Characterization of skin reactions and pain reported by patients receiving radiation therapy for cancer at different sites

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Background Skin reactions and pain are commonly reported side effects of radiation therapy (RT).

Objective To characterize RT-induced symptoms according to treatment site subgroups and identify skin symptoms that correlate with pain.

Methods A self-report survey—adapted from the MD Anderson Symptom Inventory and the McGill Pain Questionnaire—assessed RT-induced skin problems, pain, and specific skin symptoms. Wilcoxon Sign Ranked tests compared mean severity of pre- and post-RT pain and skin problems within each RT-site subgroup. Multiple linear regression (MLR) investigated associations between skin symptoms and pain.

Results Survey respondents (N = 106) were 58% female and on average 64 years old. RT sites included lung, breast, lower abdomen, head/neck/brain, and upper abdomen. Only patients receiving breast RT reported significant increases in treatment site pain and skin problems ($P \leq .007$). Patients receiving head/neck/brain RT reported increased skin problems ($P < .0009$). MLR showed that post-RT skin tenderness and tightness were most strongly associated with post-RT pain ($P = .066$ and $P = .122$, respectively).

Limitations Small sample size, exploratory analyses, and nonvalidated measure.

Conclusions Only patients receiving breast RT reported significant increases in pain and skin problems at the RT site while patients receiving head/neck/brain RT had increased skin problems but not pain. These findings suggest that the severity of skin problems is not the only factor that contributes to pain and that interventions should be tailored to specifically target pain at the RT site, possibly by targeting tenderness and tightness. These findings should be confirmed in a larger sampling of RT patients.

Radiation-induced skin reactions or radiation dermatitis is reported in 95% of cancer patients undergoing radiation therapy (RT).[1-3] These skin changes range from mild erythema to dry or moist desquamation. Pain is often the cause for premature discontinuation of RT, which may impair control of disease and quality of life.[1-5] Various treatments have been tested for prevention and treatment of radiation dermatitis, including aloe vera, hyaluronate cream, corticosteroids, antimicrobials, and dressings.[1,6] Although "washing with a mild soap" is still considered the most effective treatment for radiation dermatitis, interventions that increase moisture at the treatment site have shown some promise for decreasing moist desquamation but not pain.[1,6,7] Little research has been dedicated to assessing the incidence and severity of pain associated with radiation-induced skin reactions at various RT sites.

The severity of radiation-induced skin reactions is most commonly assessed using the Radiation Therapy Oncology Group/European Organization for Research and Treatment of Cancer (RTOG/EORTC) scoring system and the National Institutes of Health Common Toxicity Criteria-Adverse Event (NIH CTCAE).[2,3] However, these scoring systems do not evaluate the pain or quality of life

Manuscript received November 19, 2012; accepted March 11, 2013.

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Disclosures The authors have no conflicts to report.

J Support Oncol 2013;11:183-189
DOI: 10.12788/j.suponc.0009

associated with these skin reactions. Further, established skin evaluation tools like the Skindex[8] and Skin Toxicity Assessment Tool (STAT)[9] evaluate quality of life but not pain and skin symptoms simultaneously. Studies that assess pain employ the standard 11-point, 0 - 10 numeric rating scale (NRS) for pain severity. They do not relate the pain level to the treatment site, skin, or type of skin symptoms.[10,11] A new assessment tool that simultaneously assesses skin symptoms and pain would benefit research studies in radiation dermatitis.

The purpose of this study was to simultaneously obtain specific information on pain and skin problems experienced by patients receiving RT for cancer at various sites using a new survey instrument, the Pain and Skin Problem Survey (PSP), which was adapted from the McGill Pain Questionnaire-Short Form (MPQ-SF)[12] and the MD Anderson Symptom Inventory (MDASI).[13-16]

Methods

Study population and design

Eligible patients were ≥ 18 years of age, of any gender and ethnicity, able to read and understand English, had any cancer diagnosis, and were scheduled to receive RT for cancer at the University of Rochester Cancer Center. The University of Rochester Institutional Review Board approved this clinical protocol and written informed consent was obtained from each patient. Patients were enrolled prior to or within 4 days of the start of RT. Once enrolled, patients completed the pretreatment portion of the PSP either before or within 4 days of the start of their prescribed course of RT. For patient convenience, the posttreatment survey could be completed any time after but within 1 month of their last RT session. Patients were asked to consider their pain and skin problems on the last day of their RT when completing the survey no matter what date it was actually completed and returned.

