Direct Blood Pressure Monitoring in Patients with Pheochromocytoma

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SUMMARY

In patients with pheochromocytoma, blood pressure was monitored continuously for 2 days using direct measurement techniques. Systolic blood pressure sometimes increased to more than 300 mmHg. These sudden elevations of blood pressure were associated with increased levels of plasma catecholamines. Pre-operative prazosin and propranolol therapy lowered mean systolic and diastolic blood pressure throughout the 2 day observation periods and was associated with decreased hematocrit levels. However, these agents did not prevent the rapid elevation of blood pressure.

Additional Indexing Words:

Blood pressure monitoring Pheochromocytoma

CONTINUOUS blood pressure monitoring has been used lately.¹⁾⁻³⁾ In the preoperative management of patients with pheochromocytoma, prazosin has been administered as an alpha-adrenoceptor blocking agent.^{4),5)} In such patients we monitored the blood pressure changes, using continuous intra-brachial-arterial pressure measurements transmitted by telemetry, and the associated alterations of circulating catecholamines, collected through an indwelling venous catheter and measured by HPLC, 1) at control, 2) on prazosin and propranolol and 3) after surgery.

CASE REPORT

Case 1: A 39 year old man was admitted to our hospital because of

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Fig. 1. Continuous recording of blood pressure over 2 days in Case 1. Left: at control. Right: on medical therapy. Arrow indicates the time of plasma catecholamine sampling. A: epinephrine 4241 pg/ml, norepinephrine 1664 pg/ml. B: 3825, 1916. C: 3256, 1484. D: 4662, 1884. E: 2852, 1214. F: 3446, 1424, respectively.

Table I. Intra-arterial Blood Pressure

Case No.	Systolic pressure		
	Control	Medical therapy	After operation
1	187±12 (227-148)	159±14 (224-118)	137±15 (193-98)
2	170±18 (263-135)	155±29 (261-119)	110±14 (170-74)
3	129±25 (275- 88)	109±25 (259- 66)	125±17 (195-97)
4	122±37 (321- 66)	108±23 (245- 73)	111±14 (165-75)
Case No.	Diastolic pressure		
	Control	Medical therapy	After operation
1	117±9 (143-86)	92±9 (126-65)	84±11 (117-52)
2	101±12 (145-79)	86±12 (126-51)	65±7 (88-41)
3	69±9 (116-46)	62±11 (115-35)	77±10 (115-58)
4	70±13 (140-43)	63±8 (103-40)	69±6 (91-42)

Mean±SD (range): Mean blood pressure and standard deviation of the systolic and diastolic pressure for the 2 days were calculated by using 15-min pressures which were calculated every 15 min by averaging the 1-min blood pressure. The blood pressure ranges are based on the 1-min pressure measurement.

Fig. 2. Continuous recording of blood pressure over 2 days in Case 3. Left: at control. Right: on medical therapy. Arrow indicates the time of plasma catecholamine sampling. A: epinephrine 212 pg/ml, norepinephrine 2110 pg/ml. B: 398, 2640. C: 170, 1030. D: 338, 2140. E: 850, 5620. F: 148, 1380. G: 284, 2500. H: 418, 4280. I: 728, 7400. J: 198, 2510, respectively.

blurred vision. Findings on physical examination at the time of admission were within normal limits except for blood pressure (190/130 mmHg) and papilledema of the optic fundi without neurological findings. Urine catecholamine levels were elevated: 338 μ g/day of epinephrine (EPI) (normal <12 μ g/day) and 275 μ g/day of norepinephrine (NE) (normal 10–150 μ g/day). Prazosin 17.5 mg and propranolol 30 mg/day were administered (Fig. 1). Hematocrit fell from 41.0% at control to 36.8% on medical therapy. A 188 Gm pheochromocytoma in the left adrenal was removed. Recovery was uneventful. After operation, blood pressure returned to normal (130/90 mmHg) with plasma EPI 40 pg/ml (normal <120 pg/ml) and NE 188 pg/ml (normal 40–350 pg/ml). Urinary excretion of catecholamines also decreased to normal levels (7 μ g/day of EPI and 133 μ g/day of NE) (Table I).

