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Posttraumatic Symptoms, Quality of Life, and Survival among Lung Cancer Patients

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Abstract

Purpose—This longitudinal study characterized psychological adjustment in a sample of lung cancer patients by examining the occurrence of posttraumatic stress and growth and their relationships with mental and physical health quality of life and survival over time.

Methods—Two waves of consecutive cohort samples, totaling 115 participants diagnosed with lung cancer, were identified from outpatient oncology clinics. Of these, 93 consented and completed the first of three assessments, and 57 completed the study. Prevalence of posttraumatic stress symptoms (PTSD Checklist) and posttraumatic growth (Posttraumatic Growth Inventory) were assessed and used to predict physical and mental health components of quality of life (Short Form 36) and survival.

Results—Patients reported both negative and positive psychological sequelae, with prevalence of estimated PTSD ranging from 5-16% at each assessment as determined by symptom and cut-off methods. Posttraumatic stress and growth were positively related, but were differentially associated with outcomes. More posttraumatic stress predicted lower mental health quality of life, whereas more posttraumatic growth predicted better physical health quality of life and longer survival. These relationships persisted after accounting for disease variables and attrition due to death or illness.

Conclusions—These findings highlight the importance of using longitudinal designs to identify relationships between stress and resilience factors in predicting outcomes.

Keywords

posttraumatic stress; posttraumatic growth; lung cancer; quality of life; survival

Cancer diagnoses and treatments are highly threatening events that irrevocably alter the world of patients, exposing them to stress and psychological trauma. Psychological trauma, arising from diagnosis and adjustment to cancer, not only affects quality of life (QoL) but also has implications for treatment compliance and disease progression (Faller, Bülzebruck, Drings, & Lang, 1999; Montazeri, Milroy, Hole, McEwen, & Gillis, 2003). Concurrently, many patients report growth from their cancer experience, including positive changes in their outlook on life, interactions with others, and thoughts about themselves (Cordova et al., 2007; Thornton et al., 2012). However, little is known about the mental and physical health implications for cancer patients who experience posttraumatic stress (PTS) or posttraumatic growth (PTG). Most research has been limited by the overuse of cross-sectional designs, samples of patients in early stages of disease, samples of mostly long-term survivors, or samples using only those surviving across the entirety of the study (Park & Helgeson, 2006; Sawyer, Ayers & Field, 2010). Furthermore, few studies have examined the joint effects of PTS and PTG on cancer-related QoL and survival and attempted to determine their unique contributions to outcomes. The present longitudinal study addressed these issues by examining the prevalence and prospective health effects of PTS and PTG in a sample of seriously ill patients with lung or pleural cancers. Identification of patients who are vulnerable to psychiatric impairment or who are resilient will aid in the development of intervention programs designed to enhance adjustment and improve QoL.

Cancer patients experience negative psychological sequelae, ranging from acute bouts of distress and depression to the development of clinical disorders such as posttraumatic stress disorder (PTSD; Akechi, Okamura, Nishiwaki, & Uchitomi, 2001; Cordova et al., 2007; Jacobsen et al., 1998) as well as beneficial effects of trauma, such as growth from their experiences (Posluszny, Baum, Edwards, & Dew, 2011; Thornton et al., 2012). Both PTS and PTG occur as a consequence of psychological trauma and share antecedents such as perceived life threat. However, they have potentially opposite effects on disease-related outcomes (American Psychiatric Association, 2000; Lindstrom & Triplett, 2010; Tedeschi & Calhoun, 2004). Symptoms of PTS have been linked with poorer mental and physical health outcomes (Song, Li, Lu, Deng, & Sun, 2013). In contrast, the relationship between PTG and mental and physical health outcomes has been unclear. Findings have been mixed, with studies finding positive, negative, or curvilinear relationships between PTG and QoL (Affleck, Tennen, Croog, & Levine, 1987; Leung et al., 2012; Sawyer et al., 2010; Tomich & Helgeson, 2012). Similarly, associations between PTS and PTG have been positive, negative, curvilinear, or not significant (Helgeson, Reynolds, & Tomich, 2006; Kleim & Ehlers, 2009; Salsman, Segerstrom, Brechting, Carlson, & Andrykowski, 2009; Sawyer et al., 2010). The majority of studies have employed cross-sectional designs, but associations between PTS and PTG may also depend on changes across time. For example, earlier reports of PTS among former prisoners of war positively predicted later PTG but PTG did not predict later PTS (Dekel, Ein-Dor, & Solomon, 2012). Hence, symptoms of PTS and PTG may present together or apart and may have differential effects on mental and physical health outcomes

depending on how they present, when they are measured, and if measurements are taken across a span of time.

To further examine these issues, a longitudinal study of lung cancer patients was conducted to determine the differential impact of PTS and PTG on physical and mental health QoL and survival. It was expected that PTS and PTG would be positively correlated, and that PTS would predict worse QoL over time and shorter survival times. Given the mixed findings in the literature, the relationships between PTG and QoL were explored over time while controlling for co-occurring symptoms of PTS.

