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Original article

Comparison of yoga and walking-exercise on cardiac time intervals as a measure of cardiac function in elderly with increased pulse pressure

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ABSTRACT

Objective: Arterial aging along with increased blood pressure(BP) has become the major cardiovascular (CV) risk in elderly. The aim of the study was to compare the effects of yoga program and walking-exercise on cardiac function in elderly with increased pulse pressure (PP).

Methods: An open label, parallel-group randomized controlled study design was adopted. Elderly individuals aged ≥60 years with PP ≥ 60 mmHg were recruited for the study. Yoga (study) group (n = 30) was assigned for yoga training and walking (exercise) group (n = 30) for walking with loosening practices for one hour in the morning for 6 days in a week for 3 months. The outcome measures were cardiac time intervals derived from pulse wave analysis and ECG: resting heart rate (RHR), diastolic time(DT), ventricular ejection time(LVET), upstroke time(UT), ejection duration index (ED%), pre-ejection period (PEP), rate pressure product (RPP) and percentage of mean arterial pressure (%MAP).

Results: The mean within-yoga group change in RHR(bpm) was 4.41 (p = 0.031), PD(ms): −50.29 (p = 0.042), DT(ms): −49.04 (p = 0.017), ED%: 2.107 (p = 0.001), ES(mmHg/ms): 14.62 (p = 0.118), ET(ms): −0.66 (p = 0.903), UT(ms): −2.54 (p = 0.676), PEP(ms): −1.25 (p = 0.11) and %MAP: 2.08 (p = 0.04). The mean within-control group change in HR (bpm) was 0.35 (p = 0.887), PD (ms): 11.15(p = 0.717), DT (ms): 11.3 (p = 0.706), ED%: −0.101 (p = 0.936), ES (mmHg/ms): 0.75 (p = 0.926), ET(ms): 2.2 (p = 0.721), UT (ms):4.7(p = 455), PEP (ms): 2.1(p = 0.11), %MAP: 0.65 (p = 0.451). A significant difference between-group was found in RHR (p = 0.036), PD (p = 0.02), ED% (p = 0.049), LVET (p = 0.048), DT (p = 0.02) and RPP (p = 0.001).

Conclusions: Yoga practice for 3 months showed a significant improvement in diastolic function with a minimal change in systolic function. Yoga is more effective than walking in improving cardiac function in elderly with high PP.

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1. Introduction

Arterial aging along with increased blood pressure (BP) has become the major cardiovascular (CV) risk in elderly. Structural and functional changes take place in heart and blood vessels with advancing age. The reduction of vascular compliance with age due to stiffening of arteries is the major contributor for elevation of BP, especially systolic pressure resulting in isolated systolic hypertension (ISH) in elderly[1,2]. Systolic BP increases and diastolic BP falls with age leading to widening of pulse pressure (PP). Pulse pressure is a best tool for measuring vascular aging and a good marker for CV risk in elderly. Pulse pressure is an independent indicator of arterial stiffness[3]. It is more closely associated to CV events than systolic BP or diastolic BP alone[4].

Age-associated stiffening of aorta and increased systolic pressure increases left ventricle (LV) after-load. Increased ventricular load causes LV hypertrophy and increases LV oxygen demand. Due to these changes, LV contract and relax slowly, so that systolic time is increased while diastolic time is reduced[5]. Left ventricle becomes stiff with decreased compliance and impaired relaxation, leading to increased end diastolic pressure and diastolic dysfunction. Age associated major changes in heart function occurs mainly in left ventricular diastolic function. So, elderly individuals (especially hypertensive patients) often manifest diastolic dysfunction[6].

Although physical training programs are recommended for CV prevention and rehabilitation[7], their effects on cardiac function in

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elderly individuals remain unclear. Few authors demonstrated a beneficial effect of exercise training program on left ventricular function in elderly[8–10] while others reported either least change[11] or no change[12–16]. Moreover, most of these studies are done on trained athletes and healthy elderly individuals.

Yoga is emerging as an effective life-style modality and mind-body medicine. It is a skill to control mind and involuntary functions voluntarily. Many studies have showed beneficial effects of yoga program on CV health in young and older adults[17–20]. Again, most of the studies have either included young and middle aged individuals or mixed population with wide range of age. We did not find any studies investigating the effect of yoga on cardiac function in elderly individuals with hypertension. In the present study, we compared the effects of yoga program and walking-exercise on cardiac function in elderly with increased PP (as mentioned previously that PP is a better predictor of CV events than SBP or DBP in elderly).