Case 2: A 33 year old woman was referred to our hospital because of headaches and palpitations. Blood pressure of 180/120 mmHg was the only abnormality detected on physical examination at admission. Her urine contained 738 μ g/day of EPI and 1540 μ g/day of NE. On prazosin 9 mg and propranolol 40 mg/day, blood pressure was 160/110 mmHg with plasma EPI 2160 pg/ml and NE 8220 pg/ml. Hematocrit fell 40.2% to 38.5%. A 151 Gm pheochromocytoma was removed from the left adrenal. Recovery

was uneventful; postoperative blood pressure was normal (120/78 mmHg). Plasma EPI and NE fell to 8 pg/ml and 210 pg/ml respectively. Urinary catecholamine excretion (3 μ g/day of EPI and 81 μ g/day of NE) was also normal (Table I).

Case 3: A 34 year old man was referred to our hospital for complaints of palpitations, headaches and chest pain. Findings on physical examination at admission were normal, including a blood pressure of 146/76 mmHg. Urine contained EPI 112 μ g/day and NE 383 μ g/day. Prazosin 22.5 mg and propranolol 40 mg/day were administered (Fig. 2). Hematocrit fell from 35.4% at control to 29.6% on medical therapy. A 45 Gm pheochromocytoma in the right adrenal was removed. An uneventful recovery included a blood pressure 124/80 mmHg with plasma EPI 16 pg/ml and NE 128 pg/ml. Urinary EPI of 4 μ g/day and NE of 89 μ g/day were also normal (Table I).

Case 4: A 50 year old man was referred to our hospital for complaints of palpitations, pallor, and nausea. Findings on physical examination at admission were normal, including a blood pressure 110/66 mmHg. Urine contained EPI 380 μ g/day and NE 565 μ g/day. At control, the plasma EPI of 1091 pg/ml and NE of 2470 pg/ml corresponded with a blood pressure 122/82 mmHg; these increased to 5000 pg/ml and 7540 pg/ml respectively, with a corresponding increase of blood pressure to 287/117 mmHg. Plasma EPI, 934 pg/ml, and NE, 2230 pg/ml, rose to 5430 pg/ml and 9150 pg/ml respectively during treatment with prazosin 16 mg and propranolol 40 mg/day when blood pressure increased from 96/57 mmHg to 204/94 mmHg. Hematocrit decreased from 42.2% to 36.1%. A 68 Gm pheochromocytoma of the left adrenal was removed. Recovery was uneventful. Postoperative blood pressure was 108/70 mmHg. Plasma EPI, 24 pg/ml, and NE, 66 pg/ml, were normal as was urinary catecholamine excretion (EPI, 5 μ g/day and NE, 74 μ g/day) (Table I).

DISCUSSION

The patients who experienced sudden elevations of blood pressure had associated increases in plasma catecholamine concentrations as has been reported previously.⁶⁾ Prazosin lowered mean systolic and diastolic pressure throughout the 2 days. Various alpha-adrenoceptor blocking agents have been used preoperatively to control blood pressure.^{4),5),7),8)} Alpha-adrenoceptor blocking agents can be classified into two general categories: competitive inhibitors (e.g. phentolamine and prazosin) and noncompetitive inhibitors (e.g. phenoxybenzamine). The competitive inhibitor simply moves the dose-related response curve for the agonist to the right without altering

the slope or the maximum response.⁹⁾ In our study, prazosin appeared to act as a competitive inhibitor and lowered mean systolic and diastolic blood pressure during therapy. However, this antagonist could not prevent the rapid elevation of blood pressure due to the massive surge in agonist which presumably could override the inhibition. In addition, EPI and NE have equal affinity for both α_1 - and α_2 -adrenoceptors and prazosin is a selective α_1 -adrenoceptor blocking agent.¹⁰⁾ Vasoconstriction is produced not only by postsynaptic α_1 -adrenoceptors but also by postsynaptic α_2 -adrenoceptors.^{10),11)} The sudden elevation of blood pressure in the presence of prazosin could be due, in part, to postsynaptic α_2 -adrenoceptor activation. These phenomena may explain why prazosin did not prevent the rapid blood pressure fluctuation.

Prazosin also lowered the hematocrit. Phentolamine and phenoxybenzamine are reported to reduce hematocrit and thereby restore plasma volume.¹²⁾ Lowered hematocrit was thought to be beneficial in short term preoperative therapy with prazosin and propranolol. However, we found this drug combination to be ineffective in preventing the rapid elevation of blood pressure in these patients.

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