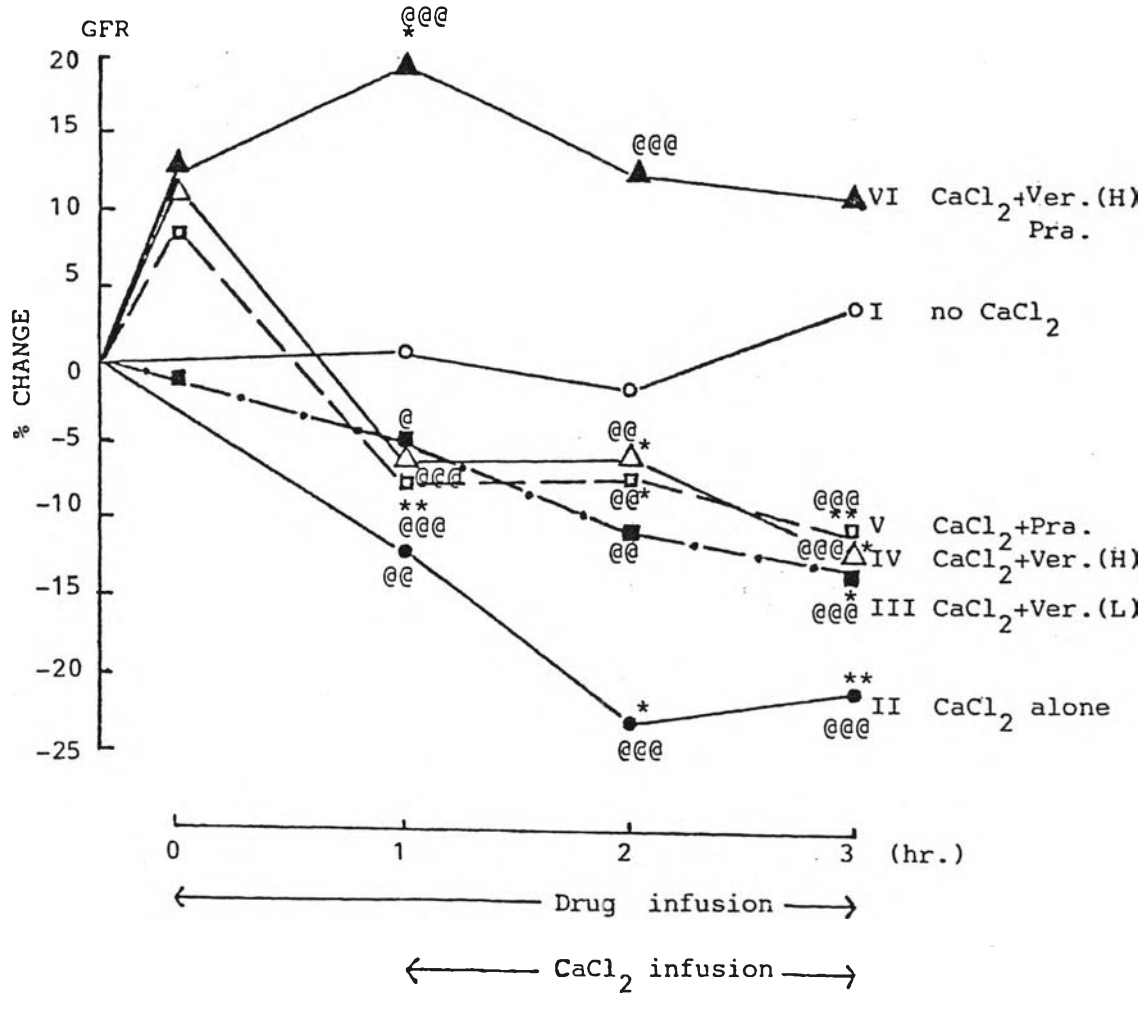

Fig.8:Percentage changes of glomerular filtration rate(GFR) in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H) dose of Verapamil(Ver.),Prazosin(Pra.) and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$

p-values with respect to groupI at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

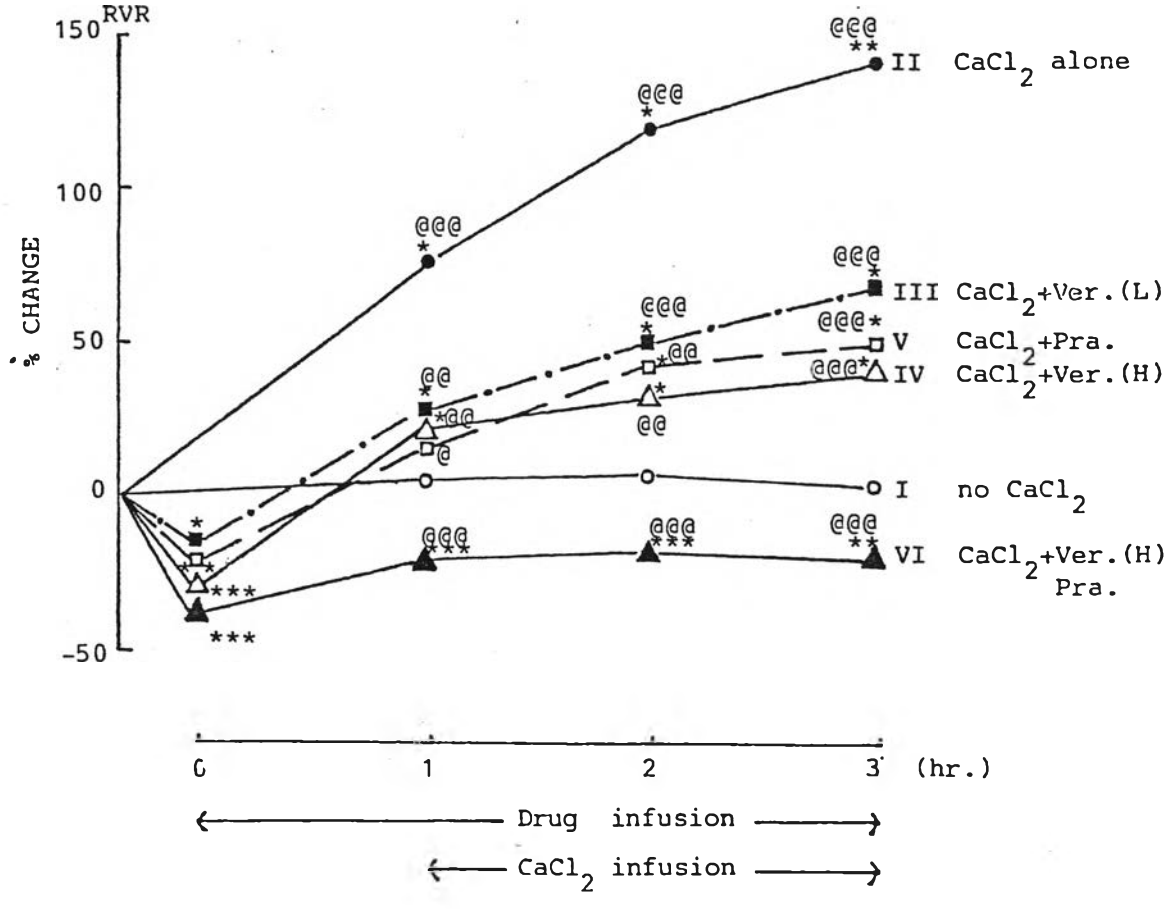

Fig.9 :Percentage changes of renal vascular resistance(RVR) in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H) dose of Verapamil(Ver.),Prazosin(Pra.) and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to groupI at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

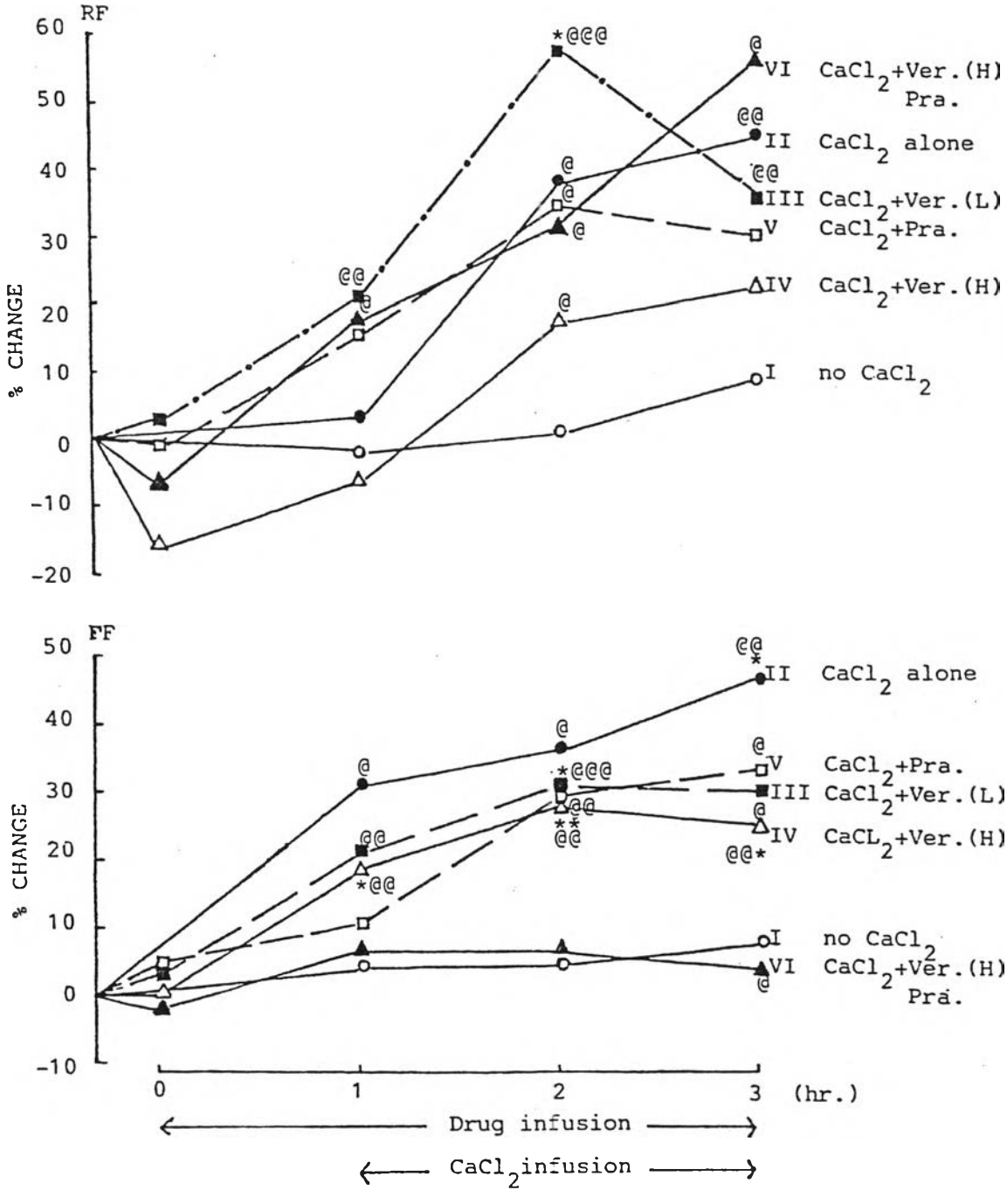

Fig.10:Percentage changes of renal fraction(RF) and filtration fraction(FF) in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H) dose of Verapamil(Ver.),Prazosin(Pra.) and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$

p-values with respect to groupI at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

