CARDIAC VAGAL CONTROL AS A PROSPECTIVE PREDICTOR OF ANXIETY IN WOMEN DIAGNOSED WITH BREAST CANCER

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Abstract

▪ Cardiac vagal control, as measured by respiratory sinus arrhythmia (RSA), indexes individual differences in ability to regulate emotions and respond to environmental demands.

▪ Across the literature, low cardiac vagal control has been associated with state and trait anxiety as well as anxiety spectrum disorders.

▪ The present study examined the association between resting RSA and anxiety in a sample of 39 women diagnosed with stage 0, I, II, or III breast cancer. At an oncology clinic visit, two 5-minute resting electrocardiographic segments were recorded; RSA values averaged across segments were used in the analysis.

▪ Participants completed the Taylor Manifest Anxiety Scale (TMAS) at the initial visit and then again every three months. Data for up to a year after the initial visit were used in the analyses.

▪ RSA was a significant predictor of change in anxiety over a 1-year period, such that lower RSA at initial assessment may place individuals at risk for increasing anxiety and higher RSA at initial assessment may buffer against increasing anxiety.

▪ These results are consistent with the hypothesis that resting RSA taps the ability to modulate anxiety in women coping with significant stressors of breast cancer diagnosis and treatment.

Introduction

▪ Within the framework of Polyvagal theory (Porges, 1995), cardiac vagal control, as measured by respiratory sinus arrhythmia (RSA), has been linked to regulation of emotion, attention, and communication.

▪ Data suggest that reduction in RSA is associated with anxiety-related phenomena. Several lines of research converge to indicate that low RSA is associated with clinical forms of anxiety as well as state and trait anxiety (Cohen & Benjamin, 2006; Friedman, 2007).

▪ Despite improvements in cancer treatments, being diagnosed with cancer remains a life-threatening event and cancer patients often experience emotional turmoil and symptoms of depression and anxiety immediately after the diagnosis (McGarvey et al., 1998). Data suggest that the first year post-diagnosis may be especially stressful for women with breast cancer as they are faced with multiple stressors associated with breast cancer treatment and transitioning to the survivorship or reentry phase (Stanton et al., 2005).

▪ The present study investigated whether ability to regulate emotions, as indexed by RSA, is associated with ability to modulate anxiety as assessed by a trait measure of anxiety, the Taylor Manifest Anxiety Scale (TMAS), during a 1-year period following the initial assessment in women diagnosed with breast cancer.

▪ We predicted that baseline cardiac vagal control, as indexed by RSA, would influence the trajectory of change in anxiety over the ensuing year after the initial assessment such that those participants with higher RSA at baseline would evidence a decrease in anxiety, whereas those participants with lower baseline RSA would evidence an increase in anxiety.

Method

Subjects

▪ A total of 106 female participants with stage 0, I, II, or III breast cancer participated in the study. All participants were tested in conjunction with oncology clinic visits.

▪ Participants who were currently taking anxiolytic medications, undergoing cardio-toxic chemotherapy regimens or taking medications that affect cardiac functioning were excluded from analyses. Additionally, only participants who filled out TMAS on at least 3 occasions were included in the analyses (min number of observations per subject = 3, max number of observations per subject = 5), leaving a final sample of 39 participants (Mean age = 53.5, SD = 9.6; Mean time since diagnosis = 135 days, SD = 121.8 days; min = 14 days, max = 447 days).

Procedure

▪ To record the ECG signal, a J & J Amplifier System (Poulsbo, WA) was used. Gel free Ag – AgCl electrodes were attached to the left and right wrist and the ground electrode was attached to the lower right forearm. A sample rate of 512 Hz was used to record the ECG signal. No instructions on how to breathe were given to the participants.

▪ Two 5-minute resting ECG segments were obtained at the initial visit. RSA values were averaged across two recording segments to produce an average baseline RSA value.

▪ Participants filled out a trait measure of anxiety, Taylor Manifest Anxiety Scale (TMAS), and a measure of stress, Perceived Stress Scale (PSS), at the initial visit and then approximately every three months. Observations for up to 1 year after the initial assessment were included in the analyses.