Assessment

The PSP is a new instrument based on the MPQ-SF[12] and the MDASI.[13-16] It was developed to evaluate pain and skin problems associated with RT. The pretreatment portion was completed before or at the start of RT while the posttreatment portion was completed after the completion of RT. The PSP involved a series of 6-point, 0 - 5 Likert Scales. Patients were asked to rate the severity of pain and skin problems at the treatment site on a 6-point scale anchored by 0 = "Not Present" and 5 = "Very Severe." Patients were also asked to describe the feeling or appearance of their skin problems at the treatment site using 8 specified descriptive symptoms: itchy, throbbing/aching, tenderness, hot-burning, tightness/splitting, redness/discolored, flaking/peeling, and bumpy/spotted. Subjects rated the severity of the symptom on a similar Likert Scale. A chart review was also performed to determine which participants were prescribed opioid pain medications during radiation treatment. If the medication was prescribed between the dates that the subject completed the pre- and posttreatment surveys, it was considered "prescribed during treatment."

Statistical analyses

In this exploratory analysis, differences in mean severity between pre- and post-RT pain, skin problems, and skin symptoms at the RT site were assessed using the Wilcoxon Signed Rank tests within each treatment site subgroup. Treatment site subgroups were defined by body region to assess how skin in different regions responded to RT. For analyses of changes in severity of pain and skin problems at treatment sites, significant *P*-values were set using the Holm-Bonferroni correction method accounting for 5 RT site subgroups (first *P*-value = .01). For analyses regarding changes in severity of specific skin symptoms, the first significant *P*-value for the Holm-Bonferroni method was set to correct for the 8 skin symptoms investigated (first *P*-value = .00625). Multiple linear regression (MLR) analysis was used to determine predictors of posttreatment pain and skin problems. Independent variables included pretreatment pain or skin problems, age, gender, RT-site (breast or head/neck/brain vs other), total number of radiation treatments, and total dose of radiation. MLR analysis was used to assess how strongly the severity of each skin problem descriptor correlated with the severity of pain or skin problems at the treatment site ($P < .05$ considered significant for MLR). All statistical analyses were performed in JMP 10 (SAS Institute, Carey, NC).

Results

Patient characteristics

A total of 154 patients were recruited and consented to participate in the study. Of these 154 patients, 111 completed both the pre- and posttreatment portions of the PSP. Thus, the overall response rate was 72%. Five participants were excluded for incorrect completion of the posttreatment survey. The analyses reported herein were conducted on the 106 patients who completed both pre- and posttreatment surveys. The majority of patients were white (96%) and female (65%) with an average age of 64 years (Table 1). Approximately half of the patients had advanced cancer (48%), and the majority of patients had previous surgery (55%) or chemotherapy (58%). The most common primary cancer diagnoses were lung (26%), breast (18%), alimentary/gastrointestinal (17%), hematologic (11%), and genitourinary (7.5%). RT site subgroups included lung (30%), breast (16%), lower abdomen (14%),

head/neck/brain (13%), upper abdomen (12%), and "other" (14%). The lower-abdomen group included irradiations for genitourinary, colorectal, and prostate cancers. The upper-abdomen group included irradiations for esophageal, gall bladder, pancreas, and liver cancers. The head/neck/brain group consisted of patients with head/neck tumors (n = 2), brain tumors (n = 8), or metastatic lesions in the brain (n = 2). The "other" group included patients receiving RT for hematologic cancers, melanoma, sarcomas, and spinal irradiations for metastatic cancer. The mean total number of RT sessions was 20 and the mean total dose was 54 Gy (Table 1).

