



CHAPTER IV

RESULTS

Effects on general circulation (table 1-4)

Group I (Norepinephrine-induced Acute Renal Failure in untreated animals)

Intrarenal arterial infusion of Norepinephrine (NE) produced a marked changes in general circulation as shown in Table 1. Mean arterial blood pressure (MAP) increased 22.7% from control (126.7 ± 17.04 to 155.54 ± 10.39 mmHg) after infusion of NE and then returned to the control level within 4 hour period. Heart rate decreased significantly from 167.5 ± 24.7 (control) to 140 ± 26.6 (NE infusion beat/min after infusion of NE ($P < 0.05$) and then it was increased by 18% from control within 4 hour. After NE infusion, packed cell volume (PCV) increased significantly from 27.1 ± 5.66 (control) to $37.8 \pm 3.09\%$ (NE infusion) ($P < 0.05$) and its returned to control level within 4 hour.

Group II (Norepinephrine-induced Acute Renal Failure Tetrachloro-decaoxide (TCDO) 0.005 mg/kg.bw. treated animals)

Effect of TCDO 0.005 mg/kg on Norepinephrine induced acute renal failure (ARF) dogs are shown in Table 2 TCDO caused no significant different effects on MAP, HR and packed cell volume from control group.

Group III (Norepinephrine-induced Acute Renal Failure in Tetrachlor-decaoxide (TCDO 0.01 mg/kg.bw. treated animals)

Effect of TCDO 0.01 mg/kg on Norepinephrine induced ARF dogs are shown in Table 3. There was no significant different effect of this group from Group I on MAP, HR and packed cell volume.

Group IV (Norepinephrine-induced Acute Renal Failure in Furosemide treated animals)

Effect of Furosemide on Norepinephrine induced ARF dogs are shown in Table 4. The result of MAP and HR of this group were not different from control group (Group I). The packed cell volume (PCV) of this group was increased from control period after NE infusion and than control level by 16.4%.

In conclusion, in all group mean arterial blood pressure (MAP) increased transiently by 30-50 mmHg above control values during NE infusion. These increments were about 4.4, 9.4, 13 and 1mmHg in Group I, II, III and IV respectively. There were no significant differences between groups in any experimental period.

During NE infusion heart rate in all groups decreased by 6-26 beats/min from the control values and then elevated above control. At the end of the experiment, the increments were 18%, 15%, 1% and 10.5% in group I, II, III and IV respectively. There were no significant differences between group in any experimental period. The significant increase of packed cell volume (PCV) were noted during norepinephrine infusion of group I, II and III and then it decreased to the value below the control level within four hours. While the packed cell volume (PCV) of group IV remained increase throughout the experimental period.

Table 1 Effects of intrarenal arterial infusion of norepinephrine on mean arterial blood pressure, heart rate, packed cell volume plasma constituents and plasma osmolality in three normal dogs. ($\bar{X} \pm \text{SD}$)

	control	hour after NE infusion				
		1 1/2	2	2 1/2	3	4
MAP (mmHg)	127 \pm 17	128 \pm 14	131 \pm 13	131 \pm 13	125 \pm 9	126 \pm 9
heart rate (beats/min)	167 \pm 25	193 \pm 22*	195 \pm 22*	198 \pm 18*	198 \pm 23*	198 \pm 20*
packed cell volume (%)	27.10 \pm 5.66	32.38 \pm 8.04	25.87 \pm 3.96	24.87 \pm 3.75	24.62 \pm 3.71	24.62 \pm 3.59
P _{Na} (mEq/L)	140.0 \pm 3.0	139.0 \pm 6.0	138.0 \pm 3.5	139.3 \pm 7.2	139.0 \pm 6.9	138.7 \pm 7.6
P _K (mEq/L)	3.8 \pm 0.72	3.82 \pm 0.55	3.77 \pm 0.40	3.80 \pm 0.44	3.93 \pm 0.67	3.77 \pm 0.47
P _{Cl} (mEq/L)	106.3 \pm 5.7	107.0 \pm 7.2	113.7 \pm 3.1	114.0 \pm 2.6	112.0 \pm 1.7	113.0 \pm 2.6
P _{PI} (mg%)	5.55 \pm 1.20	5.70 \pm 1.35	5.50 \pm 1.20	5.40 \pm 1.31	5.40 \pm 1.30	5.40 \pm 1.30
P _{osm} (mOsm/L)	274 \pm 1.4	276.5 \pm 7.7	285.5 \pm 3.5	283.5 \pm 3.5	286 \pm 1.4	277 \pm 4.2

P Value with respect to control, * P < 0.05

Table 2 Effects of intrarenal arterial infusion of norepinephrine on mean arterial blood pressure, heart rate, packed cell volume plasma constituents and plasma osmolality in four dogs treated with TCDO 0.005 mg/kg. ($\bar{X} \pm \text{SD}$)

	control		hour after NE infusion			
		1 1/2	2	2 1/2	3	4
MAP (mmHg)	129 \pm 28.1	133 \pm 25	136 \pm 14	138 \pm 16	138 \pm 15	138 \pm 15
heart rate (beats/min)	164 \pm 42	203 \pm 25*	186 \pm 42*	188 \pm 43*	188 \pm 43*	188 \pm 43*
packed cell volume (%) ²	30.25 \pm 3.10	37.13 \pm 2.10	28.0 \pm 3.42	27.13 \pm 3.17	27.13 \pm 3.09	27.13 \pm 2.78
P _{Na} (mEq/L)	141.8 \pm 1.9	138.7 \pm 5.4	135.5 \pm 4.7	135.5 \pm 1.3	136.8 \pm 2.5	136.0 \pm 3.7
P _K (mEq/L)	3.32 \pm 0.25	3.47 \pm 0.25	3.35 \pm 0.31	3.43 \pm 0.21	3.45 \pm 0.25	3.40 \pm 0.16
P _{Cl} (mEq/L)	111.0 \pm 4.1	106.5 \pm 6.4	108.0 \pm 5.0	109.8 \pm 2.6	112.0 \pm 1.7	109.5 \pm 4.7
P _{P₁} (mg%)	5.27 \pm 0.82	5.47 \pm 0.8	5.50 \pm 0.90	5.03 \pm 1.05	4.90 \pm 0.99	5.0 \pm 1.02
P _{osm} (mOsm/L) ¹	281.5 \pm 2.6	279 \pm 6.6	280 \pm 7.5	281.5 \pm 5.9	280 \pm 7.7	281.2 \pm 6.5

P. Value with respect to control, *P < 0.05

Table 3 Effects of intrarenal arterial infusion of norepinephrine on mean arterial blood pressure, heart rate, packed cell volume plasma constituents and plasma osmolality in four dogs treated with TCDO 0.01 mg/kg. ($\bar{X} \pm \text{SD}$)

	control	hour after NE infusion				
		1 1/2	2	2 1/2	3	4
MAP (mmHg)	110 \pm 11	121 \pm 16	122 \pm 14	123 \pm 16	120 \pm 18	118 \pm 20
heart rate (beats/min)	148 \pm 8	155 \pm 7	173 \pm 9*	160 \pm 8*	158 \pm 11	156 \pm 8
packed cell volume (%)}	28.38 \pm 5.11	36.75 \pm 6.13	26.0 \pm 3.94	26.0 \pm 3.93	25.38 \pm 4.03	25.38 \pm 4.31
P _{Na} (mEq/L)	143.0 \pm 1.3	141.5 \pm 1.3	142.0 \pm 0.8	141.8 \pm 1.3	142.0 \pm 0.8	142.0 \pm 1.6
P _K (mEq/L)	3.20 \pm 0.08	3.57 \pm 0.09	3.53 \pm 0.05	3.55 \pm 0.06	3.58 \pm 0.10	3.53 \pm 0.05
P _{Cl} (mEq/L)	113.0 \pm 0.8	108.3 \pm 1.0	107.2 \pm 1.3	111.8 \pm 0.5	113.0 \pm 1.2	111.0 \pm 0.8
P _{PI} (mg%)	4.40 \pm 0.33	4.59 \pm 0.37	4.67 \pm 0.45	4.60 \pm 0.22	4.50 \pm 0.29	4.50 \pm 0.16
P _{osm} (mOsm/L)	274.2 \pm 12.9	275.2 \pm 17.7	272.7 \pm 23.1	279.7 \pm 10.3	277.3 \pm 12.7	282 \pm 24

P value with respect to control , *P<0.05

Table 4 Effects of intrarenal arterial infusion of norepinephrine on mean arterial blood pressure, heart rate, packed cell volume plasma constituents and plasma osmolality in four dogs treated with furosemide 10 mg/kg. ($\bar{X} \pm \text{SD}$)

	control	hour after NE infusion				
		1 1/2	2	2 1/2	3	4
MAP (mmHg)	105 \pm 23	91 \pm 14	88 \pm 12	103 \pm 23	105 \pm 9	103 \pm 20
heart rate (beats/min)	143 \pm 29	167 \pm 40	176 \pm 45*	176 \pm 45*	176 \pm 45*	158 \pm 43
packed cell volume (%)	32.13 \pm 7.45	36.37 \pm 7.16	37.25 \pm 4.87	37.38 \pm 6.42	37.37 \pm 6.42	36.75 \pm 6.56
P _{Na} (mEq/L)	140.3 \pm 4.5	142.8 \pm 2.2	137.8 \pm 2.8	143.3 \pm 2.8	139.5 \pm 2.6	141.5 \pm 2.5
P _K (mEq/L)	3.10 \pm 3.36	3.50 \pm 0.49	3.18 \pm 0.62	3.20 \pm 0.63	3.30 \pm 0.59	3.25 \pm 0.46
P _{Cl} (mEq/L)	109.5 \pm 1.7	106.8 \pm 1.7	105.8 \pm 3.1	107.0 \pm 2.0	107.8 \pm 0.9	106.5 \pm 2.6
P _{PI} (mg%)	4.90 \pm 0.50	6.30 \pm 0.90	6.39 \pm 0.74	6.50 \pm 0.79	7.0 \pm 0.74	6.80 \pm 0.60
P _{osm} (mOsm/L)	280 \pm 9.1	282 \pm 10.6	281.5 \pm 13.1	283 \pm 11.4	277.5 \pm 15.2	278.7 \pm 14.0

P value with respect to control , *P<0.05

The concentrations for plasma electrolytes (Na, K, Cl, Pi) and plasma osmolality did not show any significant changes throughout the period of the experiment in all groups.