Lung and pleural malignancies were of particular interest because they are associated with a grim prognosis and are particularly threatening and stressful. Patients are often diagnosed in later stages of the disease, and there is always a threat of recurrence or eventual death. Five-year survival rates for lung and pleural cancers range from 6.5 to 19% based on cell type (Howlader et al., 2013). One result of this grim prognosis is that the life of an individual diagnosed with lung cancer is upended. Once treatment begins it often produces many side effects and corresponds with significant lifestyle changes. Although lung cancer patients report a considerable amount of stress, prevalence of PTSD has not been established. Lung cancer patients have also reported growth (O'Connor, Wicker, & Germino, 1990; Thornton et al., 2012), but conditions under which positive and negative outcomes are expected are not yet clear. Because of the relatively poor prognosis, the necessity for a comprehensive response, and the pain and discomfort that accompany treatment, lung cancer is an excellent model of psychological trauma that can be used to characterize the experiences of PTS, PTG, and adaptation to cancer. To better capture these relationships, this study used statistical models that accounted for attrition related to disease progression and mortality, rather than excluding these cases from analyses as has been more traditionally done (e.g. Tomich & Helgeson, 2012). The statistical models used did not require complete data. Furthermore, the models examined and adjusted for differences due to attrition and disease progression on PTS, PTG, and QoL.

Method

Participants

A total of 115 patients receiving treatment for diagnoses of primary cancers in the lung or pleura agreed to participate in the study. Twenty-two patients did not complete the first assessment (T1) because they were too ill to participate, deceased, or were not reachable, and the current sample was comprised of the remaining 93 patients who consented to participate and who completed T1. Median time from diagnosis to T1 was 103 days (range: 15-667 days). By the second assessment (T2), 17 of these patients had died and another 7 patients were lost to follow-up or too ill to participate. Two of these patients were recovered by the third assessment (T3), but another 14 patients had died and a total of 57 patients submitted data at T3. The amount of individuals who were dead by T3 or otherwise failed to submit T3 (likely because they were too sick to do so) produced concern that removing responses from these individuals from final analyses would bias the results. Therefore, a dichotomous grouping variable was created that compared these noncompleters with the 57 participants who submitted T3. Statistical methods were used that did not require removal of

these noncompleters, and furthermore controlled for any differences between noncompleters and completers in the final models. This coding scheme was considered the most appropriate because alternative coding schemes (e.g., dummy coding attrition at T2 as well as T3, or only coding those confirmed to have died by T3) either resulted in too much loss of statistical power or failed to control for individuals who did not submit T3 because they were too ill to participate. Upon initial inspection, patients who submitted T3 were older than those who were already dead or too ill to turn in T3, $M = 60.94$ and 65.88 , $SD = 10.84$ and 10.14 respectively, $t(91) = -2.22$, $p = .03$, $d = 0.47$. Otherwise, these groups did not differ with respect to any other measured demographic and disease variables (diagnosis date, type and stage of cancer, and chemotherapy treatment) or in reports of PTS and PTG (p 's $> .05$).

Reflecting the population prevalence rates for each cell type, the majority of diagnoses were non-small cell lung cancer (NSCLC; $n = 77$), followed by small cell lung cancer (SCLC; $n = 13$) and malignant mesothelioma ($n = 3$; Howlader et al., 2013). As expected, most patients with NSCLC ($n = 62$) presented with advanced disease (i.e., stage IIIb or IV) and all patients with SCLC or mesothelioma were diagnosed with extensive stage disease. Sample characteristics reflected the demographics of the surrounding area and of the lung cancer patient population (Howlader et al., 2013). See Table 1 for a breakdown of the demographic characteristics.

Measures

Personal and disease characteristics—Characteristics were reported by patients and retrieved from medical charts. Personal characteristics included age, gender, race, family income, education, and smoking history. Disease characteristics included diagnosis date, type and stage of cancer, and chemotherapy treatment.

Symptoms of PTS—Symptoms were assessed using the PTSD Checklist-Specific version (PCL-S; Blanchard, Jones-Alexander, Buckley, & Forneris, 1996; Weathers, Litz, Herman, Huska, & Keane, 1993). Participants indicated the frequency to which they experienced 17 symptoms of PTSD in the past month in reference to “being told you have lung cancer” (α 's = .91 for T1, .93 for T2, and .94 for T3). Estimates of PTSD caseness were calculated using the symptom and cut-off methods for descriptive purposes only (Weathers et al., 1993). Symptom method scores followed the DSM-IV-TR (American Psychiatric Association, 2000) diagnostic criteria for PTSD. Those who were classified as having met the threshold for estimated PTSD reported at least one re-experiencing symptom (Cluster B), three or more avoidance symptoms (Cluster C), and two or more hyperarousal symptoms (Cluster D). Those who were classified as subthreshold estimated PTSD met the criteria for two of these three clusters. Under the cutoff method, individuals who scored 50 points or more on the PCL were classified as threshold estimated PTSD and individuals who score less than 50 points were classified as absent. Both calculation methods are commonly used with the PCL and have good diagnostic efficiency (Blanchard et al., 1996; Weathers et al. 1993). This study was focused on estimating symptoms of PTS and no formal clinical PTSD diagnosis was done, nor were any participants excluded based on PCL-S score. Among participants who submitted data for all assessments, the likelihood of estimated PTSD caseness did not

differ over time based on either the symptom or the cutoff methods, $\chi^2(2, N = 55) = 2.93, p = 0.23$ and $\chi^2(2, N = 55) = 1.20, p = 0.55$, respectively.

