Chapter IV

Results

Effects of Russell's viper venom on the level of plasma norepinephrine and general circulation. (Table 1-4 , Figure 1-5)

Group I : animals pretreated with 0.9% NSS solution (placebo) before envenomation.

Effects of Russell's viper venom on changes of plasma norepinephrine level (NE) and general circulation in group I are shown in Table 1 . After envenomation, a significant increase in circulating norepinephrine was apparent by an average from 1.9 $\pm$1.4 to 2.5 $\pm$1.4 ug/ 100 ml with in 10 minutes and sustaining in a high level throughout the experiment. Envenomation in the first 10 minutes caused singificant decrease in mean arterial pressure (MAP) by average from 117.6 $\pm$ 9.21 to 42.0 $\pm$ 13.9 mmHg , pulse pressure (PP) from 64.0 $\pm$ 8.2 to 21.0 $\pm$ 8.2 mmHg and heart rate (HR) from 171 $\pm$ 19 to 144 $\pm$ 8 beats/min while the packed cell volume (PCV) significantly increased from 28.8 $\pm$ 8.8 to 34.0 $\pm$ 6.2% after venom injection.

Group II : animals pretreated with 0.7 ug/kg of prazosin before envenomation.

The results in Table 2 demonstrate that pretreatment of prazosin depressed circulating norepinephrine (NE) level slightly. After injection

Table 1. Effects of Russell's viper venom on plasma norepinephrine and general circulation in five dogs of group I (Mean ± S.D.)

Parameter	0.9 % Saline intravenous infusion						
	Control	NSS	Post - envenomation (RVV 0.1 mg/kg.bw i.v.)				
Time elapse (min)	0-20	20-60	60-70	90-120	120-150	150-180	180-220
NE (µg/100 ml.)	1.9 ± 1.4	1.9 ± 1.4	2.5 ± 1.4**	3.5 ± 3.3	3.3 ± 2.7	2.4 ± 1.7	2.5 ± 1.8
MAP (mmHg)	116.3 ± 9.7	117.7 ± 9.2	42.0 ± 14.0***	102.0 ± 15.6*	102.4 ± 40	104.8 ± 35.8	118.6 ± 17.6
PP (mmHg)	66.0 ± 9.6	64.0 ± 8.2	21.0 ± 8.2**	36.0 ± 19.8*	45.0 ± 27.2	51.0 ± 17.1	53.0 ± 16.9
HR (beat/min)	175 ± 23	171 ± 19	144 ± 8**	160 ± 10	176 ± 19	176 ± 22	177 ± 21
PCV (%)	28.2 ± 7.7	28.8 ± 8.8	34.0 ± 6.3*	36.0 ± 10.4	32.8 ± 6.6	31.4 ± 5.3	25.8 ± 3.7

Group I : Effects of Russell's viper venom on plasma norepinephrine and general circulation in animals treated with NSS infusion 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 plasma norepinephrine and general circulation in five dogs of group II (Mean ± S.D.)

Parameter	0.9 % Saline intravenous infusion						
	Control	Prazosin	Post - envenomation (RVV 0.1 mg/kg i.v.)				
Time elapse (min)	0-20	20-60	60-70	90-120	120-150	150-180	180-220
NE (μg/100 ml.)	1.6 ± 0.7	1.3 ± 0.8	1.5 ± 0.6	1.5 ± 0.3	1.5 ± 0.5	1.6 ± 0.7	1.7 ± 0.6
MAP (mmHg)	127.0 ± 15.7	99.5 ± 10.0*	43.0 ± 28.1**	79.3 ± 30.0	90.0 ± 28.1	104.3 ± 20.9	108.7 ± 17.5
PP (mmHg)	63.0 ± 19.2	42.0 ± 14.4	16.0 ± 19.5*	37.0 ± 19.9*	34.0 ± 14.3	43.0 ± 14.4	41.0 ± 15.2
HR (beat/min)	150 ± 73	163 ± 26	132 ± 26*	153 ± 17	158 ± 22	174 ± 21	176 ± 21
PCV (%)	26.0 ± 2.5	21.0 ± 10.8	28.6 ± 2.7**	26.4 ± 2.0*	26.0 ± 1.7	26.0 ± 2.2	25.6 ± 3.0

Group II : Effects of Russell's viper venom on plasma norepinephrine and general circulation in animals treated with 0.7 μg/kg of prazosin before envenomation.

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

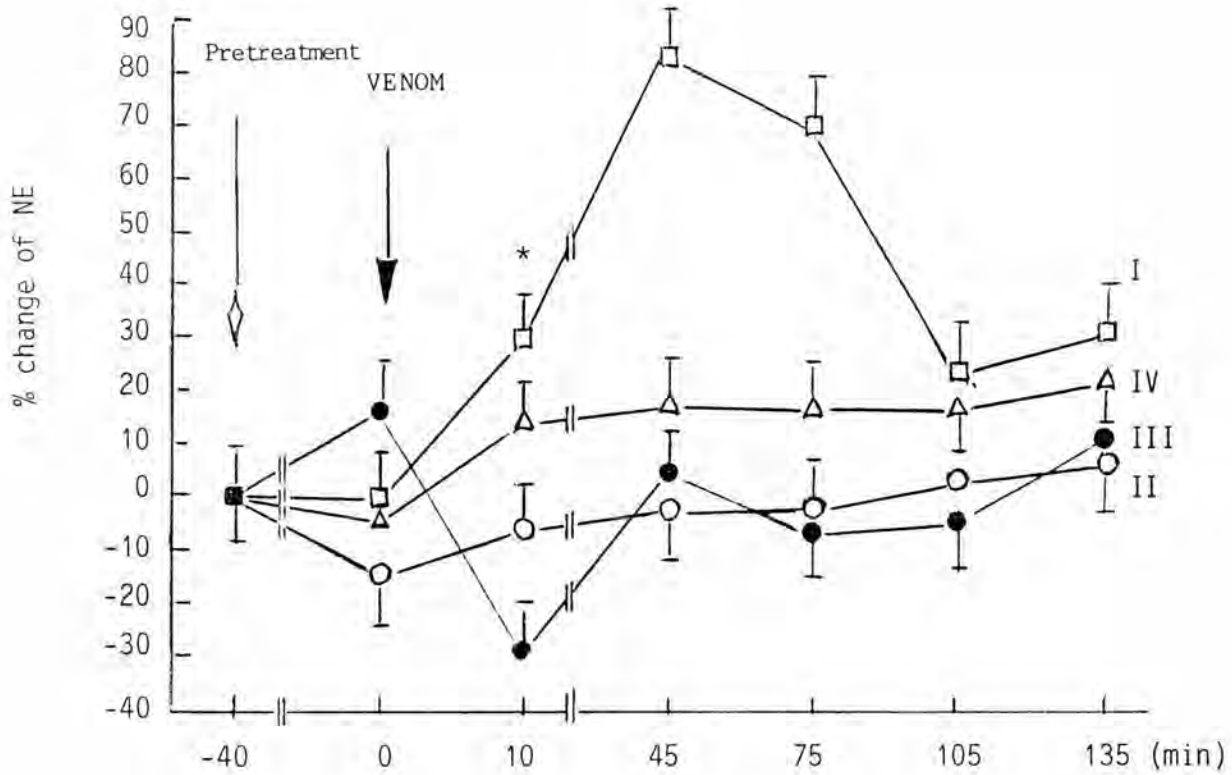

Figure 1 : Effects of intravenous injection of Russell's viper venom on % change of plasma norepinephrine (NE) in group I (control animals) , group II (animals pretreated with prazosin) , group III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin).

Values are statistically significantly different from control period of each group , * $p < 0.05$

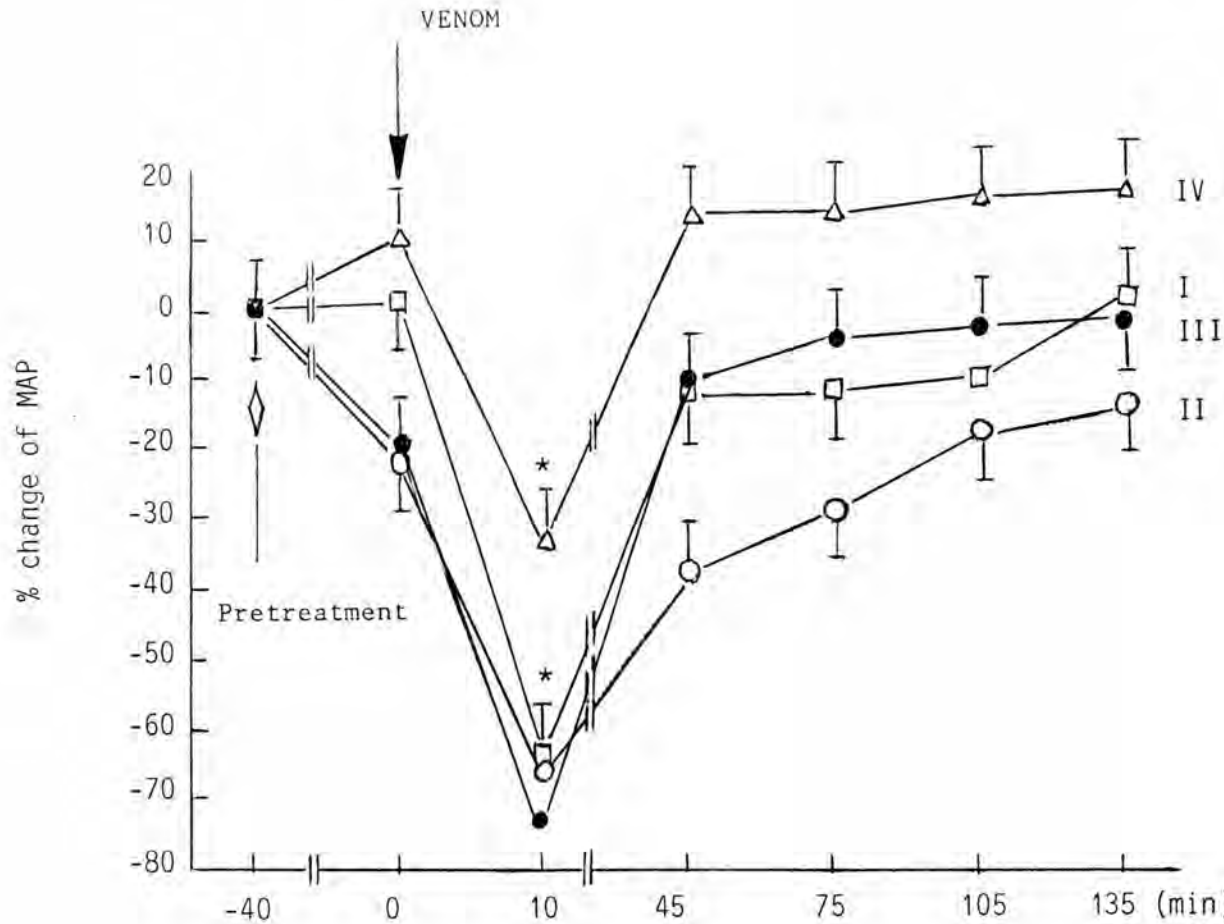

Figure 2 : The effects of intravenous injection of Russell's viper venom on % change of mean arterial pressure (MAP) in group I (control animals) ; group II (animals pretreated with (prazosin) , gorup III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin).

