

## CHAPTER IV



### Results

#### Effects of Russell's viper venom on general circulation.

Group I : Intravascular volume expansion.

An increase in plasma volume in the present experiment was performed by the infusion of dextran solution from the mean value 50.49 ml/kg. to 68.93 ml/kg. ( $P < 0.01$ ) whereas packed cell volume significantly decreased. During intravascular volume expansion before envenomation, mean arterial pressure, heart rate and cardiac output significantly increased. During intravascular volume expansion, intravenous injection of Russell's viper venom produced a marked change in general circulation (Table I). Mean arterial blood pressure (MAP) decreased significantly from  $141.59 \pm 9.16$  to  $113.43 \pm 22.30$  mm.Hg. ( $P < 0.05$ ) within 15 minute and returned to the level before volume expansion in 30 minute period. Heart rate (HR) did not changed while packed cell volume (PCV) significantly increased from  $22.83 \pm 4.96$  to  $27.67 \pm 5.32\%$  ( $P < 0.01$ ) as compared to the level before volume expansion within 15 minutes. Cardiac output (CO) significantly decreased from  $253.43 \pm 56.17$  to  $109.83 \pm 20.11$  ml/min/kg in 1 hour ( $P < 0.01$ ). after envenomation. Plasma volume (PV) and blood volume (BV) increased in the period of 15 minutes and decreased to the level of control in 60 minutes. Total peripheral resistance (TPR) increased 64 and 118.7% in 15 and 60 minutes respectively.

Group II : The intestinal and splenic blood vessels occlusion.

An increase in heart rate from the mean value of 178 to 204 beat/min ( $P < 0.05$ ) and decreased in packed cell volume from the value of 38.67 to 31.00 % ( $P < 0.05$ ) were recorded during the occlusion of the intestinal and splenic blood vessels. Intravenous injection of Russell's viper venom produced a marked change in general circulation (Table II). Mean arterial blood pressure (MAP) significantly decreased from  $97.17 \pm 30.74$  to  $40.83 \pm 14.74$  mm.Hg. ( $P < 0.01$ ) within 15 minutes and remained constant over 120 minutes. Heart rate (HR) continuously decreased from  $204 \pm 28$  to  $187 \pm 15$  beat/min in 60 minutes. Packed cell volume and cardiac output decreased significantly within 15 minute period after envenomation. Plasma volume, blood volume slightly decreased. Total peripheral resistance decreased by approximately 25% over 60 minutes.

In comparison the result between group I and group II. In group I mean arterial blood pressure decreased in 15 minutes and raised up to the control level but in group II mean arterial blood pressure decreased within the period of 15 minutes and remained lower over the period of 120 minutes after envenomation (Fig.1). Heart rate of group I did not significantly decrease in 60 minutes while group II decreased in 30 minute period (Fig.2). PCV that lowered by the volume expansion in group I increased to the control level. In group II, PCV decreased in 15 minutes and stayed constant over 120 minutes (Fig.3). Cardiac output markedly decreased in both groups (Fig.4). Plasma volume and blood volume in group I increased

in 15 minutes and returned to the normal level in 60 minutes; In group II it slightly decreased in 15 minutes and returned to the control level in 60 minutes after envenomation (Fig.5). The total peripheral resistance increased in group I whereas it decreased in group II (Fig.6).



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**Table I** Effects of intravenous injection of 0.1 mg/kg.bw. of Russell's viper venom on general circulation during intravascular volume expansion in six dogs.

| Parameter          | Pre-volume expansion | post volume expansion + venom injection |                  |                  |                  |                  |
|--------------------|----------------------|-----------------------------------------|------------------|------------------|------------------|------------------|
|                    |                      | 0 min                                   | 15 min           | 30 min           | 60 min           | 120 min          |
| MAP (mm.Hg.)       | 126.37<br>+18.08     | 141.59<br>+ 9.16                        | 113.43<br>+22.30 | 129.11<br>+20.12 | 133.56<br>+10.25 | 131.50<br>+ 5.37 |
| HR (beat/min)      | 174.00<br>+31.52     | 188.83<br>+23.95                        | 187.33<br>+32.59 | 177.00<br>+44.12 | 177.00<br>+49.33 | 200.00<br>+30.48 |
| PCV (%)            | 28.83<br>+ 7.00      | 22.83<br>+ 4.96                         | 27.67<br>+ 5.32  | 27.67<br>+ 5.68  | 27.00<br>+ 6.00  | 27.17<br>+ 5.31  |
| CO (ml/min/kg.bw.) | 192.73<br>+93.89     | 253.43<br>+56.17                        | 163.61<br>+84.53 | -                | 109.38<br>+20.11 | -                |
| PV (ml/kg.bw.)     | 50.49<br>+17.20      | 68.93<br>+20.12                         | 89.40<br>+33.36  | -                | 62.28<br>+35.66  | -                |
| BV (ml/kg.bw.)     | 69.78<br>+18.67      | 88.95<br>+23.95                         | 123.64<br>+46.98 | -                | 85.02<br>+47.83  | -                |
| TPR (%)            |                      | 100.00                                  | 164.91<br>+63.55 | -                | 217.59<br>+79.43 | -                |

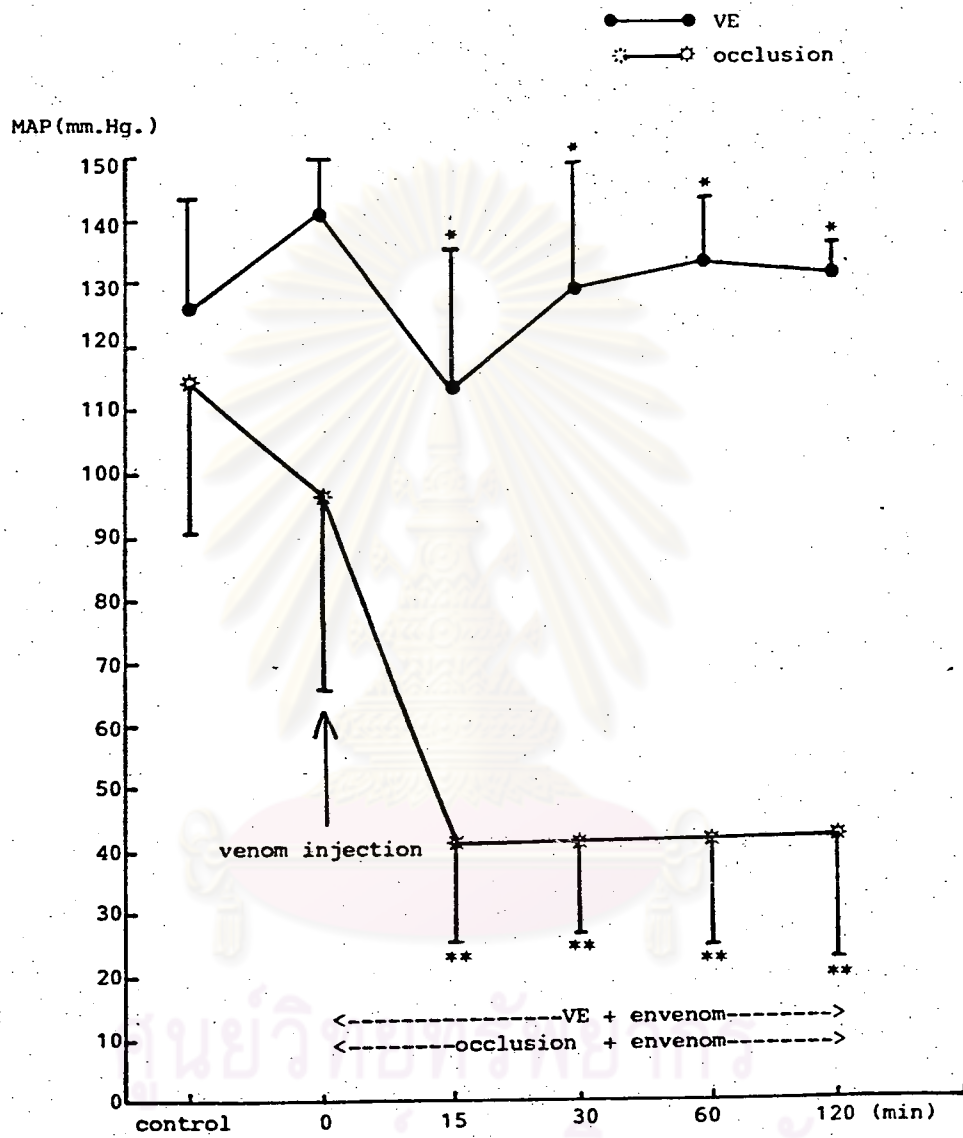
**Abbreviation** : MAP,mean arterial blood pressure;HR,heart rate;PCV,packed cell volume;PV,plasma volume;BV,blood volume;TPR,total peripheral resistance.Results are given as mean + S.D., P-value with respected to the level at 0 min. \*P<0.05, \*\*P<0.01,NS= not significant.