Posttraumatic growth—Growth was assessed with the Posttraumatic Growth Inventory (PTGI; Tedeschi & Calhoun, 1996; Tedeschi, Park, & Calhoun, 1998). Participants indicated the amount of change as a result of their lung cancer diagnosis on 21 different items (α 's = .96 for T1, .94 for T2, and .96 for T3). Additionally, the number of items out of 21 on which patients reported a score of 3 (moderate) or higher was calculated to indicate prevalence of PTG (Widows, Jacobsen, Booth-Jones, & Fields, 2005). The first score therefore provides the traditional calculation of the total perceived growth from an event, whereas the second score provides the amount of items in which an individual has perceived growth. While conceptually slightly different measures, these two scores were highly related at each timepoint (r 's = .97 for T1, .96 for T2, and .96 for T3). Among participants who submitted data for all assessments, the number of PTG items endorsed did not differ over time, $F(2,52) = 0.75, p = 0.48$.

Quality of life—Physical and mental health quality of life was measured using the physical and mental health component scores from the Short-Form 36 (SF-36; Ware, Kosinski, & Keller, 1994). The component scores were computed according to standard practices for this scale and involved weighting the sums of the individual SF-36 subscales based on population scores (yielding the same reliability for physical and mental health component scores, α 's = .95 for T1, .96 for T2, and .94 for T3; Ware, Kosinski, & Keller, 1994).

Patient survival—Length of survival was obtained by searching medical charts, obituaries, and the Social Security Death Index. By 18 months, 61 patients were deceased including all patients who had been diagnosed with SCLC or mesothelioma. Therefore, data for the remaining 32 patients were censored at 18 months following T1.

Procedure

Two samples of participants were recruited under the approval of the Institutional Review Board at the University of Pittsburgh according to NIH regulations relating to research involving human subjects. All appropriate ethical guidelines on human research were followed, and written informed consent was obtained from all subjects. All patients were diagnosed with cancer of the lung or pleura, had no prior diagnoses of cancer, were over 18 years of age, were able to read and write English, and had no concurrent psychiatric condition. There were no other study inclusion or exclusion criteria.

For the first sample ($n = 44$), patients were recruited between October, 2000 and August, 2001 during their first visit to the medical clinic at which they were being seen. The oncologists identified eligible patients and, if willing, the study was presented ($n = 97$) and informed consent was obtained ($n = 79$). Reasons for refusal ($n = 18$) included feeling too ill, being too overwhelmed by the cancer diagnosis, or not being interested. Of those who consented, 13 patients were judged not to meet eligibility requirements after further medical chart review because either the primary tumor was not lung cancer or pleural mesothelioma,

or because they had a previous cancer diagnosis. Participants were given a packet of questionnaires to take home, complete, and return in a postage pre-paid envelope.

The second sample ($n = 49$) was recruited to increase sample size, and had the same aims and procedures. Patients were recruited between October, 2004 and April, 2006. Potential patients were identified through the University of Pittsburgh Cancer Institute cancer research registry after their first visit to the medical clinic. Patients who met eligibility criteria ($n = 125$) were mailed letters introducing the study that were followed by a telephone call to explain the study in detail and address any questions. Patients either scheduled an appointment to complete T1 at the site or were mailed a packet with the informed consent, the questionnaires, and a postage pre-paid envelope to return it. Overall, 49 patients provided informed consent, 35 could not be reached, and 41 declined to participate because they were too ill, overwhelmed by their cancer diagnosis, or were not interested.

For both samples, T2 and T3 occurred two and four months after the participant completed T1. This time between assessments was based on observed survival time in the clinic and was necessarily shorter to capture changes in perceived growth and stress among individuals as treatment and illness progressed, and to capture more data among these severely ill participants. Participants were contacted and a packet of questionnaires similar to T1 was mailed to each participant along with a self-addressed stamped envelope. Questionnaires took approximately 30 minutes to complete, and participants were compensated \$30 after each assessment.

Statistical Analyses

Covariates were chosen based on the literature. It was expected that being female and younger age would predict more PTS and PTG (Breslau, 2009; Breslau, Peterson, Poisson, Schultz, & Lucia, 2004; Sawyer et al., 2010; Vishnevsky, Cann, Calhoun, Tedeschi, & Demakis, 2010). In contrast, higher income would be associated with less PTS but more PTG (Liebschutz et al., 2007; Schetter & Dolbier, 2011). Having NSCLC (vs. SCLC or mesothelioma) was expected to predict better physical and mental QoL (Howlander et al., 2013). In preliminary analyses, the influence of other disease-related variables and participant characteristics (i.e. cancer stage, smoking history, amount of time from diagnosis to consent, and whether participants were in the first or the second wave of data collection) were also evaluated, but excluded from final models because they were either confounded with the disease type covariate (i.e., cancer stage), or did not alter the results (i.e., whether or not patients were from the first versus second wave of the study, whether or not patients had a history of smoking, and amount of time from diagnosis to the initial assessment). Excluding these variables therefore avoided model misspecification and increased statistical power. It did not change the results.

