Blood Pressure

ISSN: 0803-7051 (Print) 1651-1999 (Online) Journal homepage: informahealthcare.com/journals/iblo20

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To cite this article: Paolo Palatini, Paolo Bratti, Daniela Palomba, Elisa Bonso, Francesca Saladini, Elisabetta Benetti & Edoardo Casiglia (2011) BP reactivity to public speaking in stage 1 hypertension: Influence of different task scenarios, Blood Pressure, 20:5, 290-295, DOI: 10.3109/08037051.2011.566011

To link to this article: https://doi.org/10.3109/08037051.2011.566011

Published online: 15 Mar 2011.

Blood Pressure, 2011; 20: 290–295

informa healthcare

ORIGINAL ARTICLE

BP reactivity to public speaking in stage 1 hypertension: Influence of different task scenarios

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Abstract

Aim. To investigate the blood pressure (BP) reaction to public speaking performed according to different emotionally distressing scenarios in stage 1 hypertension. *Methods.* We assessed 64 hypertensive and 30 normotensive subjects. They performed three speech tasks with neutral, anger and anxiety scenarios. BP was assessed with the Finometer beat-to-beat non-invasive recording system throughout the test procedure. *Results.* For all types of speech, the systolic BP response was greater in the hypertensive than the normotensive subjects (all $p < 0.001$). At repeated-measures analysis of covariate (R-M ANCOVA), a significant group-by-time interaction was found for all scenarios ($p \leq 0.001$). For the diastolic BP response, the between-group difference was significant for the task with anxiety scenario ($p < 0.05$). At R-M ANCOVA, a group-by-time interaction of borderline statistical significance was found for the speech with anxiety content ($p = 0.053$) but not for the speeches with neutral or anger content. Within the hypertensive group, the diastolic BP increments during the speeches with anxiety and anger scenarios were greater than those during the speech with neutral scenario (both $p < 0.001$). *Conclusions*. These data indicate that reactivity to public speaking is increased in stage 1 hypertension. A speech with anxiety or anger scenario elicits a greater diastolic BP reaction than tasks with neutral content.

Key Words: *Anger, anxiety, hypertension, psycho-social task, speech, stress*

Introduction

A range of psychological characteristics have been associated with hypertension in either cross-sectional or longitudinal studies. Anger and anxiety were the factors more commonly associated with high blood pressure (BP). Some longitudinal studies have supported the view that suppressed anger (1,2) may predict the later incidence of hypertension, whereas others have not found this association (3,4). Several studies have suggested that also high anxiety levels may predict the development of hypertension, at least in subgroups of subjects (1,3–5), but also the results of these studies were inconsistent. This may partly be because the study of discrete psychological characteristics can provide only an incomplete view of the role these factors may play in the etiology of hypertension. A well-recognized limitation of current research on the psychological determinants of hypertension is the measurement error, including the lack of objective measurements for individual psychosocial characteristics and inaccurate measurements of variables studied in relation to their putative effect on evolving hypertension. A number of studies have shown that the direct measurement of cardiovascular reactivity to tasks such as mental arithmetic, the Stroop color test or psychosocial challenges predicts future values of BP and risk of hypertension, and that exaggerated stress reactivity may contribute to the development of cardiovascular disease (6–9). However, the nature of the stressor may be of critical importance in determining the cardiovascular response to stress because the amount of "stress" mainly depends on the subject's degree of involvement in the particular task (10,11). The tests currently used to assess BP reactivity in the laboratory, such as mental arithmetic, the Stroop color test or mirror tracing, can hardly reflect stressful situations of daily life (12). Public speaking tasks are widely

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(Received 30 November 2010; accepted 16 February 2011)

ISSN 0803-7051 print/ISSN 1651-1999 online © 2011 Scandinavian Foundation for Cardiovascular Research
DOI: 10.3109/08037051.2011.566011

used to study a variety of research topics including subjects' psychosocial traits (13–15). The speech test implies speaking in front of an audience on an assigned topic while being observed and critically evaluated by laboratory staff. This test elicits a strong β-adrenergic response causing pronounced cardiovascular and neuroendocrine stress reactions (16,17). Current models of stress suggest that individuals may differ in their emotional reactions to environmental situations and that it is this emotional reactivity that drives physiological responses (18). Previous data indicate that the BP response to public speaking is enhanced in hypertension but whether the nature of the speech affects BP reactivity is not known. In particular, it is not known whether a speech with anger or anxiety content can elicit a greater reactivity than a speech with neutral content. To clarify this point, we investigated the BP reaction to public speaking performed according to different emotionally distressing scenarios in a group of young-to-middle-age subjects with stage 1 hypertension and a group of normotensive control subjects.