TABLE 1 Subject demographics

Characteristic	Patients, % (SD) (N = 106)
Age, y	64 (13)
Race	
White	96%
Other	4%
Sex	
Female	65%
Male	35%
Cancer diagnosis	
Lung	26%
Breast	18%
Alimentary	17%
Hematological	11%
Genitourinary	7.5%
Other	20.5%
RT site	
Lung	30%
Breast	16%
Lower abdomen	14%
Head/neck/brain	13%
Upper GI	12%
Other	14%
Previous txt	
Surgery	55%
Radiation	26%
Chemo	58%
None	14%
Cancer severity	
Early stage/local	52%
Advanced cancer	48%
Total # of txts	20 (11)
Total dose (Gy)	54 (25)
Days between last txt and post survey completion	6.6 (7.99)

Abbreviations: GI, gastro-intestine; Gy, greys; RT, radiation therapy; SD, standard deviation; txts, treatments.

Report of pain, skin problems, and skin symptoms at treatment site

Patients receiving RT to the breast (Figure) reported the largest and only significant increase in severity of pain at the treatment site (mean change = 1.35; 95% CI = 0.43, 2.28; $P = .01$). Patients receiving RT to the breast or the head/neck/brain region (Figure) reported significant increases in skin problems at the treatment site (breast: mean change = 2.18; 95% CI = 1.62, 2.73; $P < .0001$; head/neck/brain: mean change = 1.54; 95% CI 0.77, 2.30; $P = .004$). MLR was used to identify predictors of the severity of posttreatment pain and skin problems. Independent predictors in the models included pretreatment pain or skin problems, age, gender, RT site (breast cancer or head/neck/brain vs other), total number of RT sessions, total dose of radiation, and cancer severity (early vs late stage). RT to the breast (Table 2) was the only significant predictor of increased posttreatment pain ($b = 1.029$, 95% CI = 0.217, 1.896; $P = .014$). There was a trending association between pre- and posttreatment pain at the treatment site ($b = 0.235$; 95% CI = -0.023, 0.493; $P = .073$). Predictors of increased posttreatment skin problems (Table 2) were a greater number of total RT sessions ($b = 0.031$; 95% CI = 0.005, 0.056; $P = .017$) and receiving RT to the breast ($b = 1.629$; 95% CI = 0.900, 2.358; $P < .0001$) or head/neck/brain region ($b = 0.882$; 95% CI = 0.144, 1.620; $P = .020$).

RT-induced changes in the severity of skin redness, itching, hotness, tenderness, flaking, tightness, throbbing, and bumpiness were examined in each RT site subgroup. Significant increases were observed in specific skin symptoms only in patients receiving RT to the breast when using the Holm-Bonferroni method for multiple comparisons. Patients receiving RT to the breast reported significant increases in skin redness (mean change = 2.17; 95 CI = 1.30, 3.05; $P = .0002$), itching (mean change = 1.88; 95% CI = 1.11, 2.65; $P = .0002$), hotness (mean change = 1.47; 95% CI = 0.58, 2.36; $P = .004$), tenderness (mean change 1.25; 95% CI = 0.54, 1.96; $P = .002$), flaking (mean change = 1.31; 95% CI = 0.65, 2.00; $P = .002$), throbbing (mean change = 0.94; 95% CI = 0.41, 1.47; $P = .004$), tightness (mean change = 0.81; 95% CI = 0.25, 1.37; $P = .014$), and bumpiness (mean change = 0.94; 95% CI = 0.25, 1.63; $P = .014$). Patients receiving RT to the head/neck/brain region did not report significant increases in any individual skin symptom (Table 3).

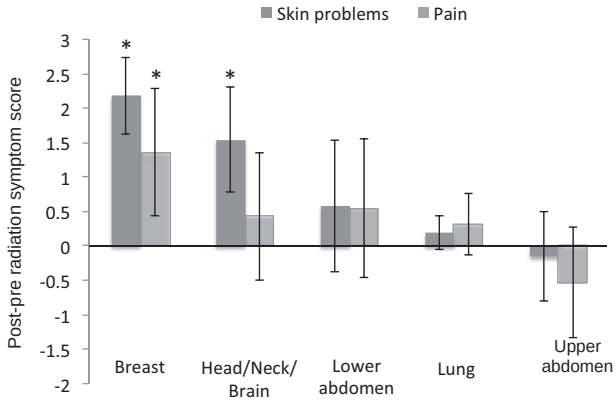

FIGURE Changes in severity of pain and skin problems by RT site. *$P < .01$ was considered significant based on the Holm-Bonferroni correction method.