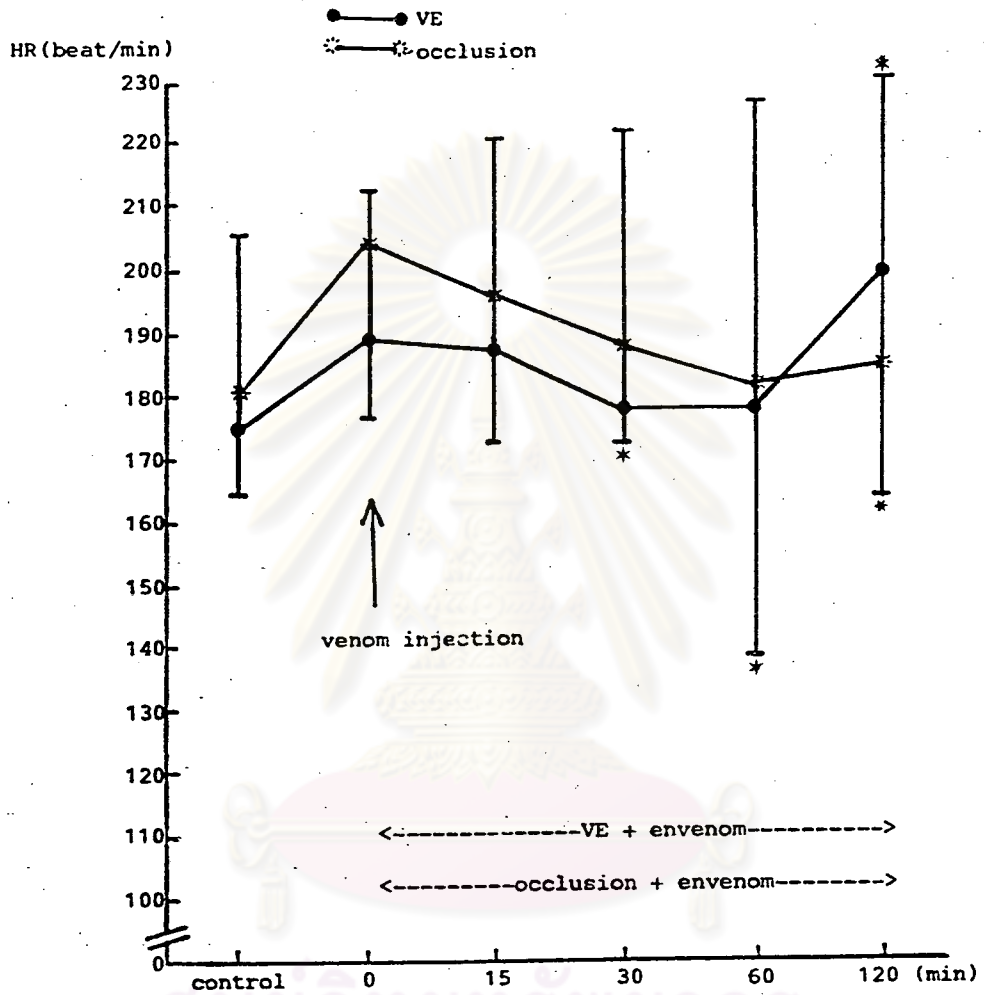
**Table II** Effects of intravenous injection of 0.05 mg/kg.bw.of Russell's viper venom on the general circulation of six dogs during intestinal and splenic blood vessels occlusion.

| Parameter          | Pre-<br>volume<br>expansion | occlusion + venom injection |                 |                 |                 |                 |
|--------------------|-----------------------------|-----------------------------|-----------------|-----------------|-----------------|-----------------|
|                    |                             | 0 min                       | 15 min          | 30 min          | 60 min          | 120 min         |
| MAP (mm.Hg.)       | 116.17<br>+25.09            | 97.17<br>+30.74             | 40.83<br>+14.74 | 42.17<br>+15.83 | 42.17<br>+17.39 | 41.50<br>+18.90 |
| HR (beat/min)      | 178<br>+14                  | 204<br>+28                  | 195<br>+23      | 187<br>+15      | 181<br>+43      | 187<br>+23      |
| PCV (%)            | 38.67<br>+ 7.12             | 31.00<br>+ 6.16             | 26.67<br>+ 6.41 | 26.67<br>+ 6.41 | 26.33<br>+ 7.71 | 28.20<br>+ 5.97 |
| CO (ml/min/kg.bw.) | 127.38<br>+24.04            | 106.09<br>+38.37            | 59.85<br>+16.35 | -               | 64.04<br>+19.54 | -               |
| PV (ml/kg.bw.)     | 49.06<br>+ 4.17             | 49.15<br>+16.12             | 39.68<br>+16.35 | -               | 42.68<br>+12.35 | -               |
| BV(ml/kg.bw.)      | 79.95<br>+ 8.01             | 71.76<br>+24.94             | 52.12<br>+20.96 | -               | 58.74<br>+19.54 | -               |
| TPR (%)            |                             | 100.00                      | 75.27<br>+38.38 | -               | 75.52<br>+58.22 | -               |

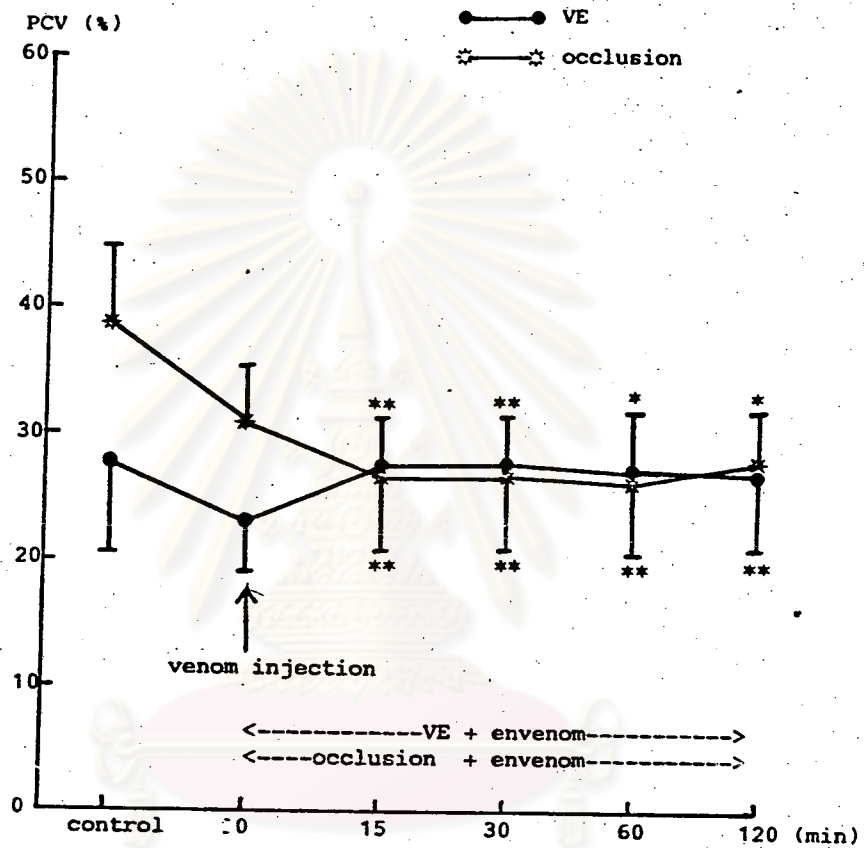
Abbreviation : are defined in Table I.



**Figure 1** : The effects of intravenous injection of Russell's viper venom on mean arterial blood pressure (MAP).The value are mean + S.D.,P-value with respected to the level at 0 min, \*P<0.05,\*\*P<0.01,VE=The intravascular volume expansion., occlusion=The intestinal and splenic blood vessels occlusion.

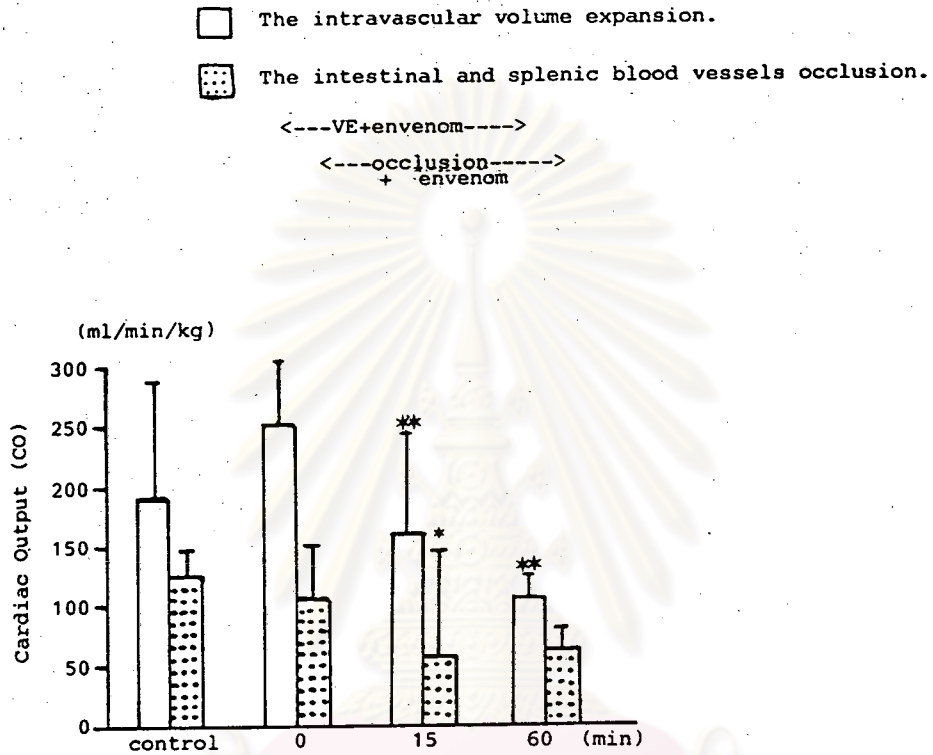


**Figure 2** :The effects of intravenous injection of Russell's viper venom on heart rate (HR).The values are mean  $\pm$  S.D.,P-value with respected to the level at 0 min, \*P < 0.05,\*\*P<0.01,VE-The intravascular volume expansion.occlusion-The intestinal and splenic blood vessels occlusion.