To describe the symptom prevalence of PTS and PTG, frequencies and means were examined across the three assessments. Hierarchical pattern mixture modeling was used to examine change over time in PTS, PTG, and mental and physical QoL while controlling for completion status. Doing so allowed for more accurate estimates from the samples because it accounted for the nonrandom missing data that occurred due to patient death or illness. Full models with maximum likelihood estimation were tested against the prior models using

change in χ^2 to determine if there was significant improvement in prediction of outcomes. Continuous variables were centered at the grand mean (Hox, 2002). Initial models contained the covariates gender, age, family income, cell type, and completion status. Subsequent models included time, PTS and PTG. Models predicting PTS controlled for PTG, and models predicting PTG controlled for PTS. Models were also calculated including only covariates and time, and also including interactions for PTS, PTG, and quality of life with time. All interactions with time were not significant, and these models were excluded for brevity. An alternative hypothesis was tested in which the relationship between PTG and mental and physical QoL was curvilinear (e.g. Tomich & Helgeson, 2012), but neither the quadratic relationships nor the interactions between these relationships and time were significant. These alternative models were also excluded for brevity. All variables were entered as fixed factors and Bonferroni corrections with $\alpha = .05$ were performed for multiple comparisons.

Cox proportional hazards regression analyses were conducted to test the effect of PTS, PTG, and QoL at T1 on survival censored at 18 months, while controlling for the covariates. Nested models were compared for change in χ^2 model fit to test model improvement, the Wald statistic was used to determine significant individual predictors in each model.

Results

Symptoms of PTS and PTG have not been commonly evaluated among patients with lung cancer. Therefore, the prevalence of PTS and PTG across time was assessed first. As expected, patients reported symptoms of both PTS and PTG (see Table 2). Using the symptom method, roughly equal numbers (21.0-31.5%) of the sample met criteria for subthreshold or threshold estimated PTSD across time. Symptoms of PTG were also prevalent with patients endorsing an average of 63-70% of the items on the PTGI (Widows et al., 2005).

To predict the relationships between PTS and PTG across time, the covariates were entered into the model first predicting PTS and PTG, followed by time. Then, PTS or PTG was added in to the model predicting the opposite variable followed by interactions between PTS and time or PTG and time. Unstandardized parameter estimates represented the average slope for the variable across all individuals and assessments, accounting for the effects of all other variables in the model (see Table 3). Having a more virulent form of lung cancer and being of younger age predicted more PTS, while being a woman and of younger age predicted more PTG. As predicted, more PTS was related to more PTG. However, tests of change over time in PTS and PTG were not significant, indicating that both PTS and PTG were relatively stable across time (see Table 3).

Models were then conducted to predict mental and physical health QoL from time, PTS, and PTG (see Table 4). Patients who completed all assessments, had a higher income, and were female reported better physical health QoL, whereas patients with NSCLC had higher levels of mental health QoL. Effects with time were not significant in either model. As expected, more symptoms of PTS predicted worse physical and mental health QoL. However, PTS was not a significant predictor of physical health QoL after including mental health QoL in the

model, but remained a significant predictor of mental health QoL after including physical health QoL. Unlike PTS, PTG predicted better physical health QoL but did not predict mental health QoL. Also unlike PTS, PTG remained a significant predictor of physical health QoL after including mental health QoL in the model (see Table 4). Overall, these results strongly suggested that unique aspects of PTG and PTS differentially predicted QoL. Perceptions of growth that were not also related to PTS predicted better physical health QoL but not mental health QoL. In contrast, perceptions of stress that were not also related to PTG predicted worse mental health QoL but not physical health QoL.

Cox proportional hazards regression analyses were then conducted to further explore differences between PTS and PTG in predicting patient survival. Analyses were conducted first to determine the influence of the covariates, followed by T1 mental and physical health QoL, then T1 PTS and PTG on survival, censoring at 18 months after T1 (see Table 5). Analyses including only the covariates revealed that patients who completed the study, patients with NSCLC, and women had longer survival (see Table 5; $n = 76$; 48 events and 28 censored observations). Neither physical health QoL nor mental health QoL predicted survival or contributed to model fit, and were thus dropped from further analysis. Adding PTS and PTG into the model produced a significantly better fit, and higher reports of PTG predicted significantly longer survival times, whereas length of survival was not predicted by level of PTS (see Table 5).