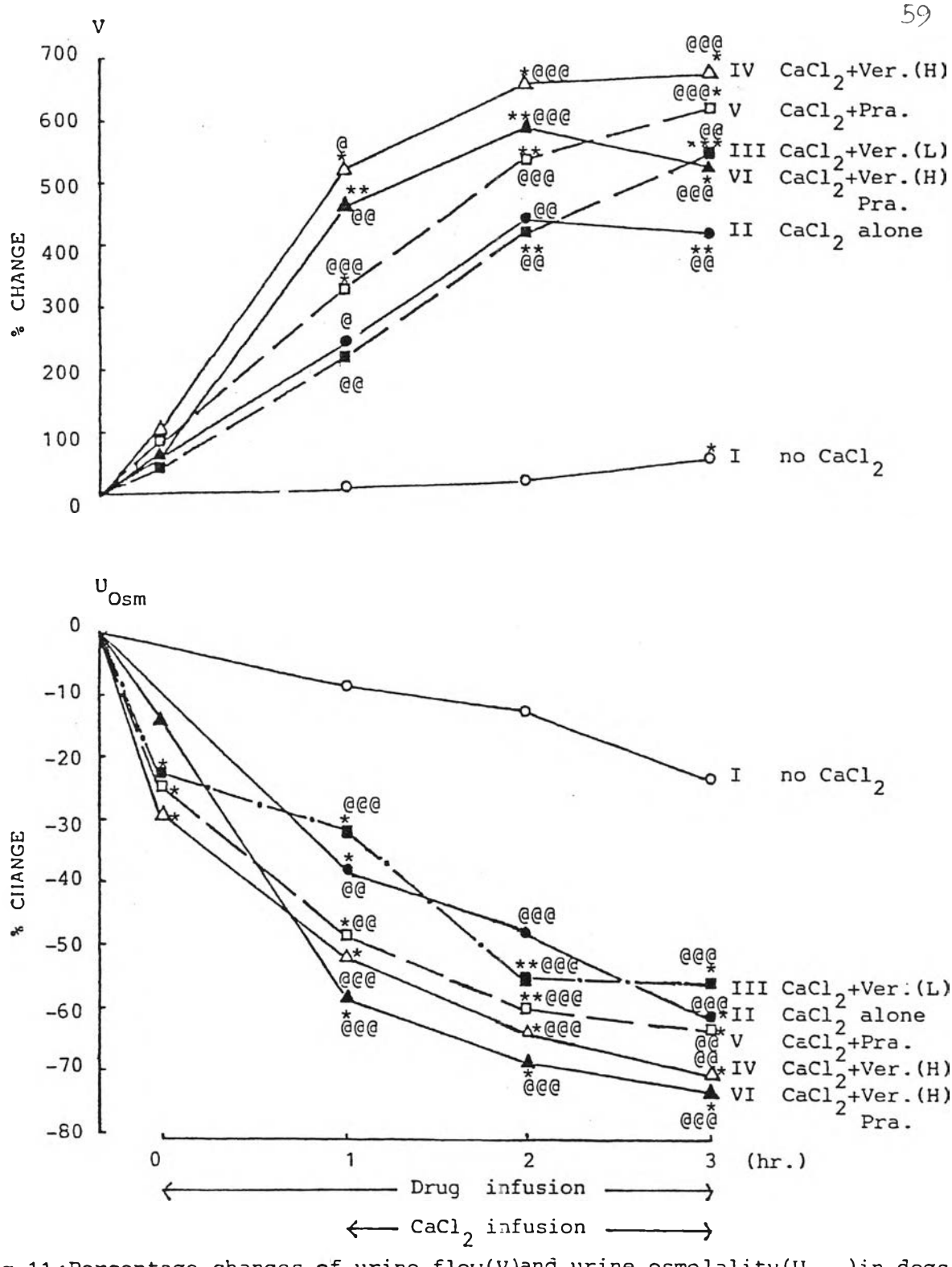

Fig.11 :Percentage changes of urine flow(V)and urine osmolality(U_{Csm})in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H) dose of Verapamil(Ver.),Prazosin(Pra.) and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to groupI at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

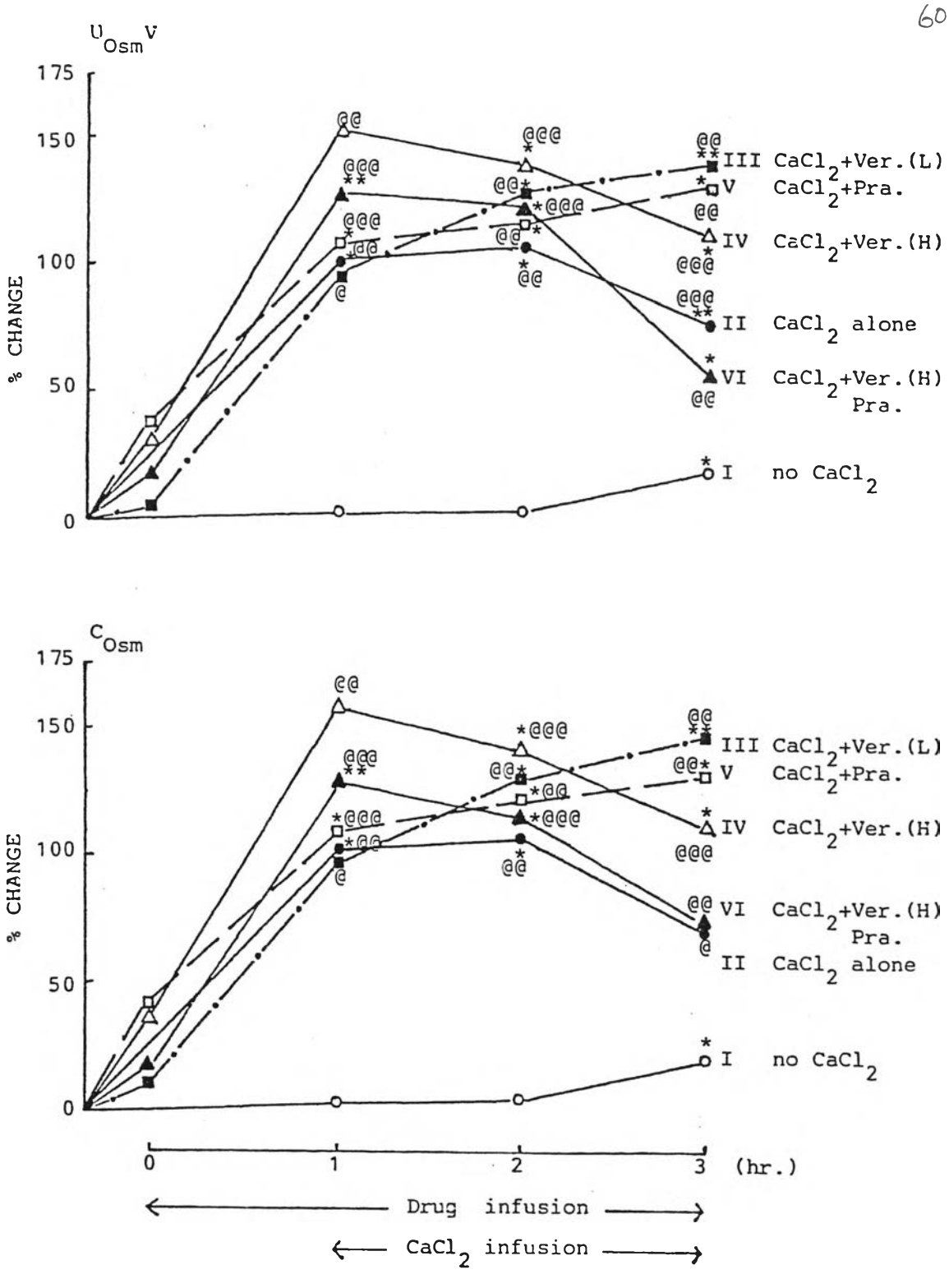

Fig.12:Percentage changes of urinary osmolar excretion($U_{Osm}V$) and osmolar clearance(C_{Osm}) in dogs infusion with $CaCl_2$ and pretreated with low(L)or high(H) dose of Verapamil(Ver.),Prazosin(Pra.) and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+ Pra.] . The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$

p-values with respect to groupI at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

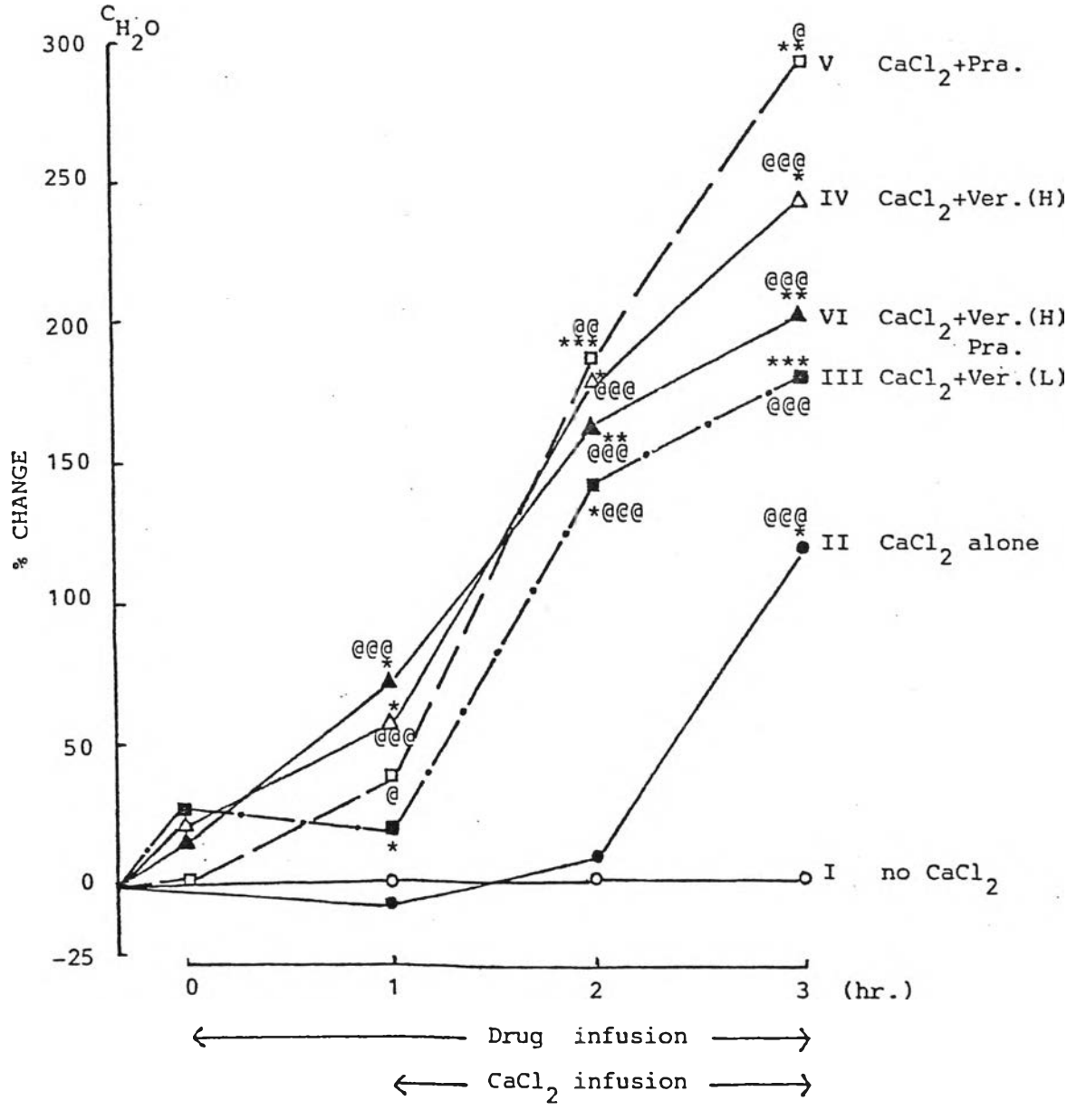

Fig.13:Percentage changes of free water clearance(C_{H_2O}) in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H) dose cf Verapamil (Ver.),Prazosin(Pra.) and the combined drugs between high dose cf Verapamil and Prazosin[Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to groupI at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

