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Effect of Yoga on Arrhythmia Burden, Anxiety, Depression, and Quality of Life in Paroxysmal Atrial Fibrillation

The YOGA My Heart Study

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Objectives The purpose of this study was to examine the impact of yoga on atrial fibrillation (AF) burden, quality of life (QoL), depression, and anxiety scores.

Background Yoga is known to have significant benefit on cardiovascular health. The effect of yoga in reducing AF burden is unknown.

Methods This single-center, pre-post study enrolled patients with symptomatic paroxysmal AF with an initial 3-month non-interventional observation period followed by twice-weekly 60-min yoga training for next 3 months. AF episodes during the control and study periods as well as SF-36, Zung self-rated anxiety, and Zung self-rated depression scores at baseline, before, and after the study phase were assessed.

Results Yoga training reduced symptomatic AF episodes (3.8 ± 3 vs. 2.1 ± 2.6, $p < 0.001$), symptomatic non-AF episodes (2.9 ± 3.4 vs. 1.4 ± 2.0; $p < 0.001$), asymptomatic AF episodes (0.12 ± 0.44 vs. 0.04 ± 0.20; $p < 0.001$), and depression and anxiety ($p < 0.001$), and improved the QoL parameters of physical functioning, general health, vitality, social functioning, and mental health domains on SF-36 ($p = 0.017$, $p < 0.001$, $p < 0.001$, $p = 0.019$, and $p < 0.001$, respectively). There was significant decrease in heart rate, and systolic and diastolic blood pressure before and after yoga ($p < 0.001$).

Conclusions In patients with paroxysmal AF, yoga improves symptoms, arrhythmia burden, heart rate, blood pressure, anxiety and depression scores, and several domains of QoL. (Yoga on Arrhythmia Burden and Quality of Life in Paroxysmal Atrial Fibrillation; NCT00798356) (J Am Coll Cardiol 2013;61:1177–82) © 2013 by the American College of Cardiology Foundation

Atrial fibrillation (AF) is the most common cardiac arrhythmia and is associated with significant morbidity, mortality and healthcare costs. In addition, AF patients have an impaired quality of life (QoL) and AF imposes a significant psychosocial burden including depression and anxiety on the individual (1). The efficacy of current treatment strategies, including antiarrhythmic drugs (AAD) and catheter ablation in AF rhythm control is quite variable and suboptimal (2). There is limited data on safety and efficacy of complementary or alternative form of therapy on AF reduction. Any such noninvasive interventions, if shown to reduce or control AF burden, will have a major public health impact.

Yoga is a combination of structured physical exercises, breathing techniques, and meditation, and is shown to positively influence cardiac autonomic function (3). It has been shown to reduce the symptoms of depression and anxiety and result in QoL improvement (4). There seems to be a complex relation among these factors, AF initiation, and maintenance. The impact of yoga in patients with AF has not been investigated. We sought to examine the effects of a structured 3-month yoga program on AF burden, QoL indicators, anxiety, and depression.

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Abbreviations and Acronyms

AAD = antiarrhythmic drugs

AF = atrial fibrillation

PAF = paroxysmal atrial fibrillation

QoL = quality of life

SAS = Zung self-assessment anxiety score

SDS = Zung self-assessment depression score

SF-36 = Short Form 36

Methods

Study design. We performed a single center, prospective, self-controlled, pre-post cohort study. After screening 103 consecutive eligible paroxysmal atrial fibrillation (PAF) patients, 52 were enrolled and 49 completed the study. Patients who required changes in AAD regimen were excluded from the study. The study consisted of control (first 3 months) and a yoga intervention phase (next 3 months). Each patient acted as his or her own control. Three patients withdrew from the study during yoga training period. All patients were on stable medical therapy during the control and intervention phases. Clinical characteristics and quality of life/anxiety/depression scores were assessed at baseline (Day 0), end of the control phase (Day 90) and end of the intervention phase (Day 180). The details of patient screening and yoga intervention are outlined in the Online Appendix.

