Complementary medicine for the management of chronic stress: superiority of active versus passive techniques

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Background **Recent epidemiological data indicate that chronic stress is an important component of cardiovascular risk, implicitly suggesting that stress management might offer a useful complement to orthodox medical treatment and prevention of hypertension. In this context, information on mechanisms, such as subclinical increases in arterial pressure and sympathetic drive, is well documented. Conversely, evidence on methodologies and comparative efficacy needs to be improved. Accordingly, this study was planned to test the autonomic and subjective effects of two popular modalities of stress management.**

Methods **We studied 70 patients complaining of stress-related symptoms, avoiding any potential autonomic confounder, such as established hypertension or drug treatment. Patients were divided in three groups: group I ($n = 30$) followed a breathing-guided relaxation training (active); group II ($n = 15$) an oriental massage, shiatsu (passive); and group III ($n = 25$) followed a sham intervention. Subjective effects of stress were assessed by validated questionnaires and autonomic nervous system regulation by spectral analysis of RR interval variability. Factor analysis was used to extract information simultaneously embedded in subjective and functional data.**

Results **Although the problem of a greater quantity of treatment procedure in the active group than in the passive group existed, results showed that active relaxation, further to slightly reducing arterial pressure, might be more effective in relieving symptoms of stress and inducing an improved profile of autonomic cardiovascular regulation, as compared with passive massage or sham intervention.**

Conclusion **This active technique seems capable of beneficially addressing simultaneously the individual psychological and physiopathological dimensions of stress in clinical settings, with potentially beneficial effects on cardiovascular risk profile.** ***J Hypertens*** **27:2421–2428 © 2009 Wolters Kluwer Health | Lippincott Williams & Wilkins.**

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Abbreviations: ANOVA, analysis of variance; CM5, bipolar chest lead; DSM, Diagnostic and Statistical Manual; VAR, Variance; VLF, Very low frequency

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Introduction

Although the notion that the mind can affect the heart is as old as mankind, irrefutable evidence linking psychosocial mechanisms, notably chronic stress, to cardiovascular conditions are relatively recent, justifying the debate about the clinical value of these findings [1–3]. A turning point might be represented by the INTERHEART [1] study, which showed that chronic stress may predict myocardial infarction with strength similar to that of more traditional risk factors, such as altered lipid profile or elevated arterial pressure.

Stress, assessed from the point of view of patients (e.g. using general scores from self-reports, as in Rosengren *et al.* [1]) is important to highlight its connection with heart disease, but could be criticized because of vagueness of the word stress [4], as in common language [5]. However, stress scores might be useful also in gauging the effects of individual components of stress management, such as relaxation training [6].

In a functional perspective, acute [7,8] and chronic [2,9–13] stress might increase sympathetic cardiovascular activity [8] and disrupt endothelial function [14], thereby facilitating the occurrence of several cardiovascular conditions, such as arterial hypertension [13], coronary artery disease or arrhythmias [1–3,7–9,15]. Thus, it might seem reasonable to include stress reduction [2,16,17] in integrated preventive strategies.

However, lack of clear guidelines and paucity of hospitals offering clinical stress management programs might force patients to look for alternatives.

This view seems supported by a 2007 National Health Statistics report [18] indicating that up to 40% of patients choose to rely on complementary medicine services for a variety of disturbances and symptoms frequently related to stress. Breathing exercise, massage and relaxation are among the practices that increased most in usage in these last years. A particularly noteworthy development might

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be that of integrating [19] conventional with complementary medicine practices, aiming at a more explicit consideration of health and well being rather than just disease and treatment [20].

In recent years, following the model of stress as a patterned autonomic activity [21] and integrating behavioral observations with autonomic measures [22], we developed a clinical approach for the management of chronic stress [11–13,23] in ambulant patients, combining [19] conventional with complementary techniques. Stress assessment is based on self-reports, to evaluate patients' view point, and on heart rate variability, to simultaneously assess autonomic cardiovascular regulation [8,9]. Stress management is based on a multidimensional approach [13]: body–mind interventions such as mental restructuring (focusing on patients view point) and relaxation techniques [19] (focusing on autonomic arousal) are combined with eating re-education and exercise training and integrated with more orthodox drug regimens [13,16,24–28] whenever so indicated. This method was applied in a working population [13] and was capable of improving stress symptom perception, slightly reducing arterial pressure and improving autonomic cardiac regulation.

