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Effect of breathing control on heart rate, blood pressure and oxygen saturation in institutionalized elderly

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Resumo

A respiração lenta aumenta a sensitividade barorreflexa nos idosos. O objetivo deste estudo foi verificar como idosos (N = 12, 81.08 ± 6.61 anos de idade, 10 mulheres) respondiam em termos de frequência cardíaca (FC), pressão sistólica (PS) e diastólica (PD), e saturação capilar periférica de oxigénio (SpO2), quando aprenderam respiração lenta predominantemente abdominal (AB), sem imposição de uma frequência respiratória (FR). Os resultados revelaram que a AB resultou numa redução significativa da FR, e teve efeitos (transientes) benéficos significativos na FC, na PS, na PD, no intervalo PS-PD e na SpO_2, principalmente para os participantes com pressão sistólica superior à normal.

Palavras-chave:

Técnica Respiratória; Idosos; Frequência Cardíaca; Pressão Arterial; Saturação Capilar Periférica de Oxigénio.

Abstract

Slow breathing increases baroreflex sensitivity in elderly. The purpose of this study was to investigate how elderly (N = 12, 81.08 ± 6.61 years old, 10 women) responded in terms of heart rate (HR), systolic (SBP) and diastolic blood pressure (DBP), and peripheral capillary oxygen saturation (SpO2), when they learned predominantly abdominal and slow breathing (AB), without imposition of respiratory frequency (RF). Results revealed that AB resulted in significant reduction of RF, and had significant beneficial (transient) effects in HR, SBP, DBP, SBP-DBP interval, and SpO_2, principally for those participants with blood pressure higher than a normal one.

Key concepts:

Breathing Technique; Elderly; Heart Rate; Blood Pressure; Peripheral Capillary Oxygen Saturation.

Introduction

Slow breathing increases baroreflex sensitivity in older adults and elderly (Gerritsen et al., 2000), and results in a significant reduction in heart rate (HR) (Song & Lehrer, 2003). In normal subjects, hypertensives and in chronic heart failure patients, the change to 6 breathings per minute can increase baroreceptor reflex sensitivity (BRS) (Lehrer et al., 2003; Reyes Del Paso et al., 2006; Bernardi et al., 2002). This breathing pattern can be used as a complement for hypertension treatment (e.g., Meles et al., 2004; Parati, Izzo, & Gavish, 2003; Viskoper et al., 2003).

The purpose of this study was to investigate how elderly (N = 12, 81.08 ± 6.61 years old; 1 hypertensive and 5 with isolated systolic hypertension, 3 of them with diabetes; 10 women, 2 men, convenience sample) responded in terms of HR, systolic (SBP) and diastolic blood pressure (DBP), and peripheral capillary oxygen saturation, when they learned predominantly abdominal and slow breathing (AB), without imposition of respiratory frequency (RF).

1. Methods

Respiratory cycles per minute (RF) were recorded through direct observation of thoracic or abdominal movements. The physiological data acquisition and recording were carried out through Polar V800 (HR; e.g., Giles, Draper, & Neil, 2016), with continuous registration; Pic Classic Check sphygmomanometer (SBP, DBP), every minute; and, Comed Eco Oximeter (SpO_2), every 15 seconds.

The experimental session was structured according to the following sequence: 6 min of rest with normal breath, taken as baseline, and 6 min abdominal breathing technique. In a previous training period, of about 10 to 15 min, participants were instructed relative to abdominal breathing technique, as follows: (1) put one hand on your chest and the other on your belly, (2) breath only through your nose, (3) fill your belly with air, and then let it go out slowly. No pace of breathing was imposed (see, Stark, Schienle, Walter, & Vaitl, 2000; Denot-Ledunois, Vardon, Perruchet, & Gallego, 1998). Data were collected at the institution; and, room temperature was around 20-22 degrees. Based on clinical history, ambulatory and successive experimental blood pressure registrations, no signs of white coat effect or masked hypertension were detected. No control was made about consumption of smoke, alcohol or coffee before data collection, and of physical activity habits. One participant was taking medication for depression. There was no report of damage of kidney, heart or brain (see, Mancia et al., 2007; Laurent et al., 2006; Chobanian et al., 2003; Jonas, Franks, & Ingram, 1996). Elderly with respiratory (e.g., asthma) or cardiac diseases were excluded.

2. Statistical Analysis

Data were statistically treated with program IBM-SPSS, version 22. Wilcoxon test was used to compare conditions. To compare blood pressure groups, Kruskal-Wallis test was used, followed by Mann-Whitney U test, with Bonferroni correction. Effect size *r* was calculated (Field, 2013). Criteria for definition of hypertensive subjects followed Mancia et al. (2007) guidelines.