Subjects. Patients with paroxysmal AF between 18 and 80 years of age and willing to participate in the study were enrolled. Patients with a history of AF ablation within 3 months, contraindications for yoga training, life expectancy <1 year, advanced heart failure, and patients who practiced any form of yoga in the preceding 6 months were excluded. The protocol was approved by the Human Subjects Committee at the University of Kansas Medical Center.

Yoga intervention. During the intervention period, all patients underwent the structured Iyengar yoga (details in the Online Appendix) training at least twice weekly. All training sessions were conducted in groups of 15 to 20 people in a yoga studio by a certified professional yoga instructor and lasted for 60 min. During each yoga session, 10 min of *pranayamas*, 10 min of warm-up exercises, 30 min of *asanas*, and 10 min of relaxation exercises were performed. An educational DVD was also provided to each participant, and depending on the comfort level, patients were encouraged to practice these postures on their own at home on a daily basis. Compliance was reinforced with biweekly phone calls.

Outcome measurements. EFFICACY OUTCOMES. The primary outcomes included change in symptomatic AF, symptomatic non-AF, and asymptomatic AF episodes. Secondary outcomes included change in Short Form 36 (SF-36) QoL score, Zung self-assessment anxiety score (SAS) and Zung self-assessment depression score (SDS).

SAFETY OUTCOMES. These included any adverse effects related to the yoga intervention including injury or trauma during the interventional period.

Symptoms and AF monitoring. AF (>30 s) during the study period was monitored using self-reporting (symptom diary) and cardiac nonlooping event monitors (Cardio Labs, Inc., Franklin, Tennessee) and logged as an episode. Patients were asked to log episodes that were consistent with symptoms of AF and at least 1 recording per day if they did not have symptoms. All recorded symptomatic episodes were correlated with the rhythm findings on the event monitor to distinguish between the symptomatic and asymptomatic AF episodes. Events associated with symptoms and AF on the event monitor was labeled as *symptomatic AF episodes*. Events associated with symptoms and no AF on the monitor was labeled as *symptomatic non-AF episodes*. Events associated with no symptoms but documented AF on the monitor were labeled as *asymptomatic AF episodes*.

Assessment of QoL, anxiety, and depression scores. SDS and SAS were used to assess depression and anxiety pre- and post-yoga intervention (8). SF-36 scoring system was used to assess the QoL (9).

Statistical analysis. The Kolmogorov-Smirnov test was used to test for data normality, and accordingly nonparametric methods were used where indicated. The Wilcoxon signed rank test was used to compare the primary outcome measures between the control and intervention phases; and the Friedman test was used to compare baseline, and pre- and post-yoga measurements of anxiety, depression, and QoL scores. Noninvasive hemodynamic parameters met normality assumptions so were compared using a repeated measures analysis of variance with post hoc testing utilizing the Bonferroni adjustment. The effect of yoga compliance was assessed using the Mann-Whitney *U* test and the Kruskal-Wallis *H* test. The nonparametric equiva-

Table 1 Baseline Characteristics of Participants

Clinical characteristics	
Gender (M/F)	23 (46.9)/26 (53.1)
Age, yrs	60.6 ± 11.5
BMI, kg/m^2	28.0 ± 5.9
Duration of AF, months	63.9 ± 71.9
Symptomatic AF	43 (87.7)
LV ejection fraction, %	58.5 ± 6.3
LA size, cm	4.01 ± 0.50
Comorbid conditions	
Coronary artery disease	9 (18.4)
Diabetes mellitus	1 (2.0)
Hypertension	19 (38.8)
Hyperlipidemia	20 (40.8)
Obstructive sleep apnea	11 (22.4)
Prior revascularization (PCI/CABG)	4 (8.2)
Medication use	
Aspirin	28 (57.1)
Beta-blockers	31 (63.3)
ACE-I/ARB	10 (20.4)
Statins	16 (32.7)
Antiarrhythmic medications	38 (77.6)

Values are n (%) or mean ± SD.