Values are statistically significantly different from control period of each group , * $p < 0.05$

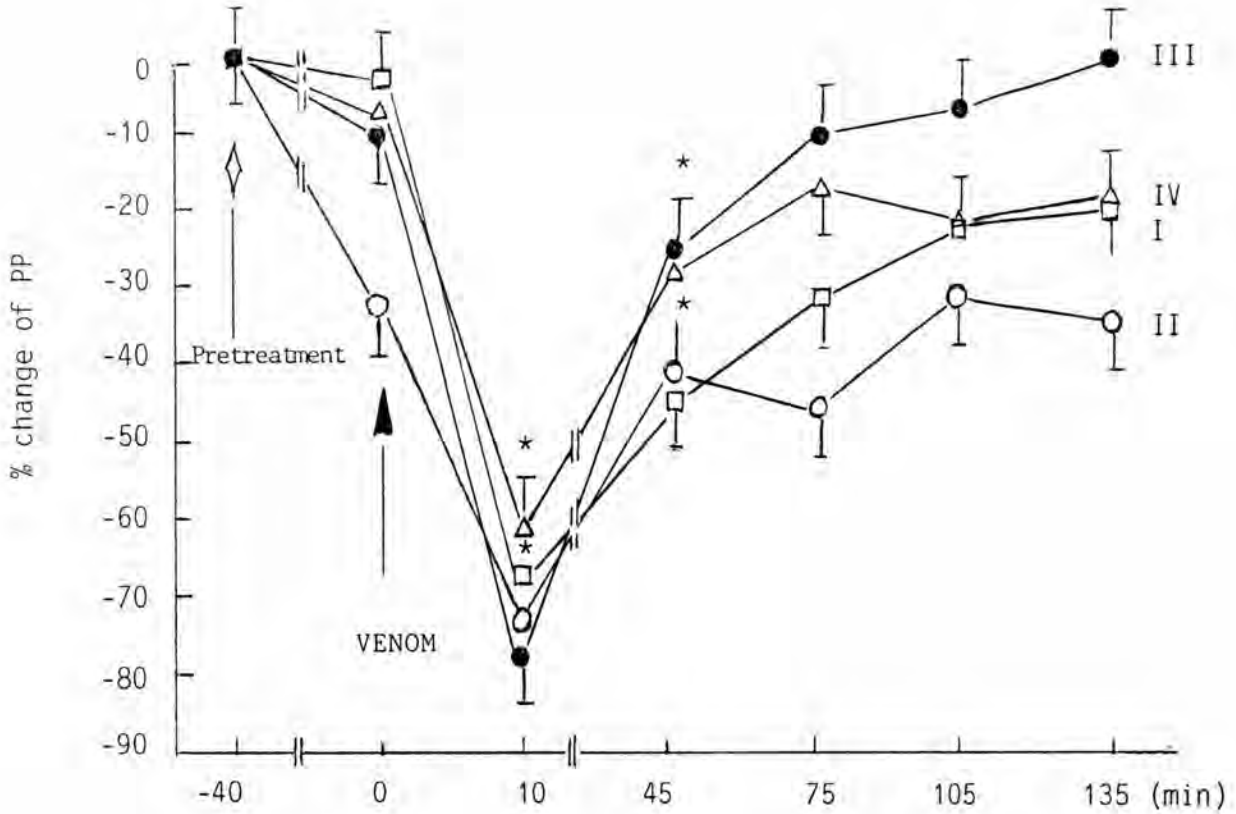

Figure 3 : The effects of intravenous injection of Russell's viper venom on % change of pulse pressure (PP) in group I (control group), group II (animals pretreated with prazosin) , group III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin)

Values are statistically significantly different from control period of each group , * $p < 0.05$

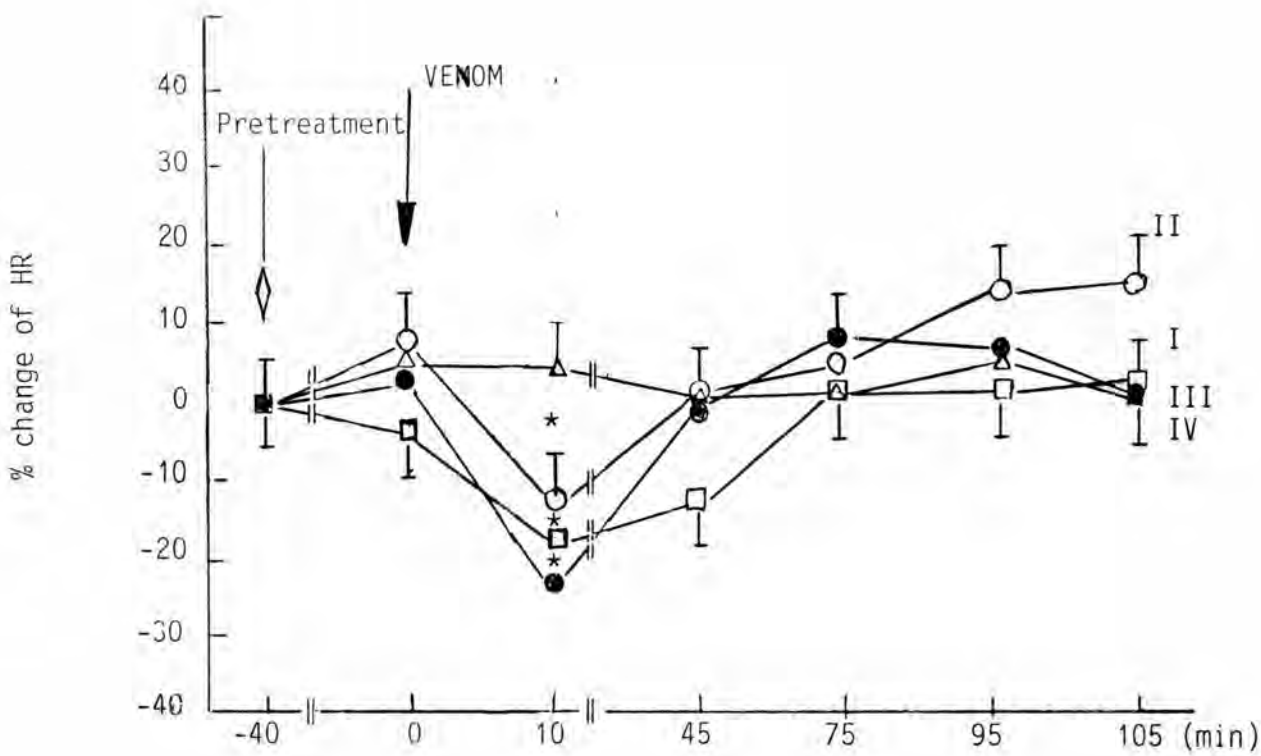

Figure 4 : The effects of intravenous injection of Russell's viper venom on % change of heart rate (HR) in group I (control group) , group II (animals pretreated with prazosin) , group III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin)

Values are statistically significantly different from control period of each group, * $p < 0.05$