Effects on renal hemodynamics (Table 5-8)

Group I : (Norepinephrine-induced Acute Renal Failure in untreated animals)

The result summarized in Table 5. During NE infusion, there was no urine flow on the left infused kidney and the effective renal blood flow (ERBF), effective renal plasma flow (ERPF) and glomerular filtration rate (GFR) were unmeasurable.

After NE infusion, the urine flow rate was returned to control level and slightly increased till the end of experiment in the left kidney and there was a significant increase in the contralateral right kidney by 120-170 % from control value throughout the experimental period.

Effective renal blood flow after NE infusion remained decrease in the left kidney throughout the experiment. In the right kidney, effective renal blood flow decreased from control level on the first hour (30%) and on the fourth hour (23.8%).

There was a significant decrease in effective renal plasma flow in the left kidney by 67.34% and 60.8% ($P < 0.05$) from control value at 1 1/2 hour and 4 hour, respectively after NE infusion and in the right kidney, ERPF showed to be slightly lower than the control level throughout the experimental period.

Glomerular filtration rate in the left kidney significantly declined in the same pattern till the end of experiment, whereas in the right kidney, it increase by approximately 34-52 % from control level throughout the experiment. Filtration fraction was suddenly increased at 1 1/2 hour in both kidney and remained at these value till the experiment was over. There was markedly significant increase in renal vascular resistance of left (from 1066.96 ± 23.2 to 3446.95 ± 51.6 $P < 0.01$) and right kidney (from 960 ± 24.3 % to 1381.57 ± 33.9 % $P < 0.05$) at 1 1/2 hour and persisted at this high level throughout the experimental period.

Group II (Norepinephrine-induced Acute Renal Failure in 0.005 mg/kg.bw. treated animals)

The result summarized in Table 6. The urine flow rate of the left kidney did not show any significant changes from control period at 1 1/2 hour and then increased to approximately 27 % at 4 hour while in the right kidney, the urine flow rate increased nearly two folds throughout the experimental period.

After NE infusion and TCDO 0.005 mg/kg.bw. were infused, effective renal blood flow (ERBF) remained depressed in the left kidney by 68.8 % at 1 1/2 hour and 46 % at 4 hour in comparison with control value. Effective renal plasma flow was decreased by 60.4 % at 1 1/2 hour and 44.3 % at 4 hour in the left kidney. The glomerular filtration rate in the left kidney was decreased 47 % at 1 1/2 hour and 42.5 % at 4 hour. In the right kidney showed a marked but not significant reduction of both effective renal blood flow and effective renal plasma flow within 1 1/2 hour and it remained in a lower level throughout the experiment. Glomerular filtration rate in

the right kidney returned to the control level after NE infusion with treated of TCDO and this level was not altered throughout the experimental period.

At 1 1/2 hour after norepinephrine and TCDO 0.005 mg/kg.bw. infusion, there was an increase in filtration fraction (FF) in the left kidney (from 27.8 ± 5.9 % (control) to 41.45 ± 18.6 %). The similar increase in filtration fraction was observed in the right kidney. After norepinephrine infusion in TCDO-treated animal. The renal vascular resistance of the left kidney increased by 230% from control value and maintained at high level till the end of experiment while the 36.3 % increment at 1 1/2 hour was found in the right kidney and then gradually increased throughout the experiment.

Group III (Norepinephrine-induced Acute Renal Failure in TCDO 0.01 mg/kg.b.w.-treated animals)

The result summarized in Table 7. The rate of urine flow in the left kidney was nearly the control value at 1 1/2 to 2 hour and then gradually increase till the end of experiment while in the right kidney, these was markedly significant increased in urine flow rate throughout the experiment.

In the left kidney, there were significant decreases in effective renal blood flow, effective renal plasma flow and glomerular filtration rate at 1 1/2 hour by 69.25 % , 68.16 % and 65 % , respectively and it still decreased in the fourth hour by 63 % , 61.6 % and 54 % , respectively. The right kidney showed the 24.3 % and 29.15 % decrement from control value of the effective renal plasma flow and effective renal blood flow, respectively at 1 1/2 hour and

then slightly increased till the experiment was over. Glomerular filtration rate of the right kidney was not altered throughout the experiment. Filtration fraction was slightly increased from control value in the left kidney while in the right kidney, there was a significant increase in filtration fraction throughout the experiment. The renal vascular resistance of the both kidneys were significantly increased throughout the experimental period, however the magnitude of increment was higher in the left kidney.

Group IV (Norepinephrine-induced Acute Renal Failure in Furosemide-treated animals)

The result summarized in Table 8. There was a markedly significant increase at 1 1/2 hour in the urine flow rate of the left kidney (from 0.28 ± 0.13 to 2.02 ± 1.06 ml/min, $P < 0.01$) and the right kidney (from 0.25 ± 0.05 to 2.26 ± 0.5 ml/min, $P < 0.01$), and then gradually decreased till the end of experiment in both kidneys.

In the left kidney showed a significant decline of effective renal plasma flow and effective renal blood flow by 53.11 % and 55.9 % on 1 1/2 hour and by 62.13 % and 64.28 % at 4 hour when compared with the control level while the magnitude of the reduction of those in the right kidney were lower than in the left kidney. Glomerular filtration rate in the left kidney was increased by 47.7 % on 1 1/2 hour and by 50.9 % on 4 hour and in the right kidney, there was a slight decrease in glomerular filtration rate throughout the experiment. The filtration fraction of both kidneys were increased approximately by 28 % - 30 % from control value and persisted at this level till the end of experiment. The increase in renal vascular resistance of the left kidney in the group was lower

Table 5 Effects of intrarenal arterial infusion of norepinephrine on renal hemodynamic in three normal dogs. ($\bar{X} \pm \text{SD}$)

		control	hour after NE infusion				
			1 1/2	2	2 1/2	3	4
V (ml/min)	Lt	0.17±0.05	0.17±0.06	0.17±0.06	0.19±0.80	0.30±0.19*	0.30±0.29*
	Rt	0.17±0.05	0.39±0.34*	0.47±0.53*	0.43±0.45*	0.39±0.40*	0.36±0.38*
GFR (ml/min)	Lt	1.60±0.35	0.72±0.49*	0.74±0.45*	0.76±0.46	0.79±0.47	0.79±0.44
	Rt	1.88±0.4	2.63±2.03	2.52±0.183	2.85±2.44	2.77±2.28	2.69±2.07
ERPF (ml/min)	Lt	6.92±1.22	2.26±1.50*	2.37±1.54*	2.50±1.68*	2.66±1.82*	2.71±1.77*
	Rt	7.60±1.26	5.55±2.07	6.16±2.42	6.18±2.52	6.27±2.49	6.07±1.66
ERBF (ml/min)	Lt	9.52±1.41	2.97±2.03**	3.1±1.97**	3.25±2.15*	3.47±2.33*	3.53±2.25*
	Rt	10.58±1.93	7.41±2.63	8.23±3.38	8.23±3.48	8.33±3.40	8.06±3.60
FF (%)	Lt	22.3±4.4	30.8±4.5	31.0±6.5	32.4±4.4*	32.6±5.9*	32.6±6.3*
	Rt	24.5±3.4	43.9±14.0*	37.7±11.5	40.9±17.6*	40.8±14.6*	44.1±13.1*
RVR (%)	Lt	1066.96	3446.95**	3379.8**	3223.8**	2881.13**	2854.81*
		+23.2	+51.6	+62.3	+77	+82.3	+79.7
	Rt	960	1381.57*	1273.07*	1273.07*	1200*	1250.3*
		+24.3	+33.9	+41.5	+44.7	+42.3	+39.7