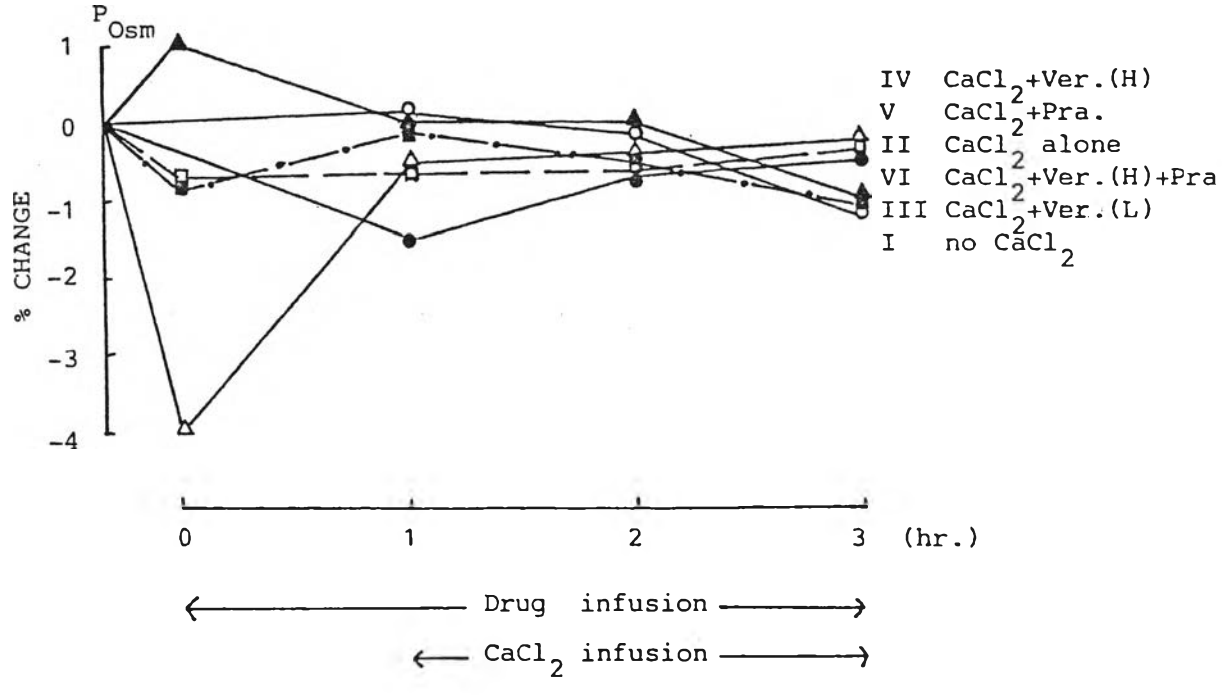

Fig.14: Percentage changes of plasma osmolality(P_{Osm}) in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H) dose of Verapamil(Ver.), Prazosin(Pra.) and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.]

The values are mean±S E.

No significant differences($P<0.05$) were noted from the values during control period and during experimental period

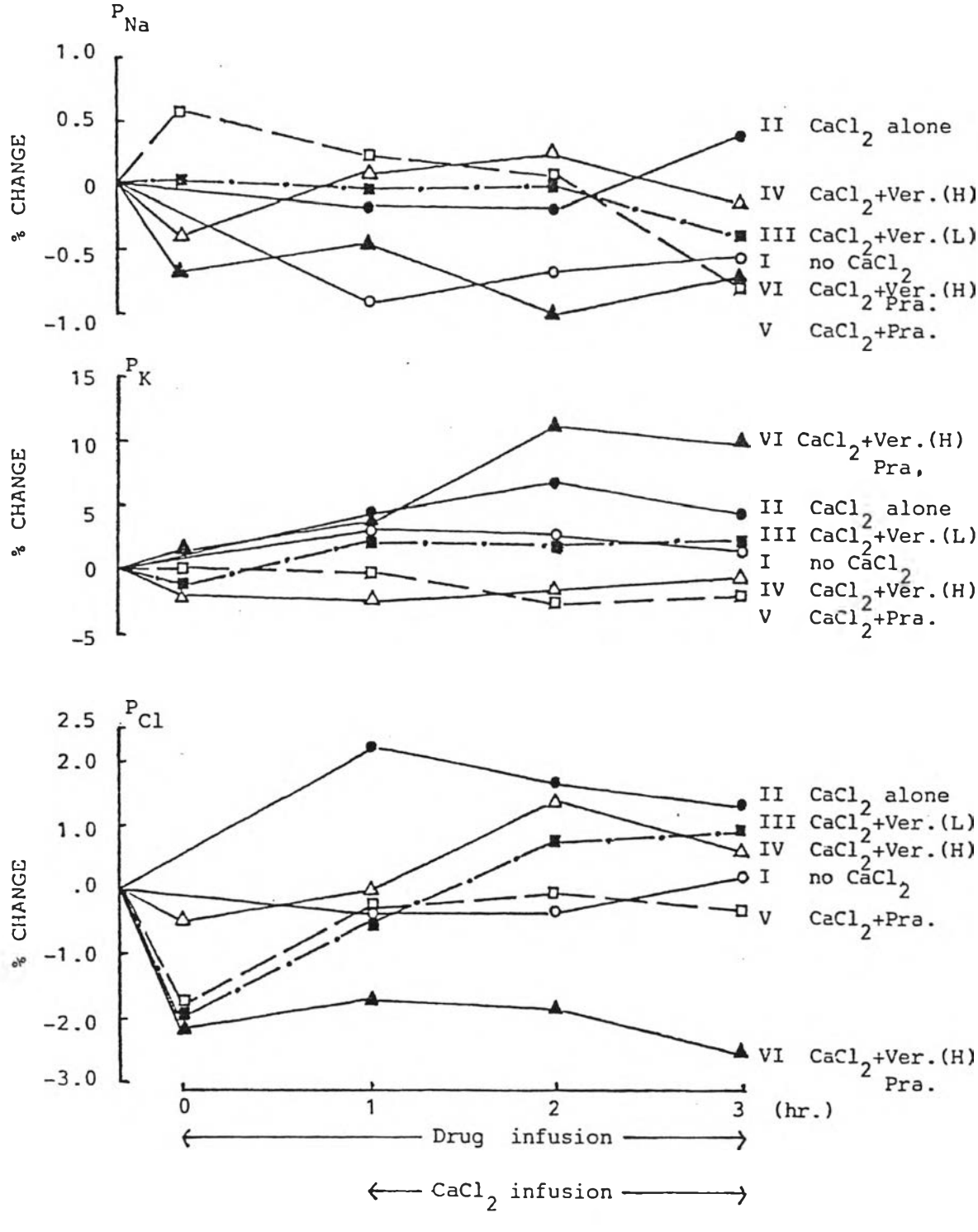

Fig.15 :Percentage changes of plasma sodium(P_{Na}),potassium(P_K)and chloride (P_{Cl}) concentration in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H) dose of Verapamil(Ver.),Prazosin(Pra.) and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+ Pra.]. The values are mean±S.E.

No significant differences($p<0.05$)were noted from the values during control period and during experimental period

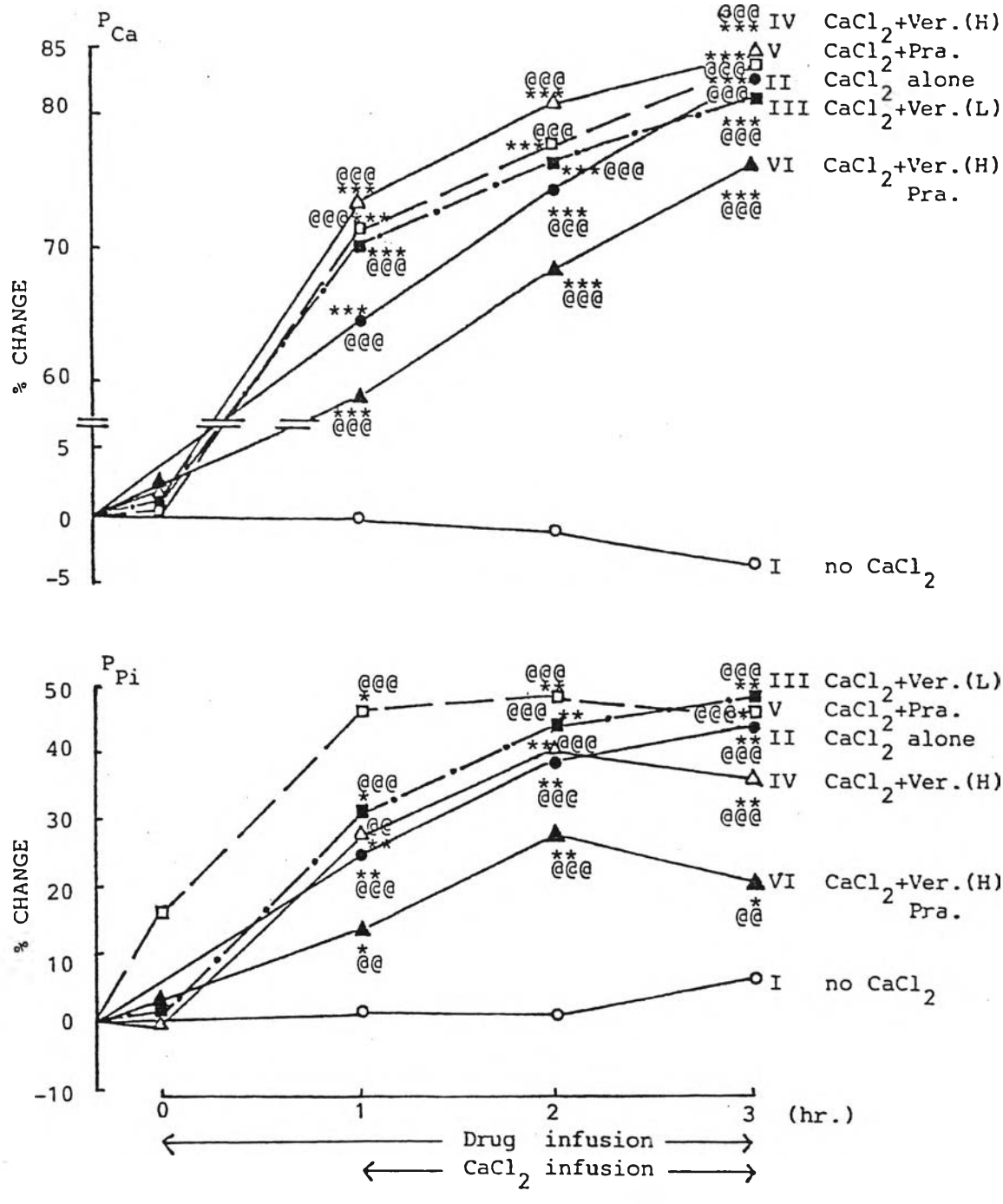

Fig.16 : Percentage changes of plasma calcium(P_{Ca}) and inorganic phosphorus (P_{Pi}) concentration in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H) dose of Verapamil(Ver.), Prazosin(Pra.) and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+ Pra.] . The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to groupI at the same time interval, $^{@@}p<0.01$, $^{@@@}p<0.001$

plasma osmolality (Fig.14), plasma concentrations of sodium, potassium and chloride (Fig.15) throughout the experimental period of $CaCl_2$ infusion. Since the animals given intravenous $CaCl_2$ infusion, plasma concentration of calcium (Fig.16) elevated persistently all along the study periods. It was observed that plasma concentration of inorganic phosphorus (Fig.16) also increased to the higher level as compared with the control group (group I).