ACE-I = angiotensin-converting enzyme inhibitor; AF = atrial fibrillation; ARB = angiotensin receptor blocker; BMI = body mass index; CABG = coronary artery bypass grafting surgery; LA = left atrium; LV = left ventricular; PCI = percutaneous coronary intervention.

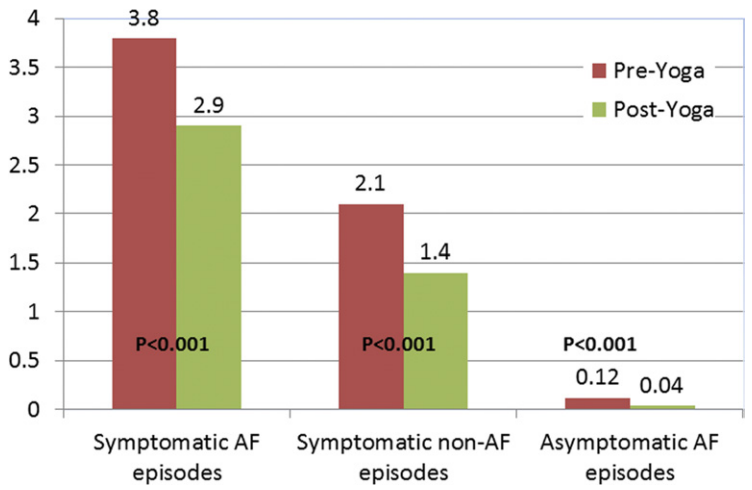

Figure 1 Differences in Primary Efficacy Outcomes Measures Between the Control and Intervention Phase

Values are mean ± SD.

lent of the Pearson correlation coefficient, the Spearman's rho statistic, was used to evaluate the relationship of anxiety and depression with episodes of AF.

Results

Baseline characteristics. The mean age of study subjects (47% men) was 61 ± 11 years and mean body mass index was 28 ± 5.9 kg/m^2 (Table 1). The mean duration of AF since diagnosis was approximately 5 years with a mean left atrial size of 4.01 ± 0.5 cm and left ventricular ejection fraction of 59 ± 6%.

Effect of yoga on primary efficacy outcomes. Yoga significantly reduced the number of symptomatic AF episodes (3.8 ± 3 vs. 2.1 ± 2.6; $p < 0.001$), symptomatic non-AF episodes (2.9 ± 3.4 vs. 1.4 ± 2.0; $p < 0.001$) and asymptomatic AF episodes (0.12 ± 0.44 vs. 0.04 ± 0.20; $p < 0.001$) from the end of control phase to the end of intervention phase (Fig. 1). Eleven (22%) patients with documented AF during the control pre-yoga phase did not have any AF episode during the yoga phase.

Effect of yoga on secondary efficacy outcomes. Except for the General Health domain on SF-36, the SDS, SAS, or the SF-36 scores did not change from baseline to the end of the control (pre-yoga) phase (Table 2). However, at the end of yoga intervention phase, the SDS and SAS scores improved significantly ($p < 0.001$ for both). Similarly, SF-36 scores improved after yoga therapy on the following domains: physical functioning ($p = 0.017$), general health ($p < 0.001$),

Table 2 Comparison of Baseline, and Pre- and Post-Yoga Intervention Secondary Efficacy Outcome Measures

