The Influence of Marital Adjustment on 3-Year Left Ventricular Mass and Ambulatory Blood Pressure in Mild Hypertension

Brian Baker, MBChB, FRCPC; Miney Paquette, MSc; John P. Szalai, PhD; Helen Driver, PhD; Tamara Perger, MSW; Karin Helmers, PhD; Brian O’Kelly, MD, FRCPC; Sheldon Tobe, MD, FRCPC

Background: Of psychosocial stressors, job strain has been associated with a sustained increase in blood pressure. The impact of marital factors on blood pressure and target organ has not been explored.

Objectives: To evaluate whether marital adjustment, measured at baseline by self-report (Dyadic Adjustment Scale) influences left ventricular mass index (LVMI) and ambulatory blood pressure measured over 3 years in patients with mild hypertension.

Methods: A prospective cohort study was conducted on 103 cohabiting males or females, including 72 with technically adequate echocardiograms, who at baseline were unmedicated, employed, and living with a significant other, all for a minimum of 6 months and had repeated elevated office diastolic blood pressure.

Main Outcome Measures: Left ventricular mass by M-mode echocardiography indexed to body surface area and blood pressure were measured by ambulatory blood pressure every 15 minutes (daytime) and hourly between 11 PM and 7 AM.

Results: Marital adjustment, smoking, drinking, and baseline LVMI contributed significantly to the prediction of 3-year LVMI (semipartial correlation, \( r^2 = 0.04, 0.07, 0.03, \) and \( 0.22; P = 0.03, 0.008, 0.08, \) and < .001, respectively) together accounting for 36% of the total variability in follow-up LVMI. Three-year ambulatory blood pressure measures were not significantly related to marital adjustment but there were correlations with Dyadic Adjustment Scale subscales. Low or high levels of spousal contact during 3-year ambulatory blood pressure monitoring were associated with an increase or decrease of 3-year, 24-hour diastolic blood pressure, consistent with the quality of marital adjustment (\( P = 0.04 \)) or marital satisfaction (Dyadic Adjustment Scale subscale, \( P = 0.008 \)).

Conclusions: In a cohort of subjects with mild essential hypertension, marital adjustment had an influence on 3-year LVMI. Depending on the quality of marital adjustment, spousal contact at 3 years was associated with an increase or decrease of 3-year diastolic blood pressure. Confirmation of these results, including objective marital assessment and the participation of normotensive subjects, is required.

Arch Intern Med. 2000;160:3453-3458

Marital disharmony is common and adversely affects emotional and physical health\(^1-7\); whether, like job strain\(^8-12\) it is associated with an increased prevalence of systemic hypertension and an increase in left ventricular mass index (LVMI) is unknown. Accordingly we examined the relationship between marital adjustment and 3-year LVMI in subjects with mild essential hypertension.

RESULTS

OVERALL RESULTS

Of the 205 baseline subjects, 30 refused to participate, there was 1 death, for 32 the reason was not given, and for 24 the reason was recorded as “unable to contact.” Of the remaining 118 subjects, 15 had incomplete data (from questionnaires or procedures), resulting in 103 subjects with complete data. Of the 176 subjects who had technically adequate echocardiograms, there were 72 such subjects at 3-year follow-up with complete data. The participants and nonparticipants were compared on baseline measures; of the whole group there were no differences, except nonparticipants had lower nighttime SBPs and DBPs than participants (128±14.5 mm Hg vs 131.9±13 mm Hg, \( P = 0.047 \); 79.4±10.5 mm Hg vs 82.6±9.4 mm Hg, \( P = 0.02 \), respectively). Of those with technically adequate echocardiograms, there were no statistically significant differences between participants and nonparticipants.
SUBJECTS AND METHODS

STUDY SUBJECTS

From August 1993 to March 1996 subjects participated in a study to examine the association of marital factors with LVMI and ambulatory blood pressure (ABP). 

At 3-year follow-up, 52% were receiving antihypertensive medication, 15% were smokers, and 20% reported having job strain.

Table 1 gives the ABP, LVMI, and marital adjustment measures comparing male and female subjects with the total sample. At baseline, male subjects had higher

©2000 American Medical Association. All rights reserved.
daytime diastolic ABP and greater LVMi and, at 3 years, higher daytime and nighttime ABP and greater LVMi than female subjects.