P. Value with respect to control, * P < 0.05, **P < 0.01

Table 6 Effects of intrarenal arterial infusion of norepinephrine on renal hemodynamic in four dogs treated with TCDO 0.005 mg/kg. ($\bar{X} \pm SD$)

		control	hour after NE infusion				
			1 1/2	2	2 1/2	3	4
V (ml/min)	Lt	0.41±0.33	0.43±0.45	0.37±0.37	0.37±0.33	0.37±0.37	0.52±0.44
	Rt	0.18±0.1	0.40±0.14*	0.43±0.19*	0.51±0.23*	0.47±0.17*	0.52±0.20*
GFR (ml/min)	Lt	1.34±1.00	0.71±0.79*	0.79±0.99*	0.69±0.78*	0.73±0.81*	0.77±0.76*
	Rt	1.33±0.34	1.40±0.48	1.18±0.35	1.38±0.41	1.25±0.42	1.50±0.46
ERPF (ml/min)	Lt	4.24±3.10	1.68±1.09*	2.40±2.80*	2.10±2.20*	2.12±2.20*	2.34±2.20*
	Rt	5.17±1.60	4.01±1.20	3.24±0.86	3.45±1.10	3.01±1.07	4.38±0.50
ERBF (ml/min)	Lt	6.19±4.60	1.93±1.79*	2.80±4.10*	2.45±3.20*	2.43±3.10*	3.34±3.40*
	Rt	7.40±2.70	5.60±1.80	4.50±1.20	4.79±1.60	4.15±1.50	4.83±1.60
FF (%)	Lt	27.8±5.9	41.5±18.6*	36.3±7.9	41.6±5.2*	47.1±10.2*	47.6±9.5*
	Rt	26.7±4.9	41.6±18.5	36.1±7.9	36.5±5.3	40.5±3.6*	41.8±2.5*
RVR (%)	Lt	1666.78	5511.57***	3884.7***	4505***	4542.07***	3304.56**
		±38.5	±46.7	±59.3	±68.7	±53.6	±60.7
	Rt	1394.24	1899.53*	2417.17*	2304.22*	2659.57**	2285.14*
		±32.3	±44.4	±46.5	±43.2	±42.6	±48.2

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

Table 7 Effects of intrarenal arterial infusion of norepinephrine on renal hemodynamic in four dogs treated with TCDO 0.01 mg/kg.

($\bar{X} \pm \text{SD}$)

		control	hour after NE infusion				
			1 1/2	2	2 1/2	3	4
V (ml/min)	Lt	0.27±0.25	0.21±0.15	0.24±0.13	0.41±0.15	0.43±0.17*	0.59±0.26*
	Rt	0.17±0.14	0.47±0.30*	0.41±0.20*	0.36±0.23	0.37±0.18*	0.39±0.19*
GFR (ml/min)	Lt	1.58±0.37	0.56±0.54*	0.46±0.43*	0.85±0.50	0.83±0.53	0.74±0.62
	Rt	1.68±0.57	1.78±0.61	1.68±0.56	1.68±0.87	1.89±0.44	1.98±0.62
ERPF (ml/min)	Lt	5.73±0.59	1.85±1.28*	1.55±0.76*	1.87±0.89*	1.82±0.65*	2.23±1.10*
	Rt	6.30±1.04	4.77±1.30	4.84±0.92	4.88±0.87	5.01±0.44	5.44±0.38
ERBF (ml/min)	Lt	8.08±1.38	2.50±1.70*	2.10±1.0*	2.52±1.25*	2.46±2.99*	3.01±1.60*
	Rt	9.57±1.21	6.78±1.10	6.60±1.10	6.56±1.20	6.71±0.41	7.30±0.34
FF (%)	Lt	26.6±7.1	28.9±7.1	29.9±9.9	29.9±9.0	32.4±10.3	31.9±9.3
	Rt	26.2±4.0	38.0±1.6	37.4±1.7	39.9±2.4*	42.7±3.3*	41.5±2.5*
RVR (%)	Lt	1088.83	3871.03**	4646.37**	3903.78**	3901.46**	3135.43**
		±46.5	±50.8	±47.8	±49.5	±51.2	±48.7
	Rt	919.31	1427.37*	1478.41*	1499.62*	1430.34*	1292.8*
		±33.2	±36.7	±30.5	±40.1	±35.5	±37.3

P. Value with respect to control, * P < 0.05, ** P < 0.01

Table 8 Effects of intrarenal arterial infusion of norepinephrine on renal hemodynamic in four dogs treated with furosemide 10 mg/kg. ($\bar{X} \pm \text{SD}$)

		control	hour after NE infusion				
			1 1/2	2	2 1/2	3	4
V (ml/min)	Lt	0.28±0.13	2.02±1.06**	1.77±0.96**	1.37±0.72**	1.18±0.50**	1.06±0.54**
	Rt	0.25±0.05	2.26±0.50**	2.15±0.49**	1.96±0.57**	1.54±0.75**	1.39±0.59**
GFR (ml/min)	Lt	1.74±0.43	0.92±0.78	0.85±0.66	0.92±0.65	0.98±0.66	0.86±0.49
	Rt	1.66±0.29	1.21±0.40	1.17±0.19	1.25±0.19	1.27±0.23	1.27±0.19
ERPF (ml/min)	Lt	7.60±3.50	3.40±3.10	3.09±2.60*	3.20±2.50*	3.27±2.30*	2.75±1.93**
	Rt	7.19±2.60	3.86±1.30*	3.76±1.20*	3.82±1.30*	4.14±1.20	4.05±1.50
ERBF (ml/min)	Lt	10.90±4.20	5.20±4.60*	4.70±3.90*	4.90±3.70*	5.02±3.3*	4.20±2.70*
	Rt	10.50±3.40	6.37±1.70	6.0 ±1.40	6.13±1.70	6.52±1.30	6.30±2.09
FF (%)	Lt	25.2±7.2	31.8±6.9	32.4±7.1	31.9±4.8	30.8±4.7	35.9±8.1
	Rt	25.2±6.8	33.8±8.5	32.7±5.8	34.7±7.6	32.1±7.9	34.6±9.8
RVR (%)	Lt	770.5	1399.6*	1497.5*	1681.2*	1672.9*	1961.4**
		+35.5	+49.3	+59.7	+63.2	+64.5	+59.7
	Rt	799.8	1142.6*	1173.04*	1343.9*	1288.02*	1307.61*
		+37.8	+42.3	+44.6	+52.4	+46.9	+39.6

P. Value with respect to control, * P < 0.05, **P < 0.01

than that of in group I whereas the value of the right kidney did not differ from other groups.

Effects on the urinary electrolytes excretion (Table 9-12)

Group I (Norepinephrine-induced Acute Renal Failure in untreated animals)

The result summarized in Table 9 on 1 1/2 hour after NE infusion, the urinary excretion of sodium and chloride of the left kidney decreased by 63.3 % and 60.8 % from control period and then gradually increased throughout the experiment while in the right kidney, there were markedly significant increased in urinary excretion of sodium and chloride at 1 1/2 to 2 1/2 hour and then gradually decreased to the control level. The urinary excretion of potassium in the left kidney markedly decreased from control value at 1 1/2 hour and then gradually increase till the end of experiment whereas, a slight increase of urinary excretion of potassium was occurred in the right kidney throughout the experiment. After NE infusion, the urinary excretion of inorganic phosphorus in the left kidney fell from 6.30 ± 5.5 to 1.20 ± 0.9 and remained this value till the experiment was over while in the right kidney, the significant increment of urinary excretion inorganic phosphorus was observed throughout the study period. The fractional excretion of sodium, potassium, chloride and inorganic phosphorus of both kidney were increased throughout the experiment.

There were no significant changes on the osmolar clearance in both kidney. There was slightly decrement of free water clearance in the left kidney while no different changes from control period in the right kidney.

Group II (Norepinephrine-induced Acute Renal Failure in TCDO 0.005 mg/kg.bw.-treated animals)

The result summarized in Table 10. Infusion of TCDO in NE-induced acute renal failure produced the increments of the urinary excretion of sodium, potassium and chloride in both kidneys however, the magnitude of increments were higher in the right kidney. The urinary excretion of inorganic phosphorus showed a markedly reduction with slow recovery to the control level in the left kidney whereas there was significant increase at 3 and 4 hour after NE infusion in the right kidney.

The fractional excretion of sodium, potassium and chloride of the left kidney increased by 29 %, 35 % and 126 % respectively at 1 1/2 hour and then the fractional excretion of sodium and potassium remained these value throughout the experimental period whereas that of chloride decreased by approximately 41-60 % of control value till the end of experiment. There were similar changes of the fractional excretion of sodium, potassium and chloride in the right kidney.

There were no significant difference of the alterations of fractional excretion of inorganic phosphorus, the osmolar clearance and free water clearance in both kidney between group I and group II in any experimental period.

Group III (Norepinephrine-induced Acute Renal Failure in TCDO 0.01 mg/kg.bw.-treated animals)

The result summarized in Table 11. TCDO 0.01 mg/kg.bw. induced a reduction of the urinary excretion of sodium and chloride by 41 % and 32 % of control value respectively on 1 1/2 hour in left

kidney and the slightly increments of these parameters were observed in the right kidney. The urinary excretion of potassium in left kidney was no significant difference from control period whereas it was a slightly increment at 1 1/2 hour in the right kidney. The urinary excretion of inorganic phosphorus in left kidney was suddenly decreased by 65 % and 51 % of control value at 1 1/2 and 4 hour respectively whereas in the right kidney, the increment of that by 16.4 % on 1 1/2 hour was observed.

The fractional excretion of sodium and potassium of the both kidneys slightly increased on 1 1/2 hour and persisted at these level throughout the experiment. In the left kidney showed that the fractional excretion of chloride slightly decreased on 1 1/2 hour by approximately 35 % of control and then increased again at the end of experiment while in the right kidney, the slightly increased was observed on 1 1/2 hour and then declined to approach the control level.