Because of the crucial role of patients' preferences [29] in determining the effects of the behavioral treatment, we hypothesized that active or passive techniques could lead to different clinical results.

The present exploratory investigation was, therefore, designed to test the hypothesis that an integrated complementary medicine approach to stress management would be more efficacious if comprising an active, as opposed to a passive, technique. We considered respectively breathing-guided relaxation training (active) or oriental massage, shiatsu (passive) [20]. To account for the inextricable intertwining of subjective and functional elements [5], we employed factor analysis [30] to extract latent variables from the simultaneous examination of all psychological and autonomic measurements. This approach has the additional advantage of enhancing the informational power that can be obtained from experimental data [31]. Results suggest the superiority of active techniques over passive ones.

Methods

Study population

This study involves 70 consecutive patients (age 42 ± 1 years; 34 men; 36 women) who complained of stress and unexplained medical symptoms lasting more than 3 months, and asked our advise.

In all patients, the presence of concomitant diseases, pharmacological treatment or cigarette smoking, alcohol or food abuse was excluded by standard medical examination and tests. The average BMI was 22.7 ± 0.3 kg/m^2 and none was on any medication. An additional group of 110 healthy participants (age 40 ± 1 years; 44 men; 66 women; BMI 23.3 ± 0.3 kg/m^2; all NS) provided reference control values.

After careful clinical examination, patients were offered the possibility of enrolment in a 3-month clinical treatment, either following an active or passive paradigm. The active paradigm was based on weekly encounters of 1-h duration with an expert technician. The trainer invited the patients to lie down on a soft mattress and to focus their attention on their breathing pattern and rate. Progressively, they were asked to deepen, regularize and slow their respiration, reaching a most comfortable mix. On average, nominal rate was about 8–10 breaths/min; and the suggested inspiratory-to-respiratory ratio was from about 3/7 vs. 4/7 to 3/8 vs. 5/8 (silent counting could be used to help out). Patients were also asked to relax their musculature progressively and disregard any intervening thought. The trainer also provided introductory mechanistic information and psychophysiological insight. Patients were strongly recommended to perform unsupervised home daily exercises (group I). The passive method consisted of biweekly treatments of 1-h duration of an oriental (shiatsu) massage (group II) delivered by an expert technician. This type of treatment, at variance with for example acupuncture requiring needles, is delivered by hands only and consists of deep pressure applied slowly and progressively in different bodily points, according to a personalized scheme focusing particularly on the spine, the arms and the legs. It is believed that shiatsu massage activates the central or the autonomic nervous system. A third group, who declined either approach, received structured information (booklets and a lecture on stress management) on the potential symptomatic advantages of stress management and was considered sham treatment (group III).

Symptom evaluation

All patients were assessed by a trained clinical psychologist through a semi-structured interview in order to establish the presence and level of chronic psychosocial stress, of stress-related symptoms and to exclude patients with psychiatric diseases (with particular attention to depression and somatoform disorders) following DSM IV criteria [32].

As in prior studies [11–13] on the autonomic effects of stress, all participants filled a self-administered questionnaire [23] providing nominal self-rated scales that focus on overall stress perception and on stress-related symptoms.

Autonomic evaluation

After a preliminary 10-min rest period in the supine position, allowed for stabilization, blood pressure, single-channel ECG (CM5) and respiratory activity were recorded over a 10-min supine baseline and over a subsequent 7-min period of active standing.

To minimize possible emotional bias of the recording procedure, the ECG and the respiratory signal were recorded in all participants with a two-way wireless radiotelemetry system (Marazza, Monza, Italy).

Data were acquired with a personal computer, using an acquisition rate of 250 samples/channel per s.

From the continuous RR series extracted from ECG recording, an autoregressive spectral algorithm [33,34] provided a series of indexes indirectly reflecting autonomic cardiovascular modulation.

RR interval spectral powers were quantified in the low-frequency (0.03–014 Hz) and the high-frequency (0.15–0.35 Hz) regions. Low frequency spectral powers were normalized according to the formula $P_{\text{low frequency}}$ (normalized units) = [($P_{\text{low frequency}}$ (ms^2)/(VAR$_{RR}$ (ms^2) − VLF (ms^2)] × 100 (where $P_{\text{low frequency}}$ (normalized units) = low-frequency powers in normalized unit, VAR = total variance; VLF = very low frequency component, <0.03 Hz); similar normalization was performed for high-frequency powers. Low frequency/high frequency of RR interval variability power ratio was also computed.