**Figure 3 :** The effects of intravenous injection of Russell's viper venom on packed cell volume (P C V ). The values are mean  $\pm$  S.D., P-value with respected to the level at 0 min, \* $P < 0.05$ , \*\* $P < 0.01$ , VE = The intravascular volume expansion., occlusion = The intestinal and splenic blood vessels occlusion.

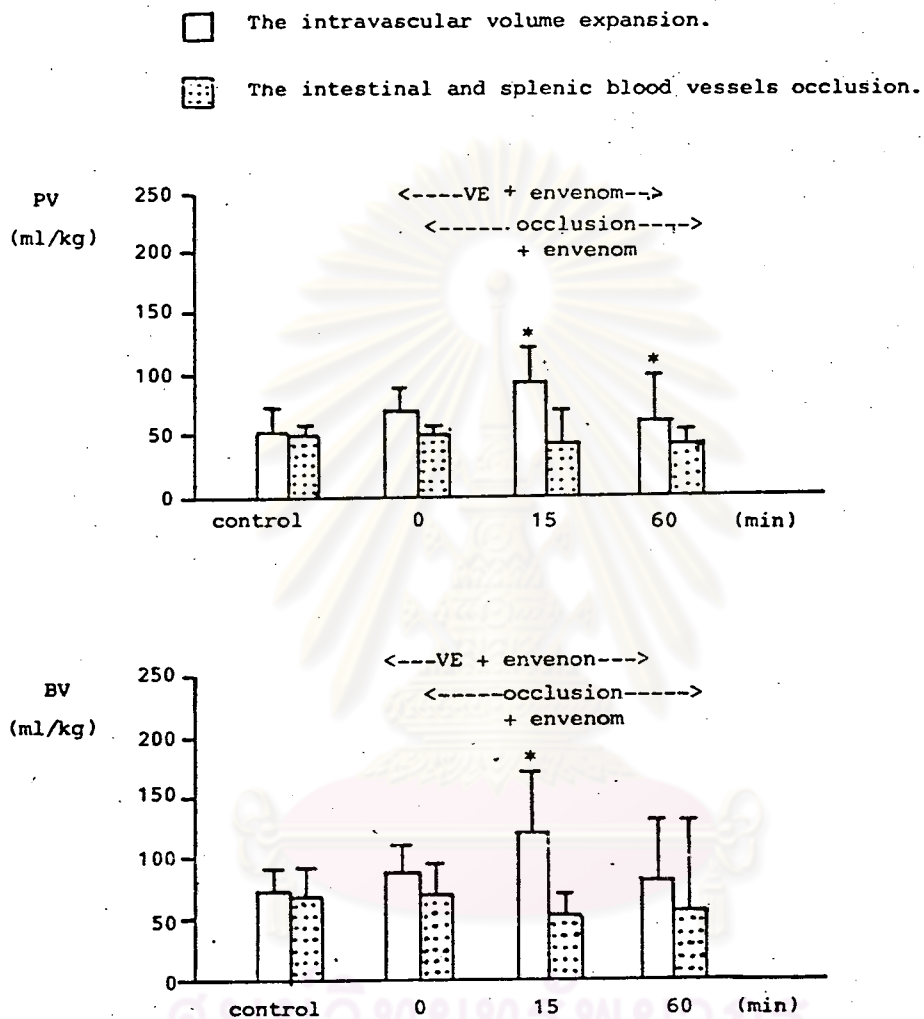




**Figure 4 :** The effects of intravenous injection of Russell's viper venom on cardiac output (CO) at 0, 15, and 60 min. after envenomation. The values are mean  $\pm$  S.D., P-value with respected to the level at 0 min., \*P<0.05, \*\*P<0.01.

VE = The intravascular volume expansion.  
 occlusion = The intestinal and splenic blood vessels occlusion.

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**Figure 5 :** The effects of intravenous injection of Russell's viper venom on plasma volume (PV), (upper panel) and blood volume (BV), (lower panel). The values are mean  $\pm$  S.D., P-value with respect to the level at 0 min., \* $P < 0.05$ , \*\* $P < 0.01$ .

VE = The intravascular volume expansion.

occlusion = The intestinal and splenic blood vessels occlusion.

- The intravascular volume expansion
- ▣ The intestinal and splenic blood vessels occlusion.

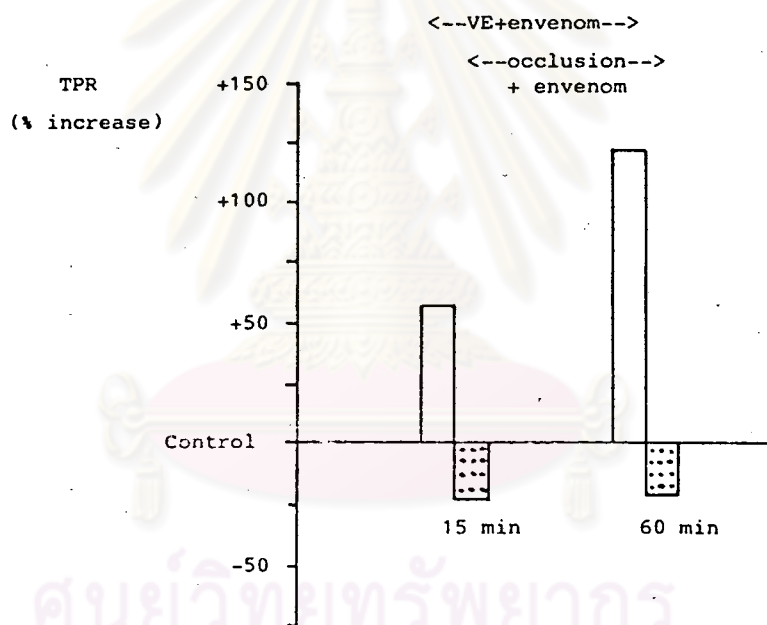


Figure 6 : Percentage changes in total peripheral resistance. (TPR). by the effect of intravenous injection of Russell's viper venom.



Effects of Russell's viper venom on renal functions.

Group I : Intravascular volume expansion.

The results in table III showed that after envenomation the rate of urine flow (V) decreased rapidly but transiently from  $224.49 \pm 170.82$  to  $38.57 \pm 41.10$  ( $P < 0.05$ ) and then slight returned in 30 minutes to  $80.77 \pm 62.35$  ul/min/kg.bw. After 30 minutes, it continued to decrease again reached  $57.02 \pm 40.31$  ul/min/kg.bw. in 120 minutes. Glomerular filtration rate (GFR) significantly decreased from  $3.16 \pm 0.74$  to  $1.08 \pm 1.22$  ml/min/kg.bw. in 15 minutes ( $P < 0.05$ ). Renal plasma flow (RPF) and renal blood flow (RBF) decreased significantly ( $P < 0.01$ ) in 15 minutes and maintained at low level over 120 minutes. Filtration fraction (FF) maintained in first 15 minutes and showed the tendency to increase. Renal fraction (R.F.) decreased significantly from  $12.81 \pm 4.09$  to  $4.76 \pm 5.47\%$  in 15 minutes ( $P < 0.05$ ) and returned to the initial level in 60 minutes. Renal vascular resistance (RVR) increased approximately 66%

The data in Table IV and Table V showed that plasma concentrations of sodium, potassium, chloride and osmolality were not altered. Electrolyte excretion did not significantly decrease. Fractional excretion of sodium and chloride decreased by approximately 66% and 78% respectively at the end of the experiment. Fractional excretion of potassium increased by approximately 85% at 15 minutes and then fell to the initial level in 30 minutes. Urinary osmolar excretion and osmolar clearance decreased by approximately 70% in the period of 120 minutes. Free water clearance

after envenomation approximately by 99% after 120 minutes.

Group II : Intestinal and splenic blood vessels occlusion.

Effect of Russell's viper venom on renal function during intestinal and splenic blood vessels occlusion are shown in Table VI. The reduction of urine flow rate (87%), glomerular filtration rate (87%), renal plasma flow (87%) and renal blood flow (88%) were recorded after venom injection until the end of experimental period. Filtration fraction decreased insignificantly, while a significant decrease of renal fraction in 15 minutes. Renal vascular resistance increased by approximately 368% in 60 minutes after envenomation.

Table VII and Table VIII showed the effects of Russell's viper venom on renal electrolyte excretion. Plasma concentrations of sodium, potassium, chloride and osmolality were constant throughout the experiment, while urinary concentration of sodium, potassium, chloride and osmolality did not significantly decrease. Fractional excretion of sodium decreased throughout the experiment but potassium and chloride decreased in 15 minutes and tended to increase to the control level. Urinary osmolar excretion and osmolar clearance decreased by approximately 83%, and 83% respectively. Free water clearance increased by approximately 85%.

Comparing the effect of Russell's viper venom on renal functions during intravascular volume expansion and the intestinal and splenic blood vessels occlusion. After venom injection the urine flow rate, renal plasma flow and glomerular filtration rate decreased in both group (Fig.7, Fig.8, Fig.9). Filtration fraction in group I

did not change, while in group II decreased in 15 minutes period. Renal fraction in both groups decreased in 15 minutes period but group I returned to the level of pre-venom injection in 60 minutes (Fig.10).

