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Research Article

Arterial Compliance is Positively associated with Shoulder Muscle Strength in Tai Chi Qigong-Trained Survivors of Nasopharyngeal Cancer: a Pilot Study

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Abstract

Objective: The aim of this pilot study was to explore the association between arterial compliance and shoulder rotator muscle strength in Tai Chi (TC) Qigong-trained survivors of Nasopharyngeal Cancer (NPC).

Methods: Thirteen survivors of NPC (mean age ±SD=55.3±6.8years; five males and eight females) who had more than 1 month of TC Qigong experience participated in the study. The maximum isometric muscle strength of the internal and external rotators in the shoulder of the dominant arm was measured using the Lafayette Manual Muscle Test System with standardized measurement procedures and dynamometer placements. Arterial compliance, represented by large and small artery elasticity indices, was measured using an HDI Pulse Wave CR-2000 Research Cardiovascular Profiling System. Pearson's r was used to determine the degree of association between the artery elasticity indices and the outcomes of the shoulder muscle strength measurements.

Results: In TC Qigong-trained survivors of NPC, a large artery elasticity index was highly and positively associated with muscle strength in the internal rotator (r=0.580, p=0.038) and external rotator (r=0.758, p=0.003) of the shoulder. A small artery elasticity index was also highly and positively associated with muscle strength in the external rotator of the shoulder (r=0.814, p=0.001) but not the internal rotator (r=0.388, p=0.190).

Conclusion: Arterial compliance was positively associated with shoulder muscle strength in TC Qigong-trained survivors of NPC. Our results suggest that arterial compliance might not be jeopardized by increased muscular strength due to practicing TC Qigong.

Keywords: Head and neck cancer; Mind–body exercise; Vascular elasticity; Muscular strength

Abbreviations

NPC: Nasopharyngeal cancer; TC: Tai Chi

Introduction

Nasopharyngeal Cancer (NPC) is endemic in Southeast Asia and North Africa (incidence rate: 25 to 50 per 100,000) [1]. Survivors of NPC often develop vascular complications following conventional cancer treatments, because the toxicity resulting from chemotherapy in combination with radiotherapy can interfere with endothelial function and hence compromise vascular elasticity or arterial compliance [2]. We are specifically concerned with the compliance/stiffness of arteries as this is closely related to heart disease [3], hypertension, stroke [4] and bone health [5,6].

In addition to vascular complications, shoulder dysfunction (e.g. a decrease in shoulder muscle strength) arising from complications of upper-body surgery and radiotherapy may also persist in survivors of NPC [7]. Previous research has shown that progressive resistance exercise training can improve shoulder muscle strength and decrease disability in survivors of head and neck cancer [8]. However, strengthening muscles through resistance exercise may physiologically compromise arterial compliance [9]. How, then, can both arterial compliance and muscular strength be improved simultaneously? A suitable method may be to increase muscular strength using Tai Chi (TC) Qigong-a traditional Chinese mind-and-body exercise that focuses on coordinated breathing and slow and graceful body movements [10-12]. It has been reported that TC training can improve muscular strength without jeopardizing arterial compliance in healthy older people [13,14]. However, it is not known whether this would also be the case for survivors of NPC, who are prone to vascular and muscular complications. This pilot study therefore explored the association between shoulder muscle strength and arterial compliance in TC Qigong-trained survivors of NPC. Our results may shed light on the use of TC Qigong in improving both vascular elasticity and muscular strength in this particular group of individuals.

