
Effect of breathing control on heart rate, blood pressure and oxygen saturation in elderly living at home

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Resumo

A respiração lenta aumenta a sensibilidade barorreflexa nos idosos. O objetivo deste estudo foi verificar como idosos ($N = 10$, 70.70 ± 5.27 anos de idade, 6 mulheres) respondiam em termos de frequência cardíaca (FC), pressão sistólica (PS) e diastólica (PD), e saturação capilar periférica de oxigénio (SpO_2), 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, no intervalo PS-PD e na SpO_2 , principalmente para os participantes com pressão sistólica isolada ligeira.

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 ($N = 10$, 70.70 ± 5.27 years old, 6 women) responded in terms of heart rate (HR), systolic (SBP) and diastolic blood pressure (DBP), and peripheral capillary oxygen saturation (SpO_2), 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, SBP-DBP interval, and SpO_2 , principally for participants with mild isolated systolic pressure.

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).

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1. Methods

The sample was composed of ten elderly (70.70 ± 5.27 years old, 6 women), three with mild isolated systolic hypertension, one of them with non-insulin dependent diabetes. Informed consent was obtained. Criteria for definition of hypertensive subjects followed

Mancia et al. (2007) guidelines. 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 (SpO₂), every 15 seconds. Protocols of data collection were previously tested.

The experimental session was structured according to the following sequence: first, 6 min of rest with normal breath, taken as baseline, followed by 6 minutes abdominal breathing technique. All vital signs were collected with the participant in dorsal decubitus position. In a previous training period, of about 10 to 15 minutes, 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. No participant was taking medication for anxiety, depression, blood pressure, diabetes or cholesterol; and, 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).

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).

2. Results

RF proved to be significantly lower ($Z = 6.404$, $p < 0.0001$, $r = 0.58$) in AB (14.42 ± 3.36 , $Md = 15.5$) compared to resting condition (RC) (19.42 ± 4.26 , $Md = 20$). Participants significantly reduced HR ($Z = 17.952$, $p < 0.0001$, $r = 0.20$) in AB (69.85 ± 9.78 , $Md = 70$) compared to RC (71.47 ± 8.95 , $Md = 70$), as well as SBP ($Z = 7.556$, $p < 0.0001$, $r = 0.69$) in AB (122.23 ± 14.78 , $Md = 123.5$) compared

to RC (124.82 ± 17.16 , $Md = 125$), and kept DBP ($Z = .467$, ns, $r = 0.04$) in AB (71.27 ± 7.91 , $Md = 72$) compared to RC (71.32 ± 6.51 , $Md = 72$), which resulted in a significant reduction in the SBP-DBP interval ($Z = 2.142$, $p < 0.05$, $r = 0.20$) in AB (50.97 ± 15.04 , $Md = 55.5$) compared to RC (53.50 ± 16.80 , $Md = 59$). Finally, SpO₂ significantly increased ($Z = 7.556$, $p < 0.0001$, $r = 0.25$) in AB (96.30 ± 2.36 , $Md = 97$) compared to RC (95.48 ± 1.62 , $Md = 96$).

When participants are allocated according to blood pressure classification (Mancia et al., 2007) (optimal - $n = 4$; normal - $n = 2$; high normal - $n = 1$; mild isolated systolic - $n = 3$), we can observe that in AB, DBP doesn't alter its values (Figure 1), but that SBP diminish in those participants where it is higher than normal (Figure 2).

