



CHAPTER IV

RESULTS

GROUP I (CONTROL ANIMALS)

GENERAL CIRCULATION

Effects of hypertonic and hypotonic saline intrarenal infusion on general circulation of six dogs in group I are shown in Table 1. During intrarenal infusion of hypertonic saline (537 mOsm/kg) and hypotonic saline (27 mOsm/kg) solutions, each period was 10 minutes, it was found that cardiac output (CO), mean arterial pressure (MAP), heart rate (HR), total peripheral resistance (TPR), packed cell volume (PCV), plasma volume (PV) and blood volume (BV) changed insignificantly.

There were some systemic changes during hypotonic saline infusion, since effective renal plasma flow (ERPF) and renal blood flow (RBF) decreased significantly ($P < 0.05$) in the contralateral kidney. During hypertonic saline infusion, there were no significant changes in ERPF, RBF and RVR of the contralateral kidney. Thus, general circulation would not be effected by hypertonic saline solution.

RENAL FUNCTIONS

In the control animals, the effects of hypertonic and hypotonic saline infusion on renal hemodynamics were shown in Table 2,3,4,5. The results were compared with the control state of the same kidney.

Table 1 Effects of hypertonic and hypotonic saline infusion on general circulation of six dogs in the control group.

	Isotonic saline	Hypertonic saline	Hypotonic saline
CO (ml/min/kg)	111.13 ± 30.79	104.04 ± 28.54 ^{NS}	122.79 ± 55.31 ^{NS}
MAP (mmHg)	121.89 ± 21.59	122.56 ± 20.49 ^{NS}	128.67 ± 18.93 ^{NS}
HR (beat/min)	139.00 ± 20.00	146.00 ± 20.00 ^{NS}	127.00 ± 22.00 ^{NS}
TPR(dyne-sec/cm ⁵ /kg)	503.39 ± 285.39	531.25 ± 247.10 ^{NS}	548.49 ± 394.67 ^{NS}
PCV (%)	31.00 ± 6.09	29.83 ± 7.08 ^{NS}	28.50 ± 5.86 ^{NS}
PV (ml/kg)	53.82 ± 14.91	61.73 ± 12.26 ^{NS}	47.43 ± 13.01 ^{NS}
BV (ml/kg)	84.90 ± 20.00	89.17 ± 19.65 ^{NS}	67.35 ± 21.94 ^{NS}

Values were statistically significantly different by paired t-test with respect to the same state of control. (NS = not significant)

(MEAN ± SD.)

Table 2 Effects of hypertonic and hypotonic saline infusion on renal hemodynamics compared with the control state in the control group. (MEAN \pm SD.)

	Urine flow (ml/min)	GFR (ml/min/100gm)	ERPF (ml/min/100gm)	RBF (ml/min/100gm)	FF (%)	Renal fraction (%)	RVR ⁵ (dyne-sec/cm ⁵ /100gm)
EFFECT OF HYPERTONIC SALINE							
- Contralateral kidney	0.27 \pm 0.15	66.66 \pm 13.81	193.91 \pm 40.06	292.02 \pm 84.00	34.51 \pm 5.51	7.67 \pm 2.57	34530.36 \pm 5697.39
- Infused kidney (isotonic)	0.32 \pm 0.14	61.39 \pm 15.53	179.97 \pm 41.47	265.94 \pm 78.05	34.11 \pm 3.15	7.21 \pm 2.45	38028.71 \pm 6065.99
- Contralateral kidney	0.28 \pm 0.14 ^{NS}	58.97 \pm 21.71 ^{NS}	198.27 \pm 65.93 ^{NS}	290.93 \pm 112.70 ^{NS}	30.91 \pm 9.73 ^{NS}	8.52 \pm 4.51 ^{NS}	37707.89 \pm 13802.13 ^{NS}
- Infused kidney (hypertonic)	0.62 \pm 0.42 [*]	69.12 \pm 13.02 ^{NS}	199.13 \pm 58.02 ^{NS}	289.69 \pm 100.84 ^{NS}	35.99 \pm 7.58 ^{NS}	8.57 \pm 4.22 ^{NS}	35931.84 \pm 8209.58 ^{NS}
EFFECT OF HYPOTONIC SALINE							
- Contralateral kidney	0.42 \pm 0.28	77.44 \pm 24.55	205.21 \pm 90.97	299.27 \pm 149.87	40.09 \pm 10.11	7.67 \pm 2.57	39049.34 \pm 16011.19
- Infused kidney (isotonic)	0.56 \pm 0.40	74.29 \pm 21.72	176.86 \pm 76.66	273.01 \pm 121.49	46.13 \pm 15.61	7.21 \pm 2.45	43857.13 \pm 22419.20
- Contralateral kidney	0.41 \pm 0.24 ^{NS}	76.03 \pm 33.08 ^{NS}	175.52 \pm 80.37 [*]	251.55 \pm 125.50 [*]	45.37 \pm 15.79 ^{NS}	6.49 \pm 3.82 ^{NS}	48740.96 \pm 21865.69 [*]
- Infused kidney (hypotonic)	0.43 \pm 0.38 ^{NS}	60.14 \pm 27.14 ^{NS}	144.22 \pm 55.41 ^{NS}	215.74 \pm 82.88 [*]	41.99 \pm 12.47 ^{NS}	5.31 \pm 2.61 ^{NS}	54635.97 \pm 25522.11 [*]

Values were statistically significantly different by paired t-test (*p < 0.05, NS = not significant)

Table 3 Effects of hypertonic and hypotonic saline infusion on plasma concentration of electrolytes (P_E) compared with control state in the control group. (MEAN \pm SD.)

Plasma concentration	Isotonic saline	Hypertonic saline	Hypotonic saline
Na (mEq/L)	140.00 \pm 3.95	139.17 \pm 7.49 ^{NS}	138.17 \pm 2.32 ^{NS}
K (mEq/L)	2.78 \pm 0.20	2.80 \pm 0.29 ^{NS}	3.13 \pm 0.33 ^{NS}
Cl (mEq/L)	117.83 \pm 5.95	113.84 \pm 10.91 ^{NS}	114.00 \pm 12.28 ^{NS}
Ca (mg%)	7.46 \pm 0.61	7.51 \pm 0.29 ^{NS}	7.45 \pm 0.43 ^{NS}
Pi (mg%)	2.78 \pm 0.64	2.85 \pm 0.71 ^{NS}	2.73 \pm 0.69 ^{NS}

Values were statistically significantly different by paired t-test. (NS = not significant)

Table 4 Effects of hypertonic and hypotonic saline infusion on urinary excretion of electrolytes ($U_E V$) and fractional excretion of electrolytes (FE_E) compared with the control state in the control group. (MEAN \pm S.D.)

	$U_{Na} V$ (uEq/min/kg)	$U_K V$ (uEq/min/kg)	$U_{Cl} V$ (uEq/min/kg)	$U_{Ca} V$ (mg%/min/kg)	$U_{Pi} V$ (mg%/min/kg)	FE_{Na} (%)	FE_K (%)	FE_{Cl} (%)	FE_{Ca} (%)	FE_{Pi} (%)
EFFECT OF HYPERTONIC SALINE										
contralateral kidney	3.28 \pm 1.88	0.74 \pm 0.25	2.22 \pm 2.05	0.07 \pm 0.06	1.09 \pm 0.58	1.28 \pm 0.71	14.16 \pm 5.21	1.23 \pm 1.02	0.58 \pm 0.54	20.29 \pm 8.27
fused kidney (isotonic)	4.46 \pm 2.22	0.66 \pm 0.21	3.59 \pm 2.57	0.13 \pm 0.08	1.21 \pm 0.65	2.05 \pm 1.36	13.52 \pm 3.87	2.12 \pm 1.84	1.09 \pm 0.83	23.97 \pm 10.11
contralateral kidney	3.68 \pm 1.99 ^{NS}	0.78 \pm 0.19 ^{NS}	2.77 \pm 2.44 ^{NS}	0.09 \pm 0.05 ^{NS}	1.43 \pm 0.58 ^{NS}	1.82 \pm 1.11 ^{NS}	18.07 \pm 6.82 ^{NS}	1.71 \pm 1.58 ^{NS}	0.81 \pm 0.60 ^{NS}	31.14 \pm 8.88 ^{NS}
fused kidney (hypertonic)	7.83 \pm 5.31*	0.93 \pm 0.24*	7.38 \pm 6.03*	0.18 \pm 0.13 ^{NS}	1.47 \pm 0.66 ^{NS}	3.24 \pm 2.55 ^{NS}	17.75 \pm 8.03 ^{NS}	3.84 \pm 3.45 ^{NS}	1.34 \pm 1.15 ^{NS}	26.49 \pm 10.14 ^{NS}
EFFECT OF HYPOTONIC SALINE										
contralateral kidney	5.11 \pm 3.81	1.11 \pm 0.92	4.13 \pm 4.20	0.10 \pm 0.07	1.71 \pm 0.61	1.91 \pm 1.60	18.18 \pm 14.83	1.97 \pm 2.08	0.66 \pm 0.49	32.72 \pm 13.98
fused kidney (isotonic)	6.24 \pm 4.61	1.29 \pm 0.92	5.33 \pm 4.77	0.09 \pm 0.06	1.40 \pm 0.63	2.38 \pm 1.93	21.77 \pm 15.29	2.51 \pm 2.34	0.67 \pm 0.50	26.86 \pm 12.21
contralateral kidney	4.93 \pm 3.28 ^{NS}	1.33 \pm 0.87 ^{NS}	3.85 \pm 3.42 ^{NS}	0.09 \pm 0.06 ^{NS}	1.81 \pm 0.62 ^{NS}	1.63 \pm 0.82 ^{NS}	21.66 \pm 12.17 ^{NS}	2.03 \pm 1.63 ^{NS}	0.73 \pm 0.83 ^{NS}	36.96 \pm 13.21 ^{NS}
fused kidney (hypotonic)	4.91 \pm 4.49 ^{NS}	1.28 \pm 1.06 ^{NS}	3.86 \pm 4.77 ^{NS}	0.08 \pm 0.05 ^{NS}	1.35 \pm 0.61 ^{NS}	2.22 \pm 1.49 ^{NS}	25.25 \pm 15.90 ^{NS}	2.36 \pm 2.13 ^{NS}	0.79 \pm 0.53 ^{NS}	33.16 \pm 16.76 ^{NS}

Values were statistically significantly different by paired t-test. (*p < 0.05, NS = not significant)

Table 5 Effects of hypertonic and hypotonic saline infusion on plasma osmolarity, urine osmolarity, U/P osmolarity ratio, osmolar clearance and free water clearance compared with the control state in the control group. (MEAN \pm SD.)

	Plasma osmolarity (mOsm/L)	Urine osmolarity (mOsm/L)	U/P osmolarity ratio	Osmolar clearance (ml/min)	Free water clearance (ml/min)
EFFECT OF HYPERTONIC SALINE					
- Contralateral kidney		915.13 \pm 635.81	3.21 \pm 2.22	0.67 \pm 0.35	- 0.40 \pm 0.40
- Infused kidney (isotonic)	287.10 \pm 10.42	729.87 \pm 475.54	2.55 \pm 1.66	0.64 \pm 0.24	- 0.32 \pm 0.33
- Contralateral kidney		854.93 \pm 640.97 ^{NS}	2.99 \pm 2.26 ^{NS}	0.67 \pm 0.34 ^{NS}	- 0.39 \pm 0.36 ^{NS}
- Infused kidney (hypertonic)	287.93 \pm 8.75 ^{NS}	663.13 \pm 483.24 ^{NS}	2.31 \pm 1.71 ^{NS}	0.92 \pm 0.19 ^{NS}	- 0.31 \pm 0.42 ^{NS}
EFFECT OF HYPOTONIC SALINE					
- Contralateral kidney		650.00 \pm 671.22	2.28 \pm 2.35	0.74 \pm 0.64	- 0.32 \pm 0.47
- Infused kidney (isotonic)	284.78 \pm 6.97	602.73 \pm 494.38	2.11 \pm 1.73	0.87 \pm 0.62	- 0.31 \pm 0.40
- Contralateral kidney		776.93 \pm 729.79 ^{NS}	2.72 \pm 2.54 ^{NS}	0.83 \pm 0.49 ^{NS}	- 0.42 \pm 0.37 ^{NS}
- Infused kidney (hypotonic)	286.10 \pm 4.19 ^{NS}	615.90 \pm 470.27 ^{NS}	2.15 \pm 1.64 ^{NS}	0.75 \pm 0.69 ^{NS}	- 0.32 \pm 0.38 ^{NS}

Values were statistically significantly different by paired t-test. (NS = not significant)

During the control period, the experimental kidney was infused with isotonic saline (290 mOsm/kg). In the experimental period, hypertonic saline (537 mOsm/kg) was then infused into the renal artery. It was calculated that sodium concentration in the renal artery was elevated by 2.67 ± 1.81 (Mean \pm S.D.) $\mu\text{Eq/ml/min}$. The rate of urine flow of the infused kidney was increased significantly ($P < 0.05$) from a mean value of 0.32 (mean \pm S.D.) ml/min to 0.62 (mean \pm S.D.) ml/min while the contralateral kidney was not markedly changed. The urinary excretion of sodium ($U_{\text{Na}}V$), potassium ($U_{\text{K}}V$) and chloride ($U_{\text{Cl}}V$) of the infused kidney were increased significantly ($P < 0.05$). The glomerular filtration rate (GFR), the effective renal plasma flow and the renal blood flow increased by approximately 13%, 11% and 9% respectively while the renal vascular resistance (RVR) decreased by approximately 5%. There were no marked changes in urinary excretion of calcium ($U_{\text{Ca}}V$), inorganic phosphorous ($U_{\text{Pi}}V$), plasma concentration of electrolytes (P_{E}), osmolar clearance (C_{Osm}) and free water clearance ($C_{\text{H}_2\text{O}}$). During hypertonic saline infusion, the renal hemodynamics of the contralateral kidney were not changed significantly.

