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Post-exercise reduction in blood pressure in hypertensive subjects: effects of angiotensin converting enzyme inhibition

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1 Much attention has been given to the effects of various classes of antihypertensive drugs on blood pressure and haemodynamics. The effects of a single bout of exercise on post-exercise blood pressure have also been studied by several investigators. However, the combined effects of prior exercise and antihypertensive medication has drawn less attention.

2 We examined the separate and combined effects of a single bout of exercise and of angiotensin converting enzyme (ACE) inhibition with a new ACE inhibitor (fosinopril, 20 mg day^{-1}) on post-exercise blood pressure and systemic and regional haemodynamics. Ten patients with mild-to-moderate hypertension were studied with a double-blind, randomized crossover, placebo- and rest period-controlled study design.

3 At rest, mean arterial pressure (MAP, -10 ± 2 mm Hg), total peripheral resistance (TPR, $-11 \pm 5\%$) and forearm vascular resistance (FVR, $-17 \pm 8\%$) were significantly ($P < 0.05$) reduced during ACE inhibition as compared with the placebo phase.

4 During the placebo phase, MAP (-3 ± 1 mm Hg), TPR ($-10 \pm 4\%$) and FVR ($-9 \pm 4\%$) were lower after exercise as compared with the control rest period.

5 During ACE inhibition, MAP (-3 ± 1 mm Hg) and TPR ($-8 \pm 4\%$) were lower, but FVR ($+32 \pm 15\%$) was increased after exercise as compared with the control rest period.

6 Thus, blood pressure and TPR decreased similarly after exercise during the placebo phase and during ACE inhibition. However, differences in post-exercise forearm haemodynamics during the placebo phase and during ACE inhibition indicate that underlying regional haemodynamics are modified.

Keywords fosinopril blood pressure total peripheral resistance forearm vascular resistance plasma noradrenaline concentrations

Introduction

Nowadays, many hypertensive individuals who receive antihypertensive medication have a physically active lifestyle. In this context, it is interesting that regular exercise by itself has been shown to exert a significant antihypertensive effect [1]. In addition to the long-term effects of regular exercise, a single bout of dynamic physical exercise induces a significant post-exercise reduction in blood pressure that lasts as long as 4–6 h after the cessation of exercise in mild-to-moderate hypertensive subjects [2–7]. The haemodynamic changes associated with the post-exercise fall in blood pressure include decreased total peripheral resistance (TPR) and forearm vascular resistance (FVR) [2]. Moreover, little is known about the combined effects of antihypertensive medication and acute exercise on the post-exercise blood pressure and haemodynamics. We have previously reported that the blood pressure reduction induced by calcium channel blockade at rest was maintained after exercise [8], i.e., prior exercise and calcium antagonism exerted additive blood pressure lowering effects. Furthermore, the post-exercise decrease in blood pressure during calcium channel blockade was associated with greater decreases in TPR [8] and FVR [9] than found after either intervention separately. There is presently no data in the literature on the effects of other antihypertensive classes of drugs on post-exercise blood pressure. In the present study, we examine the effects of ACE inhibiton with fosinopril, a new ACE inhibitor,

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on post-exercise blood pressure and systemic and regional haemodynamics in subjects with mild-to-moderate essential hypertension.

Methods

Subjects

Ten mild-to-moderate hypertensive men gave their informed consent to participate in this study, which was approved by our institutional ethics committee on human research. All subjects had their blood pressure measured during the 3 weeks preceding entry into the study. Office blood pressure was taken as the mean of three readings in the sitting position at 5-min intervals. The patients qualified for the study if their diastolic blood presure (DBP) was between 95 and 114 mm Hg in the last two visits of this period.

Secondary hypertension was ruled out by clinical and laboratory evaluation. Patients with a history of myocardial infarction, heart failure, angina pectoris or exercise-induced angina pectoris or with any medically significant deviation from normal laboratory values were excluded from the study. Patients previously on antihypertensive therapy were gradually weaned off therapy over 2 weeks and remained without treatment during an additional 4-week period before entering the study. As part as the screening procedure, all patients underwent a clinical treadmill test (Bruce protocol) with 12-lead electrocardiogram recording to rule out ischaemic heart disease. None of the subjects displayed an abnormal response to this test, defined as a downsloping or a depression of the ST segment by 1 mm or more within 0.085 s of the R wave when exercising at up to 90% of the maximal age-predicted heart rate.