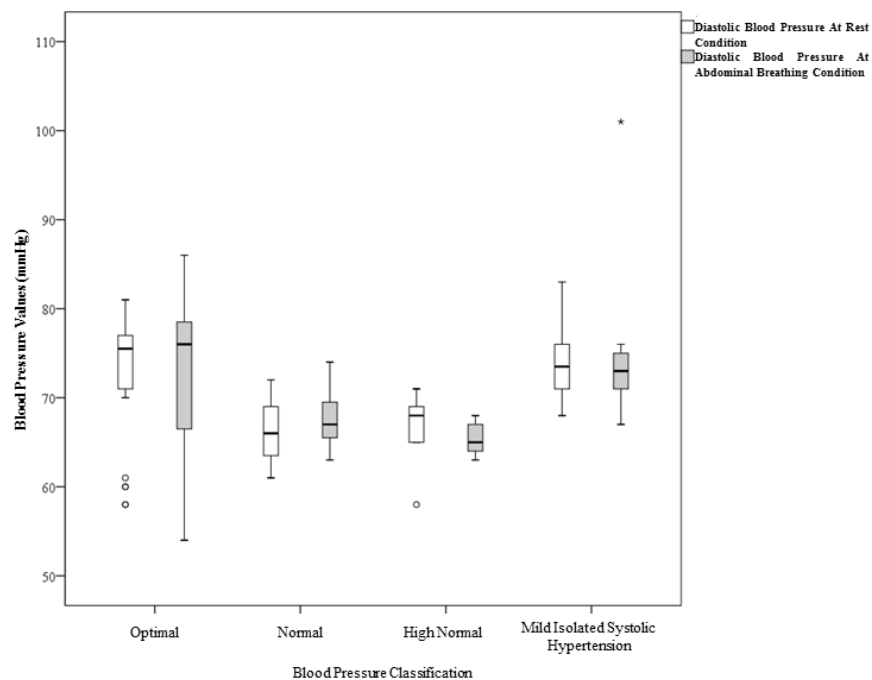


Figure 1. Box plot of diastolic blood pressure, for both conditions (at rest - white, abdominal breathing - grey), per group (Mancia et al., 2007).

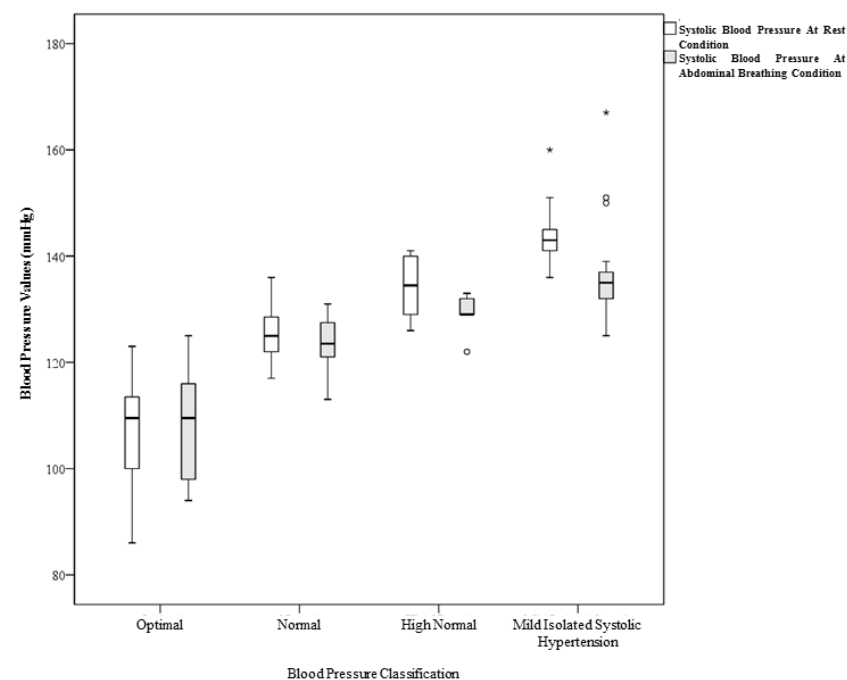


Figure 2. Box plot of systolic blood pressure, for both conditions (at rest - white, abdominal breathing - grey), per group (Mancia et al., 2007).

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 SpO₂ ($Z = 3.569, p < 0.0001, r = 0.30$); nullifying SpO₂ 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 SpO₂ ($Z = 3.966, p < 0.0001, r = 0.29$).

Discussion

A RF between 11 and 17 cycles per minute, predominantly abdominal, had beneficial (transient) effects in BP, HR, and SpO₂ 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 SpO₂ (cf., Bernardi et al., 1998); but in both condition there were no systematic cases of low saturation levels (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 (e.g., Lehrer et al., 2003; Reyes Del Paso et al., 2006; Bernardi et al., 2002).

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, 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).

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Curriculum

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