Intrarenal infusion of hypotonic saline solution (27 mOsm/kg), it was calculated that sodium concentration in the renal artery was decreased by 2.87 ± 1.94 (Mean \pm S.D.) $\mu\text{Eq/ml/min}$. The RBF was decreased significantly whereas RVR increased significantly ($P < 0.05$). The rate of urine flow and GFR were decreased by approximately 23% and 18% respectively. Urinary sodium and chloride excretions were decreased proportionally to the rate of urine flow. The infusion of hypotonic saline caused slight decreases in $U_{\text{K}}V$, $U_{\text{Ca}}V$, $U_{\text{Pi}}V$, U/P osmolarity ratio, urine osmolarity and $C_{\text{H}_2\text{O}}$ while there were no significant changes

in plasma concentrations of electrolytes and plasma osmolarity. C_{Osm} was decreased by approximately 13% from the mean control value. The effect of hypotonic saline infusion on the contralateral kidney showed that ERPF and RBF decreased significantly ($P < 0.05$) while RVR increased significantly ($P < 0.05$). There were no significant changes in the rate of urine flow, GFR, $U_{Na}V$, U_KV , $U_{Cl}V$, $U_{Ca}V$, $U_{Pi}V$, plasma concentrations of electrolytes, urine osmolarity, C_{H_2O} and C_{Osm} .

GROUP II (HYPOTHYROID ANIMALS)

The present data show that the concentration of serum thyroxine (T_4) in the hypothyroid group was lower by approximately 87% as compared with the control group. The mass of thyroid gland and the kidney were not different from the control group (Table 16).

GENERAL CIRCULATION

It was found that HR in the hypothyroid group (Group II) decreased significantly ($P < 0.05$) with respect to the control group while CO, MAP, PV and BV did not change significantly (Figure 1). There were no changes in CO, MAP, HR, PCV, PV and BV during either hypertonic or hypotonic saline infusion (Table 6). There were some systemic changes during hypertonic saline infusion because $U_{Na}V$ and fractional excretion of sodium significantly increased ($P < 0.05$) in the contralateral kidney. No systemic alterations were seen in hypothyroid animals during hypotonic saline infusion.

Table 6 Effects of hypertonic and hypotonic saline infusion on general circulation of six dogs in the hypothyroid group.

	Isotonic saline	Hypertonic saline	Hypotonic saline
CO (ml/min/kg)	124,54 ± 88,86	95,12 ± 35,50 ^{NS}	85,12 ± 31,72 ^{NS}
MAP (mmHg)	102,11 ± 20,22	99,58 ± 16,81 ^{NS}	102,50 ± 20,12 ^{NS}
HR (beat/min)	110,00 ± 21,00	112,00 ± 15,00 ^{NS}	94,00 ± 23,00 ^{NS}
TPR (dyne ₅ sec/cm ⁵ /kg)	410,89 ± 234,95	436,87 ± 170,58 ^{NS}	529,29 ± 310,37 ^{NS}
PCV (%)	28,17 ± 8,68	28,00 ± 8,19 ^{NS}	27,58 ± 9,60 ^{NS}
PV (ml/kg)	67,75 ± 27,01	50,01 ± 10,53 ^{NS}	58,00 ± 20,98 ^{NS}
BV (ml/kg)	94,90 ± 40,00	70,80 ± 10,00 ^{NS}	87,50 ± 20,00 ^{NS}

Values were statistically significantly different by paired t-test with respect to the same state of control.

(NS = not significant) (MEAN ± SD)

Table 7 Effects of hypertonic and hypotonic saline infusion on renal hemodynamics compared with the control state in the hypothyroid group. (MEAN \pm S.D.)

	Urine flow (ml/min)	GFR (ml/min/100gm)	ERPF (ml/min/100gm)	RBF (ml/min/100gm)	FF (%)	Renal fraction (%)	RVR ₅ (dyne-sec/cm ⁵ /100gm)
EFFECT OF HYPERTONIC SALINE							
- Contralateral kidney	0.33 \pm 0.24	59.97 \pm 10.19	163.86 \pm 30.46	228.99 \pm 34.95	37.42 \pm 6.39	5.53 \pm 2.84	36238.76 \pm 8242.66
- Infused kidney (isotonic)	0.38 \pm 0.33	50.18 \pm 16.58	137.15 \pm 59.66	194.86 \pm 58.79	30.20 \pm 17.69	4.89 \pm 2.25	45483.75 \pm 16590.53
- Contralateral kidney	0.43 \pm 0.33 ^{NS}	52.59 \pm 13.31*	139.62 \pm 29.34 ^{NS}	193.14 \pm 40.07 ^{NS}	38.69 \pm 7.39 ^{NS}	5.26 \pm 2.19 ^{NS}	43130.42 \pm 13524.49 ^{NS}
- Infused kidney (hypertonic)	0.62 \pm 0.59 ^{NS}	43.53 \pm 13.46*	120.41 \pm 41.20 ^{NS}	166.28 \pm 55.69 ^{NS}	35.74 \pm 7.69 ^{NS}	5.13 \pm 2.84 ^{NS}	56429.17 \pm 33224.76 ^{NS}
EFFECT OF HYPOTONIC SALINE							
- Contralateral kidney	0.36 \pm 0.30	59.27 \pm 18.75	146.84 \pm 34.66	201.64 \pm 51.64	41.40 \pm 9.78	5.53 \pm 2.84	43340.77 \pm 18769.72
- Infused kidney (isotonic)	0.33 \pm 0.22	44.52 \pm 15.88	110.34 \pm 34.49	149.98 \pm 50.64	40.21 \pm 11.19	4.89 \pm 2.25	67985.38 \pm 54920.29
- Contralateral kidney	0.32 \pm 0.21 ^{NS}	60.60 \pm 15.72 ^{NS}	137.59 \pm 31.13 ^{NS}	189.62 \pm 32.89 ^{NS}	45.01 \pm 8.62 ^{NS}	5.73 \pm 1.94 ^{NS}	45643.30 \pm 17507.21 ^{NS}
- Infused kidney (hypotonic)	0.22 \pm 0.17*	33.92 \pm 13.15 ^{NS}	77.13 \pm 40.88 ^{NS}	107.68 \pm 58.92 ^{NS}	45.72 \pm 12.72 ^{NS}	3.34 \pm 1.61 ^{NS}	99972.32 \pm 56223.07 ^{NS}

Values were statistically significantly different by paired t-test. (*p < 0.05, NS = not significantly)



Table 8 Effects of hypertonic and hypotonic saline infusion on plasma concentration of electrolytes (P_E), compared with the control state in the hypothyroid group, (MEAN \pm SD.)

Plasma concentration	Isotonic saline	Hypertonic saline	Hypotonic saline
Na _e (mEq/L)	128.83 \pm 3.66	130.17 \pm 2.79 ^{NS}	129.33 \pm 2.66 ^{NS}
K (mEq/L)	2.90 \pm 0.69	2.71 \pm 0.59 ^{NS}	2.86 \pm 0.59 ^{NS}
Cl (mEq/L)	111.00 \pm 14.71	110.33 \pm 4.32 ^{NS}	111.83 \pm 6.01 ^{NS}
Ca (mg %)	5.56 \pm 1.79	5.38 \pm 1.42 ^{NS}	5.43 \pm 1.86 ^{NS}
Pi (mg %)	2.55 \pm 1.33	2.39 \pm 1.09 ^{NS}	2.41 \pm 1.09 ^{NS}

Values were statistically significantly different by paired t-test. (NS = not significant)

Table 9 Effects of hypertonic and hypotonic saline infusion on urinary excretion of electrolytes ($U_E V$) and fractional excretion of electrolytes (FE_E) compared with the control group in the hypothyroid group. (MEAN \pm S.D.)

	$U_{Na} V$ (μ Eq/min/kg)	$U_K V$ (μ Eq/min/kg)	$U_{Cl} V$ (μ Eq/min/kg)	$U_{Ca} V$ (mg%/min/kg)	$U_{Pi} V$ (mg%/min/kg)	FE_{Na} (%)	FE_K (%)	FE_{Cl} (%)	FE_{Ca} (%)	FE_{Pi} (%)
EFFECT OF HYPERTONIC SALINE										
contralateral kidney	2.89 \pm 2.41	0.94 \pm 0.28	3.09 \pm 3.98	0.07 \pm 0.07	1.10 \pm 0.77	1.72 \pm 1.79	23.51 \pm 5.39	2.19 \pm 3.39	1.00 \pm 1.08	31.24 \pm 20.30
fused kidney (isotonic)	3.61 \pm 3.86	0.85 \pm 0.27	3.86 \pm 5.21	0.09 \pm 0.13	0.85 \pm 0.57	3.72 \pm 3.68	25.52 \pm 6.51	2.75 \pm 4.13	1.39 \pm 1.92	31.98 \pm 22.71
contralateral kidney	3.90 \pm 2.69*	1.01 \pm 0.33 ^{NS}	4.30 \pm 3.65 ^{NS}	0.07 \pm 0.07 ^{NS}	1.21 \pm 0.82 ^{NS}	2.44 \pm 2.13*	27.95 \pm 8.84 ^{NS}	3.05 \pm 3.53 ^{NS}	1.19 \pm 1.21 ^{NS}	42.77 \pm 25.52*
fused kidney (hypertonic)	5.07 \pm 2.99 ^{NS}	0.98 \pm 0.34 ^{NS}	6.15 \pm 4.52 ^{NS}	0.06 \pm 0.05 ^{NS}	0.95 \pm 0.70 ^{NS}	3.32 \pm 2.61 ^{NS}	28.19 \pm 7.78 ^{NS}	4.86 \pm 5.11 ^{NS}	0.89 \pm 0.55 ^{NS}	39.99 \pm 25.79 ^{NS}
EFFECT OF HYPOTONIC SALINE										
contralateral kidney	3.38 \pm 2.83	0.99 \pm 0.27	3.68 \pm 5.18	0.11 \pm 0.19	1.22 \pm 0.72	1.93 \pm 1.74	27.05 \pm 8.86	2.45 \pm 3.79	1.28 \pm 2.02	37.69 \pm 21.72
fused kidney (isotonic)	3.18 \pm 2.63	0.81 \pm 0.29	2.57 \pm 1.95	0.07 \pm 0.05	0.92 \pm 0.69	3.56 \pm 3.16	28.13 \pm 9.89	1.91 \pm 1.49	1.54 \pm 1.87	37.69 \pm 24.97
contralateral kidney	3.41 \pm 2.88 ^{NS}	0.98 \pm 0.30 ^{NS}	2.44 \pm 2.19 ^{NS}	0.11 \pm 0.16 ^{NS}	1.47 \pm 0.88 ^{NS}	2.03 \pm 2.24 ^{NS}	25.09 \pm 6.51 ^{NS}	1.87 \pm 1.85 ^{NS}	1.37 \pm 1.95 ^{NS}	43.41 \pm 28.50 ^{NS}
fused kidney (hypotonic)	2.16 2.39*	0.63 0.35 ^{NS}	1.72 2.18 ^{NS}	0.04 0.05 ^{NS}	0.93 0.92 ^{NS}	1.75 1.03 ^{NS}	26.78 7.71 ^{NS}	1.62 1.12 ^{NS}	0.96 1.15 ^{NS}	39.98 27.13 ^{NS}

Values were statistically significantly different by paired t-test. (*p < 0.05, NS = not significant)

Table 10 Effects of hypertonic and hypotonic saline infusion on plasma osmolarity, urine osmolarity, U/P osmolarity ratio, osmolar clearance and free water clearance compared with the control state in the hypothyroid group.(MEAN \pm SD.)