2. Methods

2.1. Participants and study design

A total of 60 elderly individuals aged ≥60 years with increased PP ≥ 60 mmHg were recruited for the study. Volunteers were screened from geriatric health camp and Geriatric clinic of Shri B. M. Patil Medical College, Hospital & Research Centre. An open label, parallel-group randomized controlled study design was adopted. Exclusion criteria includes subjects with SBP > 159 mmHg and DBP > 99 mmHg; CV risk factors such as diabetes mellitus, hypercholesterolemia and high triglyceride level; history of secondary hypertension, neuromuscular disorders, alcoholism; practicing yoga for one hour/day for three days in a week and on any medications. Participants were instructed for not to consume any vitamin supplements or herbal drugs during the study period. This criterion for selection of elderly subjects with high PP for life-style changes intervention for three months was as per the 2007 guidelines of the task force for the management of arterial hypertension of the European Society of hypertension and of the European Society of Cardiology[21].

During visit 1–3 (three consecutive days), volunteers were screened and their BP was measured. Baseline investigation, randomization and allocation of subjects were done at their 4th visit. They were randomly allocated to Yoga group (YG; n = 30) and exercise group (EG; n = 30) by using random number table. At visit 5, post-intervention investigations were made. All the investigations were done in the morning between 8.00 h to 11.00 h after supine rest for 10 min. No intervention was given on the day of investigation. Persons handling data analysis were kept blinded.

2.2. Ethics statement

A prior study approval has been obtained from the Institutional ethical committee of Shri B.M. Patil Medical College, Hospital and Research Centre, BLDE University, India, as per the guidelines of Indian Council of Medical Research (ICMR)[22]. The declaration of Helsinki has been followed during the entire study. Informed written consent was obtained from the participants.

2.3. Intervention

The yoga program included loosening practices, Asanas (maintaining postures), Pranayama (breathing exercises) and cyclic meditation (Table 1). Asanas were practiced for 15–20 min while pranayama and relaxation technique/meditation for 40–45 min. Emphasis was placed on practicing slow and paced breathing with asanas (maintaining postures) and other techniques of Yoga program. Cyclic meditation (CM) is a cycle of alternating stimulation and relaxation that used to go into deep silence. It is a guided relaxation technique of about 23 min. During the practice of CM, the subjects followed the instructions with eyes closed. It includes stretching and relaxing the muscles consciously (in various postures) with internal awareness by observing changes in the system. The sequence of practice is as follows: (1): It began by chanting a verse (40s) in supine position with Namaskar Mudra followed by isometric contraction of the muscles from toe to head and relaxation with awareness (1 min); (2) Linear awareness was observed in standing posture (Tadasana) and balancing the weight on both feet at ease (2 min); (3) slowly moving to the next posture (ardhakatichakrasana): bending to the right (1 min 20 s) followed with instructions about relaxation and awareness (1 min 20 s); then bending to the left (1 min 20 s) followed with relaxation (1 min 20 s); (4) slowly lied down in supine posture, right arm stretched, turned to right side with head on the right biceps, (linear awareness) then rested on back, observed the abdominal movements and breathing (3 min); (5) moved to the sitting posture (vajrasana) and observed the changes (1 min 20 s); (6) chanted (MMM.) M-Kara in another sitting posture (Sasankasana) (1 min 20 s); (7) chanted (AAA.) A-Kara in backward bending on knees posture (Ustrasana) (1 min 20 s); (8) Relaxed in supine posture (Shavasana) and chanted A, U, M –kara (7 min). The postures were practiced slowly, with awareness of all the sensations that are felt[23].

Table 1
Integrated yoga module for elderly subjects with increased pulse pressure.

Sl. No	Practice		Duration
1.	Opening Prayer		1 min
2.	Sukshma Vyayama (Loosening Practices)	Loosening of Fingers Loosening of Wrist Shoulder rotation Ankle stretch/rotation Drill walking	5 min
3.	Breathing Practices	Hands in and out breathing Ankle stretch breathing Straight leg raising breathing Lumbar stretch breathing	5 min
4.	Asana (Maintaining Postures)	Utkatasana Padhastasana Ardhachakrasana Shashankasana Ardha Ustrasana Bhujangasana Ardha Salabasana Trikonasana	15 min
5.	Pranayama	Anuloma Viloma Pranayama Brahmari Pranayama	5 min
6.	Cyclic Meditation [CM]		23 min
7.	Devotional Session – Chanting/songs		5 min
8.	Closing prayer		1 min

The protocol for the walking-exercise group consisted of loosening practices like neck rotation, shoulder and hip rotation, wrist and ankle rotation, forward and side bending; and walking (40–50 min) followed by rest (10 min). Intervention for both the groups was given for one hour/day for 6 days in a week in the morning from 06:00 h to 07:00 h for twelve weeks under the supervision of experienced authorized instructor.

2.4. Measurement of blood pressure

As BP is more variable in older people, an average of nine BP readings (measured thrice with an interval of one minute on every visit for three consecutive days in a sitting posture) was taken using mercury sphygmomanometer (Diamond, Industrial Electronic and Allied products, India)[24]. Pulse pressure was estimated

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