Protocol

The present study used a double-blind, randomized crossover, placebo- and rest period-controlled design to examine the effects of the ACE inhibition with fosinopril (20 mg once a day, Bristol-Myers Squibb, Canada) on post-exercise blood pressure, and on systemic and regional haemodynamics in hypertensive patients.

Patients first entered a single-blind placebo lead-in phase which lasted 4 weeks. Eligible patients were then randomized to receive in a double-blind fashion either fosinopril or placebo for 4 weeks. In order to eliminate a potential carry-over effect of treatment following the crossover, the patients then entered a 4-week washout period. Thereafter, the patients crossed over to the other treatment regimen (Figure 1).

During the last week of each double-blind period, all patients were studied twice, 3 to 5 days apart. On one occasion, the subjects were evaluated after a 30-min period of cycle ergometer exercise at 50% of the measured peak oxygen uptake. On the other occasion, they were evaluated after a non-exercise control period of equal duration during which the subjects remained seated. The order of these two evaluations was randomized. During exercise, oxygen uptake was monitored such that the work load could be adjusted to elicit 50% of individual peak oxygen uptake determined 2 weeks before the first haemodynamic study.

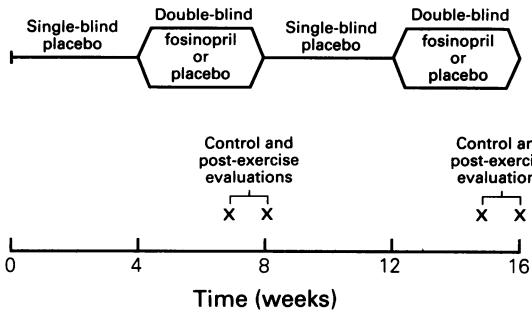

Figure 1 Schematic illustration of the double-blind, randomized crossover, placebo- and rest period-controlled study design. Patients entered a single-blind placebo phase before being randomized in a double-blind placebo or fosinopril treatment. After a second single-blind placebo phase patients crossed over from placebo to fosinopril or from fosinopril to placebo in the second double-blind treatment period. Each single or double-blind period lasted 4 weeks. The non-exercise control evaluation and the post-exercise evaluation were performed in a random order, 3 to 5 days apart, during the last week of each double-blind treatment period.

Each evaluation required 3 h. The first hour was used for exercise or rest and for setting up measurement methods. Blood pressure and haemodynamics were examined during the remaining 2 h. On arrival at the laboratory, a small catheter was placed in an antecubital vein of the subjects, who then either exercised or rested for 30 min. After a further 15 min period of recovery, the subjects moved to a bed where the measurement methods were readied. Haemodynamic measurements began 30 min after the end of the exercise or control rest period. Systemic and regional haemodynamics were each measured during three 10 min baseline periods with 10 min intervals between. It was found that both systemic and regional haemodynamics were stable over the course of the measurement period. The three sets of individual measurements were therefore averaged together. Systemic haemodynamic measurements were performed before or after regional haemodynamic measurements at random. Thus, the results are representative of the haemodynamic profile between 0.5 and 2.5 h after the control rest period and after exercise. On study days, the subjects were instructed to take their medication with a light breakfast 1 h before coming to the laboratory and to abstain from caffeine and smoking.

Measurements

The measurement methods of oxygen uptake, systemic and regional haemodynamics and plasma noradrenaline concentrations have been validated in our laboratory and were previously described in detail [2]. Briefly, they are as follows.