Type of Score (n = 49)	Baseline (Day 0)	Pre-Yoga (Day 90)	Post-Yoga (Day 180)	p Value
SDS (Depression)	31.0 (27.0–37.0)	29.0 (24.0–35.0)	27.0 (22.0–31.0)	<0.001*
SAS (Anxiety)	34.0 (31.5–37.0)	33.0 (31.0–36.5)	25.0 (23.0–30.0)	<0.001*
SF-36 (domain-wise)				
1. Physical functioning	85.0 (80.0–95.0)	85.0 (70.0–93.8)	90.0 (85.0–95.0)	0.017*
2. Role physical	100.0 (75.0–100.0)	100.0 (56.3–100.0)	100.0 (86.3–100.0)	0.304
3. Bodily pain	100.0 (67.0–100.0)	100.0 (100.0–100.0)	100.0 (100.0–100.0)	0.494
4. General health	65.0 (50.0–77.5)	60.0 (45.0–75.0)	75.0 (65.0–82.5)	<0.001*
5. Vitality	84.0 (68.0–88.0)	84.0 (73.0–91.0)	91.0 (80.0–95.8)	<0.001*
6. Social functioning	100.0 (75.0–100.0)	100.0 (75.0–100.0)	100.0 (90.0–100.0)	0.019*
7. Role emotional	68.0 (60.5–80.0)	68.0 (58.5–80.0)	78.0 (60.5–80.0)	0.212
8. Mental health	75.0 (65.0–85.0)	75.0 (65.0–80.0)	80.0 (70.0–86.0)	<0.001*
Hemodynamic parameters				
Heart rate	66.9 ± 8.3	64.7 ± 7.5†	61.5 ± 7.6†	<0.001
Systolic BP	135.0 ± 7.5	133.0 ± 6.2†	127.7 ± 6.7†	<0.001
Diastolic BP	80.9 ± 7.7	78.2 ± 6.5†	74.0 ± 6.7†	<0.001

Values are median (interquartile range) for survey assessments and mean ± SD for hemodynamic parameters. *Statistically significant with a p value <0.05 (Friedman test). †Statistically significant with a p value <0.05 (repeated measures analysis of variance with post hoc comparisons using the Bonferroni adjustment).

BP = blood pressure; SAS = Zung self-assessment anxiety score; SDS = Zung self-assessment depression score; SF-36 = Short Form 36.

Table 3 Correlation Between Change in SAS and SDS Scores and AF and Symptom Episodes

Clinical Parameter	Change in Symptomatic AF Episodes	Change in Asymptomatic AF Episodes	Change in Symptomatic Non-AF Episodes
Change in anxiety scores (post-baseline)	0.210 (p =0.148)	0.246 (p = 0.088)	0.096 (p = 0.512)
Change in anxiety scores (post-pre)	0.221 (p = 0.127)	0.257 (p = 0.075)	−0.124 (p = 0.396)
Change in depression scores (post-baseline)	−0.147 (p = 0.320)	−0.137 (p = 0.352)	−0.043 (p = 0.773)
Change in depression scores (post-pre)	−0.144 (p = 0.334)	−0.113 (p = 0.448)	0.067 (p = 0.655)

Abbreviations as in Tables 1 and 2.

vitality ($p < 0.001$), social functioning ($p = 0.019$), and mental health ($p < 0.01$). At the end of the control phase, the heart rate and systolic and diastolic blood pressures decreased from baseline ($p < 0.001$). Greater reductions in all 3 parameters were noted from the end of control phase to the end of intervention phase ($p < 0.001$).

Correlation between AF reduction and improvement in QoL. The changes in anxiety and depression scores at 3 time points (at baseline and at the end of control and yoga phases) did not significantly correlate with changes in symptomatic non-AF, asymptomatic AF, or symptomatic AF episodes (Table 3).

Correlation between changes in hemodynamic variables, arrhythmia, and outcomes. Changes in SAS scores correlated with changes in heart rate ($p = 0.024$), indicating a decrease in heart rate after yoga may be related to improvement in anxiety (Table 4). Absolute changes in SBP following yoga not only correlated with improvement in symptomatic AF episodes ($p = 0.03$), asymptomatic AF episodes ($p = 0.015$), and symptomatic non-AF episodes ($p = 0.04$), but also with SAS scores ($p = 0.04$). These data indicate that the reduction in SBP with the practice of yoga influences arrhythmia recurrence as well as QoL.

Compliance and safety. All patients had at least 2 sessions/week of intervention with a mean of 3 sessions/week and a range of 2 to 7 sessions/week. There was no correlation between the number of practice sessions and the primary or secondary outcomes (Table 5). All of the participants tolerated the practice of yoga well. No major adverse effects or complications were noted or reported due to yoga therapy during the entire study period.