	Plasma osmolarity (mOsm/L)	Urine osmolarity (mOsm/L)	U/P osmolarity ratio.	Osmolar clearance (ml/min)	Free water clearance (ml/min)
EFFECT OF HYPERTONIC SALINE					
- Contralateral kidney		696.77 \pm 296.33	2.43 \pm 1.05		
- Infused kidney (isotonic)	288.15 \pm 5.18	605.57 \pm 238.02	2.10 \pm 0.83	0.62 \pm 0.18	- 0.29 \pm 0.16
- Contralateral kidney		589.55 \pm 427.36 ^{NS}	2.01 \pm 1.46 ^{NS}	0.61 \pm 0.32	- 0.23 \pm 0.07
- Infused kidney (hypertonic)	292.27 \pm 6.81 ^{NS}	509.58 \pm 341.93 ^{NS}	1.73 \pm 1.15 ^{NS}	0.60 \pm 0.21 ^{NS}	- 0.17 \pm 0.27 ^{NS}
				0.66 \pm 0.25 ^{NS}	- 0.12 \pm 0.37 ^{NS}
EFFECT OF HYPOTONIC SALINE					
- Contralateral kidney		665.67 \pm 396.95	2.28 \pm 1.37		
- Infused kidney (isotonic)	291.20 \pm 5.36	625.07 \pm 252.91	2.15 \pm 0.87	0.67 \pm 0.35	- 0.29 \pm 0.18
- Contralateral kidney		724.70 \pm 359.17 ^{NS}	2.51 \pm 1.29 ^{NS}	0.61 \pm 0.36	- 0.29 \pm 0.20
- Infused kidney (hypotonic)	289.47 \pm 10.17 ^{NS}	632.70 \pm 271.93 ^{NS}	2.19 \pm 0.97 ^{NS}	0.65 \pm 0.27 ^{NS}	- 0.34 \pm 1.10 ^{NS}
				0.38 \pm 0.19*	- 0.16 \pm 0.05 ^{NS}

Values were statistically significantly different by paired t-test. (*p < 0.05, NS = not significant)

RENAL FUNCTIONS

Effects of hypertonic saline infusion in hypothyroid animals.

The infusion of hypertonic saline in hypothyroid dogs caused a significant decrease in GFR ($P < 0.05$) from the mean control value in the infused kidney (Table 7). The rate of urine flow increased by approximately 63% while ERPF and RBF decreased 12% and 14% respectively. U_{Na}^V , U_K^V , U_{Cl}^V and U_{Pi}^V increased by approximately 40%, 15%, 59% and 11% respectively from the mean control values (Table 9). The plasma concentrations of electrolytes, plasma osmolarity U_{Ca}^V and U_{Cl}^V did not change significantly but urine osmolarity, U/P osmolarity ratio decreased slightly (Table 8,9,10). C_{Osm} and C_{H_2O} were increased by approximately 8% and 47% respectively from the mean control values (Table 10) in the infused kidney. There was a significant decrease in GFR ($P < 0.05$) of the contralateral kidney. ERPF, RBF and renal fraction were decreased slightly but RVR and the rate of urine flow increased slightly (Table 7). The urinary excretion of sodium, fractional excretion of sodium and inorganic phosphorus increased significantly ($P < 0.05$) while U_K^V , U_{Cl}^V , FE_{Cl} , FE_{Ca} , plasma concentration of electrolytes, plasma osmolarity and C_{Osm} did not change significantly (Table 8,9,10). Urine osmolarity decreased slightly but C_{H_2O} increased slightly in the contralateral kidney (Table 10) as compared with the control state of the same kidney.

Effects of hypotonic saline infusion in hypothyroid animals.

The infusion of hypotonic saline into the infused kidney caused a significant decrease in the rate of urine flow, U_{Na}^V and C_{Osm} ($P < 0.05$) while GFR, ERPF and RBF decreased 25%, 30% and 28%

respectively. During hypotonic saline infusion, there were slight increases in FF and RVR while $U_K V$, $U_{Cl} V$, $U_{Ca} V$, FE_{Na} , FE_K , FE_{Cl} , FE_{Ca} , urine osmolarity, U/P osmolarity ratio decreased slightly. There were no marked changes in plasma osmolarity and C_{H_2O} during hypotonic saline infusion. Parameters of the contralateral control kidney did not change significantly as compared with the control state of the same kidney.

Comparison between hypothyroid and control animals. After total thyroidectomy in dogs for 1 week, the contralateral kidney showed decreases in GFR and RBF by approximately 11% and 21% respectively but RVR increased by approximately 4% when compared with the contralateral kidney of the control group (Figure 3,4,5). The rate of urine flow, filtration fraction (FF), renal fraction, $U_{Na} V$, $U_K V$, $U_{Cl} V$, $U_{Pi} V$, fractional excretion of sodium (FE_{Na}), chloride (FE_{Cl}), calcium (FE_{Ca}) and inorganic phosphorus (FE_{Pi}) changed insignificantly (Figure 2,6,7,8,9,10,11,13). During hypertonic saline infusion, there were significant decreases in GFR and RBF ($P < 0.05$) but increase in RVR by approximately 57%. The rate of urine flow, $U_{Na} V$, $U_K V$, $U_{Cl} V$, $U_{Pi} V$, FE_{Na} , FE_{Cl} , FE_{Ca} , FE_{Pi} , renal fraction and FF were increased slightly while FE_K was increased significantly ($P < 0.05$). These responses of the infused kidney in hypothyroid group were in the same direction as compared with the same state of the control group during hypertonic saline infusion.

Compared with the same state of control animals, during hypotonic saline infusion of the infused kidney, it was found that RBF decreased significantly ($P < 0.05$) while GFR, the rate of urine flow, renal fraction, $U_{Na} V$, $U_K V$, $U_{Cl} V$, and $U_{Ca} V$ decreased slightly.

There was a significant increase in FE_K ($P < 0.05$) and slight increase in RVR, FF, FE_{Na} , FE_{Cl} , FE_{Ca} while $U_{Pi}V$ and FE_{Pi} did not change significantly.

GROUP III (HYPERTHYROID ANIMALS)

The present data showed that the concentration of serum thyroxine (T_4) in the hyperthyroid group increased significantly ($P < 0.05$) compared with the control group. The mass of thyroid gland in this group was by approximately 21% lower than the control group but kidney mass was not different (Table 16).

GENERAL CIRCULATION

It was found that HR in the hyperthyroid group increased significantly ($P < 0.01$) compared with the control group. CO increased by approximately 54%, while TPR decreased by approximately 10%. PVC, PV and BV were not different from the control group (Table 16). There were no changes in CO, MAP, HR, TPR, PCV, PV and BV during either hypertonic or hypotonic saline intrarenal infusion in this group (Table 11). But there were some systemic effects during hypotonic saline infusion, since GFR decreased significantly ($P < 0.05$) of both kidneys. In hypertonic saline infusion, systemic alterations were shown because RVR decreased significantly ($P < 0.05$) in both kidneys in comparison between control and experimental period.

RENAL FUNCTIONS

Effects of hypertonic saline in hyperthyroid animals. Infusion of hypertonic saline directly into the renal artery, there were slight

Table 11 Effects of hypertonic and hypotonic saline infusion on general circulation of five dogs in the hyperthyroid group.

	Isotonic saline	Hypertonic saline	Hypotonic saline
CO (ml/min/kg)	171.78 ± 86.94	165.93 ± 81.54 ^{NS}	129.27 ± 50.62 ^{NS}
MAP (mmHg)	133.20 ± 26.60	136.27 ± 18.60 ^{NS}	128.67 ± 14.59 ^{NS}
HR (beat/min)	223.00 ± 47.00	216.00 ± 46.00 ^{NS}	230.00 ± 50.00 ^{NS}
TPR (dyne ₅ sec/cm ⁵ /kg)	450.02 ± 384.89	489.78 ± 424.72 ^{NS}	425.80 ± 262.12 ^{NS}
PCV (%)	30.80 ± 7.79	31.20 ± 8.17 ^{NS}	30.80 ± 6.76 ^{NS}
PV (ml/kg)	61.59 ± 25.14	57.17 ± 22.55 ^{NS}	63.40 ± 21.01 ^{NS}
BV (ml/kg)	70.90 ± 48.49	80.60 ± 24.30 ^{NS}	89.36 ± 24.50 ^{NS}

Values were statistically significantly different by paired t-test with respect to the same state of control.

(NS = not significant) (MEAN ± SD.)

Table 12 Effects of hypertonic and hypotonic saline infusion on renal hemodynamics compared with the control state in the hyperthyroid group. (MEAN \pm SD.)

	Urine flow (ml/min)	GFR (ml/min/100gm)	ERPF (ml/min/100gm)	RBF (ml/min/100gm)	FF (%)	Renal fraction (%)	RVR ⁵ (dyne-sec/cm ⁵ /100gm)
EFFECT OF HYPERTONIC SALINE							
- Contralateral kidney	0.73 \pm 0.36	77.79 \pm 23.83	303.73 \pm 108.18	446.11 \pm 185.88	26.66 \pm 5.26	8.06 \pm 2.42	27941.19 \pm 14653.65
- Infused kidney (isotonic)	0.81 \pm 0.46	75.68 \pm 17.29	307.41 \pm 85.02	448.39 \pm 139.64	25.27 \pm 4.53	9.01 \pm 3.62	25772.41 \pm 10033.25
- Contralateral kidney	0.79 \pm 0.53 ^{NS}	81.08 \pm 26.11 ^{NS}	315.63 \pm 137.98 ^{NS}	467.53 \pm 232.96 ^{NS}	27.97 \pm 8.89 ^{NS}	8.65 \pm 2.88 ^{NS}	29321.09 \pm 16445.05*
- Infused kidney (hypertonic)	0.87 \pm 0.59 ^{NS}	69.33 \pm 15.03 ^{NS}	285.96 \pm 78.16 ^{NS}	417.70 \pm 131.33 ^{NS}	24.87 \pm 4.23 ^{NS}	8.90 \pm 3.82 ^{NS}	28377.67 \pm 9960.34*
EFFECT OF HYPOTONIC SALINE							
- Contralateral kidney	0.52 \pm 0.29	85.90 \pm 15.88	282.49 \pm 97.33	408.07 \pm 156.30	33.35 \pm 11.53	8.06 \pm 2.42	30991.12 \pm 12722.09
- Infused kidney (isotonic)	0.62 \pm 0.39	80.03 \pm 11.97	269.99 \pm 82.39	385.75 \pm 109.64	32.61 \pm 12.33	9.01 \pm 3.62	31721.34 \pm 12789.19
- Contralateral kidney	0.49 \pm 0.32 ^{NS}	77.86 \pm 16.86*	256.89 \pm 96.09 ^{NS}	370.30 \pm 133.00 ^{NS}	34.40 \pm 14.14 ^{NS}	8.35 \pm 2.42 ^{NS}	32750.98 \pm 18484.35 ^{NS}
- Infused kidney (hypotonic)	0.58 \pm 0.42 ^{NS}	66.94 \pm 19.70*	223.78 \pm 91.99 ^{NS}	308.58 \pm 145.85 ^{NS}	33.58 \pm 13.59 ^{NS}	7.49 \pm 1.91 ^{NS}	59210.79 \pm 71990.61 ^{NS}

Values were statistically significantly different by paired t-test. (*p < 0.05, NS = not significant)

Table 13 Effects of hypertonic and hypotonic saline infusion on plasma concentration of electrolytes (P_E), compared with the control stage in the hyperthyroid group. (MEAN \pm SD.)

Plasma concentration	Isotonic saline	Hypertonic saline	Hypotonic saline
Na (mEq/L)	137.60 \pm 6.19	137.00 \pm 6.28 ^{NS}	137.60 \pm 6.58 ^{NS}
K (mEq/L)	3.08 \pm 0.66	2.98 \pm 0.63 ^{NS}	3.04 \pm 0.55 ^{NS}
Cl (mEq/L)	109.00 \pm 4.42	109.80 \pm 5.93 ^{NS}	114.00 \pm 5.83 ^{NS}
Ca (mg %)	7.06 \pm 0.24	7.31 \pm 0.58 ^{NS}	7.25 \pm 0.62 ^{NS}
Pi (mg %)	4.17 \pm 0.55	3.94 \pm 0.59 ^{NS}	3.89 \pm 1.06 ^{NS}

Values were statistically significantly different by paired t-test. (NS = not significant)

Table 14 Effects of hypertonic and hypotonic saline infusion on urinary excretion of electrolytes ($U_{E,V}$) and fractional excretion of electrolytes (FE_E) compared with the control state in the hyperthyroid dogs. (MEAN \pm SD.)