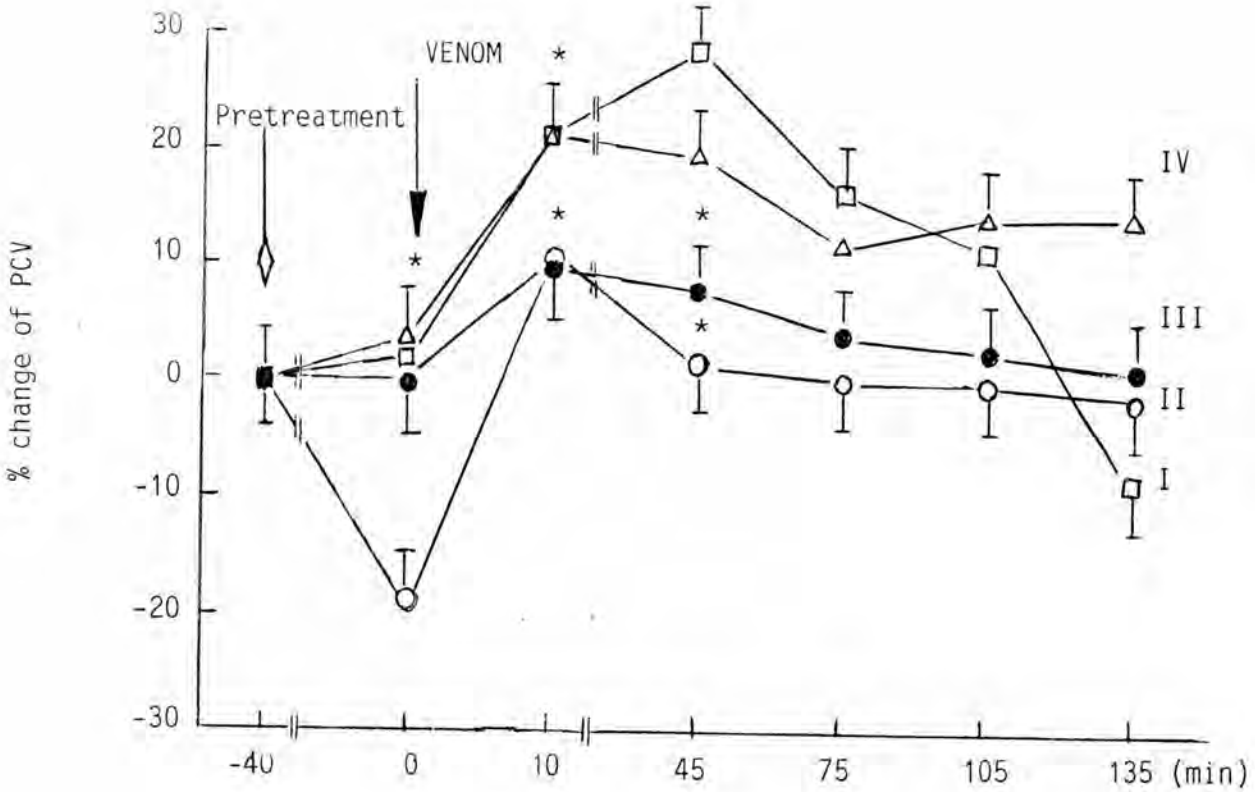

Figure 5 : The effects of intravenous injection of Russell's viper venom on % change of packed cell volume (PCV) in group I (control animals), group II (animals pretreated with prazosin) , group III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin)

Values are statistically significantly different form control period of each group , * $p < 0.05$

a bolus dose of Russell's viper venom , norepinephrine level slightly elevated from 1.3 ± 0.8 to 1.5 ± 0.6 ug/100 ml inthe period of 10 minutes and approached to the normal level wiht in 30 minutes. However , a significant reduction in mean arterial pressure (MAP) from 99.5 ± 10.0 to 43.0 ± 28.1 mmHg , pulse pressure (PP) from 42.0 ± 14.4 to 16.0 ± 19.5 mmHg and heart rate (HR) from 163 ± 26 to 132 ± 26 beats/min respectively, with in 10 minutes after given venom. Pretreatment of prazosin caused a fall in packed cell volume (PCV) from 26.0 ± 2.6 to 21.0 ± 10.8% and then increase to 28.6 ± 2.7 within 10 minutes after envenomation

Group III : animals pretreated with 10 mg/kg of enalapril maleate before envenomation.

The data in Table 3 show that pretreatment with enalapril maleate caused a slightly increase in norepinephrine level. After envenomation, circulating norepinephrine level decreased nonsignificantly from 2.4 ± 1.6 to 1,5 ± 1.0 ug/100 ml with in 10 minutes and approached to the control level in 30 minutes. There were significant reduction in mean arterial pressure (MAP) from 97.3 ± 18.2 to 33.2 ± 8.2 mmHg. , pulse pressure (PP) from 52.0 ± 8.4 to 12.0 ±4.5 mmHg and heart rate (HR) from 165 ± 14 to 123 ± 16 beats/min, while the packed cell volume (PCV) significantly increased from 25.8 ± 5.0 % in the period of 10 minute after envenomation

Group IV : animals pretreated with 5 mg/kg of indomethacin before envenomation

Table 3. Effects of Russell's viper venom on plasma norepinephrine and general circulation in five dogs of group III (Mean ± S.D.)

	0.9 % Saline intravenous infusion						
Parameter	Control	Enalapril	Post - envenomation (RVV 0.1 mg/kg i.v.)				
Time elapse (min)	0-20	20-60	60-70	90-120	120-150	150-180	180-220
NE (μg/100 ml.)	2.1 ± 1.2	2.4 ± 1.6	1.5 ± 1.0	2.2 ± 1.5	1.9 ± 1.6	1.9 ± 1.0	2.4 ± 1.4
MAP (mmHg)	123.3 ± 11.8	97.3 ± 18.2*	33.2 ± 8.2***	110.3 ± 13.5	118.3 ± 17.2	120.0 ± 27.3	122.3 ± 33.6
PP (mmHg)	58.0 ± 7.6	52.0 ± 8.4	12.0 ± 4.5***	43.0 ± 9.1*	52.0 ± 15.2	54.0 ± 19.8	58.0 ± 23.1
HR (beat/min)	159 ± 13	165 ± 14	123 ± 16**	156 ± 20	170 ± 20	165 ± 24	159 ± 24
PCV (%)	26.0 ± 4.6	25.8 ± 5	28.8 ± 5.2***	28.0 ± 5.5*	27.0 ± 5.0	26.6 ± 4.2	26.2 ± 5.0

Group III : Effects of Russell's viper venom on plasma norepinephrine and general circulation in animals treated with 10 mg/kg of enalapril maleate before envenomation.

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

Table 4. Effects of Russell's viper venom on plasma norepinephrine and general circulation in five dogs of group IV (Mean ± S.D.)

Parameter	0.9 % Saline intravenous infusion						
	Control	Indomethacin	Post - envenomation (RVV 0.1 mg/kg i.v.)				
Time elapse (min)	0-20	20-60	60-70	90-120	120-150	150-180	180-220
NE (μg/100 ml.)	2.0 ± 0.9	1.9 ± 0.8	2.3 ± 1.1	2.3 ± 1.6	2.3 ± 0.9	2.3 ± 1.0	2.4 ± 1.2
MAP (mmHg)	126.3 ± 27.2	139.7 ± 25.9	83.7 ± 49.0*	143.7 ± 20.0	144.3 ± 19.2	147.3 ± 18.6	147.9 ± 16.1
PP (mmHg)	70.0 ± 16.6	65.0 ± 16.6	26.0 ± 15.2*	50.0 ± 8.7	58.0 ± 16.0	54.0 ± 12.9	57.0 ± 19.2
HR (beat/min)	158 ± 20	169 ± 29	163 ± 45	159 ± 18	158 ± 15	163 ± 23	157 ± 26
PCV (%)	32.6 ± 3.4	33.6 ± 4.1	39.2 ± 3.3*	39.0 ± 2.3	37.6 ± 2.7	37.2 ± 3.2	37.0 ± 3.1

Group IV : Effects of Russell's viper venom on plasma norepinephrine and general circulation in animals treated with 5 mg/kg of indomethacin before envenomation

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

The results in Table 4 show that pretreatment with indomethacin in the first 10 minutes of Russell's viper injection produced a slightly elevation of plasma norepinephrine level (NE) from 1.9 ± 0.8 to 2.3 ± 1.1 ug% and caused a reduction in mean arterial pressure (MAP) from 139.7 ± 25.9 to 83.7 ± 49.0 mmHg , pulse pressure (PP) from 65.0 ± 16.6 to 26.0 ± 15.2 mmHg and heart rate (HR) from 169 ± 29 to 163 ± 45 beats/min , respectively. The packed cell volume (PCV) was significantly increased from 33.6 ± 4.1 to 39.2 ± 3.3% in the period of 10 minutes after venom injection.

Effects of Russell's viper venom on renal hemodynamics. (Table 5-8 , Figure 6-11)

Group I : animals pretreated with 0.9% NSS solution before envenomation.

Effects of Russell's viper venom on renal hemodynamics are shown in Table 5 ; Anuria was apparent in 30 minutes after envenomation and then oliguria was developed at 2 hours of experiment. Envenomation caused markedly reduction of renal plasma flow (RPF) , renal blood flow (RBF) and glomerular filtration rate (GFR) throughout the experiment. The renal vascular resistance (RVR) increased nonsignificantly by an average from 0.9 $\pm$ 0.2 to 2.0 $\pm$ 1.8 % in the period of 60 minutes after venom injection

Group II : animals pretreated with 0.7 ug/kg of prazosin before envenomation.

As shown in Table 6 , intravenous injection of prazosin produced an increase in urine volume and decrease in renal plasma flow (RPF) , renal blood flow (RBF) , glomerular filtration rate (GFR) and renal vascular resistance . After giving Russell's viper venom , the significant reduction in renal hemodynamics were apparent within 30 minutes as follow : renal plasma flow (RPF) from 5.0 $\pm$ 1.5 to 1.3 $\pm$ 0.8 ml/min/kg.bw. renal blood flow (RBF) from 6.6 $\pm$ 1.8 to 1.8 $\pm$ 1.0 ml/min/kg.bw. and glomerular filtration rate (GFR) from 1.1 $\pm$ 0.3 to 0.3 $\pm$ 0.2 ml/min/kg.bw. respectively. A significant increase in renal vascular

Table 5. Effects of Russell's viper venom on renal hemodynamics of the left kidney in five dogs of group I (Mean ± S.D.)

Parameter	0.9 % Saline intravenous infusion						
	Control	NSS	Post - envenomation (RVV 0.1 mg/kg i.v.)				
Time elapse	0-20	20-60	60-90	90-120	120-150	150-180	180-210
V (ul/min/kg.bw)	18.8 ± 12.0	19.1 ± 13.0	anuria	6.4 ± 2.9*	6.0 ± 3.7	5.9 ± 2.6	7.7 ± 4.8
RPF (ml/min/kg.bw)	7.8 ± 1.2	8.0 ± 1.4	"	4.3 ± 2.7	4.2 ± 2.1	4.7 ± 2.0	4.9 ± 1.9
RBF (ml/min/kg.bw)	11.1 ± 2.9	11.3 ± 3.3	"	7.4 ± 6.0	6.4 ± 3.6	6.9 ± 3.1	6.6 ± 2.4
GFR (ml/min/kg.bw)	1.8 ± 0.5	1.9 ± 0.8	"	1.1 ± 0.6	1.0 ± 0.5	1.1 ± 0.4	1.2 ± 0.3
FF (%)	23.5 ± 6.2	24.0 ± 6.6	"	30.3 ± 12.1	24.6 ± 4.5	24.9 ± 5.9	25.4 ± 5.7
RVR (%)	0.8 ± 0.1	0.9 ± 0.2	"	2.0 ± 1.8	1.4 ± 0.64	1.3 ± 0.5	1.5 ± 0.5

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 hemodynamics of the left kidney in five dogs of group II (Mean ± S.D.)