3. Results

RF proved to be significantly lower (*Z* = 7.170, *p*<0.0001, *r* = 0.59) in AB (12.51 ± 2.85, *Md* = 12) compared to resting condition (RC) (18.57 ± 6.67, *Md* = 18). Results revealed that participants significantly reduced (Z = 10.331, *p*<0.0001, *r* = 0.13) HR in AB (71.15 ± 8.65, *Md* = 70) compared to RC (72.11 ± 10.21, *Md* = 72), as well as SBP (*Z* = 5.966, *p*<0.0001, *r* = 0.49) in AB (130.18 ± 19.75, *Md* = 124) compared to RC (146.11 ± 21.39, *Md* = 139.5), and DBP (*Z* = 5.779, *p*<0.0001, *r* = 0.48) in AB (66.76 ± 7.79, *Md* = 67) compared to RC (74.14 ± 9.43, *Md* = 72), which resulted in a significant reduction in the SBP-DBP interval (*Z* = 4.695, *p*<0.0001, *r* = 0.39) in AB (63.42 ± 15.15, *Md* = 58) compared to RC (71.97 ± 15.13, *Md* = 69). However, in AB, SBP-DBP interval stayed significantly higher (*t*(71) = 7,514, *p*<0.0001) than the assumed cut off values (50-55 mmHg, e.g., Laurent et al., 2006). Finally, SpO_2 significantly increased (*Z* = 10.880, *p*<0.0001, *r* = 0.45) in AB (95.35 ± 2.22, *Md* = 96) compared to RC (93.26 ± 2.52, *Md* = 93).

When participants are allocated according to blood pressure classification (Mancia et al., 2007) (optimal - n = 2; normal - n = 1; high normal - n = 3; mild isolated systolic - n = 2; moderate isolated systolic - n = 3; hypertension - n = 1), we can observe that in AB, DBP (Figure 1), and SBP (Figure 2) diminish in those participants where it is higher than normal.

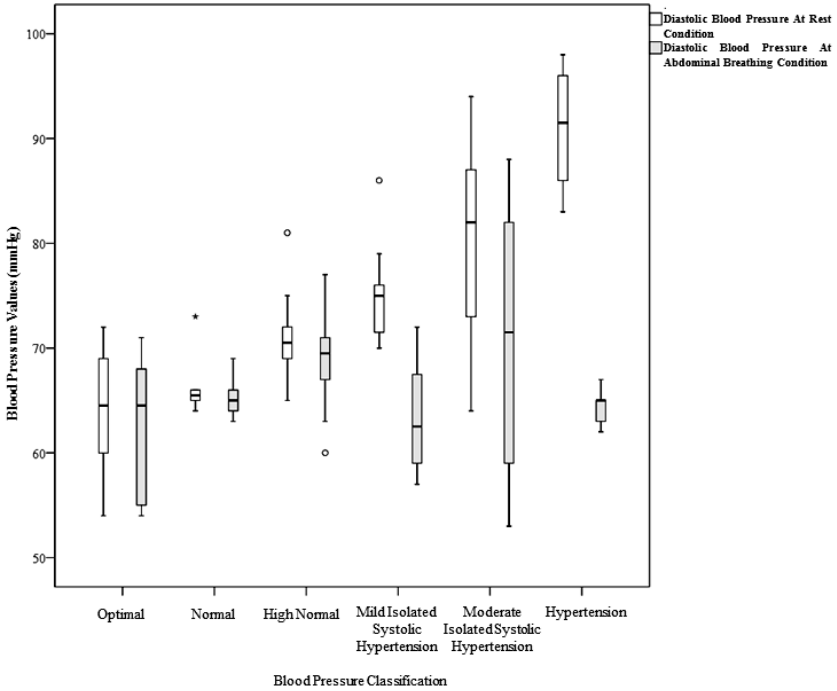

Figure 1. Box plot of diastolic blood pressure, for both conditions (at rest - white, abdominal breathing - grey), per group (Mancia et al., 2007).