Effects of intravenous $CaCl_2$ infusion on renal electrolytes excretion

Group I : Control animals

As shown in table 13, fractional excretion of calcium (FE_{Ca}) slightly decreased from 2.33±0.71 to 1.88±0.66 % ($p<0.05$) at the 2nd hour period after intravenous isotonic saline infusion. The other variables did not significantly alter thoughout the experimental period.

Group II : Hypercalcemic animals

Effects of intravenous $CaCl_2$ infusion on renal electrolytes excretion are shown in table 14. The $CaCl_2$ infusion caused a significant increase in fractional excretion of sodium (FE_{Na}) and chloride (FE_{Cl}) at the 1st hour period and increased progressively to reach a significant level at the 3rd hour period of $CaCl_2$ infusion ($p<0.01$ and $p<0.05$). It has been shown that the similar trend was observed in urinary excretion of sodium ($U_{Na}V$) and chloride ($U_{Cl}V$).

Table 13 Effects of intravenous isotonic saline infusion on renal electrolytes excretion in the left kidney of four control dogs. (Mean±S.E.)

Variables	Control	Saline infusion		
		Saline infusion		
		1 hr.	2 hr.	3 hr.
$U_{Na}V$ (μEq/min/kg.bw.)	5.38 ±0.73	5.42 ±0.67	5.33 ±0.63	6.13 ±1.03
$U_{K}V$ (μEq/min/kg.bw.)	0.85 ±0.21	0.74 ±0.15	0.74 ±0.15	0.99 ±0.28
$U_{Cl}V$ (μEq/min/kg.bw.)	5.79 ±0.80	5.86 ±0.60	5.47 ±0.58	7.15 ±0.83
$U_{Ca}V$ (μEq/min/kg.bw.)	0.13 ±0.05	0.12 ±0.05	0.11 ±0.05	0.20 ±0.05
$U_{Pi}V$ (μEq/min/kg.bw)	0.72 ±0.26	0.58 ±0.13	0.79 ±0.22	1.14 ±0.22
FE_{Na} (%)	2.31 ±0.30	2.29 ±0.22	2.32 ±0.26	2.51 ±0.35
FE_{K} (%)	16.03 ±3.56	14.07 ±3.52	13.94 ±2.73	17.73 ±4.61
FE_{Cl} (%)	2.92 ±0.34	2.94 ±0.23	2.81 ±0.26	3.44 ±0.33
FE_{Ca} (%)	2.33 ±0.71	2.15 ±0.70	1.88* ±0.66	2.17 ±0.67
FE_{Pi} (%)	14.28 ±3.42	13.96 ±3.10	16.96 ±3.81	23.54 ±6.54

P-value with respect to control, *$p<0.05$

Table 14 Effects of intravenous $CaCl_2$ infusion on renal electrolytes excretion in the left kidney of five dogs. (Mean±S.E.)

	Saline infusion			
		After $CaCl_2$ infusion		
Variables	Control	1 hr.	2 hr.	3 hr.
$U_{Na}V$ (μEq/min/kg.bw.)	3.31 ±1.18	7.13 ±1.83	7.68 ±1.89	10.57** ±1.75
$U_{K}V$ (μEq/min/kg.bw.)	0.73 ±0.17	1.48* ±0.31	1.93** ±0.21	2.65*** ±0.20
$U_{Cl}V$ (μEq/min/kg.bw.)	3.65 ±1.66	8.87 ±2.38	10.67 ±2.66	12.94* ±2.34
$U_{Ca}V$ (μEq/min/kg.bw.)	0.10 ±0.02	0.48* ±0.11	0.57** ±0.08	0.67*** ±0.06
$U_{Pi}V$ (μEq/min/kg.bw.)	0.72 ±0.16	1.37 ±0.27	1.88* ±0.39	2.34* ±0.55
FE_{Na} (%)	1.28 ±0.45	3.27 ±0.97	4.16 ±1.20	5.28** ±0.81
FE_{K} (%)	13.31 ±3.88	28.99 ±8.27	41.58** ±4.27	59.39** ±10.86
FE_{Cl} (%)	1.78 ±0.82	4.84 ±1.28	6.88 ±1.77	8.05* ±1.39
FE_{Ca} (%)	1.31 ±0.35	5.11 ±1.41	6.32 ±1.38	7.25* ±1.23
FE_{Pi} (%)	15.13 ±3.00	27.81 ±6.71	39.04 ±11.15	50.52* ±13.06

P-value with respect to control, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

There were marked increases in fractional excretion of potassium (FE_K) and urinary excretion of potassium (U_KV) as well as urinary excretion of inorganic phosphorus ($U_{Pi}V$) at the 2nd hour and 3rd hour of $CaCl_2$ infusion ($p<0.05$). Fractional excretions of both calcium (FE_{Ca}) and inorganic phosphorus (FE_{Pi}) markedly increased at the 1st hour of $CaCl_2$ infusion and revealed a significant value at the 3rd hour ($p<0.05$) whereas urinary excretion of calcium increased significantly at the 1st hour ($p<0.05$) and progressively increased at the 3rd hour of $CaCl_2$ infusion ($p<0.001$).

Group III : Animals pretreated with a low dose of Verapamil (6 μg/kg in the rate of 1 ml/min)

As shown in table 15, it was observed that after intravenous $CaCl_2$ infusion, fractional excretion of sodium increased continuously and revealed a significant value from 1.47±0.54 to 6.81±1.46 % and to 8.71±1.44 % ($p<0.01$) at the 2nd and 3rd hour of $CaCl_2$ infusion, respectively. At the same time periods, fractional excretion of chloride also increased in the similar pattern ($p<0.001$). There were significant increases in fractional excretion of potassium ($p<0.001$) and inorganic phosphorus ($p<0.01$) all the experimental periods. Fractional excretion of calcium increased persistently from 1.51±0.47 to 7.75±1.17 % ($p<0.01$) and to 9.61±0.80 % ($p<0.001$) at the 2nd and 3rd hour of $CaCl_2$ infusion, respectively. Both urinary excretion of sodium elevated progressively from 2.72±1.00 to 15.06±1.65 uEq/min/kg.bw. ($p<0.001$) and chloride from 2.44±0.83 to 17.38±1.16

Table 15 Effects of intravenous $CaCl_2$ infusion on renal electrolytes excretion in the left kidney of five dogs pretreated with a low dose of Verapamil (6 μg/kg in the rate of 1 ml/min). (Mean±S.E.)

Variables	Control	Verapamil infusion		
		Before $CaCl_2$ infusion	After $CaCl_2$ infusion	
			1 hr.	2 hr.	3 hr.
$U_{Na}V$ (μEq/min/kg.bw.)	2.72 ±1.00	3.48 ±0.81	7.18 ±2.21	12.09** ±2.33	15.06*** ±1.65
$U_{K}V$ (μEq/min/kg.bw.)	0.82 ±0.11	0.71 ±0.04	1.47** ±0.16	2.19*** ±0.08	2.40*** ±0.12
$U_{Cl}V$ (μEq/min/kg.bw.)	2.44 ±0.83	3.39 ±0.95	8.19 ±2.31	13.66** ±1.84	17.38*** ±1.16
$U_{Ca}V$ (μEq/min/kg.bw.)	0.08 ±0.03	0.08 ±0.02	0.35* ±0.10	0.62** ±0.09	0.79*** ±0.04
$U_{Pi}V$ (μEq/min/kg.bw.)	0.67 ±0.08	0.61 ±0.08	0.90* ±0.28	2.31** ±0.24	2.70*** ±0.22
FE_{Na} (%)	1.47 ±0.54	1.79 ±0.14	3.98 ±1.39	6.81** ±1.46	8.71** ±1.44
FE_{K} (%)	19.95 ±4.12	15.70 ±2.35	36.18* ±5.77	57.02*** ±5.00	63.62*** ±7.54
FE_{Cl} (%)	2.04 ±0.75	2.38 ±0.72	5.88 ±1.98	9.61** ±1.65	12.37*** ±1.65
FE_{Ca} (%)	1.51 ±0.47	1.50 ±0.35	4.37 ±1.31	7.75** ±1.17	9.61*** ±0.80
FE_{Pi} (%)	19.79 ±4.57	16.52 ±2.10	30.96* ±3.57	49.15** ±1.59	56.72** ±2.56

P-value with respect to control, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

μEq/min/kg.bw. ($p<0.001$) at the end of the experiment. Urinary excretion of potassium, calcium and inorganic phosphorus also significant increased progressively all the experimental periods ($p<0.001$).

Group IV : Animals pretreated with a high dose of Verapamil (12 μg/kg in the rate of 1 ml/min)

The results are shown in table 16. A significant increase in fractional excretion of sodium was observed gradually from 1.60±0.25 to 8.51±1.61 % ($p<0.05$) and to 9.10±1.77 % ($p<0.05$) at the 2nd and 3rd hour of $CaCl_2$ infusion, respectively; whereas fractional excretion of chloride marked increased in all the experimental periods ($p<0.01$). It was found that fractional excretion of potassium elevated progressively from 14.71±2.92 to 57.64±4.75 % ($p<0.01$) at the 3rd hour of $CaCl_2$ infusion. Fractional excretion of calcium as well as inorganic phosphorus increased from the control value and reached the significant level at the 2nd ($p<0.01$) and 3rd hour of $CaCl_2$ infusion ($p<0.01$, $p<0.05$). It was indicated that urinary excretion of sodium, potassium and chloride increased significantly as the same pattern of its fractional excretion. Either urinary excretion of calcium or inorganic phosphorus showed a significant incrase all the experimental periods.

Table 16 Effects of intravenous $CaCl_2$ infusion on renal electrolytes excretion in the left kidney of five dogs pretreated with a high dose of Verapamil (12 μg/kg in the rate of 1 ml/min). (Mean±S.E.)

		Verapamil infusion			
		Before $CaCl_2$	After $CaCl_2$ infusion		
Variables	Control	infusion	1 hr.	2 hr.	3 hr.
$U_{Na}V$ (μEq/min/kg.bw.)	3.23 ±0.54	5.39 ±1.57	11.12 ±2.89	15.48** ±2.73	15.81* ±2.92
$U_{K}V$ (μEq/min/kg.bw.)	0.65 ±0.10	0.93 ±0.18	1.85** ±0.22	2.27** ±0.23	2.33** ±0.27
$U_{Cl}V$ (μEq/min/kg.bw.)	3.13 ±0.67	4.81 ±1.68	13.11* ±2.99	18.38** ±2.86	19.55** ±3.01
$U_{Ca}V$ (μEq/min/kg.bw.)	0.10 ±0.02	0.11 ±0.04	0.56* ±0.14	0.81** ±0.37	0.88** ±0.16
$U_{Pi}V$ (μEq/min/kg.bw.)	0.73 ±0.14	0.84 ±0.13	1.39* ±0.06	2.02** ±0.12	2.21* ±0.22
FE_{Na} (%)	1.60 ±0.25	2.45 ±0.71	6.13 ±1.69	8.51* ±1.61	9.10* ±1.77
FE_{K} (%)	14.71 ±2.92	19.05 ±2.75	43.96** ±4.83	54.27** ±5.24	57.64** ±4.75
FE_{Cl} (%)	1.86 ±0.39	2.63 ±0.92	8.64* ±2.19	11.99** ±2.18	13.46** ±2.21
FE_{Ca} (%)	2.42 ±0.86	1.79 ±0.61	6.72 ±1.77	9.40** ±1.46	10.44** ±1.84
FE_{Pi} (%)	21.10 ±4.75	21.69 ±3.48	22.16 ±2.01	43.92** ±1.69	52.69* ±1.39

P-value with respect to control, * $p<0.05$, ** $p<0.01$

Group V : Animals pretreated with Prazosin
(20 µg/kg in the rate of 1 ml/min)

As shown in table 17. Fractional excretion of sodium increased from 1.66±0.45 to 9.17±2.92 % ($p<0.05$) and chloride from 1.72±0.49 to 12.57±3.56 % ($p<0.05$) after 3 hour of $CaCl_2$ infusion. A marked increase in fractional excretion of potassium was noted significantly all the experimental periods ($p<0.01$). It was observed that, both fractional excretion of calcium and inorganic phosphorus increased gradually in the same pattern at 1st , 2nd and 3rd hour of $CaCl_2$ infusion ($p<0.05$). Urinary excretion of sodium, potassium, chloride and inorganic phosphorus were elevated significantly as the same pattern of its fractional excretion at all periods.

