

SCIENTIFIC LETTER

Effects of perindopril on soluble intercellular adhesion molecule-1 in patients with congestive heart failure

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There is increasing evidence that pro-inflammatory molecules play an important role in the ventricular remodeling of congestive heart failure (CHF).¹ Among these molecules, intercellular adhesion molecule-1 (ICAM-1) is a key mediator for the necrosis of cardiac muscle. This study compares, for the first time, the effects of the angiotensin converting enzyme (ACE) inhibitor perindopril and conventional treatment on plasma soluble ICAM-1 (sICAM-1).

METHODS

Eighty four patients with CHF presenting to the department of cardiology and department of geriatrics at Xijing Hospital between December 2000 and March 2001 were recruited. Before treatment, the patients were informed about the advantages and disadvantages of perindopril treatment and treated according to their own choice. They were then divided into two treatment groups. The perindopril group comprised 42 patients (32 men, 10 women, mean (SD) age 63.2 (6.2) years, range 37-84 years), with New York Heart Association (NYHA) functional class II (7 patients), III (22 patients), and IV (13 patients) heart failure. The conventional treatment group also comprised 42 patients (25 men, 17 women, mean age 56.5 (7.6), range 42-79 years) with NYHA functional class II (9 patients), III (19 patients), and IV (14 patients) heart failure. The causes of CHF included rheumatic heart disease (29 patients), coronary heart disease (23 patients), and dilated cardiomyopathy (11 patients). The control group comprised 30 healthy individuals (20 men, 10 women, mean age 63.1 (6.5) years, range 45-75 years), and were comparable with the two treatment groups in terms of age and sex. All the subjects were free from infection, tumours, autoimmune disease or serious liver/kidney disease during the observation.

Venous blood (2 ml) was drawn from each patient immediately after their admission to the hospital and after two weeks of treatment. These samples were centrifuged at 2000 *g* rpm and stored at -80°C.

The patients in the conventional treatment group were treated with digitalis, a diuretic, and a vasodilator. The perindopril group patients received 2-4 mg perindopril daily on the basis of the above drugs.

Quantitative detection of sICAM-1 was performed using an enzyme linked immunosorbent assay (ELISA) technique employing a commercially available assay kit (Diacclone Inc, Besancon, France).

Student's *t* test was used to compare the mean sICAM-1 concentration between groups. The χ^2 test was used to compare the efficiency of treatment between groups. Statistical assay was performed using SPSS software package version 10.0 (SPSS Inc, Chicago, USA).

RESULTS

Treatment efficacy was classified into "apparently effective", "effective", and "ineffective". Apparently effective was defined as a significant improvement of symptoms and signs as well as an improvement in NYHA functional class of two levels. Effective was defined as remittance of symptoms and signs as well

Table 1 Mean (SD) serum sICAM-1 concentrations in treatment and control groups

Groups	Pre-treatment ($\mu\text{g/l}$)	Post-treatment ($\mu\text{g/l}$)	p Value
Perindopril group	591.8(155.3)	332.1 (115.8)	<0.01
Conventional group	580.0 (134.4)	423.1 (118.1)	<0.01
Control group	167.4 (34.6)		

as one level improvement of heart function. Ineffective was defined as no remittance of symptoms and signs as well as no improvement or deterioration of heart function. Total effective cases were the sum of apparently effective cases and effective cases. The apparently effective rate was 38.1% (16 patients) in the conventional treatment group and 47.7% (20 patients) in the perindopril group; the difference was non-significant ($p > 0.05$). Total effective rates were also comparable between the two groups ($p > 0.05$). The difference in average blood pressure pre- or post-treatment between the two groups was also non-significant ($p > 0.05$).

The mean (SD) concentrations of serum sICAM-1 in patients with NYHA functional class II (16/84), III (41/84), and IV (27/84) were 558.9 (152.7) $\mu\text{g/l}$, 586.7 (158.2) $\mu\text{g/l}$, and 621.6 (162.4) $\mu\text{g/l}$, respectively. Although there was no significant difference in serum sICAM-1 concentrations between NYHA functional class II and III patients ($p > 0.05$), there were significant differences in serum sICAM-1 concentrations between NYHA class II and IV as well as between class III and IV patients ($p < 0.05$).

The serum sICAM-1 concentrations in patients in the conventional treatment group and perindopril group were both decreased significantly after treatment ($p < 0.01$). Compared with the conventional treatment group, the post-treatment sICAM-1 concentration in the perindopril group was significantly lower ($p < 0.01$) (table 1).

DISCUSSION

ACE inhibitors may play an important role in protecting various organs in patients with congestive heart failure. It has been indicated that ACE inhibitors have unique advantages in the treatment of CHF, in that they not only relieve symptoms, but also delay or discontinue the progress of CHF and decrease patient mortality. The effects of ACE inhibition include improvement of persistent hyperdynamic circulation of blood in the early stages of CHF, and relief of secondary progressive ventricle remodelling mediated by inflammation.² These

Abbreviations: ACE, angiotensin converting enzyme; CHF, congestive heart failure; ELISA, enzyme linked immunosorbent assay; ICAM-1, intercellular adhesion molecule-1

effects are dependent on a neural–endocrine mechanism, which is regulated by the renin-angiotensin-aldosterone system,³ the target of ACE inhibitors.

Perindopril is a third generation long acting ACE inhibitor. In our trial, there were more apparently effective cases in the perindopril treatment group than in the conventional treatment group, but the difference was not significant. This might be related to the small number of subjects and the short treatment period of two weeks.

Expression of ICAM-1 on heart muscle cell is very low at physiological conditions and could not be detected by the usual immunological method. Under conditions such as severe impairment of the heart, reinfusion of heart muscle, and action following tumour necrosis factor or other pro-inflammatory cytokines, the expression of ICAM-1 on heart muscle cell increases several fold.⁴ Raised ICAM-1 expression could enhance the death of heart muscle cells and promote the process of heart dysfunction by recruiting and activating neutrophils, which express the ICAM-1 ligand LFA-1 on their surface and have cytotoxic activity after activation. In our trial, the serum sICAM-1 concentration in the CHF patients was much higher than in healthy controls, and increased significantly in CHF patients with deteriorating cardiac function. This result is consistent with the findings of Tousoulis and colleagues,⁵ in which plasma ICAM-1 concentrations were higher in patients with heart failure (12 patients with dilated cardiomyopathy, 23 patients with ischaemic cardiomyopathy) than in 11 healthy control subjects, indicating that sICAM-1 could be a marker for CHF. The ICAM-1 concentrations were higher in our study (mean 587.6 (152.1) µl/l) than in the study by Tousoulis and colleagues⁵ (320 (32) ng/ml to 363 (77) ng/ml), which may result from the different sensitivity of the ELISA kits used and the differing severity of baseline heart failure.

We also found that serum sICAM-1 concentrations decreased significantly after perindopril or conventional treatment, and that the decrease in the perindopril group was significantly greater than in conventional treatment group ($p < 0.01$). This result indicates that perindopril inhibits the inflammation in CHF patients more effectively than conventional treatment.

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