	0.9 % Saline intravenous infusion						
Parameter	Control	Prazosin	Post - envenomation (RVV 0.1 mg/kg i.v.)				
Time elapse (min)	0-20	20-60	60-90	90-120	120-150	150-180	180-210
V (µl/min/kg.bw)	25.8 ± 13.1	29.1 ± 15.3	6.5 ± 3.7*	27.9 ± 26.4	23.3 ± 18.3	15.3 ± 12.9	15.3 ± 11.2
RPF (ml/min/kg.bw)	6.2 ± 3.5	5.0 ± 1.5	1.3 ± 0.8***	4.9 ± 2.9	3.2 ± 1.4	3.4 ± 1.9	3.5 ± 2.1
RBF (ml/min/kg.bw)	8.5 ± 4.9	6.6 ± 1.8	1.8 ± 1.0***	6.7 ± 3.8	4.3 ± 1.8	4.5 ± 2.5	4.7 ± 2.8
GFR (ml/min/kg.bw)	1.3 ± 0.6	1.1 ± 0.3	0.3 ± 0.2***	1.1 ± 0.9	0.8 ± 0.4	0.8 ± 0.4	0.8 ± 0.4
FF (%)	21.6 ± 2.3	22.0 ± 3.8	21.5 ± 1.3	20.0 ± 5.7	24.0 ± 4.2	24.5 ± 3.9	24.4 ± 5.3
RVR (%)	1.5 ± 0.7	1.3 ± 0.4	2.8 ± 2.0*	1.1 ± 0.4	1.9 ± 0.7	2.6 ± 1.8	3.0 ± 2.7

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

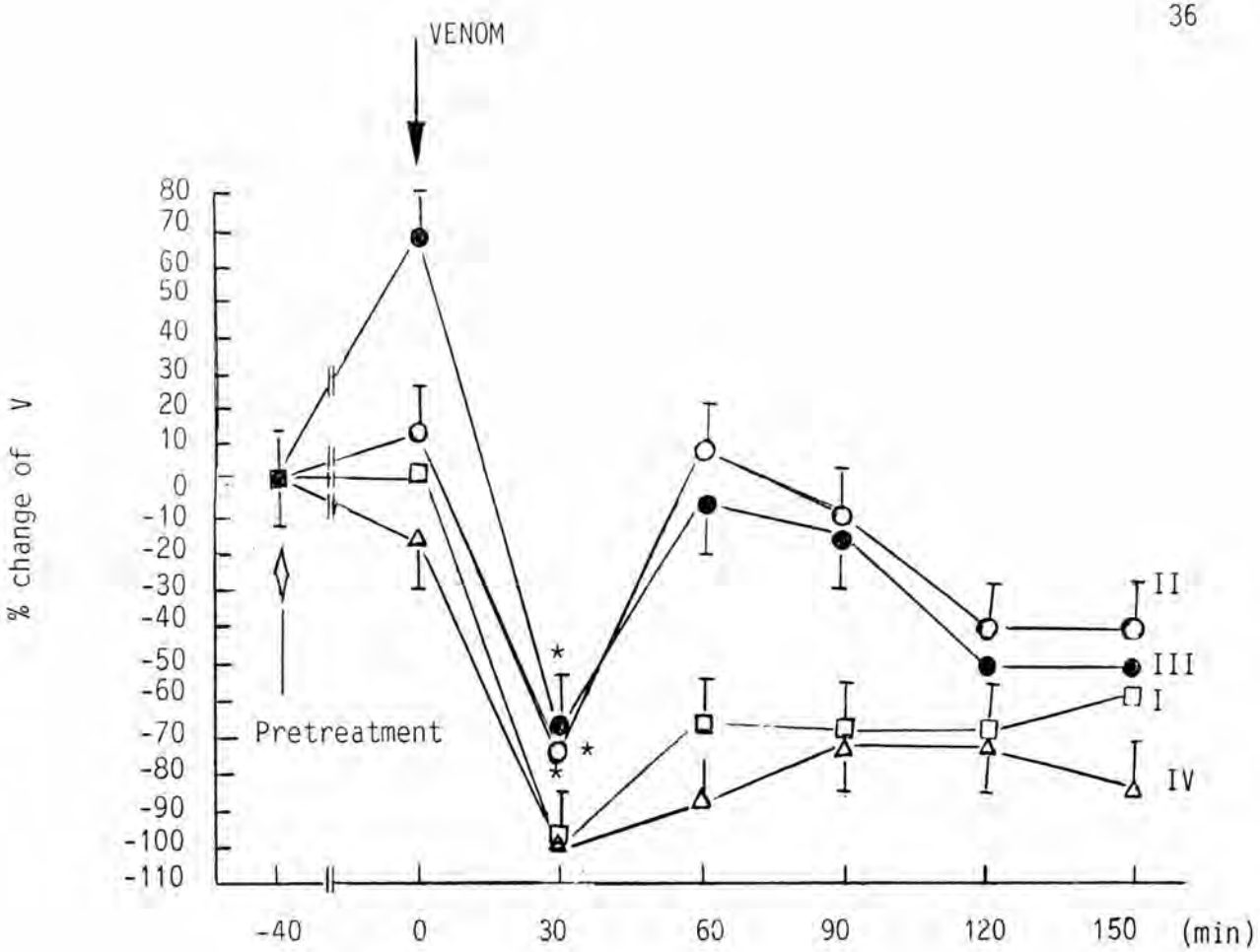

Figure 6 : The effects of intravenous injection of Russell's viper venom on % change of urine flow rate (V) in group I (control group) , group II (animals pretreated with prazosin) , group III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin)

Values are statistically significantly different from contol period of each group , * $p < 0.05$

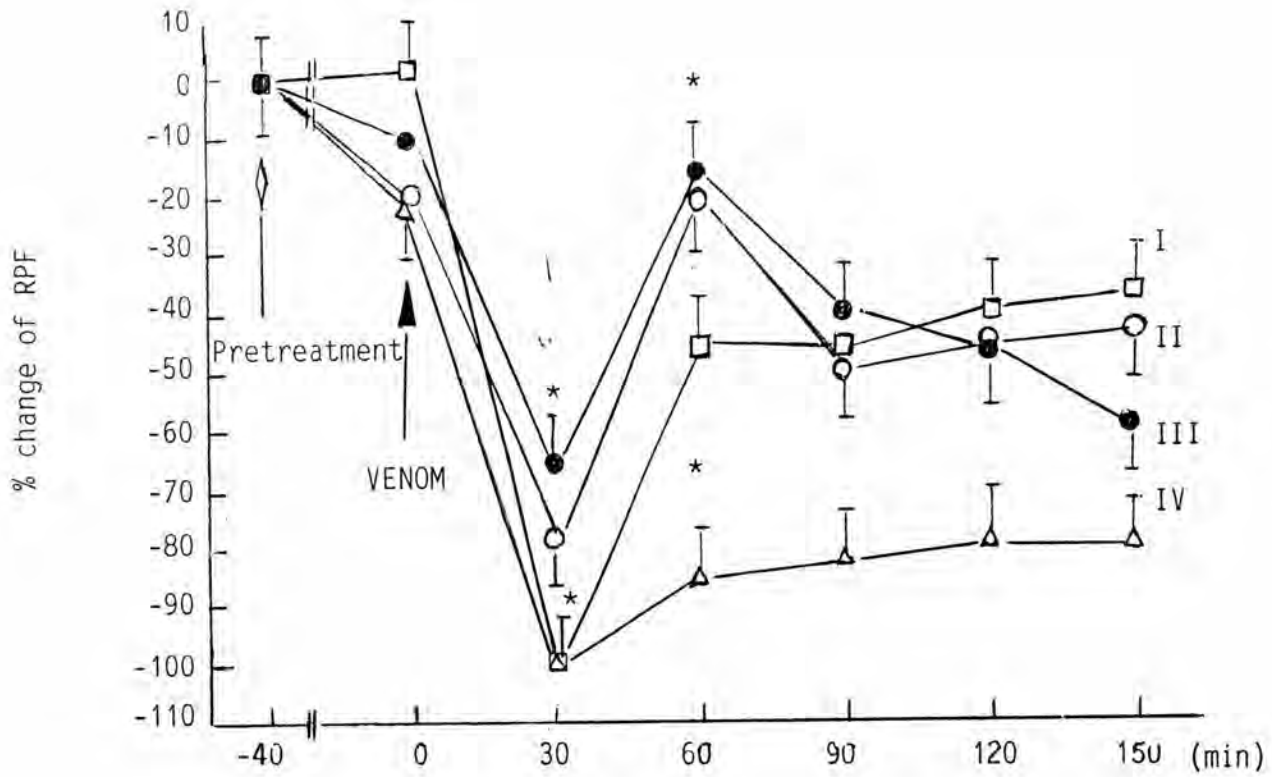

Figure 7 : The effects of intravenous injection of Russell's viper venom on % change of renal plasma flow (RPF) in group I (control group), group II (animals pretreated with prazosin) , group III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin)

Values are statistically significantly different from control period of each group , * $p < 0.05$