	$U_{Na,V}$ (μ Eq/min/kg)	$U_{K,V}$ (μ Eq/min/kg)	$U_{Cl,V}$ (μ Eq/min/kg)	$U_{Ca,V}$ (mg%/min/kg)	$U_{Pi,V}$ (mg%/min/kg)	FE_{Na} (%)	FE_K (%)	FE_{Cl} (%)	FE_{Ca} (%)	FE_{Pi} (%)
EFFECT OF HYPERTONIC SALINE										
contralateral kidney	6.93 \pm 6.99	1.73 \pm 0.77	6.79 \pm 7.10	0.15 \pm 0.10	2.11 \pm 1.12	2.02 \pm 1.71	25.13 \pm 4.78	2.52 \pm 2.25	0.94 \pm 0.43	22.12 \pm 7.82
infused kidney (isotonic)	6.67 \pm 7.87	1.84 \pm 0.84	7.33 \pm 8.56	0.13 \pm 0.08	1.73 \pm 0.86	1.88 \pm 1.97	25.78 \pm 5.29	2.55 \pm 2.73	0.75 \pm 0.34	18.08 \pm 6.57
contralateral kidney	7.10 \pm 7.70 ^{NS}	1.70 \pm 0.82 ^{NS}	6.24 \pm 6.95 ^{NS}	0.13 \pm 0.08 ^{NS}	1.73 \pm 0.87 [*]	1.99 \pm 2.08 ^{NS}	24.64 \pm 8.64 ^{NS}	2.02 \pm 2.31 ^{NS}	0.76 \pm 0.34 ^{NS}	18.89 \pm 6.56 ^{NS}
infused kidney (hypertonic)	7.67 \pm 9.62 ^{NS}	1.76 \pm 0.87 ^{NS}	8.17 \pm 10.61 ^{NS}	0.14 \pm 0.12 ^{NS}	1.78 \pm 1.39 ^{NS}	2.23 \pm 2.43 ^{NS}	27.66 \pm 6.81 ^{NS}	2.91 \pm 3.32 ^{NS}	0.83 \pm 0.64 ^{NS}	19.97 \pm 9.21 ^{NS}
EFFECT OF HYPOTONIC SALINE										
contralateral kidney	5.77 \pm 5.14	1.68 \pm 0.57	5.29 \pm 4.96	0.09 \pm 0.07	1.89 \pm 1.38	1.69 \pm 1.18	23.34 \pm 6.13	1.67 \pm 1.39	0.59 \pm 0.24	20.58 \pm 14.14
infused kidney (isotonic)	6.39 \pm 6.62	1.73 \pm 0.69	4.71 \pm 5.26	0.11 \pm 0.07	1.94 \pm 1.72	1.73 \pm 1.59	23.78 \pm 6.48	1.48 \pm 1.46	0.55 \pm 0.28	33.06 \pm 10.07
contralateral kidney	4.79 \pm 4.96 ^{NS}	1.61 \pm 0.61 ^{NS}	5.11 \pm 6.19 ^{NS}	0.08 \pm 0.04 ^{NS}	1.41 \pm 1.12 ^{NS}	1.39 \pm 1.29 ^{NS}	23.92 \pm 5.55 ^{NS}	1.86 \pm 2.15 ^{NS}	0.48 \pm 0.22 ^{NS}	15.47 \pm 9.39 ^{NS}
infused kidney (hypotonic)	4.99 \pm 5.84 ^{NS}	1.59 \pm 0.76 ^{NS}	4.52 \pm 5.56 ^{NS}	0.09 \pm 0.07 ^{NS}	1.45 \pm 1.40 ^{NS}	1.39 \pm 1.38 ^{NS}	25.19 \pm 5.54 ^{NS}	1.59 \pm 1.76 ^{NS}	0.52 \pm 0.23 ^{NS}	27.59 \pm 10.64 ^{NS}

Values were statistically significantly different by paired t-test. (*p < 0.05, NS = not significant)

Table 15 Effects of hypertonic and hypotonic saline infusion on plasma osmolarity, urine osmolarity, U/P osmolarity ratio, osmolar clearance and free water clearance compared with the control state in the hyperthyroid group (MEAN \pm SD.)

	Plasma osmolarity (mOsm/L)	Urine osmolarity (mOsm/L)	U/P osmolarity ratio	Osmolar clearance (ml/min)	Free water clearance (ml/min)
EFFECT OF HYPERTONIC SALINE					
- Contralateral kidney		369.60 \pm 163.02	1.25 \pm 0.55	0.88 \pm 0.55	- 0.13 \pm 0.49
- Infused kidney (isotonic)	295.16 \pm 3.07	334.60 \pm 99.39	1.13 \pm 0.33	0.88 \pm 0.61	- 0.11 \pm 0.26
- Contralateral kidney		322.28 \pm 52.81 ^{NS}	1.19 \pm 0.32 ^{NS}	0.81 \pm 0.43 ^{NS}	- 0.01 \pm 0.13 ^{NS}
- Infused kidney (hypertonic)	295.82 \pm 3.29 ^{NS}	317.92 \pm 129.40 ^{NS}	1.07 \pm 0.42 ^{NS}	0.80 \pm 0.51 ^{NS}	0.06 \pm 0.17 ^{NS}
EFFECT OF HYPOTONIC SALINE					
- Contralateral kidney		540.00 \pm 126.96	1.83 \pm 0.43	0.88 \pm 0.42	- 0.36 \pm 0.18
- Infused kidney (isotonic)	294.46 \pm 6.09	476.24 \pm 144.58	1.62 \pm 0.49	0.91 \pm 0.56	- 0.10 \pm 0.38
- Contralateral kidney		462.76 \pm 152.79 ^{NS}	1.56 \pm 0.52 ^{NS}	0.65 \pm 0.29*	- 0.16 \pm 0.07 ^{NS}
- Infused kidney (hypotonic)	295.26 \pm 2.68 ^{NS}	437.50 \pm 143.95 ^{NS}	1.48 \pm 0.49 ^{NS}	0.74 \pm 0.49 ^{NS}	- 0.16 \pm 0.10 ^{NS}

Value were statistically significantly different by paired t-test. (*p < 0.05, NS = not significant)

increases in the rate of urine flow and C_{H_2O} , accompany with slight changes in GFR, ERPF, RBF, plasma osmolarity, plasma concentration of electrolytes, urinary excretion of electrolytes and U/P osmolarity ratio. RVR increased markedly of both kidneys. During hypertonic saline infusion, renal functions of the contralateral control kidney except RVR did not show significant changes as compared with the control state of the same kidney (Table 12,13,14,15).

Effects of hypotonic saline infusion in hyperthyroid animals.

The effects of hypotonic saline solution on infused kidney caused a significant decrease in GFR ($P < 0.05$) while RVR increased by approximately 86% as compared with the control state of the same kidney. ERPF, RBF and rate of urine flow decreased by approximately 17%, 20% and 6% respectively. There were slight decreased in $U_K V$, $U_{Cl} V$, $U_{Ca} V$ and $U_{Pi} V$. The plasma concentrations of electrolytes and plasma osmolarity were not different from the mean control values, while urine osmolarity, U/P osmolarity ratio, C_{Osm} and C_{H_2O} were decreased slightly (Table 12,13,14, 15). When hypotonic saline was infused, the contralateral kidney showed decreased in GFR and C_{Osm} ($P < 0.05$) but increase in RVR by approximately 5%. The rate of urine flow, ERPF, RBF, urinary excretion of electrolytes did not decrease significantly. There were no significant changes in plasma concentrations of electrolytes and plasma osmolarity.

Comparison between hyperthyroid and control animals :

In comparison between these two groups, it showed that the rate of urine flow, $U_K V$ and $U_{Cl} V$ increased significantly ($P < 0.05$) in the contralateral kidney. GFR and RBF increased by approximately 39% and 61% respectively while RVR decreased to 28% (Figure 2,3,4,5). There were significant increases in $U_{Cl} V$, ($P < 0.05$), $U_K V$, ($P < 0.05$)

and FE_K ($P < 0.001$) but $U_{Na}V$, $U_{Ca}V$ and $U_{Pi}V$ increased slightly in the contralateral kidney (Figure 8,9,10,11,12,13). FE_{Na} , FE_{Cl} , FE_{Ca} and FE_{Pi} were not different from mean values of the same state of control group. In comparison between the hyperthyroid and the control groups, hypertonic saline infusion caused a significant decrease in RVR ($P < 0.05$) in both kidneys. The rate of urine flow increased significantly ($P < 0.05$) in the contralateral kidney and also increased in the infused kidney by approximately 40%. GFR, RBF, renal fraction, $U_{Na}V$, $U_{Cl}V$, and $U_{Pi}V$ increased slightly in both kidney while there was a slight decrease in RVR. FF decreased significantly in the infused kidney ($P < 0.05$) but the contralateral kidney showed a slight decrease. U_KV increased significantly in both kidneys ($P < 0.05$) whereas fractional excretion of electrolytes and $U_{Ca}V$ changed slightly (Figure 10,11,12,13). During hypotonic saline infusion in the hyperthyroid animals compared with the control group, it appeared that there were some changes in renal functions in this group. The changes of hyperthyroid group were in the same direction as those of the control group.



Table 16 Mean values (\pm S.D.) of serum thyroxine (T_4), body mass and mass of thyroid gland and kidneys in control group (group I), hypothyroid group (group II) and hyperthyroid group (group III).

Measurement	Group I (control)	Group II (hypothyroidism)	Group III (hyperthyroidism)
Serum T_4 (ug %)	0.89 \pm 0.57	0.11 \pm 0.02 ^{NS}	12.26 \pm 8.26 [*]
Mass of thyroid (mg/kg body mass)	74.04 \pm 9.75	79.69 \pm 17.90 ^{NS}	58.12 \pm 14.89 ^{NS}
Mass of kidney (gm/kg body mass)	5.85 \pm 1.09	5.04 \pm 1.32 ^{NS}	5.86 \pm 0.98 ^{NS}
Body mass (kg)	14.17 \pm 2.42	14.83 \pm 2.29 ^{NS}	13.60 \pm 1.08 ^{NS}

P-values by unpaired t-test. (*p < 0.05

NS = not significant)

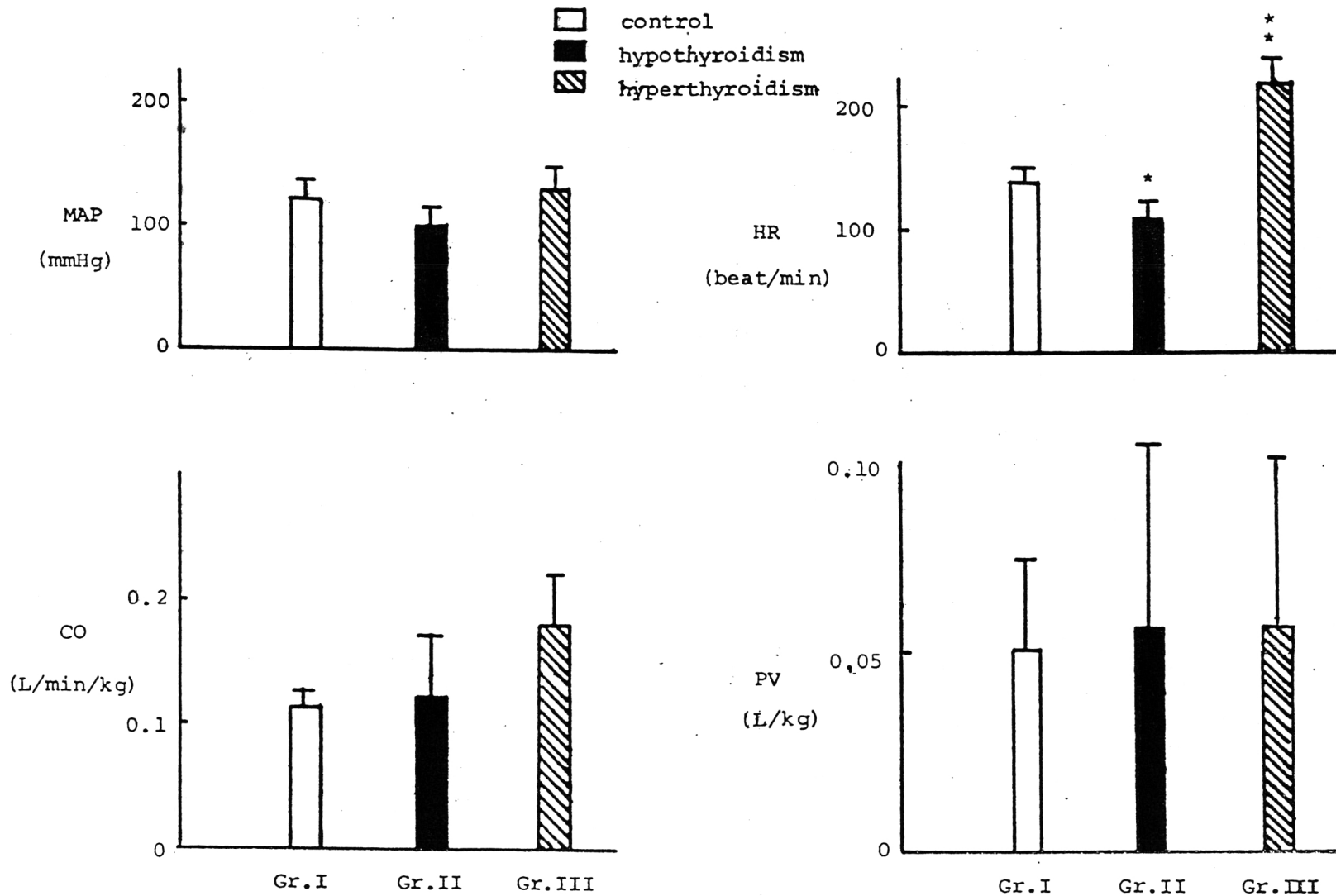


FIGURE 1 Values are means \pm SD, Cardiac out put (CO), mean arterial blood pressure (MAP), heart rate (HR) and plasma volum (PV) in control group (Gr.I), hypothyroid group (Gr.II) and hyperthyroid group (Gr.III). The statistical difference between group I and group II or group I and group III at the same state was tested by unpaired t-test. (* $P < 0.05$, ** $P < 0.01$)