Materials and Methods

Participants

Thirteen survivors of NPC (mean age ±SD=55.3±6.8years;

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five males and eight females; mean weight=61.0±15.3kg; mean height=162.1±10.8cm; mean post-NPC duration = 13.8 ± 5.5 years; received radiotherapy n = 11; received both radiotherapy and chemotherapy n = 2) who had more than 1 month of TC Qigong experience were recruited from the Nature Health Qigong Association (Hong Kong, China) by convenience sampling. They were screened by a medical practitioner and had to meet the following inclusion criteria: (1) have a history of NPC (positive test results for Epstein–Barr virus DNA and biopsy) and be cancer-free during the study period;(2) be medically stable; (3) be between 40 and 85 years old and have an expected survival time of >1 year; (4) be Can toneseandresided in Hong Kong because NPC is endemic in Southern China; (5) have normal cognitive function; and (6) have practiced the 18 Forms Tai Chi Internal Qigong [10] for more than 1 month (2-3 times per week). The detailed training protocol was described in Fong et al. [12]. The exclusion criteria were: (1) be still receiving active cancer treatments or alternative medicine; (2) have a chronic disease such as diabetes mellitus or hypertension; (3) have a musculoskeletal, neurological, cardiopulmonary or peripheral vascular disorder; or (4) be a smoker. Ethical approvals were obtained from the University of Hong Kong and the Hong Kong Institute of Education. Written informed consent was obtained from each participant before data were collected. All of the procedures were conducted according to the Declaration of Helsinki guidelines.

Outcome measurements

The following assessments were performed by a trained research assistant at a medical clinic over several evenings (6-8pm). The ambient temperature of the assessment room was maintained at around 22°C.

Arterial compliance

Arterial compliance was measured in the right arm using an HDI Pulse Wave CR-2000 Research Cardiovascular Profiling System (Hypertension Diagnostics, Eagan, MN, USA) because of its reliability and validity [15,16]. Details of the assessment procedures have been described in our previous studies [5,6,13,14]. This profiling system generates two indices corresponding to arterial compliance—a large and a small artery elasticity index. The large artery elasticity index represents the elasticity of the aorta and large arteries, whereas the small artery elasticity index represents the elasticity of the small arteries and the arterioles in general. Higher values indicate greater arterial compliance and a healthier vascular system [5,6].

Shoulder muscle strength

The maximum isometric muscle strength (peak force, in kg) of the internal and external rotators in each participant's right shoulder was measured using the Lafayette Manual Muscle Test System (Model 01165, Lafayette Instrument Company, Indiana, USA) with standardized measurement procedures [17] and dynamometer placements [18]. The participants completed only two trials of manual muscle testing for each muscle group to avoid fatigue. The average peak force of the two trials was used for analysis.

Statistical analysis

Statistical analysis was performed using SPSS version 20.0 software (IBM, Armonk, NY, USA). The Pearson product–moment correlation coefficient (r) was used to determine the degree of association between the artery elasticity indices and the outcomes of the shoulder muscle strength measurements. The significance level was set to 5%.

Results

The results revealed that in this group of TC Qigong-trained survivors of NPC, a large artery elasticity index was highly and positively correlated with muscle strength in the internal rotator (r=0.580, p=0.038) and external rotator (r=0.758, p=0.003) of the shoulder. The small artery elasticity index was also highly and positively associated with muscle strength in the external rotator of the shoulder (r=0.814, p=0.001) but not the internal rotator (r=0.388, p=0.190).

Discussion

Our results showed that shoulder muscle strength increased linearly with arterial compliance in survivors of NPC who practiced TC Qigong. Thus, arterial compliance should not be jeopardized by increasing muscular strength through practicing TC Qigong [19]. This may be because the parasympathetic nervous system activity that is dominant during the practice of TC Qigong may prevent arterial constriction induced by muscular contractions due to TC Qigong movements [20]. In addition, the stretching movements of TC Qigong may increase arterial compliance [21]. Based on these preliminary findings, we further hypothesized that TC Qigong might be an appropriate exercise for improving both vascular compliance and shoulder muscle strength in survivors of NPC.A randomized controlled clinical trial that includes a larger sample is required to confirm this hypothesis and to establish causality. Further studies should also take the confounding factors such as strength and length of radiation therapy and gender into account.

Conclusion

Arterial compliance was positively associated with shoulder muscle strength in TC Qigong-trained survivors of NPC. Our results indicated that arterial compliance might not be jeopardized by increasing muscular strength through practicing TC Qigong.

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