TABLE 2 Multiple linear regression model for predictors of post-RT pain and skin problems

Model Outcome: post-RT pain problems		
Predictor	***b* (95 % CI)**	***P*-value**
Pre-RT pain	0.235 (−0.023, 0.493)	.07
Total # of RT txts	0.021 (−0.007, 0.050)	.143
RT site		
(Breast vs other)	1.029 (0.217, 1.896)	.014
(HNB vs other)	−0.018 (−0.828, 0.792)	.965
	Adjusted R^2 =0.122, obs = 102	
Model Outcome: post-RT skin problems		
Predictor	***b* (95 % CI)**	***P*-value**
Pre-RT skin problems	0.168 (−0.131, 0.468)	.268
Total # of RT txts	0.031 (0.005, 0.056)	.017
RT site		
(Breast vs other)	1.629 (0.900, 2.358)	<.0001
(HNB vs other)	0.882 (0.144, 1.620)	.02
	Adjusted R^2 = 0.3358, obs = 103	

Models also adjusts for age, gender, total radiation dose, and cancer severity (early vs advanced stage).
Abbreviations: HNB, head/neck/brain; Obs, observations; RT, Radiation therapy; txts, treatments.

MLR analysis (Table 4) demonstrated that the severity of skin redness ($P < .0001$), itching ($P = .0009$), and tenderness ($P = .013$) significantly correlated with the reported severity of "skin problems at treatment site" (adjusted $R^2 = 0.776$). Although no skin symptoms were significantly correlated with pain at the treatment site, the severity of skin tenderness ($P = .07$) and tightness/splitting ($P = .12$) showed trending associations with the severity of pain at the treatment site (adjusted $R^2 = 0.457$). These data suggest that specific skin symptoms may be linked to patients' reported pain at their radiation treatment site.

Opioids prescribed during RT are inadequate

Patients who had an increase of ≥ 2 units of pain from before to after completion of their RT were more likely to have opioids prescribed during the course of RT than those with a pain increase < 2 (42.9% vs 15.2%, respectively; $P < .03$) (data not shown). Despite the prescription of opioids to patients during RT, increased pain at the treatment site was reported by patients. These data suggest that an opioid prescription is insufficient to control pain associated with RT-induced skin reactions.

Discussion

Radiation-induced skin problems are among the most frequently reported side effects of cancer treatment. Approximately 10% of patients will experience moist desquamation and ulceration, which may result in treatment delays,[17] decreased quality of life, and pain.[4,5] These skin reactions are most common in sarcoma as well as breast, head, neck, and lung cancer patients.[18,19] However, little research has specifically investigated the skin-associated pain experienced by patients receiving RT to each of these sites. In this study, only patients receiving RT to the breast reported significant RT-induced skin problems and pain at the treatment site. Patients receiving RT to the head/neck/brain region reported increased skin problems but not pain at the treatment site. Of the symptoms investigated, tenderness and tightness/splitting of the skin were most closely associated with radiation-induced pain at the treatment site. Only patients receiving RT to the breast reported significant increases in individual skin symptoms, including tenderness and tightness.

The fact that patients receiving RT to the head/neck/brain region report increased severity of skin reactions, but not pain, suggests that the severity of skin reactions is not the only factor that is related to pain experienced with RT. Our data suggest that the RT site is an important predictive factor for RT-induced pain. MLR showed that while the total number of RT sessions and the site of RT (breast or head/neck/brain vs other sites) predicted the severity of the skin problems, only RT of the breast predicted increased pain at the treatment site. These data demonstrate that it is important to evaluate both pain and skin problems when investigating interventions for radiation dermatitis and not to assume that pain will increase at the same rate for different RT sites as the severity of skin reactions increases. Future research should investigate if this disparity between RT-induced pain and skin problems exists when radiation der-

TABLE 3 Changes in skin symptoms at the treatment site after radiation therapy in patients receiving RT to the breast of head/neck/brain region