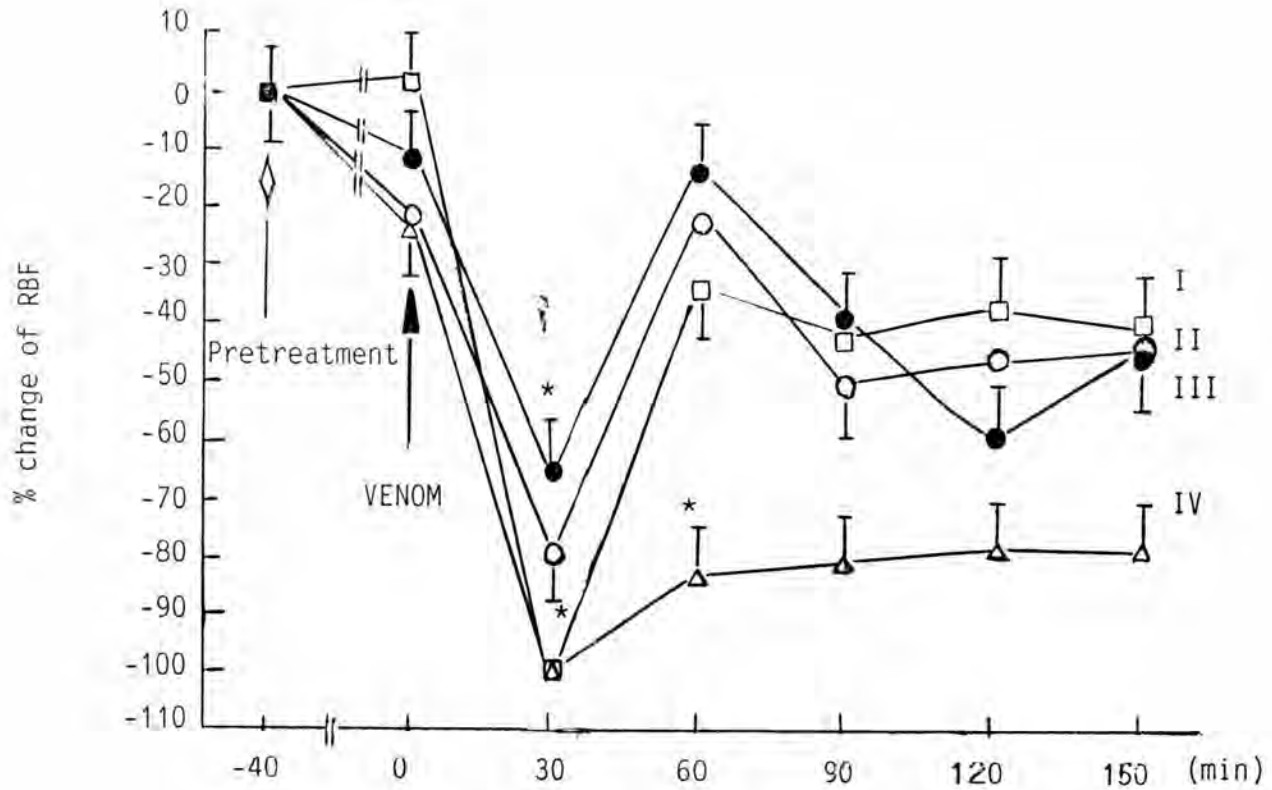

Figure 8 : The effects of intravenous injection of Russell's viper venom on % change of renal blood flow (RBF) in group I (control group) , group II (animals pretreated with prazosin) , group III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin)

Values are statistically significantly different from control period of each group , * $p < 0.05$

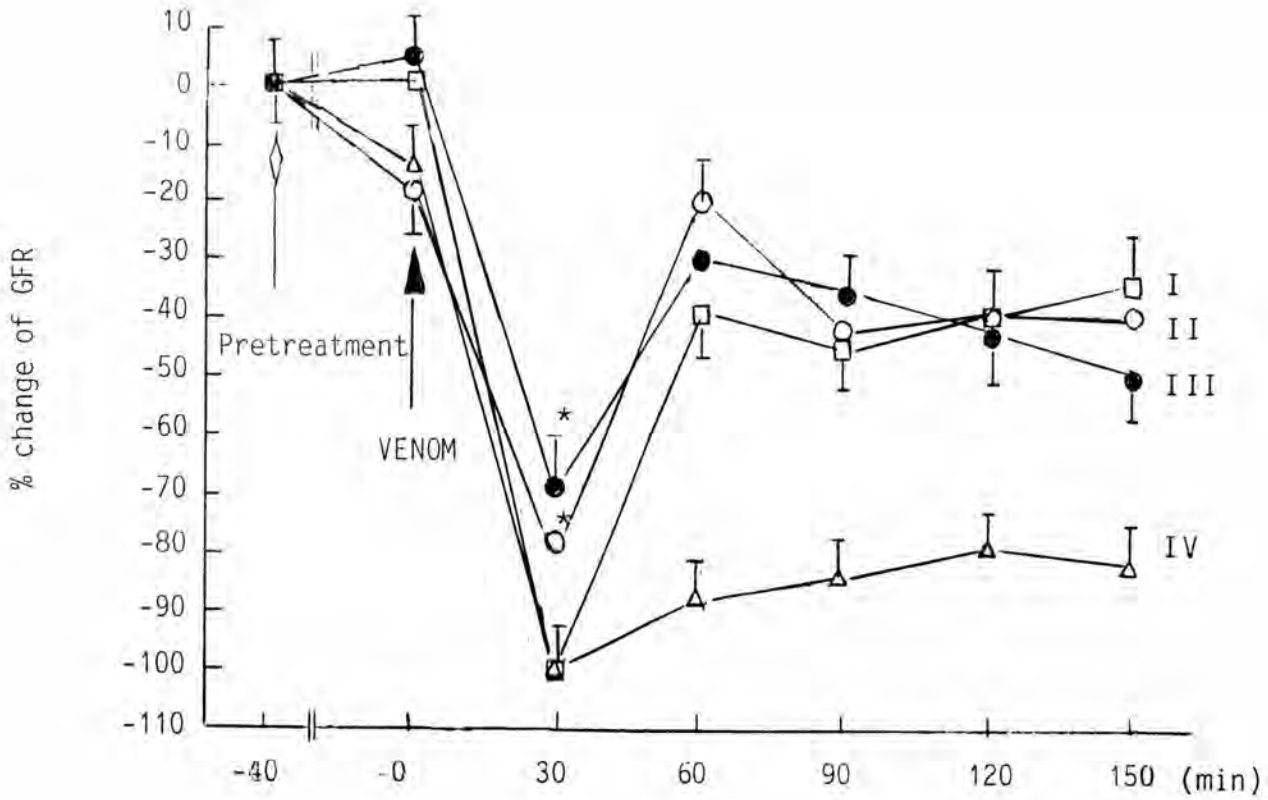

Figure 9 : The effects of intravenous injection of Russell's viper venom on % change of glomerular filtration rate (GFR) in group I (control group), group II (animals pretreated with prazosin) , group III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin)

Values are statistically significantly different from control period of each group , * $p < 0.05$

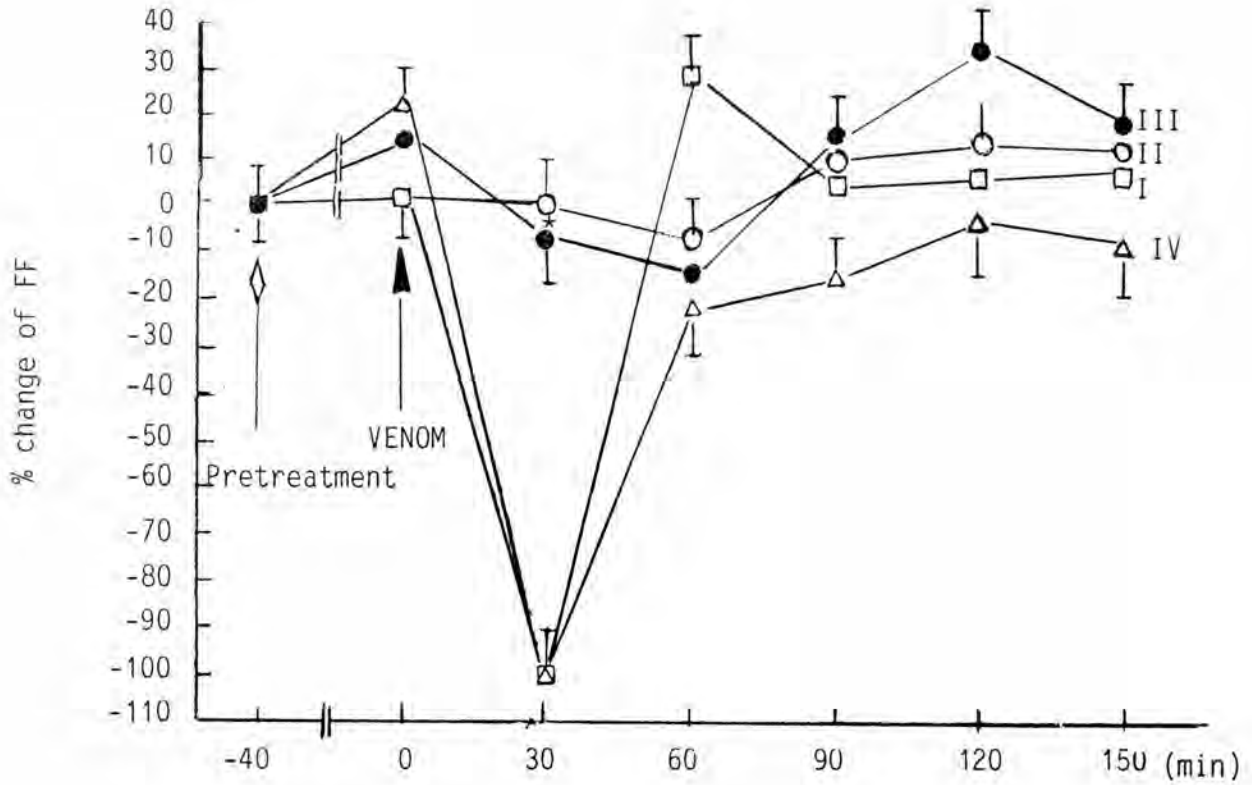

Figure 10 : The effects of intravenous injection of Russell's viper venom on % change of filtration fraction (FF) in group I (control group) , group II (animals pretreated with prazosin) , group III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin)