Discussion

Salient findings. This is the first study to evaluate the role of yoga, a noninvasive complementary and alternative medicine intervention, in the management of AF. Our results show that yoga therapy significantly reduces symptomatic and asymptomatic AF burden, and improves anxiety, depression, resting heart rate and blood pressure and the QoL in patients with PAF. These findings underscore the therapeutic value of a low-cost noninvasive therapy such as yoga to effectively complement the conventional treatment strategies in improving AF patient care. Given the high prevalence of AF and costs of conventional therapy, the public health relevance of these findings is very pertinent.

Yoga and AF. Although the precise mechanisms underlying the benefits in AF remain unclear, existing literature supports the multisystem benefits of yoga that may explain our findings. Extreme and nonphysiologic fluctuations in the autonomic tone, especially surges in sympathetic tone, often precede the onset of PAF episodes (5). Continued systemic and regional inflammation, oxidative stress and endothelial dysfunction can promote substrate changes that help sustain AF. Several studies suggest that practicing yoga can decrease systemic stress, down regulate the hypothalamic-pituitary-adrenal axis, which in turn can reduce sympathetic nervous system activity and increase parasympathetic activity. Yoga practice was shown to decrease blood pressure, improve endothelial function and reduce inflammation (6–8). Yoga may prevent the AF initiation and perpetuation through its pleiotropic effects such as: 1) increasing the baseline parasympathetic tone; 2) suppressing extreme fluctuations in the 2 autonomic nervous system components; and 3) decreasing the progression of the arrhythmia by preventing or minimizing atrial remodeling.

Yoga and QoL, depression, anxiety, and hemodynamic variables. Our results indicate that the practice of yoga can result in significant improvement in QoL, anxiety, and depression scores in patients with AF. This is likely explained by yoga related attenuation of neurohormonal

Table 4 Correlation Between HR, SBP, and DBP Changes and Other Measured Clinical Outcomes

Changes in Hemodynamic Parameters	Change in Symptomatic AF Episodes	Change in Asymptomatic AF Episodes	Change in Symptomatic Non-AF Episodes	Change in Anxiety (Post-Pre)	Change in Depression Scores (Post-Pre)
Change in HR (post-pre yoga)	0.139 (p = 0.208)	0.133 (p = 0.226)	0.157 (p = 0.148)	**0.237 (p = 0.024)**	−0.027 (p = 0.802)
Change in DBP (post-pre yoga)	0.114 (p = 0.292)	0.126 (p = 0.239)	−0.095 (p = 0.372)	0.190 (p = 0.065)	−0.011 (p = 0.919)
Change in SBP (post-pre yoga)	**0.237 (p = 0.030)**	**0.264 (p = 0.015)**	**0.213 (p = 0.046)**	**0.209 (p = 0.045)**	**−0.052 (p = 0.624)**

Bold values are statistically significant.
DBP = diastolic blood pressure; HR = heart rate; SBP = systolic blood pressure.

Table 5 Differences in Clinical Outcomes at Various Compliance Levels Pre- and Post-Yoga