Methods

Study population

The present study involved 64 patients screened for stage 1 hypertension aged 18–45 years who had never been treated for hypertension. Subjects with diastolic BP between 90 and 99 mmHg and/or systolic BP between 140 and 159 mmHg at baseline examination were enrolled. Participants were recruited in the context of a larger ongoing longitudinal study of BP reactivity to psychological stressors (19). Patient recruitment was obtained with the collaboration of the local general practitioners who were instructed during local meetings. Consecutive patients with the above-mentioned clinical characteristics seen in the offices of the general practitioners and willing to participate in the study were eligible for recruitment and were sent to the University of Padova General Hospital. Patients with diabetes mellitus, nephropathy and cardiovascular disease were excluded. Patients' clinical characteristics are reported in Table I. The higher prevalence of men among our study participants confirms previous observations of a much higher prevalence of men in the young-to-middle age segment of the hypertensive population (20). Thirty normotensive subjects of similar age and sex distribution recruited from healthy hospital staff and relatives of the patients served as controls. All were asymptomatic, had no history of cardiovascular disease and were normal at physical examination. Standard ECG, blood chemistry and urinalysis were normal in all of the subjects. Their BP measured six times over a 2-week period was always lower than 140/90 mmHg.

Procedures

All subjects underwent physical examination, anthropometry, blood chemistry and urine analysis. Participants completed questionnaires about their medical history, family history of hypertension, physical activity and dietary habits, including coffee intake, alcohol use and cigarette smoking. Screening BP was the mean of six readings obtained in the supine position during two visits performed 2 weeks apart. Body mass index (BMI) was considered an index of adiposity (weight divided by height squared). At each visit, BP was measured in triplicate in the lying posture and in the standing position according to the recommendations of the British Society of Hypertension. To assess the BP response to public speaking, BP was monitored with a finger device (Finometer, Finapres Medical Systems, Amsterdam, The Netherlands), which provides beat-to-beat BP measurements. This technique correlates closely with direct intra-arterial measurements (21). The finger BP recording was performed continuously with the patient in the semi-recumbent position on an armchair with the head elevated about 30° from horizontal. This position was kept constant from baseline to the end of the speech test. The cuffed hand was positioned at the heart level.

Public speaking

Participants were asked to refrain from smoking, drinking alcohol or beverages containing caffeine for at least 24 h before the study. The test was performed

Table I. Clinical characteristics of the study subjects.

Variable	Normotensives, $n = 30$	Hypertensives, $n = 64$	Unadjusted p-value	p-value adjusted for age and sex
Male gender, n (%)	25 (83.3)	53 (82.8)	0.95	–
Age (years)	32.1 ± 7.7	29.2 ± 9.5	0.076	–
Body mass index (kg/m^2)	24.3 ± 2.6	25.3 ± 3.6	0.14	0.09
Screening systolic blood pressure (mmHg)	119.4 ± 9.5	142.9 ± 9.8	<0.001	<0.001
Screening diastolic blood pressure (mmHg)	71.5 ± 8.5	90.2 ± 6.5	<0.001	<0.001
Screening heart rate (beats/min)	71.4 ± 9.0	73.2 ± 9.6	0.32	0.44
Systolic blood pressure at baseline (mmHg)	119.8 ± 9.6	136.1 ± 17.3	<0.001	<0.001
Diastolic blood pressure at baseline (mmHg)	71.6 ± 8.4	80.7 ± 9.3	<0.001	<0.001

Values are given as mean ± SD.