Values are statistically significantly different from control period of each group , * $p < 0.05$

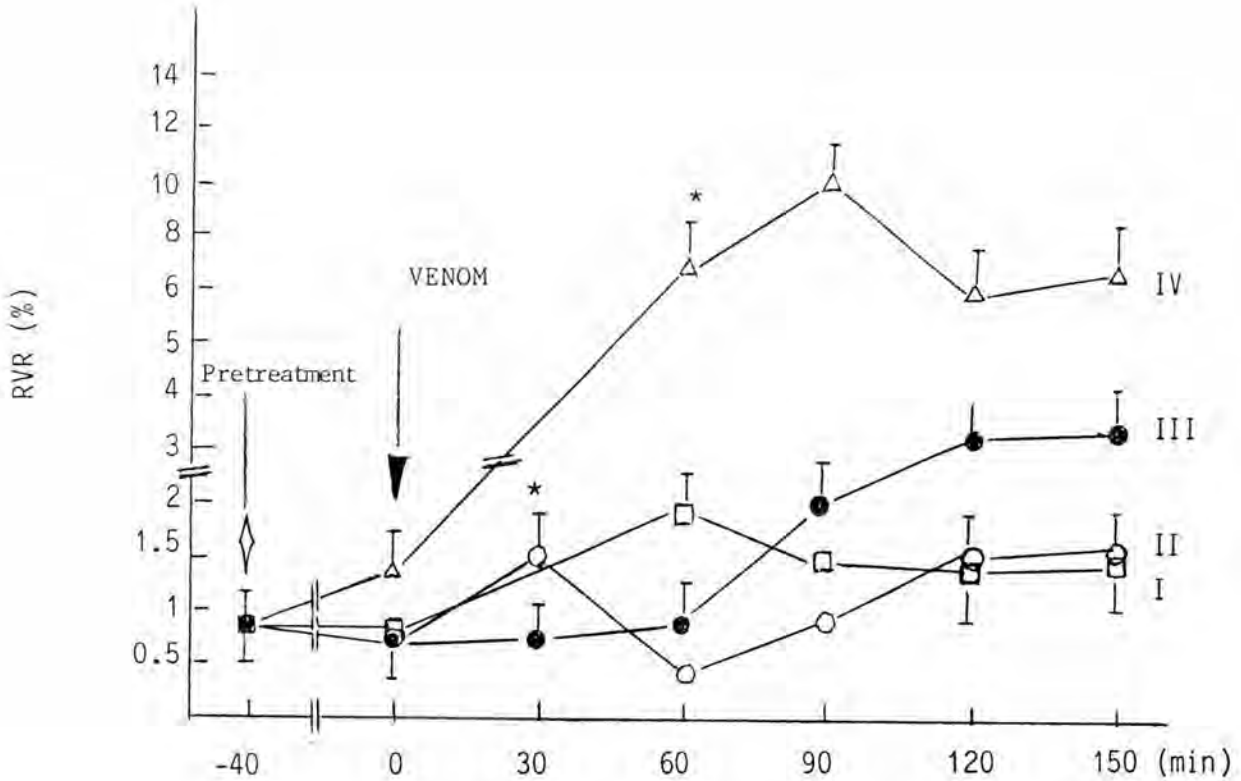

Figure 11 : The effects of intravenous injection of Russell's viper venom on % of renal vascular resistance (RVR) in group I (control group) , group II (animals pretreated with prazosin) , group III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin)

Values are statistically significantly different from control period of each group , * $p < 0.05$

resistance (RVR) from 1.3 ± 0.4 to 2.8 ± 2.0% was observed in 30 minutes following venom injection. However , these parameters were approached to the normal level in the period of 60 minutes after envenomation.

Group III : animals pretreated with 10 mg/kg of enalapril maleate before envenomation.

The results in Table 7 show that pretreatment of enalapril maleate produced diuresis despite a slightly decrease in renal plasma flow (RPF) and renal blood flow (RBF) . After venom injection , there were singificantly decreased in renal plasma flow (RPF) from 6.0 ± 0.9 to 2.2 ± 0.9 ml/min/kg.bw. renal plasma flow (RPF) from 8.0 ± 0.9 to 3.1 ± 1.2 ml/min/kg.bw. and glomerular filtration rate (GFR) from 1.3 ± 0.3 to 0.4 ± 0.2 ml/min/kg.bw. respectively in the period of 30 minutes. Interestingly , a renal vascular resistance (RVR) in animals pretreated with enalapril maleate was not affected by Russell's viper venom injection in the early phase and trend to elevate in the latter phase of envenomation.

Group IV : animals pretreated with 5 mg/kg of indomethacin before envenomation.

The data in Table 8 demonstrate that pretreatment of indomethacin caused a reduction in renal hemodynamics. Intravenously injection of Russell's viper venom produced anuria at the first period and persisted oliguria throughout the experiment coincided with significant reduction in renal plasma flow (RPF) , renal blood flow (RBF) and glomerular

Table 7. Effects of Russell's viper venom on renal hemodynamics of the left kidney in five dogs of group III (Mean ± S.D.)

Parameter	0.9 % Saline intravenous infusion						
	Control	Enalapril	Post - envenomation (RVV 0.1 mg/kg. i.v.)				
Time elapse (min)	0-20	20-60	60-90	90-120	120-150	150-180	180-210
V (µl/min/kg.bw)	27.3 ± 13.8	46.1 ± 21.3	8.6 ± 2.7*	25.8 ± 14.1*	23.3 ± 19.2	13.5 ± 16.7	13.4 ± 15.4
RPF (ml/min/kg.bw	6.6 ± 1.1	6.0 ± 0.9	2.2 ± 0.9**	5.6 ± 2.0*	4.0 ± 2.6*	3.6 ± 3.2***	2.7 ± 1.7*
RBF (ml/min/kg.bw)	9.0 ± 1.8	8.0 ± 0.9	3.1 ± 1.2**	7.8 ± 3.4	5.5 ± 3.8*	3.6 ± 2.4***	4.9 ± 4.6
GFR (ml/min/kg.bw)	1.3 ± 0.1	1.3 ± 0.3	0.4 ± 0.2**	0.9 ± 0.3	0.8 ± 0.4	0.7 ± 0.6	0.7 ± 0.3
FF (%)	19.6 ± 2.0	22.6 ± 5.4	18.2 ± 4.2*	16.7 ± 4.0*	22.6 ± 3.7	26.4 ± 6.1	23.2 ± 4.7
RVR	1.2 ± 0.2	1.4 ± 0.2	1.1 ± 0.6	1.3 ± 0.5	2.5 ± 1.4	3.8 ± 2.7	4.7 ± 5.3

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

Table 8. Effects of Russell's viper venom on renal hemodynamics of the left kidney in five dogs of group IV (Mean ± S.D.)

Parameter	0.9 % Saline intravenous infusion						
	Control	Indomethacin	Post - envenomation (RVV 0.1 mg/kg i.v.)				
Time elapse (min)	0-20	20-60	60-90	90-120	120-150	150-180	180-210
V (µl/min/kg.bw)	29.6 ± 3.0	24.9 ± 14.2	anuria	3.7 ± 4.2*	8.4 ± 14.5	8.1 ± 12.8	4.8 ± 5.4
RPF (ml/min3kg.bw)	6.1 ± 1.4	4.8 ± 1.9	"	1.0 ± 0.8**	1.1 ± 1.3*	1.3 ± 1.2*	1.3 ± 1.2*
RBF (ml/min/kg.bw)	9.1 ± 2.2	7.1 ± 2.6	"	1.6 ± 1.3**	1.8 ± 2.1**	2.0 ± 1.9*	2.0 ± 1.9*
GFR (ml/min/kg.bw)	1.6 ± 0.7	1.4 ± 0.4	"	0.2 ± 0.2**	0.3 ± 0.4**	0.4 ± 0.4*	0.3 ± 0.3*
FF (%)	26.0 ± 6.8	31.9 ± 15.3	"	20.4 ± 7.1	22.4 ± 6.1	25.2 ± 11.4	23.9 ± 11.8
RVR	1.3 ± 0.3	2.1 ± 1.0	"	13.5 ± 10.4*	15.6 ± 16.4	10.7 ± 6.1*	13.3 ± 10.7*

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

filtration rate (GFR). A significant rapidly elevation of renal vascular resistance by an average from 2.1 ± 1.0 to 13.5 ± 10.4 % was apparent in the period of 60 minutes after envenomation and persisted the variable rise at the end of experiment.

Effects of Russell's viper venom on urinary electrolyte excretion (Table 9 - 12 , Figure 12 - 15)

Group I : animals pretreated with 0.9% NSS solution before envenomation.

Effects of Russell's viper venom on urinary electrolyte excretion are shown in Table 9 . In the period of 60 minutes after envenomation , the animals showed markedly significant decrease in urinary sodium excretion ($U_{Na}V$) from 3.5 ± 1.9 to 1.3 ± 1.4 uEq/min/kg.bw. and non significant decrease in urinary potassium excretion (U_kV) , fractional sodium excretion (FE_{Na}) . A markedly increase in fractional potassium excretion (FE_k) was apparent in the 60 minutes of envenomation.

Group II : animals pretreated with 0.7 ug/kg of prazosin before envenomation.

The data in Table 10 indicate that pretreatment of prazosin abolished the effects of Russell's viper venom on urinary electrolyte excretion as compare to control group (group I) in the first 30 minutes. The urinary sodium excretion ($U_{Na}V$) was significantly decreased by average from 8.2 ± 3.4 to 1.4 ± 0.8 uEq/min/kg.bw. in the 30 minutes after envenomation and approach to the control level in the period of 60 and 90 minutes. The non significant changes of urinary potassium excretion (U_kV) and fractional sodium and potassium excretion were noted after envenomation

Table 9. Effects of Russell's viper venom on electrolyte excretion of left kidney in five dogs of group I (Mean ± S.D.)