Table 2 gives significant variables from the multiple regression analysis on 3-year LVMi. Baseline LVMi, alcohol use, smoking, and marital adjustment contributed significantly to the model, together accounting for 36% of the total variability in follow-up LVMi. The semipartial correlation was 0.36% of the total variability in follow-up LVMi. The semipartial correlation was 0.388% of the total variability in follow-up LVMi. The semipartial correlation was 0.04, 0.07, 0.03, and 0.22, respectively (P = .03, P = .008, P = .08, and P = .001). Every point of diminution of the DAS total score was associated with a 0.3-g/m² increase in LVMi.

To ascertain whether there was any effect of degree of alcohol intake, frequency of exercise, or level of BP elevation, a further analysis was performed. Alcohol consumption was stratified into whether the subject consumed alcohol (ie, drink or did not drink) or was a regular drinker, defined as more than 2 drinks 5 times per week (see baseline study). Exercise was graded according to how frequently the subject exercised per week. Ambulatory blood pressure was stratified based on daytime SBP higher than 140 mm Hg, nighttime SBP higher than 125 mm Hg, daytime DBP higher than 90 mm Hg, and nighttime DBP higher than 80 mm Hg, according to American Society of Hypertension guidelines.

In the multiple regression analysis, baseline LVMi, smoking, exercise, and total DAS contributed significantly to the model, constituting 38.8% of the total variability in follow-up LVMi. The semipartial correlation was 0.196, 0.08, 0.046 and 0.06, respectively (P < .001, .008, .04, and .01, respectively).

Marital adjustment alone was not significantly related to any of the 3-year ABP measures. Those subjects with poor marital cohesion and/or satisfaction (lowest quartile on either satisfaction or cohesion, DAS subscales) had increased 24-hour diastolic and systolic ABPs at 3-year follow-up (sr² = 0.045 and 0.024; P = .01 and P = .05, respectively).

The Figure shows the relation between spousal contact and ABP. Low or high current spousal contact was associated with an increase or decrease of 3-year, 24-hour DBP, depending on the quality of baseline marital adjustment (marital distress or not, P = .04) and controlling for sex and years of marriage. This interaction was more pronounced with marital satisfaction (DAS subscale, P = .008).

To examine the association between subjective and objective ratings of the marital relationship, a substudy was performed. Couples who had previously participated in the main study and who gave consent completed self-report questionnaires (the DAS and Areas of Change Questionnaire) and each partner was interviewed separately. Thereafter, they were videotaped while discussing a previously determined problem area of conflict for 10 to 15 minutes. This had been preceded by a neutral discussion and was followed by a discussion of a pleasant topic, both for 10 minutes. Blood pressure was recorded on both partners every 3 minutes throughout all discussion periods. The videotape was sent to an inde-