Oxygen uptake Oxygen uptake was measured from expired gases with infrared absorption and zirconium cell analyzers for carbon dioxide and oxygen, respectively (Energy Expenditure Unit 2900, Sensormedics, Anaheim, Calif., USA). Peak oxygen uptake was measured during a progressively increasing work load test on a cycle

ergometer (Ergomedic 829E, Monark, Varberg, Sweden) with increments of 50 Watts every 2 min. Peak value was considered to be attained when an increase in work load did not further elicit an increase in oxygen uptake or in heart rate and respiratory exchange ratio was greater than 1.1 [10].

Blood pressure and heart rate Blood pressure was measured with a standard mercury sphygmomanometer taking the first and the fifth Korotkoff sounds as systolic blood pressure (SBP) and DBP, respectively, with a cuff of appropriate size [11]. Mean arterial pressure (MAP) was calculated as DBP plus one-third pulse pressure. Heart rate was measured with a tachograph triggered by the R wave of the electrocardiogram recorded in lead III (model 7P4, Grass Instrument Co., Quincy, Mass., USA) and both traces were recorded on polygraph paper.

Systemic haemodynamics Stroke volume was determined from M mode echocardiographic measurements (Mark III Ultrasonograph, ATL Company, Seattle, Wash., USA) of end-diastolic and end-systolic left ventricular internal diameters over three consecutive cardiac cycles during which heart rate was stable. The transverse axis was located in two-dimensional mode.

Cardiac output was obtained from the product of stroke volume and heart rate recorded at the moment of echocardiographic measurement. TPR was calculated by dividing mean arterial pressure by cardiac output and multiplying by 80. The blood pressure value used for this calculation was the mean of the reading preceding and the reading following echocardiographic measurements. Changes in plasma volume that could have occurred as a result of the exercise were estimated from haematocrit and haemoglobin concentration in samples taken at midpoint during the control evaluation and after exercise [12].

Regional haemodynamics Forearm blood flow was measured by venous occlusion plethysmography (model EC-4, D. E. Hokanson Inc., Bellevue Wash., USA) using mercury-in-silastic strain gauge [13] applied around the arm contralateral to that used for blood pressure measurements and blood sampling. The strain gauge was placed 4–5 cm below the antecubital crease. Measurements were made at constant room temperature (23°–24° C) while circulation to the hand was excluded by inflating a wrist cuff 40 mm Hg above systolic blood pressure. Measurements were derived from the average of three consecutive flow curves. FVR was calculated by dividing MAP by the forearm blood flow.

Plasma noradrenaline concentrations Blood samples were taken during the last minute of each baseline period during regional haemodynamic measurements for the determination of plasma noradrenaline concentrations. Blood was drawn through the indwelling catheter (Cathlon IV, Critikon Inc., Markham, Ont., Canada) that was maintained patent with a heparin-lock solution. Plasma noradrenaline concentrations were assayed in duplicate with a specific and sensitive radioenzymatic assay using thin-layer chromatography for separation of methylated derivatives [14].

Statistical analysis

Results are expressed as means ± s.e. mean. The 95% confidence intervals for differences (95% CI diff) between control rest and post-exercise results during placebo and during ACE inhibition are also provided. Results were compared by analysis of variance for repeated measurements. When a significant ($P < 0.05$) F ratio was observed, Duncan's test was used to locate significant differences [15]. Correlation coefficients were calculated by the method of least squares.

Results

Subjects

Ten patients with mild-to-moderate hypertension participated in this study. Mean age, height, weight and peak oxygen uptake were 42.8 ± 2 years, 173 ± 15 cm, 73.6 ± 2.6 kg and 36.1 ± 1.5 ml kg^{-1} min^{-1}, respectively. During the last 2 weeks of the screening period, average seated SBP was 146 ± 3 mmHg, DBP was 100 ± 4 mm Hg, and calculated MAP was 115 ± 3 mm Hg. At the end of the first and second single-blind placebo periods, similar values of blood pressure (SBP/DBP: 143 ± 4/101 ± 2 and 141 ± 5/98 ± 2 mm Hg, respectively, NS) were found in the five patients that received fosinopril during the first double-blind treatment period, indicating that the therapeutic effect of fosinopril did not persist during the second double-blind treatment period.