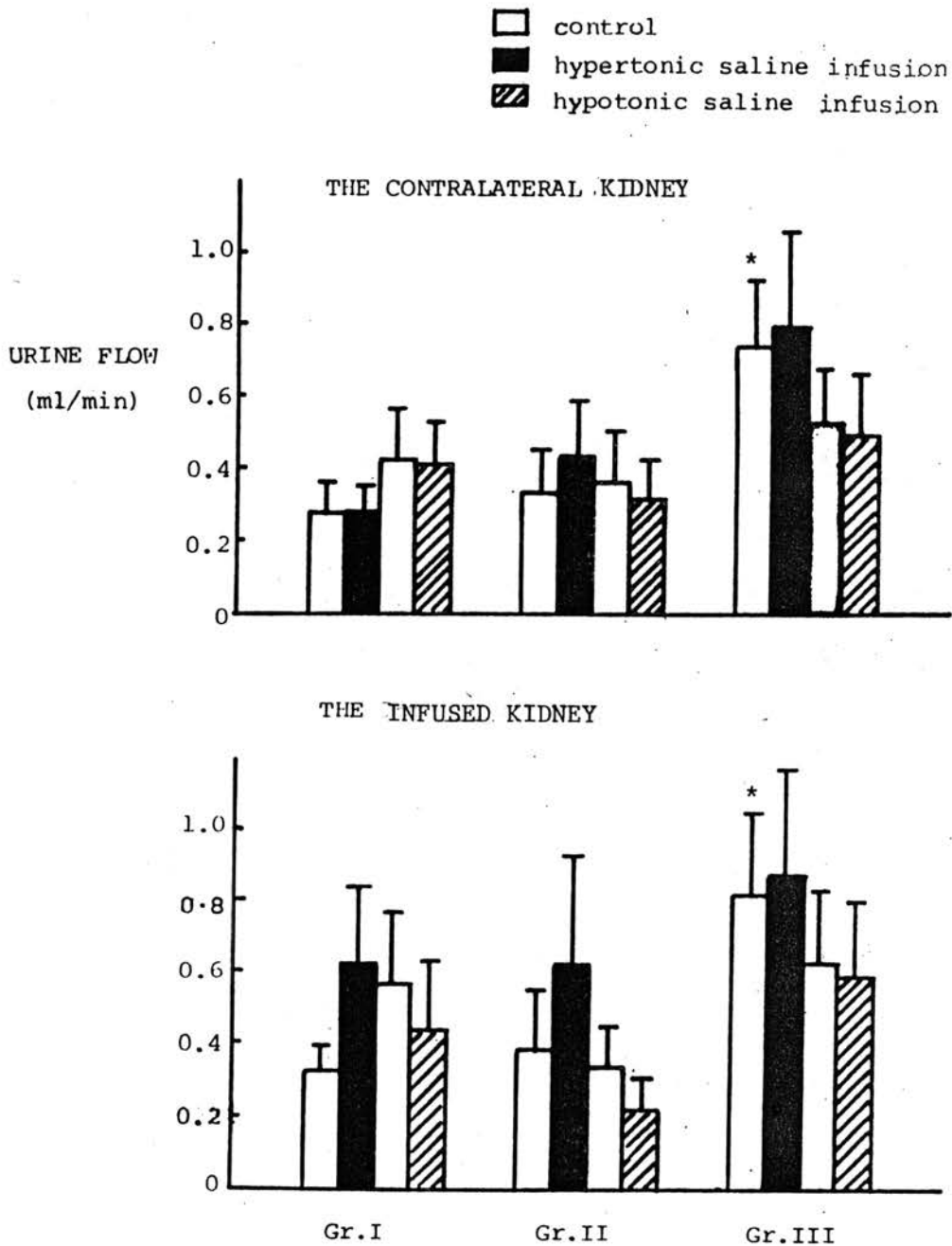


FIGURE 2 Effects of hypertonic and hypotonic saline infusion on urine flow in control group (Gr.I), hypothyroid group (Gr.II) and hyperthyroid group (Gr.III). Results are means \pm SD. The statistical difference between group I and group II or group I and group III at the same state was tested by unpaired t-test (* $P < 0.05$)

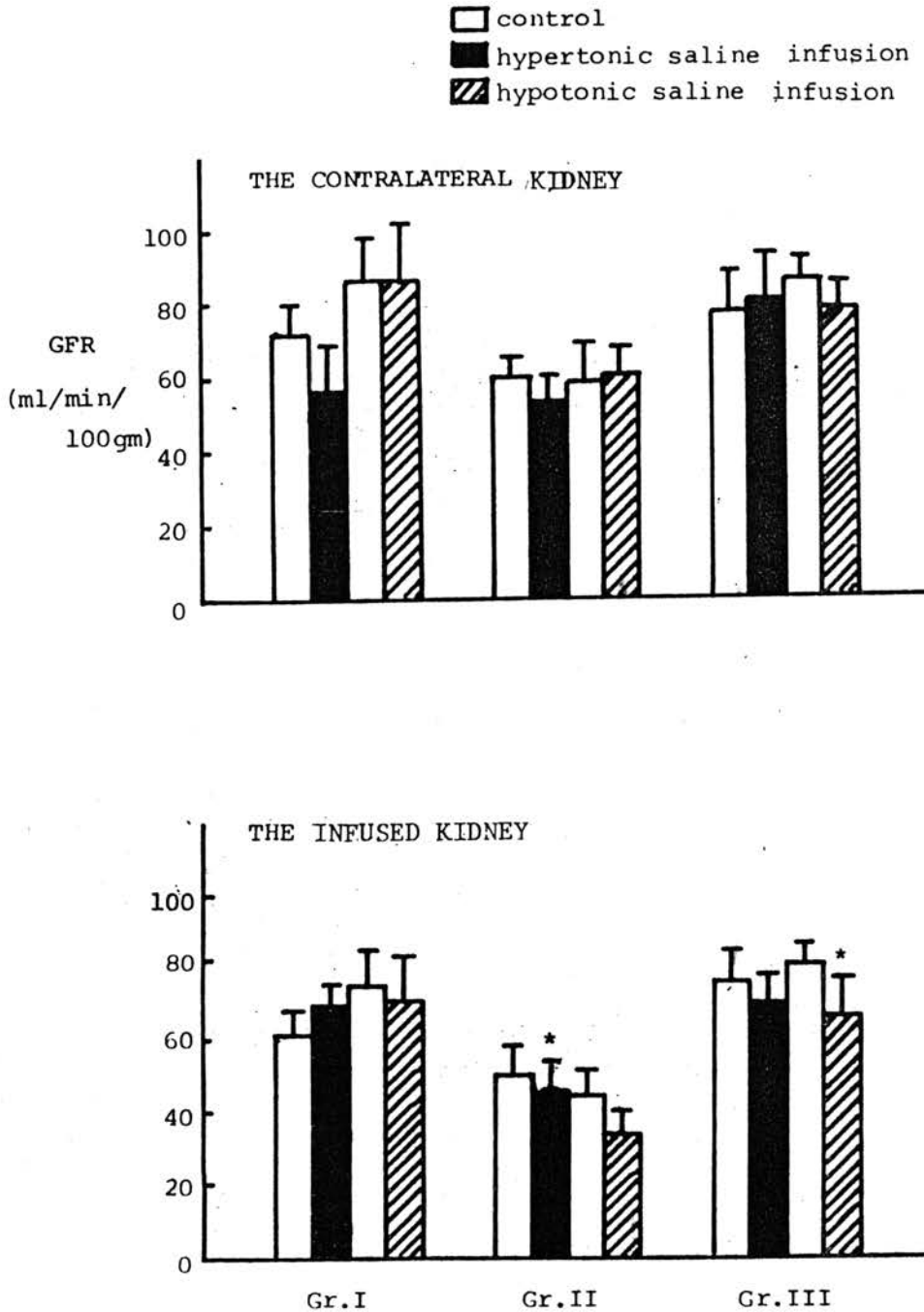


FIGURE 3 Effects of hypertonic and hypotonic saline infusion on glomerular filtration rate (GFR), in control group (Gr.I), hypothyroid group (Gr.II) and hyperthyroid group (Gr.III). Results are means \pm SD. The statistical difference between group I and group II or group I and group III at the same state was tested by unpaired t test (* $P < 0.05$)

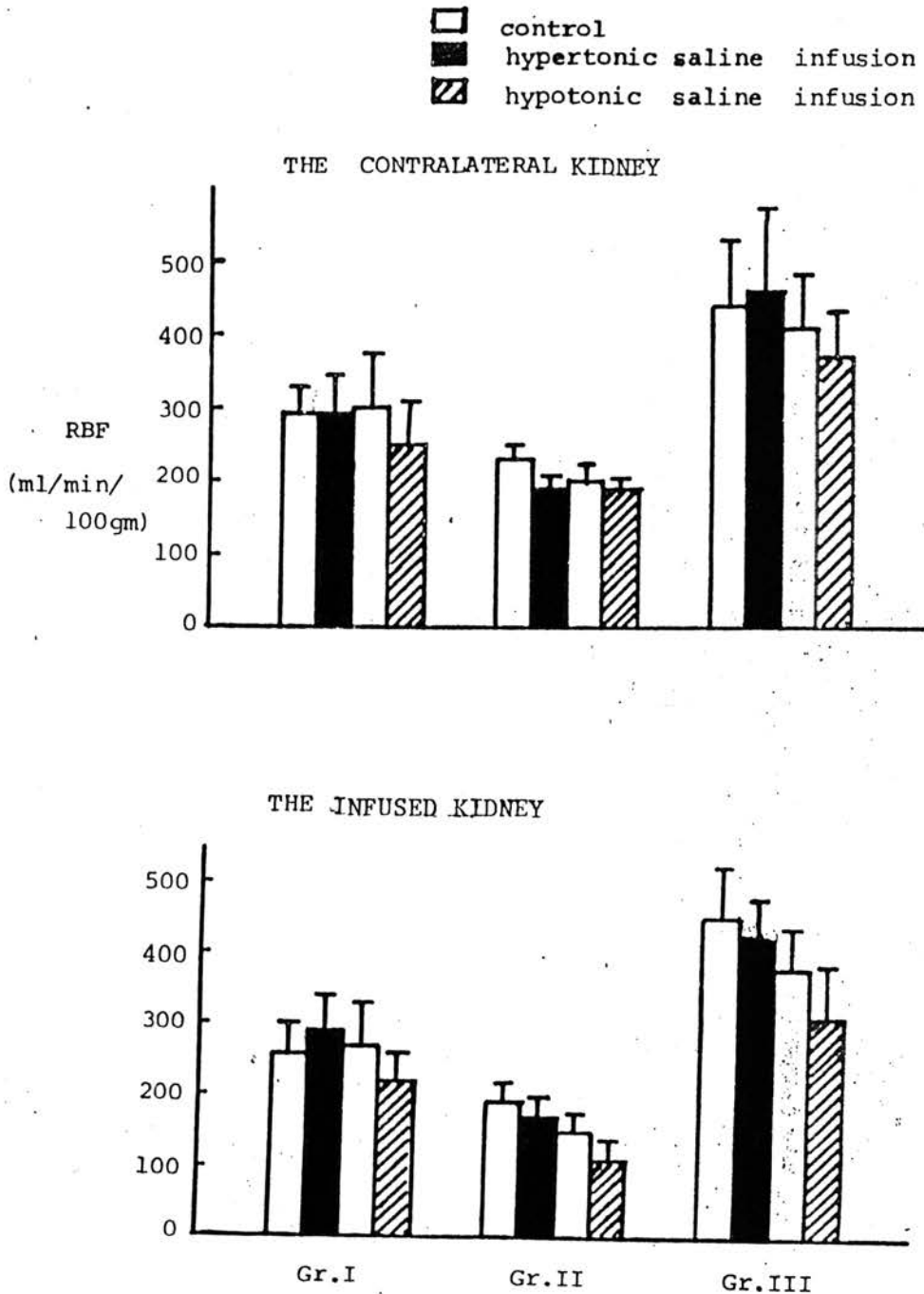


FIGURE 4 Effects of hypertonic and hypotonic saline infusion on renal blood flow..(RBF) in control group (Gr.I), hypothyroid group (Gr.II) and hyperthyroid group (Gr.III). Results are means \pm SD. The statistical difference between group I and group II or group I and group III at the same stage was tested by unpaired t-test.