in the afternoon in a quiet room in an outpatient clinic with a temperature of approximately 22°C. All subjects were naive to the applied stress procedure. Participants were given instructions to prepare three different speeches. They were informed of the nature of the tasks beforehand and were encouraged to prepare for the speech. They were not, however, given the opportunity to make any notes. They were asked to make up a story according to three different scenarios. For the speech at neutral content, they were asked to speak about an event in which they were not emotionally involved and were given a list of possible topics (i.e. hobbies, sports, working environment, family, etc). For the two other speech tasks, we wanted to closely mimic a real life situation. Participants were asked to describe a real life stressful event with recall of mood-congruent information, one with anger-provoking scenario and one with anxiety-provoking scenario. The sequence of the three speeches was randomly determined and instructions were provided from a standard script read by staff. Participants were given 3 min to think about what they might say, after which they delivered their speech for 3 min in front of an audience in which all participants (three persons) were wearing white coats, as in prior research (19). They were told that their speech would be evaluated later for content and quality of the speech. Whenever a participant finished his speech in less than 3 min, a physician told the subject "You still have some time left. Please continue!" If the subject finished a second time before the 3 min were over, the physician asked prepared standard questions. Each speech test was followed by a 3-min recovery period. While the participants were in the semi-recumbent position, the Finometer cuff was applied to their finger and the device was calibrated. Subjects rested quietly for the first 10 min of the testing to establish an average of resting baseline BP. To calculate the BP and heart rate reaction to public speaking, the beat-to-beat readings obtained with the device were averaged. The BP and heart rate responses to speech tests were calculated from the difference between the BP and heart rate recorded during the test and the initial resting period. To compute this difference, we used the last 5 min of the initial baseline recording and the whole period of the performance phase of the three tests.

Data analysis

Differences between groups were assessed with the *t*-test for the variables normally distributed. Data were adjusted for age and sex by use of linear regression analysis. Responses to speech test were analyzed by repeated-measures analysis of covariate (R-M ANCOVA) with time (before vs during test) as within-factor and group (hypertensives vs normotensives) as between-factor. The key variable was the group-by-time interaction. We used the BP difference between average BP during the speech task and baseline BP before the test as index of reactivity. This index may be susceptible, however, to the well-known problems involved in relating change in a variable to initial values. Therefore, when comparing the hypertensive subjects with the normotensive controls, differences were adjusted also for baseline BP. The significance of differences in categorical variables was assessed with the χ^2 test and the Fisher exact test. Pearson correlation coefficients were used to determine the relationship between the BP responses to the speech tests. The Bonferroni correction was applied to adjust the probability values. Values are expressed as mean ± SD. Values of $p < 0.05$ were considered significant. Analyses were performed using Systat versions 10 and 11 (SPSS Inc., Evanston, IL, USA).

Ethical considerations

The procedures followed were in accordance with institutional guidelines. The study was approved by the Ethics Committee of the University of Padova, and written informed consent was given by the participants.

Results

The hypertensive patients were slightly younger than the normotensive subjects of control, while no difference was observed for sex distribution (Table I). BMI was slightly greater in the hypertensive subjects but the difference did not attain the level of statistical significance. Heart rate was similar in the two groups.

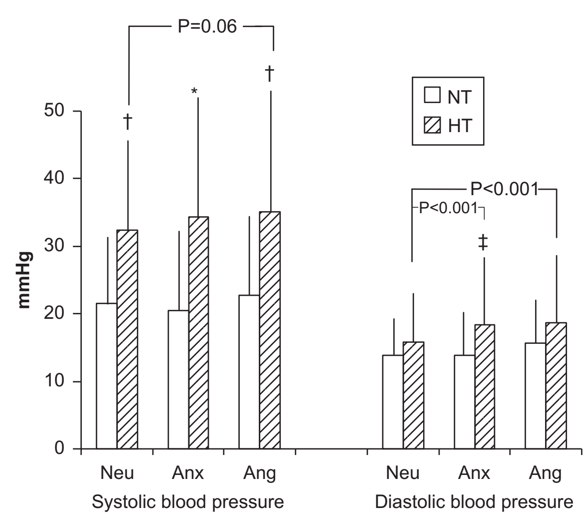

Figure 1. Blood pressure reaction to public speaking (test – baseline) with three different types of scenario in the hypertensive subjects and a group of normotensive subjects of control. Data are adjusted for age, sex, body mass index and baseline blood pressure. NT indicates normotensive subjects of control; HT, hypertensive subjects; Neu, neutral content; Anx, anxiety content; Ang, anger content. *p*-values are related to comparisons within the hypertensive subjects. $^{*}p < 0.001$, $^{\dagger}p < 0.01$, $^{\ddagger}p = 0.036$ vs NT.