Exercise results

The subjects exercised at the same work load at the end of the placebo and fosinopril phases (85 ± 4 watts) (Table 1). During exercise SBP, DBP and heart rate were significantly lower ($P < 0.05$) during fosinopril treatment than during the placebo phase. Exercise induced similar increases in percent peak oxygen uptake during placebo and during fosinopril treatment.

Haemodynamic results

Blood pressure During the non-exercise control period. MAP was significantly lower during ACE inhibition than during the placebo phase (95% CI diff: −10, −4 mm Hg; $P < 0.05$) (Figure 2). This was due to decreases in SBP (from 135 ± 3 to 122 ± 3 mm Hg; 95% CI diff: −18,

Table 1 Blood pressure, heart rate and exercise intensity during the 30 min period of cycle exercise

Variable	*Placebo*	*Fosinopril*	*Lower and upper 95% CI difference*
SBP (mm Hg)	180 ± 3	163 ± 5*	−21 and −12
DBP (mm Hg)	96 ± 2	91 ± 2*	−7 and −2
HR (beats min^{-1})	138 ± 2	133 ± 2*	−9 and −3
% VO_2 max	52 ± 1	51 ± 2	−2 and 0
Work load (Watts)	85 ± 4	85 ± 4	−1 and 2

95% Cl diff: 95 percent confidence intervals for differences, % VO_2 max: percent of maximum oxygen uptake.
* $P < 0.05$ *vs* placebo.

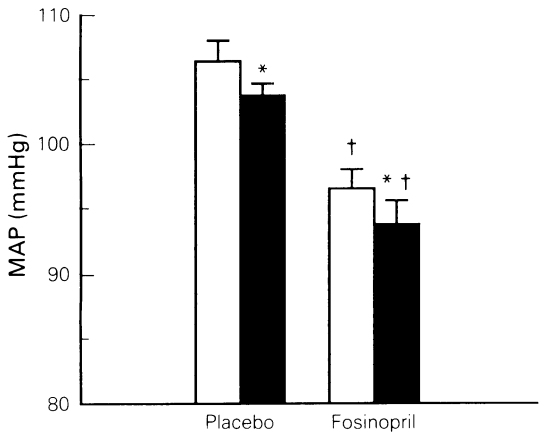

Figure 2 Supine mean arterial pressure (MAP) measured over 1 h between 30 and 90 min after the non-exercise control period (□) and after the period of cycle exercise (■). Measurements were made at the end of each 4 week double-blind treatment period with placebo and fosinopril. *$P < 0.05$ compared with respective control, † $P < 0.05$ compared with respective situation during placebo.

−7 mm Hg) and DBP (from 92 ± 2 to 84 ± 1 mm Hg; 95% CI diff: −12, −5 mm Hg). During the placebo phase, MAP decreased after exercise as compared with the non-exercise control period (95% CI diff: −4, −2 mm Hg; $P < 0.05$) (Figure 2). This decrease was mainly related to changes in SBP which decreased from 135 ± 3 mm Hg during the non-exercise control evaluation to 131 ± 1 mm Hg after exercise (95% CI diff: −6, −2 mm Hg; $P < 0.05$). No significant difference was observed for DBP (92 ± 2 and 90 ± 1 mm Hg) during control and post-exercise evaluations.

As to the effects of fosinopril on the post-exercise response, a significant decrease in MAP was found after exercise compared with non-exercise control (95% CI diff: −4, −2 mm Hg; $P < 0.05$) (Figure 2). This was mainly related to a decrease in SBP (from 122 ± 3 mm Hg during non-exercise control to 117 ± 3 mm Hg after exercise; 95% CI diff: −8, −2 mm Hg; $P < 0.05$), but not in DBP (84 ± 1 mm Hg during non-exercise control and 82 ± 2 mm Hg after exercise). The post-exercise decrease in MAP during the placebo phase and during fosinopril treatment were superimposable (both −3 ± 1 mm Hg).

Plasma volume As estimated from changes in haematocrit and haemoglobin concentration, plasma volume did not change significantly between control and post-exercise evaluations during the placebo phase (+1.9 ± 1.7%; NS) or during ACE inhibition (−0.6 ± 1.7%; NS).