### Table 1. Ambulatory Blood Pressure, Left Ventricular Mass Index, and Marital Adjustment Measures*

<table>
<thead>
<tr>
<th></th>
<th>Male Subjects (n = 66)</th>
<th>Female Subjects (n = 37)</th>
<th>Total No. of Subjects (n = 103)</th>
<th>Male vs Female Subjects†</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline Values</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DBP, mm Hg</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daytime</td>
<td>91.7 ± 5.9</td>
<td>86.5 ± 7.7</td>
<td>90.6 ± 6.7</td>
<td>.02</td>
</tr>
<tr>
<td>Nighttime</td>
<td>83.8 ± 9.4</td>
<td>80.4 ± 8.8</td>
<td>82.5 ± 9.3</td>
<td>.084</td>
</tr>
<tr>
<td><strong>SBP, mm Hg</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daytime</td>
<td>140.8 ± 8.8</td>
<td>139.2 ± 12.7</td>
<td>140.3 ± 10.4</td>
<td>.452</td>
</tr>
<tr>
<td>Nighttime</td>
<td>132.4 ± 12.7</td>
<td>130.8 ± 14.0</td>
<td>131.8 ± 13.2</td>
<td>.564</td>
</tr>
<tr>
<td><strong>LVMI, g/m²</strong></td>
<td>97.0 ± 15.9</td>
<td>83.7 ± 19.18</td>
<td>91.5 ± 18.5</td>
<td>.000</td>
</tr>
<tr>
<td>Left ventricular hypertrophy, % of subjects‡</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>.632</td>
</tr>
<tr>
<td>White-coat hypertension, % of subjects§</td>
<td>9</td>
<td>30</td>
<td>17</td>
<td>.012</td>
</tr>
<tr>
<td>Total DAS score</td>
<td>107.2 ± 17.2</td>
<td>110.5 ± 13.9</td>
<td>108.4 ± 16.1</td>
<td>.345</td>
</tr>
<tr>
<td>DAS score = 100, % of subjects</td>
<td>32</td>
<td>24</td>
<td>29</td>
<td>.501</td>
</tr>
<tr>
<td><strong>3-Year Follow-up Values</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DBP, mm Hg</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daytime</td>
<td>87.7 ± 8.2</td>
<td>81.8 ± 6.9</td>
<td>85.5 ± 8.3</td>
<td>.000</td>
</tr>
<tr>
<td>Nighttime</td>
<td>75.0 ± 8.0</td>
<td>67.6 ± 7.3</td>
<td>72.3 ± 8.5</td>
<td>.000</td>
</tr>
<tr>
<td><strong>SBP, mm Hg</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daytime</td>
<td>137.7 ± 11.4</td>
<td>132.8 ± 11.9</td>
<td>135.9 ± 11.8</td>
<td>.042</td>
</tr>
<tr>
<td>Nighttime</td>
<td>121.8 ± 11.5</td>
<td>114.6 ± 12.2</td>
<td>119.2 ± 12.2</td>
<td>.005</td>
</tr>
<tr>
<td><strong>LVMI, g/m²</strong></td>
<td>93.0 ± 18.5</td>
<td>81.0 ± 18.2</td>
<td>88.5 ± 19.2</td>
<td>.006</td>
</tr>
<tr>
<td>Left ventricular hypertrophy, % of subjects‡</td>
<td>4</td>
<td>10</td>
<td>6</td>
<td>.354</td>
</tr>
<tr>
<td>Total DAS score</td>
<td>107.8 ± 17.5</td>
<td>111.1 ± 15.1</td>
<td>109.0 ± 16.7</td>
<td>.319</td>
</tr>
<tr>
<td>DAS score = 100, % of subjects</td>
<td>27</td>
<td>24</td>
<td>26</td>
<td>.818</td>
</tr>
</tbody>
</table>

*All values are expressed as mean ± SD unless otherwise indicated. DBP indicates diastolic blood pressure; SBP, systolic blood pressure; LVMI, left ventricular mass index; and DAS, Dyadic Adjustment Scale.
†P value obtained by t test.
‡Values used were more than 131 g/m² for men and more than 100 g/m² for women.
§Less than 85 mm Hg daytime DBP.
SUBSTUDY RESULTS

Twenty-three couples (46 subjects) completed the protocol. There were 8 female subjects (34.8%); the mean (±SD) DAS score was 112±15. The RMICS has 11 codes: 5 positive, 5 negative, and an “other.” Reliability was established for 9 (39.1%) of the 23 couples. The average percentage of rater agreement was 86.4%. Constructive Problem Solving, a positive code, constituted 79.6%±13.4% of the ratings (k=0.65, V k=0.67). Ratings of negative codes constituted 3.6%±6.5% of the total, but included 20 of 46 subjects. Significant inverse associations were found between marital adjustment (by total DAS score), marital satisfaction (DAS subscale score) and the negative code of Distress Maintaining Attribution (k=0.79, V k=−0.81, r=−0.38, P=.01 and r=−0.53, P<.001). After removal of the Constructive Problem Solving outliers greater than 2 SDs (n=3), combined positive codes were related both to marital adjustment and marital satisfaction (r=0.30, P=.05, r=0.30, P=.05), as were Distress Maintaining Attribution associations (r=−0.36, P=.02 and r=−0.43, P=.004). Diastolic blood pressure was higher during problem discussion (94±11 mm Hg) than during the pleasant discussion (91±11 mm Hg) (F=1.4, P=.05). During the pleasant discussion, subjects with low marital satisfaction (n=9) had greater DBP than those with high marital satisfaction (n=37) (97.89±9.51 mm Hg vs 89.96±10.75 mm Hg, P=.049).

