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SHORT COMMUNICATION

Posttraumatic growth and diurnal cortisol slope among women with metastatic breast cancer

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Breast cancer;
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Summary
Background: A cancer diagnosis leads to increased psychological and emotional distress. However, in the aftermath of a traumatic event, such as being diagnosed with breast cancer, an individual may also experience beneficial changes in life perspective, relationships with others, and more. These changes are collectively known as posttraumatic growth (PTG). Studies have demonstrated that cortisol levels have been linked with cancer survival, yet an investigation of the relationship between PTG and cortisol has yet to be conducted among cancer patients.
Methods: The relationship of PTG to cortisol levels was examined among 99 metastatic breast cancer patients.
Results: We found a significant correlation between PTG and diurnal cortisol slope (Spearman's rho = −0.21, $p < 0.05$), indicating a link between positive psychological changes and healthier endocrine functioning in cancer patients.
Conclusions: PTG in response to the stress of cancer was related to more normal (i.e., steeper) diurnal cortisol patterns. Longitudinal studies are recommended to investigate these mechanisms in relationship to cancer survival.

1. Introduction

Cancer diagnosis and treatment is an extremely stressful and even traumatic experience that can result in poor psychological adjustment. Although extensive research has shown psychologically damaging effects of cancer, it can also

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stimulate positive psychological changes, identified as posttraumatic growth (PTG). In 1995, American psychologists Richard Tedeschi and Lawrence Calhoun coined the term ''posttraumatic growth'' (PTG) to describe the struggle with adversity that ultimately leads to positive life changes (Tedeschi and Calhoun, 1995). A substantial literature has documented PTG in a wide range of people, but our study focused on its implications in breast cancer patients (see Cordova, 2008). With an overall lifetime prevalence of 12.3% in American females (Howlader et al., 2013), we found that focusing on breast cancer would provide meaningful results for many individuals who might be struggling with the non-biological consequences of cancer. Further, metastatic breast cancer's prognosis remains low, with a survival rate of 24.3% over a five-year period (Howlader et al., 2013). This threat to one's mortality can be considered a traumatic event, and the growth that often occurs in the aftermath is a prime example of PTG.

While many studies have found that negative psychological outcomes of cancer disrupt cortisol rhythms (Bower et al., 2005; Giese-Davis et al., 2006), it is unclear if individuals who are better able to cope with cancer and its sequelae have healthier cortisol patterns. Since flatter cortisol slopes predict worse survival in breast and lung cancer patients (Sephton et al., 2000, 2013), a relationship between PTG and cortisol levels is of great interest for determining the potential protective effects of positive adjustment to cancer. This study sought to link PTG with biological benefits in the form of healthier endocrine function as defined by a steeper decline from morning to evening—negative cortisol slope.

Cortisol levels typically fluctuate throughout the day, peaking just before awakening and declining over the rest of the day, resulting in the 24-h cycle known as the diurnal cortisol rhythm (Edwards et al., 2001). To date, there have been relatively few studies examining psychosocial variables that might predict a more normal (i.e., negative) cortisol slope in metastatic breast cancer patients. Cruess and colleagues found that cognitive-behavioral stress management enhanced benefit finding in breast cancer patients and reduced serum cortisol levels (Cruess et al., 2000). Other studies have also revealed the potential biological benefits of PTG in cancer populations, identifying improved immune function in participants who reported higher levels of PTG (Dunigan et al., 2007; McGregor et al., 2004).

The current literature has emphasized that negative psychological effects of cancer are related to dysregulation of the HPA axis, but there is relatively little examination of the potential biological benefits of PTG. We hypothesized that higher scores on the Posttraumatic Growth Inventory (Tedeschi and Calhoun, 1995) would be related to more negative cortisol slope (greater decline from morning to evening), implying a healthier endocrine response. Such a finding would emphasize not just the negative impact of a cancer diagnosis, but also the potential for growth in the aftermath of such a traumatic event accompanied by stabilization of HPA stress response.

2. Methods

The study was a secondary analysis from a previous study on HPA axis dysregulation in metastatic breast cancer (Spiegel et al., 2006). In order to participate in the study, patients must have had documented metastatic or recurrent breast cancer, live in the Greater San Francisco Bay Area, have proficiency in English, and have a Karnofsky rating of at least 70% to indicate performance status (Spiegel et al., 2006). From a total pool of 221 metastatic breast cancer patients, 111 were eligible and consented to participate. These patients became aware of the study through referrals from oncologists at Stanford and other nearby hospitals, newspaper advertisements, and word of mouth. Of the 111 patients who consented and were eligible, eight dropped out and four subjects were later excluded due to steroid use during baseline assessment. The final study sample consisted of 99 female metastatic breast cancer patients.

3. Assessments

Collection of baseline saliva to monitor cortisol levels was obtained after participants consented to the study (Range = 7—20 days). Saliva samples were obtained on two consecutive days at five intervals throughout the day in their homes (at waking, 30 min after waking, noon, 1700 h, and 2100 h). After collecting cortisol samples from participants, they were stored at −70 °C until laboratory centrifugation and duplicate assays for salivary cortisol were obtained using luminescence immunoassay (LIA) reagents from Immuno-Biological Laboratories, Inc. in Hamburg, Germany. Assay sensitivity was measured to be 0.015 μg/dL (Spiegel et al., 2006).

Cortisol levels were computed in three different ways. (1) The slope of diurnal cortisol was measured. Samples were taken at waking, noon, 5 and 9 PM (excluding 30 min post-waking) for two consecutive days. To provide a better fit for the data, a logarithmic transformation was applied to the cortisol levels. The two-day baseline log cortisol slope measured the overall trend in cortisol levels, with a greater negative number indicating an adaptive slope, declining through the day ($M = -0.15626$, $SD = 0.0724$). This was chosen as the primary cortisol measure to be examined in relationship to PTG because in prior studies it proved to be an independent predictor of subsequent survival time (Sephton et al., 2000, 2013). (2) A second measurement was the total concentration of cortisol upon waking ($M = -0.7228$, $SD = 0.580$). (3) Finally, cortisol levels were compared at waking and 30 min after waking to determine this waking rise ($M = 0.3209$, $SD = 0.571$). The rise in cortisol 30 min after waking is a measure of adrenal responsiveness to stimulation by ACTH, (Schmidt-Reinwald et al., 1999) and is associated with flatter diurnal cortisol slopes (Giese-Davis et al., 2006) and is steeper on weekdays than weekends, independent of time of awakening (Thorn et al., 2006). We included these two secondary measures to examine HPA activity in relation to morning arousal, and because they are sensitive to depression in this population (Giese-Davis et al., 2006).

The Posttraumatic Growth Inventory (PTGI; Tedeschi and Calhoun, 1995) is a 21-item self-report measure that asks participants to quantify the extent to which they have experienced certain positive life changes as a result of a traumatic experience. Items are rated on a six-point Likert scale, from zero (''I did not experience this change as a result of the event'') to five (''I experienced this change to a very great degree as a result of the event''). The items are