Skin symptom	Breast RT		Head/Neck/Brain RT		Holm-Bonferroni adjusted
	Mean change (95% CI)	*P*-value	Mean change (95% CI)	*P*-value	*P*-value
Redness	2.18 (1.3, 3.05)	.0002*	1.31 (0.45, 2.14)	.016	.0065
Itching	1.88 (0.36, 2.65)	.0002*	1.08 (−0.01, 2.17)	.125	.007
Flaky	1.32 (0.65, 1.98)	.002*	1.08 (0.24, 1.91)	.047	.013
Tenderness	1.25 (0.53, 1.97)	.002*	0.45 (0.09, 2.08)	.063	.01
Hot	1.47 (0.42, 2.36)	.004*	0.82 (−0.02, 1.66)	.125	.008
Throbbing	0.94 (0.41, 1.47)	.004*	0.54 (−0.27, 1.36)	.250	.025
Tightness	0.81 (0.26,1.37)	.014*	0.36 (−0.09, 0.82)	.250	.016
Bumpy	0.94 (0.25, 1.63)	.014*	0.58 (−0.33, 1.5)	.250	.05

* Indicates associations that are significant using the Holm-Bonferroni significance thresholds shown in the last column.

TABLE 4 Multiple linear regression analysis of skin symptom characteristics associated with skin problems and pain

Skin description	Skin problems		Pain	
	b (95% CI)	*P*-value	*b* (95% CI)	*P*-value
Redness	0.379 (0.200, 0.556)	<.0001	−0.117 (−0.388, 0.154)	.393
Itching	0.287 (0.122, 0.452)	.0009	0.021 (−0.237, 0.278)	.874
Hotness	0.030 (−0.175, 0.236)	.769	0.086 (−0.222, 0.395)	.581
Tenderness	0.300 (0.065, 0.535)	.013	0.336 (−0.022, 0.695)	.066
Throbbing	−0.230 (−0.486, 0.031)	.062	0.132 (−0.260, 0.525)	.504
Flaking	−0.007 (−0.492, 0.156)	.156	0.134 (−0.112, 0.380)	.281
Bumpy	0.118 (−0.051, 0.287)	.163	0.127 (−0.082, 0.683)	.324
Tightness	0.106 (−0.148, 0.360)	.408	0.301 (0.011, 0.689)	.122
	Adjusted R^2 = 0.776, obs = 92		Adjusted R^2 = 0.441, obs = 90	

Abbreviation: Obs, observations.

matitis is evaluated objectively using a clinical skin toxicity scale.

The fact that the PSP is a nonvalidated survey instrument is a limitation of this study. However, the survey was developed with 8 pretest iterations with feedback from a panel including 2 nurses, 4 physicians, 5 researchers, and 1 full-time student prior to implementation of this study. The Chronbach's alpha for all of the survey sections was above 0.9, supporting the internal validity of this new assessment tool. The PSP was adapted from 2 validated instruments, the MPQ-SF and the MDASI, which are self-report questionnaires for pain and symptom severity as well as pain type. Our study demonstrated that the new PSP can identify changes in pain and skin problems in populations receiving RT to the breast and head/neck/brain regions. Further, trending associations between pain and specific skin symptoms were identified using this survey that would likely be significant in a larger sample size.

Currently, no instruments exist that simultaneously evaluate pain and skin problems in radiation dermatitis, highlighting the need for one such survey. Although the Skindex and the STAT tools are useful to assess acute radiation skin toxicity and which symptoms are most bothersome to patients, these tools do not incorporate pain assessment.[9,20] Future research should confirm the external validity of this new measure in RT patients by administration with the Skindex, MPQ, and clinical skin-toxicity scales. The combination of the clinical scoring scales and patient-report surveys would further support the validity and accuracy of our survey instrument; and provide insight into which skin symptoms are most troublesome and painful for patients.

Recent trials testing interventions for radiation dermatitis have not assessed pain. For example, Schmuth et al examined the effects of a topical corticosteroid cream on radiation dermatitis. The cream did not prevent radiation dermatitis but did reduce the severity of the skin reactions.[20] Unfortunately, the measures used in this trial (Skindex, SF-36) did not evaluate pain.[20] Neben-Wittich et al compared the Skindex-16, STAT, and NIH CTC-AE in a phase III clinical trial testing mometasone cream versus placebo for radiation dermatitis in breast cancer patients.[21] The patient-reported Skindex-16 and STAT did not correlate with the physician-reported NIH CTC-AE scores. The study concluded that the 2 patient-reported questionnaires provided additional information about the skin reaction that was not captured by the clinical rating.