During all speech tests, systolic BP markedly rose in both groups. The systolic BP changes during the three types of test closely correlated with one another, with correlation coefficients ranging from 0.78 to 0.87 within the normotensive group and from 0.78 to 0.88 within the hypertensive group (all Bonferroni corrected $p < 0.001$). The systolic BP increase was greater in the hypertensive than the normotensive subjects (Figure 1). For all scenarios, average systolic BP during the speech was higher in the hypertensive subjects than the normotensive controls ($p < 0.001$ at R-M ANCOVA). A significant group-by-time interaction was found for all tests ($p \leq 0.001$ for all).

Also, the diastolic BP increment was greater in the hypertensive than the normotensive subjects but the between-group difference was significant only for the speech with anxiety content (Figure 1). The diastolic BP changes during the three types of test closely correlated with one another, with correlation coefficients ranging from 0.74 to 0.87 within the normotensive group and from 0.76 to 0.87 within the hypertensive group (all Bonferroni corrected $p < 0.001$). At R-M ANCOVA, a group-by-time interaction of borderline statistical significance was found for the speech with anxiety content ($p = 0.053$) but not for the speeches with neutral or anger content. Within the hypertensive group, the diastolic BP increments during the speeches with anxiety and anger content were similar (p = n.s.) and greater than those during the speech with neutral content ($p < 0.001$, Figure 1). A similar trend was found for the systolic BP responses but the differences with the speech at neutral content did not reach the level of statistical significance.

Also the heart rate increases during the three types of test closely correlated with one another, with correlation coefficients ranging from 0.71 to 0.81 within the normotensive group and from 0.84 to 0.87 within the hypertensive group (all Bonferroni corrected $p < 0.001$). The heart rate increase was greater in the hypertensive than the normotensive subjects for the speech at neutral content ($p = 0.017$) and the speech at anxiety content ($p = 0.011$) but not for the speech at anger content ($p = 0.14$). No group-by-time interaction was found for all tests.

Preparation to speech caused a smaller systolic and diastolic BP increment than speech in both normotensive and hypertensive individuals (all $p < 0.001$). However, systolic and diastolic BP changes during preparation were closely correlated with BP changes during speech for all types of speech task. Correlation coefficients were generally higher within the hypertensive group ($r = 0.81$–0.93, all $p < 0.001$) than among the normotensive individuals ($r = 0.74$–0.82, all $p < 0.001$).

Discussion

Although the precise character of the risk conferred by cardiovascular hyperreactivity to stressors remains a matter of speculation, the hypothesis that cardiovascular reactions to episodic psychological stress are involved in the etiology of essential hypertension continues to receive much attention (22–24). However, it is not known whether exaggerated BP reactivity is similar for all psychological stressors or it varies according to the nature of the stressor. The present study's main question was whether the BP reactivity to public speaking is increased in young-to-middle-age subjects in stage 1 hypertension compared with a group of normotensive subjects of control and whether, within the hypertensive subjects, the response may vary according to a specific scenario. People vary distinctly in the magnitude of their cardiovascular reactions to psychological stress and people known to be at increased risk for hypertension because of increased, although subhypertensive, resting BP, may have increased reactivity. Our finding that systolic BP and heart rate reactions to speech tests were greater in subjects in stage 1 hypertension than in the normotensive subjects complements previous studies that showed larger hemodynamic reactions to stress in subjects with borderline hypertension relative to normotensive controls (22–25), and attests to enhanced beta-adrenergic response in the hypertensive subjects.

A novel finding of the present study is that among the hypertensive patients, the speech tasks with anxiety or anger scenarios elicited a greater BP response than the speech with neutral content. In addition, when compared with the normotensive subjects of control, the hypertensive subjects exhibited a greater diastolic BP reaction to the speech with anxiety content than to the speech with neutral content. These data are in agreement with previous results by Steptoe et al. (26) who found a greater diastolic BP reaction to an anxiety-provoking movie or videogame in a group of mild hypertensive subjects compared with a group of normotensive controls. In addition, it is known that different types of acute stressors differentially affect the frequency and amplitude of sympathetic bursts and the firing pattern of sympathetic fibers and may have different effects on diastolic BP (27,28).