Plasma concentration of sodium, potassium and chloride were not altered throughout the experimental period in both groups. Plasma osmolality and urine osmolality did not significantly change (Fig.11; Fig.12). Urinary excretion and fractional excretion of sodium decreased in group I while in group II the slight decline was observed after envenomation from the low level of the control period (Fig.13). Urinary excretion of potassium in both groups decreased but fractional excretion did not change (Fig.14). Urinary excretion and fractional excretion of chloride markedly decreased in group I whereas it slightly decreased from the low level of the control period in group II (Fig.15).

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**Table III** Effects of intravenous injection of 0.1 mg/kg.bw.of Russell's viper venom on renal functions during intravascular volume expansion in six dogs.

| Parameter           | Pre-<br>volume<br>expansion | post volume expansion + venom injection |                 |                 |                   |                 |
|---------------------|-----------------------------|-----------------------------------------|-----------------|-----------------|-------------------|-----------------|
|                     |                             | 0 min                                   | 15 min          | 30 min          | 60 min            | 120 min         |
| V (ul/min/kg.bw.)   | 26.60<br>+ 7.22             | 224.49<br>+170.82                       | 38.57<br>+41.10 | 80.77<br>+62.35 | 66.01<br>+55.44   | 57.02<br>+40.31 |
| GFR (ml/min/kg.bw.) | 3.51<br>+ 1.39              | 3.16<br>+ 0.74                          | 1.08<br>+ 1.22  | 1.79<br>+ 1.03  | 1.74<br>+ 0.50    | 1.37<br>+ 0.25  |
| RPF (ml/min/kg.bw.) | 14.57<br>+ 3.23             | 23.70<br>+ 6.90                         | 4.57<br>+ 5.39  | 9.54<br>+ 4.86  | 9.06<br>+ 1.61    | 7.58<br>+ 4.00  |
| RBF (ml/min/kg.bw.) | 20.41<br>+ 3.79             | 31.12<br>+10.30                         | 6.54<br>+ 7.79  | 12.97<br>+ 6.53 | 15.00<br>+ 6.58   | 10.76<br>+ 6.33 |
| F.F.(%)             | 25.84<br>+ 7.79             | 17.89<br>+ 9.96                         | 19.15<br>+15.79 | 19.47<br>+12.36 | 20.37<br>+ 8.92   | 28.20<br>+21.59 |
| R.F. (%)            | 10.04<br>+ 7.41             | 12.81<br>+ 4.09                         | 4.76<br>+ 5.47  | -               | 11.00<br>+ 3.29   | -               |
| RVR (%)             | -                           | 100.00                                  | -               | -               | 166.11<br>+142.58 | -               |

**Abbreviation :** V;urine flow rate;GFR,glomerular filtration rate;RPF,renal plasma flow;RBF,renal blood flow; F.F.,filtration fraction; R.F.,renal fraction;RVR,renal vascular resistance.Results are given as mean +S.D.,P-values with respected to the level at 0 min.,\*P<0.05,\*\*P<0.01,NS=not significant.

**Table IV** Effects of intravenous injection of 0.1 mg/kg.bw.of Russell's viper venom on renal hemodynamics during intravascular volume expansion in six dogs.

| Parameter            | Pre-<br>volume<br>expansion | post volume expansion + venom injection |        |        |        |         |
|----------------------|-----------------------------|-----------------------------------------|--------|--------|--------|---------|
|                      |                             | 0 min                                   | 15 min | 30 min | 60 min | 120 min |
| $P_{Na}$ (mEq/L)     | 146.67                      | 143.50                                  | NS     | NS     | NS     | NS      |
|                      | + 3.88                      | + 2.57                                  | + 2.56 | + 1.10 | + 2.43 | + 1.49  |
| $P_K$ (mEq/L)        | 3.37                        | 3.28                                    | NS     | NS     | NS     | NS      |
|                      | + 0.52                      | + 0.39                                  | + 0.31 | + 0.38 | + 0.45 | + 0.19  |
| $P_{Cl}$ (mEq/L)     | 115.50                      | 120.67                                  | NS     | NS     | NS     | NS      |
|                      | + 6.50                      | + 4.00                                  | + 3.35 | + 5.35 | + 6.16 | + 6.46  |
| $P_{Osm}$ (mOsm/kg.) | 285.32                      | 287.28                                  | NS     | NS     | NS     | NS      |
|                      | +10.67                      | +13.47                                  | +14.77 | +15.95 | +11.87 | +13.81  |

**Abbreviation** :  $P_{Na}$ , plasma concentration of sodium;  $P_K$ , plasma concentration of potassium;  $P_{Cl}$ , plasma concentration of chloride;  $P_{Osm}$ , plasma osmolality. P-values with respected to the level at 0 min., NS=not significant.

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**Table V** Effects of intravenous injection of 0.1 mg/kg.bw.of Russell's viper venom on renal hemodynamics during intravascular volume expansion in six dogs.

| Parameter                        | Pre-volume expansion | post volume expansion + venom injection |                        |                       |                       |                       |
|----------------------------------|----------------------|-----------------------------------------|------------------------|-----------------------|-----------------------|-----------------------|
|                                  |                      | 0 min                                   | 15 min                 | 30 min                | 60 min                | 120 min               |
| $U_{Na}^V$<br>(uEq/min/kg.bw.)   | 5.26<br>+ 1.47       | 19.17<br>+ 9.77                         | NS<br>4.85<br>+ 3.09   | NS<br>2.73<br>+ 1.77  | NS<br>2.14<br>+ 1.15  | NS<br>3.80<br>+ 0.52  |
| $U_K^V$<br>(uEq/min/kg.bw.)      | 2.37<br>+ 1.04       | 3.89<br>+ 0.68                          | NS<br>2.29<br>+ 1.56   | NS<br>2.86<br>+ 2.22  | NS<br>1.98<br>+ 0.92  | NS<br>1.64<br>+ 0.56  |
| $U_{Cl}^V$<br>(uEq/min/kg.bw.)   | 5.93<br>+ 2.50       | 21.04<br>+11.77                         | NS<br>4.05<br>+ 2.30   | NS<br>2.62<br>+ 1.52  | NS<br>1.91<br>+ 1.38  | NS<br>2.18<br>+ 1.14  |
| F.E. of Na (%)                   | 1.12<br>+ 0.44       | 4.71<br>+ 2.65                          | NS<br>3.62<br>+ 1.68   | NS<br>0.86<br>+ 0.61  | NS<br>0.79<br>+ 0.32  | NS<br>1.61<br>+ 0.64  |
| F.E. of K (%)                    | 20.59<br>+ 5.87      | 38.44<br>+ 5.63                         | NS<br>71.18<br>+30.35  | NS<br>30.68<br>+12.68 | *                     | NS<br>39.57<br>+13.81 |
| F.E. of Cl (%)                   | 1.50<br>+ 0.79       | 6.12<br>+ 3.66                          | NS<br>4.15<br>+ 2.66   | NS<br>0.74<br>+ 0.53  | NS<br>0.75<br>+ 0.48  | NS<br>1.32<br>+ 0.35  |
| $U_{Osm}^V$<br>(uOsm/min/kg.bw.) | 31.50<br>+ 2.71      | 55.17<br>+16.36                         | NS<br>19.04<br>+12.04  | NS<br>15.49<br>+ 3.75 | NS<br>15.14<br>+ 7.14 | NS<br>16.72<br>+ 6.95 |
| $C_{Osm}$<br>(ul/min/kg.bw.)     | 110.38<br>+46.28     | 192.05<br>+55.10                        | NS<br>65.77<br>+42.01  | NS<br>55.52<br>+14.95 | NS<br>52.21<br>+23.93 | NS<br>56.90<br>+24.42 |
| $C_{H_2O}$<br>(ul/min/kg.bw.)    | -83.81<br>+40.94     | 32.44<br>+115.06                        | NS<br>-19.50<br>+12.11 | NS<br>25.28<br>+47.35 | NS<br>13.80<br>+31.78 | NS<br>00.07<br>+49.62 |

**Abbreviation :**  $U_{Na}^V$ , urinary excretion of sodium;  $U_K^V$ , urinary excretion of potassium;  $U_{Cl}^V$ , urinary excretion of chloride;  $U_{Osm}^V$ , urinary osmolar excretion;  $C_{Osm}$ , osmolar clearance;  $C_{H_2O}$ , Free water clearance. P-values with respected to the level at 0 min, \*P<0.05, \*\*P<0.01, NS=not significant.