Systemic haemodynamics The results concerning heart rate, stroke volume, cardiac output, and TPR appear in Figure 3. During the non-exercise control period, fosinopril treatment did not affect heart rate, stroke volume, and cardiac output, but significantly reduced TPR by 11 ± 5% (95% CI diff: −373, −200 dyn s^{-1} cm^{-5}) compared with placebo. After exercise during the placebo phase, no significant differences were found in heart rate, stroke volume and cardiac output, although heart rate ($P = 0.08$) and cardiac output ($P = 0.06$) tended to be increased compared with the non-exercise control evaluation. However, TPR was significantly reduced by 10 ± 4% after exercise (95% CI diff: −359, −134 dyn s^{-1} cm^{-5}; $P < 0.05$).

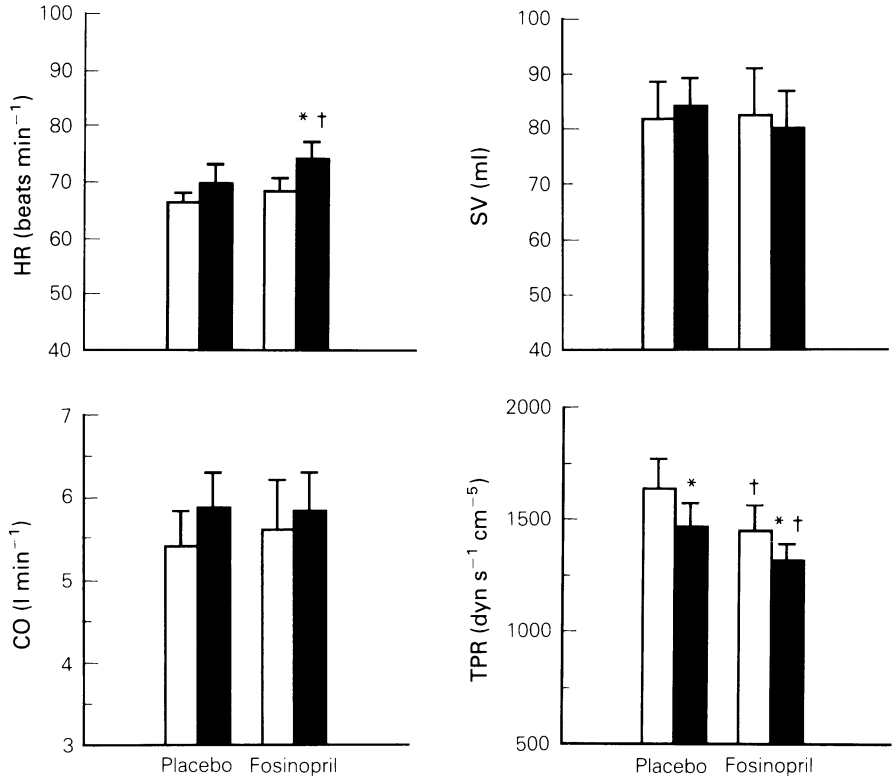

Figure 3 Supine heart rate (HR), stroke volume (SV), cardiac output (CO), and total peripheral resistance (TPR) measured over 1 h after the non-exercise control period (□) and after the period of cycle exercise (■). Measurements were made at the end of each 4 week double-blind treatment period with placebo and fosinopril. *$P < 0.05$ compared with respective control, †$P < 0.05$ compared with respective situation during placebo.