The main finding from this study is that marital adjustment was one of the factors associated with left ventricular mass over 3 years in subjects with mild hypertension. In comparison with a factor such as baseline LVMI, the contribution of marital adjustment to the model is modest. A 3-g/m² increase in LVMI would require a 10-point diminution in DAS score where a 10-point change may be associated with an observable effect in marital counseling.37

There is no comparable follow-up study for job strain and left ventricular mass. In a case-control study of 149 men from 8 work sites in New York the effect of job strain was 7.3 g/m².11,12 In both our cross-sectional and follow-up studies, we found no association between job strain and LVMI; however, job strain is not a fixed construct and it is possible that other formulations may have yielded an association with LVMI.10,38 As with the evaluation of work factors, marital assessment is complex and will depend on the purpose of the evaluation.39 The inclusion of both objective assessment in addition to subjective measures would contribute to a more comprehensive evaluation of marital functioning to further clarify the role of marital factors on the course of early hypertension.18,34,39

Results of our marital interaction substudy confirm that there is a relation between the DAS (a self-report questionnaire) and the RMICS (an objectively measured system). The negative code of the RMICS of Distress Maintaining Attribution has been related to outcome in marital therapy.40 This substudy is limited by having a small sample of subjects and, in particular, of those with marital problems as measured by the DAS and RMICS. The DAS total scores reflect high mean marital adjustment and the RMICS reveals that the vast majority of interactions (>95%) were positive. Ewart et al41 showed in a study of 24 females with essential hypertension that hostile marital interaction and marital dissatisfaction were associated with increased BP response but not supportive or neutral interactions. To further investigate objective and subjective marital ratings and BP response, larger studies of subjects with marital distress are warranted.

Psychosocial factors may have their most salient effects on early hypertension.42 This sample was composed of subjects with mild essential hypertension who responded to medication over a 3-year period with reduction of ABP and LVMI. Despite this, at 3 years,
LVMI correlated with baseline marital adjustment. Left ventricular mass is partially determined by the cumulative effect of fluctuations in systemic BP. The single study examining job strain in men and its relation to LVMI revealed a significant relationship only when 3 subjects with a history of antihypertensive medication use were included in the analysis. Marital disharmony, by causing periodic increases in systemic BP, could result in increased left ventricular mass and possible vascular remodeling and yet not cause a sustained increase in BP over the course of a single 24-hour ABP recording. This may relate to the amount of contact between partners and the duration of time it takes an at-risk individual to develop sustained hypertension. We did not find that there was a direct association between baseline marital adjustment and 3-year ABP; however, in those with baseline marital distress or low marital satisfaction there was an association of current spousal contact and a significant increase in 3-year DBP. Conversely, in those who were not distressed or dissatisfied in their marriages at baseline, current spousal contact was associated with a protective effect on 3-year, 24-hour DBP.

Job strain has been linked to sustained BP during and after a usual workday in normotensive subjects and with subjects with essential hypertension, especially in males. Job strain or marital factors may be viewed as initiating and aggravating factors in essential hypertension, but it is unlikely that psychosocial factors alone can sustain BP elevation. It is more likely that job and/or marital factors modify existing biologic factors in the context of the person's unique genetic predisposition. This effect is expected to occur in early hypertension before compensatory changes caused by elevations in BP become established. This study population of subjects with early hypertension was ideal for exploring this hypothesis; however, this study is not generalizable in that normotensive subjects were excluded; thus, there is the possibility that our results are skewed due to a biased sample.

In comparing subjects from baseline and follow-up studies for baseline variables, participants in the follow-up study were similar to nonparticipants (subjects from the baseline study who did not participate in the follow-up study). This applied to those with technically adequate echocardiograms and for the whole group, except in the whole group nonparticipants had lower nighttime BP than participants. However, after adjusting the significance level for multiple testing, no variable would have been significant.

In our study the levels of marital distress (based on DAS scores) are 29% at baseline and 26% at 3-year follow-up that is only slightly higher than the general population norms of 16% to 20%. This suggests that the subject with mild hypertension may not experience much more marital distress than in the general population; however, the presence of a comparative normotensive group would have been helpful to clarify whether marital distress is common in the subject with hypertension.

These are initial results showing a relation between marital factors, LVMI, and ABP. Further confirmation using objective and self-report measures of marital functioning and with normotensive subjects as well as subjects with mild hypertension are required.

Accepted for publication June 30, 2000.

This study was supported in part by the Heart and Stroke Foundation, Toronto, Ontario (Dr Baker), and grant 522790 from the Medical Research Council (Dr Helmers).

We acknowledge with gratitude all subjects and spouses, staff, and referring physicians who were involved in these studies.

Corresponding author: Brian Baker, MBChB, FRCP, 3D Edith Cavell Wing, Toronto Western Hospital, 399 Bathurst St, Toronto, Ontario, Canada M5T 2S8 (e-mail: brian.baker@utoronto.ca).

REFERENCES