**Table VI** Effects of intravenous injection of 0.05 mg/kg.bw. of Russell's viper venom on renal function of six dogs during intestinal and splenic blood vessels occlusion.

| Parameter           | Pre-occlusion   | post occlusion + venom injection |                |                 |                    |                |
|---------------------|-----------------|----------------------------------|----------------|-----------------|--------------------|----------------|
|                     |                 | 0 min                            | 15 min         | 30 min          | 60 min             | 120 min        |
| V (ul/min/kg.bw.)   | 28.95<br>+17.23 | 18.38<br>+19.91                  | 0.80<br>+ 1.55 | 3.27<br>+ 5.39  | 2.42<br>+ 3.96     | 2.42<br>+ 2.17 |
| GFR (ml/min/kg.bw.) | 2.31<br>+ 0.79  | 1.39<br>+ 1.41                   | 0.07<br>+ 0.14 | 0.18<br>+ 0.27  | 0.22<br>+ 0.32     | 0.14<br>+ 0.16 |
| RPF (ml/min/kg.bw.) | 7.71<br>+ 1.83  | 5.62<br>+ 5.93                   | 0.83<br>+ 1.94 | 1.43<br>+ 3.04  | 1.17<br>+ 2.17     | 0.70<br>+ 1.27 |
| RBF (ml/min/kg.bw.) | 12.40<br>+ 1.85 | 8.32<br>+ 8.91                   | 1.16<br>+ 2.74 | 2.02<br>+ 4.28  | 1.70<br>+ 3.16     | 1.01<br>+ 1.83 |
| F.F. (%)            | 32.49<br>+16.13 | 32.20<br>+19.63                  | 7.14<br>+14.12 | 25.05<br>+27.48 | 23.37<br>+22.46    | -              |
| R.F. (%)            | 9.95<br>+ 1.99  | 7.04<br>+ 7.25                   | 1.65<br>+ 3.89 | -               | 2.30<br>+ 4.77     | -              |
| RVR (%)             |                 | 100.00                           | -              | -               | 368.67<br>+1025.02 | -              |

Abbreviation : are defined in Table III

**Table VII** Effects of intravenous injection of 0.05 mg/kg.bw.of Russell's viper venom on renal hemodynamics of six dogs during intestinal and splenic blood vessels occlusion.

| Parameter                   | Pre-occlusion | post occlusion + venom injection |        |        |        |         |
|-----------------------------|---------------|----------------------------------|--------|--------|--------|---------|
|                             |               | 0 min                            | 15 min | 30 min | 60 min | 120 min |
| P <sub>Na</sub> (mEq/L)     | 147.17        | 144.67                           | NS     | NS     | NS     | NS      |
|                             | + 6.21        | + 3.50                           | + 2.73 | + 3.54 | + 4.61 | + 4.60  |
| P <sub>K</sub> (mEq/L)      | 3.67          | 3.42                             | NS     | NS     | NS     | NS      |
|                             | + 0.52        | + 0.41                           | + 0.37 | + 0.40 | + 0.76 | + 1.18  |
| P <sub>Cl</sub> (mEq/L)     | 112.00        | 116.17                           | NS     | NS     | NS     | NS      |
|                             | + 7.97        | + 4.88                           | + 6.08 | + 5.25 | + 7.73 | + 4.67  |
| P <sub>Osm</sub> (mOsm/kg.) | 303.83        | 299.00                           | NS     | NS     | NS     | NS      |
|                             | + 5.42        | + 8.56                           | + 4.53 | + 3.02 | +26.44 | + 9.44  |

**Abbreviation :** Are defined in Table IV.

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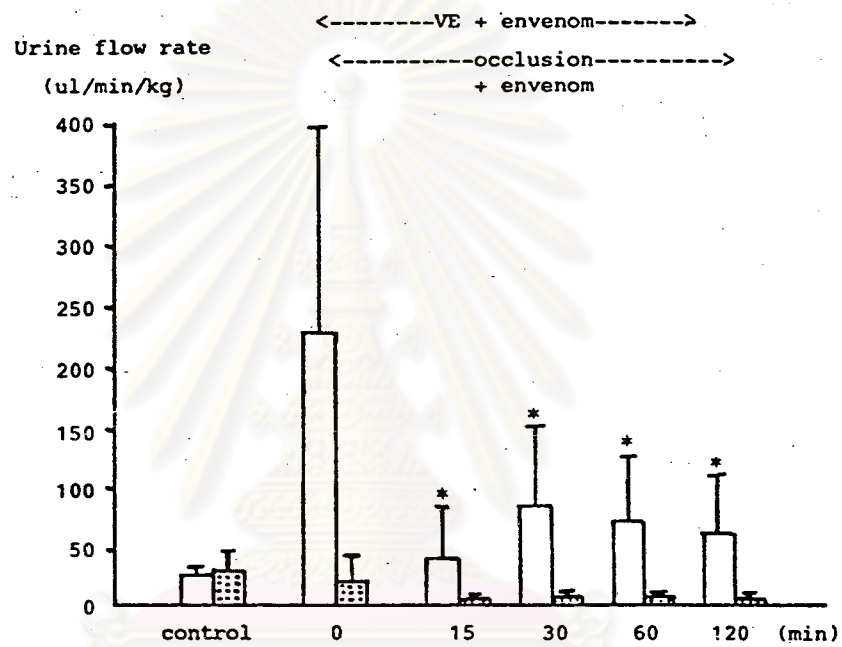
Table VIII Effects of intravenous injection of 0.05 mg/kg.bw.of Russell's viper venom on renal hemodynamics of six dogs during intestinal and splenic blood vessels occlusion.

| Parameter                                          | Pre-occlusion    | post occlusion + venom injection |        |                        |                        |                        |
|----------------------------------------------------|------------------|----------------------------------|--------|------------------------|------------------------|------------------------|
|                                                    |                  | 0 min                            | 15 min | 30 min                 | 60 min                 | 120 min                |
| U <sub>Na</sub> <sup>V</sup><br>(uEq/min/kg.bw.)   | 40.76<br>+ 3.73  | 1.67<br>+ 1.71                   | -      | NS<br>0.22<br>+ 0.25   | NS<br>0.13<br>+ 0.15   | NS<br>0.11<br>+ 0.12   |
| U <sub>K</sub> <sup>V</sup><br>(uEq/min/kg.bw.)    | 1.72<br>+ 0.33   | 1.16<br>+ 0.76                   | -      | NS<br>0.44<br>+ 0.51   | NS<br>0.41<br>+ 0.44   | NS<br>0.26<br>+ 0.22   |
| U <sub>Cl</sub> <sup>V</sup><br>(uEq/min/kg.bw.)   | 2.85<br>+ 2.13   | 0.97<br>+ 0.95                   | +      | NS<br>0.08<br>+ 0.07   | NS<br>0.06<br>+ 0.04   | NS<br>0.05<br>+ 0.02   |
| F.E.of Na (%)                                      | 1.35<br>+ 1.02   | 0.58<br>+ 0.35                   | -      | NS<br>0.36<br>+ 0.25   | NS<br>0.35<br>+ 0.25   | NS<br>0.19<br>+ 0.21   |
| F.E.of K (%)                                       | 22.75<br>+ 9.40  | 23.54<br>+ 6.88                  | -      | NS<br>#17.77<br>+22.45 | NS<br>#18.55<br>+19.45 | NS<br>#21.30<br>+16.07 |
| F.E.of Cl (%)                                      | 1.15<br>+ 0.85   | 0.46<br>+ 0.21                   | -      | NS<br># 0.21<br>+ 0.16 | NS<br># 0.33<br>+ 0.33 | NS<br># 0.60<br>+ 0.66 |
| U <sub>Osm</sub> <sup>V</sup><br>(uOsm/min/kg.bw.) | 20.64<br>+10.00  | 12.10<br>+ 8.70                  | -      | NS<br># 2.92<br>+ 3.09 | NS<br># 3.28<br>+ 2.25 | NS<br># 2.08<br>+ 1.17 |
| C <sub>Osm</sub><br>(ul/min/kg.bw.)                | 68.25<br>+33.80  | 41.10<br>+30.32                  | -      | NS<br># 9.60<br>+10.23 | -                      | -                      |
| C <sub>H<sub>2</sub>O</sub><br>(ul/min/kg.bw.)     | -39.31<br>+29.42 | -19.73<br>+13.24                 | -      | #-4.06<br>+ 4.11       | #-4.42<br>+ 3.46       | #-2.83<br>+ 2.00       |

Abbreviation : are defined in Table V.

# n= 3 (inadequate the volume of the urine sample.)

- The intravascular volume expansion.
- ▣ The intestinal and splenic blood vessels occlusion.

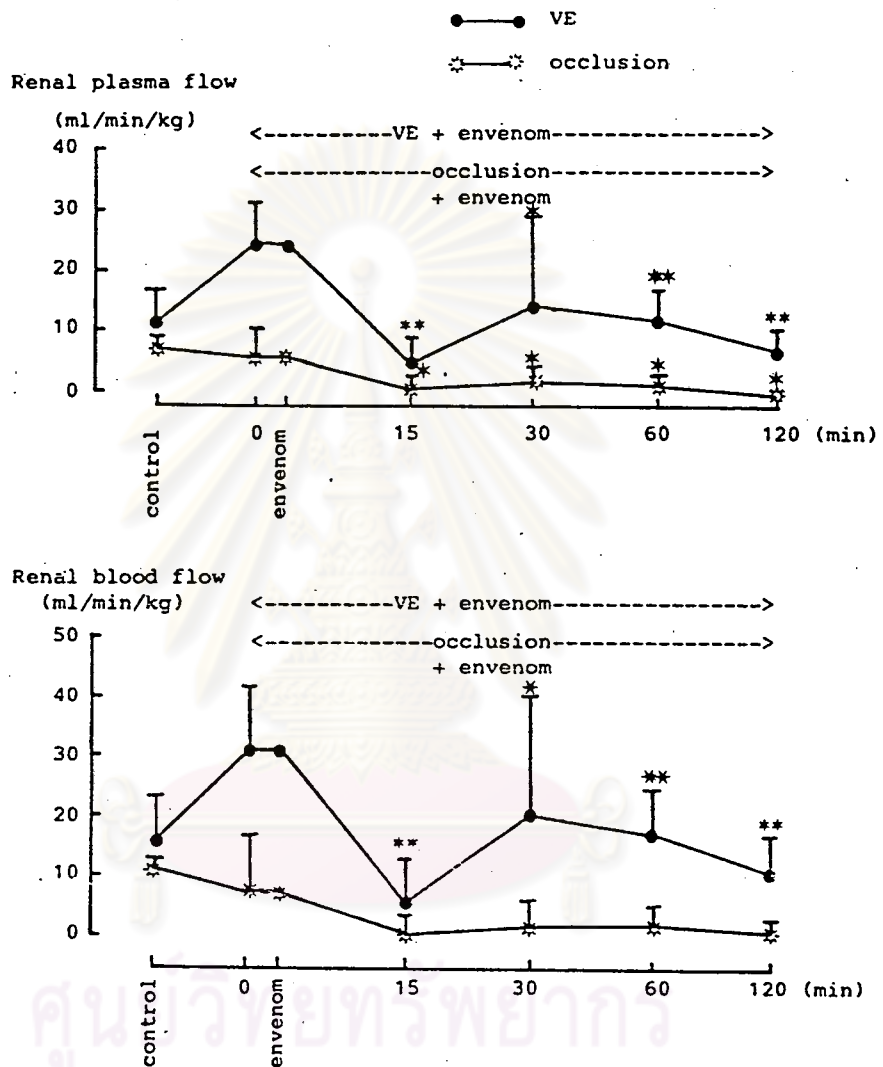


**Figure 7** : The effects of intravenous injection of Russell's viper venom on urine flow rate (V). The values are mean  $\pm$  S.D., P-value with respected to the level at 0 min.