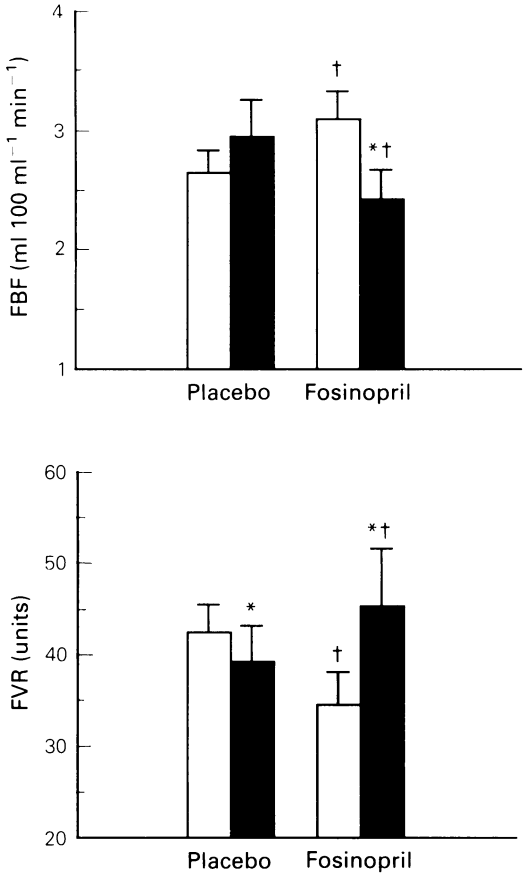

Figure 4 Forearm blood flow (FBF) and forearm vascular resistance (FVR) measured over 1 h after the non-exercise control period (□) and after the period of cycle exercise (■). Measurements were made at the end of each 4 week double-blind treatment period with placebo and fosinopril. * $P < 0.05$ compared with respective control, †$P < 0.05$ compared with respective situation during placebo.

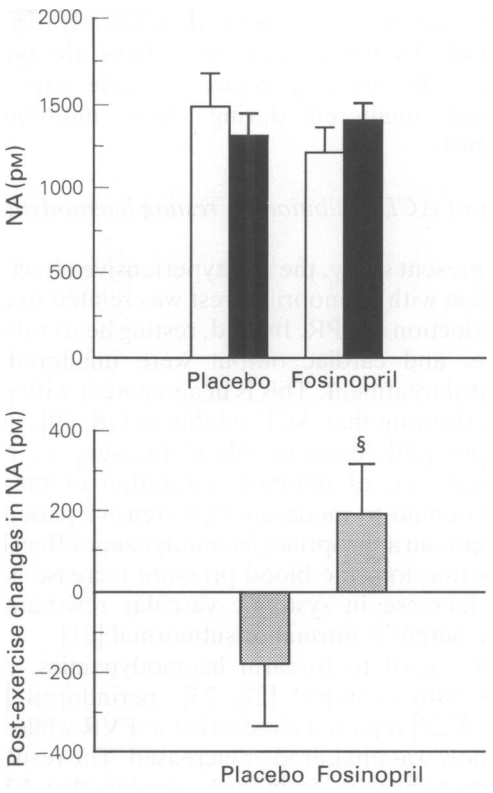

Figure 5 Plasma noradrenaline concentrations (NA) measured over 1 h after the non-exercise control period (□) and after the period of cycle exercise (■). Measurements were made at the end of each 4 week double-blind treatment period with placebo and fosinopril. Post-exercise differences in noradrenaline levels during placebo and fosinopril treatment are illustrated and compared in the lower panel. §$P < 0.05$ compared with post-exercise change during placebo.

After exercise during fosinopril treatment, an increase in heart rate (6 ± 3 beats min^{-1}) and a decrease in TPR by 8 ± 4% (95% CI diff: −197, −73 dyn s^{-1} cm^{-5}) were observed compared with the non-exercise control period, whereas stroke volume and cardiac output were unchanged. The post-exercise decreases in TPR were similar during placebo and fosinopril treatment (−175 ± 87 and −138 ± 43 dyn s^{-1} cm^{-5}, respectively).