The fractional excretion of inorganic phosphorus slightly increased throughout the experiment in both kidneys. A markedly decrease of the osmolar clearance was occurred in the left kidney on 1 1/2 hour of experiment. In the right kidney the suddenly increment of the osmolar clearance and free water clearance were found throughout the experimental period. Free water clearance of the left kidney was decreased throughout the experimental period after administration of both NE and TCDO.

Group IV (Norepinephrine-induced Acute Renal Failure in Furosemide-treated animals)

The result summarized in Table 12. In both kidneys, significant elevation of the urinary excretion of sodium, potassium and chloride ($P < 0.05$, $P < 0.01$, $P < 0.001$) were apparent throughout the

experimental period. But the urinary excretion of inorganic phosphorus was slightly decreased in the left kidney and in the right kidney, it progressively elevated till the experiment was over.

Administration of furosemide produced a significant increase in fractional excretion of sodium, potassium and chloride of both kidneys throughout the experiment. Fractional excretion of inorganic phosphorus in both kidneys decreased on 1 1/2 hour and then gradually increased to approach the control level at 4 hour. There were significant increased in the osmolar clearance and free water clearance of the both kidneys till the end of the experiment. ($P < 0.05$, $P < 0.01$).

Effective on oxygen uptake, respiratory quotient and oxygen extraction ratio

The result summarized in Table 13. The oxygen uptake within 4 hours after NE infusion decreased by 35 % , 41 % ,26 % and 17 % in group I,II,III,IV respectively. The maredly reduction of respiratory quotient was found in group I and IV whereas there were significant increment of respiratory quotient in both TEDO-Treated groups there were no significant changes in oxygent extraction ratio in all groups.

In conclusion, comparison the effects on general circulation of four groups. There were no significant difference between groups in any experimental period. However the persentage recovery of effective renal plasma flow, effective renal blood flow and glomerular filtration rate in left kidney of Group II were higher than those of Group I , TCDO 0.005 (gr.II) and 0.01 mg/kg.bw.(gr.III) produced no significant difference in alterations of urine flow rate (Fig 1,2),effective renal plasma flow (Fig 3,4),effective renal blood flow (Fig 5,6), glomerular

filtration rate (Fig 7), urinary and fractional excretion of all electrolytes, osmolar clearance and free water clearance of both kidneys from control group (gr.I).

The urine flow rate, urinary excretion of sodium, potassium and chloride, osmolar clearance and free water clearance were significant increased in both kidneys of Furosemide-treated group (gr.IV). These elevations were significant higher than other groups.

Comparison the effects on oxygen uptake, respiratory quotient and oxygen extraction ratio of four groups were shown in Table 13 which indicated that respiratory quotient of Group II and III were significant higher than Group I and IV.



ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

Table 9 Effects of intrarenal arterial infusion of norepinephrine on urinary and fractional excretion of electrolytes (Na^+ , K^+ , Cl^- , P), osmolar clearance and free water clearance in three normal dogs. ($\bar{X} \pm \text{SD}$)

		control	hour after NE infusion				
			1 1/2	2	2 1/2	3	4
U_{Na} V (Eq/min)	Lt	39.70 \pm 17.33 (1.06 \pm 0.25)	14.56 \pm 3.88* (2.57 \pm 1.40)	17.40 \pm 0.17 (2.10 \pm 0.26)	21.10 \pm 2.36 (2.10 \pm 0.82)	34.13 \pm 33.23 (2.23 \pm 1.23)	43.70 \pm 57.80 (2.070 \pm 1.45)
	Rt	57.80 \pm 33.15 (1.43 \pm 0.90)	84.37 \pm 53.8* (2.10 \pm 0.83)	95.10 \pm 71.70* (2.10 \pm 0.82)	102.30 \pm 87.90* (2.25 \pm 0.80)	84.0 \pm 109.10* (1.80 \pm 0.60)	64.97 \pm 54.10 (1.63 \pm 0.59)
U_{K} V (Eq/min)	Lt	12.57 \pm 5.12 (17.6 \pm 2.16)	7.29 \pm 7.54* (20.7 \pm 7.75)	6.83 \pm 5.52* (26.8 \pm 7.4)	7.73 \pm 6.15 (30.4 \pm 4.0)	8.83 \pm 4.74 (31.7 \pm 4.5)	10.0 \pm 5.30 (32.6 \pm 4.9)
	Rt	16.73 \pm 6.95 (20.07 \pm 2.17)	20.7 \pm 0.61 (27.8 \pm 3.23)	21.5 \pm 3.93 (28.11 \pm 5.37)	22.6 \pm 6.35 (31.63 \pm 5.0)	22.67 \pm 6.5 (28.08 \pm 2.70)	18.63 \pm 2.95 (27.8 \pm 0.74)
U_{Cl} V (Eq/min)	Lt	34.67 \pm 18.62 (0.93 \pm 0.50)	13.6 \pm 3.85* (2.38 \pm 1.09)	15.63 \pm 1.12* (2.55 \pm 1.30)	16.37 \pm 6.27 (2.19 \pm 1.0)	30.27 \pm 31.14 (2.73 \pm 1.80)	39.87 \pm 51.38 (2.20 \pm 1.50)
	Rt	54.7 \pm 42.84 (1.03 \pm 0.82)	117.8 \pm 126.6* (1.67 \pm 0.94)	79.63 \pm 69.4 (1.63 \pm 0.97)	97.3 \pm 98.1* (1.80 \pm 0.88)	91.17 \pm 99.70* (1.50 \pm 0.76)	54.0 \pm 48.5 (1.43 \pm 0.65)
U_{P} V (gm/min)	Lt	6.30 \pm 5.5 (23.8 \pm 9.0)	1.20 \pm 0.90 (31.4 \pm 11.3)	1.10 \pm 0.92 (29.1 \pm 1.6)	1.20 \pm 1.06 (35.7 \pm 1.7)	1.32 \pm 1.12 (38.1 \pm 7.1)	1.60 \pm 1.30 (33.9 \pm 10.2)
	Rt	22.5 \pm 4.7 (25.2 \pm 5.1)	44.9 \pm 16.1* (36.8 \pm 4.4)	43.4 \pm 19.6 (36.6 \pm 6.4)	50.0 \pm 19.0 (47.9 \pm 8.6)	35.8 \pm 11.2 (39.1 \pm 17.9)	38.9 \pm 13.8 (44.8 \pm 7.4)
C_{osm} (ml/min)	Lt	0.557 \pm 0.135	0.453 \pm 0.220	0.420 \pm 0.191	0.477 \pm 0.246	1.13 \pm 0.781	0.40 \pm 0.20
	Rt	0.666 \pm 0.042	0.80 \pm 0.10	0.80 \pm 0.10	0.777 \pm 0.112	0.737 \pm 0.138	0.67 \pm 0.132
$C_{\text{H}_2\text{O}}$ (ml/min)	Lt	-0.38 \pm 0.113	-0.293 \pm 0.182	-0.273 \pm 0.170	-0.327 \pm 0.188	-0.337 \pm 0.203	-0.287 \pm 0.176
	Rt	-0.50 \pm 0.072	-0.59 \pm 0.061	-0.557 \pm 0.118	-0.570 \pm 0.036	-0.547 \pm 0.085	-0.51 \pm 0.104

*Figure in parenthesis indicated fractional excretion of electrolytes
P. Value with respect to control, $P < 0.05$

Table 10 Effects of intrarenal arterial infusion of norepinephrine on urinary and fractional excretion of electrolytes (Na^+ , K^+ , Cl^- , P), osmolar clearance and free water clearance in four dogs treated with TCDO 0.005 mg/kg. ($\bar{X} \pm \text{S.E.}$)

		control	hour after NE infusion				
			1 1/2	2	2 1/2	3	4
$U_{\text{Na}} V$ (Eq/min)	Lt	18.45±2.82 (3.47±0.08)	23.5 ±3.18 (4.22±1.17)	27.47±10.67 (5.27±2.5)	26.4±8.70 (5.40±3.10)	24.93±7.23 (5.35±2.80)	24.05±7.74 (5.80±3.0)
	Rt	35.5 ± 9.36 (1.90±0.05)	73.6 ± 7.76* (2.74±0.12)	75.5 ± 7.75* (2.55±0.07)	84.3 ± 17.8* (2.60±0.12)	78.3±12.9* (2.62±0.11)	68.89±17.49 (2.64±0.09)
$U_{\text{K}} V$ (Eq/min)	Lt	5.05±3.10 (17.24±0.07)	5.49±3.46 (21.56±3.10)	6.08±4.66 (23.70±2.90)	7.40±4.70 (20.60±2.30)	6.73±3.79 (24.60±2.70)	7.23±3.90 (25.40±3.20)
	Rt	7.18±4.66 (13.38±0.06)	14.90±5.25* (23.30±1.30)	18.87±6.41 (27.50±1.10)	21.28±5.99 (27.50±0.09)	20.83±6.13 (27.60±0.08)	21.88±6.13* (26.0±0.07)
$U_{\text{Cl}} V$ (Eq/min)	Lt	14.65±1.62 (3.62±0.05)	25.15±6.22 (8.20±2.30)	27.15±16.87 (5.80±2.50)	27.89±16.88 (5.74±3.10)	27.03±16.36 (5.43±2.20)	25.03±14.97 (5.10±1.80)
	Rt	16.85±8.85 (2.80±0.06)	52.38±25.71* (5.60±3.40)	68.08±5.03* (5.50±2.70)	78.02±13.61** (5.40±2.80)	70.6±13.51* (6.50±3.20)*	62.1±18.98* (3.40±1.90)
$U_{\text{P}} V$ (gm/min)	Lt	21.15±1.50 (21.9±7.5)	11.1±6.3 (27.9±7.9)	11.2±8.3 (34.4±10.2)	12.3 ±8.6 (37.3±11.5)	13.0±11.0 (34.2±9.6)	14.7 ±11.7 (35.2±9.9)
	Rt	16.3±2.3 (28.5±6.7)	27.2±9.0 (36.7±8.5)	34.2±10.4 (46.2±7.4)	36.3±12.9 (47.5±7.6)	43.6±18.0* (57.5±8.8)	44.4±21.4* (53.4±6.3)
C_{osm} (ml/min)	Lt	0.723±0.450	0.773±1.080	0.608±0.902	0.610±0.889	0.448±0.568	0.70±0.911
	Rt	0.30 ±0.148	0.535±0.181	0.583±0.177	0.590±0.243	0.658±0.249	0.642±0.233
$C_{\text{H}_2\text{O}}$ (ml/min)	Lt	-0.605±0.60	-0.665±0.92	-0.440±0.590	-0.48±0.64	-0.12±0.07	-0.380±0.440
	Rt	-0.170±0.08	-0.190±0.12	-0.14±0.18	-0.160±0.24	-0.120±0.16	-0.10±0.12