Group VI : Animals pretreated with the combination both of high dose of Verapamil and Prazosin

The results are summarized in table 18. The $CaCl_2$ infusion caused a significant increase in fractional excretion of sodium from 2.37±0.55 to 5.69±0.50 % ($p<0.001$) and chloride from 2.54±0.66 to 8.72±0.62 % ($p<0.01$) at the end of $CaCl_2$ infusion. Fractional excretion of calcium was also increased progressively which correlated with its urinary excretion ($p<0.01$). Both urinary excretion of sodium and chloride elevated significantly in the same pattern of its fractional excretion at all periods ($p<0.001$ and $p<0.01$). There was indicated that, urinary excretion of potassium increased slightly at the 2nd hour

Table 17 Effects of intravenous $CaCl_2$ infusion on renal electrolytes excretion in the left kidney of five dogs pretreated with Prazosin (20 μg/kg in the rate of 1 ml/min).(Mean±S.E.)

Variables	Control	Prazosin infusion		
		Before $CaCl_2$ infusion	After $CaCl_2$ infusion	
			1 hr.	2 hr.	3 hr.
$U_{Na}V$ (μEq/min/kg.bw.)	3.10 ±0.87	5.19 ±1.56	8.71* ±2.05	13.56* ±2.71	14.54* ±3.77
$U_{K}V$ (μEq/min/kg.bw.)	0.60 ±0.09	0.71 ±0.08	1.52** ±0.14	2.27*** ±0.12	2.24** ±0.28
$U_{Cl}V$ (μEq/min/kg.bw.)	2.78 ±0.77	4.78 ±1.61	10.36* ±2.18	16.31** ±2.87	17.43* ±4.02
$U_{Ca}V$ (μEq/min/kg.bw.)	0.09 ±0.03	0.17 ±0.06	0.59* ±0.16	0.72** ±0.12	0.84* ±0.18
$U_{Pi}V$ (μEq/min/kg.bw.)	0.68 ±0.14	1.06 ±0.38	1.65** ±0.11	2.13** ±0.20	2.23** ±0.18
FE_{Na} (%)	1.66 ±0.45	2.51 ±0.69	5.10* ±1.33	8.01* ±2.07	9.17* ±2.92
FE_{K} (%)	13.19 ±1.64	14.44 ±1.05	37.30** ±3.96	57.38** ±5.35	59.57* ±10.64
FE_{Cl} (%)	1.72 ±0.49	2.81 ±0.87	6.94* ±1.55	11.15* ±2.61	12.57* ±3.56
FE_{Ca} (%)	1.99 ±0.56	3.34 ±1.19	8.13* ±2.45	9.39* ±1.89	11.36* ±2.74
FE_{Pi} (%)	19.44 ±3.11	25.14 ±4.32	37.84** ±4.05	49.55* ±6.31	55.45* ±9.48

P-value with respect to control, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 18 Effects of intravenous $CaCl_2$ infusion on renal electrolytes excretion in the left kidney of five dogs pretreated with the combination of high dose of Verapamil and Prazosin (Mean±S.E.)

Variables	Control	Verapamil+Prazosin infusion			
		Before $CaCl_2$ infusion	After $CaCl_2$ infusion		
			1 hr.	2 hr.	3 hr.
$U_{Na}V$ (μEq/min/kg.bw.)	4.95 ±0.83	5.82 ±1.03	13.43*** ±0.77	15.84** ±1.59	13.75** ±1.06
$U_{K}V$ (μEq/min/kg.bw.)	0.50 ±0.14	0.66 ±0.08	1.20 ±0.18	1.56* ±0.16	1.82* ±0.18
$U_{Cl}V$ (μEq/min/kg.bw.)	4.38 ±0.99	5.51 ±0.76	15.26*** ±0.73	18.17** ±1.88	17.14** ±1.34
$U_{Ca}V$ (μEq/min/kg.bw.)	0.10 ±0.02	0.13 ±0.03	0.82** ±0.10	1.02** ±0.15	0.97** ±0.17
$U_{Pi}V$ (μEq/min/kg.bw.)	0.84 ±0.28	0.78 ±0.31	1.56** ±0.27	2.04** ±0.38	2.49*** ±0.17
FE_{Na} (%)	2.37 ±0.55	2.52 ±0.53	5.16** ±0.34	6.45** ±0.65	5.69*** ±0.50
FE_{K} (%)	11.23 ±4.31	13.23 ±2.75	20.39 ±1.81	26.42 ±3.16	30.66* ±5.02
FE_{Cl} (%)	2.54 ±0.66	2.98 ±0.62	7.63*** ±0.66	9.07** ±0.95	8.72** ±0.62
FE_{Ca} (%)	1.99 ±0.58	2.28 ±0.53	8.37** ±1.04	10.39** ±1.74	9.58** ±1.96
FE_{Pi} (%)	22.17 ±6.41	18.15 ±6.67	29.17 ±5.23	36.20* ±6.93	46.81** ±5.63

P-value with respect to control, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

($p<0.01$) and 3rd hour of $CaCl_2$ infusion ($p<0.05$), whereas fractional excretion of potassium increased significantly only at the 3rd hour of $CaCl_2$ infusion ($p<0.05$). Fractional excretion of inorganic phosphorus increased slightly and reached a significant level at the 2nd and 3rd hour of $CaCl_2$ infusion ($p<0.01$), while its urinary excretion increased significantly at all periods.

In comparison of the results, three hour after intravenous $CaCl_2$ infusion, fractional excretion of sodium (Fig.17), potassium (Fig.18), chloride (Fig.19), calcium (Fig.20) and inorganic phosphorus (Fig.21) were increased significantly all experimental periods in group II-VI as compared to the control group (group I) at the same time interval. It was indicated that, urinary excretion of sodium (Fig.22), potassium (Fig.23), chloride (Fig.24), calcium (Fig.25) and inorganic phosphorus (Fig.26) of animals in group II-VI markedly increased in the similar pattern which significantly differed from the control group (group I) throughout the experimental periods. It has been shown that alterations of percentages of fractional excretion of sodium (Fig.17) and chloride (Fig.19) of animals in group VI were less than that of group II-V throughout the study period. Similar changes were noted in urinary excretion of sodium (Fig.22) and chloride (Fig.24) in the same time interval.

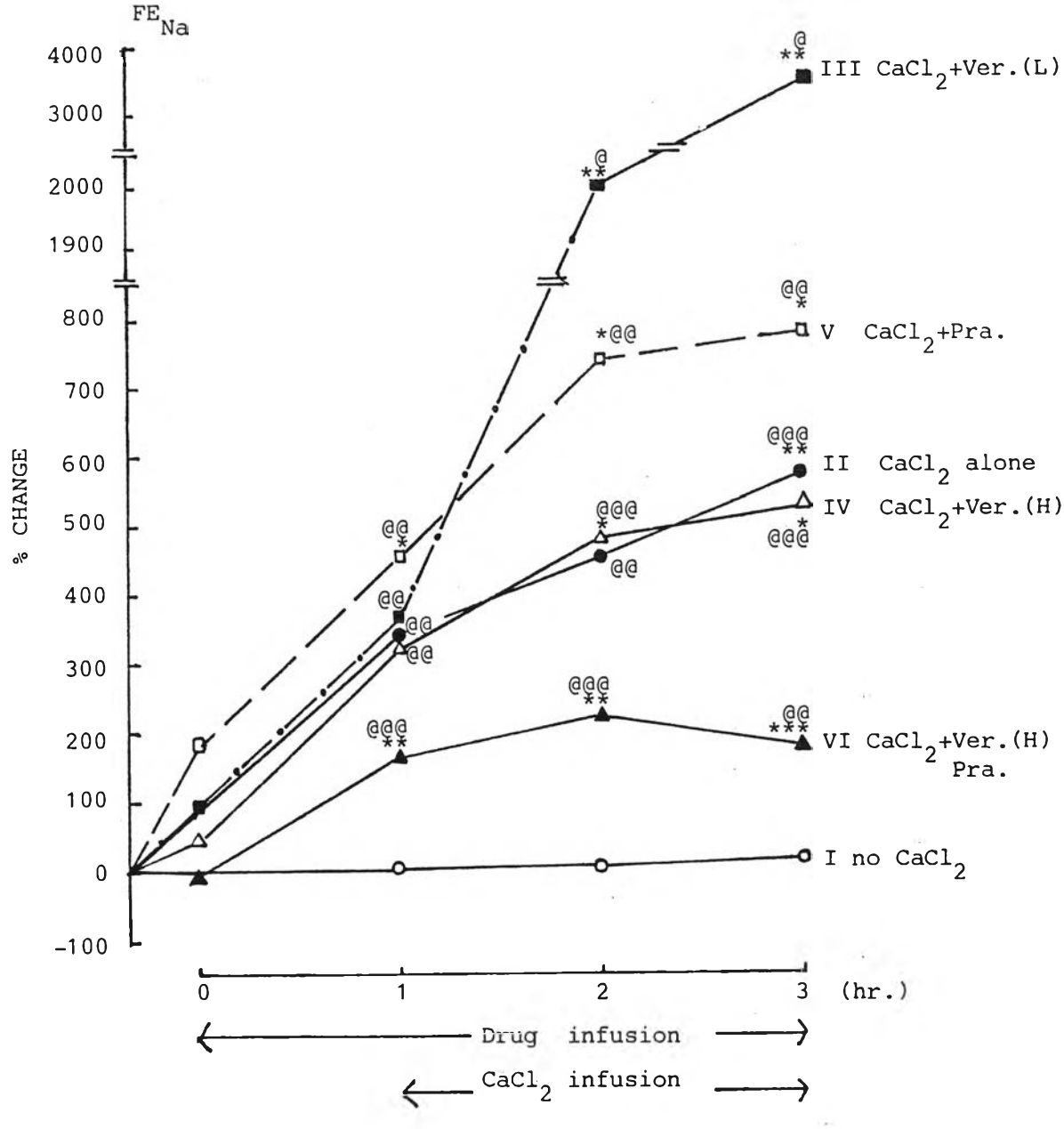

Fig.17: Percentage changes of fractional excretion of sodium(FE_{Na}) in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H)dose of Verapamil(Ver.),Prazosin(Pra.)and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+ Pra.]. The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$ $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to group I at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