Discussion

Lung cancer patients report both PTS and PTG, and these experiences differentially predict QoL and survival. Symptom reports of PTS and PTG were stable and positively related over time. Despite their co-occurrence, PTS and PTG had different effects on self-reported health outcomes and survival. More PTG was consistently associated with better physical QoL, and this relationship persisted after controlling for disease-related variables, posttraumatic symptoms and mental health, and even missingness due to death and illness. Conversely, more PTS symptoms predicted poorer mental QoL, but did not predict physical QoL after controlling for PTG and mental QoL. Contrary to expectations, PTS did not predict survival. Instead, more PTG predicted longer survival even after controlling for disease-related covariates. These findings underscore the need to simultaneously examine both negative and positive psychological responses to life-threatening illnesses in order to assess their unique impact on health outcomes, and to do so using statistical methods that can properly include participants in the models even when they do not provide all data.

Prevalence of PTS and PTG

This is the first study to examine rates of PTS in a sample of seriously ill lung cancer patients exclusively. Combined, 21%-31.5% of the sample reported considerable PTS that remained stable over the course of the study. Estimates of threshold and subthreshold estimated PTSD were comparable to those from other cancer samples (Jacobsen et al., 1998; Smith, Redd, Peyser, & Vogl; 1999). Time since diagnosis varied widely among individuals (with a range from 15 to 667 days to T1) and although symptoms of PTS may presumably change across time, in this sample of seriously ill advanced stage lung cancer patients, time

since diagnosis was not related to symptoms of PTS and did not influence outcomes. Patients also reported growth from their experience, endorsing at least a moderate amount of growth in two-thirds of the items at all timepoints (Table 2). Reports of PTG were consistent across time and were comparable to those reported by patients with other types of cancer and a sample of lung cancer patients (Cordova et al., 2007; Thornton et al., 2012; Posluszny et al., 2011). Stable reports of PTS and PTG may be attributable to the ongoing nature of dealing with a severe, life-threatening illness. However, failure to find changes in posttraumatic symptoms may be due to the compressed time frame necessitated by the poor prognosis as evidenced by the observed mortality rates or due to the smaller sample size. Future studies with larger sample sizes may provide the power to detect changes in PTS and PTG over time.

As expected, PTS and PTG were positively related across the assessments. This is in contrast to previous longitudinal studies that have found a more dynamic relationship in which initial reports of PTS predicted later PTG (Dekel et al., 2012). The positive relationship in the current sample may have been due to the nature of lung cancer, which is an on-going, severe, life-threatening illness rather than an event with an easily identifiable resolution point. Some patients with the most severe illness did not complete the assessments, but the analytic method employed allowed use of the data they had already provided. While the true nature of the relationship cannot be presently discerned, findings from the use of these analytic techniques support the argument that PTS and PTG are related because they share similar antecedents and mechanisms (e.g., intrusive thoughts and distress) but there are distinct components of each construct (Tedeschi & Calhoun, 2004). Proper characterization of PTS and PTG in future studies will require a careful understanding of the sample population and whether PTS and PTG should change over time. In those cases, multiple assessments over time with large sample sizes should be employed rather than more convenient cross-sectional designs (Helgeson et al., 2006).

Quality of Life

Consistent with previous research, greater PTS predicted poorer mental QoL across all assessments (Amir & Ramati, 2002; Jacobsen et al., 1998; Smith et al., 1999). Although, greater PTS was also associated with poorer physical QoL, this relationship disappeared after taking into account mental QoL suggesting that any relationship between PTS and physical QoL was through its relationship with mental QoL. These findings suggested that many lung cancer patients were suffering from stress associated with psychological trauma, due in part to deteriorating health. Given the nature of these cancers and their poor prognosis, acute interventions designed to alleviate stress and improve mental QoL should be considered for this population.

Previous findings have indicated that patients with advanced cancers (like the current sample) report more PTG (Posluszny et al., 2011). This is consistent with models in which individuals report PTG as they try to make sense of the traumatic event and their changing world (Calhoun & Tedeschi, 1998; Calhoun & Tedeschi, 2006). These findings demonstrated that more PTG consistently predicted better physical QoL, suggesting that there are some elements of PTG that have a protective effect on health outcomes. The fact

that this relationship was observed *after* taking into account co-occurring PTS and mental QoL suggests that there was a unique positive relationship between PTG and physical QoL. These findings are consistent with previous samples of breast cancer and colorectal or lung cancer survivors, among whom researchers also found a protective effect of PTG (Tomich & Helgeson, 2002; Tomich & Helgeson, 2012), and are also consistent with theories of PTG that hypothesize experiencing PTG would result in improvement over time (Calhoun & Tedeschi, 2006). Although it was possible that patients with better physical health (who felt better and lived longer during the study) experienced more positive mood states and thereby reported more PTG and less PTS, this alternative explanation appeared unlikely because reports of PTG and PTS were not predicted by whether or not the patients were able to complete the study. Furthermore, alternative models to explain these findings using a quadratic relationship between PTG and QoL (e.g. Tomich & Helgeson, 2012) were not significant in this sample. Future research needs to explore the complex association between PTG and PTS in relation to health outcomes and to employ rigorous controls when doing so.