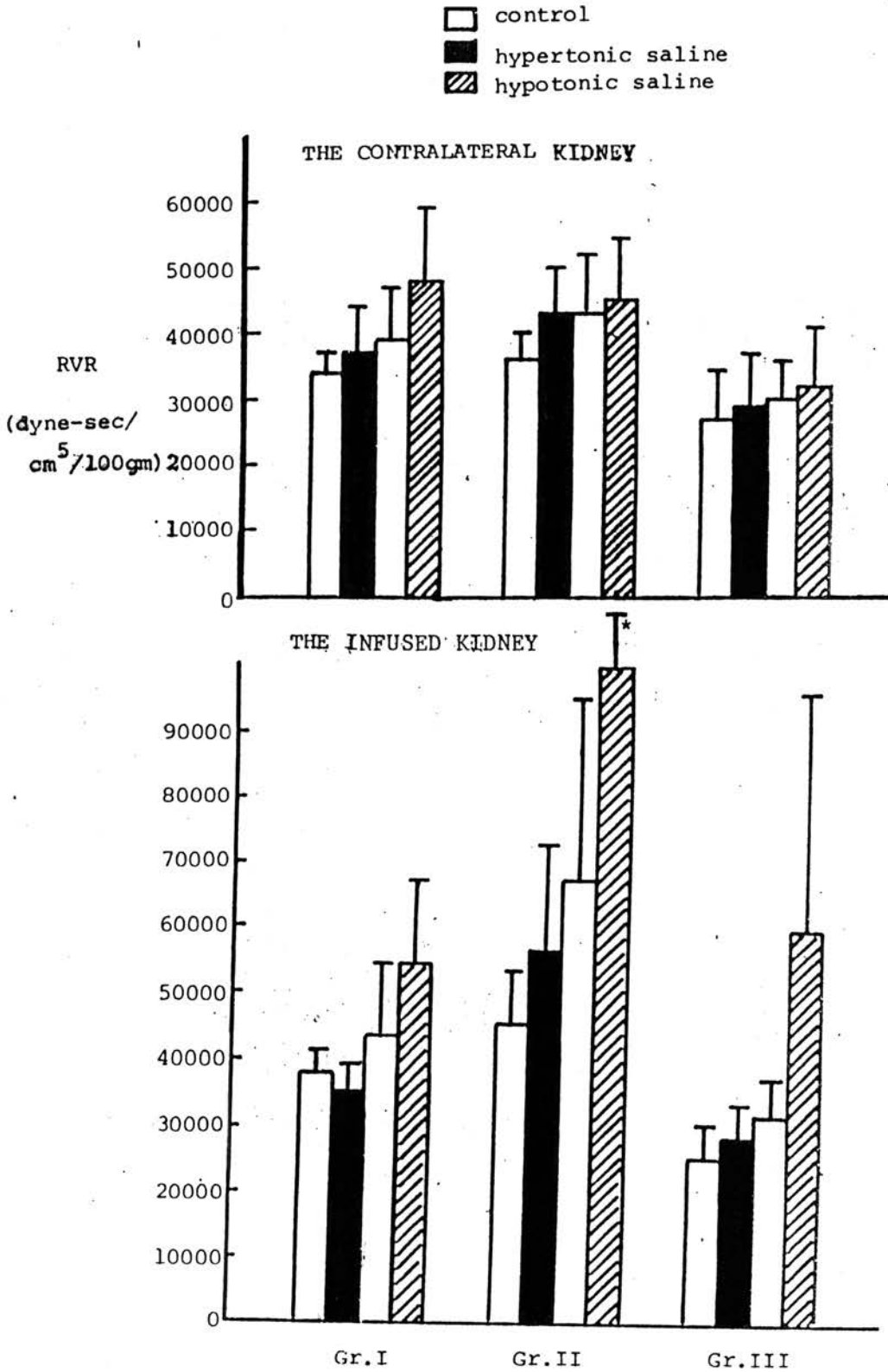


FIGURE 5 Effects of hypertonic and hypotonic saline infusion on renal vascular resistance (RVR) in group I (control), group II (hypothyroidism) and group III (hyperthyroidism). Results are means \pm SD. The statistical difference between group I and group II or group I and group III, at the same state was tested by unpaired t-test. (* $p < 0.05$)

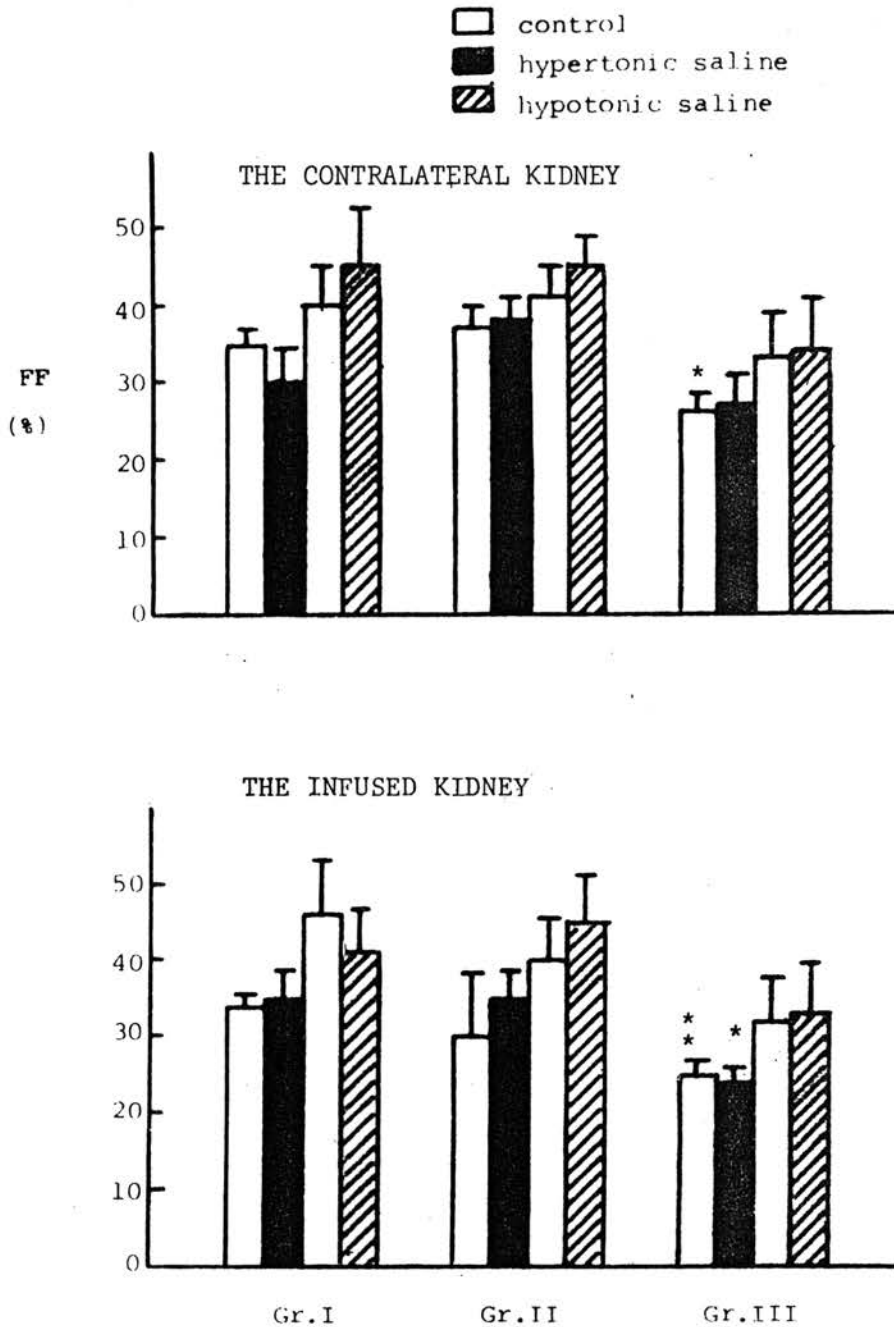


FIGURE 6 Values are means \pm SD. of filtration fraction in control group (Gr. I), hypothyroid group (Gr. II) and hyperthyroid group (Gr. III) during hypertonic and hypotonic saline infusion. The statistical difference between group I and group II or group I and group III at the same state was tested by unpaired t-test. (* $p < 0.05$, ** $p < 0.01$)

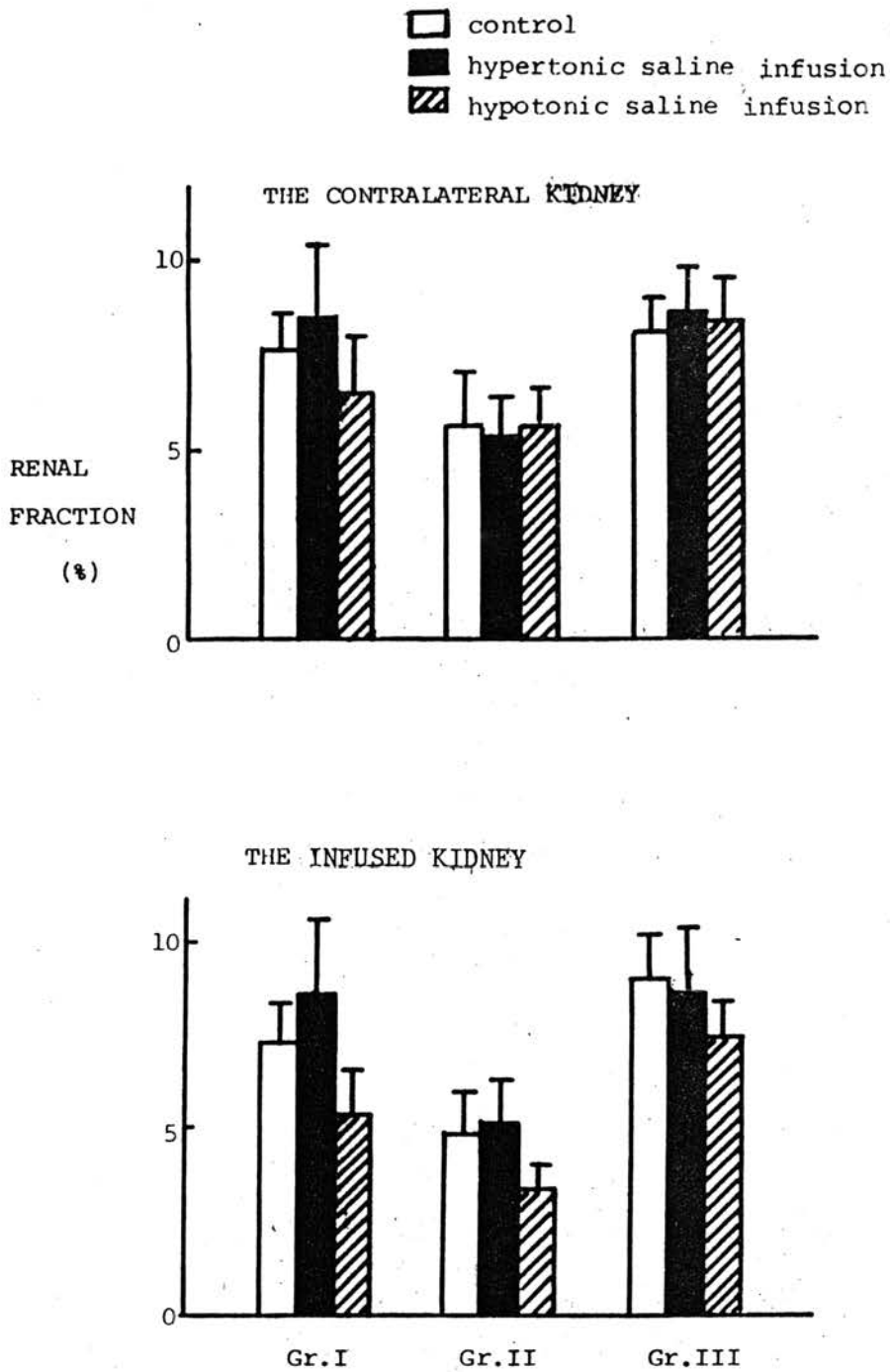


FIGURE 7 Values are means \pm SD. of renal fraction in control group (Gr. I), hypothyroid group (Gr. II) and hyperthyroid group (Gr. III) during hypertonic and hypotonic saline infusion. The statistical difference between group I and group II or group I and group III at the same state was tested by unpaired t-test,