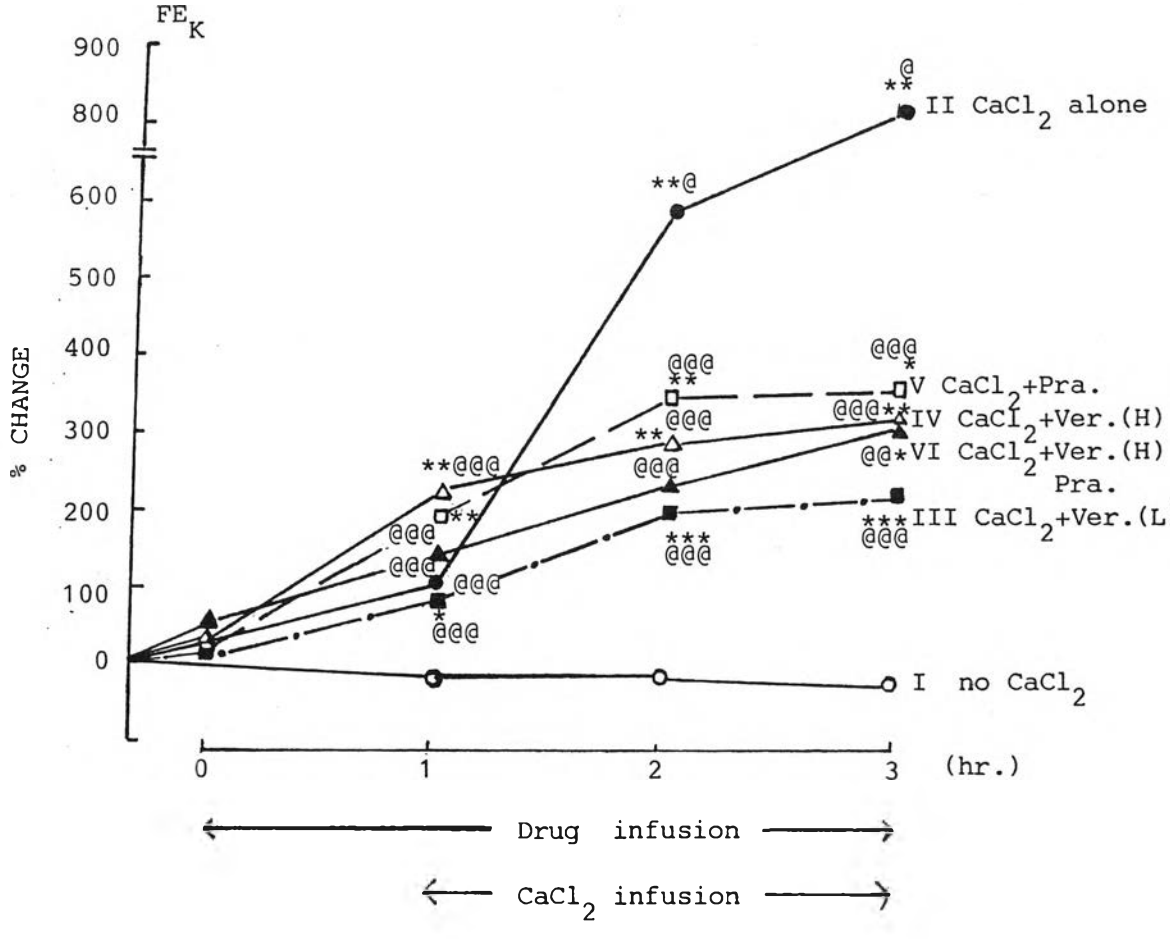

Fig.18: Percentage changes of fractional excretion of potassium(FE_K) in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H)dose of Verapamil(Ver.),Prazosin(Pra.)and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.] The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to group I at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

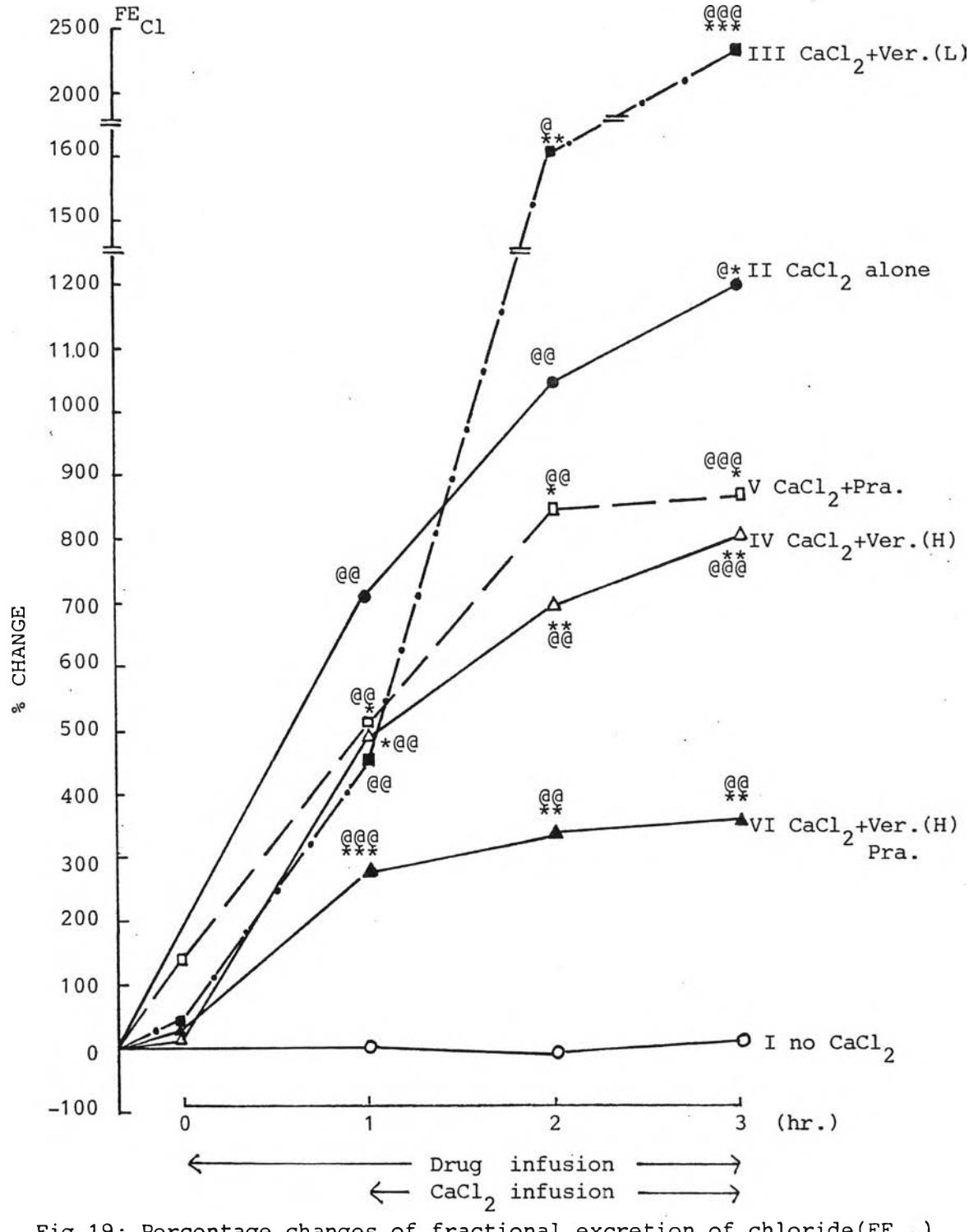

Fig.19: Percentage changes of fractional excretion of chloride(FE_{Cl}) in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H)dose of Verapamil(Ver.),Prazosin(Pra.)and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.] The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to group I at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

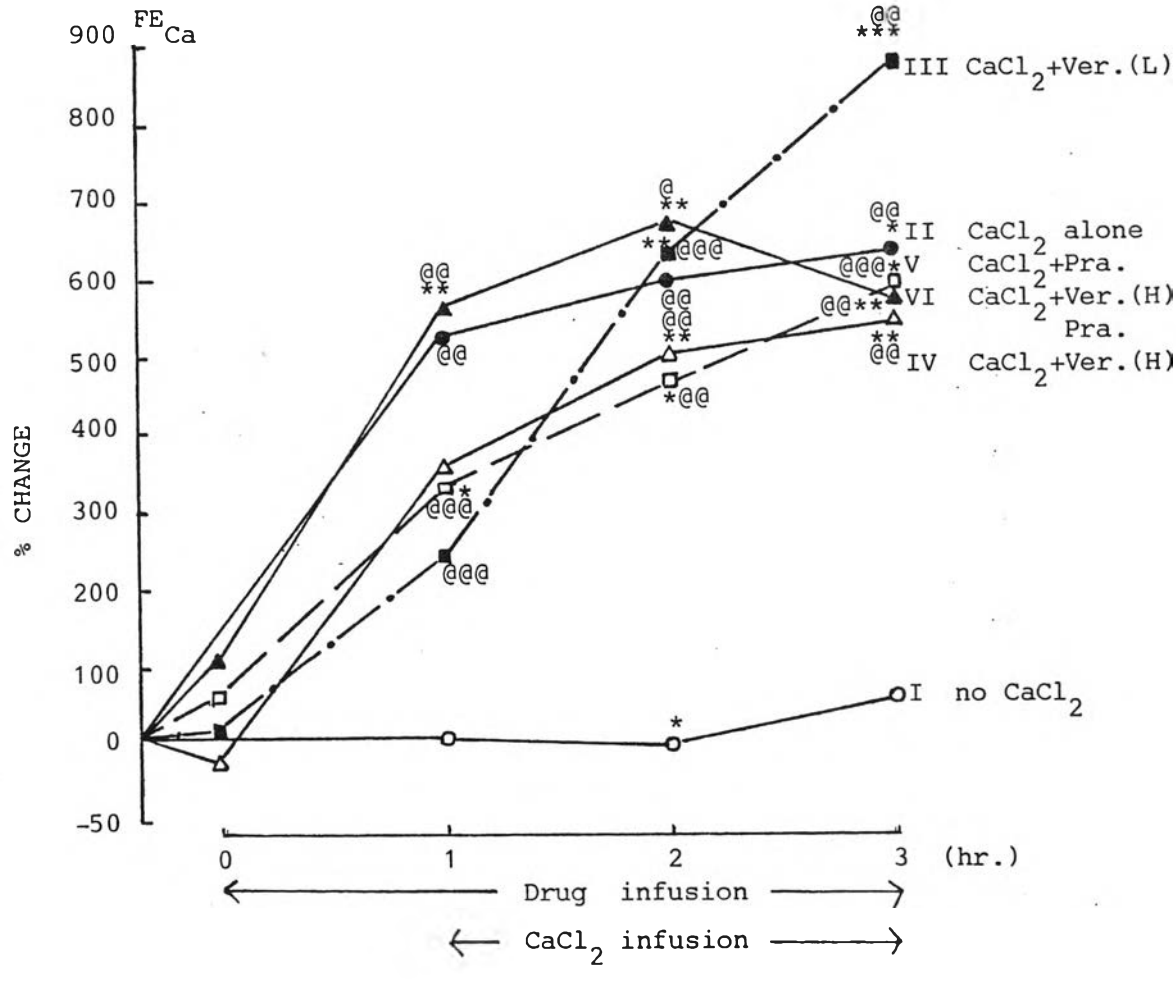

Fig.20: Percentage changes of fractional excretion of calcium(FE_{Ca}) in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H)dose of Verapamil(Ver.),Prazosin(Pra.)and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.] The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to group I at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