Survival

The differences between PTG and PTS extended beyond mental and physical health QoL. In this sample, greater reports of growth from cancer experiences predicted longer survival. These findings were consistent with a study in which patients who perceived benefits after a heart attack were less likely to have a recurrence and to have lower disease incidence for 8 years following (Affleck et al., 1987). Furthermore, this relationship was found among individuals who were not in recovery and even after controlling for disease-related variables and PTS, suggesting that PTG plays a unique and important psychological role in improving outcomes.

Identifying the mechanisms behind the potentially protective effects of PTG is an intriguing challenge for future research. It seems unlikely that changes in health behaviors other than smoking cessation (e.g., increased exercise, better diet) could be a primary mechanism whereby PTG affects mortality for lung cancer patients. One possibility is that having more PTG may be associated with increased adherence to treatment regimens, as was found in a sample of coronary artery disease outpatients (Leung et al., 2012). Greater PTG has also been associated with greater use of approach-oriented coping among lung cancer patients (Thornton et al., 2012) that, in turn, may result in survival benefits. Additionally, experiencing PTG is a reflection of other personal resources such as optimistic expectations regarding health, self-efficacy for recovery, or some combination thereof. There are many such avenues for further research but to decrease the likelihood of erroneous and contradictory findings, such research should be carefully designed to match the experiences of patients. In this regard, it will be important for future researchers to consider whether experiences may change over time and whether such research designs and analyses adequately capture that change.

Limitations

While this study represents an initial attempt to characterize the influence of PTS and PTG on QoL and survival among a novel population of severely ill lung cancer patients, there are limitations that should be mentioned. This sample was necessarily small, and the time frame

was compressed into three assessments within four months. Four months was chosen based on survival data in the clinic at the time the original study was designed. Patients were more likely to attend the clinics with advanced disease. In fact, 33% of the sample died between completing the first assessment and the four month follow-up. The four month shorter time frame may have been adequate for capturing the lived experiences of an ongoing, life-threatening event. These experiences of patients with severe disease, many of whom were literally dying, may follow flat trajectories for PTS and PTG which vary significantly from those observed in more traditional populations. More research is needed with patients with advanced stage disease to see if their mental and physical health needs are related to the same psychosocial factors as in other patient samples.

While it is possible that these patients may have continued to follow flat PTS and PTG trajectories, the addition of longer term follow-up assessments may have revealed important changes that occurred in PTS, PTG, or QoL. Due to advances in imaging and treatment, some patients with advanced stage lung cancer may live years or even decades. This variability in length of survival poses challenges for study design and the four month time frame did not capture this far end of the spectrum. One approach in the future may be to focus on patients with specific types of lung cancer, such as non-small cell lung cancer adenocarcinoma, which is more likely to have variable prognoses and may facilitate examination of longer-term relationships.

Additionally, a portion of participants chose not to participate in the study or failed to complete the study for reasons related to the outcomes (quality of life and survival).and these missing data may have impacted statistical methods used to test the hypotheses. A total of 59 patients initially declined to participate in the study because they were too ill, too overwhelmed by the cancer diagnosis, or not interested, indicating that the patients with the worst physical and mental health may have chosen to not participate. Unfortunately, this is a common problem when recruiting participants who have experienced a stressful event. Although it is impossible to know how the results may have been different had these individuals been included in the study, it seems likely that their exclusion limited the sizes of the effects that were observed and had they been included the true relationships may have been more pronounced. Another 36 patients did not complete the study. While the analyses used in this study accounted for the non-random attrition due to patient illness and death, the results may nevertheless have been different if it were possible to assess the sickest patients across the entire study, if the study had assessed more patients in general, and if the study had included a long-term follow-up for survivors.

This study did not include comparison groups or intervention components in an effort to first establish base rates of PTS and PTG and their associated health outcomes among seriously ill patients, including survival. The lack of a comparison group precluded the ability to determine differences in findings between this sample and healthier comparison participants. However it facilitated examination of survival effects. This study included no intervention components but results did show that having PTG was related to better physical health quality of life and longer survival. While it may be tempting to aggressively promote growth as a means to improve health among cancer patients, such efforts should be viewed with a great deal of caution. Relatively few studies have demonstrated positive effects of growth on

health, especially among cancer patients, and researchers have cautioned that focusing on growth may generate false-promises (Coyne & Tennen, 2010). Researchers need to identify mechanisms of growth that consistently produce health benefit among individuals before such interventions should be widely adopted.

Conclusions and Future Directions

The psychological needs of lung cancer patients have been largely ignored in the research literature possibly due to advanced stage at diagnosis and low survival rates. It was found that PTS and PTG had differential relationships with self-reported health outcomes and survival. The findings from this longitudinal study with patients with advanced stage disease varied from previous studies that have used cross-sectional designs, completers only, patients with early-stage disease, or long-term survivors. These findings may have arisen from the use of longitudinal research designs and analytic methods that accounted for nonrandom missing data. Specifically, the analyses allowed all patients to be included in the models, rather than only those that were healthy enough to complete all assessments. Attrition due to death or being too ill to continue participation was included as a variable in the statistical models. Such statistical methods provided a better representation of the experiences of patients with severe and life-threatening illness, and may have revealed otherwise hidden relationships. Results from such methods may be more representative of the experiences of individuals diagnosed with severe and life-threatening illnesses. However, these findings are from one study only and would need to be replicated in order to make definitive comparisons with other studies. These results do underscore the need for future longitudinal studies and highlight a significant contribution to the current literature and discussion surrounding the influence of PTS and PTG. Overall, it is important for clinicians to consider these complex relationships, but it is too soon to make recommendations for psychosocial interventions that encourage personal growth.