Clinical Outcome Measure	Average Δ From Pre to Post by Average Number of Sessions/Week				p Value
	≤2 (n = 6)	>2 and ≤3 (n = 16)	>3 and ≤4 (n = 18)	>4 (n = 9)	
Primary efficacy measures					
Symptomatic episodes with documented AF	−2.3 ± 1.9	−1.2 ± 1.8	−1.7 ± 1.9	−1.2 ± 2.3	0.658
Symptomatic episodes without documented AF	−0.3 ± 2.3	−2.0 ± 4.0	−1.4 ± 2.1	−2.0 ± 2.5	0.813
AF episodes	−2.7 ± 2.3	−1.4 ± 1.7	−1.7 ± 1.9	−1.2 ± 2.3	0.692
Asymptomatic episodes with documented AF	−0.3 ± 0.5	−0.2 ± 0.5	0.0 ± 0.0	0.0 ± 0.0	0.058
Secondary efficacy measures					
SDS	−1.5 ± 13.4	−2.7 ± 4.0	−3.8 ± 3.5	−3.7 ± 7.4	0.626
SAS	−6.7 ± 6.6	−6.9 ± 3.9	−7.7 ± 5.2	−2.8 ± 5.8	0.162
SF-36 QoL measures (domain wise)					
1. Physical functioning	10.8 ± 15.3	12.7 ± 19.8	3.3 ± 12.8	6.7 ± 11.5	0.518
2. Role physical	7.5 ± 36.6	12.7 ± 21.0	6.4 ± 30.4	8.3 ± 41.5	0.543
3. Bodily pain	27.8 ± 44.4	15.1 ± 36.8	1.2 ± 26.9	−7.3 ± 14.6	0.061
4. General health	14.2 ± 14.3	15.5 ± 13.9	18.3 ± 18.0	16.4 ± 11.7	0.985
5. Vitality	7.7 ± 16.1	11.5 ± 16.1	8.3 ± 9.0	7.1 ± 14.9	0.830
6. Social functioning	14.3 ± 9.5	1.9 ± 15.2	5.8 ± 13.0	5.7 ± 12.9	0.194
7. Role emotional	11.7 ± 7.5	5.3 ± 18.0	2.0 ± 15.4	−1.9 ± 19.5	0.492
8. Mental health	4.2 ± 13.2	6.2 ± 7.3	7.1 ± 8.9	4.1 ± 8.7	0.907
Hemodynamic parameters					
Systolic BP, mm Hg	−5.0 ± 5.4	−5.4 ± 4.2	−4.8 ± 5.3	−6.1 ± 5.3	0.812
Diastolic BP, mm Hg	−5.7 ± 4.1	−5.6 ± 6.7	−2.8 ± 9.2	−3.9 ± 7.3	0.887
Heart rate, beats/min	−1.7 ± 3.1	−3.5 ± 2.0	−3.2 ± 4.4	−3.8 ± 2.8	0.600

QoL = quality of life; abbreviations as in Tables 1 and 2.

response to triggers of stress (9). Finally, the benefit from the emotionally supportive atmosphere at yoga training centers, and the positive impact by the caring relationships, change in diet and life style modification associated with yoga practice on physiological parameters cannot be underestimated.

Alternative therapeutic interventions for AF. Very little information currently exists on the efficacy of alternative therapy for AF. Recently, in a small cohort of patients Lombardi et al. have shown that acupuncture is effective in decreasing AF recurrences after electrical cardioversion in persistent AF (10). In a smaller follow-up study on paroxysmal AF they have shown similar effects of acupuncture on AF burden reduction (11). Use of therapeutic hypnosis was found to be associated with a statistically significant lower incidence of PAF (6% vs. 24%) and AAD use (14% vs. 28%) (12). However, the impact of yoga therapy on AF has not been evaluated heretofore, and our current results constitute the first evidence that yoga is effective as a complementary therapy for the alleviation of AF burden and consequences.

Study limitations. We did not study the variations in autonomic tone, systemic inflammatory markers, and endothelial function that could have provided a better foundation in explaining our findings. Additionally, our study was not designed to assess if the initiation of the AF episodes in the study population was vagally mediated or not. The overall asymptomatic AF episodes could have been grossly underestimated due to the low sampling rates inherent to the non-looping event recorders.

Future directions. This is a small, proof-of-concept study and future large focused randomized controlled studies will be necessary to examine the previous postulates and potential additional mechanisms through which yoga may exert beneficial effects in patients with AF.

Conclusions

The practice of yoga improves symptoms and arrhythmia burden, reduces anxiety and depression, and improves QoL in patients with AF. Yoga is an effective complementary and alternative therapy in the management of AF and can be incorporated in comprehensive AF management strategies.

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Key Words: arrhythmia burden ■ atrial fibrillation ■ quality of life ■ yoga.

APPENDIX

For an expanded Methods section, please see the online version of this article.