Figure 4 shows the effects of acute exercise on regional haemodynamics during the placebo phase and ACE inhibiton. During the non-exercise control period, fosinopril treatment significantly decreased FVR by 17 ± 8% (95% CI diff: −10.2, −4.7 units; $P < 0.05$) and this was mainly due to an increase in forearm blood flow (+0.4 ± 0.2 ml 100 ml^{-1} min^{-1}; 95% CI diff: 0.0, 0.8 ml 100 ml^{-1} min^{-1}). During the placebo phase, FVR was significantly reduced by 9.0 ± 4.3% (95% CI diff: −5.3, −1.0 units; $P < 0.05$), but forearm blood flow was unchanged after exercise compared with the non-exercise control period. However, during ACE inhibition, FVR was found to increase by 32.3 ± 14.9% (95% CI diff: 6.4, 14.3 units; $P < 0.05$). While forearm blood flow decreased (−0.7 ± 0.2 ml 100 ml^{-1} min^{-1}; 95% CI diff: −0.8, −0.5 ml 100 ml^{-1} min^{-1}; $P < 0.05$) after exercise compared with the non-exercise control evaluation.

Figure 5 shows the effects of prior exercise on plasma noradrenaline levels during the placebo phase and during ACE inhibition. During the non-exercise control period, noradrenaline levels were not different during fosinopril treatment compared with the placebo phase. No significant differences were found in plasma noradrenaline levels after exercise during the placebo phase or during fosinopril treatment. However, it was found that the post-exercise changes in noradrenaline during placebo and fosinopril treatment were significantly different (95% CI diff: 200, 547 pM; $P < 0.05$) (Figure 5).

Discussion

Blood pressure

The results of the present study show that ACE inhibition with fosinopril significantly decreased resting SBP, MAP, and DBP. In agreement with previous findings, our results demonstrate that during the placebo phase, an acute bout of leg exercise induced a significant and sustained decrease in SBP and MAP [3, 5, 7, 16, 17], but not in DBP [3, 17] during the hours following the end of exercise in untreated mild-to-moderate hypertensive patients. Most importantly, the post-exercise decrease in blood pressure was maintained during ACE inhibition. Furthermore, the antihypertensive effect of exercise was quantitatively identical during the placebo phase and during fosinopril treatment. As seen during the placebo phase, the post-exercise reduction in MAP during

fosinopril treatment was related exclusively to a reduced SBP while DBP was unchanged. Thus, the qualitative nature of the blood pressure decrease after exercise remained unaltered during ACE inhibition with fosinopril.

Effects of ACE inhibition on resting haemodynamics

In the present study, the antihypertensive effect of ACE inhibition with fosinopril at rest was related to a significant reduction in TPR. Indeed, resting heart rate, stroke volume, and cardiac output were unaltered during fosinopril treatment. This is in agreement with previous results showing that ACE inhibitors [18, 19], including fosinopril [20], decrease blood pressure by reducing TPR with no, or minimal, alteration of the cardiac output in mild-to-moderate hypertensive patients. This represents an appropriate haemodynamic effect because in hypertension, the blood pressure increase is related to an increase in systemic vascular resistance while cardiac output is normal or subnormal [21].

With regard to forearm haemodynamics, previous studies with captopril [22, 23], perindopril [24], or enalapril [25] reported a reduction in FVR while forearm blood flow was unaltered or increased. The results of the present study with fosinopril showing that FVR was reduced and that forearm blood flow was increased are concordant with these earlier findings.

Post-exercise haemodynamics during the placebo phase

Our results indicate that the post-exercise decrease in MAP during the placebo phase was related to a decrease in TPR whereas cardiac output tended to increase. These results support earlier findings showing a reduced TPR with an increased cardiac output after exercise [2, 26], although an increased TPR and a reduced cardiac output have also been reported [3]. With regard to forearm haemodynamics, the present results showing that FVR is reduced after exercise also agree with earlier findings [2, 26].

Little is known about the mechanisms underlying the blood pressure and haemodynamic changes after acute exercise. There is evidence that inhibition of sympathetic nervous activity may be involved [17]. The findings of the present study indicate that the post-exercise hypotension was not associated with reflex tachycardia and there was a modest decrease in plasma noradrenaline. This decrease in sympathetic nervous activity may be related to a modification of inhibitory cardiopulmonary baroreflexes [27] with possible involvement of central opioid pathways [28].