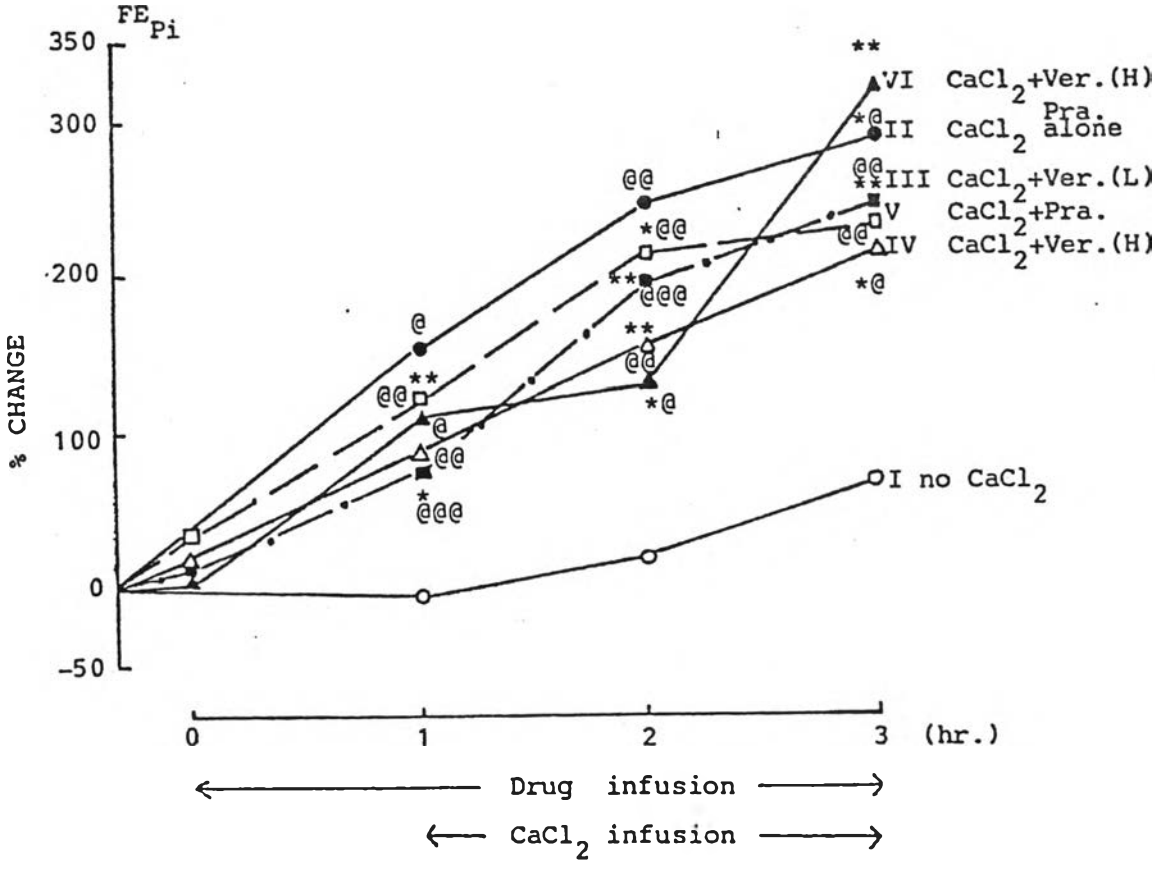

Fig.21: Percentage changes of fractional excretion of inorganic phosphorus(FE_{Pi}) in dogs infusion with $CaCl_2$ and pretreated with low (L)or high(H)dose of Verapamil(Ver.),Prazosin(Pra.) and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$

p-values with respect to group I at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

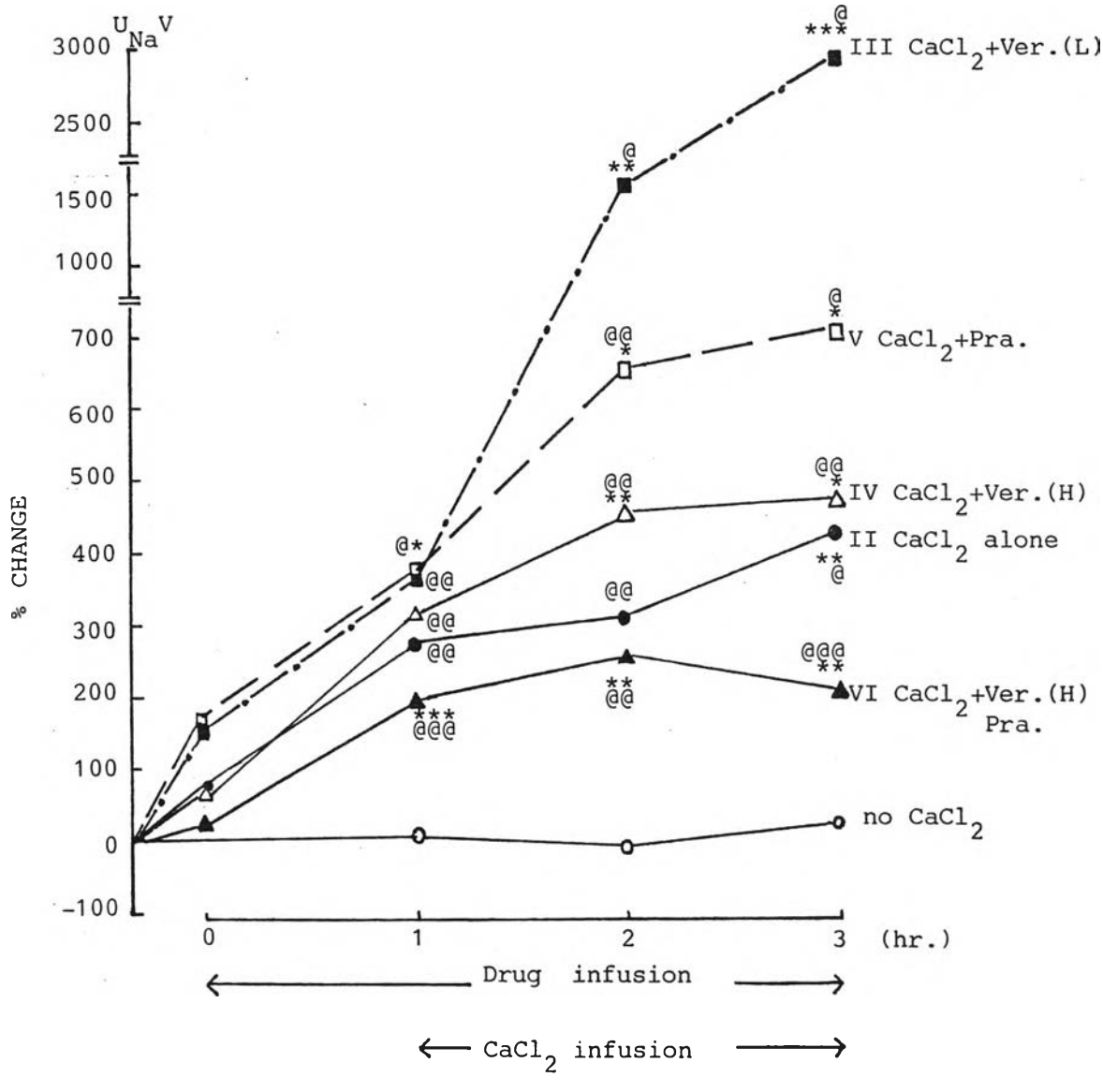

Fig. 22: Percentage changes of urinary excretion of sodium($U_{Na}V$)in dogs infusion with $CaCl_2$ and pretreated with low(L)or high(H)dose of Verapamil(Ver.),Prazosin(Pra.)and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respext to control condition of each group,
$^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to group I at the same time interval,
$^{@}p<0.05$, $^{@@}p<0.01$, $^{@@}p<0.001$

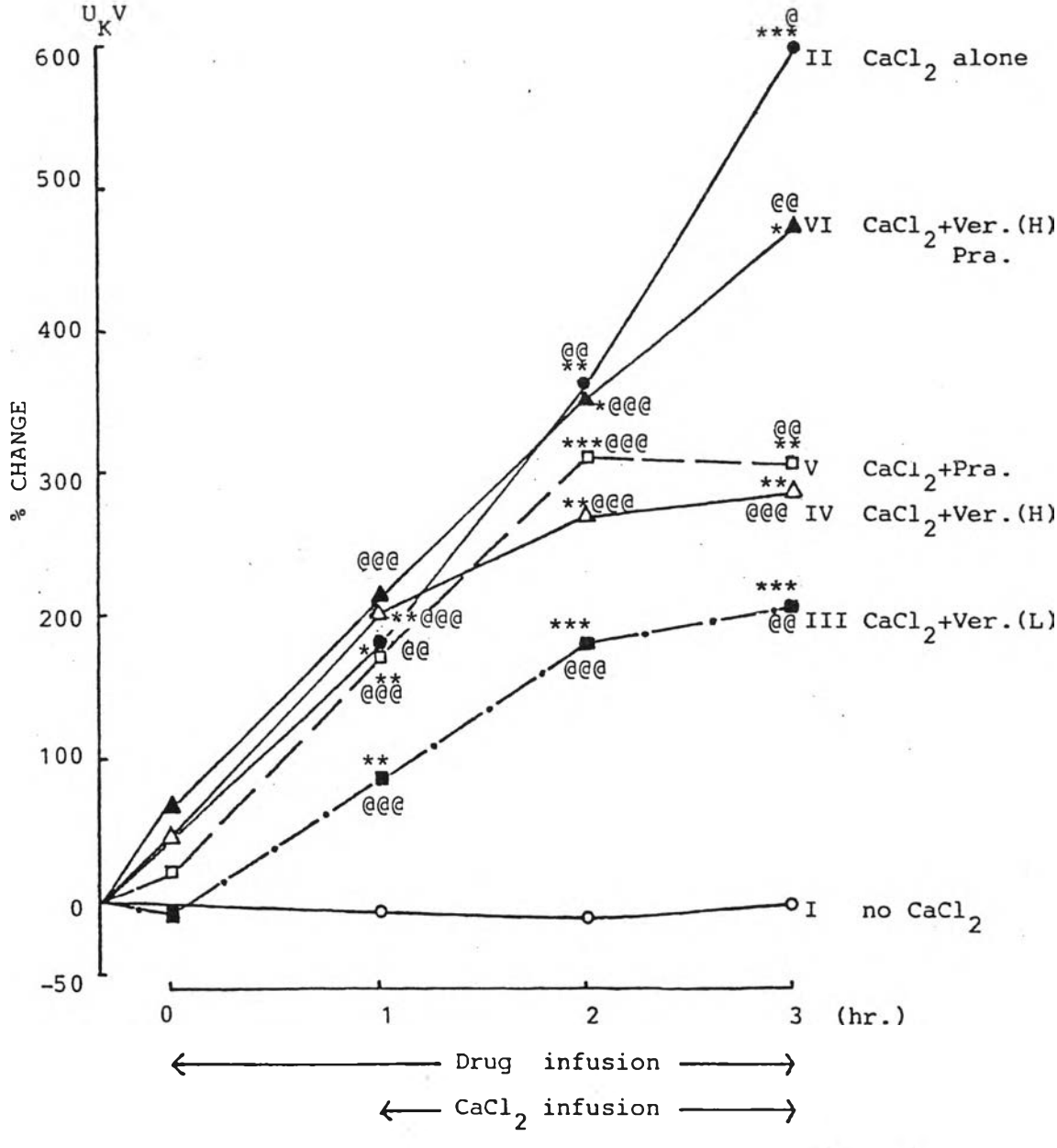

Fig.23:Percentage changes of urinary excretion of potassium($U_K V$) in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H)dose of Verapamil(Ver.),Prazosin(Pra.) and the combined drugs between high dose of Verapamil and Frazosin[Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to groupI at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