Monovariate and bivariate spectral analysis of RR interval variability and respiration were employed to ensure that in all participants included in the study respiratory rate coincided with the high-frequency component of RR variability and no respiratory entrainment was present.

On the day of the study, participants were instructed to avoid alcohol and caffeinated beverages for the 12 preceding hours, to abstain from heavy physical activity since the day before and, after a light breakfast, to come to the laboratory between 0830 and 1230 h. All participants were instructed about the study procedure and gave their informed consent. Our Institution Ethics Committee approved the protocol of the study.

Patients were studied twice: first at enrolment and then after the active, the passive or the sham treatment. The control reference participants were studied only once.

Statistics

Summary data are presented as mean ± SEM. Simple ANOVA was used to describe baseline data. The effects of the relaxation procedures (active, passive or sham) on patients were preliminarily examined considering the treatment-induced changes from baseline with a univariate analysis. Because the small group sizes could adversely affect inferences, nonparametric testing procedures, that is Kruskal–Wallis (K–W) and Jonckheere–Terpstra (J–T) test, followed by Mann–Whitney test on pair-wise comparisons, were also performed with empirical significance level (*P* value) estimated by Monte Carlo method [35]. Subsequently, in order to account for the inextricable interaction between subjective and objective components and to allow for information spread across variables, first a multivariate ANOVA (MANOVA) was carried out. Latent variables were in addition obtained with factor analysis carried out with the principal component extraction method and varimax rotation from both self-reports scores and functional variables. Significance of differences between latent variables in the groups was assessed with both parametric and nonparametric procedures. Regarding the former, a significance test on squared Mahalanobis distances between pairs of group centroids was performed in addition to multivariate and univariate ANOVA. As for nonparametric procedures, Kruskal–Wallis and Jonckheere–Terpstra tests were involved. A level of 0.05 was considered significant. If so, the power of test was computed in correspondence of the observed values.

Results

Table 1 provides a descriptive overview of the study population, confirming that, as per design, patients showed psychological and autonomic markers of moderate stress as compared to the reference control group. Sham group, however, showed somewhat less severe stress symptoms but similar autonomic markers. A univariate ANOVA subsequently performed to assess the effects of treatments on single variables clearly indicated that there was a significant difference between employed modalities. In particular, the power of this test computed for significant results was found to be about 0.5–0.8. A further analysis about treatment effects and made through nonparametric procedures gave the results reported in Table 2. Jonckheere–Terpstra test gives empirical evidence to a growing effect in reducing psychological stress scores when passing from sham group to passive treatment and then finally to active treatment.

Comparing more directly with sham group, Mann–Whitney test shows that both active (group I) and passive treatment (group II) procedures induced significant reductions in psychological stress scores (stress: $P_I = 0.003$, $P_{II} = 0.032$; tiredness: $P_I = 0.001$, $P_{II} = 0.004$; and symptoms perception: $P_I = 0.000$, $P_{II} = 0.053$), whereas active relaxation appeared to induce in addition a small reduction in systolic arterial pressure ($P_I = 0.000$), oscillatory autonomic (low frequency: $P_I = 0.015$ and low frequency/high frequency: $P_I = 0.004$) indices and respiratory rate ($P_I = 0.006$). Conversely, sham treatment appeared ineffective (group III), which is in line with the simpler observation that the changes in psychological variables were negligible (stress scores) or even worsened slightly (tiredness and 4SQ; Table 2).