*figure in parenthesis indicated fractional excretion of electrolytes

P. Value with respect to control, *P < 0.05), ** P < 0.01

Table 11 Effects of intrarenal arterial infusion of norepinephrine on urinary and fractional excretion of electrolytes (Na^+ , K^+ , Cl^- , P), osmolar clearance and free water clearance in four dogs treated with TCDO 0.01 mg/kg. ($\bar{X} \pm \text{S.E.}$)

		control	hour after NE infusion				
			1 1/2	2	2 1/2	3	4
$U_{\text{Na}} V$	Lt	48.5 \pm 9.34	68.37 \pm 3.08	62.37 \pm 8.29	48.4 \pm 6.17	63.97 \pm 7.26	65 \pm 13.65
	(Eq/min)	(4.65 \pm 0.07)	(6.04 \pm 3.40)	(6.45 \pm 3.04)	(4.0 \pm 2.12)	(6.13 \pm 3.20)	(7.0 \pm 4.1)
	Rt	78.97 \pm 10.51	88.85 \pm 2.70	82.4 \pm 2.88	77 \pm 3.07	70.75 \pm 5.70	65.75 \pm 1.87
		(2.55 \pm 0.07)	(3.0 \pm 0.14)	(2.85 \pm 0.07)	(2.65 \pm 0.20)	(2.4 \pm 0.28)	(2.5 \pm 0.30)
$U_{\text{K}} V$	Lt	15.43 \pm 1.18	16.63 \pm 0.71	15.45 \pm 0.95	15.28 \pm 0.99	16.6 \pm 0.95	16.5 \pm 1.47
	(Eq/min)	(32.57 \pm 2.10)	(36.23 \pm 2.80)	(20.40 \pm 2.80)	(20.40 \pm 2.50)	(37.80 \pm 2.0)	(30.10 \pm 2.3)
	Rt	11.58 \pm 0.95	17.3 \pm 0.62	21.15 \pm 0.51	23.50 \pm 0.42	20.6 \pm 1.02	17.83 \pm 1.14
		(19.20 \pm 0.05)	(23.2 \pm 1.20)	(28.8 \pm 0.09)	(28.50 \pm 0.12)	(28.10 \pm 0.30)	(25.0 \pm 0.10)
$U_{\text{Cl}} V$	Lt	43.2 \pm 1.22	57.05 \pm 1.10	62.43 \pm 1.78	56.25 \pm 8.28	71.9 \pm 2.20	73.8 \pm 2.99*
	(Eq/min)	(5.63 \pm 2.00)	(3.65 \pm 2.20)	(5.03 \pm 2.50)	(3.03 \pm 3.10)	(5.11 \pm 3.30)	(5.40 \pm 3.70)
	Rt	69.9 \pm 1.47	79.08 \pm 3.12	72.4 \pm 4.28	71.1 \pm 1.54	59.18 \pm 3.22	63.53 \pm 1.16
		(3.42 \pm 0.10)	(4.64 \pm 1.80)	(4.10 \pm 1.30)	(3.02 \pm 1.25)	(3.04 \pm 2.20)	(3.20 \pm 1.80)
$U_{\text{P}} V$	Lt	25.73 \pm 7.4	9.07 \pm 4.5*	8.2 \pm 3.4*	10.4 \pm 4.7*	10.5 \pm 4.4*	12.7 \pm 6.11*
	(gm/min)	(28.2 \pm 3.37)	(31.5 \pm 4.6)	(32.5 \pm 5.6)	(31.33 \pm 3.6)	(32.03 \pm 4.3)	(31.35 \pm 2.7)
	Rt	38.8 \pm 8.6	45.17 \pm 7.5	48.18 \pm 2.84	54 \pm 10	52.2 \pm 12.6	50.8 \pm 12.4
		(36.5 \pm 5.8)	(45.1 \pm 7)	(44.3 \pm 2.8)	(46.7 \pm 5.4)	(44.8 \pm 4.7)	(42.3 \pm 6.62)
C_{osm}	Lt	0.680 \pm 0.429	0.250 \pm 0.156	0.425 \pm 0.198	0.423 \pm 0.178	0.580 \pm 0.194	0.623 \pm 0.262
	(ml/min)	Rt	0.521 \pm 0.194	1.103 \pm 0.276	1.070 \pm 0.236	1.130 \pm 0.248	1.010 \pm 0.161
$C_{\text{H}_2\text{O}}$	Lt	-0.123 \pm 0.434	0.125 \pm 0.197	0.047 \pm 0.166	-0.080 \pm 0.139	-0.158 \pm 0.223	-0.028 \pm 0.179
	(ml/min)	Rt	-0.395 \pm 0.086	-0.633 \pm 0.102	-0.635 \pm 0.059	-0.725 \pm 0.050	-0.64 \pm 0.082

* Figure in parenthesis indicated fractional excretion of electrolytes
P value with respect to control, *P < 0.05

Table 12 Effects of intrarenal arterial infusion of norepinephrine on urinary and fractional excretion of electrolytes (Na^+ , K^+ , Cl^- , P), osmolar clearance and free water clearance in four dogs treated with furosemide 10 mg/kg. ($\bar{X} \pm \text{SD}$)

		control	hour after NE infusion				
			1 1/2	2	2 1/2	3	4
$U_{\text{Na}} V$ (Eq/min)	Lt	60.78 \pm 38.28	217.28 \pm 110.20 ^{***}	190.54 \pm 107.25 ^{**}	154.7 \pm 86.8 ^{**}	127.1 \pm 70.8 [*]	107.3 \pm 51.4 [*]
	Rt	(2.46 \pm 1.40)	(19.74 \pm 11.30) ^{**}	(15.39 \pm 6.10)	(10.68 \pm 4.20)	(10.42 \pm 3.16)	(9.73 \pm 3.90)
$U_{\text{K}} V$ (Eq/min)	Lt	72.30 \pm 30.70	272.2 \pm 99.70 ^{***}	255.4 \pm 92.3 ^{***}	230.5 \pm 106.2 ^{***}	210.7 \pm 119.5 ^{***}	170.8 \pm 85.3 ^{**}
	Rt	(2.47 \pm 0.90)	(12.96 \pm 4.70) ^{**}	(12.29 \pm 5.20)	(10.76 \pm 5.80)	(9.13 \pm 5.0)	(8.30 \pm 4.60)
U_{Cl} (Eq/min)	Lt	10.10 \pm 2.99	20.15 \pm 7.58 [*]	17.70 \pm 6.59	15.30 \pm 8.26	18.0 \pm 9.31	16.4 \pm 8.98
	Rt	(15.08 \pm 1.90)	(80.0 \pm 38.8) ^{**}	(66.83 \pm 25.3)	(52.6 \pm 22.3)	(54.4 \pm 16.8)	(54.4 \pm 20.2)
$U_{\text{P}_i} V$ (gm/min)	Lt	10.80 \pm 2.38	31.28 \pm 12.50 [*]	29.60 \pm 13.30 [*]	28.17 \pm 15.74 [*]	25.3 \pm 14.1 [*]	23.6 \pm 9.32 [*]
	Rt	(16.38 \pm 3.70)	(64.9 \pm 21.1) ^{**}	(50.08 \pm 12.7)	(54.4 \pm 30)	(47.9 \pm 21.0)	(47.6 \pm 17.1)
C_{osm} (ml/min)	Lt	53.05 \pm 34.3	71.6 \pm 51.3 [*]	229.8 \pm 113.3 ^{***}	202.3 \pm 121.5 ^{**}	145.3 \pm 89.7 ^{**}	136.1 \pm 75.1 ^{**}
	Rt	(2.62 \pm 1.7)	(26.78 \pm 13.13) [*]	(21.3 \pm 7.2)	(15.9 \pm 6.47)	(15.0 \pm 4.4)	(13.9 \pm 5.8)
$C_{\text{H}_2\text{O}}$ (ml/min)	Lt	68.2 \pm 33.54	293.7 \pm 105.6 ^{**}	269.1 \pm 100.1 ^{***}	239.7 \pm 105.7 ^{***}	217.6 \pm 125.9 ^{**}	177.8 \pm 79.4 ^{**}
	Rt	(2.40 \pm 1.0)	(18.12 \pm 6.09) [*]	(17.35 \pm 7.4)	(14.5 \pm 7.6)	(12.63 \pm 7.0)	(11.6 \pm 6.05) ^{**}
$C_{\text{H}_2\text{O}}$ (ml/min)	Lt	13.25 \pm 7.19	10.07 \pm 8.23	11.09 \pm 9.27	10.10 \pm 9.18	11.14 \pm 10.19	10.8 \pm 9.6
	Rt	(21.9 \pm 8.5)	(10.9 \pm 2.6)	(15.6 \pm 2.8)	(15.3 \pm 2.8)	(19.23 \pm 3.6)	(19.3 \pm 2.6)
C_{osm} (ml/min)	Lt	20.9 \pm 7.9	21.73 \pm 8.5	22.7 \pm 11.2	26.6 \pm 14.4	32.6 \pm 16.4	33.12 \pm 18.20 [*]
	Rt	(35.2 \pm 18.5)	(12.5 \pm 2.5)	(14.3 \pm 2.6)	(17.5 \pm 5.8)	(28.9 \pm 9.8)	(32.5 \pm 9.6)
C_{osm} (ml/min)	Lt	0.853 \pm 0.461	1.665 \pm 1.051 [*]	1.80 \pm 1.019 [*]	1.305 \pm 0.694	1.42 \pm 0.682	1.168 \pm 0.589 [*]
	Rt	0.68 \pm 0.169	2.30 \pm 0.572 [*]	2.19 \pm 0.533 [*]	2.075 \pm 0.680 [*]	1.715 \pm 0.889 [*]	1.668 \pm 0.750 [*]
$C_{\text{H}_2\text{O}}$ (ml/min)	Lt	-0.573 \pm 0.331	0.343 \pm 0.926 ^{**}	0.208 \pm 0.494 ^{**}	0.020 \pm 0.395	-0.243 \pm 0.206	-0.099 \pm 0.296
	Rt	-0.555 \pm 0.202	-0.045 \pm 0.105 ^{**}	-0.059 \pm 0.263	-0.138 \pm 0.457	-0.20 \pm 0.29	-0.28 \pm 0.22