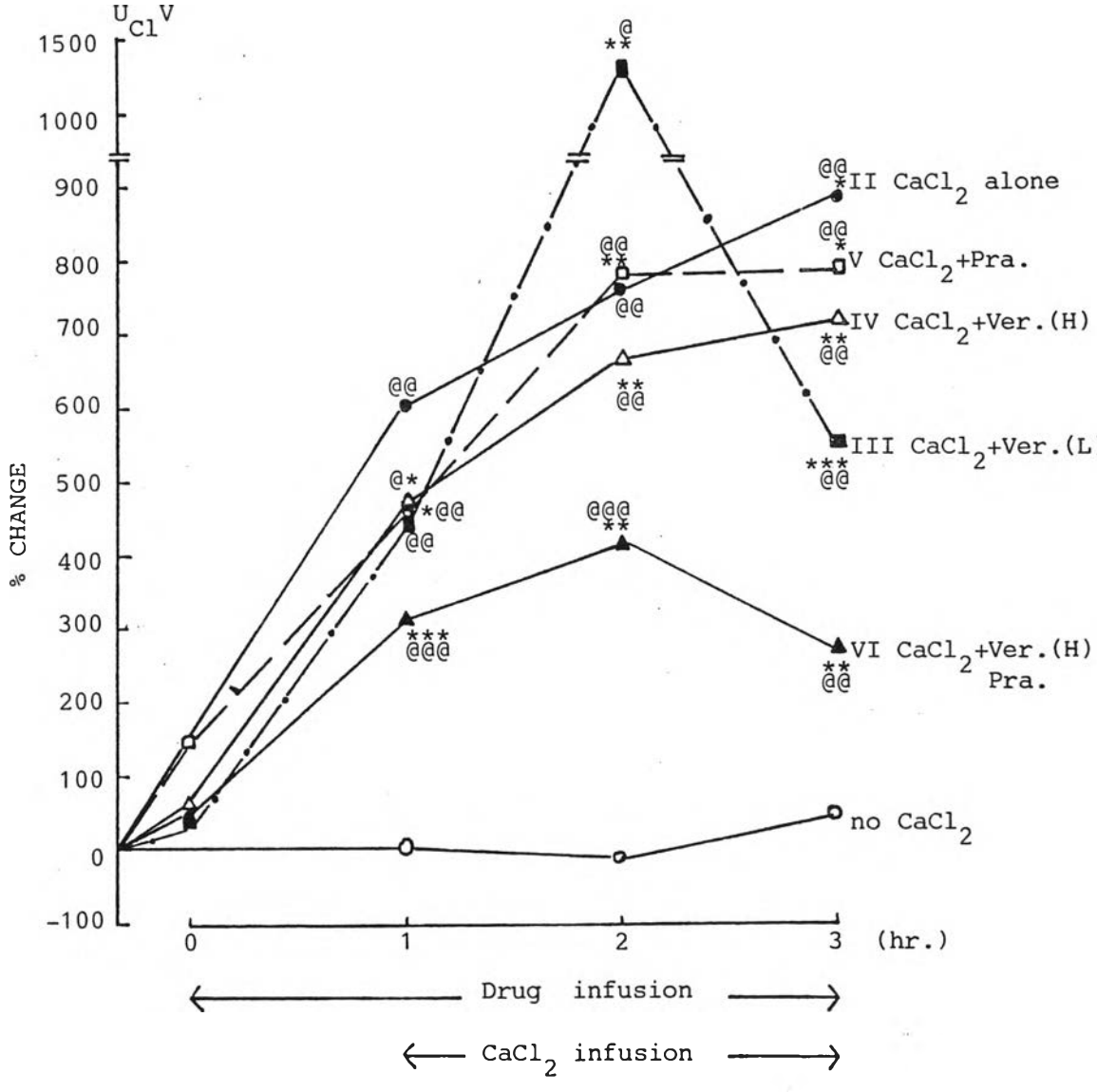

Fig. 24: Percentage changes of urinary excretion of chloride($U_{Cl}V$) in dogs infusion with $CaCl_2$ and pretreated with low(L)or high(H)dose of Verapamil(Ver.),PRazosin(Pra.)and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+ Pra.]

The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to group I at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

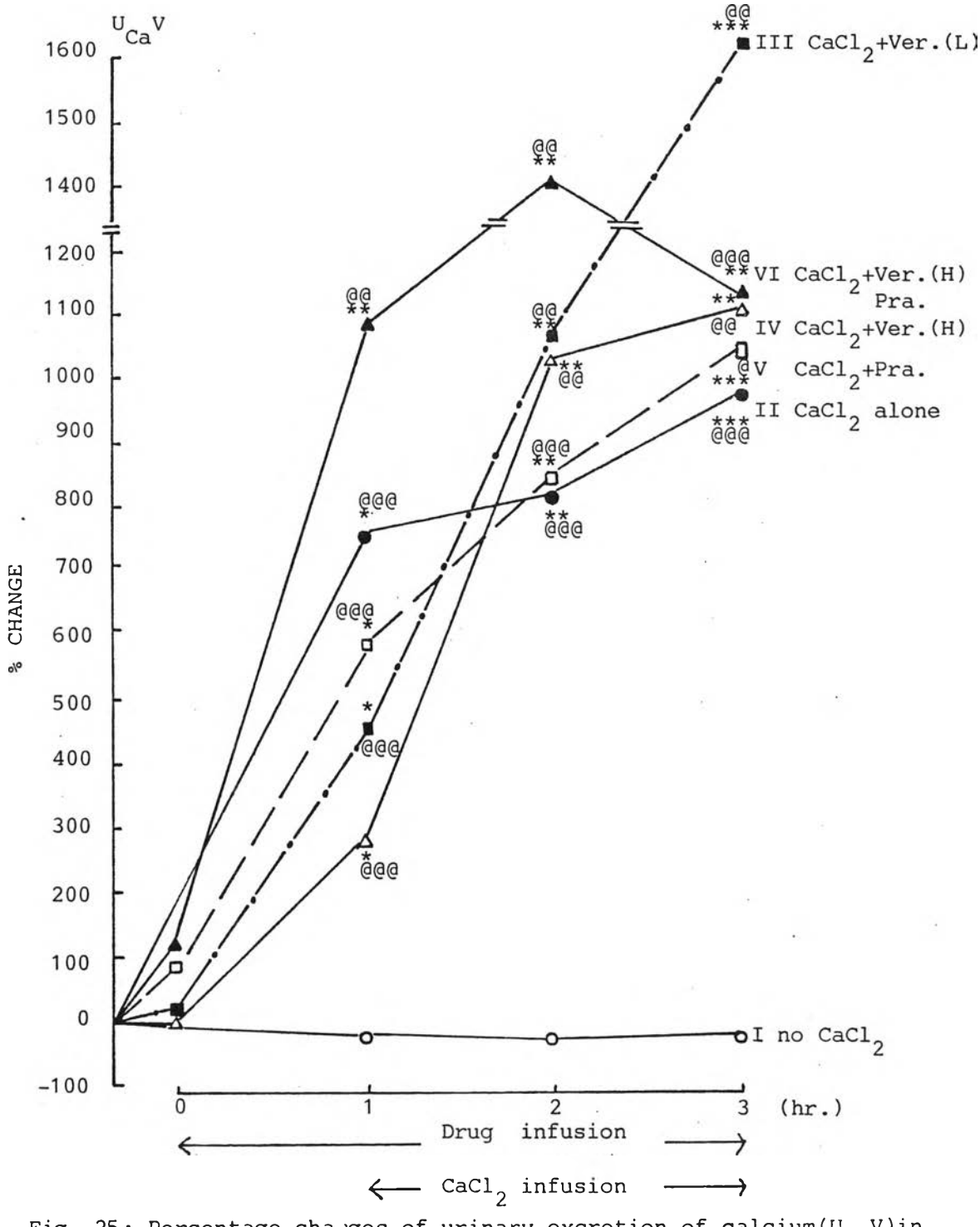

Fig. 25· Percentage cha ıges of urinary excretion of calcium($U_{Ca}V$)in dogs infusion with $CaCl_2$ and pretreated with low(L)or high(H) dose of Verapamil(Ver.),Prazosin(Pra.)and the combined drugs between high dose of Verapamil and Prazosin[Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respect to control condition of each group, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to group I at the same time interval, $^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$

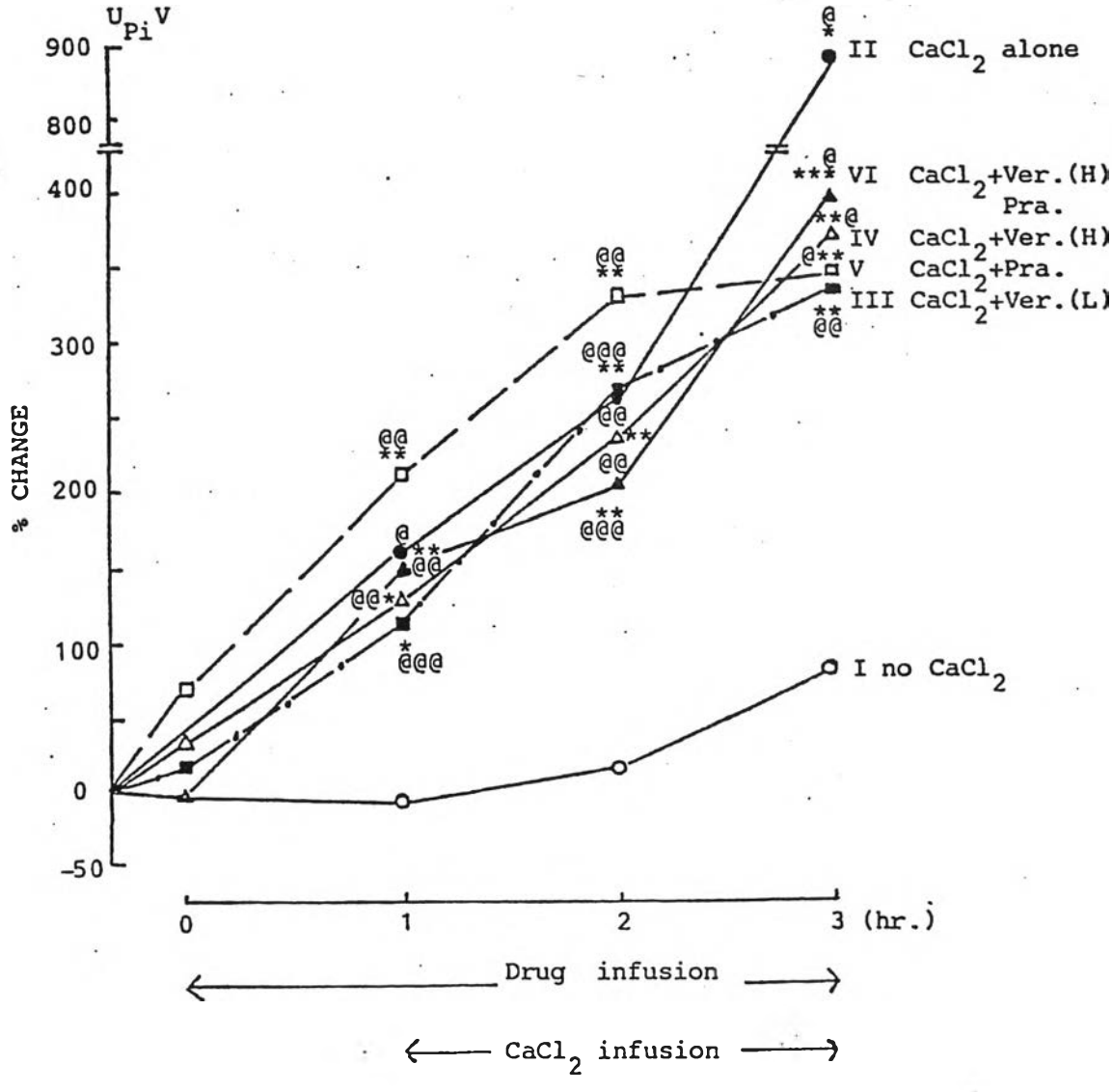

Fig. 26: Percentage changes of urinary excretion of inorganic phosphorus ($U_{Pi}V$)in dogs infusion with $CaCl_2$ and pretreated with low(L) or high(H)dose of Verapamil(Ver.),Prazosin(Pra.)and the combined drugs between high dose of Verapamil and Prazosin [Ver.(H)+Pra.]

The values are mean±S.E.

p-values with respect to control condition of each group,
$^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

p-values with respect to group I at the same time interval,
$^{@}p<0.05$, $^{@@}p<0.01$, $^{@@@}p<0.001$