Table 1 Study population and descriptive statistics of psychological and autonomic variables in reference and patients groups

Variable	Reference	Relax	Shiatsu	Sham	Significance
n	110	30	15	25	–
Age (years)	40.2 ± 1.1	42.7 ± 1.4	39.8 ± 3.3	42.7 ± 1.7	NS
Sex (male/female) (%)	40.0/60.0	33/67	33/67	72/28	NS
BMI (kg/m^2)	23.3 ± 0.4	22.5 ± 0.4	21.5 ± 0.8	23.7 ± 0.6	NS
Smoke (no/yes) (%)	81/19	90/10	73/27	92/8	NS
Stress perception (a.u.)	3.44 ± 0.23	6.82 ± 0.46[a,b]	6.33 ± 0.39[a]	4.64 ± 0.41	0.000
Tiredness perception (a.u.)	3.76 ± 0.24	6.21 ± 0.52[a,b]	6.80 ± 0.55[a,b]	4.40 ± 0.48	0.000
Somatic symptoms perception (a.u.)	17.12 ± 1.94	62.03 ± 4.86[a,b]	61.80 ± 8.18[a,b]	35.84 ± 5.56[a]	0.000
SAP (mmHg)	118.5 ± 1.4	120.4 ± 3.2	115.0 ± 3.2	117.7 ± 2.8	NS
DAP (mmHg)	73.7 ± 0.8	77.3 ± 1.72	73.3 ± 3.1	77.2 ± 1.8	NS
HR (beats/min)	64.5 ± 1.1	66.4 ± 3.0[c]	52.7 ± 1.7[a,b]	70.5 ± 2.3	0.000
RR (ms)	962 ± 17	943 ± 32[c]	1156 ± 42[a,b]	879 ± 36	NS
VAR_{RR} (ms^2)	2483 ± 225	2457 ± 332	3697 ± 652	2871 ± 948	NS
LF (ms^2)	762 ± 119	858 ± 138	1264 ± 339	799 ± 237	NS
LF (nu)	49.3 ± 1.6	62.7 ± 3.7[a]	56.3 ± 5.1	61.6 ± 3.3[a]	0.000
HF (ms^2)	576 ± 67	401 ± 76	643 ± 129	387 ± 135	NS
HF (nu)	41.2 ± 1.6	31.2 ± 3.2[a]	35.4 ± 4.8	28.3 ± 3.0[a]	0.001
LF/HF	1.9 ± 0.2	4.5 ± 1.3[a]	2.4 ± 0.5	3.4 ± 0.6	0.008
Respiratory frequency (Hz)	0.25 ± 0.00	0.26 ± 0.01	0.20 ± 0.01[a,b]	0.27 ± 0.01	0.014

a.u., arbitrary units; DAP, diastolic arterial pressure; HF, high-frequency component; HR, heart rate; LF, low-frequency component; LF/HF, ratio between low and high frequency components; NS, not significant; nu, normalized units; RR, RR interval; SAP, systolic arterial pressure; VAR_{RR}, RR variance. Significance tested with UNI ANOVA; followed by Tukey contrasts, is indicated (χ^2-test employed for sex and smoke). [a] Significant different from reference group. [b] Significant different from sham group. [c] Significant different from shiatsu group (all $P < 0.05$).

The difference between treatment modalities was also confirmed by a multivariate analysis of variance (Wilks' lambda: $P = 0.016$; Hotelling–Lawley trace: $P = 0.017$).

It should be noticed that changes were small and, furthermore, potentially clouded by the likely interaction between stress symptoms and autonomic regulation. Accordingly, latent variables were subsequently sought and then extracted with factor analysis in order to account for the intertwining of information. Table 3 shows the pattern matrix of factorial loadings for the solution obtained in four dimensions, which accounts for the 78.9% of the total variance of data. It is possible to interpret clearly each factor in terms, respectively, of absolute autonomic indices (total power and absolute values of low-frequency and high-frequency components; factor 1), psychological stress scores (factor 2), normalized power of oscillatory autonomic indices (low frequency and high frequency in normalized units and low frequency/high frequency ratio, factor 3) and heart rate and respiration indices (factor 4). These four factors reproduce a very close percentage of the total variance (respectively, 21.13, 20.10, 19.98, 17.74%), suggesting an approximately similar informational value.

A subsequent analysis taking into account the experimental groups I, II and III reveals that the latent variables are not uniformly distributed within them (Fig. 1), being above all factors 2 and 3 selectively different across groups. In particular, they reach a minimum in group I (active relaxation) that is notably smaller than observed in sham group III (group II shows an intermediate position).