^{*} Figure in parenthesis indicated fractional excretion of electrolytes
P. Value with respect to control, ^{*}P < 0.05, ^{**}P < 0.01, ^{***}P < 0.001

Table 13 Effects of intrarenal arterial infusion of norepinephrine infusion on oxygen uptake (O_2 uptake), respiratory quotient (RQ) and oxygen extraction ratio in dogs.

		control	4 hours after NE infusion
	O_2 uptake (mmole/min)	5.3 \pm 0.872	3.433 \pm 1.29
Group I	RQ	3.9 \pm 2.66	1.313 \pm .95
	O_2 extraction ratio	.16 \pm .07	.22 \pm .05
	O_2 uptake (mmole/min)	5 \pm 4.5	2.93 \pm 2.03
Group II	RQ	1.38 \pm 1.032	4.35 \pm 1.33 ^{*o}
	O_2 extraction ratio	.13 \pm .06	.13 \pm .07
	O_2 uptake (mmole/min)	4.03 \pm 2.65	2.963 \pm 1.54
Group III	RQ	2.2 \pm 0.7	3.84 \pm 2.7 ^{*o}
	O_2 extraction ratio	.13 \pm .02	.15 \pm .07
	O_2 uptake (mmole/min)	5.23	4.34 \pm 1.57
Group IV	RQ	2.23 \pm 2.17	1.67 \pm 0.58
	O_2 extraction ratio	.19 \pm .13	.2 \pm .11

P.Value with respect to control group (Group I), *P < 0.05

P> Value with respect to group IV, °P < 0.05

จุฬาลงกรณ์มหาวิทยาลัย

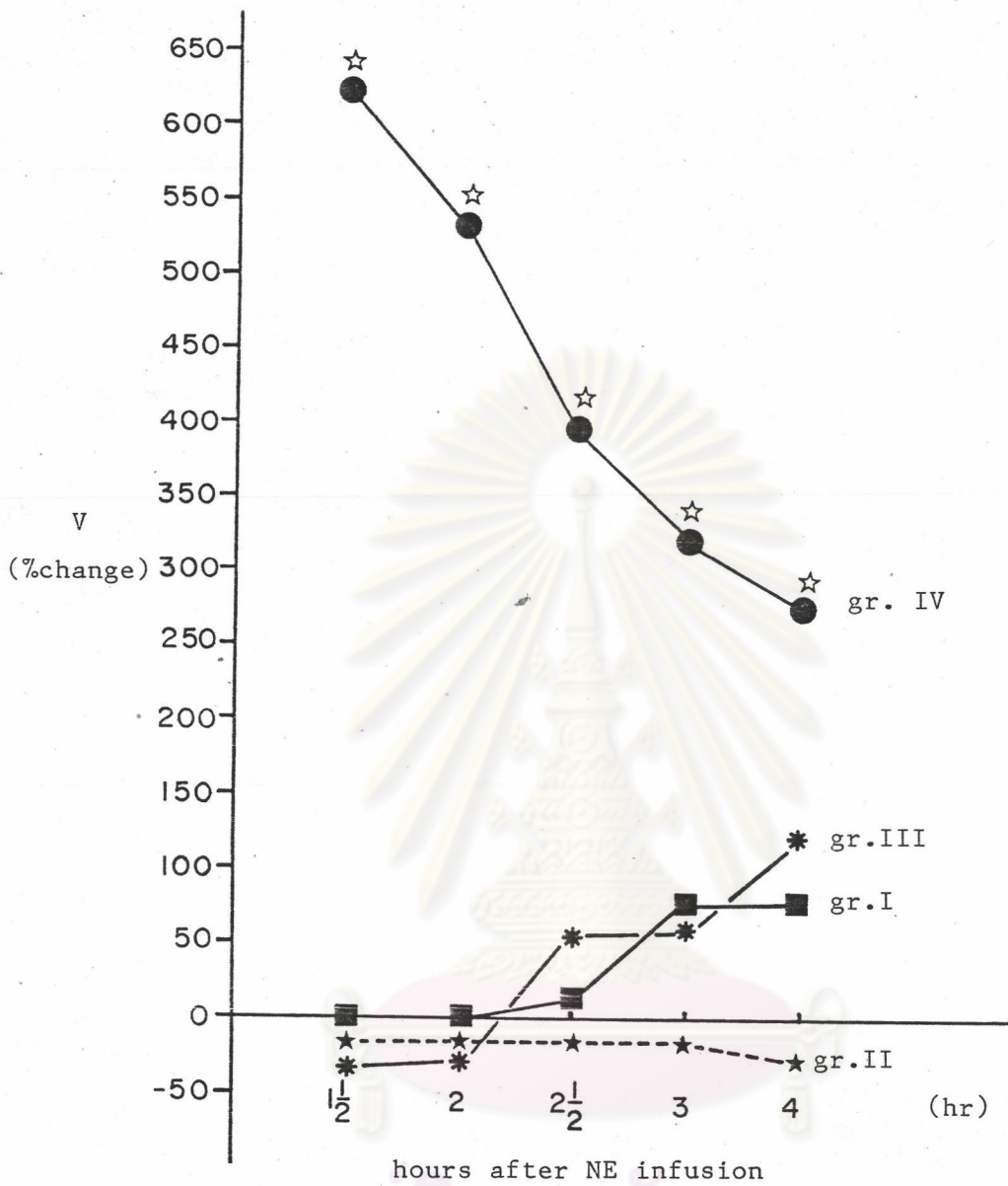


Fig. 1 Percentage changes in urine flow rate in left kidney as compared to control period of each group in four groups of animals.