\*  $P < 0.05$ , \*\* $P < 0.01$ .

VE = The intravascular volume expansion.

occlusion = The intestinal and splenic blood vessels occlusion.



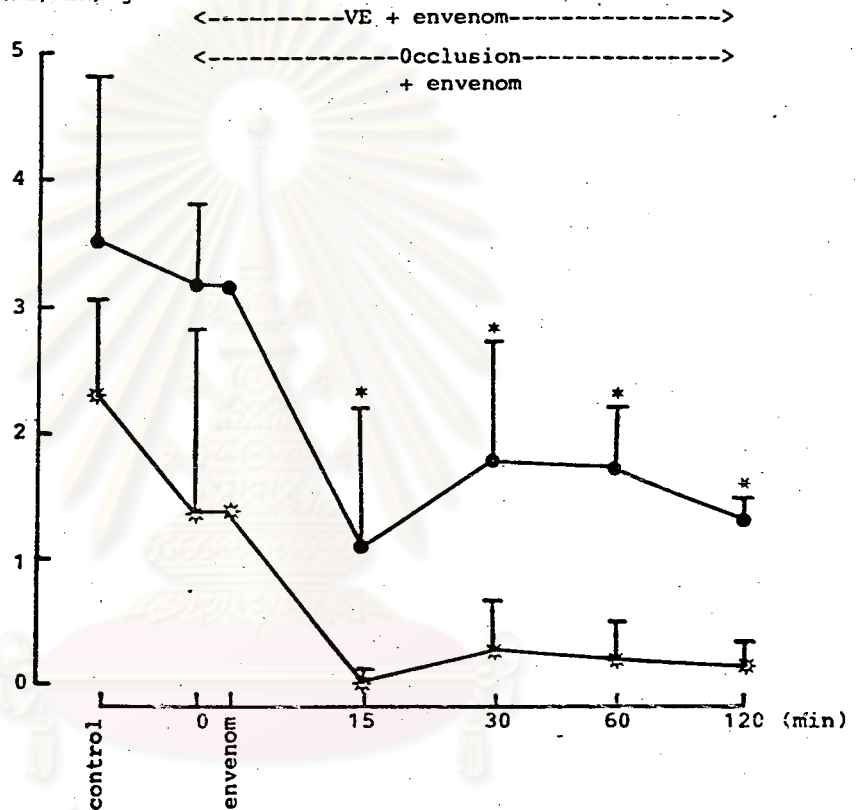
**Figure 8** : The effects of intravenous injection of Russell's viper venom on renal plasma flow (upper panel) and renal blood flow (lower panel). The values are mean + S.D. P-value with respected to the level at 0 min., \*P<0.05, \*\*P<0.01.



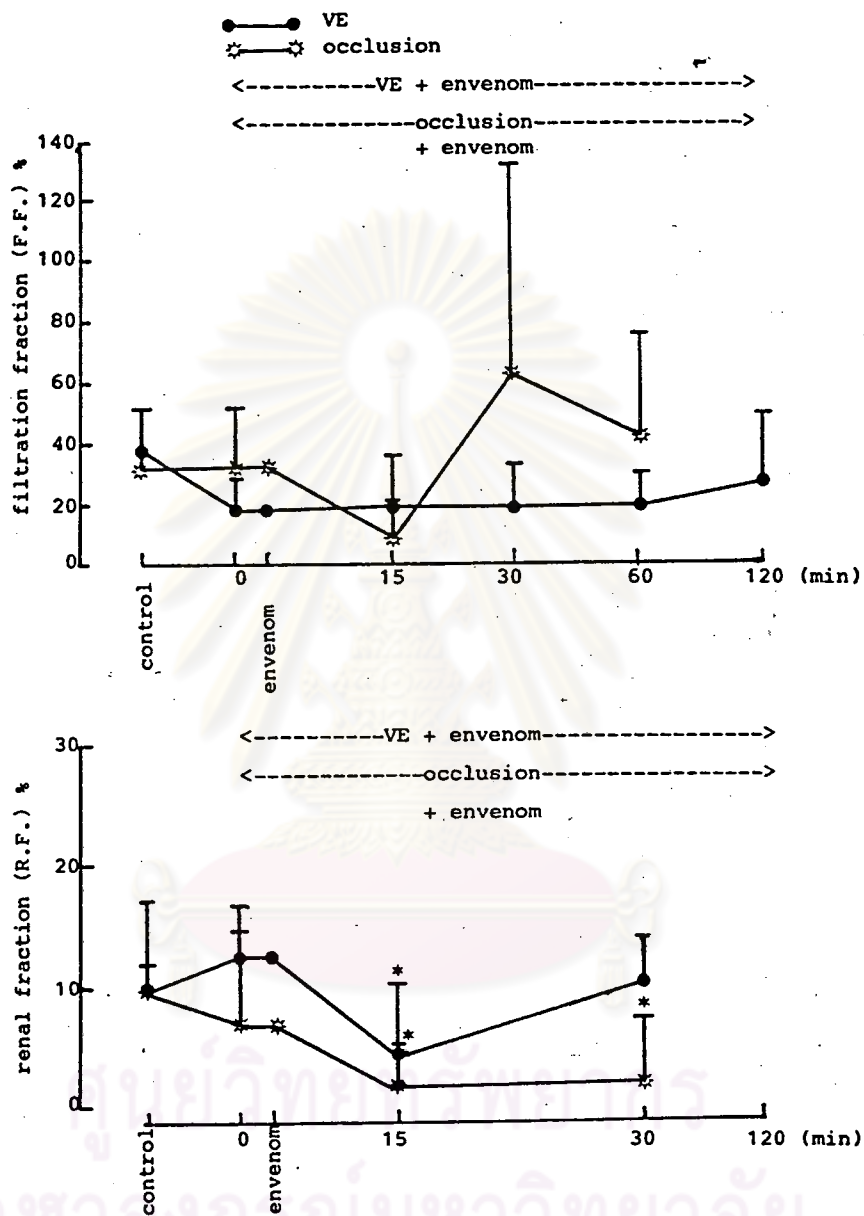
●—● VE  
 \*—\* occlusion

Glomerular filtration rate

(ml/min/kg)