Personality and behavioral characteristics have been intensely investigated in patients with borderline and mild hypertension. Anger and anxiety were the factors more commonly associated with high BP or later incidence of hypertension but this association was not found by some investigators (1–5,29,30). The inconsistent findings may reflect differences in psychometric instruments and evaluations used in those studies. In a previous study, subjects with social phobia showed very different patterns of arousal during a speech task but did not differ on any of the social phobia measures (31). In the present study, to investigate the relationship between BP and psychological characteristics, we assessed the BP reaction to a psychosocial stressor. The tests more often used to assess BP reactivity to mental stress in the laboratory are mental arithmetic, the Stroop color test or mirror tracing. These laboratory tasks elicit smaller hemodynamic responses than can be elicited by psychosocial stressors, and weaker sympatho-adrenal medullary responses (17,32). The most common rationale for using a public speaking task in psychological studies is that it involves interpersonal components and elicits a social-evaluation threat (15,17). By using ego-involving and arousing topics, our participants during the speech tasks with anger and anxiety content were exposed both to the concern about social-evaluation and to the emotional distress related to the specific scenario. It might be speculated that young-to-middle-age hypertensive subjects generally appraise acute psychosocial stressors with an anxiety or anger scenario as more stressful and less controllable than stressors with different scenarios, which translates into increased BP and heart rate reactivity. However, it should be noted that the differences in BP reactivity between the three tests were quantitatively small. It is thus likely that the demand of maintaining poise and control in front of an audience and the fear of poor performance are more important than the nature of the topic discussed for triggering the hemodynamic response. Thus, for practical purposes also, a speech test with neutral content can be used to identify subjects with increased reactivity to stress.

Previous research has shown that some socially anxious individuals may not show a stronger response during a public speaking task, but may show a stronger response in anticipation of the task (31). This distinction might be important for investigating developmental patterns and arousal in socially anxious individuals. In the present study, the BP response to the tasks was consistently greater during the performance phase of the tests than during the preparation phase and a strong correlation was found between the two phases chiefly among the hypertensive individuals. Thus, the present data indicate that patterns of anxious arousal during psychological stressors are consistent in young-to-middle-age individuals screened for stage 1 hypertension and that the peak increase in BP occurs in the performance phase.

Study limitations

Several limitations of the current research should be noted. In the present study, affective state was not assessed and no psychometric information was available regarding the subjects. In addition, participants' emotional responses were not assessed after the scenarios and thus we cannot say whether there was an equal manipulation of the emotional responses. Also, we did not measure neurohumoral factors such as cortisol and catecholamines, which are considered reliable markers of sympathetic nervous system and hypothalamic–pituitary–adrenal axis activation in response to psychological stress (33). However, the main objective of our study was to investigate whether in clinical practice a speech characterized by a stressful scenario could elicit a greater cardiovascular response than speeches with neutral scenario. Another possible limitation is that our data were not adjusted for other risk factors such as glucose or lipid abnormalities. However, it should be pointed out that our participants were subjects at low cardiovascular risk (19).

Summary

The hypothesis that increased reactivity to psychosocial stressors can contribute to the etiology of essential hypertension continues to receive much attention. The present findings indicate that BP and heart rate reactivity to a speech task is increased in young-to-middle-age hypertensive subjects compared with their normotensive peers and that tasks characterized by an anxiety or anger content elicit a slightly greater BP reaction than do tasks that do not recall a stressful event. However, we cannot say whether the increased hemodynamic reactivity found in the hypertensives was related to a different subjects' interpretation or appraisal of a threatening and demanding situation or to a different cardiovascular, neural or endocrine response to stress exposure. Future research needs to establish whether reactivity to these tasks is actually related to personal characteristics and stress levels in similar situations in real life. Whether the relation between reactions of BP to psychological stressors and hypertension development depends on the nature of the stressor also remains to be established.

Acknowledgements

No other persons have made substantial contributions to this manuscript. The study was funded by the University of Padova, Padova, Italy, and from the Associazione "18 Maggio 1370", San Daniele del Friuli, Italy.

Conflict of interest

The authors have no conflict of interest for the present study.

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