p-value with respect to group I at the same time interval,
 ☆P < 0.01

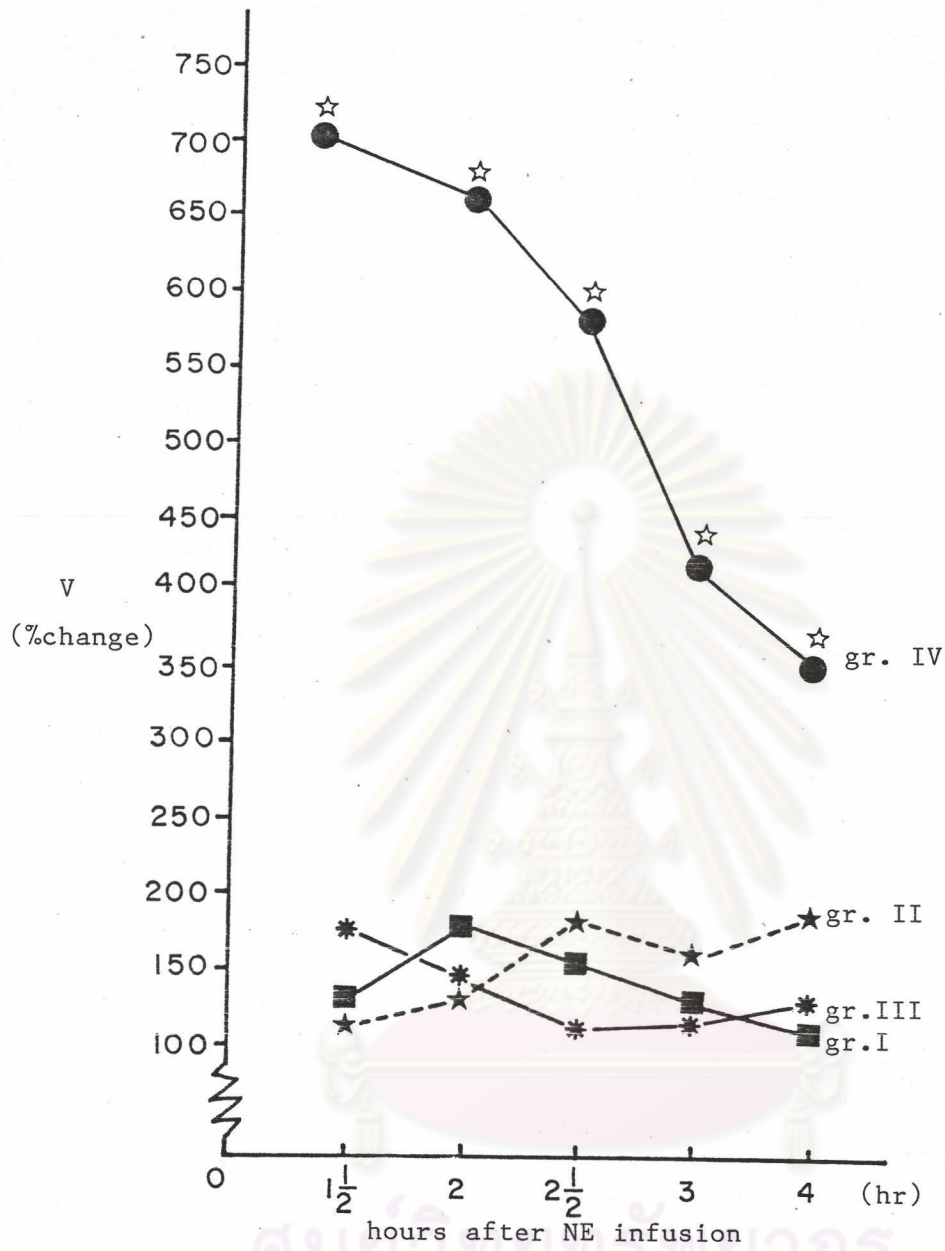


Fig. 2 Percentage changes in urine flow rate in right kidney as compared to control period of each group in four groups of animals.

p-value with respect to group I at the same time interval,

☆P < 0.01

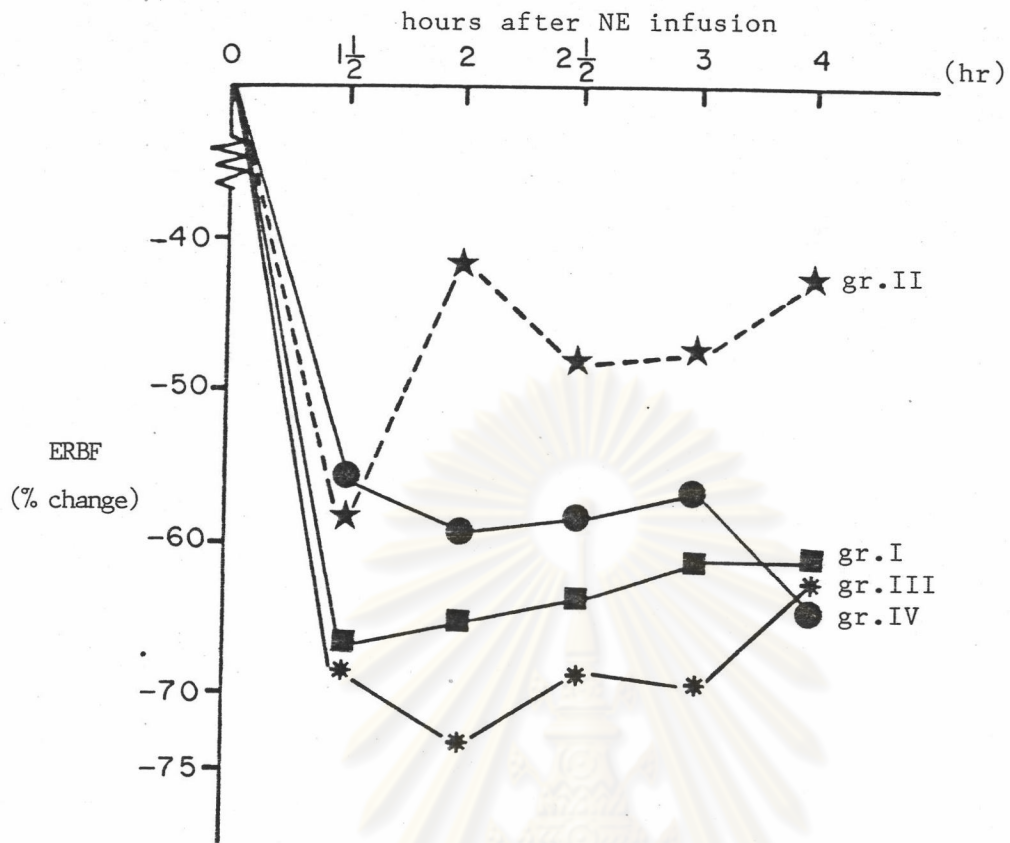


Fig. 3 Percentage change in effective renal plasma flow in left kidney as compared to control period of each group in four groups of animals.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

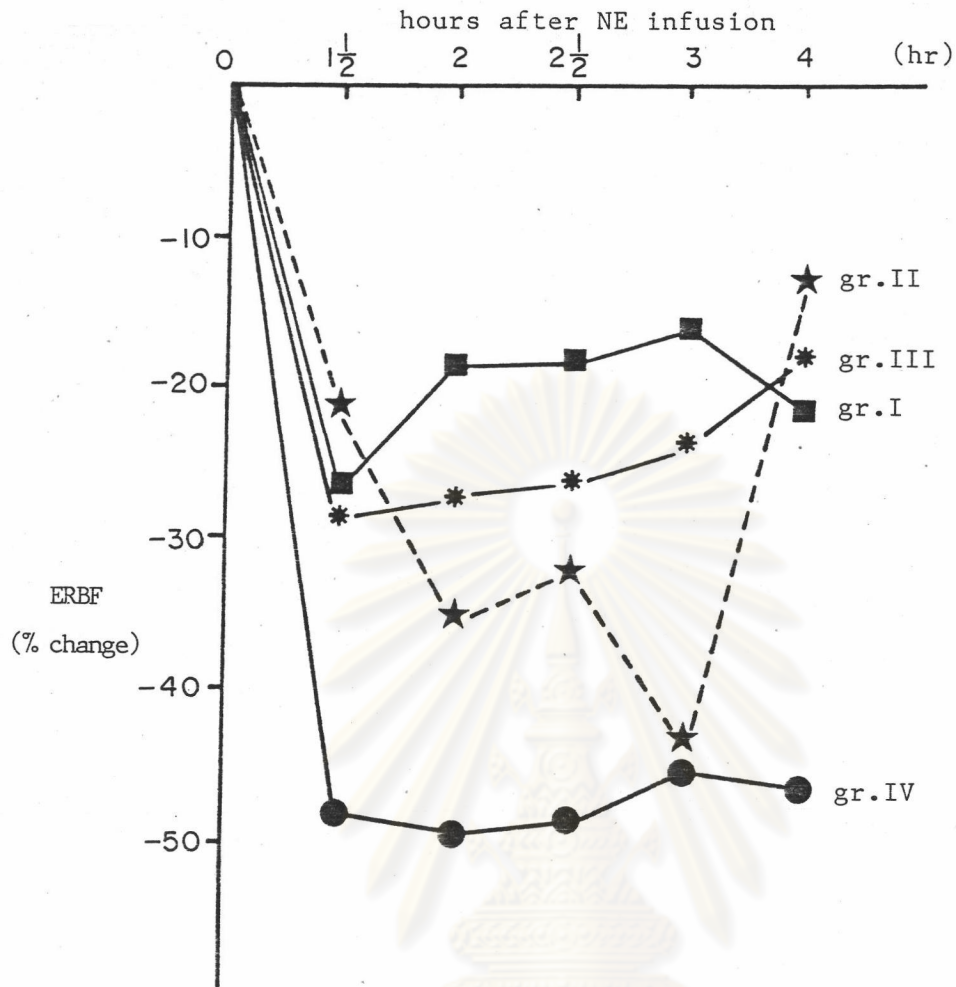


Fig. 4 Percentage changes in effective renal plasma flow in right kidney as compared to control period of each group in four groups of animals.