Effects of ACE inhibition on post-exercise haemodynamics

Similar to that found during the placebo phase, the post-exercise decrease in MAP during fosinopril treatment was related to a decrease in TPR. Although heart rate was higher and stroke volume was unchanged after exercise during ACE inhibition, this did not significantly affect cardiac output. Therefore, fosinopril treatment did not modify to any significant extent the post-exercise changes in systemic haemodynamics. In contrast, the post-exercise regional haemodynamic responses were strikingly different during the placebo phase and during ACE inhibition. Indeed, forearm blood flow was found to decrease and FVR was found to increase in the post-exercise period during ACE inhibition. The increase that was observed in FVR after exercise during fosinopril treatment was twice as pronounced as the decrease that occurred after exercise during the placebo phase. This finding diverges from the parallel decreases in MAP and FVR found after exercise during calcium channel antagonism in an earlier study [9].

The reasons for those differences are not readily apparent since ACE inhibition and prior exercise independently reduced FVR. In light of the results showing that TPR decreased similarly after exercise during the placebo phase and during ACE inhibition, one is lead to conclude that vasodilatation must have occurred in other vascular beds than those of the forearm after exercise during ACE inhibition. Thus, in this particular instance, the changes in FVR oppose, rather than contribute to, the fall in blood pressure. The increase in FVR after exercise during ACE inhibition could have resulted from reflex sympathetic activation mediated by the fall in blood pressure. That an increase in sympathetic nervous tone occurred in this condition is suggested by the observation of different changes in forearm venous noradrenaline concentrations after exercise during the placebo phase and during ACE inhibition. Antecubital venous plasma noradrenaline has been shown to derive mainly from local release in the forearm and was suggested to be an index of regional sympathetic nervous activity [29]. Thus, an increase in sympathetic tone to the forearm could have been involved in the increase in FVR after exercise during ACE inhibition. There is evidence from studies in isolated tissue preparations, including skeletal muscles [30], that angiotensin II facilitates the release of noradrenaline from sympathetic nerve varicosities [31]. In the present study, the facilitation of noradrenaline release by angiotensin II is presumably reduced during ACE inhibition. These observations therefore additionally support the hypothesis that the increase in FVR after exercise during ACE inhibition was mediated by an increase in sympathetic nervous activity.

The site(s) and/or mechanism(s) of the vasodilatation in other vascular beds (than those of the forearm) can only be speculated upon. It is possible that the combination of exercise and ACE inhibition enhanced the post-exercise dilatation in the vascular beds of the skeletal muscles that were active during the exercise, i.e. leg muscles. This would imply that angiotensin II may have an important role in the normal post-exercise regulation of circulation by maintaining vascular tone in the dilated vascular beds of the previously active muscles. The potentiation of vasodilatory peptides such as bradykinin, prostacyclin, or prostaglandins may play a significant role in the effects of ACE inhibition on circulation [32]. To the extent that the release of these peptides may contribute to the post-exercise vasodilatation in previously active skeletal muscles—a possibility which has not previously been given mush attention—it can tentatively be proposed that the aftereffects of a single bout of exercise may reinforce the ACE inhibition-mediated potentiation of these vasodilatory peptides.

Another hypothesis concerns the possibility that

different effects of ACE inhibition and of exercise on regional blood flow distribution may be involved. It was reported that the decrease in FVR during ACE inhibition with enalapril was related to a reduction in subcutaneous vascular resistance, whereas skeletal muscle vascular resistance was unchanged [25]. On the other hand, the post-exercise reduction in FVR has been suggested to be related to events taking place mainly at the level of the skeletal muscle vascular beds [2, 27]. During ACE inhibition, it is possible that the vascular resistance in skeletal muscles is still reduced after exercise, but that vascular resistance increases out of proportion in the subcutaneous circulation. However, the results of the present study do not allow to determine which situation prevails and this question must await further investigation.

In conclusion, the results of this study indicate that ACE inhibition with fosinopril maintained its antihypertensive effect during the post-exercise period in patients with mild-to-moderate hypertension. This antihypertensive effect occurred as a result of similar modifications of TPR after exercise during the placebo phase and during ACE inhibition. However, differences in post-exercise forearm haemodynamics during the placebo phase and during ACE inhibition indicate that underlying regional haemodynamics are modified.

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