Parameter	0.9 % Saline intravenous infusion						
	Control	NSS	Post - envenomation (RVV 0.1 mg/kg I.V.)				
Time elapse (min)	0-20	20-60	60-90	90-120	120-150	150-180	180-210
U_{Na} V (μEq/min/kg.bw)	3.3 ± 1.9	3.5 ± 1.9	anuria	1.3 ± 1.5*	0.7 ± 0.6	1.1 ± 1.5	1.0 ± 1.2
U_K V (μEq/min/kg.bw)	0.9 ± 0.4	0.9 ± 0.4	anuria	0.7 ± 0.4	0.6 ± 0.5	0.6 ± 0.3	0.5 ± 0.3
FE_{Na} (%)	1.5 ± 0.9	1.5 ± 0.8	anuria	0.9 ± 0.7	0.6 ± 0.6	0.6 ± 0.6	0.5 ± 0.4
FE_K (%)	16.0 ± 8.7	16.0 ± 7.8	anuria	20.5 ± 6.3*	16.4 ± 9.4	16.1 ± 8.3	18.3 ± 7.6

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

Table 10. Effects of Russell's viper venom on electrlyte excretion of left kidney in five dogs of group II (Mean ± S.D.)

	0.9 % Saline intravenous infusion						
Parameter	Control	Prazosin	Post - envenomation (RVV 0.1 mg/kg i.v.)				
Time elapse (min)	0-20	20-60	60-90	90-120	120-150	150-180	180-210
$U_{Na}V$ (μEq/min/kg.bw)	6.1 ± 2.8	8.2 ± 3.4	1.4 ± 0.8*	6.0 ± 6.5	6.2 ± 6.4	3.6 ± 3.6	3.5 ± 3.0
$U_{K}V$ (μEq/min/kg.bw)	0.5 ± 0.2	1.0 ± 0.4	0.2 ± 0.1	1.1 ± 0.7	0.8 ± 0.5	0.7 ± 0.5	0.7 ± 0.4
FE_{Na} (%)	3.9 ± 2.1	5.9 ± 2.1	4.1 ± 2.8	3.9 ± 2.8	4.5 ± 2.3	3.1 ± 2.3	2.9 ± 1.8
FE_{K} (%)	16.1 ± 5.9	29.3 ± 21.0	22.1 ± 8.2	32.4 ± 11.2*	31.4 ± 6.6*	24.0 ± 10.0*	26.7 ± 18.3

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

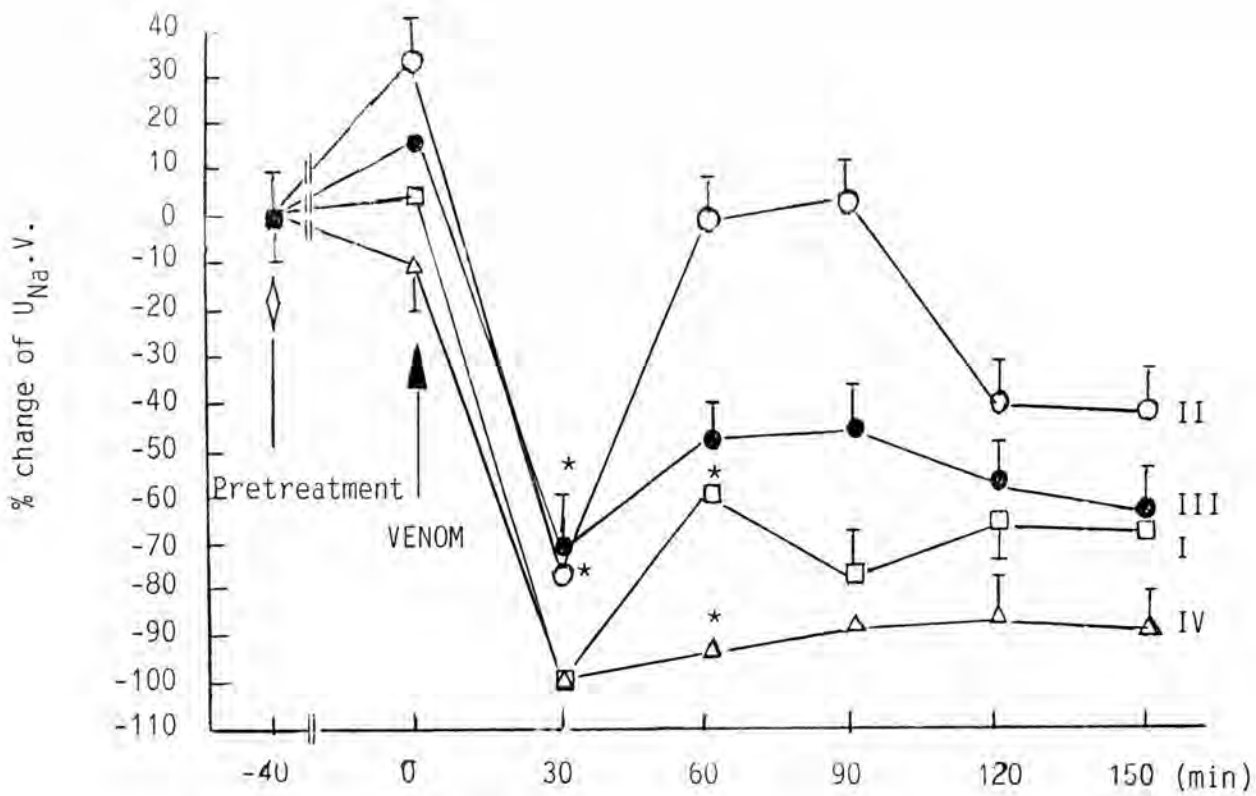

Figure 12 : The effects of intravenous injection of Russell's viper venom on % change of urinary sodium excretion ($U_{Na}.V$) in group I (control group), group II (animals pretreated with prazosin), group III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin)

Values are statistically significantly different from control period of each group , * $p < 0.05$

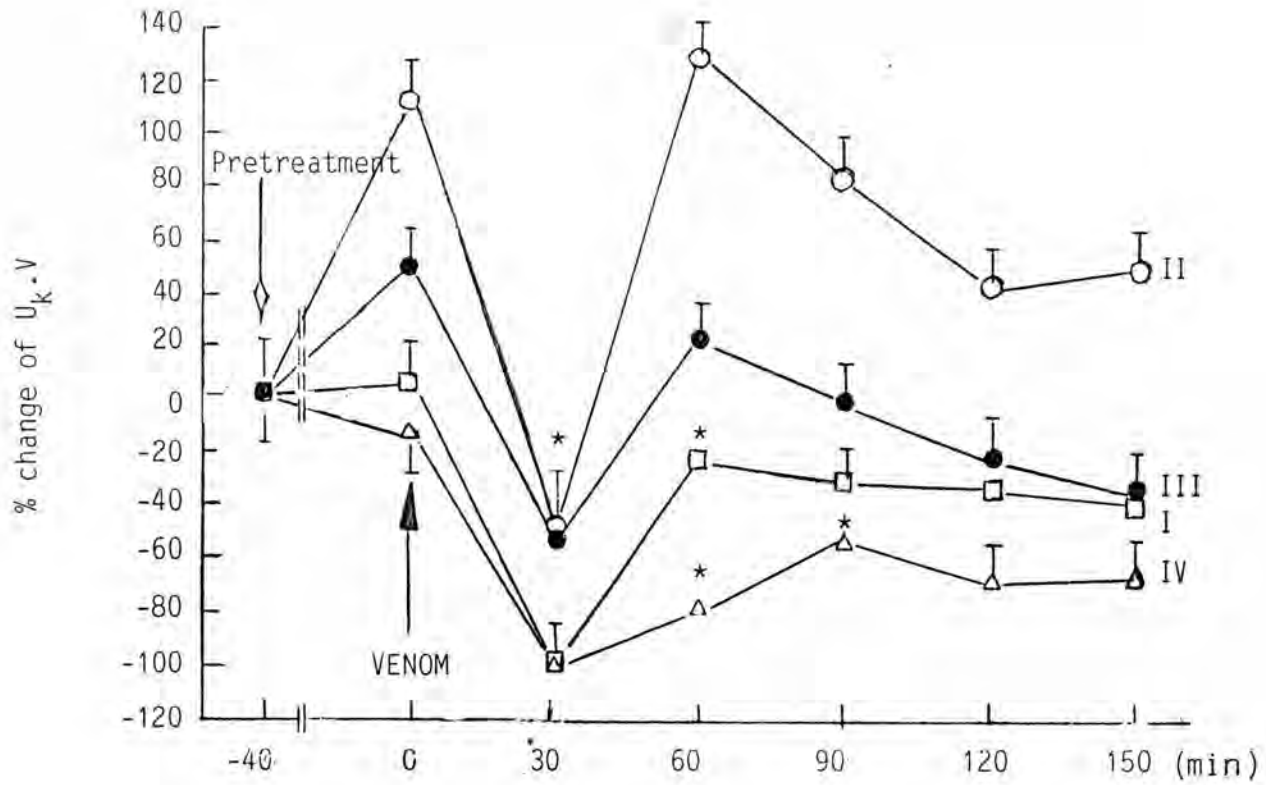

Figure 13 : The effects of intravenous injection of Russell's viper venom on % change of urinary potassium excretion ($U_k.V$) in group I (control group) , group II (animals pretreated with prazosin) , group III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin)

Values are statistically significantly different from control period of each group , * $p < 0.05$