Significance tests subsequently performed give evidence, firstly, to the existence of a significant group effect on the whole latent variable configuration (MANOVA, Wilks'

Table 2 Intervention induced changes in psychological and autonomic variables in the three groups

Variable	Group I relax, $N = 30$	Group II shiatsu, $N = 15$	Group III sham, $N = 25$	Significance
ΔStress perception (a.u.)	−1.97 ± 0.5*	−1.93 ± 0.7†	−0.08 ± 0.5	0.005
ΔTiredness perception (a.u.)	−1.53 ± 0.6*	−1.73 ± 0.6†	0.68 ± 0.5	0.000
ΔSomatic symptoms perception (a.u.)	−21.0 ± 5.5*	−13.4 ± 8.5†	4.52 ± 3.4	0.001
ΔSAP (mmHg)	−8.09 ± 1.87*	−3.0 ± 2.7†	7.0 ± 3.6	0.000
ΔDAP (mmHg)	−8.9 ± 4.6	−2.3 ± 2.4	1.0 ± 2.0	NS
ΔHR (beats/min)	−3.2 ± 2.7	−1.09 ± 1.5	−2.6 ± 1.8	NS
ΔRR (ms)	22.7 ± 25.8	38.1 ± 32.4	9.81 ± 27.3	NS
ΔVAR_{RR} (ms^2)	−153 ± 310	936 ± 1152	−645 ± 824	NS
ΔLF (ms^2)	−205 ± 118	358 ± 434	−32 ± 171	NS
ΔLF (nu)	−14.0 ± 2.8*,‡	−3.50 ± 3.7	−2.73 ± 3.9	0.004
ΔHF (ms^2)	183 ± 82	635 ± 418	−62 ± 82	NS
ΔHF (nu)	9.47 ± 2.8	1.72 ± 3.9	5.65 ± 4.2	NS
ΔLF/HF	−2.8 ± 1.0*	−0.15 ± 0.3	0.62 ± 0.9	0.001
ΔRespiratory frequency (Hz)	−0.04 ± 0.02*,‡	0.00 ± 0 0.01	−0.00 ± 0.01	0.004

Δ, changes produced by intervention; a.u. arbitrary units; DAP, diastolic arterial pressure; HF, high-frequency component; HR, heart rate; LF, low-frequency component; LF/HF, ratio between low-frequency and high-frequency components; NS, not significant; nu, normalized units; RR, RR interval; SAP, systolic arterial pressure; VAR_{RR}, RR variance. Significance tested with Jonckheere–Terpstra nonparametric procedure; empirical significance level estimated by Monte Carlo procedure. Pair-wise comparisons assessed with Mann–Whitney test. Significant differences. * $P < 0.05$ relax vs. sham. † $P < 0.05$ shiatsu vs. sham. ‡ $P < 0.05$ relax vs. shiatsu.

Table 3 Latent variables, as extracted from rotated factorial scheme

	Factor 1	Factor 2	Factor 3	Factor 4
ΔHF (ms^2)	90*	−10	−23	−10
ΔLF (ms^2)	90*	−5	−5	−17
$ΔVAR_{RR}$ (ms^2)	87*	−10	4	−24
ΔStress perception	−11	92*	8	6
ΔTiredness perception	−11	87*	13	−8
ΔSomatic symptoms perception	−1	82*	1	2
ΔLF (nu)	−5	23	90*	10
ΔLF/HF	11	−3	75*	10
ΔHF(nu)	4	−4	−90*	−6
ΔHR (beats/min]	−13	−15	3	95*
ΔRespiratory frequency (Hz)	−6	18	25	59*
ΔRR (ms)	31	4	−3	−87*

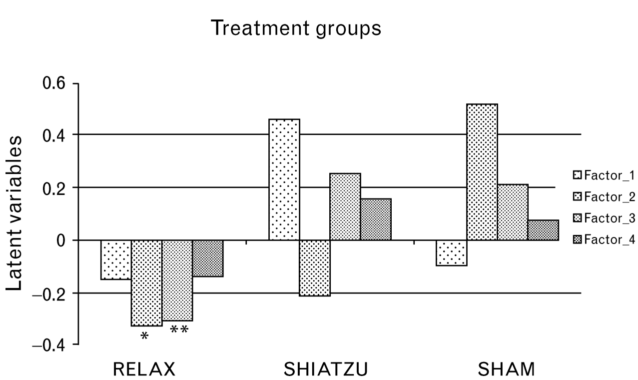
Values are normalized by multiply each one by 100 and rounding to closest unity. Significant differences (*) $P < 0.05$. Δ, changes produced by intervention; HF, high-frequency component; HR, heart rate; LF, low-frequency component; nu, normalized units; VAR_{RR}, RR variance. Factor 1 = RR interval oscillations; factor 2 = psychological stress perception; factor 3 = normalized autonomic oscillatory indices; factor 4 = heart rate and respiration.