While these studies provide insight into the complicated nature of assessing skin reactions and quality of life, none of these studies explored radiation skin toxicity in the context of pain or pain type. Bostrom et al did assess skin toxicity, skin symptoms, and pain in breast cancer patients receiving mometasone cream or placebo.[22] The study asked patients to rate the severity of itching, burning, and pain on a 0 to 10 scale. No statistically significant differences were observed in these symptoms between groups.[22] However, itching and burning are not the only symptoms descriptors for radiation dermatitis. Our PSP incorporates commonly reported symptoms of radiation dermatitis based on MPQ-SF, such as hot-burning, tightness, tenderness, throbbing, itching, and pain. Thus, we expect the PSP to provide another dimension to the subjective assessment of pain and skin problems in patients receiving RT and insight into effective amelioration of skin problems and skin-associated pain.

Other limitations of this study include its exploratory nature and relatively small sample size. Although the associations between tenderness and tightness/splitting with pain at the treatment site were at least 2 times larger in magnitude than the next strongest association of other skin symptoms with pain, the associations between tenderness and tightness/splitting with pain were trending but not significant ($P = .07$ and $P = .12$, respectively) even though the model accounted for 44% of the variance. This is likely due to the relatively small sample size for a model with 8 independent variables. This study needs to be repeated with a larger sample and *a priori* hypotheses to confirm these trending associations.

Although the overall response rate (72%) is acceptable for a longitudinal survey in cancer patients,[23-25] another limitation of this study is the posttreatment survey nonresponse rate (28%). The distribution of RT sites, total radiation dose, and total number of radiation treatments were similar between patients that completed only the first survey and those that completed both surveys ($P > .15$). Since radiation dose and RT site were the characteristics associated with severity of pain and skin reactions—and were similar between completers and noncompleters of the second survey—we estimate a low level of nonresponse bias from missing data. A higher percentage of patients with advanced cancer completed only the first survey compared to both surveys (71% vs 48%; $P = .009$). Other research has also shown that survey response rates are lower in metastatic cancer patients.[23,25] However, cancer severity was not associated with pain or skin problems and, therefore, unlikely to contribute to nonresponse bias. Possible differences in unmeasured characteristics associated with pain and skin problems can always cause nonresponse bias, which should be considered when interpreting these results.

Although patients were asked to think about their pain and skin problems on the last day of their RT treatment, they were allowed to complete the survey up to 1 month after RT completion. The ability to detect a difference between pre-RT and post-RT pain as well as skin problems is limited by the error induced by this protocol flexibility. Thus, statistical differences in groups other than breast and head/neck/brain may have been missed. Nevertheless, the fact that differences were detected in the breast and head/neck/brain groups in spite of this error suggests that these groups are important research targets for RT-induced pain and skin reactions. This is especially true considering ANOVA showed similar elapsed time between RT and post survey across groups (mean time elapsed = 6.8 days; $P = .3$) and, therefore, we expect similar magnitudes of error across groups. Further, Brauer et al has reported that retrospective reports on pain severity are extremely reliable for up to 3 months after the time of event.[26] Our results suggest possible therapeutics for painful radiation dermatitis should be investigated in patients receiving RT to the breast. However, a larger study with equal representation of RT sites could reveal other important target populations.

The fact that tenderness and tightness are the symptoms most closely associated with pain suggests that future studies should investigate topical interventions with analgesic and moisturizing components for radiation-induced skin damage. Graham et al[7] found that a no-sting barrier film increased moisture at the treatment site; and reduced incidence and duration of moist desquamation but did not improve pain or itching. This study suggests that moisturizing alone is insufficient to control the pain and itching associated with radiation therapy, which supports the concept of a combined topical with moisturizing and analgesic properties.

The need for a novel treatment to control RT-induced pain is highlighted by the fact that prescription opioids did not control RT-induced pain. Patients with the largest increase in pain between pre- and post-RT were more likely to be prescribed opioids during treatment, suggesting that clinicians and

patients are attempting to control the pain but that opioids are insufficient. The interpretation of these results is limited by the fact that the chart review method cannot determine if patients actually took the prescribed opioids. Future prospective studies that monitor type, dose, and compliance with prescribed pain medications would clarify some of these questions. Regardless of whether the opioids were taken or not, this research suggests that prescription of these medications is insufficient to control pain associated with RT-induced skin reactions. Research regarding new interventions tailored toward skin tenderness and tightness, which showed trending associations with pain at the treatment site, is warranted. Topical applications specifically would be advantageous to avoid opioid-associated systemic side effects, which could prevent patients from taking recommended doses.