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Table 1

Participant Demographic Information

	M	SD	Range
Age	64	11 <i>n</i>	35-88 %
Gender			
Male		54	58.1
Female		39	41.9
Race			
White/Caucasian		89	95.7
Black/African American		3	3.2
Asian		1	1.1
Partnership Status			
Married/Living with Partner		61	65.6
Not Married/Not Living with Partner		32	34.4
Family Annual Income Range			
<= \$20,000		16	17.2
\$20,001 - \$40,000		36	38.7
\$40,001 - \$70,000		19	20.4
> \$70,000		12	12.9
<i>missing</i>		10	10.75
Education Level			
Some High School or Less		13	19.9
High School Degree		62	66.7
College Degree		10	10.8
Graduate School Degree		7	7.5
<i>missing</i>		1	1.1
Employment Status			
Currently Employed		27	29.0
Not Currently Employed		65	69.9
<i>missing</i>		1	1.1
Tobacco Use			
Current		12	12.9
History of Use		73	78.5
Never Used		8	8.6
Stage of Disease (combined NSCLC, SCLC, and Mesothelioma)			
Local or Limited		15	16.1
Advanced		78	89.9

Table 2

Total PTS and PTG Scores, Number of PTG Items Endorsed, and Estimated PTSD Caseness

	Time 1	Time 2	Time 3
	<i>M (SD, n)</i>		
Total Scores			
PTS	31.11 (10.73, 92)	30.89 (11.67, 68)	29.51 (11.96, 56)
PTG	68.85 (26.40, 88)	61.38 (21.91, 67)	63.78 (23.06, 55)
PTG Item Endorsement	13.22 (6.20, 88)	13.97 (5.40, 67)	14.60 (5.78, 55)
	% (<i>n</i>)		
Estimated PTSD Caseness			
Symptom Method			
Threshold	16.3% (15)	14.7% (10)	12.5% (7)
Subthreshold	15.2% (14)	16.2% (11)	8.5% (5)
Absent	68.5% (63)	69.1% (47)	78.6% (44)
Cut-off Method			
Threshold	8.7% (8)	8.8% (6)	5.4% (3)
Absent	91.3% (84)	91.2% (62)	94.6% (53)

Table 3

Models Predicting PTG and PTS across Time (df = 193)

<i>Covariates-Only Models</i>	PTG b (SE)	t	PTS b (SE)	t
Completion Status	-4.44 (4.10)	-1.08	1.63 (1.82)	0.90
Cell Type	-3.34 (4.62)	-0.72	6.55 (2.05)	3.19**
Gender	-8.39 (3.57)	-2.30*	1.02 (1.59)	0.64
Age	-0.36 (0.16)	-2.25*	-0.15 (0.07)	-2.15*
Income Level	-0.92 (0.90)	-1.02	-0.25 (0.40)	-0.63
<i>Models with Time</i>				
Completion Status	-3.24 (4.40)	-0.74	1.10 (1.95)	0.56
Cell Type	-3.42 (4.62)	-0.74	6.58 (2.05)	3.21**
Gender	-8.41 (3.57)	-2.36*	1.03 (1.58)	0.65
Age	-0.36 (0.16)	-2.26*	-0.15 (0.07)	-2.15*
Income Level	-0.93 (0.90)	-1.03	-0.25 (0.40)	-0.62
Months after Assessment (0 vs 4)	-3.38 (4.46)	-0.76	1.49 (1.98)	0.75
Months after Assessment (2 vs 4)	-2.23 (4.51)	-0.50	0.86 (2.00)	0.43
<i>Models with PTS and PTG</i>				
Completion Status	-3.94 (4.22)	-0.94	1.51 (1.87)	0.81
Cell Type	-7.64 (4.54)	-1.68 [†]	7.02 (1.97)	3.56***
Gender	-9.07 (3.42)	-2.65**	2.09 (1.54)	1.36
Age	-0.26 (0.16)	-1.70 [†]	-0.11 (0.07)	-1.56
Income Level	-0.77 (0.87)	-0.89	-0.13 (0.38)	-0.34
Months after Assessment (0 vs 4)	-4.33 (4.28)	-1.01	1.91 (1.90)	1.01
Months after Assessment (2 vs 4)	-2.79 (4.33)	-0.64	1.15 (1.92)	0.60
PTS	0.64 (0.16)	4.12***	--	--
PTG	--	--	0.13 (0.03)	4.12***

Note: b-weights represent unstandardized parameter estimates.