lambda: $P = 0.006$; Hotelling–Lawley trace: $P = 0.007$), which especially regards factor 2 (ANOVA: $P = 0.004$; Kruskal–Wallis: $P = 0.002$; Jonckheere–Terpstra: $P = 0.000$) and factor 3, although less clearly (ANOVA: NS; Kruskal–Wallis: NS; Jonckheere–Terpstra: $P = 0.016$). Second, a more direct comparison between pairs of groups, as made through Mahalanobis distances computed with the four latent variables, shows that a significant difference separates group I from group III, whereas group II is intermediate (Table 4).

Discussion

The present investigation supports the hypothesis that active relaxation procedures may be more effective in the clinical treatment of stress [28], because in addition to improving symptoms profile, they ameliorate autonomic cardiovascular regulation and slightly reduce systolic arterial pressure [13,36–38].

Fig. 1



Results of factor analysis on the effects of different stress treatments, comparing active (relax), passive (shiatsu) and sham modalities. Notice that only the relaxation group shows a clear reduction in factors 2 (psychological stress perception) and 3 (normalized autonomic oscillatory indices). No difference is present in factor 1 (absolute autonomic indices) and factor 4 (heart rate and respiration). Significance $*P < 0.05$; $**P < 0.01$.

Table 4 Mahalanobis distances between pairs of centroids of the three groups

	Group I relax	Group II shiatzu	Group III sham
A			
Group I relax	0	0.88017	1.25455
Group II shiatzu	0.88017	0	0.95259
Group III sham	1.25455	0. 5259	0
B			
Group I relax	1.0000	0.0908	0.0052
Group II shiatzu	0.0908	1.0000	0.0869
Group III sham	0.0052	0.0869	1.0000

A, squared distance from different groups. B, probability of Mahalanobis distance from different groups.

Stress is a complex, difficult to define concept, pertaining to both psychological and physiological domains [10]. Thus, studies on the effects of stress and of its treatment must explicitly consider simultaneously these two different aspects [16,17,25,27].

In the present investigation, we employed fully non-invasive approaches [33] to account for the potential methodological bias that might arise from invasive methodologies, which, by inducing fear and anxiety, might acutely increase sympathetic drive, clouding the baseline autonomic profile. This is particularly critical when dealing with the autonomic physiology of chronic stress, a condition that is characterized by a resting sympathetic prevalence [9]. Accordingly, we employed an indirect assessment of autonomic cardiovascular regulation [39], considering both an hemodynamic component, as indicated by arterial pressure changes (under the simplified assumption that lower pressure suggests less vascular sympathetic drive [40]), and sympathovagal cardiac regulation, as inferred from spectral analysis of RR variability [33,34].

This proved valuable in previous studies and capable of unmasking beneficial effects of integrated stress management approaches in workers subjected to long-term stress [13,16]. Notably, in our previous studies on stress management, we addressed simultaneously the psychological and the functional components by a personalized combination of cognitive restructuring, moderate exercise and breathing techniques that induced a small reduction in arterial pressure and an improved autonomic cardiac profile, suggestive of reduced sympathetic and increased vagal drive.

A number of recent studies seem to indicate that appropriate respiratory input manipulation might beneficially affect autonomic cardiovascular regulation, particularly utilizing respiratory training obtained either behaviorally [41] or with an ad-hoc device [42,43]. Admittedly, other potentially important aspects (such as immunological and hormonal markers [8]) are, at the moment, disregarded.

A key potential limitation of our study, shared by many others on stress [5], is the suboptimal blinding design and an inescapable component of self-selection in participants. In fact, only participants willing to participate and engage easily accept the protocol and remain compliant throughout the study. This possibility is suggested also by the higher subjective indexes (stress perception, tiredness perception and somatic symptoms perception) measured at baseline in groups I and II when compared with those of the sham group. The ensuing possible bias could be minimized by considering changes in subjective indexes normalized by the baseline value: this analysis provided a similar picture (data not shown for simplicity). Finally, there is no way to blind the active, passive or sham protocols. It has also been affirmed that in behavioral studies on stress, randomization might even be nondesirable from an ethical point of view [5].