ECG Data Reduction

▪ The raw digitized ECG signals from each 5-minute resting session were analyzed off-line. Interbeat interval (IBI) series from the raw ECG recording was extracted by using QRSTool Software (Allen, Chambers, & Towers, 2007). The extracted interbeat series was hand-corrected for artifacts such as missed, erroneous, or ectopic beats.

▪ An estimate of respiratory sinus arrhythmia was calculated with CMetX Cardiac Metric Software (Allen et al., 2007) by deriving heart rate variability in the HF band (0.12–0.4 Hz), which is assumed to be related to respiration. CMetX converts the IBI series to a time-series sampled at 10 Hz with linear interpolation and then applies a 241-point optimal finite impulse response digital filter designed using FWTGEN V3.8 (Cook & Miller, 1992) with half-amplitude frequencies of a .12–.40 Hz. The natural log of the variance of the filtered waveform was used as the estimate of RSA.

Results

▪ Consistent with the literature on RSA, there was a significant negative correlation between RSA and age (r = -.33, p = .02). Therefore, age was entered in the regression model as a predictor of RSA and nonstandardized residuals were calculated. Values of RSA residualized on age were used in all of the following analyses.

▪ In the multilevel model, Time since initial assessment (in days) and perceived stress measured by PSS scale were entered as within-participant independent variables, RSA and Time from diagnosis to initial assessment (in days) were entered as between-participant independent variables, and anxiety measured by TMAS was entered as a dependent variable.

▪ Initial level of RSA prospectively predicted trajectory of change in anxiety scores on TMAS over the 1-year period following the initial assessment.

Table 1. Parameters of the model with multiple predictors of trajectory of change in TMAS

Parameter	Variable Level	DF	*B*	*SE β*	*t*	*p*
Intercept		36	2.98***	0.740	4.02***	<.001
Time since initial assessment	1	135	0.0003	0.001	0.31	*ns*
PSS	1	135	0.24**	0.079	2.99**	<.01
Time from diagnosis to initial assessment	2	135	0.01*	0.004	2.09*	<.05
RSA	2	135	-0.48	0.425	-1.13	*ns*
RSA X Time since initial assessment	n/a	135	-0.002*	0.001	-2.40*	<.05

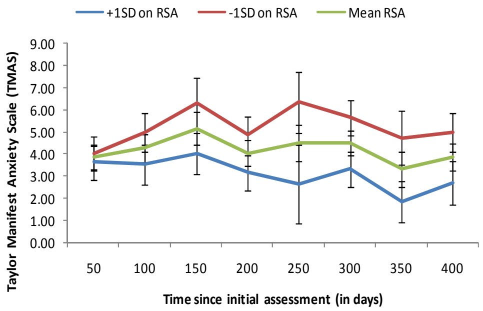

Figure1. Depiction of the significant Time since initial assessment X RSA interaction.

Those individuals with higher initial RSA showed a trajectory of decreasing anxiety over time, while those with lower initial RSA showed a trajectory of increasing anxiety over time.

Discussion

▪ Consistent with the literature on RSA and anxiety in individuals free from cancer diagnosis (Friedman, 2007), higher RSA was associated with a beneficial trajectory of anxiety over time. Those participants who had higher baseline RSA evidenced a decrease in anxiety, whereas participants with lower baseline RSA appeared to be at a higher risk for stable or increasing anxiety during the first year after the initial assessment. Additionally, anxiety was influenced by time since diagnosis and perceived stress, such that those participants who reported higher stress and who entered the study later after diagnosis exhibited greater anxiety across assessments.

▪ RSA has been proposed to index emotion regulation and the ability to adapt to stressors (Porges, 1995), and the present findings are consistent with this idea. In this study, women were undergoing the transition from active treatment to survivorship and may have been experiencing stress and anxiety from the treatments themselves as well as due to concerns of recurrence. In this context, RSA may reflect the extent to which these women adaptively coped with the stressors of breast cancer diagnosis, treatment, and recovery.

▪ Future studies will need to establish what other factors may influence the trajectory of change in anxiety in breast cancer patients as well as in other high-stress/high risk-populations.

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