[†] p < .10,

* p < .05,

** p < .01,

*** p < .001

Table 4

Models Predicting Physical and Mental QoL (df = 187)

<i>Covariates-Only Models</i>	<i>Physical Health QoL</i>		<i>Mental Health QoL</i>	
	<i>b</i> (SE)	<i>t</i>	<i>b</i> (SE)	<i>t</i>
Completion Status	-8.34 (1.88)	-4.44***	0.65 (1.98)	0.33
Cell Type	-0.54 (2.07)	-0.26	-8.19 (2.18)	-3.76***
Gender	-3.59 (1.59)	-2.26*	0.29 (1.67)	0.17
Age	0.13 (0.07)	1.73 [†]	0.09 (0.08)	1.17
Income Level	1.49 (0.4)	3.72***	0.20 (0.42)	0.48
<i>Models with Time, PTG, and PTS</i>				
Completion Status	-7.95 (1.95)	-4.07***	1.63 (1.72)	0.95
Cell Type	1.27 (2.08)	0.61	-3.37 (1.84)	-1.83 [†]
Gender	-2.68 (1.56)	-1.71 [†]	1.11 (1.38)	0.80
Age	0.12 (0.07)	1.66 [†]	-0.01 (0.06)	-0.13
Income Level	1.53 (0.39)	3.93***	0.15 (0.34)	0.43
Months after Assessment (0 vs 4)	0.61 (1.92)	0.32	-0.74 (1.7)	-0.43
Months after Assessment (2 vs 4)	1.37 (1.93)	0.71	-0.91 (1.7)	-0.54
PTG	0.09 (0.03)	2.65**	0.05 (0.03)	1.73 [†]
PTS	-0.21 (0.07)	-2.88**	-0.64 (0.07)	-9.80***
<i>Models with Time, PTG, PTS, and QoL</i>				
Completion Status	-8.14 (1.94)	-4.19***	2.39 (1.79)	1.34
Cell Type	1.68 (2.09)	0.80	-3.49 (1.83)	-1.91 [†]
Gender	-2.81 (1.56)	-1.81 [†]	1.36 (1.38)	0.99
Age	0.12 (0.07)	1.69 [†]	-0.02 (0.06)	-0.30
Income Level	1.51 (0.39)	3.91***	0.00 (0.36)	0.01
Months after Assessment (0 vs 4)	0.70 (1.91)	0.36	-0.79 (1.69)	-0.47
Months after Assessment (2 vs 4)	1.48 (1.92)	0.77	-1.04 (1.7)	-0.61
PTG	0.08 (0.03)	2.46*	0.04 (0.03)	1.43
PTS	-0.14 (0.09)	-1.49	-0.62 (0.07)	-9.34***
Mental Health QoL	0.12 (0.08)	1.48	--	--
Physical Health QoL	--	--	0.09 (0.06)	1.48

Note. *b*-weights represent unstandardized parameter estimates. Models were also calculated with only the covariates and time, but time was not significant and did not add to the model fit. This model was excluded for brevity.

[†] $p < .10$,

* $p < .05$,

** $p < .01$,

 $p < .001$

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Table 5

Models Predicting Survival from Physical and Mental QoL and from PTG and PTS

	Unstandardized Coefficient (SE)	Wald Statistic	Hazard Ratio
<i>Covariates-Only Models</i> $-2 \text{ Log Likelihood} = 335.81, \chi^2(5) = 51.12^{***}$			
Completion Status	-0.74 (0.17)	18.35 ^{***}	0.48
Cell Type	-0.62 (0.18)	11.53 ^{***}	0.54
Gender	-0.32 (0.16)	3.76 [*]	0.73
Age	-0.01 (0.02)	0.74	0.99
Income Level	-0.10 (0.09)	1.27	0.90
<i>Models with QoL</i> $-2 \text{ Log Likelihood} = 333.15, \chi^2(2) = 2.66$			
Completion Status	-0.73 (0.19)	14.94 ^{***}	0.48
Cell Type	-0.60 (0.19)	9.72 ^{**}	0.55
Gender	-0.34 (0.17)	4.10 [*]	0.71
Age	-0.01 (0.02)	0.65	0.99
Income Level	-0.08 (0.09)	0.87	0.92
Physical QoL	-0.02 (0.01)	1.38	0.98
Mental QoL	-0.01 (0.01)	0.90	0.99
<i>Models with Posttraumatic Symptoms</i> $-2 \text{ Log Likelihood} = 329.26, \chi^2(2) = 6.55^*$			
Completion Status	-0.75 (0.18)	17.39 ^{***}	0.47
Cell Type	-0.60 (0.19)	9.74 ^{**}	0.55
Gender	-0.34 (0.17)	4.12 [*]	0.71
Age	-0.02 (0.02)	1.65	0.98
Income Level	-0.15 (0.10)	2.32	0.86
PTG	-0.02 (0.01)	6.40 [*]	0.99
PTS	0.01 (0.02)	0.19	1.01

* $p < .05$,** $p < .01$,*** $p < .001$