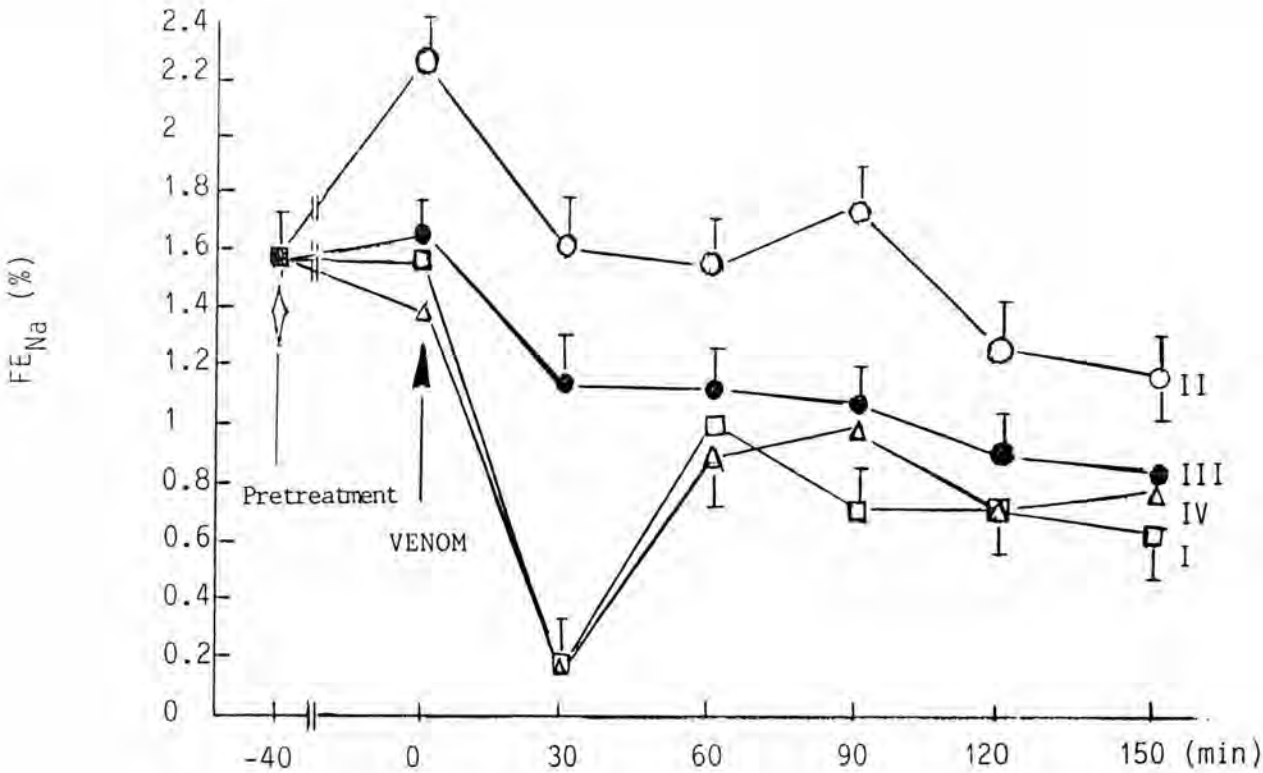

Figure 14 : The effects of intravenous injection of Russell's viper venom on % of fractional sodium excretion (FE_{Na}) in group I (control group) , group II (animals pretreated with prazosin), group III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin)

Values are statistically significantly different from control period of each group , * $p < 0.05$

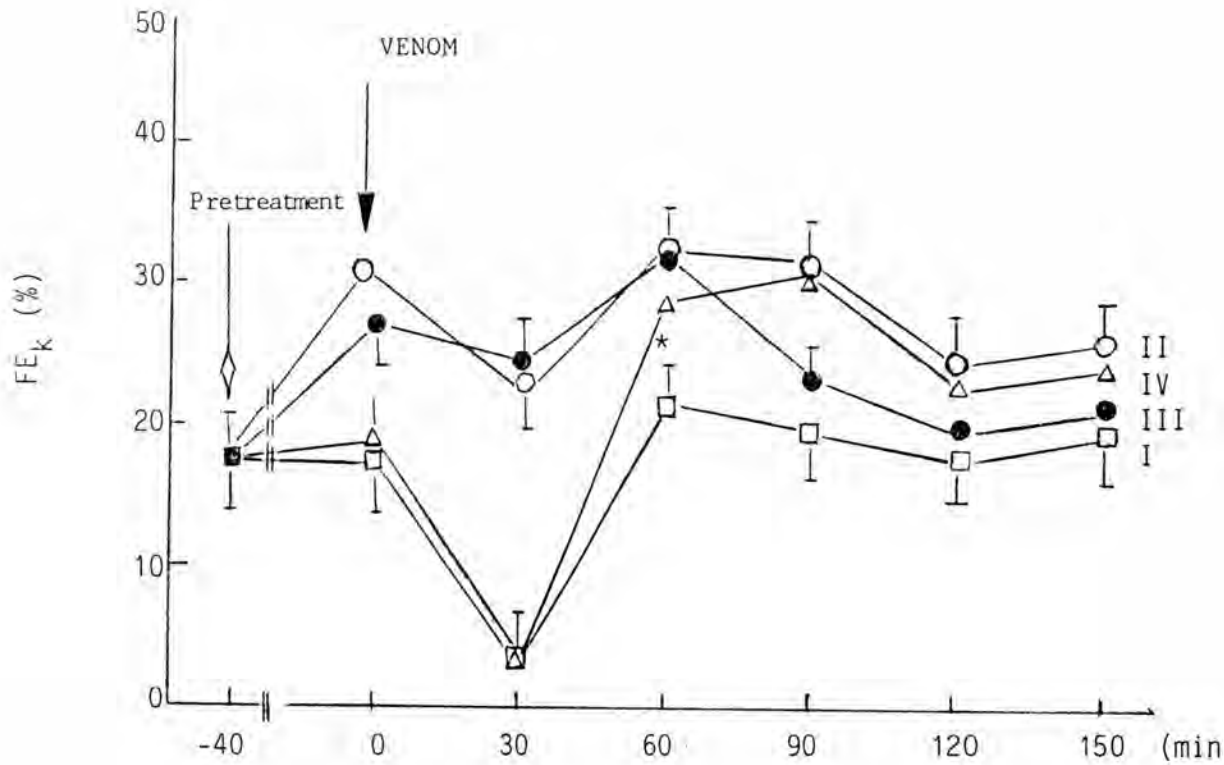

Figure 15 : The effects of intravenous injection of Russell's viper venom on % of fractional potassium excretion (FE_K) in group I (control group) , group II (animals pretreated with prazosin), group III (animals pretreated with enalapril) and group IV (animals pretreated with indomethacin)

Values are statistically significantly different from control period of each group , * $p < 0.05$

Group III : animals pretreated with 10 mg/kg of enalapril maleate before envenomation

The results in Table 11 show that pretreatment of enalapril maleate exhibited an improvement of urinary electrolyte excretion in the early phase of envenomation as well as pretreatment of prazosin in group II . The significant decrease in urinary sodium excretion ($U_{Na}V$) from 8.4 $\pm$ 5.8 to 2.0 $\pm$ 0.7 uEq/min/kg.bw. and urinary potassium excretion ($U_{K}V$) from 1.2 $\pm$ 0.5 to 0.4 $\pm$ 0.2 uEq/min/kg.bw. were observed in the 30 minutes after envenomation but not approach to control level in the 60 or 90 minutes. The fractional sodium and potassium excretions were not significantly changed in this experiment.

Group IV : animals pretreated with 5 mg/kg of indomethacin before envenomation.

The results in Table 12 indicate that administration of indomethacin produced a slightly change in urinary electrolyte excretion. Injection of Russell's viper venom in animals pretreated with indomethacin showed markedly reduction in urinary sodium excretion ($U_{Na}V$) from 5.5 $\pm$3.3 to 0.4 $\pm$ 0.3 uEq/min/kg.bw. while fractional sodium excretion (FE_{Na}) was nonstatistically decreased. The urinary potassium excretion ($U_{K}V$) seemed to increase in the period of 60 and 90 minutes after envenomation.

Table 11. Effects of Russell's viper venom on electrolyte excretion of left kidney in five dogs of group III (Mean ± S.D.)

Parameter	0.9 % Saline intravenous infusion						
	Control	Enalapril	Post - envenomation (RVV 0.1 mg/kg i.v.)				
Time elapse (min)	0-20	20-60	60-90	90-120	120-150	150-180	180-210
U_{Na} V (μEq/min/kg.bw)	7.2 ± 5.1	8.4 ± 5.8	2.0 ± 0.7*	3.7 ± 3.1	3.9 ± 3.8	3.0 ± 4.2	2.6 ± 3.7
U_K V (μEq/min/kg.bw)	0.8 ± 0.4	1.2 ± 0.5	0.4 ± 0.2*	1.0 ± 0.4	0.8 ± 0.5	0.6 ± 0.6	0.5 ± 0.5
FE_{Na} (%)	4.5 ± 2.3	4.8 ± 3.1	3.2 ± 3.2	3.2 ± 2.3	3.0 ± 2.6	2.5 ± 2.9	2.3 ± 2.3
FE_K (%)	20.0 ± 11.4	33.7 ± 17.7	29.7 ± 12.9	40.3 ± 16.7*	28.7 ± 12.5	23.4 ± 14.4	25.4 ± 13.9

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

Table 12. Effects of Russell's viper venom on electrolyte excretion of left kidney in five dogs of group IV (Mean ± S.D.)

Parameter	0.9 % Saline intravenous infusion						
	Control	Indomethacin	Post - envenomation (RVV 0.1 mg/kg i.v.)				
Time elapse	0-20	20-60	60-90	90-120	120-150	150-180	180-210
U_{Na} V (μEq/min/kg.bw)	6.2 ± 2.1	5.5 ± 3.3	anuria	0.4 ± 0.3*	0.7 ± 0.9*	0.8 ± 1.1	0.6 ± 0.8
U_{K} V (μEq/min/kg.bw)	1.1 ± 0.4	1.0 ± 0.3	anuria	0.2 ± 0.2	0.5 ± 0.9	0.4 ± 0.5	0.4 ± 0.5
FE_{Na} (%)	3.3 ± 1.4	2.9 ± 1.3	anuria	1.8 ± 1.1	2.0 ± 0.9	1.3 ± 1.0	1.5 ± 1.1
FE_{K} (%)	19.8 ± 4.2	21.9 ± 7.1	anuria	35.7 ± 15.5	38.2 ± 12.5	27.3 ± 20.0	29.1 ± 12.3

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