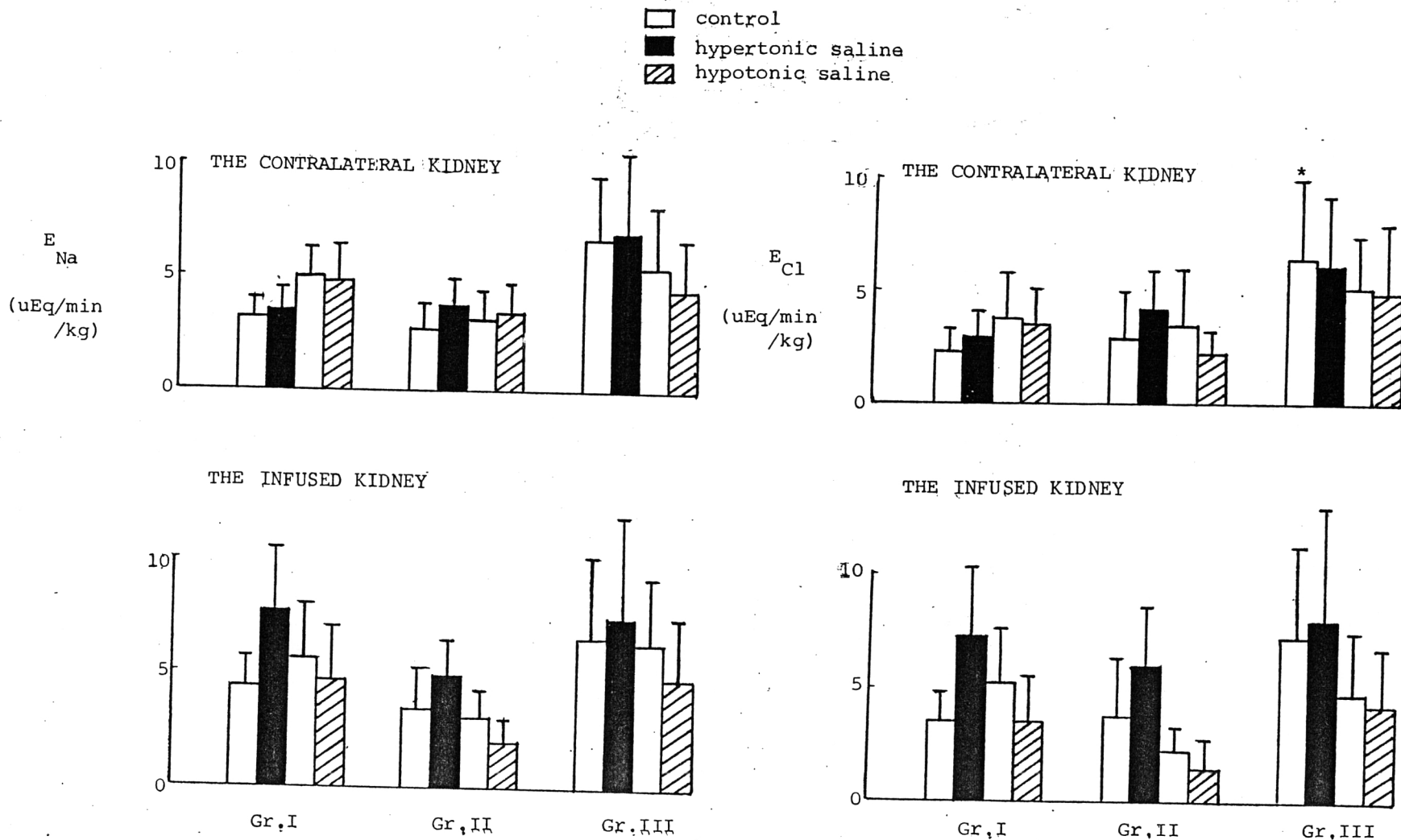


FIGURE 8 Effects of hypertonic and hypotonic saline infusion on urinary excretion of sodium and chloride in control group (Gr.I), hypothyroid group (Gr.II) and hyperthyroid group (Gr.III). Results are mean \pm SD. The statistical difference between group I and group II or group I and group III at the same state was tested by unpaired t-test.

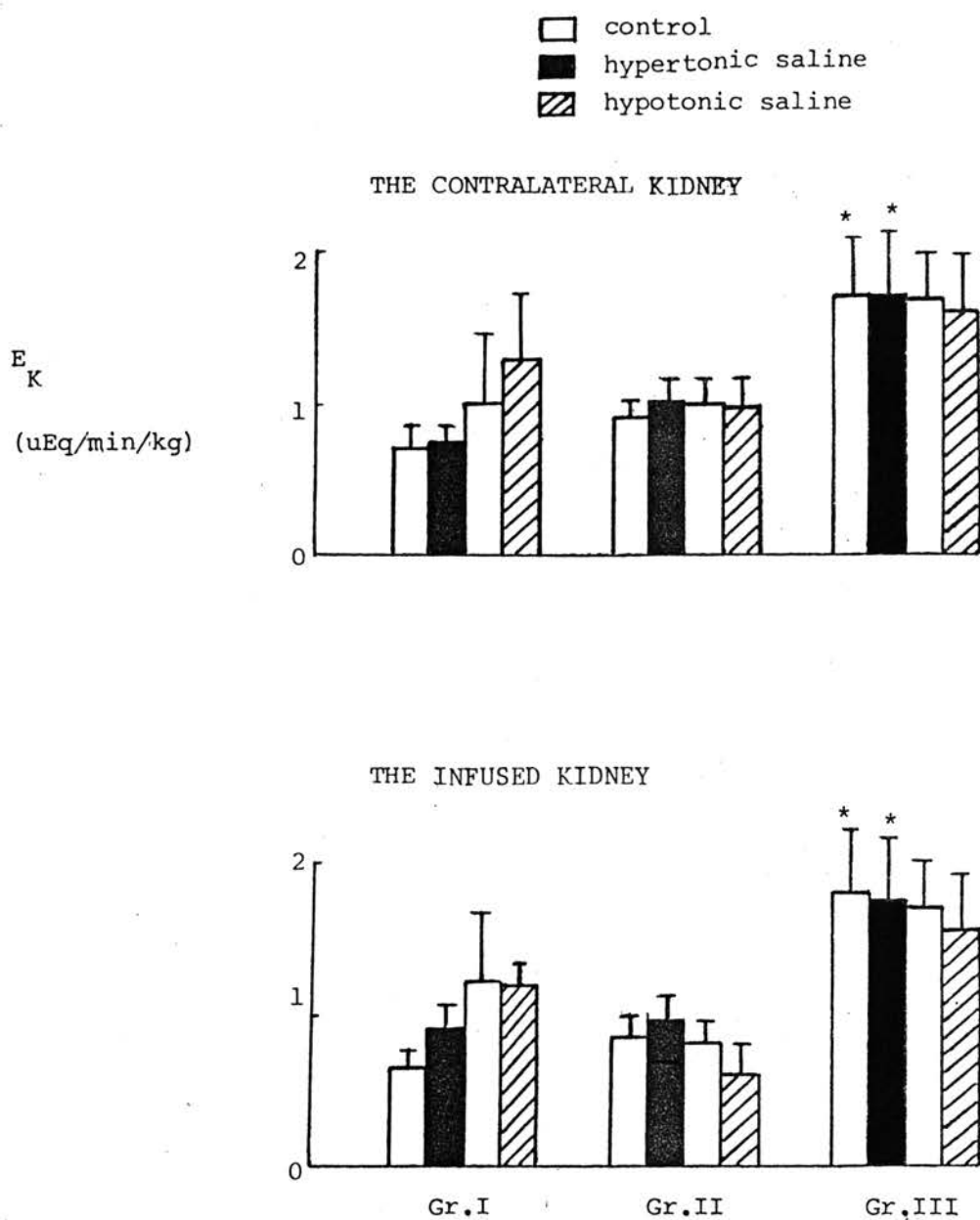


FIGURE 9 Effects of hypertonic and hypotonic saline infusion on urinary excretion of potassium in control group (Gr.I), hypothyroid group (Gr.II) and hyperthyroid group (Gr.III). The statistical difference between group I and group II or group I and group III at the same state was tested by unpaired t-test. ($p < 0.05$)

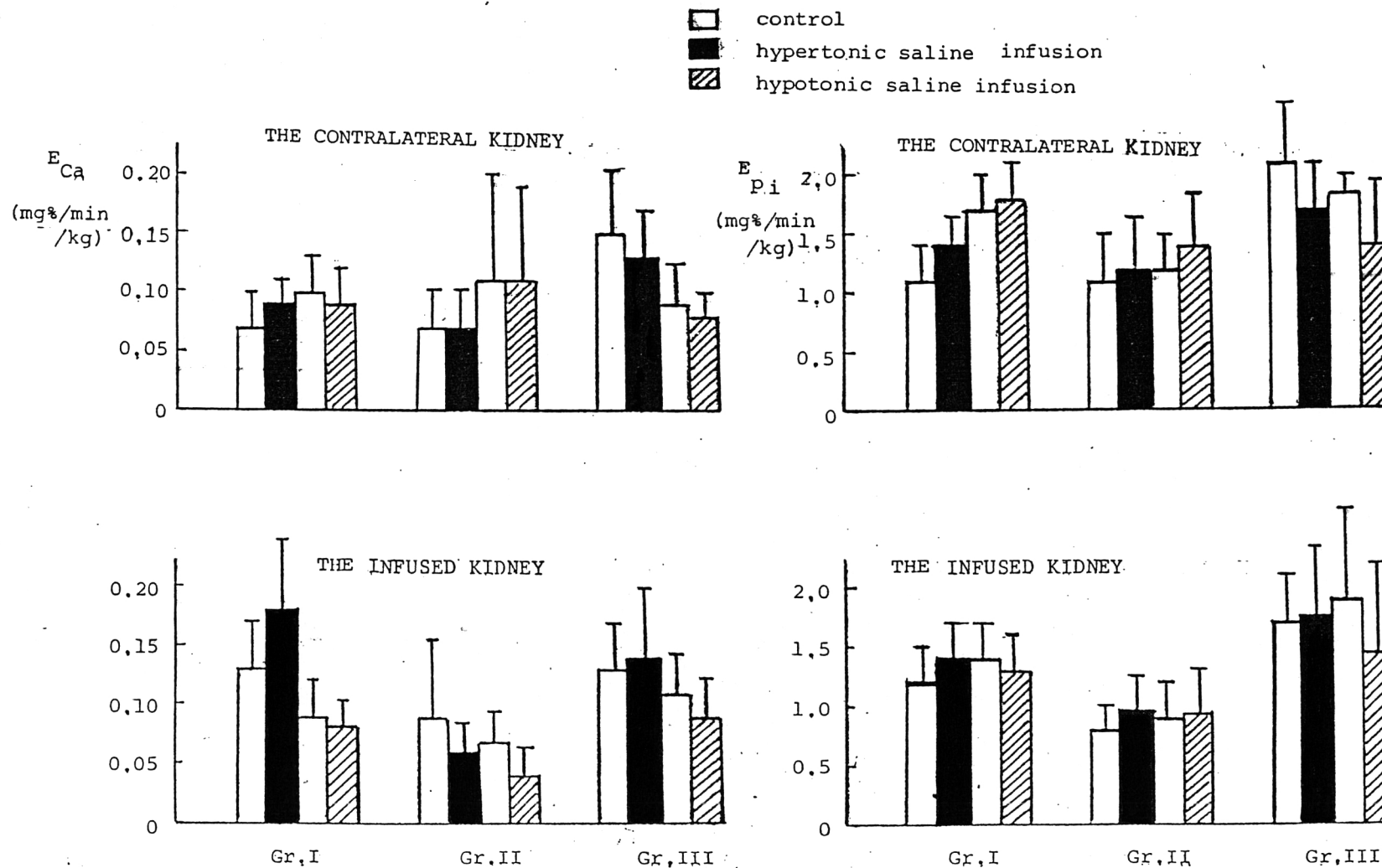


FIGURE 10 Effects of hypertonic and hypotonic saline infusion on urinary excretion of calcium and inorganic phosphorus in control group (Gr. I), hypothyroid group (Gr. II), and hyperthyroid group (Gr. III). Results are mean \pm SD. The statistical difference between group I and group II or group I and group III at the same state was tested by unpaired t-test.