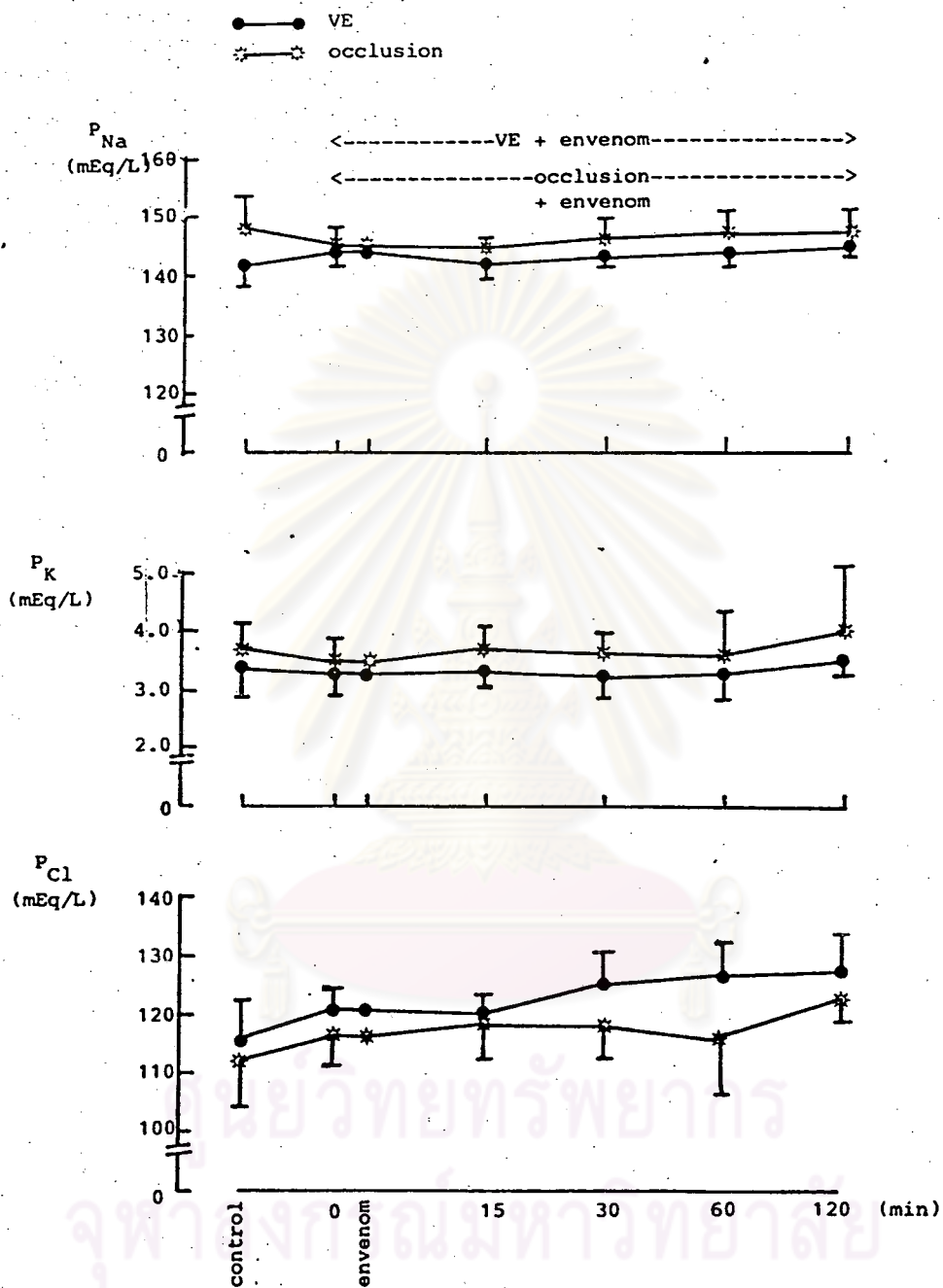


**Figure 9** : The effects of intravenous injection of Russell's viper venom on glomerular filtration rate (GFR). The values are mean + S.D., P-value with respected to the level at 0 min., \*P<0.05, \*\*P<0.01.  
 VE = The intravascular volume expansion.  
 occlusion = The intestinal and splenic blood vessels occlusion.

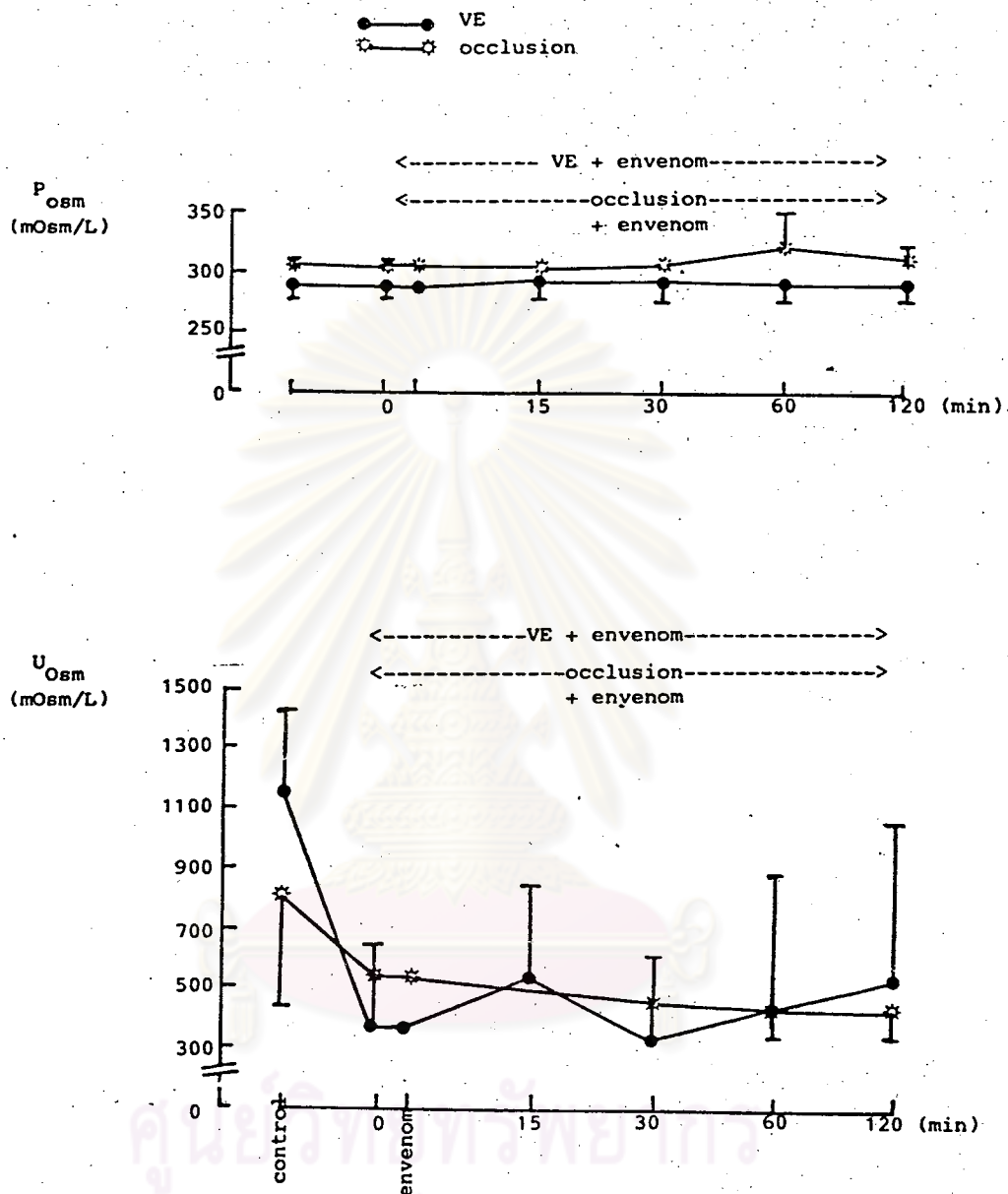


**Figure 10** : The effects of intravenous injection of Russell's viper venom on filtration fraction (F.F.) (upper panel) and renal fraction (R.F.) (lower panel). The values are mean  $\pm$  S.D., P-Value with respected to the level at 0 min., \* P<0.05, \*\* P<0.01. VE = The intravasular volume expansion. occlusion = The intestinal and splenic blood vessels occlusion.