It is our experience that in stress management studies the control group may only imperfectly match the active treatment groups [44]. To an extent, this might also lead to a sex issue, as men, who more frequently have a hectic work also outside of the office, tend to choose the sham intervention, which impacts less on their working routines [13].

An additional point regards the usually small changes that can be obtained with behavioral interventions and the ensuing difficulty to clearly extract meaning from experimental and biological noise, particularly if several variables describing different domains (e.g. psychological and functional) are assessed individually.

The present approach accounts in part for these drawbacks, addressing explicitly both the patients' viewpoint, by way of a battery of self-reports describing mostly symptoms (such as fatigue and bodily complaints) and the autonomic part. These different domains are subsequently recombined in a complex, yet unitary, statistical evaluation, capable of expanding our interpretation, using a factor analysis for extracting latent variables [30] from the entire dataset. This method reduced all information into four latent variables, relating to amplitude of RR interval oscillations (factor 1), psychological stress perception (factor 2), normalized autonomic oscillatory indices (factor 3), heart rate and respiration (factor 4).

These factors provide a quantitative indication of the information carried collectively by the various elements of the usual univariate analysis, thus strengthening the inference that can be drawn from the dataset.

Although the study population is not large, and a slight imbalance between the three groups at baseline was unavoidable, data clearly suggest a superiority of active techniques of stress management over passive ones. However, the limited sample size calls for some restraint in extrapolating data to other populations.

Both active and passive techniques improve the disturbed psychological stress profiles to a similar extent in all examined domains: stress, fatigue and somatic symptoms perception. Only the active treatment, notably, reduced in addition indices of sympathetic modulation and slightly diminished systolic arterial pressure. Accordingly, the possible reduction in risk induced by relaxation practices might not be related to the improved subjective component of stress, but is more likely to reflect a more balanced autonomic profile. We cannot define the mechanisms responsible for these changes; however, it can be hypothesized that some effects of the active training protocol on respiration [41–43,45], documented by the reduction in respiratory rate observed in group I, might play a role, as corroborated by recent studies with slow breathing training in hypertension [42] and heart failure [43]. An improved baroreflex gain [45] was also observed by our group in healthy participants after a period of similar relaxation training.

A possible clinical advantage of the present active treatment is that patients learn to actively relax [25,28,46] and focus on a personally chosen breathing pattern, which can be maintained without the need for specific instrumentation [42,43], thus including relaxation technique as a component of their usual daily routine. Also, passive treatment allows a betterment of psychological indices while showing no effects on physiological variables. This finding may suggest the role of nonspecific factors [47] in reliving the perception of stress and arousal, altering the personal experience of stress. Among these factors, we may consider the belief that the chosen technique is effective [48], personal expectations, relaxing clinical setting, the pleasant feeling of the massage, the positive value of dedicating time to own personal care. This psychological involvement may mirror the placebo capability of altering the expectation of pain in humans observed in studies employing functional MRI [49,50]. Patients in the active group, however, performed daily exercises at home, which, in a sense, implies a greater treatment quantity, hence possibly preferable results. Accordingly, this aspect should be better clarified in future studies before generalizing present results.

The extent to which the observed reduction in systolic arterial pressure and improved oscillatory profile of autonomic cardiac regulation might be extrapolated to actual prevention requires additional longer term studies with larger groups of patients. The proposed technique seems capable of beneficially addressing simultaneously the individual psychological and physiopathological dimensions of stress in clinical settings, with potentially beneficial effects on cardiovascular risk profile, whereby even small pressure changes are clinically relevant [51].

In conclusion, given the growing recognition that stress is a component of cardiovascular risk, and that even small changes in risk factors might eventually have clinical relevance, as shown by hypertension epidemiology [51], strategies to manage stress could become of clinical importance [6]. In this context, the present data may be of interest because they suggest that active methods of stress management appear more efficacious than passive ones not only in reducing symptoms, but also in improving potential mechanisms, as indicated by spectral analysis of RR variability. Moreover, this exploratory investigation confirms the feasibility of integrating conventional and complementary medicine for the treatment of chronic stress in a hospital setting and suggests the choice of active rather than passive techniques.

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