Conclusion

This study provides insight into the difficulty of assessing and treating radiation-induced pain and skin problems in cancer patients. It highlights the importance of assessing pain and skin reactions simultaneously and targeting pain specifically, not only by attempting to decrease skin reactions. Specific RT-induced skin symptoms that correlate with increases in patient-reported pain provide possible avenues for targeted interventions. More information on radiation-induced pain and skin problems is clearly needed. These findings support future studies using the new PSP to address uncontrolled radiation-induced pain and skin reactions as well as targeted therapies to ameliorate these side effects.

Acknowledgements

We thank the patients for their time. A special thanks goes to Kassie Haitz, Prianca Naik, and Shilpa Cheela for their work with recruiting patients.

Funding/source. Funding was provided by The National Cancer Institute (R25CA10618 and U10CA37420).

Role of the sponsor. The funding source played no role in the study design; collection, analysis, and interpretation of the data; writing the report; or the decision to submit the manuscript.

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Whole brain radiotherapy for poor prognosis patients with brain metastases: predictably poor results

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Background Patients with brain metastases from solid tumors can be subdivided by characteristics into separate prognostic groups, such as the Radiation Therapy Oncology Group's Recursive Partitioning Analysis (RPA) or the Graded Prognostic Assessment (GPA). At our institution, patients falling into the poorest prognostic groups are often treated with whole brain radiotherapy (WBRT).

Objective To determine if observed survival of poor prognosis patients treated with WBRT for brain metastases at our institution matches the survival predicted by RPA and GPA prognostic indices.

Methods The charts of 101 consecutive patients with newly diagnosed brain metastases from solid tumors who received WBRT were retrospectively reviewed. We calculated each patient's RPA and GPA and compiled treatment and survival data. Observed median survival was compared to that predicted by the RPA and GPA prognostic indices.

Results RPA III patients (n = 25) had a median survival of 2.4 months in our study. GPA 0.0-1.0 patients (n = 35) had a median survival of 2.4 months in our study. These values did not vary significantly from those predicted by the respective indices.

Limitations This is a retrospective analysis and subject to selection bias.

Conclusion Given the delivery time for WBRT and the potential side effects associated with the treatment, the predictably short overall survival in poor prognosis patients calls into question the value of WBRT in this patient subgroup.

Over 170,000 cases of metastatic brain tumors are diagnosed in the United States each year; and the length of survival for patients with brain metastases is often quite limited, ranging from a few weeks to several months.[1] The Radiation Therapy Oncology Group (RTOG) Recursive Partitioning Analysis (RPA) and the Graded Prognostic Assessment (GPA) are 2 prognostic indices that have been validated to predict survival and guide the treatment of these patients.[2-5] The RPA and GPA indices were formulated by comparing survival to patient and tumor characteristics compiled from RTOG brain metastasis treatment protocols spanning greater than 3 decades.

The RPA has 3 classes of patients enumerated as "I", "II", and "III," with class I patients having the longest predicted survival and class III patients having the worst prognosis. The RPA classes are based upon factors that include patient age and Karnofsky Performance Status (KPS) as well as control of the primary tumor and evidence of extra-cranial metastases (Table 1).[2] The GPA has 4 classes of patients with a score that may be considered analogous to a grade point average achieved by students in school. The classes are arranged into 4 groupings, which are divided from best to worst prognosis as follows: 3.5 to 4.0, 3.0, 1.5 to 2.5, and 0.0 to 1.0. The GPA employs criteria similar to but slightly different from those used in the RPA, estimating survival by patient age and performance status as well as the number of brain metastases and evidence of extracranial metastases (Table 2).[4]

Manuscript received September 6, 2012; accepted December 10, 2012.

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Disclosures The authors have completed the ICMJE Form for Disclosure of Potential Conflicts of Interest. All authors have received tuition support from the Indiana University Simon Cancer Center William J. Wright Scholarship Fund for Cancer Research.

J Support Oncol 2013;11:190-195
DOI: 10.12788/j.suponc.0006