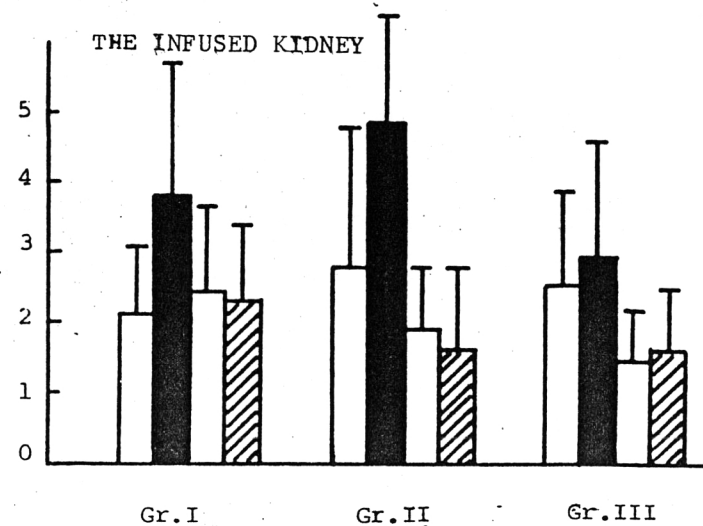
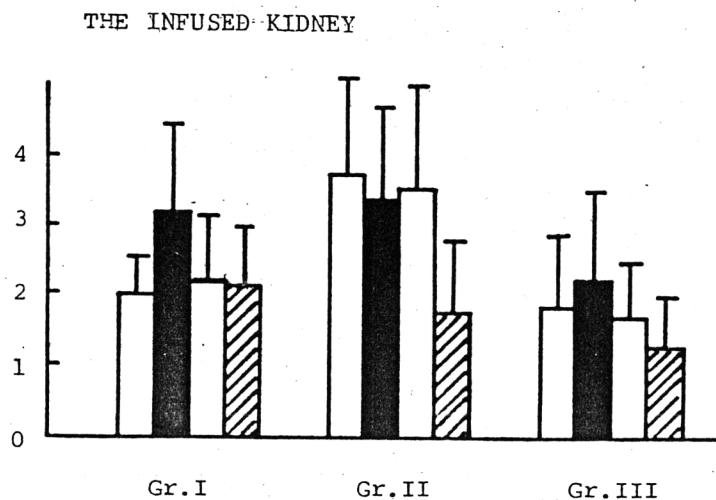
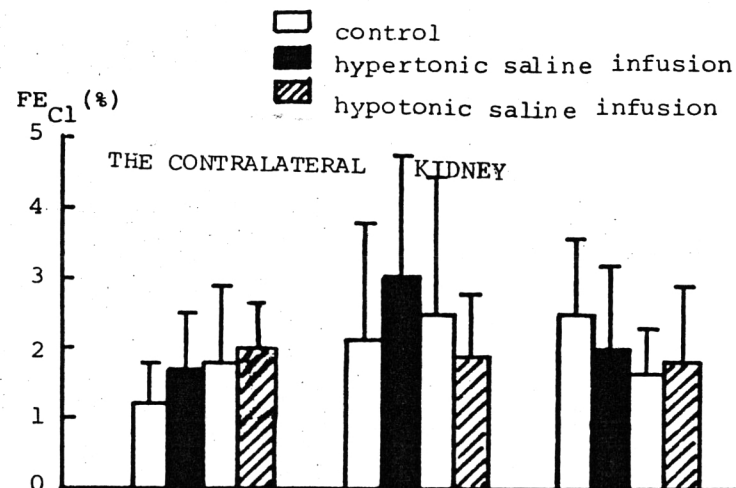
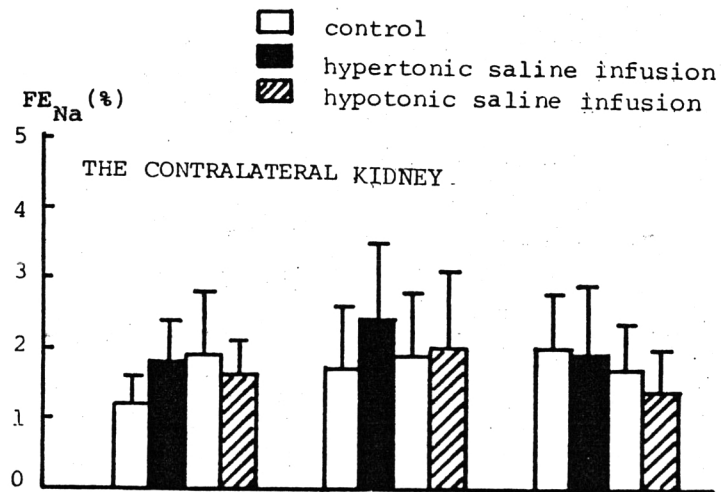


FIGURE 11 Effects of hypertonic and hypotonic saline infusion on fractional excretion of sodium and chloride in control group (Gr.I), hypothyroid group (Gr.II) and hyperthyroid group (Gr.III). Results are mean \pm SD. The statistical difference between group I and group II or group I and group III at the same state was tested by unpaired t-test.

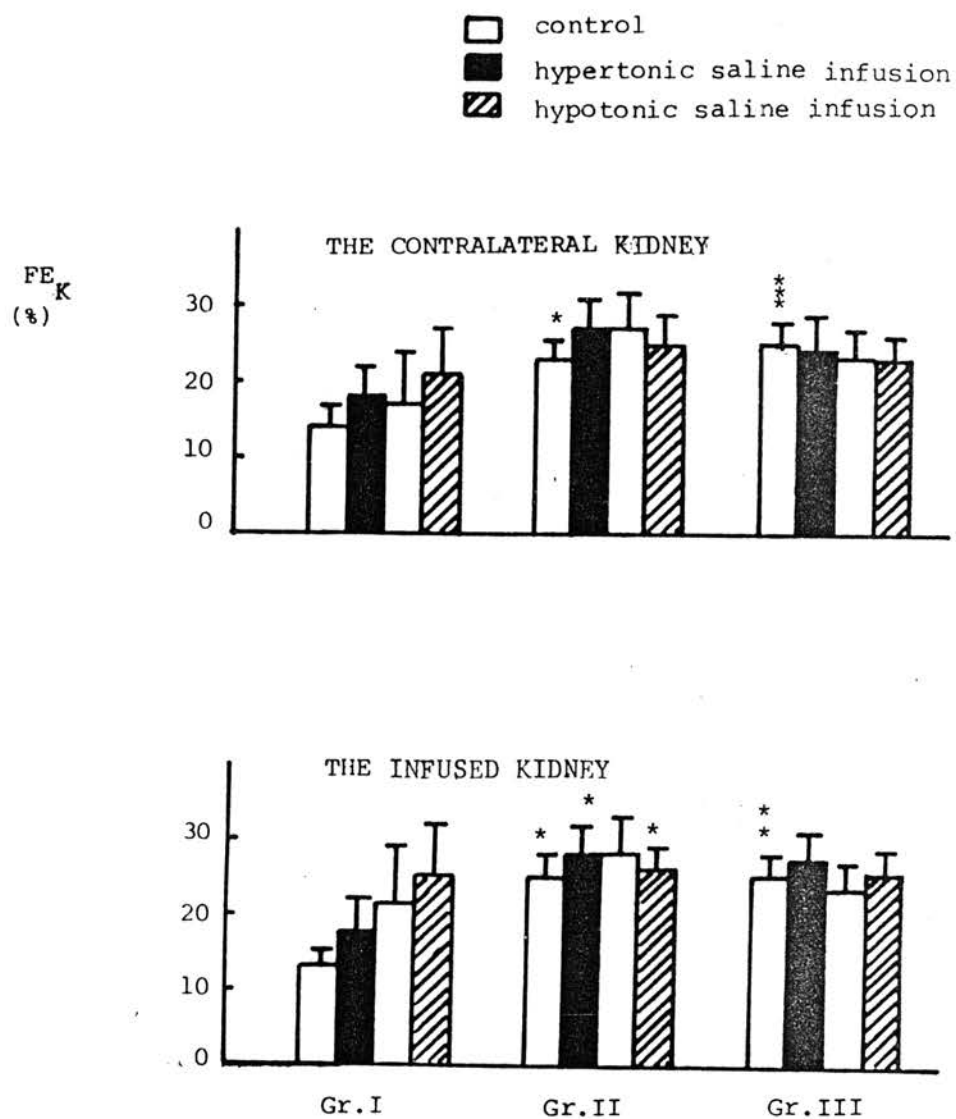


FIGURE 12 Effects of hypertonic and hypotonic saline infusion on fractional excretion of potassium in control group (Gr. I), hypothyroid group (Gr. II) and hyperthyroid group (Gr. III). Results are means \pm SD. The statistical difference between group I and group II or group I and group III at the same state was tested by unpaired t-test. (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)

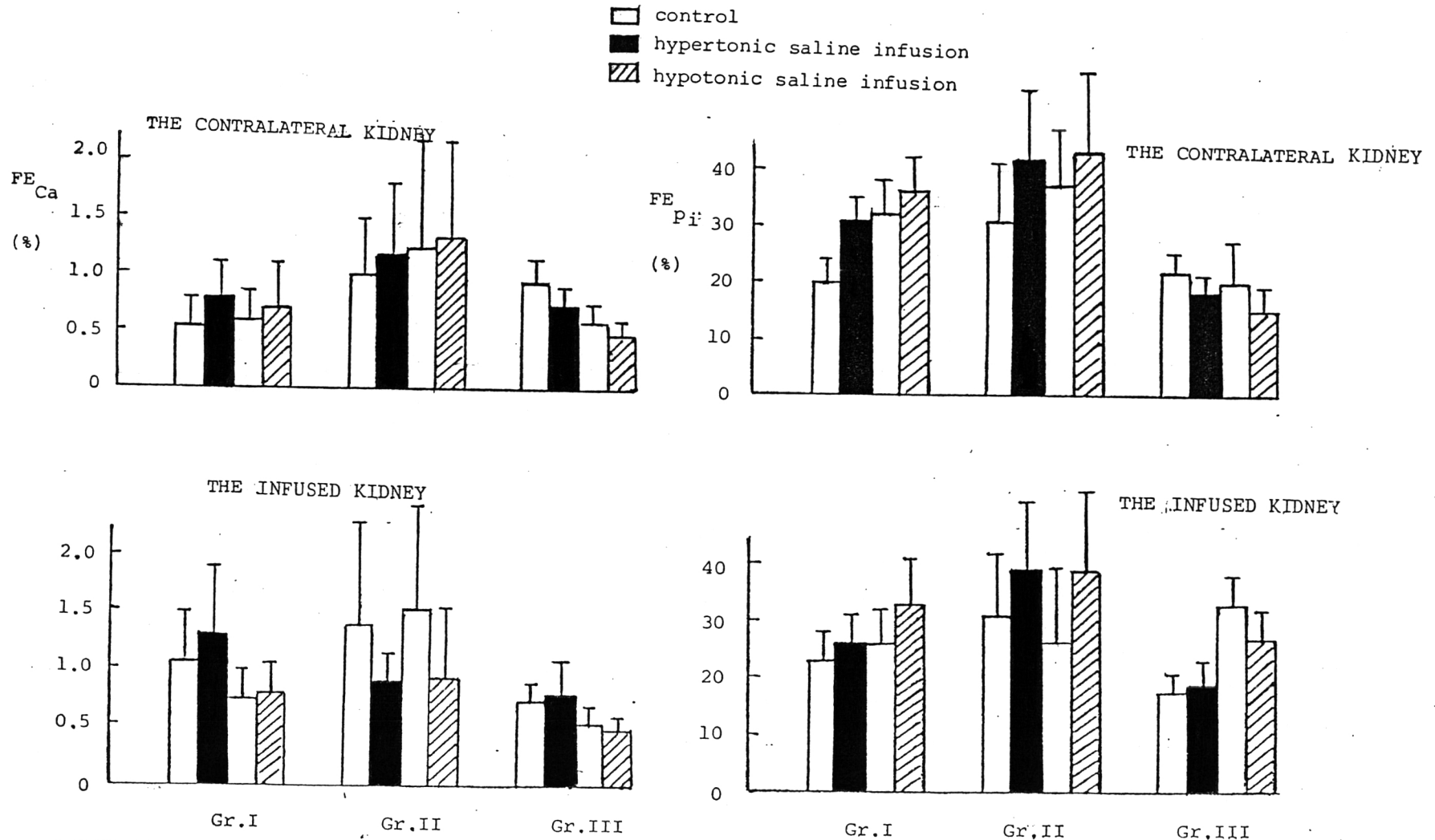


FIGURE 13 Effect of hypertonic and hypotonic saline infusion on fractional excretion of calcium and inorganic phosphorus in control group (Gr. I), hypothyroid group (Gr. II) and hyperthyroid group (Gr. III). Results are means \pm SD. The statistical difference between group I and group II or group I and group III at the same state was tested by unpaired t-test.