จุฬาลงกรณ์มหาวิทยาลัย

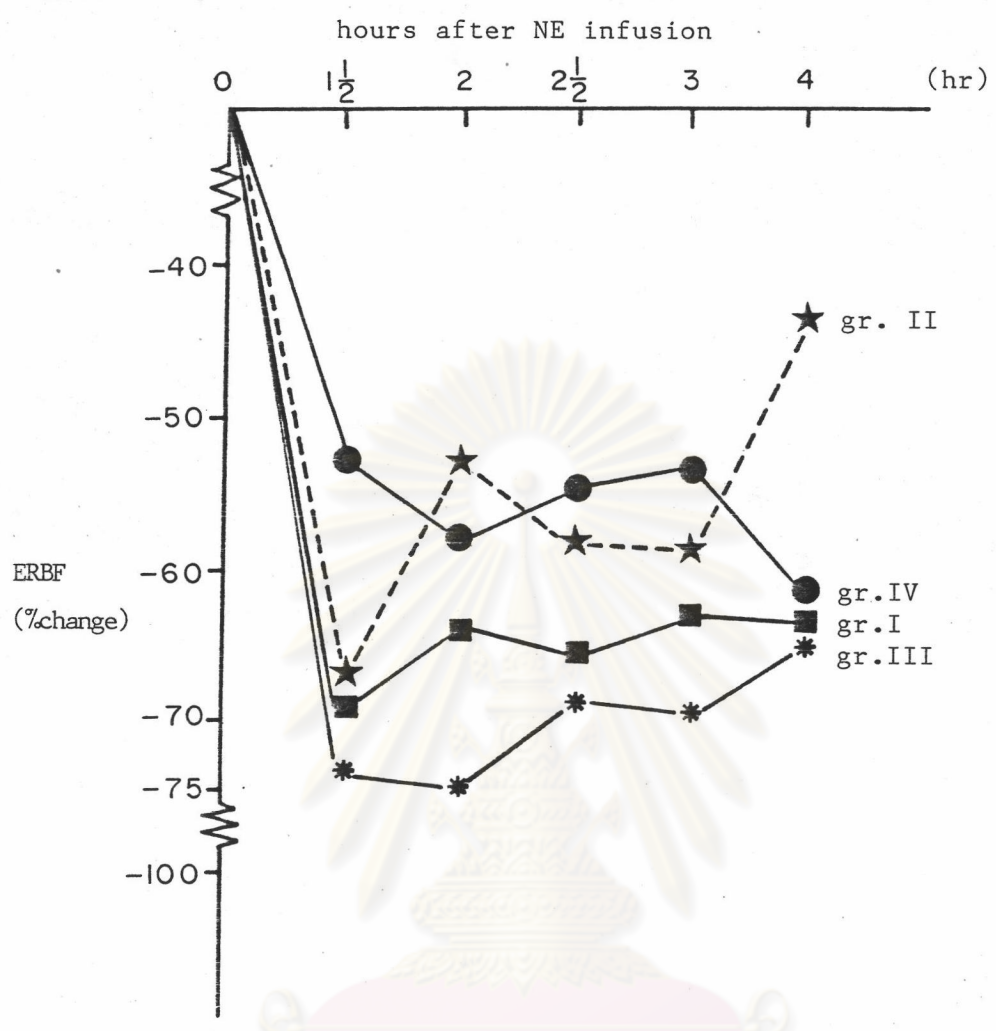


Fig.5 Percentage changes in effective renal blood flow in left kidney as compared to control period of each group in four groups of animals.

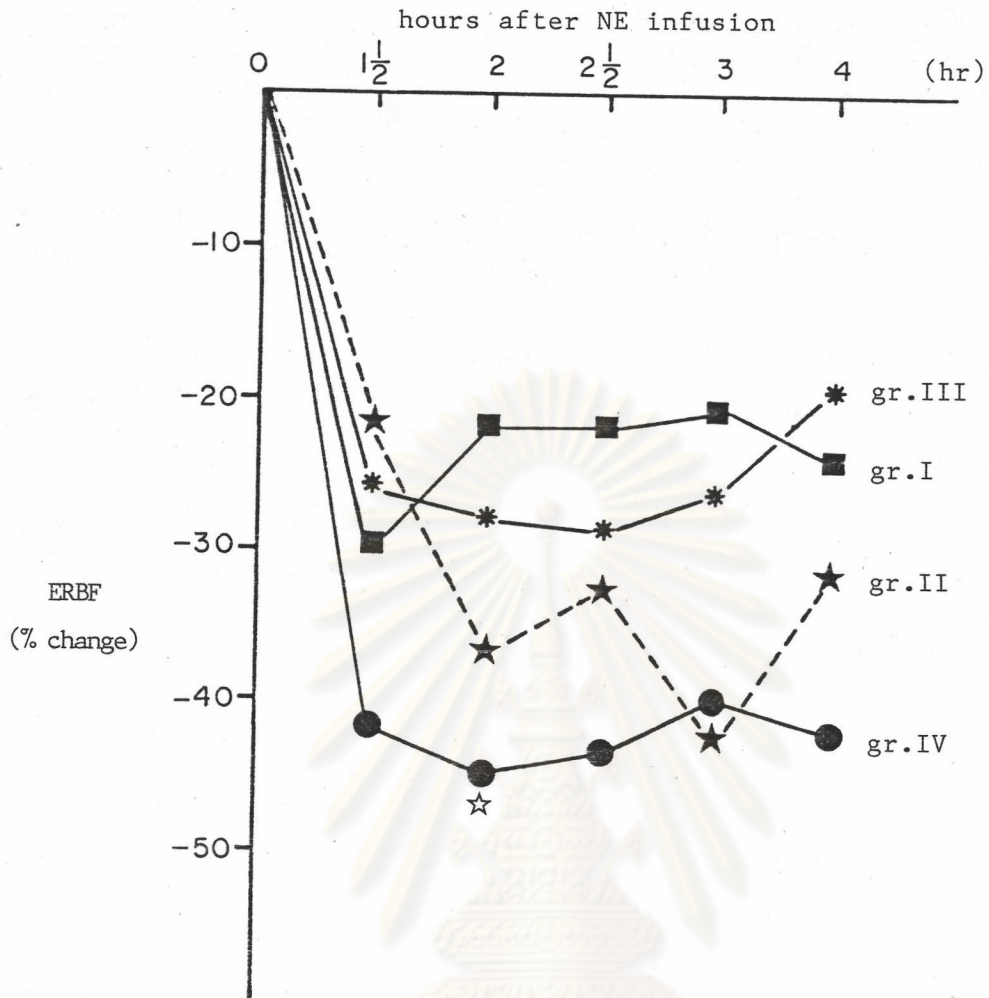


Fig. 6 Percentage changes in effective renal blood flow in right kidney as compared to control period of each group in four groups of animals.

p-value with respect to group I at the same time interval,
 $\star P < 0.05$

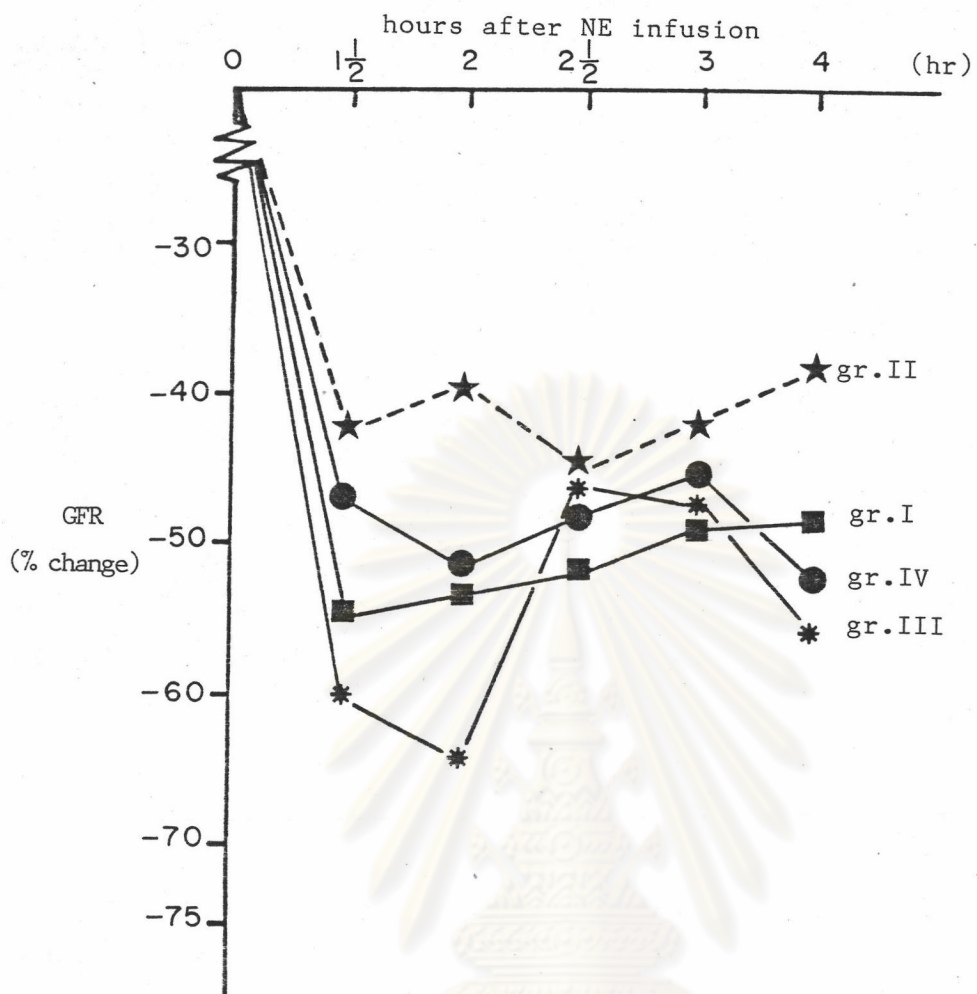


Fig. 7 Percentage changes in glomerular filtration rate in left kidney as compared to control period of each group in four groups of animals.

จุฬาลงกรณ์มหาวิทยาลัย