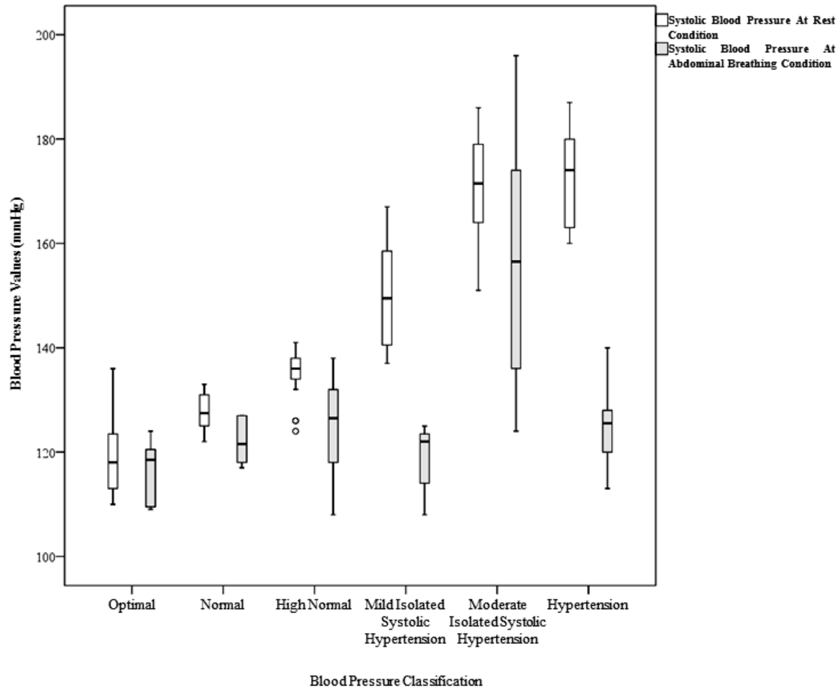

Figure 2. Box plot of systolic blood pressure, for both conditions (at rest - white, abdominal breathing - grey), per group (Mancia et al., 2007).

In fact, in AB, participants with mild isolated systolic blood pressure (n = 3) revealed significantly reduced HR ($Z = 15.656$, $p<0.0001$, $r = 0.32$), as well as SBP ($Z = 2.398$, $p<0.05$, $r = 0.40$), that resulted in a significant reduction in the SBP-DBP interval ($Z = 2.273$, $p<0.05$, $r = 0.38$); and, also significantly increased SpO_2 ($Z = 3.569$, $p<0.0001$, $r = 0.30$); nullifying SpO_2 significant difference to participants with optimal blood pressure from rest condition ($Z = 3.003$, $p<0.01$, $r = 0.16$) to AB ($Z = 1.462$, ns, $r = 0.08$). On the opposite side, and logically, participants with optimal blood pressure (n = 4) only revealed significant reduction in HR ($Z = 12.344$, $p<0.0001$, $r = 0.21$), and, significant increase in SpO_2 ($Z = 3.966$, $p<0.0001$, $r = 0.29$).

4. Discussion

A RF between 10 and 14 cycles per minute, predominantly abdominal, had beneficial (transient) effects in BP, HR, and SpO_2 in these elderly (cf., Reyes Del Paso et al., 2006; Joseph et al., 2005). AB condition afforded these elderly to a lower RF, associated with enhanced SpO_2 (cf., Bernardi et al., 1998); when in rest condition there were some cases of low saturation levels (78-85%) (e.g., Hirst et al., 2002; Colodny, 2001). With simple instructions, the elderly reduced their breathing frequency, heart rate, systolic pressure, and, pulse pressure (systolic minus diastolic), and elevated their peripheral capillary oxygen saturation, even without reaching 6 respiratory cycles per minute.

The reduction of systolic pressure and of the pulse pressure is a stimulating result, because in elderly's hypertension with cardiovascular risk factor or associated clinical conditions, the pulse pressure showed a strong predictive value for cardiovascular events (Darne et al., 1989; Benetos et al., 1997; Gasowski et al., 2002; Blacher et al., 2000).

The results of this study showed that a respiratory training intervention, based on the acquisition of predominantly slow abdominal breathing (as described above), brief and of low-cost, can be used to benefit cardiovascular functions in elderly (cf., Cea et al., 2005; Meles et al., 2004; Parati et al., 2003; Viskoper et al., 2003). Our results support the hypothesis that slow breathing frequency, predominantly abdominal, can be used as complementary non-pharmacological treatment for hypertension, probably, with additional advantage of bettering peripheral capillary oxygen saturation (e.g., Bernardi et al., 1998); and, higher baroreflex sensitivity, which is related inversely to arterial pressure (e.g., Joseph et al., 2005; Gerritsen et al., 2000, Smyth et al., 1969). It´s advisable, and possible with the used equipment, the inclusion of heart rate variability analysis in future studies (e.g., Song, & Lehrer, 2003), however longer time series, than the obtained with this sample, are needed for that purpose.

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Curriculum

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