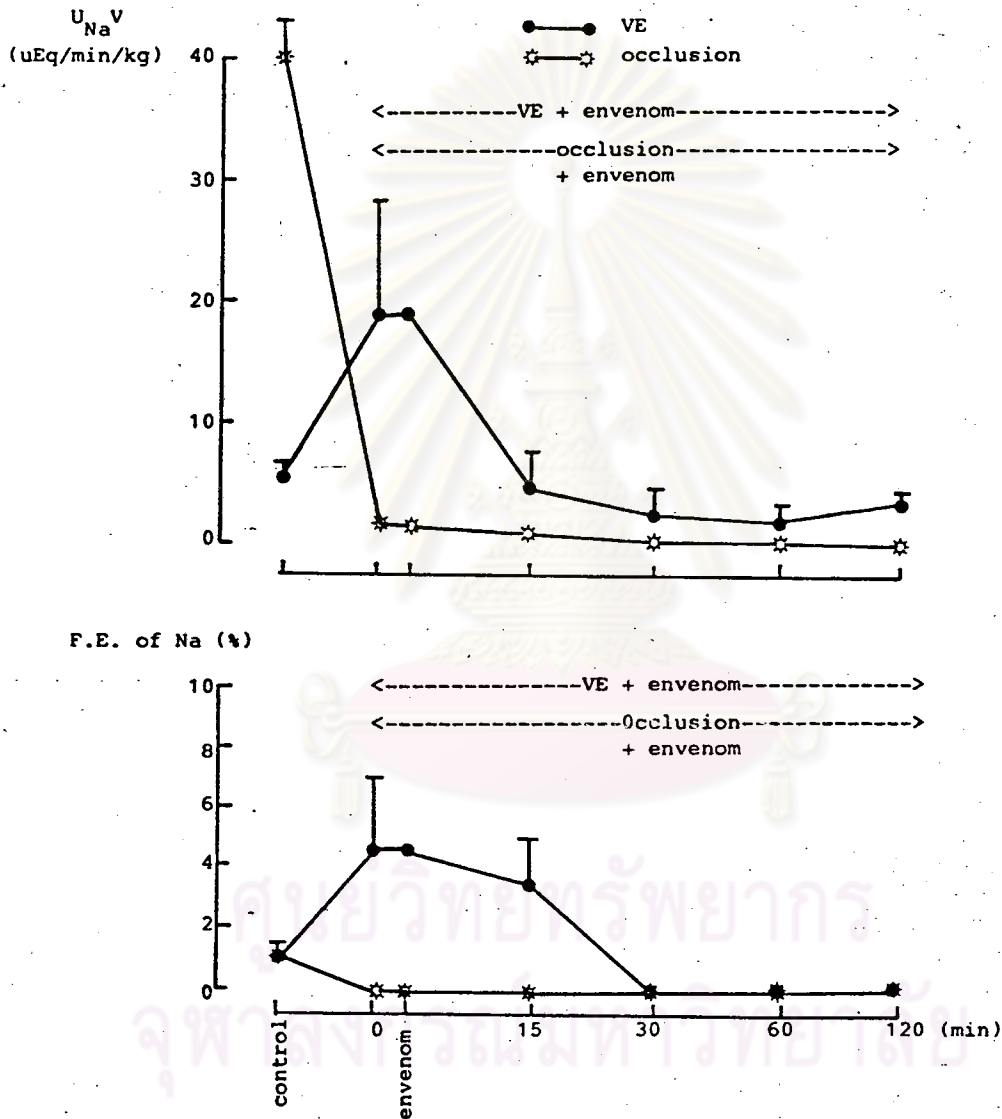




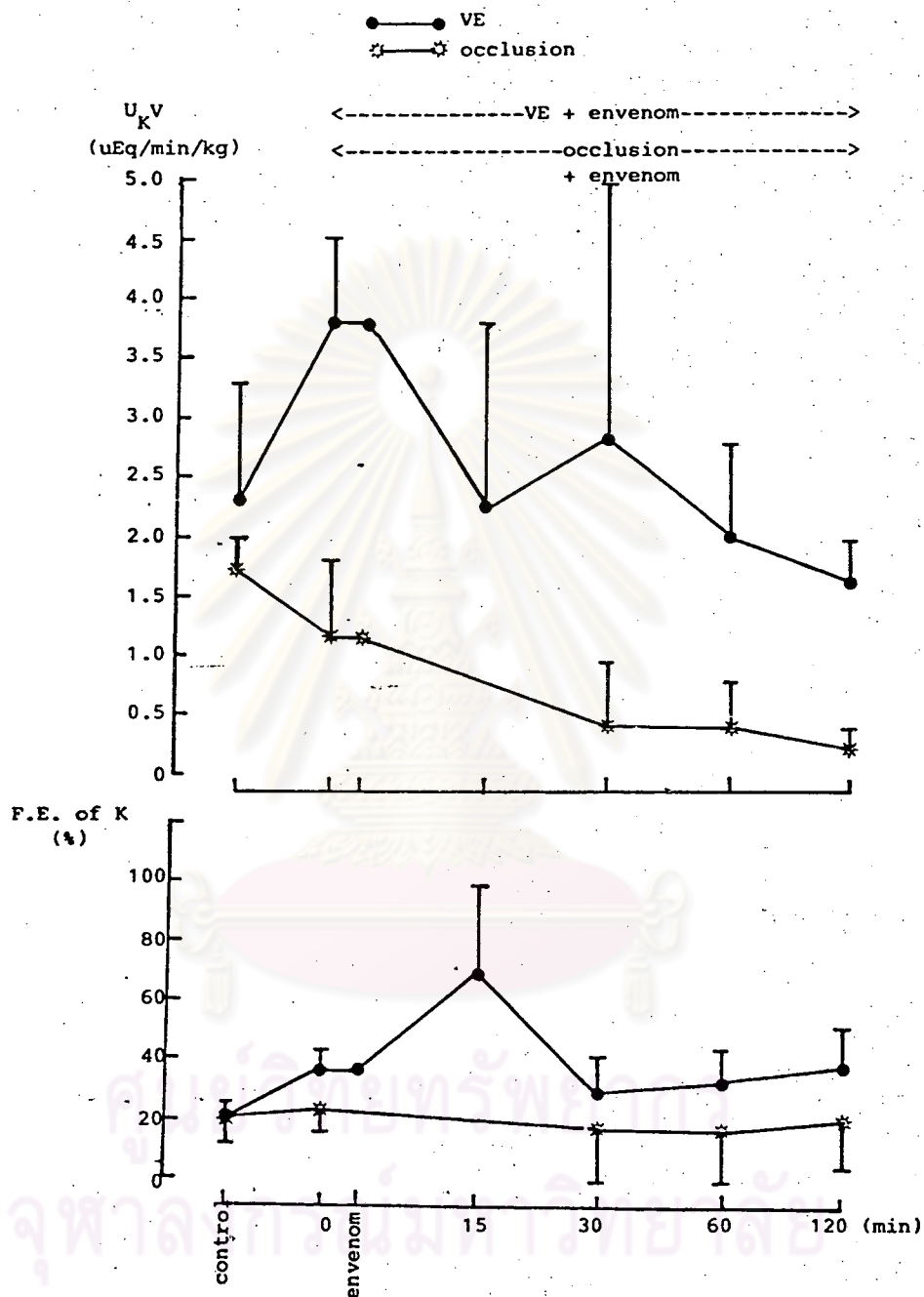
**Figure 11 :** The effects of intravenous injection of Russell's viper venom on plasma concentration of sodium ( $P_{Na}$ ; upper panel), potassium ( $P_K$ ; mid panel) and chloride ( $P_{Cl}$ ; lower panel). The values are mean  $\pm$  S.D. VE = The intravascular volume expansion. occlusion = The intestinal and splenic blood vessels occlusion.



**Figure 12** : The effects of intravenous injection of Russell's viper venom on plasma ( $P_{Osm}$ ; upper panel) and urine ( $U_{Osm}$ ; lower panel) osmolality. The values are mean  $\pm$  S.D. VE = The intravascular volume expansion. occlusion = The intestinal and splenic blood vessels occlusion



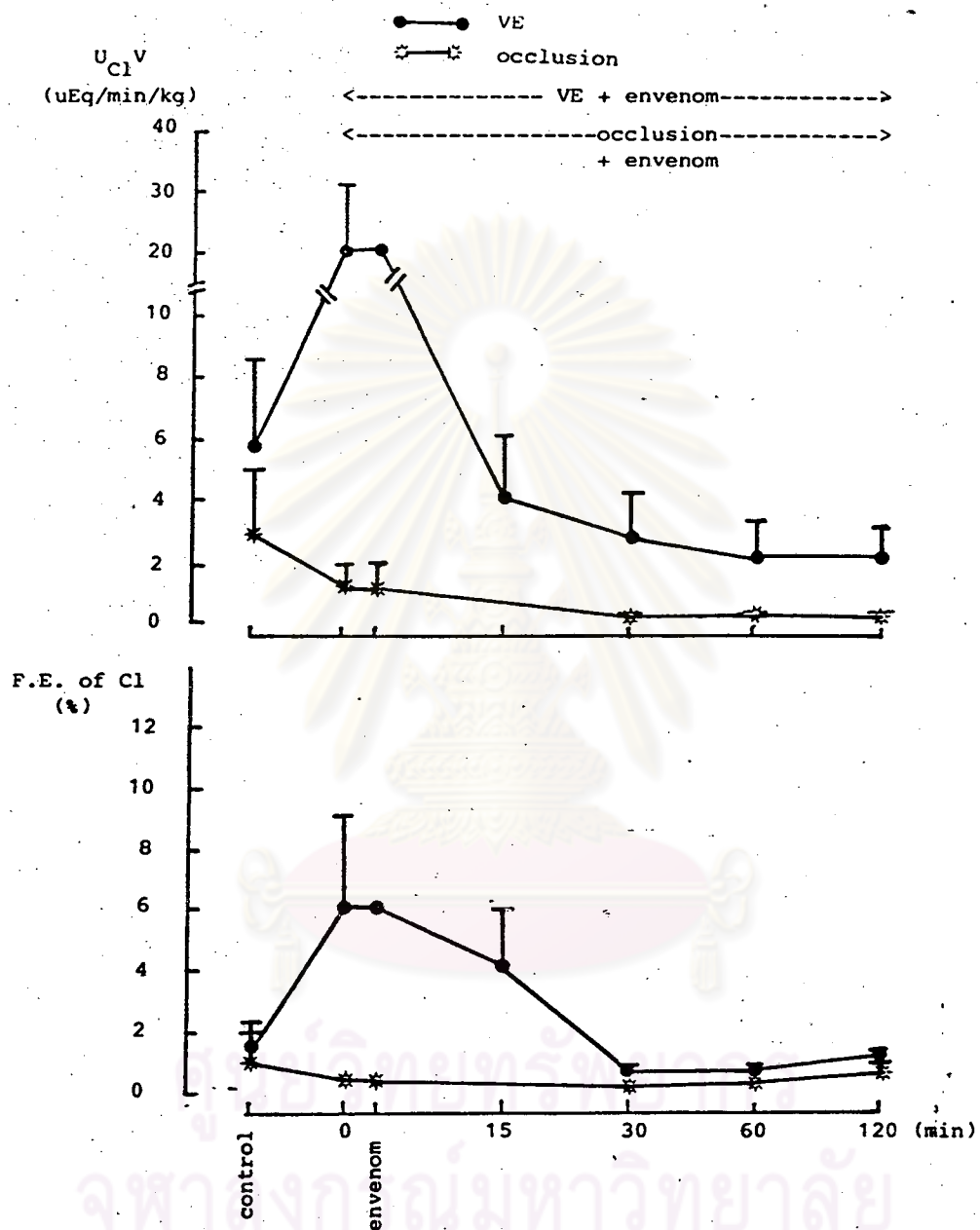
**Figure 13 :** The effects of intravenous injection of Russell's viper venom on urinary excretion of Na ( $U_{Na}V$ ; upper panel) and fractional excretion of Na (F.E. of Na; lower panel). The values are mean  $\pm$  S.D.  
 VE = The intravascular volume expansion.  
 occlusion = The intestinal and splenic blood vessels occlusion.



**Figure 14 :** The effects of intravenous injection of Russell's viper venom on urinary excretion of K ( $U_K V$ ; upper panel) and fraction excretion of K (F.E. of K; lower panel). The values are mean  $\pm$  S.D.

VE = The intravascular volume expansion.

occlusion = The intestinal and splenic blood vessels occlusion.



**Figure 15 :** The effects of intravenous injection of Russell's viper venom on urinary excretion of Cl ( $U_{ClV}$ ; upper panel) and fraction excretion of Cl (F.E. of Cl; lower panel).  
 VE = The intravascular volume expansion.  
 occlusion = The intestinal and splenic blood vessels occlusion.